পশ্চিমবঙ্গ রাষ্ট্রীয় বিশ্ববিদ্যালয়

বেরুনানপুকুরিয়া, মালিকাপুর, বারাসাত, কলকাতা ১২৬

প্রাক্-স্নাতক বাংলা (সাধারণ) প্রস্তাবিত পাঠক্রম ২০১৮

(Proposed B.A. **(Pass)** CBCS Syllabus in BENGALI, **with effect from July 2018)**

ডিসিপ্লিন স্পেসিফিক কোর কোর্স স্তরে ২০০ নম্বরের মোট চারটি (৪) কোর্স সাধারণ নিয়মে তিন বছরে প্রথম চারটি সেমেস্টারে পড়ানো হবে। প্রতিটি কোর কোর্সের পূর্ণমান ২৫+ ৫০ × ৭৫ X ৪= মোট ৩০০ নম্বর । প্রতিটি কোর কোর্সের ক্রেডিট ১+ ৫= ৬ । প্রতিটি ক্রেডিটের জন্য ১৫ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে। ৬ ক্রেডিট × ৪ টি কোর্স = মোট ২৪ ক্রেডিট × ১৫ ঘন্টা পাঠদান = মোট ৩৬০ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

প্রতিটি সেমেস্টারে অভ্যন্তরীণ মূল্যায়ন (Internal assessment) ২০+৫ = ২৫ নম্বর এবং ষান্মাষিক মূল্যায়ন (End Semester assessment) মোট ৫০ নম্বর হবে। প্রতিটি পরীক্ষায় ৪০% নম্বর পেতেই হবে। তার কম নম্বর পেলে অকৃতকার্য / ফেল হিসাবে গণ্য হবে।

B.A. Part- 1

Semester- I

CC (DSC 1A) (Discipline Specific Core Course) : CODE: BNGGCOR01T বাংলা সাহিত্য এবং বাঙালির সংস্কৃতি চর্চার ইতিহাস, পূর্ণমান ২৫+৫০=৭৫, ক্রেডিট ১+৫ = ৬, মোট ১৫+৭৫=৯০ ঘন্টা পাঠদান দিতে হবে। (১৫ ঘন্টা টিউটোরিয়াল এবং ৭৫ ঘন্টা প্রত্যক্ষ পাঠদান)।

Unit I : বাংলা সাহিত্যের আদিপর্বে বৌদ্ধধর্ম ও বৌদ্ধ সংস্কৃতি চর্চা এবং বিবর্তনের ইতিহাস, কমপক্ষে ১৮ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit II : বাংলা সাহিত্যে আর্য-অনার্য সংস্কৃতি ও তার সমন্বয়ের ইতিহাস, কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit III : মধ্যযুগে বৈষ্ণব-শাক্ত-নাথ সাহিত্য ও সংস্কৃতি চর্চার ইতিহাস, কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit IV : অবক্ষয় যুগে বাঙালির কবি-টপ্পা-আখড়াই-হাফ-আখড়াই-খেউড় গানের চর্চা ও তার সামাজিক ফলশ্রুতি,কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

গ্রন্থতালিকাঃ

১। দীনেশচন্দ্র সেনঃ বঙ্গভাষা ও সাহিত্যঃ পশ্চিমবঙ্গ রাজ্য পুস্তক পর্ষদ

২। সুকুমার সেনঃ বাঙ্গালা সাহিত্যের ইতিহাস (১ম -৫ম খণ্ড), আনান্দ পাবলিশার্স

৩। শ্রীকুমার বন্দ্যোপাধ্যায়ঃ বাংলা সাহিত্যের রূপরেখা(১ম ও ২য় খণ্ড)

৪। অসিতকুমার বন্দ্যোপাধ্যায়ঃ বাংলা সাহিত্যের ইতিবৃত্ত(১ম-৯ম খণ্ড)

৫। ভূদেব চৌধুরীঃ বাংলা সাহিত্যের ইতিকথা(১ম-৪থ খণ্ড), দে'জ সংস্করণ

৬। গোপাল হালদারঃ বাংলা সাহিত্যের রূপরেখা (১ম-২য় খণ্ড)

CC: DSC 2A**(Discipline Specific Core Course)**

CC: English / AECC: Environmental Science

SEMESTER- II

CC 2 (DSC 1B) : CODE: BNGGCOR02T বাংলা ভাষার ইতিহাস ও ভাষাতত্ব , পূর্ণমান ২৫+৫০=৭৫, ক্রেডিট ১+৫ = ৬, মোট ১৫+৭৫=৯০ ঘন্টা পাঠদান দিতে হবে। (১৫ ঘন্টা টিউটোরিয়াল এবং ৭৫ ঘন্টা প্রত্যক্ষ পাঠদান)।

Unit I : প্রাচীন ভারতীয় আর্যভাষা থেকে আধুনিক ভারতীয় আর্যভাষায় বিবর্তন, বাংলা ভাষার উদ্ভব এবং প্রাচীন, আদি-মধ্য,অন্ত্য-মধ্য বাংলা ভাষার ভাষাতাত্বিক লক্ষণ, কমপক্ষে ১৮ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit II : বাংলা ভাষার উপভাষা সংক্রান্ত আলোচনা, কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit III : বাংলা ধ্বনি পরিবর্তন ও শব্দার্থ পরিবর্তনের ধারা, কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit IV : রোমান হরফের পরিচয় ও রোমান হরফে লিপ্যন্তরকরণ এবং আন্তর্জাতিক ধ্বনিমূলক বর্ণমালার পরিচয় ও লিপ্যন্তরকরণ, কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

সহায়ক গ্রন্থঃ

১। রবীন্দ্রনাথ ঠাকুরঃ বাংলা ভাষা পরিচয়

২। সুনীতিকুমার চট্টোপাধ্যায়ঃ বাংলা ভাষাতত্ত্বের ভূমিকা/ ভাষা প্রকাশ বাংলা ব্যাকরণ

৩। পার্বতীচরণ ভট্টাচার্যঃ বাংলা ভাষা

৪। সুকুমার সেনঃ ভাষার ইতিবৃত্ত

৫। পরেশচন্দ্র ভট্টাচার্যঃ ভাষাবিদ্যা পরিচয়

৬। পরেশচন্দ্র মজুমদারঃ বাংলা ভাষা পরিক্রমা / সংস্কৃত ও প্রাকৃত ভাষার ক্রমবিকাশ

৭। রামেশ্বর শঃ সাধারণ ভাষাবিজ্ঞান ও বাংলা ভাষা

CC: DSC 2**(Discipline Specific Core Course)**

CC: English

AECC: English/ **MIL Communication: CODE: BNGSAEC01T পূর্ণমান ৫ + ২০=২৫, ক্রেডিট ২, কমপক্ষে ৩০ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।**

পশ্চিমবঙ্গ রাষ্ট্রীয় বিশ্ববিদ্যালয়

বেরুনানপুকুরিয়া, মালিকাপুর, বারাসাত, কলকাতা ১২৬

প্রাক্-স্নাতক বাংলা (সাম্মানিক) প্রস্তাবিত পাঠক্রম ২০১৮

(Proposed B.A. CBCS Syllabus in BENGALI , with effect from July 2018)

কোর কোর্স স্তরে ১০৫০ নম্বরের মোট চোদ্দটি (১৪) কোর্স সাধারণ নিয়মে তিন বছরের মোট ছটি সেমেস্টারে পড়ানো হবে । প্রতিটি কোর কোর্সের পূর্ণমান ২৫+৫০= ৭৫ × ১৪ টি কোর কোর্স = মোট নম্বর ১০৫০ । প্রতিটি কোর কোর্সের ক্রেডিট ১+ ৫ = ৬ । প্রতিটি ক্রেডিটের জন্য ১৫ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে। ৬ ক্রেডিট × ১৪ টি কোর্স = মোট ৮৪ ক্রেডিট × ১৫ ঘন্টা পাঠদান = মোট ১২৬০ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে তিন বছরে।

প্রতিটি সেমেস্টারে অভ্যন্তরীণ মুল্যায়ন (Internal Assessment) ২০+৫=২৫ নম্বর এবং ষান্মাষিক মূল্যায়ন (End Semester Assessment) মোট ৫০ নম্বর হবে। প্রতিটি পরীক্ষায় ৪০% নম্বর পেতেই হবে। তার কম নম্বর পেলে অকৃতকার্য / ফেল হিসাবে গণ্য হবে।

B.A. (HONOURS) PART-I

SEMSETER: 1 (Session: July to December)

CC 1: Code: BNGACOR01T প্রাগাধুনিক বাংলা সাহিত্যের ইতিহাস , পূর্ণমান ২৫+৫০=৭৫, ক্রেডিট ১+৫ = ৬, মোট ১৫+৭৫=৯০ ঘন্টা পাঠদান দিতে হবে। (১৫ ঘন্টা টিউটোরিয়াল এবং ৭৫ ঘন্টা প্রত্যক্ষ পাঠদান)

(সামাজিক, অর্থনৈতিক, রাষ্ট্রনৈতিক পটপরিবর্তনের ইতিহাস সহ)

Unit I: অষ্টম থেকে পঞ্চদশ শতাব্দীতে রচিত বাংলা সাহিত্যধারা (চর্যাপদ থেকে শ্রীকৃষ্ণকীর্তন পর্যন্ত), কমপক্ষে ১৮ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit II: বাংলা মঙ্গলকাব্যের ধারা। (মনসামঙ্গল, চণ্ডীমঙ্গল, ধর্মমঙ্গল, শিবায়ন, অন্নদামঙ্গল ও অন্যান্য অপ্রধান মঙ্গলকাব্যের ধারা) কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit III: বাংলা অনুবাদ সাহিত্যের ধারা। (রামায়ণ, মহাভারত, ভাগবত, রোসাঙ রাজসভার সাহিত্যসহ অন্যান্য অনুবাদ সাহিত্যের ধারা) কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit IV: বাংলা পদাবলী সাহিত্য, চৈতন্য জীবনী সাহিত্য ও ধর্মীয় সাহিত্যের ধারা (বৈষ্ণব পদাবলী, শাক্ত পদাবলী ও অন্যান্য পদাবলী এবং নাথ সাহিত্যসহ অন্যান্য ধর্মিয় সাহিত্য ধারা) কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

গ্রন্থতালিকাঃ

১। দীনেশচন্দ্র সেনঃ বঙ্গভাষা ও সাহিত্যঃ পশ্চিমবঙ্গ রাজ্য পুস্তক পর্ষদ

২। সুকুমার সেনঃ বাঙ্গালা সাহিত্যের ইতিহাস (১ম -৫ম খণ্ড), আনান্দ পাবলিশার্স

৩। শ্রীকুমার বন্দ্যোপাধ্যায়ঃ বাংলা সাহিত্যের রূপরেখা(১ম ও ২য় খণ্ড)

৪। অসিতকুমার বন্দ্যোপাধ্যায়ঃ বাংলা সাহিত্যের ইতিবৃত্ত(১ম-৯ম খণ্ড)

৫। ভূদেব চৌধুরীঃ বাংলা সাহিত্যের ইতিকথা(১ম-৪থ খণ্ড), দে'জ সংস্করণ

৬। গোপাল হালদারঃ বাংলা সাহিত্যের রূপরেখা (১ম-২য় খণ্ড)

CC 2: Code: BNGACOR02T প্রাগাধুনিক বাংলা সাহিত্য পাঠ , পূর্ণমান ২৫+৫০=৭৫, ক্রেডিট ১+৫ = ৬, মোট ১৫+৭৫=৯০ ঘন্টা পাঠদান দিতে হবে। (১৫ ঘন্টা টিউটোরিয়াল এবং ৭৫ ঘন্টা প্রত্যক্ষ পাঠদান)

Unit I: বৈষ্ণব পদাবলী (২০টি নির্বাচিত পদ), কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

১। নীরদ নয়নে নীর ঘন সিঞ্চনে ২। চম্পক শোন কুসুম কনকাচল ৩। দাঁড়াইয়া নন্দের আগে গোপাল ৪। আমার শপতি লাগে না ধাইও ৫। সই কেবা শুনাইল শ্যাম নাম ৬। আলো মুঞি জানো না ৭। নহাই উঠল তীরে রাই কমলমুখী ৮। রূপ লাগি আঁখি ঝুরে ৯। সখি কি পুছসি অনুভব মোয় ১০। কন্টক গাড়ী কমল-সম ১১। মাধব কি কহব দৈব- বিপাক ১২। বঁধু, কি আর বলিব তোরে ১৩। কি মোহিনী জান বঁধু কি মোহিনী জান ১৪। বঁধু কি আর বলিব আমি ১৫। বঁধু তুমি সে আমার প্রাণ ১৬। এ সখি হামারি দুখের নাহি ওর ১৭। অঙ্কুর তপন তাপে যদি ১৮। বহুদিন পরে বঁধুয়া এলে ১৯। আজু রজনী হাম ভাগে ২০। মাধব, বহুত মিনতি করি তোয়।

Unit II: শাক্ত পদাবলী (২০টি নির্বাচিত পদ), কমপক্ষে ১৮ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

১। গিরিবর, আর আমি পারিনে হে, ২। আর জাগাস্‌ নে মা জয়া ৩। গিরি, এবার আমার উমা এলে ৪। আমি কি হেরিলাম নিশি-স্বপনে ৫। কবে যাবে বল গিরিরাজ, গৌরীরে আনিতে ৬। আজ শুভনিশি পোহাইল তোমার ৭। ওরে নবমী-নিশি, না হইও রে অবসান ৮। যেয়ো না রজনি, আজি ল'য়ে তারাদলে ৯। কি হলো, নবমী নিশি হৈলো অবসান গো ১০। ওহে প্রাণনাথ গিরিবর হে, ভয়ে তনু কাঁপিছে আমার ১১। মায়ের মূর্ত্তি গড়াতে চাই, মনের ভ্রমে মাটি দিয়ে ১২। রঙ্গে নাচে রণ-মাঝে, কারা কামিনী মুক্তকেশী ১৩। ও জননী, অপরা জন্ম-জরা-হরা জননী ১৪। মজিল মন-ভ্রমরা, কালী-পদ-নীলকমলে ১৫। কেবল আসার আশা, ভবে আসা ১৬। মা আমায় ঘুরাবে কত, ১৭। আমায় দেও মা তবিলদারী, ১৮। এমন দিন কি হবে তারা, ১৯। ও মন, তোর ভ্রম গেল না ২০। ইচ্ছাময়ী তারা গো, তোর ইচ্ছা কে বুঝিতে পারে।

Unit III: চণ্ডীমঙ্গল (আখেটিক খণ্ড), কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit IV: চৈতন্যভাগবত (আদি খণ্ড), কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

গ্রন্থতালিকাঃ

১। সতীশচন্দ্র রায়ঃ পদকল্পতরু

২। সুশীল কুমার দেঃ Early History of the Vaishnava Faith and Movement in Bengal.

৩। হরেকৃষ্ণ মুখোপাধ্যায়ঃ পদাবলী পরিচয়

৪। কালিদাস রায়ঃ পদাবলী সাহিত্য

৫। শশিভূষণ দাশগুপ্তঃ শ্রীরাধার ক্রমবিকাশ- দর্শনে ও সাহিত্যে

৬। ক্ষুদিরাম দাসঃ বৈষ্ণব রসপ্রকাশ

৭। শঙ্করীপ্রসাদ বসুঃ চণ্ডীদাস ও বিদ্যাপতি / মধ্যযুগের কবি ও কাব্য

৮। নরেশচন্দ্র জানাঃ বৈষ্ণব কবিতায় কালিদাসের উত্তরাধিকার / গাথাসপ্তশতী ও বৈষ্ণব পদাবলী/ বৃন্দাবনের ছয় গোস্বামী

৯। সুখেন্দুসুন্দর গঙ্গোপাধ্যায়ঃ গৌড়ীয় বৈষ্ণব দর্শনের ভূমিকা

১০। সত্যবতী গিরিঃ বাংলা সাহিত্যে কৃষ্ণকথার ক্রমবিকাশ

১১। দেবনাথ বন্দ্যোপাধ্যায়ঃ বৈষ্ণব কবিপ্রসঙ্গে

১২। সত্যবতী গিরিঃ বাংলা সাহিত্যে কৃষ্ণকথার ক্রমবিকাশ

১৩। জাহ্নবীকুমার চক্রবর্তীঃ শাক্ত পদাবলী ও শক্তি সাধনা

১৪। অরুণকুমার বসুঃ শাক্তগীতি পদাবলী

১৫। চারুচন্দ্র বন্দ্যোপাধ্যায়ঃ চণ্ডীমঙ্গল বোধিনী

১৬। সুকুমার সেন সম্পাদিত চণ্ডীমঙ্গল

১৭। ক্ষুদিরাম দাস সম্পাদিত কবিকঙ্কণ চণ্ডী

১৮। আশুতোষ ভত্তাচার্যঃ বাংলা মঙ্গলকাব্যের ইতিহাস

১৯। মোহিনীমোহন সরদারঃ কবিকঙ্কণ চণ্ডীঃ বৈচিত্র্যের অনুসন্ধান

২০। বিশ্বনাথ রায় সম্পাদিত কবি মুকুন্দের চণ্ডীমঙ্গলঃ বীক্ষা ও সমীক্ষা

২১। বিষ্ণুপদ পাণ্ডা সম্পাদিত শ্রীশ্রীচৈতন্যভাগবত , বসুমতী কর্পরেসন লিমিটেড প্রকাশিত

GE I (Generic Elective) : CODE: BNGHGEC01T বাংলা সাহিত্য এবং বাঙালির সংস্কৃতি চর্চার ইতিহাস, পূর্ণমান ২৫+৫০=৭৫, ক্রেডিট ১+৫=৬, মোট ১৫+৭৫= ৯০ ঘন্টা পাঠদান দিতে হবে। (১৫ ঘন্টা টিউটোরিয়াল এবং ৭৫ ঘন্টা প্রত্যক্ষ পাঠদান)

Unit I : বাংলা সাহিত্যের আদিপর্বে বৌদ্ধধর্ম ও বৌদ্ধ সংস্কৃতি চর্চা এবং বিবর্তনের ইতিহাস, কমপক্ষে ১৮ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit II : বাংলা সাহিত্যে আর্য-অনার্য সংস্কৃতি ও তার সমন্বয়ের ইতিহাস, কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে। ।

Unit III : মধ্যযুগে বৈষ্ণব-শাক্ত-নাথ সাহিত্য ও সংস্কৃতি চর্চার ইতিহাস, কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে। ।

Unit IV : অবক্ষয় যুগে বাঙালির কবি-টপ্পা-আখড়াই-হাফ-আখড়াই-খেউড় গানের চর্চা ও তার সামাজিক ফলশ্রুতি ,কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

গ্রন্থতালিকাঃ

১। দীনেশচন্দ্র সেনঃ বঙ্গভাষা ও সাহিত্যঃ পশ্চিমবঙ্গ রাজ্য পুস্তক পর্ষদ

২। সুকুমার সেনঃ বাঙ্গালা সাহিত্যের ইতিহাস (১ম -৫ম খণ্ড), আনান্দ পাবলিশার্স

৩। শ্রীকুমার বন্দ্যোপাধ্যায়ঃ বাংলা সাহিত্যের রূপরেখা(১ম ও ২য় খণ্ড)

৪। অসিতকুমার বন্দ্যোপাধ্যায়ঃ বাংলা সাহিত্যের ইতিবৃত্ত(১ম-৯ম খণ্ড)

৫। ভূদেব চৌধুরীঃ বাংলা সাহিত্যের ইতিকথা(১ম-৪থ খণ্ড), দে'জ সংস্করণ

৬। গোপাল হালদারঃ বাংলা সাহিত্যের রূপরেখা (১ম-২য় খণ্ড)

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CC 3: Code: BNGACOR03T ভাষাতত্ব , পূর্ণমান ২৫+৫০=৭৫, ক্রেডিট ১+৫ = ৬, মোট ১৫+৭৫=৯০ ঘন্টা পাঠদান দিতে হবে। (১৫ ঘন্টা টিউটোরিয়াল এবং ৭৫ ঘন্টা প্রত্যক্ষ পাঠদান)

Unit I: প্রাচীন ভারতীয় আর্যভাষা থেকে আধুনিক ভারতীয় আর্যভাষার বিবর্তন। বাংলা ভাষার উদ্ভব এবং প্রাচীন, আদি-মধ্য, অন্ত-মধ্য বাংলা ভাষার ভাষাতাত্বিক লক্ষণ। কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit II: বাংলা ভাষার উপভাষা ও নিভাষা সংক্রান্ত আলোচনা। কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit III: উচ্চারণস্থান ও উচ্চারণ প্রকৃতি অনুযায়ী বাংলা স্বর ও ব্যঞ্জন ধ্বনির বর্গীকরণ ও পরিচয় এবং ধ্বনি পরিবর্তনের রীতি ও প্রকৃতি। কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit IV: বাংলা ভাষার শব্দভাণ্ডার, শব্দ বিবর্তন ও শব্দার্থের পরিবর্তন। কমপক্ষে ১৮ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

গ্রন্থতালিকাঃ

১। রবীন্দ্রনাথ ঠাকুরঃ বাংলা ভাষা পরিচয়

২। সুনীতিকুমার চট্টোপাধ্যায়ঃ বাংলা ভাষাতত্ত্বের ভূমিকা/ ভাষা প্রকাশ বাংলা ব্যাকরণ

৩। পার্বতীচরণ ভট্টাচার্যঃ বাংলা ভাষা

৪। সুকুমার সেনঃ ভাষার ইতিবৃত্ত

৫। পরেশচন্দ্র ভট্টাচার্যঃ ভাষাবিদ্যা পরিচয়

৬। পরেশচন্দ্র মজুমদারঃ বাংলা ভাষা পরিক্রমা / সংস্কৃত ও প্রাকৃত ভাষার ক্রমবিকাশ

৭। রামেশ্বর শঃ সাধারণ ভাষাবিজ্ঞান ও বাংলা ভাষা

CC 4: Code: BNGACOR04T আধুনিক বাংলা সাহিত্যের ইতিহাস , পূর্ণমান ২৫+৫০=৭৫, ক্রেডিট ১+৫ = ৬, মোট ১৫+৭৫=৯০ ঘন্টা পাঠদান দিতে হবে। (১৫ ঘন্টা টিউটোরিয়াল এবং ৭৫ ঘন্টা প্রত্যক্ষ পাঠদান)

Unit I: বাংলা গদ্য ও প্রবন্ধ সাহিত্যের ধারা (ফোর্ট উইলিয়াম কলেজ থেকে প্রমথ চৌধুরী পর্যন্ত), কমপক্ষে ১৮ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit II: বাংলা নাট্য সাহিত্যের উদ্ভব ও বিকাশ (রামনারায়ণ তর্করত্ন থেকে বাদল সরকার পর্যন্ত), কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit III: বাংলা কাব্য-কবিতার উদ্ভব ও বিকাশ (ঈশ্বরগুপ্ত থেকে শক্তি চট্টোপাধ্যায় পর্যন্ত), কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit IV: বাংলা কথাসাহিত্যের উদ্ভব ও বিকাশের ইতিহাস (বঙ্কিমচন্দ্র চট্টোপাধ্যায় থেকে সুনীল গঙ্গোপাধ্যায়পর্যন্ত), কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

গ্রন্থতালিকাঃ

১। দীনেশচন্দ্র সেনঃ বঙ্গভাষা ও সাহিত্যঃ পশ্চিমবঙ্গ রাজ্য পুস্তক পর্ষদ

২। সুকুমার সেনঃ বাঙ্গালা সাহিত্যের ইতিহাস (১ম -৫ম খণ্ড), আনান্দ পাবলিশার্স

৩। শ্রীকুমার বন্দ্যোপাধ্যায়ঃ বাংলা সাহিত্যের রূপরেখা(১ম ও ২য় খণ্ড)

৪। অসিতকুমার বন্দ্যোপাধ্যায়ঃ বাংলা সাহিত্যের ইতিবৃত্ত(১ম-৯ম খণ্ড)

৫। ভূদেব চৌধুরীঃ বাংলা সাহিত্যের ইতিকথা(১ম-৪থ খণ্ড), দে'জ সংস্করণ

৬। গোপাল হালদারঃ বাংলা সাহিত্যের রূপরেখা (১ম-২য় খণ্ড)

GE II : CODE: BNGHGEC02T বাংলা ভাষার ইতিহাস ও ভাষাতত্ব , পূর্ণমান ২৫+৫০=৭৫, ক্রেডিট ১+৫=৬, মোট ১৫+৭৫= ৯০ ঘন্টা পাঠদান দিতে হবে। (১৫ ঘন্টা টিউটোরিয়াল এবং ৭৫ ঘন্টা প্রত্যক্ষ পাঠদান)

Unit I : প্রাচীন ভারতীয় আর্যভাষা থেকে আধুনিক ভারতীয় আর্যভাষায় বিবর্তন, বাংলা ভাষার উদ্ভব এবং প্রাচীন,

মধ্য, অন্ত-মধ্য বাংলা ভাষার ভাষাতাত্বিক লক্ষণ, কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit II : বাংলা ভাষার উপভাষা সংক্রান্ত আলোচনা, কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit III : বাংলা ধ্বনি পরিবর্তন ও শব্দার্থ পরিবর্তনের ধারা, কমপক্ষে ১৮ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

Unit IV : রোমান হরফে লিপ্যন্তরকরণ এবং আন্তর্জাতিক ধ্বনিমূলক বর্ণমালার পরিচয় ও লিপ্যন্তরকরণ,কমপক্ষে ১৯ ঘন্টা প্রত্যক্ষ পাঠদান দিতে হবে।

গ্রন্থতালিকাঃ

১। রবীন্দ্রনাথ ঠাকুরঃ বাংলা ভাষা পরিচয়

২। সুনীতিকুমার চট্টোপাধ্যায়ঃ বাংলা ভাষাতত্ত্বের ভূমিকা/ ভাষা প্রকাশ বাংলা ব্যাকরণ

৩। পার্বতীচরণ ভট্টাচার্যঃ বাংলা ভাষা

৪। সুকুমার সেনঃ ভাষার ইতিবৃত্ত

৫। পরেশচন্দ্র ভট্টাচার্যঃ ভাষাবিদ্যা পরিচয়

৬। পরেশচন্দ্র মজুমদারঃ বাংলা ভাষা পরিক্রমা / সংস্কৃত ও প্রাকৃত ভাষার ক্রমবিকাশ

৭। রামেশ্বর শঃ সাধারণ ভাষাবিজ্ঞান ও বাংলা ভাষা

AECC: English/ **MIL Communication: CODE: BNGSAEC01T**

Syllabus under CBCS

FOR

THREE YEARS B.A.SANSKRIT (PROGRAMME)

WEST BENGAL STATE UNIVERSITY

BARASAT

NORTH 24 PARGANAS

PIN – 700126

West Bengal State University

Syllabus under CBCS

FOR

B.A. Programme in Sanskrit

(6 Semesters Pattern)

- All questions will be set in Sanskrit Language with Devnagari Script.
- 20% of Questions are to be answered compulsorily in Sanskrit with Devanagari script in 1st and 2nd Semesters.
- 30% of Questions are to be answered compulsorily in Sanskrit with Devanagari script in 3rd and 4th Semesters.
- 40% Questions are to be answered compulsorily in Sanskrit with Devanagari script in 5th and 6th Semesters.
- B.A. Sanskrit Programme Core Courses are similar to Generic Elective Honours Courses.

DETAILS OF COURSE STRUCTURE

Semester	Core	DSE	GE	AECC	SEC	Total credit
I	DSC 1A DSC 2A English			Environmental Science		20
II	DSC 1B DSC 2B English			English/MIL Communication		20
III	DSC 1C DSC 2C MIL				SEC1	20
IV	DSC 1D DSC 2D MIL				SEC2	20
V		DSE1A DSE2A	GE1		SEC1	20
VI		DSE1B DSE2B	GE2		SEC2	20
Total number of courses	12	4	2	2	4	120

		Semester I			Marks		
Course Code	Course Type	**Course Title& Topics**	Credits	Lec +Tu	IA	ESE	TOTAL
SANGCOR01T	Discipline Specific Core1A	**Sanskrit Poetry** **Section 'A' (20 Classes)** Raghuvaṁśam: Canto-I (Verse: 1-25) **Section 'B' (18 Classes)** Kumārasambhavam: Canto-V (Verse: 1-30) **Section 'C' (22 Classes)** Nītiśatakam (1-20 Verses, 1st two Paddhatis)-M. R. Kale Edition. **Section 'D' (15 Classes)** History of Sanskrit Poetry	6	5 + 1	25 (5+20)	50	75
	Discipline Specific Core2A		6	5 + 1	25 (5+20)	50	75
	ENGLISH		6	5 + 1	25 (5+20)	50	75
ENVSAEC01T	AECC	ENVS	2	2	5	20	25

		Semester II			Marks		
Course Code	Course Type	**Course Title& Topics**	Credits	Lec +Tu	IA	ESE	TOTAL
SANGCOR02T	Discipline Specific Core1B	**Sanskrit Prose** **Section 'A' (15 Classes)** Śukanāsopadeśa **Section 'B' (30 Classes)** Śivarājavijayam, Niśwāsa-I **Section 'C' (30 Classes)** Survey of Sanskrit Literature- Prose	6	5 + 1	25 (5+20)	50	75
	Discipline Specific Core2B		6	5 + 1	25 (5+20)	50	75
	ENGLISH		6	5 + 1	25 (5+20)	50	75
SANSAEC01M	AECC	ENGLISH/ Bengali/ **Sanskrit** Declension : Nara, Muni, Sādhu, Pitri, Latā, Mati, Madhu, Marut, Nadī, Dhenu, Badū, Phala, Vāri, Asmad, Yusmad, Tat, Yat Conjugation : Pat, Pac, Gam, Kri, Bhū, Ad, As, Han, Hū, Dib,Tan, Tud, Su, Krī, Sev, Chur Kārakavibhakti Rules, ktva, tumun, Shatri, Shanach, nistha, kritya Comprehension	2	2	5	20	25

		Semester III			Marks		
Course Code	Course Type	**Course Title& Topics**	Credits	Lec +Tu	IA	ESE	TOTAL
SANGCOR03T	Discipline Specific Core1C	**Sanskrit Drama**	6	5 + 1	25 (5+20)	50	75
		Section 'A' (25 Classes) Svapnavāsavadattam– Bhāsa **Section 'B' (50 Classes)** Abhijānaśākuntalam					
	Discipline Specific Core2C		6	5 + 1	25 (5+20)	50	75
SANLCOR01T	Modern Indian Language	English/Bengali/ **Sanskrit** A. Prastavana& 1st two stories from Mitralabha B. Nitishatakam–Bhatrihari(1-20 Verses, 1st two Paddhatis)	6	5 + 1	25 (5+20)	50	75

		Semester IV			Marks		
Course Code	Course Type	**Course Title& Topics**	Credits	Lec +Tu	IA	ESE	TOTAL
SANGCOR04T	Discipline Specific Core1D	**Sanskrit Grammar**	6	5 + 1	25 (5+20)	50	75
		Section 'A' (25 Classes) Laghusiddhāntakaumudī : Samjyāprakaran **Section 'B' (50 Classes)** Laghusiddhāntakaumudī : Sandhiprakaran **Section 'C' (30 Classes)** Laghusiddhāntakaumudī: Vibhakti Prakaran					
	Discipline Specific Core2D		6	5 + 1	25 (5+20)	50	75
SANLCOR02T	Modern Indian Language	English/Bengali/ **Sanskrit** A. Sandhi, Karaka B. Panchatantra - Mitraveda	6	5 + 1	25 (5+20)	50	75

		Semester V			Marks		
Course Code	Course Type	**Course Title& Topics**	Credits	Lec +Tu	IA	ESE	TOTAL
		Chose any One Course from SANGDSE01T & SANGDSE02T					
SANGDSE01T	Discipline Specific Elective1A	**Veda&Darshana**– i) Śuklayajurveda :Rudrādhyāy ii)Brihadarnnyakopanishad – Ch –IV.4 & 5 Bramhanas.	6	5 + 1	25 (5+20)	50	75
SANGDSE02T	Discipline Specific Elective1A	**Vyakarana&Kavya** i) Kavirahasyam **ii)**Sahityadarpana- 1-3 Chapters	6	5 + 1	25 (5+20)	50	75
	Discipline Specific Elective (DSE2A)		6	5 + 1	25 (5+20)	50	75
	Generic Elective Elective	Interdisciplinary(Any Discipline other than Sanskrit) (75 classes)	6	5 + 1	25 (5+20)	50	75

		Semester VI			Marks		
Course Code	Course Type	**Course Title& Topics**	Credits	Lec +Tu	IA	ESE	TOTAL
		Chose any One Course from SANGDSE03T & SANGDSE04T					
SANGDSE03T	Discipline Specific Elective1B	**Veda&Darshana** i)Vedic Culture & Vedic studies in West Bengal ii) Bangiyadarshanachinta: Ramakrishna-Vivekananda darshan, GouriyaVaishnabdarshan Shaktadarshan	6	5 + 1	25 (5+20)	6	5 + 1
SANGDSE04T	Discipline Specific Elective1B	**Vyakarana&Kavya** i)Computational linguistics ii) Kavyalankarasutravritti- 1-4 Chapters	6	5 + 1	25 (5+20)	50	75
	Discipline Specific Elective (DSE2B)		6	5 + 1	25 (5+20)	50	75
	Generic Elective Course	Interdisciplinary(Any Discipline other than Sanskrit) (75 classes)	6	5 + 1	25 (5+20)	50	75

SKILL ENHANCEMENT COURSES (SEC)

❖ **All questions will be set in Sanskrit Language with Devnagari Script.**

		Odd Semesters (III / V)			Marks		
Course Code	Course Type	**Course Title& Topics**	Credits	Lec +Tu	IA	ESE	TOTAL
SANSSEC01M	SEC1 (Skill Based)	**Basic Sanskrit** Translation(From Bengali/English to Sanskrit) (20 Classes) Paragraph Writing (5 Classes) Letter Writing (5 Classes)	2	2	5	20	25
		Even Semesters (IV / VI)					
Course Code	Course Type	**Spoken Sanskrit & Computer Awareness for Sanskrit**	2	2	5	20	25
SANSSEC02M	SEC2 (Skill Based)	Conversation (Asmad, yusmad, tat, yat, etat, bhavat) Lakara, samkhya, avyaya, samaya, Kathapatha, Vibhakti, krit-prtyaya, Lingabheda, kriyapadapryoga. (10 Marks) Basic Computer Awareness, Typing in Unicode for Preservation and Digitalization of Sanskrit Text Web Publishing (10 Marks)					

Generic Elective Course(Non-Sanskrit Pass)

- ❖ **All questions will be set in Sanskrit Language with Devnagari Script.**
- ❖ **40% Questions are to be answered compulsorily in Sanskrit with Devanagari script in 5th and 6th Semesters.**

		Semester V			Marks		
Course Code	Course Type	**Course Title& Topics**	Credits	Lec +Tu	IA	ESE	Total
SANGGEC01T	Generic Elective Course	**Basic Sanskrit** **Section 'A' Grammar and composition Part I(20 Classes)** Nominative forms of pronouns- asmad, yuṣmad, etat and tat in masculine, feminine and neuter. Nominative forms of 'a' ending masculine and neuter gender nouns with paṭh, khād, likh and similar simple verbs in present, past and future. Objective forms of the above nouns and pronouns in singular with more simple verbs Instrumental, dative, ablative forms of the above nouns and pronouns in singular, dual and plural instrumental, dative, ablative forms of all the words in this syllabus 'ā' and ' ī' ending feminine words in nominative and accusative cases with loṭlakāra (imperative). 'ā' and ' ī' ending feminine nouns in singular in Genitive/ possessive and locative cases, genitive and locative cases in singular in pronouns tat, etat, yat, kim Masculine and Feminine nouns ending in 'i' and masculine nouns ending in 'u' in various cases in singular Masculine nouns ending in consonants – bhavat, guṇin, ātman and Feminine nouns ending in consonants – vāk, Neuter nouns ending in consonants – jagat , manas **Section 'B' Grammar and composition Part II(25 Classes)** Special Verb forms – in parasmaipada –past, present, future and imperative - kṛ, śrū Special Verb forms – in parasmaipada –past, present, future and imperative jñā . Special Verb forms – in parasmaipada –past, present, future and imperative dā. ātmanepada – sev, labh Phonetic changes – visargasandhi vowelsandhis. Participles - śatṛ, śānac, ktavatu, kta. Pratyayas – ktvā, lyap, tumun. Active – passive structures in lakāras – (third person forms only) and pratyayas kta, ktavatu **Section 'C' Literature (30 Classes)** Gita Chapter XII	6	5 + 1	25	50	75

		Semester VI			Marks		
Course Code	Course Type	**Course Title & Topics**	Credits	Lec +Tu	IA	ESE	Total
SANGGEC02T	Generic Elective Course	**Critical Survey of Sanskrit Literature** **Section 'A' (20 Classes)** Vedic Literature Saṁhitā (Ṛk, Yajuḥ, Sāma, Atharva) time, subject–matter, religion & Philosophy, social life Brāhmaṇa, Āraṇyaka, Upaniṣad, Vedāṅga (Brief Introduction) **Section 'B'(10 Classes)** Rāmāyaṇa Rāmāyaṇa-time, subject–matter, Rāmāyaṇa as anĀdikāvya. Rāmāyaṇa as a Source Text and its Cultural Importance. **Section 'C'(10 Classes)** Mahābhārata Mahābhārata and its Time, Development, and subject matter Mahābhārata :Encyclopaedic nature, as a Source, Text, Cultural Importance. **Section 'D'(10 Classes)** Purāṇas Purāṇas : Subject matter, Characteristics Purāṇas : Social, Cultural and Historical Importance **Section 'E'(25 Classes)** General Introduction to Vyākaraṇa, Darśana and Sāhityaśāstra *General Introduction to Vyākaraṇa:* Brief History of Vyākaraṇaśāstra *General Introduction to Darśana:* Major schools of Indian Philosophy Cārvāka, Bauddha, Jaina, Sāṅkhya-yoga, Nyāya-Vaiseśika, Pūrva-mīmāṁsā and Uttaramīmāṁsā. *General Introduction to Poetics:* Six major Schools of Indian Poetics-Rasa, Alaṁkāra, Rīti, Dhvani,Vakrokti and Aucitya	6	5 + 1	25	50	75

QUESTION PATTERN

B. A. (Programme) in Sanskrit

SEMESTER – I

DSC – 1A

Full Marks – 75

End Semester Full Marks - 50

Section –A	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		OneShort Note/Explanation	1x5 = 5
Section – B	-	One long answer type Question	1x10 = 10
		Two Short explanatory notes/Explanations	2x5 = 10
Section – C	-	One long answer type Question	1x10 = 10
		One Short explanatory note/Explanation	1x5 = 5

Internal Assessment Full Marks - 25

Section – D	--	Project	10
		Short answer type Questions (Any two should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

SEMESTER – II

DSC – 1B

Full Marks – 75

End Semester Full Marks - 50

Section –A	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		TwoShort Notes/Explanations	2x5 = 10
Section – B	-	One long answer type Question	1x10 = 10
		One Short explanatory note/Explanation	1x5 = 5
Section – C	-	One long answer type Question	1x10 = 10
		One Short explanatory note/Explanation	1x5 = 5

Internal Assessment Full Marks - 25

Section – C	-	Project	10
		Short answer type Questions (Any two should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

AECC

Full Marks – 25

Only Internal Assessment Full Marks - 25

Multiple Choice Based Questions	20
Attendance -	5

SEMESTER – III

DSC – 1C

Full Marks – 75

End Semester Full Marks - 50

Section –A	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – B	-	Twolong answer type Questions	2x10 = 20
		Four Short explanatory note/Explanation (Any one should be In Sanskrit Language with Devanagari Script)	4x5 = 20

Internal Assessment Full Marks - 25

Section – A	-	Project	10
		Short answer type Questions (Any three should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

MIL

Full Marks – 25

Only Internal Assessment Full Marks - 25

Multiple Choice Based Questions	20
Attendance -	5

SEC1

(Skill Based)

Full Marks – 25

Only Internal Assessment Full Marks - 25

Translation(From Bengali/English to Sanskrit)	10
Paragraph Writing or Letter Writing	10
Attendance	5

SEMESTER – IV

DSC – 1D

Full Marks – 75

End Semester Full Marks - 50

Section –A	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		One Long answer type Question	1x10 = 10
Section – B	-	One long answer type Question	1x10 = 10
		Four Short explanatory notes/Explanations (Any one should be In Sanskrit Language with Devanagari Script)	4x5 = 20

Internal Assessment Full Marks - 25

Section – C	-	Project	10
		Short answer type Questions (Any three should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

MIL

Full Marks – 25

Only Internal Assessment Full Marks - 25

Multiple Choice Based Questions	20
Attendance -	5

SEC2

(Skill Based)

Full Marks – 25

Only Internal Assessment Full Marks - 25

Viva on Spoken Sanskrit	10
Practical on Computer Awareness	10
Attendance -	5

SEMESTER – V

DSE1A (SANGDSE01T)

Veda &Darshana

Full Marks – 75

End Semester Full Marks - 50

i)	---	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		One long answer type question	1x10 = 10
		Two Short notes/Explanations	2x5 = 10
ii)	---	One long answer type question	1x10 = 10
		Two Short notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10

Internal Assessment Full Marks - 25

ii)	---	Project	10
		Short answer type questions (Any Four should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

DSE1A (SANGDSE02T)

Vyakarana&Kavya

Full Marks – 75

End Semester Full Marks - 50

Kavirahasyam -	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
	Two Short notes/Explanations (Any two In Sanskrit Language with Devanagari Script)	2x5 = 10
Sahityadrpana -	Two long answer type questions	2x10 = 20
	Two Short notes/Explanations (Any two In Sanskrit Language with Devanagari Script)	2x5 = 10

Internal Assessment Full Marks - 25

Sahityadrpana -	Project	10
	Short answer type questions (Any four should be In Sanskrit Language with Devanagari Script)	2x5 = 10
	Attendance	5

SEC1

(Skill Based)

Full Marks – 25

Only Internal Assessment Full Marks - 25

Translation(From Bengali/English to Sanskrit)	10
Paragraph Writing or Letter Writing	10
Attendance	5

SEMESTER – VI

DSE1B (SANGDSE03T)

Veda &Darshana

Full Marks – 75

End Semester Full Marks - 50

i)	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		One long answer type question	1x10 = 10
ii)	-	Four Short notes/Explanations (Any two In Sanskrit Language with Devanagari Script)	4x5 = 20
		One long answer type question	1x10 = 10

Internal Assessment Full Marks - 25

ii)	-	Project	10
		Short answer type questions (Any four should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

DSE1B (SANGDSE04T)

Vyakarana&Kavya

Full Marks – 75

End Semester Full Marks - 50

i)	---	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		Two Short notes/Explanations	2x5 = 10
ii)	---	Two long answer type questions	2x10 = 20
		Two Short notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10

Internal Assessment Full Marks - 25

ii)	---	Project	10
		Short answer type questions (Any four should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

SEC2

(Skill Based)

Full Marks – 25

Only Internal Assessment Full Marks - 25

Viva on Spoken Sanskrit	10
Practical on Computer Awareness	10
Attendance -	5

N.B.: - The Question Pattern of Generic Elective(H) is similar to the Question Pattern of B.A. Sanskrit Programme(Core Courses).

Generic Elective Course (Non-Sanskrit Pass)

SEMESTER V

GE1

Full Marks – 75

End Semester Full Marks - 50

Section – A	--	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section-- B	--	Four Short Notes/Explanations (Any two should be in Sanskrit Language with Devanagari Script)	4x5 = 20
Section – B	--	One long answer type question	10
Section – C	--	One long answer type question	10

Internal Assessment Full Marks - 25

Section – C	---	Project	10
		Short answer type questions (Any four should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

SEMESTER VI

GE2

Full Marks – 75

End Semester Full Marks - 50

Section –A	---	One long answer type question	1x10 = 10
		One Short note/Explanation	1x5 = 5
Section – D	---	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		Two Short Notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10
Section – E	---	One long answer type question	1x10 = 10
		One Short note/Explanation	1x5 = 5

Internal Assessment Full Marks - 25

Section – C	--	Project	10
Section – B	--	Short answer type questions (Any four should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

WEST BENGAL STATE UNIVERSITY

DRAFT SYLLABUS IN CHEMISTRY (GENERAL)

UNDER

CHOICE BASED CREDIT SYSTEM

2018

Scheme for CBCS Curriculum for BSc. Chemistry

Credit Distribution across Courses

Credits				
Course Type		Total Papers	Theory + Practical	
Core Courses	4 papers each from 3 disciplines of choice	12	12X4 =48 12X2 =24	
Elective Courses	2 papers each from 3 discipline of choice including interdisciplinary papers	6	6X4=24 6X2=12	
Ability Enhancement Language Courses		2	2X2=4	
Skill Enhancement Courses		4	4X2=8	
Totals		24	120	

Scheme for CBCS Curriculum

Semester	Course Name	Course Detail	Credits	Marks
I	Ability Enhancement Compulsory Course–I	English communication / Environmental Science	2	25
	Core course–I	**CEMGCOR01T**	4	50
	Core course–I Practical	**CEMGCOR01P**	2	25
	Core course–II	Core Course 2A from other chosen discipline	4	50
	Core course–II Practical	Core Course 2A Practical from other chosen discipline	2	25
	Core course – III	Core Course 3A from other chosen discipline	4	50
	Core course – III Practical	Core Course 3A Practical from other chosen discipline	2	25

II	Ability Enhancement Compulsory Course–II	English communication / Environmental Science	2	25
	Core course–IV	**CEMGCOR02T**	4	50
	Core course–IV Practical	**CEMGCOR02P**	2	25
	Core course–V	Core Course 2B from other chosen discipline	4	50
	Core course– V Practical	Core Course 2B Practical from other chosen discipline	2	25
	Core course – VI	Core Course 3B from other chosen discipline	4	50
	Core course – VI Practical	Core Course 3B Practical from other chosen discipline	2	25
III	Core course VII	**CEMGCOR03T**	4	50
	Core course–VII Practical	**CEMGCOR03P**	2	25
	Core course – VIII	Core Course 2C from other chosen discipline	4	50
	Core course – VIII Practical	Core Course 2C Practical from other chosen discipline	2	25
	Core course–IX	Core Course 3C from other chosen discipline	4	50
	Core course–IX Practical	Core Course 3C Practical from other chosen discipline	2	25
	Skill Enhancement Course–1		2	25
IV	Core course–X	**CEMGCOR04T**	4	50
	Core course – X Practical	**CEMGCOR04P**	2	25
	Core course–XI	Core Course 2D from other chosen discipline	4	50
	Core course–XI Practical	Core Course 2D Practical from other chosen discipline	2	25
	Core course–XII	Core Course 3D from other chosen discipline	4	50
	Core course–XII Practical	Core Course 3D Practical from other chosen discipline	2	25
	Skill Enhancement Course-2		2	25
V	Skill Enhancement Course – 3		2	25
	Discipline Specific Elective 1	**DSE** is to be chosen from **CEMGDSE01T and CEMGDSE02T**	4	50

	Discipline Specific Elective 1 Practical	**DSE** is to be chosen from **CEMGDSE01P and CEMGDSE02P**	2	25
	Discipline Specific Elective 2	DSE 2A from other chosen discipline	4	50
	Discipline Specific Elective 2 Practical	DSE 2A Practical from other chosen discipline	2	25
	Discipline Specific Elective 3	DSE 3A from other chosen discipline	4	50
	Discipline Specific Elective 3 Practical	DSE 3A Practical from other chosen discipline	2	25
VI	Skill Enhancement Course – 4		2	25
	Discipline Specific Elective 4	**DSE** is to be chosen from **CEMGDSE03T and CEMGDSE04T**	4	50
	Discipline Specific Elective 4 Practical	**DSE** is to be chosen from **CEMGDSE03P and CEMGDSE04P**	2	25
	Discipline Specific Elective 5	DSE 2B from other chosen discipline	4	50
	Discipline Specific Elective 5 Practical	DSE 2B Practical from other chosen discipline	2	25
	Discipline Specific Elective 6	DSE 3B from other chosen discipline	4	50
	Discipline Specific Elective 6 Practical	DSE 3B Practical from other chosen discipline	2	25
		Total	**120**	**1500**

Discipline Specific Elective papers (Credit: 06 each) (DSE 1, DSE 2):

Chemistry

1. **CEMGDSE01T** : Polymer Chemistry (4)
   CEMGDSE01P : Polymer Chemistry Lab (2)
2. **CEMGDSE02T**: Green Chemistry (4)
   CEMGDSE02P: Green Chemistry Lab (2)
3. **CEMGDSE03T:** Inorganic Materials of Industrial Importance (4)
   CEMGDSE03T: Inorganic Materials of Industrial Importance Lab (2)
4. **CEMGDSE04:** ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY (4)
   CEMGDSE04: ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY Lab (2)

SEMESTER-I

CEMGCOR01T: ATOMIC STRUCTURE, CHEMICAL PERIODICITY, ACIDS AND BASES,REDOX REACTIONS, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Section A: Inorganic Chemistry-I

(30 Lectures) Marks: 25

Atomic Structure (10 Lectures)

Bohr's theory for hydrogen atom (simple mathematical treatment), atomic spectra of hydrogen and Bohr's model, Sommerfeld's model, quantum numbers and their significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many-electron atoms, *Aufbau* principle and its limitations.

Chemical Periodicity (05 Lectures)

Classification of elements on the basis of electronic configuration: general characteristics of s-, p-, d- and f-block elements. Positions of hydrogen and noble gases. Atomic and ionic radii, ionization potential, electron affinity, and electronegativity; periodic and group-wise variation of above properties in respect of s- and p- block elements.

Acids and bases (10 Lectures)

Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process.

Redox reactions (05 Lectures)

Balancing of equations by oxidation number and ion-electron method oxidimetry and reductimetry.

Section B: Organic Chemistry-I

(30 Lectures) Marks: 25

Fundamentals of Organic Chemistry (5 Lectures)

Electronic displacements: inductive effect, resonance and hyperconjugation; cleavage of bonds: homolytic and heterolytic; structure of organic molecules on the basis of VBT; nucleophiles electrophiles; reactive intermediates: carbocations, carbanions and free radicals.

Stereochemistry (8 Lectures)

Different types of isomerism; geometrical and optical isomerism; concept of chirality and optical activity (up to two carbon atoms); asymmetric carbon atom; elements of symmetry (plane and centre); interconversion of Fischer and Newman representations; enantiomerism and diastereomerism, *meso* compounds; *threo* and *erythro*, D and L, *cis* and *trans* nomenclature; CIP Rules: *R/S* (upto 2 chiral carbon atoms) and *E/Z* nomenclature.

Nucleophilic Substitution and Elimination Reactions (5 Lectures)

Nucleophilic substitutions: S_N1 and S_N2 reactions; eliminations: E1 and E2 reactions (elementary mechanistic aspects); Saytzeff and Hofmann eliminations;elimination *vs* substitution.

Aliphatic Hydrocarbons (12 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structures.

Alkanes:(up to 5 Carbons). *Preparation:* catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* mechanism forfree radical substitution: halogenation.

Alkenes:(up to 5 Carbons). *Preparation:* elimination reactions: dehydration of alcohols and dehydrohalogenation of alkyl halides; *cis* alkenes (partial catalytic hydrogenation) and *trans* alkenes (Birch reduction). *Reactions: cis*-addition (alkaline $KMnO_4$) and *trans*-addition (bromine) with mechanism, addition of HX [Markownikoff's (with mechanism) and antiMarkownikoff's addition], hydration, ozonolysis, oxymercuration-demercuration and hydroboration-oxidation reaction.

Alkynes: (up to 5 Carbons). *Preparation:* acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alkaline $KMnO_4$.

Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in InorganicChemistry*, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry:Principles of Structure and Reactivity*, Pearson Education India, 2006.
5. Sethi, A. *Conceptual Organic Chemistry;* New Age International Publisher.
6. Parmar, V. S. *A Text Book of Organic Chemistry*, S. Chand & Sons.
7. Madan, R. L. *Organic Chemistry*, S. Chand & Sons.

8. Wade, L. G., Singh, M. S., *Organic Chemistry*.
9. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
10. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
11. Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds*, Wiley: London, 1994.
12. Sen Gupta, Subrata. *Basic Stereochemistry of Organic molecules.*
13. Kalsi, P. S. *Stereochemistry Conformation and Mechanism*, Eighth edition, New Age International, 2014.
14. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.

CEMGCOR01P: ATOMIC STRUCTURE, CHEMICAL PERIODICITY, ACIDS AND BASES, REDOX REACTIONS, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS LAB

(60 Lectures/Contact Hours) Marks: 25

Section A: Inorganic Chemistry –LAB ***(30 Lectures)***

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.

2. Estimation of oxalic acid by titrating it with $KMnO_4$.

3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.

5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

Section B: Organic Chemistry- LAB **(30 Lectures)**

Qualitative Analysis of Single Solid Organic Compound(s)

Experiment A: Detection of special elements (N, Cl, and S) in organic compounds.

Experiment B: Solubility and Classification (solvents: H_2O, dil. HCl, dil. NaOH)

Experiment C: Detection of functional groups: Aromatic-NO_2, Aromatic -NH_2, -COOH, carbonyl (no distinction of –CHO and >C=O needed), -OH (phenolic) in solid organic compounds.

Experiments A - C with unknown (at least 6) solid samples containing not more than two of the above type of functional groups should be done.

Reference Books:

1. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.
2. Das, S. C., Chakraborty, S. B., *Practical Chemistry.*
3. Mukherjee, K. S. *Text book on Practical Chemistry*, New Oriental Book Agency.
4. Ghosal, Mahapatra & Nad, *An Advanced course in practical Chemistry*, New Central Book Agency.
5. Vogel, A. I. *Elementary Practical Organic Chemistry*, Part 2: *Qualitative Organic Analysis*, CBS Publishers and Distributors.
6. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
7. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

SEMESTER-II

CEMGCOR02T: STATES OF MATTER & CHEMICAL KINETICS, CHEMICAL BONDING & MOLECULAR STRUCTUR, p-BLOCK ELEMENTS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures **Marks: 50**

Section A: Physical Chemistry-I

(30 Lectures) **Marks: 25**

Kinetic Theory of Gases and Real gases **(10 Lectures)**

Concept of pressure and temperature; Collision of gas molecules; Collision diameter; Collision number and mean free path; Frequency of binary collisions (similar and different molecules); Rate of effusion

Nature of distribution of velocities, Maxwell's distribution of speed and kinetic energy; Average velocity, root mean square velocity and most probable velocity; Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases

Deviation of gases from ideal behavior; compressibility factor; Boyle temperature; Andrew's and Amagat's plots; van der Waals equation and its features; its derivation and application in explaining real gas behaviour; Existence of critical state, Critical constants in terms of van der Waals constants; Law of corresponding states

Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only)

Liquids **(06 Lectures)**

Definition of Surface tension, its dimension and principle of its determination using stalagmometer; Viscosity of a liquid and principle of determination of coefficient of viscosity using Ostwald viscometer; Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

Solids **(06 Lectures)**

Forms of solids, crystal systems, unit cells, Bravais lattice types, Symmetry elements; Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices; Miller indices

of different planes and interplanar distance, Bragg's law; Structures of NaCl, KCl and CsCl (qualitative treatment only); Defects in crystals; Glasses and liquid crystals.

Chemical Kinetics **(08 Lectures)**

Introduction of rate law, Order and molecularity; Extent of reaction; rate constants; Rates of First, second and nth order reactions and their Differential and integrated forms (with derivation); Pseudo first order reactions; Determination of order of a reaction by half-life and differential method; Opposing reactions, consecutive reactions and parallel reactions

Temperature dependence of rate constant; Arrhenius equation, energy of activation; Collision theory; Lindemann theory of unimolecular reaction; outline of Transition State theory (classical treatment)

Reference Books:

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
5. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
6. Chugh, K.L., Agnish, S.L. *A Text Book of Physical Chemistry* Kalyani Publishers7.Bahl, B.S., Bahl, A., Tuli, G.D., *Essentials of Physical Chemistry* S. Chand & Co. ltd.
8. Palit, S. R., *Elementary Physical Chemistry* Book Syndicate Pvt. Ltd.
9. Mandal, A. K. *Degree Physical and General Chemistry* Sarat Book House
10. Pahari, S., *Physical Chemistry* New Central Book Agency
11. Pahari, S., Pahari, D., *Problems in Physical Chemistry* New Central Book Agency

Section B: Inorganic Chemistry-II

(30 Lectures) **Marks: 25**

Chemical Bonding and Molecular Structure **(16 Lectures)**

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionicbonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, BornHaber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basisof VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p*combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods. (including idea of *s- p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches.

Comparative study of p-block elements: (14 Lectures)

Group trends in electronic configuration, modification of pure elements, common oxidation states, inert pair effect, and their important compounds in respect of the following groups of elements:

i)B-Al-Ga-In-Tl
ii)C-Si-Ge-Sn-Pb
iii)N-P-As-Sb-Bi
iv)O-S-Se-Te v)F-Cl-Br-I

Reference Books:

1. Cotton, F.A. & Wilkinson, G. *Basic Inorganic Chemistry*, Wiley.
2. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
3. Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
4. Rodgers, G.E. *Inorganic & Solid State Chemistry*, Cengage Learning India Ltd., 2008.

CEMGCOR02P: STATES OF MATTER & CHEMICAL KINETICS, CHEMICAL BONDING & MOLECULAR STRUCTUR, p-BLOCK ELEMENTS LAB

(60 Lectures/Contact Hours) Marks: 25

Section A: Physical Chemistry-LAB **(15x2=30 Lectures)**

(Minimum **five** experiments to complete)

(I) Surface tension measurement (use of organic solvents excluded)

a) Determination of the surface tension of a liquid or a dilute solution using a Stalagmometer

b) Study of the variation of surface tension of a detergent solution with concentration

(II) Viscosity measurement (use of organic solvents excluded)

a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer

b) Study of the variation of viscosity of an aqueous solution with concentration of solute

(III) Study the kinetics of the following reactions

a) Initial rate method: Iodide-persulphate reaction

b) Integrated rate method:

(i) Acid hydrolysis of methyl acetate with hydrochloric acid

(ii) Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

Reference Books:

1. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.
2. Palit, S.R., *Practical Physical Chemistry* Science Book Agency
3. Mukherjee, N.G., *Selected Experiments in Physical Chemistry* J. N. Ghose & Sons
4. Dutta, S.K., *Physical Chemistry Experiments* Bharati Book Stall

Section B: Inorganic Chemistry-LAB **(30 Lectures)**

Qualitative semimicro analysis of mixtures containing three radicals. Emphasis should be given to the understanding of the chemistry of different reactions.

Acid Radicals: Cl^-, Br^-, I^-, NO_2^-, NO_3^-,S^{2-}, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, H_3BO_3. Basic Radicals: Na^+, K^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, Cr^{3+}, Mn^{2+}, Fe^{3+}, Ni^{2+}, Cu^{2+}, NH_4^+.

Reference Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

SEMESTER-III

CEMGCOR03T: CHEMICAL ENERGETICS, EQUILIBRIA, ORGANIC CHEMISTRY-II

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Section A: Physical Chemistry-II

(30 Lectures) Marks: 25

Chemical Energetics (14 Lectures)

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics; Concept of heat, work, internal energy and statement of first law; enthalpy, H; relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases

Standard states; Heats of reaction; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; Laws of thermochemistry; bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equations and effect of pressure on enthalpy of reactions; Adiabatic flame temperature; explosion temperature

Statement of the second law of thermodynamics; Concept of heat reservoirs and heat engines; Carnot cycle; Physical concept of Entropy; Carnot engine, refrigerator and efficiency; Entropy change of systems and surroundings for various processes and transformations; Auxiliary state functions (G and A) and Criteria for spontaneity and equilibrium.

Chemical Equilibrium: (08 Lectures)

Thermodynamic conditions for equilibrium, degree of advancement; Variation of free energy with degree of advancement; Equilibrium constant and standard Gibbs' free energy change; Definitions of K_P, K_C and K_X and relation among them; van't Hoff's reaction isotherm, isobar and isochore from different standard states; Shifting of equilibrium due to change in external parameters e.g. temperature and pressure; variation of equilibrium constant with addition to inert gas; Le Chatelier's principle

Ionic Equilibria: (08 Lectures)

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water; Ionization of weak acids and bases, pH scale, common ion effect; Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts; Buffer solutions; Solubility and solubility product of sparingly soluble salts – applications of solubility product principle

Reference Books:

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
5. Ekambaram, S. *General Chemistry*, Pearson.
6. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
7. Chugh, K.L., Agnish, S.L. *A Text Book of Physical Chemistry* Kalyani Publishers8.Bahl, B.S., Bahl, A., Tuli, G.D., *Essentials of Physical Chemistry* S. Chand & Co. ltd.
9. Palit, S. R., *Elementary Physical Chemistry* Book Syndicate Pvt. Ltd.
10. Mandal, A. K. *Degree Physical and General Chemistry* Sarat Book House
11. Pahari, S., *Physical Chemistry* New Central Book Agency
12. Pahari, S., Pahari, D., *Problems in Physical Chemistry* New Central Book Agency

Section-B: Organic Chemistry-II

(30 Lectures) Marks: 25

Functional group app roach for the following reactions (preparations & reactions) to be studied in context to their structures.

Aromatic Hydrocarbons 06 Lectures)

Benzene:Preparation: from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. *Reactions*: electrophilic substitution (general mechanism); nitration (with mechanism), halogenations (chlorination and bromination), sulphonation and Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene); side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

Organometallic Compounds (2 Lectures)

Introduction; *Grignard reagents*: *Preparations* (from alkyl and aryl halide); concept of *umpolung;* Reformatsky reaction.

Aryl Halides (3 Lectures)

Preparation: (chloro-, bromo- and iodobenzene): from phenol, Sandmeyer reactions. *Reactions (Chlorobenzene):* nucleophilic aromatic substitution (replacement by –OH group) and effect of nitro substituent (activated nucleophilic substitution).

Alcohols, Phenols and Ethers (11 Lectures)

Alcohols:(up to 5 Carbons). *Preparation:* 1°-, 2°- and 3°- alcohols: using Grignard reagent, reduction of aldehydes, ketones, carboxylic acid and esters; *Reactions:* With sodium, HX (Lucas test), oxidation (alkaline $KMnO_4$, acidic dichromate, concentrated HNO_3);

Oppenauer oxidation;

Diols: Preparation (with OsO_4); pinacol- pinacolone rearrangement (with mechanism) (*with symmetrical diols* only).

Phenols:Preparation: cumene hydroperoxide method, from diazonium salts; acidic nature of phenols; *Reactions:* electrophilic substitution: nitration and halogenations; Reimer -Tiemann reaction, Houben–Hoesch condensation, Schotten –Baumann reaction, Fries rearrangement and Claisen rearrangement.

Ethers:Preparation: Williamson's ether synthesis; *Reaction*: cleavage of ethers with HI.

Carbonyl Compounds (08 Lectures)

Aldehydes and Ketones (aliphatic and aromatic):(Formaldehye, acetaldehyde, acetone and benzaldehyde): *Preparation:* from acid chlorides, from nitriles and from Grignard reagents; general properties of aldehydes and ketones; *Reactions:* with HCN, ROH, $NaHSO_3$, NH_2-G derivatives and with Tollens' and Fehling's reagents; iodoform test; aldol condensation (with mechanism); Cannizzaro reaction (with mechanism), Wittig reaction, benzoin condensation; Clemmensen reduction, Wolff- Kishner reduction and Meerwein-Pondorff-Verley (MPV) reduction.

Reference Books:

1. Sethi, A. *Conceptual Organic Chemistry;* New Age International Publisher.
2. Parmar, V. S. *A Text Book of Organic Chemistry*, S. Chand & Sons.
3. Madan, R. L. *Organic Chemistry*, S. Chand & Sons.
4. Wade, L. G., Singh, M. S., *Organic Chemistry, Pearson*.
5. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
7. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.

CEMGCOR03P: CHEMICAL ENERGETICS, EQUILIBRIA, ORGANIC CHEMISTRY LAB

(60 Lectures/Contact Hours) Marks: 25

Section A: Physical Chemistry-LAB **(15x2=30 Lectures)**

(Minimum **five** experiments to complete)

(I) Thermochemistry (Any **three**)

1. Determination of heat capacity of calorimeter for different volumes
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide
3. Determination of enthalpy of ionization of acetic acid
4. Determination of enthalpy of hydration of copper sulphate

(II) Ionic Equilibria (Any **two**)

a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter and compare it with the indicator method

b) Preparation of buffer solutions and find the pH of an unknown buffer solution by colour matching method (using following buffers)
   (i) Sodium acetate-acetic acid
   (ii) Ammonium chloride-ammonium hydroxide

c)Study of the solubility of benzoic acid in water

Reference Books:

1. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.
2. Palit, S.R., *Practical Physical Chemistry* Science Book Agency
3. Mukherjee, N.G., *Selected Experiments in Physical Chemistry* J. N. Ghose & Sons
4. Dutta, S.K., *Physical Chemistry Experiments* Bharati Book Stall

Section B: Organic Chemistry-LAB

Identification of a pure organic compound

Solid compounds: oxalic acid, tartaric acid, succinic acid, resorcinol, urea, glucose, benzoic acid and salicylic acid.

Liquid Compounds: methyl alcohol, ethyl alcohol, acetone, aniline, dimethylaniline, benzaldehyde, chloroform and nitrobenzene

Reference Books:

1. Bhattacharyya, R. C, *A Manual of Practical Chemistry.*
2. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbookof Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

SEMESTER-IV

CEMGCOR04T: SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE,

ELECTROCHEMISTRY & ANALYTICAL AND ENVIORNMETAL CHEMISTRY-I

(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures Marks: 50

Section A: Physical Chemistry-III
(30 Lectures) Marks: 25

Solutions (06 Lectures)

Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions; Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions; Distillation of solutions; Lever rule; Azeotropes

Critical solution temperature; effect of impurity on partial miscibility of liquids; Immiscibility of liquids- Principle of steam distillation; Nernst distribution law and its applications, solvent extraction

Phase Equilibria (08 Lectures)

Phases, components and degrees of freedom of a system, criteria of phase equilibrium; Gibbs' Phase Rule and its thermodynamic derivation; Derivation of Clausius – Clapeyron equation and its importance in phase equilibria; Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (leadsilver, $FeCl_3$-H_2O and Na-K only)

Conductance (08 Lectures)

Conductance, cell constant, specific conductance and molar conductance; Variation of specific and equivalent conductance with dilution for strong and weak electrolytes; Kohlrausch's law of independent migration of ions; Equivalent and molar conductance at infinite dilution and their determination for strong and weak electrolytes; Ostwald's dilution law; Application of conductance measurement (determination of solubility product and ionic product of water); Conductometric titrations (acid-base)

Transport Number and principles of Hittorf's and Moving-boundary method

Electromotive force (08 Lectures)

Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry; Chemical cells, reversible

and irreversible cells with examples; Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential; Electrochemical series;

Thermodynamics of a reversible cell, calculation of thermodynamic properties: *G*, *H* and *S* from EMF data

Concentration cells with and without transference, liquid junction potential; pH determination using hydrogen electrode and quinhydrone; Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation)

Reference Books:

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
5. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
6. Chugh, K.L., Agnish, S.L. *A Text Book of Physical Chemistry* Kalyani Publishers7.Bahl, B.S., Bahl, A., Tuli, G.D., *Essentials of Physical Chemistry* S. Chand & Co. ltd.
8. Palit, S. R., *Elementary Physical Chemistry* Book Syndicate Pvt. Ltd.
9. Pahari, S., *Physical Chemistry* New Central Book Agency
10. Pahari, S., Pahari, D., *Problems in Physical Chemistry* New Central Book Agency

Section B: Analytical and Environmental Chemistry
(30 Lectures) Marks: 25

Chemical Analysis (15 Lectures)

Gravimetric analysis: solubility product and common ion effect; requirements of gravimetry; gravimetric estimation of chloride, sulphate, lead, barium, nickel, copper and zinc.

Volumetric analysis: primary and secondary standard substances; principles of acid-base, oxidation –reduction and complexometric titrations; indicators: acid-base, redox and metal ion; principles of estimation of mixtures: $NaHCO_3$ and Na_2CO_3 (by acidimetry); iron, copper, manganese and chromium (by redox titration); zinc, aluminum, calcium and magnesium (by complexometric EDTA titration).

Chromatography: chromatographic methods of analysis: column chromatography and thin layer chromatography.

Environmental Chemistry (15 Lectures)

The Atmosphere: composition and structure of the atmosphere; troposphere, stratosphere, mesosphere and thermosphere; ozone layer and its role; major air pollutants: CO, SO_2, NO_x and particulate matters – their origin and harmful effects; problem of ozone layer depletion; green house effect; acid rain and photochemical smog; air pollution episodes: air quality

standard; air pollution control measures: cyclone collector, electrostatic precipitator, catalytic converter.

The Hydrosphere: environmental role of water, natural water sources, water treatment for industrial, domestic and laboratory uses; water pollutants; action of soaps and detergents, phosphates, industrial effluents, agricultural runoff, domestic wastes; thermal pollution, radioactive pollution and their effects on animal and plant life; water pollution episodes: water pollution control measures : waste water treatment; chemical treatment and microbial treatment; water quality standards: DO, BOD, COD, TDS and hardness parameters; desalination of sea water : reverse osmosis, electrodialysis.

The Lithosphere: water and air in soil, waste matters and pollutants in soil, waste classification, treatment and disposal; soil pollution and control measures.

Reference Books:

1. Banerjee, S. P. *A Text Book of Analytical Chemistry*, The New Book Stall.
2. Gangopadhyay, P. K. *Application Oriented Chemistry*, Book Syndicate.
3. Mondal, A. K & Mondal, S. *Degree Applied Chemistry*, Sreedhar Publications.
4. Banerjee, S. P. *A Text Book of Analytical Chemistry*, The New Book Stall.

CEMGCOR04P: SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE,

ELECTROCHEMISTRY & FUNCTIONAL ORGANIC CHEMISTRY-II LAB

(60 Lectures/Contact Hours) Marks: 25

Section A: Physical Chemistry-LAB **(15x2=30 Lectures)**

(Minimum **six** experiments to complete)

(I) Distribution Law (Any **one**)

Study of the equilibrium of **one of the following reactions** by the distribution method:

$$I_2(aq) + I^-(aq) = I_3^-(aq)$$

$$Cu^{2+}(aq) + xNH_2(aq) = [Cu(NH_3)_x]^{2+}$$

(II) Phase equilibria (Any **one**)

a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves

b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it

(III) Conductance

a) Determination of dissociation constant of a weak acid (cell constant, equivalent conductance are also determined)

b) Perform the following conductometric titrations: (Any **one**)
   (i) Strong acid vs. strong base
   (ii) Weak acid vs. strong base

(IV) Potentiometry

Perform the following potentiometric titrations:
   (i) Weak acid vs. strong base
   (ii) Potassium dichromate vs. Mohr's salt

Reference Books:

1. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.
2. Palit, S.R., *Practical Physical Chemistry* Science Book Agency

3. Mukherjee, N.G., *Selected Experiments in Physical Chemistry* J. N. Ghose & Sons
4. Dutta, S.K., *Physical Chemistry Experiments* Bharati Book Stall

Section B: Analytic and Environmental Chemistry-LAB (30 Lectures)

1. To find the total hardness of water by EDTA titration.
2. To find the PH of an unknown solution by comparing color of a series of HCl solutions + 1 drop of methyl orange, and a similar series of NaOH solutions + 1 drop of phenolphthalein.
3. To determine the rate constant for the acid catalysed hydrolysis of an ester.
4. Determination of the strength of the H_2O_2 sample.
5. To determine the solubility of a sparingly soluble salt, e.g. KHTa (one bottle)

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
2. Ghosal, Mahapatra & Nad, *An Advanced Course in Practical Chemistry,* New Central Book Agency.
3. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N. University of Calcutta, 2003.
4. Das, S. C., Chakraborty, S. B., *Practical Chemistry.*

Discipline Specific Electives

CHEMISTRY-DSE I-IV (ELECTIVES)

CEMGDSE01T: POLYMER CHEMISTRY

(Credits: Theory-06, Practicals-02)

Theory: 60 Lectures Marks:50

Introduction and history of polymeric materials:

(4 Lectures) Marks:04

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of polymers.

Functionality and its importance:

(8 Lectures) Marks:06

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

Kinetics of Polymerization:

(8 lectures) Marks:06

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Crystallization and crystallinity:

(4 Lectures) Marks:04

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Nature and structure of polymers-

(2 Lectures) Marks:04

Structure Property relationships.

Determination of molecular weight of polymers

(8 Lectures) Marks:06

(M_n, M_w, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

Glass transition temperature (Tg) and determination of Tg,

(8 Lectures) Marks:06

Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg).

Polymer Solution –

(8 Lectures) Marks:06

Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

Properties of Polymers

(10 Lectures) Marks:08

(Physical, thermal, flow & mechanical properties).

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes,

Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

Reference Books:

- Seymour, R.B.& Carraher, C.E. *Polymer Chemistry: An Introduction*, Marcel Dekker, Inc. New York, 1981.
- Odian, G. *Principles of Polymerization*, 4th Ed. Wiley, 2004.
- Billmeyer, F.W. *Textbook of Polymer Science*, 2nd Ed. Wiley Interscience, 1971. Ghosh, P. *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991.
- Lenz, R.W. *Organic Chemistry of Synthetic High Polymers.* Interscience Publishers, New York, 1967.

CEMGDSE01P: POLYMER CHEMISTRY

(60 Lectures/Contact Hours) Marks: 25

1. **Polymer synthesis**

1.Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).

   a. Purification of monomer
   b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bisisobutylonitrile (AIBN)

2. Preparation of nylon 66/6

1.Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein

   a. Preparation of IPC
   b. Purification of IPC
   c. Interfacial polymerization

3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparation of urea-formaldehyde resin
6. Preparations of novalac resin/resold resin.
7. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight by viscometry:
   (a) Polyacrylamide-aq.$NaNO_2$ solution
   (b) (Poly vinyl proplylidine (PVP) in water
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
4. Testing of mechanical properties of polymers.
5. Determination of hydroxyl number of a polymer using colorimetric method.

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
2. Instrumental Techniques
3. IR studies of polymers
4. DSC analysis of polymers
5. Preparation of polyacrylamide and its electrophoresis *at least 7 experiments to be carried out.

Reference Books:

- M.P. Stevens, *Polymer Chemistry: An Introduction*, 3rd Ed., Oxford University Press, 1999.
- H.R. Allcock, F.W. Lampe & J.E. Mark, *Contemporary Polymer Chemistry*, 3rd ed. Prentice-Hall (2003)
- F.W. Billmeyer, *Textbook of Polymer Science*, 3rd ed.Wiley-Interscience (1984)
- J.R. Fried, *Polymer Science and Technology*, 2nd ed.Prentice-Hall (2003)
- P. Munk & T.M. Aminabhavi, *Introduction to Macromolecular Science*, 2nd ed.John Wiley & Sons (2002)
- L. H. Sperling, *Introduction to Physical Polymer Science*, 4th ed.John Wiley & Sons (2005)
- M.P. Stevens, *Polymer Chemistry: An Introduction* 3rd ed.Oxford University Press (2005).
- Seymour/ Carraher's Polymer Chemistry, 9th ed.by Charles E. Carraher, Jr. (2013).

CEMGDSE02T: GREEN CHEMISTRY

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Introduction to Green Chemistry

(4 Lectures) Marks: 05

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry

Principles of Green Chemistry and Designing a Chemical synthesis

(30 Lectures) Marks: 25

Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following:

- Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products , Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.

- Prevention/ minimization of hazardous/ toxic products reducing toxicity.
  risk = (function) hazard × exposure; waste or pollution prevention hierarchy.

- Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents.
- Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy.
- Selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups.
- Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.
- Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.
- Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.

Examples of Green Synthesis/ Reactions and some real world cases

(16 Lectures) Marks: 12

1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis)
2. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction
3. Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction

(Ultrasonic alternative to Iodine)

4 Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.

5 Designing of Environmentally safe marine antifoulant.

6 Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments.

7 An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

8 Healthier fats and oil by Green Chemistry: Enzymatic interesterification for production of no Trans-Fats and Oils

9 Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting

Future Trends in Green Chemistry

(10 Lectures) Marks: 08

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal controlled solid state synthesis (C^2S^3); Green chemistry in sustainable development.

Reference Books:

- Ahluwalia, V.K. & Kidwai, M.R. *New Trends in Green Chemistry*, Anamalaya Publishers (2005).
- Anastas, P.T. & Warner, J.K.: *Green Chemistry - Theory and Practical*, Oxford University Press (1998).
- Matlack, A.S. *Introduction to Green Chemistry*, Marcel Dekker (2001).
- Cann, M.C. & Connely, M.E. *Real-World cases in Green Chemistry*, American Chemical Society, Washington (2000).
- Ryan, M.A. & Tinnesand, M. *Introduction to Green Chemistry*, American Chemical Society, Washington (2002).
- Lancaster, M. *Green Chemistry: An Introductory Text* RSC Publishing, 2nd Edition, 2010.

CEMGDSE02P: GREEN CHEMISTRY

(60 Lectures/Contact Hours) Marks: 25

1. Safer starting materials

- Preparation and characterization of nanoparticles of gold using tea leaves.

2. Using renewable resources

- Preparation of biodiesel from vegetable/ waste cooking oil.

3. Avoiding waste

Principle of atom economy.

- Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.
- Preparation of propene by two methods can be studied

(I) Triethylamine ion + $OH^- \rightarrow$ propene + trimethylpropene + water

(II) 1-propanol $\xrightarrow{H_2SO_4/\square}$ propene + water

- Other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.

4. Use of enzymes as catalysts

- Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

5. Alternative Green solvents

Extraction of D-limonene from orange peel using liquid CO_2 prepared form dry ice.

Mechanochemical solvent free synthesis of azomethines

6. Alternative sources of energy

- Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).
- Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Reference Books:

- Anastas, P.T & Warner, J.C. *Green Chemistry: Theory and Practice,* Oxford University Press (1998).
- Kirchoff, M. & Ryan, M.A. *Greener approaches to undergraduate chemistry experiment*. American Chemical Society, Washington DC (2002).
- Ryan, M.A. *Introduction to Green Chemistry*, Tinnesand; (Ed), American Chemical Society, Washington DC (2002).
- Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. *Green Chemistry Experiment: A monograph International Publishing House Pvt Ltd. New Delhi*. Bangalore CISBN 978-93-81141-55-7 (2013).
- Cann, M.C. & Connelly, M. E. *Real world cases in Green Chemistry*, American Chemical Society (2008).
- Cann, M. C. & Thomas, P. *Real world cases in Green Chemistry*, American Chemical Society (2008).
- Lancaster, M. *Green Chemistry: An Introductory Text* RSC Publishing, 2nd Edition, 2010.
- Pavia, D.L., Lampman, G.M., Kriz, G.S. & Engel, R.G. *Introduction to Organic Laboratory Techniques: A Microscale and Macro Scale Approach*, W.B.Saunders, 1995.

CEMGDSE03T: INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Silicate Industries

(16 Lectures) Marks: 12

*Glass:*Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

*Ceramics:*Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

*Cements:*Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

Fertilizers:

(10 Lectures) Marks: 10

Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

Surface Coatings:
(8 Lectures) Marks: 06

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

Batteries:

(8 Lectures) Marks: 06

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

Alloys:

(8 Lectures) Marks: 06

Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

Catalysis:

(6 Lectures) Marks: 06

General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts.

Phase transfer catalysts, application of zeolites as catalysts.

Chemical explosives:

(4 Lectures) Marks: 04

Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

Reference Books:

- E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
- J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- P. C. Jain & M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
- B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut

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CEMGDSE03P:
INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE
(60 Lectures/Contact Hours) Marks: 25

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of calcium in calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Electroless metallic coatings on ceramic and plastic material.

5. Determination of composition of dolomite (by complexometric titration).
6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
7. Analysis of Cement.
8. Preparation of pigment (zinc oxide).

Reference Books:

- E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
- W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
- J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
- Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

CEMGDSE04T:
ORGANOMETALLICS, BIOINORGANIC CHEMISTRY,
POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures Marks: 50

Section A: Inorganic Chemistry-4
(30 Lectures) Marks: 25

Chemistry of 3d metals (6 Lectures)

Oxidation states displayed by Cr, Fe, Co, Ni and Co.

A study of the following compounds (including preparation and important properties);

Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

Organometallic Compounds (12 Lectures)

Definition and Classification with appropriate examples based on nature of metalcarbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-

acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).

Bio-Inorganic Chemistry (12 Lectures)

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).

Section B: Organic Chemistry-4
(30 Lectures) Marks: 25

Polynuclear and heteronuclear aromatic compounds: (6 Lectures)

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene , Furan, Pyrrole, Thiophene, and Pyridine.

Active methylene compounds: (6 Lectures)

Preparation: Claisen ester condensation. Keto-enol tautomerism.

Reactions: Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having upto 6 carbon).

Application of Spectroscopy to Simple Organic Molecules (18 Lectures)

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λ_{max}&ε_{max}, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating l max of conjugated dienes and α,β – unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

Reference Books:

- James E. Huheey, Ellen Keiter & Richard Keiter: *Inorganic Chemistry: Principles of Structure and Reactivity,* Pearson Publication.
- G.L. Miessler & Donald A. Tarr: *Inorganic Chemistry,* Pearson Publication.
- J.D. Lee: *A New Concise Inorganic Chemistry,* E.L.B.S.
- F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley & Sons.
- I.L. Finar: *Organic Chemistry* (Vol. I & II), E.L.B.S.
- John R. Dyer: *Applications of Absorption Spectroscopy of Organic Compounds,* Prentice Hall.

- R.M. Silverstein, G.C. Bassler & T.C. Morrill*: Spectroscopic Identification of Organic Compounds*, John Wiley& Sons.
- R.T. Morrison & R.N. Boyd: *Organic Chemistry*, Prentice Hall.
- Peter Sykes: *A Guide Book to Mechanism* in *Organic Chemistry*, Orient Longman.
- Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand.

CEMGDSE04P:

(60 Lectures/Contact Hours) Marks: 25

Section A: Inorganic Chemistry

1. Separation of mixtures by chromatography: Measure the R_f value in each case. (Combination of two ions to be given)

Paper chromatographic separation of Fe^{3+}, $A1^{3+}$ and Cr^{3+} or

Paper chromatographic separation of Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+}

2. Preparation of any two of the following complexes and measurement of their conductivity:

(i) tetraamminecarbonatocobalt (III) nitrate
(ii) tetraamminecopper (II) sulphate
(iii) potassium trioxalatoferrate (III) trihydrate

Compare the conductance of the complexes with that of M/1000 solution of NaCl, $MgCl_2$ and $LiCl_3$.

Section B: Organic Chemistry

Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

Reference Books:

- A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

WEST BENGAL STATE UNIVERSITY

DRAFT SYLLABUS IN CHEMISTRY (HONOURS)

UNDER

CHOICE BASED CREDIT SYSTEM

Scheme for CBCS Curriculum

Semester	Course with Code	Course Detail	Credits	Marks
I	Ability Enhancement Compulsory Course – I	Environmental Science	2	25
	Core course – I **CEMACOR01T**	Organic Chemistry I	4	50
	Core course – I Practical **CEMACOR01P**	Organic Chemistry I	2	25
	Core course – II **CEMACOR02T**	Physical Chemistry I	4	50
	Core course – II Practical **CEMACOR02P**	Physical Chemistry I	2	25
	Genetic Elective – 1		4	50
	Generic Elective – 1 Practical		2	25
II	Ability Enhancement Compulsory Course – II	English / MIL communication	2	25
	Core course – III **CEMACOR03T**	Inorganic Chemistry I	4	50
	Core course – III Practical **CEMACOR03P**	Inorganic Chemistry I	2	25
	Core course – IV **CEMACOR04T**	Organic Chemistry II	4	50
	Core course – IV Practical **CEMACOR04P**	Organic Chemistry II	2	25
	Generic Elective – 2		4	50
	Generic Elective – 2 Practical		2	25
III	Core course – V **CEMACOR05T**	Physical Chemistry II	4	50
	Core course – V Practical **CEMACOR05P**	Physical Chemistry II	2	25
	Core course – VI **CEMACOR06T**	Inorganic Chemistry II	4	50
	Core course – VI Practical **CEMACOR06P**	Inorganic Chemistry II	2	25
	Core course – VII **CEMACOR07T**	Organic Chemistry III	4	50
	Core course – VII Practical **CEMACOR07P**	Organic Chemistry III	2	25

	Skill Enhancement Course – 1		2	25
	Generic Elective – 3		4	50
	Generic Elective – 3 Practical		2	25
IV	Core course – VIII **CEMACOR08T**	Physical Chemistry III	4	50
	Core course – VIII Practical **CEMACOR08P**	Physical Chemistry III	2	25
	Core course – IX **CEMACOR09T**	Inorganic Chemistry III	4	50
	Core course – IX Practical **CEMACOR09P**	Inorganic Chemistry III	2	25
	Core course – X **CEMACOR10T**	Organic Chemistry IV	4	50
	Core course – X Practical **CEMACOR10P**	Organic Chemistry IV	2	25
	Skill Enhancement Course-2		2	25
	Generic Elective – 4		4	50
	Generic Elective – 4 Practical		2	25
V	Core course – XI **CEMACOR11T**	Inorganic Chemistry IV	4	50
	Core course – XI Practical **CEMACOR11P**	Inorganic Chemistry IV	2	25
	Core course – XII **CEMACOR12T**	Organic Chemistry V	4	50
	Core course – XII Practical **CEMACOR12P**	Organic Chemistry V	2	25
	Discipline Specific Elective – 1		4	50
	Discipline Specific Elective – 1 Practical		2	25
	Discipline Specific Elective – 2		4	50
	Discipline Specific Elective – 2 Practical		2	25
VI	Core course – XIII **CEMACOR13T**	Inorganic Chemistry V	4	50
	Core course – XIII Practical **CEMACOR13P**	Inorganic Chemistry V	2	25
	Core course – XIV **CEMACOR14T**	Physical Chemistry IV	4	50

	Core course – XIV Practical **CEMACOR14P**	Physical Chemistry IV	2	25
	Discipline Specific Elective – 3		4	50
	Discipline Specific Elective – 3 Practical		2	25
	Discipline Specific Elective – 4		4	50
	Discipline Specific Elective – 4 Practical		2	25
		Total:	**140**	**1750**

Choices for Discipline Specific Electives

Discipline Specific Elective – 1-3 Choose any two (2) for Sem - V	**Discipline Specific Elective – 4-6 Choose any two (2) for Sem - VI**
Advanced Physical Chemistry CEMADSE01	Green Chemistry CEMADSE04
Analytical Methods in Chemistry CEMADSE02	Inorganic Materials of Industrial Importance CEMADSE05
Instrumental Methods of Chemical Analysis CEMADSE03	Polymer Chemistry CEMADSE06

Choices for Skill Enhancement Courses

Skill Enhancement Course-1	**Skill Enhancement Course-2**
Basic Analytical Chemistry CEMSSEC001	Analytical Clinical Biochemistry CEMSSEC002

CORE COURSE (HONOURS) IN CHEMISTRY

SEMESTER-I

CEMACOR01T: **ORGANIC CHEMISTRY-I**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures **Marks: 50**

Basics of Organic Chemistry Bonding and Physical Properties
(25 Lectures) **Marks: 20**

Valence Bond Theory: concept of hybridisation, shapes of molecules, resonance (including hyperconjugation); calculation of formal charges and double bond equivalent (DBE); orbital pictures of bonding (sp^3, sp^2, sp: C-C, C-N & C-O systems and *s-cis* and *s-trans* geometry for suitable cases).

Electronic displacements: inductive effect, field effect, mesomeric effect, resonance energy; bond polarization and bond polarizability; electromeric effect; steric effect, steric inhibition of resonance.

MO theory: qualitative idea about molecular orbitals, bonding and antibonding interactions, idea about σ, σ^*, π, π^*, n – MOs; basic idea about Frontier MOs (FMO); concept of HOMO, LUMO and SOMO; interpretation of chemical reactivity in terms of FMO interactions; sketch and energy levels of π MOs of i) acyclic p orbital system (C=C, conjugated diene, triene, allyl and pentadienyl systems) ii) cyclic p orbital system (neutral systems: [4], [6]-annulenes; charged systems: 3-,4-,5-membered ring systems); Hückel's rules for aromaticity up to [10]-annulene (including mononuclear heterocyclic compounds up to 6-membered ring); concept of antiaromaticity and homoaromaticity; non-aromatic molecules; Frost diagram; elementary idea about α and β; measurement of delocalization energies in terms of β for buta-1,3-diene, cyclobutadiene, hexa-1,3,5-triene and benzene.

Physical properties: influence of hybridization on bond properties: bond dissociation energy (BDE) and bond energy; bond distances, bond angles; concept of bond angle strain (Baeyer's strain theory); melting point/boiling point and solubility of common organic compounds in terms of covalent & non-covalent intermolecular forces; polarity of molecules and dipole moments; relative stabilities of isomeric hydrocarbons in terms of heat of hydrogenation, heat of combustion and heat of formation.

General Treatment of Reaction Mechanism I
(10 Lectures) **Marks: 10**

Mechanistic classification: ionic, radical and pericyclic (definition and example); reaction type: addition, elimination and substitution reactions (definition and example); nature of bond cleavage and bond formation: homolytic and heterolytic bond fission, homogenic and heterogenic bond formation; curly arrow rules in representation of mechanistic steps; reagent type: electrophiles and nucleophiles (elementary idea); electrophilicity and nucleophilicity in terms of FMO approach.
Reactive intermediates: carbocations (carbenium and carbonium ions), carbanions, carbon radicals, carbenes: generation and stability, structure using orbital picture and electrophilic/nucleophilic behavior of reactive intermediates (elementary idea).

Stereochemistry I
(25 Lectures) **Marks: 20**

Bonding geometries of carbon compounds and representation of molecules: tetrahedral nature of carbon and concept of asymmetry; Fischer, sawhorse, flying-wedge and Newman projection formulae and their inter translations.

Concept of chirality and symmetry: symmetry elements and point groups ($C_{\alpha v}$, C_{nh}, C_{nv}, C_n, $D_{\alpha h}$, D_{nh}, D_{nd}, D_n, S_n(C_s, C_i); molecular chirality and centre of chirality; asymmetric and dissymmetric molecules; enantiomers and diastereomers; concept of epimers; concept of stereogenicity, chirotopicity and pseudoasymmetry; chiral centres and number of stereoisomerism: systems involving 1/2/3-chiral centre(s) (AA, AB, ABA and ABC types).

Relative and absolute configuration: D/L and *R/S* descriptors; *erythro/threo* and *meso* nomenclature of compounds; *syn/anti* nomenclatures for aldols; *E*/*Z* descriptors for C=C, conjugated diene, triene, C=N and N=N systems; combination of *R/S*- and *E/ Z*-isomerisms.

Optical activity of chiral compounds: optical rotation, specific rotation and molar rotation; racemic compounds, racemisation (through cationic, anionic, radical intermediates and through reversible formation of stable achiral intermediates); resolution of acids, bases and alcohols via diastereomeric salt formation; optical purity and enantiomeric excess; invertomerism of chiral trialkylamines.

Reference Books

1. Clayden, J., Greeves, N. & Warren, S. *Organic Chemistry*, Second edition, Oxford University Press, 2012.
2. Keeler, J., Wothers, P. *Chemical Structure and Reactivity – An Integrated approach*, Oxford University Press.
3. Sykes, P., *A guidebook to Mechanism in Organic Chemistry,* Pearson Education, 2003.
4. Smith, J. G. *Organic Chemistry*, Tata McGraw-Hill Publishing Company Limited.
5. Carey, F. A., Guiliano, R. M. *Organic Chemistry*, Eighth edition, McGraw Hill Education, 2012.
6. Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds*, Wiley: London, 1994.

7. Nasipuri, D. *Stereochemistry of Organic Compounds,*Wiley Eastern Limited.
8. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
10. Fleming, I. *Molecular Orbitals and Organic Chemical Reactions*, Reference/Student Edition, Wiley, 2009.
11. James, J., Peach, J. M. *Stereochemistry at a Glance*, Blackwell Publishing, 2003. 12. Robinson, M. J. T., *Stereochemistry*, Oxford Chemistry Primer, Oxford University Press, 2005.

CEMACOR01P: **ORGANIC CHEMISTRY-I LAB**
(60 Lectures/Contact Hours) **Marks: 25**

1. Separation, based upon solubility, by using common laboratory reagents like water (cold, hot), dil. HCl, dil. NaOH, dil. $NaHCO_3$, *etc*., of components of a binary solid mixture; purification of **any one** of the separated components by crystallization and determination of its melting point. The composition of the mixture may be of the following types: Benzoic acid/*p*-Toluidine; *p*-Nitrobenzoic acid/*p*-Aminobenzoic acid; *p*-Nitrotoluene/*p*-Anisidine; *etc.*

2. Determination of boiling point of common organic liquid compounds e.g., ethanol, cyclohexane, chloroform, ethyl methyl ketone, cyclohexanone, acetylacetone, anisole, crotonaldehyde, mesityl oxide, *etc*. [Boiling point of the chosen organic compounds should preferably be less than 160 °C]

3. **Identification of a Pure Organic Compound**

Solid compounds: oxalic acid, tartaric acid, citric acid, succinic acid, resorcinol, urea, glucose, cane sugar, benzoic acid and salicylic acid

Liquid Compounds: formic acid, acetic acid, methyl alcohol, ethyl alcohol, acetone, aniline, dimethylaniline, benzaldehyde, chloroform and nitrobenzene

Reference Books

1. Bhattacharyya, R. C, *A Manual of Practical Chemistry.*
2. Vogel, A. I. *Elementary Practical Organic Chemistry,* Part 2: *Qualitative Organic Analysis*, CBS Publishers and Distributors.
3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009).
4. Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. *Practical Organic Chemistry,5th Ed.*, Pearson (2012).
5. Dutta, S, *B. Sc. Honours Practical Chemistry*, Bharati Book Stall.

CEMACOR02T: **PHYSICAL CHEMISTRY-I**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Kinetic Theory and Gaseous state
(20 Lectures) Marks: 16

Kinetic Theory of gases: Concept of pressure and temperature; Collision of gas molecules; Collision diameter; Collision number and mean free path; Frequency of binary collisions (similar and different molecules); Rate of collision on wall and rate of effusion.

Maxwell's distribution of speed and energy: Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions; Kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values in each case; Calculation of number of molecules having energy $\geq \varepsilon$, Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases

Real gas and virial equation: Deviation of gases from ideal behavior; compressibility factor; Boyle temperature; Andrew's and Amagat's plots; van der Waals equation and its features; its derivation and application in explaining real gas behaviour, other equations of state (Berthelot, Dietrici); Existence of critical state, Critical constants in terms of van der Waals constants; Law of corresponding states; virial equation of state; van der Waals equation expressed in virial form and significance of second virial coefficient; Intermolecular forces (Debye, Keesom and London interactions; LennardJones potential - elementary idea)

Chemical Thermodynamics
(25 Lectures) Marks: 20

Zeroth and 1st law of Thermodynamics: Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics;Concept of heat, work, internal energy and statement of first law; enthalpy, *H*; relation between heat capacities, calculations of *q*, *w*, *U* and *H* for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions; Joule's experiment and its consequence

Thermochemistry:Standard states; Heats of reaction; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; Laws of thermochemistry; bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equations and effect of pressure on enthalpy of reactions; Adiabatic flame temperature; explosion temperature

Second Law:Need for a Second law; statement of the second law of thermodynamics; Concept of heat reservoirs and heat engines; Carnot cycle; Physical concept of Entropy; Carnot engine and refrigerator; Kelvin – Planck and Clausius statements and equivalence of the two statements with entropic formulation; Carnot's theorem; Values of $\oint dQ/T$ and Clausius inequality; Entropy change of systems and surroundings for various processes and transformations; Entropy and unavailable work; Auxiliary state functions (G and A) and their variation with T, P and V. Criteria for spontaneity and equilibrium.

Thermodynamic relations: Maxwell's relations; Gibbs- Helmholtz equation, JouleThomson experiment and its consequences; inversion temperature; Joule-Thomson coefficient for a van der Waals gas; General heat capacity relations

Chemical kinetics
(15 Lectures) **Marks: 14**

Rate law, order and molecularity: Introduction of rate law, Extent of reaction; rate constants, order; Forms of rates of First, second and n-th order reactions; Pseudo first order reactions (example using acid catalyzed hydrolysis of methyl acetate); Determination of order of a reaction by half-life and differential method; Opposing reactions, parallel reactions and consecutive reactions (with explanation of kinetic and thermodynamic control of products; all steps first order) ; Rate equation for the fast reaction

Role of T and theories of reaction rate: Temperature dependence of rate constant; Arrhenius equation, energy of activation; Rate-determining step and steady-state approximation – explanation with suitable examples; Collision theory; Lindemann theory of unimolecular reaction; outline of Transition State theory (classical treatment)

Homogeneous catalysis: Homogeneous catalysis with reference to acid-base catalysis; Primary kinetic salt effect; Enzyme catalysis; Michaelis-Menten equation, LineweaverBurk plot, turn-over number

Autocatalysis; periodic reactions

Reference Books

1. Atkins, P. W. & Paula, J. de *Atkins' Physical Chemistry*, Oxford University Press
2. Castellan, G. W. *Physical Chemistry*, Narosa
3. McQuarrie, D. A. & Simons, J. D. *Physical Chemistry: A Molecular Approach*, Viva Press
4. Engel, T. & Reid, P. *Physical Chemistry*, Pearson
5. Levine, I. N. *Physical Chemistry*, Tata McGraw-Hill
6. Maron, S. & Prutton *Physical Chemistry*
7. Ball, D. W. *Physical Chemistry*, Thomson Press
8. Mortimer, R. G. *Physical Chemistry*, Elsevier
9. Laidler, K. J. *Chemical Kinetics*, Pearson
10. Glasstone, S. & Lewis, G.N. *Elements of Physical Chemistry*
11. Rakshit, P.C., *Physical Chemistry* Sarat Book House

12. Zemansky, M. W. & Dittman, R.H. *Heat and Thermodynamics*, Tata-McGraw-Hill
13. Rastogi, R. P. & Misra, R.R. *An Introduction to Chemical Thermodynamics*, Vikas
14. Klotz, I. M. & Rosenberg, R. M. Chemical Thermodynamics, Wiley

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CEMACOR02T: **PHYSICAL CHEMISTRY-I LAB**

(60 Lectures/Contact Hours**)** **Marks: 25**

Experiment 1: Determination of pH of unknown solution (buffer), by color matching method

Experiment 2: Determination of heat of neutralization of a strong acid by a strong base

Experiment 3: Study of kinetics of acid-catalyzed hydrolysis of methyl acetate

Experiment 4: Study of kinetics of decomposition of H_2O_2

Experiment 5: Determination of heat of solution of oxalic acid from solubility measurement

Reference Books

1. Viswanathan, B., Raghavan, P.S. *Practical Physical Chemistry* Viva Books (2009)
2. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson
3. Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007)
4. Palit, S.R., De, S. K. *Practical Physical Chemistry* Science Book Agency
5. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta
6. Levitt, B. P. edited *Findlay's Practical Physical Chemistry* Longman Group Ltd.
7. Gurtu, J. N., Kapoor, R., *Advanced Experimental Chemistry* S. Chand & Co. Ltd.

SEMESTER-II

CEMACOR03T: **INORGANIC CHEMISTRY-I**

(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures Marks: 50

Extra nuclear Structure of atom
(18 Lectures) Marks: 14

Bohr's theory, its limitations and atomic spectrum of hydrogen atom; Sommerfeld's Theory. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s, p, d* and *f* orbitals. Pauli's Exclusion Principle, Hund's rules and multiplicity, Exchange energy, Aufbau principle and its limitations, Ground state Term symbols of atoms and ions for atomic number upto 30.

Chemical periodicity
(8 Lectures) Marks: 10

Modern IUPAC Periodic table, Effective nuclear charge, screening effects and penetration, Slater's rules, atomic radii, ionic radii (Pauling's univalent), covalent radii, lanthanide contraction. Ionization potential, electron affinity and electronegativity (Pauling's, Mulliken's and Allred-Rochow's scales) and factors influencing these properties, group electronegativities. Group trends and periodic trends in these properties in respect of s-, p- and d-block elements. Secondary periodicity, Relativistic Effect, Inert pair effect.

Acid-Base reactions
(16 Lectures) Marks: 12

Acid-Base concept: Arrhenius concept, theory of solvent system (H_2O, NH_3, SO_2 and HF), Bronsted-Lowry's concept, relative strength of acids, Pauling's rules. Lux-Flood concept, Lewis concept, group characteristics of Lewis acids, solvent levelling and differentiating effects. Thermodynamic acidity parameters, Drago-Wayland equation. Superacids, Gas phase acidity and proton affinity; HSAB principle. Acid-base equilibria in aqueous solution (Proton transfer equilibria in water), pH, buffer. Acidbase neutralisation curves; indicator, choice of indicators.

Redox Reactions and precipitation reactions
(18 Lectures) Marks: 14

Ion-electron method of balancing equation of redox reaction. Elementary idea on standard redox potentials with sign conventions, Nernst equation (without derivation). Influence of complex formation, precipitation and change of pH on redox potentials; formal potential. Feasibility of a redox titration, redox potential at the equivalence point, redox indicators. Redox potential diagram (Latimer and Frost diagrams) of common elements and their applications. Disproportionation and comproportionation reactions.

Solubility product principle, common ion effect and their applications to the precipitation and separation of common metallic ions as hydroxides, sulfides, phosphates, carbonates, sulfates and halides.

Reference Books

1. Lee, J. D. *Concise Inorganic Chemistry*,5th Ed., Wiley India Pvt. Ltd., 2008.
2. Douglas, B.E. and McDaniel, D.H. *Concepts & Models of Inorganic Chemistry* Oxford, 1970.
3. Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry*, ACS Publications, 1962.
4. Atkin, P. *Shriver & Atkins' Inorganic Chemistry*, 5th Ed., Oxford University Press (2010).
5. Cotton, F.A., Wilkinson, G. and Gaus, P.L., *Basic Inorganic Chemistry 3rd Ed.;* Wiley India.
6. Sharpe, A.G., *Inorganic Chemistry*, 4th Indian Reprint (Pearson Education) 2005.
7. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles ofStructure and Reactivity 4th Ed.*, Harper Collins 1993, Pearson,2006.
8. Atkins, P.W. & Paula, J. *Physical Chemistry*, Oxford Press, 2006.
9. Mingos, D.M.P., *Essential trends in inorganic chemistry*. Oxford University Press (1998).
10. Winter, M. J., The Orbitron, http://winter.group.shef.ac.uk/orbitron/ (2002). An illustrated gallery of atomic and molecular orbitals.
11. Burgess, J., *Ions in solution: basic principles of chemical interactions*. Ellis Horwood (1999).

CEMACOR01P: **INORGANIC CHEMISTRY-I LAB**

60 (**Lectures**/Contact Hours) **Marks: 25**

Acid and Base Titrations:

1.Estimation of carbonate and hydroxide present together in mixture2.Estimation of carbonate and bicarbonate present together in a mixture.

3.Estimation of free alkali present in different soaps/detergents. **Oxidation-Reduction Titrimetric**

1. Estimation of Fe(II) using standardized $KMnO_4$ solution
2. Estimation of oxalic acid and sodium oxalate in a given mixture
3. Estimation of Fe(II) and Fe(III) in a given mixture using $K_2Cr_2O_7$ solution.
4. Estimation of Fe(III) and Mn(II) in a mixture usingstandardized $KMnO_4$ solution
5. Estimation of Fe(III) and Cu(II) in a mixture using $K_2Cr_2O_7$.
6. Estimation of Fe(III) and Cr(III) in a mixture using $K_2Cr_2O_7$.

Reference Books

1.Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis* 6th Ed., Pearson, 2009.

CEMACOR04T: **ORGANIC CHEMISTRY-II**

(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures Marks: 50

Stereochemistry II
(20 Lectures) Marks: 16

Chirality arising out of stereoaxis: stereoisomerism of substituted cumulenes with even and odd number of double bonds; chiral axis in allenes, spiro compounds, alkylidenecycloalkanes and biphenyls; related configurational descriptors (R_a/S_a and *P/M*); atropisomerism; racemisation of chiral biphenyls; *buttressing* effect.

Concept of prostereoisomerism: prostereogenic centre; concept of (*pro*)^n-*chirality*: topicity of ligands and faces (elementary idea); *pro-R/pro-S*, *pro-E/pro-Z* and *Re/Si* descriptors; *pro-r* and *pro-s* descriptors of ligands on propseudoasymmetric centre.

Conformation: conformational nomenclature: eclipsed, staggered, *gauche*, *syn* and *anti*; dihedral angle, torsion angle; Klyne-Prelog terminology; *P/M* descriptors; energy barrier of rotation, concept of torsional and steric strains; relative stability of conformers on the basis of steric effect, dipole-dipole interaction and H-bonding; *butane gauche* interaction; conformational analysis of ethane, propane, *n*-butane, 2methylbutane and 2,3-dimethylbutane; haloalkane, 1,2-dihaloalkanes and 1,2-diols (up to four carbons); 1,2-halohydrin; conformation of conjugated systems (*s-cis* and *s-trans*).

General Treatment of Reaction Mechanism II
(22 Lectures) Marks: 18

Reaction thermodynamics: free energy and equilibrium, enthalpy and entropy factor, calculation of enthalpy change via BDE, intermolecular & intramolecular reactions.

Concept of organic acids and bases: effect of structure, substituent and solvent on acidity and basicity; proton sponge; gas-phase acidity and basicity; comparison between nucleophlicity and basicity; HSAB principle; application of thermodynamic principles in acid-base equilibria.

Tautomerism: prototropy (keto-enol, nitro - *aci*-nitro, nitroso-oximino, diazo-amino and enamine-imine systems); valence tautomerism and ring-chain tautomerism; composition of the equilibrium in different systems (simple carbonyl; 1,2- and 1,3dicarbonyl systems, phenols and related systems), factors affecting keto-enol tautomerism; application of thermodynamic principles in tautomeric equilibria.

Reaction kinetics: rate constant and free energy of activation; concept of order and molecularity; free energy profiles for one-step, two-step and three-step reactions; catalyzed reactions: electrophilic and nucleophilic catalysis; kinetic control and thermodynamic control of reactions; isotope effect: primary and secondary kinetic isotopic effect (k_H/k_D); principle of microscopic reversibility; Hammond's postulate.

Substitution and Elimination Reactions
(18 Lectures) Marks: 16

Free-radical substitution reaction: halogentaion of alkanes, mechanism (with evidence) and stereochemical features; reactivity-selectivity principle in the light of Hammond's postulate.

Nucleophilic substitution reactions: substitution at sp^3 centre: mechanisms (with evidence), relative rates & stereochemical features: S_N1, S_N2, S_N2', S_N1' (allylic rearrangement) and S_Ni; effects of solvent, substrate structure, leaving group and nucleophiles (including ambident nucleophiles, cyanide & nitrite); substitutions involving NGP; role of crown ethers and phase transfer catalysts; [systems: alkyl halides, allyl halides, benzyl halides, alcohols, ethers, epoxides].

Elimination reactions: E1, E2, E1cB and Ei (pyrolytic *syn* eliminations); formation of alkenes and alkynes; mechanisms (with evidence), reactivity, regioselectivity (Saytzeff/Hofmann) and stereoselectivity; comparison between substitution and elimination; importance of Bredt's rule relating to the formation of C=C.

Reference Books

1. Clayden, J., Greeves, N., Warren, S. *Organic Chemistry,* Second edition, Oxford University Press 2012.
2. Sykes, P., *A guidebook to Mechanism in Organic Chemistry,* Pearson Education, 2003.
3. Smith, J. G. *Organic Chemistry,* Tata McGraw-Hill Publishing Company Limited.

4. Carey, F. A. & Guiliano, R. M. *Organic Chemistry*, Eighth edition, McGraw Hill Education, 2012.
5. Loudon, G. M. *Organic Chemistry*, Fourth edition, Oxford University Press, 2008.
6. Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds*, Wiley: London, 1994.
7. Nasipuri, D. *Stereochemistry of Organic Compounds,* Wiley Eastern Limited.
8. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. Finar, I. L. *Organic Chemistry (Volume 1)* Pearson Education.
10. Graham Solomons, T.W., Fryhle, C. B. *Organic Chemistry*, John Wiley & Sons, Inc.
11. James, J., Peach, J. M. *Stereochemistry at a Glance*, Blackwell Publishing, 2003.
12. Robinson, M. J. T., *Stereochemistry*, Oxford Chemistry Primer, Oxford University Press, 2005.
13. Maskill, H., *Mechanisms of Organic Reactions*, Oxford Chemistry Primer, Oxford University Press.

CEMACOR04P: **ORGANIC CHEMISTRY-II LAB**

60 (**Lectures**/Contact Hours) **Marks: 25**

Organic Preparations

A. The following reactions are to be performed, noting the yield of the crude product:

1. Nitration of aromatic compounds
2. Condensation reactions
3. Hydrolysis of amides/imides/esters
4. Acetylation of phenols/aromatic amines
5. Benzoylation of phenols/aromatic amines
6. Side chain oxidation of aromatic compounds
7. Diazo coupling reactions of aromatic amines
8. Bromination of anilides using green approach (Bromate-Bromide method)
9. Redox reaction including solid-phase method
10. Green 'multi-component-coupling' reaction
11. Selective reduction of *m*-dinitrobenzene to *m*-nitroaniline

Students must also calculate percentage yield, based upon isolated yield (crude) and theoretical yield.

B. Purification of the crude product is to be made by crystallisation from water/alcohol, crystallization after charcoal treatment, or sublimation, whichever is applicable.

C. Melting point of the purified product is to be noted.

Reference Books

1. Vogel, A. I. *Elementary Practical Organic Chemistry,* Part 1: *Small scale Preparations,* CBS Publishers and Distributors.
2. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N. University of Calcutta, 2003.
3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009).
4. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.* Pearson (2012).
5. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press (2000).
6. *Practical Workbook Chemistry (Honours), UGBS, Chemistry*, University of Calcutta, 2015.

SEMESTER-III

CEMACOR05T: **PHYSICAL CHEMISTRY-II**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Transport processes
(15 Lectures) Marks: 14

Fick's law: Flux, force, phenomenological coefficients & their inter-relationship (general form), different examples of transport properties

Viscosity:General features of fluid flow (streamline flow and turbulent flow); Newton's equation, viscosity coefficient; Poiseuille's equation; principle of determination of viscosity coefficient of liquids by falling sphere method; Temperature variation of viscosity of liquids and comparison with that of gases

Conductance and transport number: Ion conductance; Conductance and measurement of conductance, cell constant, specific conductance, equivalent conductance and molar conductance; Variation of specific and equivalent conductance with dilution for strong and weak electrolytes; Kohlrausch's law of independent migration of ions; Equivalent and molar conductance at infinite dilution and their determination for strong and weak

electrolytes; Debye –Huckel theory of Ion atmosphere (qualitative)-asymmetric effect, relaxation effect and electrophoretic effect; Ostwald's dilution law; Ionic mobility; Application of conductance measurement (determination of solubility product and ionic product of water); Conductometric titrations

Transport number, Principles of Hittorf's and Moving-boundary method; Wien effect, Debye-Falkenhagen effect, Walden's rule

Applications of Thermodynamics – I
(25 Lectures) Marks: 20

Partial properties and Chemical potential: Chemical potential and activity, partial molar quantities, relation between Chemical potential and Gibbs' free energy and other thermodynamic state functions; variation of Chemical potential (μ) with temperature and pressure; Gibbs-Duhem equation; fugacity and fugacity coefficient; Variation of thermodynamic functions for systems with variable composition; Equations of states for these systems, Change in G, S, H and V during mixing for binary solutions

Chemical Equilibrium: Thermodynamic conditions for equilibrium, degree of advancement; van't Hoff's reaction isotherm (deduction from chemical potential); Variation of free energy with degree of advancement; Equilibrium constant and standard Gibbs' free energy change; Definitions of K_P, K_C and K_X; van't Hoff's reaction isobar and isochore from different standard states; Shifting of equilibrium due to change in external parameters e.g. temperature and pressure; variation of equilibrium constant with addition to inert gas; Le Chatelier's principle and its derivation

Nernst's distribution law; Application- (finding out K_{eq} using Nernst dist law for $KI+I_2 = KI_3$ and dimerization of benzene)

Chemical potential and other properties of ideal substances- pure and mixtures: a) Pure ideal gas-its Chemical potential and other thermodynamic functions and their changes during a change of Thermodynamic parameters of mixing; Chemical potential of an ideal gas in an ideal gas mixture; Concept of standard states and choice of standard states of ideal gases

b) Condensed Phase – Chemical potential of pure solid and pure liquids, Ideal solution – Definition, Raoult's law; Mixing properties of ideal solutions, chemical potential of a component in an ideal solution; Choice of standard states of solids and liquids

Foundation of Quantum Mechanics
(20 Lectures) Marks: 16

Beginning of Quantum Mechanics: Black-body radiation and Planck's theory of radiation; Light as particles: photoelectric and Compton effects; electrons as waves; Wave-particle duality: de Broglie hypothesis, Uncertainty relations (without proof)

Wave function: Schrödinger time-independent equation; nature of the equation, acceptability conditions imposed on the wave functions and probability interpretations of wave function; Orthogonal and normal functions; Schmidt's orthogonalization

Concept of Operators: Elementary concepts of operators, eigenfunctions and eigenvalues; Linear operators; Commutation of operators, commutator and uncertainty relation; Expectation value; Hermitian operator; Postulates of Quantum Mechanics; General structure of Schrodinger equation (S.E.) and time dependency; Stationary state

Particle in a box: Setting up of S.E. for one-dimensional well and its solution; Comparison with free particle eigenfunctions and eigenvalues. Properties of PB wave functions (normalisation, orthogonality, probability distribution); Expectation values of x, x^2, p_x and p_x^2 and their significance in relation to the uncertainty principle; Extension of the problem to two and three dimensions and the concept of degenerate energy levels; Accidental degeneracy

Simple Harmonic Oscillator: setting up of the Schrodinger stationary equation, energy expression (without derivation), expression of wave function for n = 0 and n = 1 (without derivation) and their characteristic features

Reference Books

1. Atkins, P. W. & Paula, J. de *Atkins', Physical Chemistry*, Oxford University Press
2. Castellan, G. W. *Physical Chemistry*, Narosa
3. McQuarrie, D. A. & Simons, J. D. *Physical Chemistry: A Molecular Approach*, Viva Press
4. Levine, I. N. *Physical Chemistry*, Tata McGraw-Hill
5. Rakshit, P.C., *Physical Chemistry*, Sarat Book House
6. Moore, W. J. *Physical Chemistry*, Orient Longman
7. Mortimer, R. G. *Physical Chemistry*, Elsevier
8. Denbigh, K. *The Principles of Chemical Equilibrium* Cambridge University Press
9. Engel, T. & Reid, P. *Physical Chemistry*, Pearson
10. Levine, I. N. *Quantum Chemistry*, PHI
11. Atkins, P. W. *Molecular Quantum Mechanics*, Oxford
12. Zemansky, M. W. & Dittman, R.H. *Heat and Thermodynamics*, Tata-McGraw-Hill
13. Rastogi, R. P. & Misra, R.R. *An Introduction to Chemical Thermodynamics*, Vikas
14. Klotz, I.M., Rosenberg, R. M. *Chemical Thermodynamics:Basic Concepts and Methods* Wiley
15. Glasstone, S. *An Introduction to Electrochemistry*, East-West Press

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CEMACOR05P: **PHYSICAL CHEMISTRY-II LAB**

60 (Lectures/Contact Hours) Marks: 25

Experiment 1: Study of viscosity of unknown liquid (glycerol, sugar) with respect to water

Experiment 2: Determination of partition coefficient for the distribution of I_2 between water and CCl_4

Experiment 3: Determination of K_{eq} for $KI + I_2 = KI_3$, using partition coefficient between water and CCl_4

Experiment 4: Conductometric titration of an acid (strong, weak/ monobasic, dibasic) against base strong

Experiment 5: Study of saponification reaction conductometrically

Experiment 6: Verification of Ostwald's dilution law and determination of K_a of weak acid

Reference Books

1. Viswanathan, B., Raghavan, P.S. *Practical Physical Chemistry* Viva Books (2009)
2. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson
3. Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007)
4. Palit, S.R., De, S. K. *Practical Physical Chemistry* Science Book Agency
5. *University Hand Book of Undergraduate Chemistry Experiments,* edited by Mukherjee, G. N., University of Calcutta
6. Levitt, B. P. edited *Findlay's Practical Physical Chemistry* Longman Group Ltd.
7. Gurtu, J. N., Kapoor, R., *Advanced Experimental Chemistry* S. Chand & Co. Ltd.

CEMACOR06T: **INORGANIC CHEMISTRY-II**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Chemical Bonding-I
(24 Lectures) Marks: 20

(i) *Ionic bond:* General characteristics, types of ions, size effects, radius ratio rule and its application and limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy. Defects in solids (elememetary idea). Solubility energetics of dissolution process.

(ii) *Covalent bond:* Polarizing power and polarizability, ionic potential,Fazan's rules. Lewis structures, formal charge. Valence Bond Theory. The hydrogen molecule (Heitler-London approach), directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rule, Dipole moments, VSEPR theory, shapes of

molecules and ions containing lone pairs and bond pairs (examples from main groups chemistry) and multiple bonding (σ and π bond approach).

Chemical Bonding-II

(24 Lectures) Marks: 20

(i) Molecular orbital concept of bonding (The approximations of the theory, Linear combination of atomic orbitals (LCAO)) (elementary pictorial approach): sigma and pibonds and delta interaction, multiple bonding. Orbital designations: *gerade, ungerade,* HOMO, LUMO. Orbital mixing,. MO diagrams of H_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, and their ions wherever possible; Heteronuclear molecular orbitals: CO, NO, NO^+, CN^-, HF, BeH_2, CO_2 and H_2O. Bond properties: bond orders, bond lengths.

(ii) *Metallic Bond:* Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

(iii) *Weak Chemical Forces:* van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Intermolecular forces: Hydrogen bonding (theories of hydrogen bonding, valence bond treatment), receptor-guest interactions, Halogen bonds. Effects of chemical force, melting and boiling points.

Radioactivity

(12 Lectures) Marks: 10

Nuclear stability and nuclear binding energy. Nuclear forces: meson exchange theory. Nuclear models (elementary idea): Concept of nuclear quantum number, magic numbers. Nuclear Reactions: Artificial radioactivity, transmutation of elements, fission, fusion and spallation. Nuclear energy and power generation. Separation and uses of isotopes. Radio chemical methods: principles of determination of age of rocks and minerals, radio carbon dating, hazards of radiation and safety measures.

Reference Books

1. Lee, J. D. *Concise Inorganic Chemistry, 5th Ed.,* Wiley India Pvt. Ltd., 2008.
2. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles ofStructure and Reactivity 4th Ed.,* Harper Collins 1993, Pearson, 2006.
3. Douglas, B.E. and McDaniel, D.H. *Concepts & Models of Inorganic Chemistry* Oxford, 1970.
4. Porterfield, H. W., *Inorganic Chemistry*, Second Edition, Academic Press, 2005.
5. Purecell, K.F. and Kotz, J.C., *An Introduction toInorganic Chemistry*, Saunders: Philadelphia, 1980.
6. Cotton, F.A., Wilkinson, G., & Gaus, P.L. *Basic Inorganic Chemistry 3rd Ed.;* Wiley India.
7. Gillespie, R. J. and Hargittai, I., The VSEPR Model of Molecular Geometry, Prentice Hall (1992).
8. Albright, T., *Orbital interactions in chemistry,* John Wiley and Sons (2005).
9. Mingos, D.M.P., *Essential trends in inorganic chemistry*. Oxford University Press (1998).

10. Miessler, G. L., Fischer, P. J., Tarr, D. A., *Inorganic Chemistry,* Pearson, 5th Edition.
11. Kaplan, I., *Nuclear Physics,* Addison-Wesley Publishing Company Inc. London, 1964.
12. Friedlander, G., Kennedy, J. W., Macias, E. S. And Miller, J. M., *Nuclear and Radiochemistry,* Wiley, 1981.

CEMACOR06P: INORGANIC CHEMISTRY-II LAB

60 (Lectures/Contact Hours) Marks: 25

Iodo-/ Iodimetric Titrations

1. Estimation of Cu(II)
2. Estimation of Vitamin C
3. Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically
4. Estimation of available chlorine in bleaching powder. **Estimation of metal content in some selective samples**

1. Estimation of Cu in brass.
2. Estimation of Cr and Mn in Steel.
3. Estimation of Fe in cement.

Reference Books

1.Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis* 6th Ed., Pearson, 2009.

***CEMACOR07T:* ORGANIC CHEMISTRY-III**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Chemistry of alkenes and alkynes
(15 Lectures) Marks: 12

Addition to C=C: mechanism (with evidence wherever applicable), reactivity, regioselectivity (Markownikoff and anti-Markownikoff additions) and stereoselectivity; reactions: hydrogenation, halogenations, iodolactonisation, hydrohalogenation, hydration, oxymercuration-demercuration, hydroboration-oxidation, epoxidation, *syn* and *anti*-hydroxylation, ozonolysis, addition of singlet and triplet carbenes; electrophilic addition to diene (conjugated dienes and allene); radical addition: HBr addition; mechanism of allylic and benzylic bromination in competition with brominations across C=C; use of

NBS; Birch reduction of benzenoid aromatics; interconversion of *E* - and *Z* - alkenes; contra-thermodynamic isomerization of internal alkenes.

Addition to C≡C (in comparison to C=C): mechanism, reactivity, regioselectivity (Markownikoff and anti-Markownikoff addition) and stereoselectivity; reactions: hydrogenation, halogenations, hydrohalogenation, hydration, oxymercurationdemercuration, hydroboration-oxidation, dissolving metal reduction of alkynes (Birch); reactions of terminal alkynes by exploring its acidity; interconversion of terminal and non-terminal alkynes.

Aromatic Substitution
(10 Lectures) Marks: 08

*Electrophilic aromatic substitution:*mechanisms and evidences in favour of it; orientation and reactivity; reactions: nitration, nitrosation, sulfonation, halogenation, Friedel-Crafts reaction; one-carbon electrophiles (reactions: chloromethylation, Gatterman-Koch, Gatterman, Houben-Hoesch, Vilsmeier-Haack, Reimer-Tiemann, Kolbe-Schmidt); *Ipso* substitituion.

Nucleophilic aromatic substitution: addition-elimination mechanism and evidences in favour of it; S_N1 mechanism; cine substitution (benzyne mechanism), structure of benzyne.

Carbonyl and Related Compounds
(30 Lectures) Marks: 22

Addition to C=O: structure, reactivity and preparation of carbonyl compounds; mechanism (with evidence), reactivity, equilibrium and kinetic control; Burgi-Dunitz trajectory in nucleophilic additions; formation of hydrates, cyano hydrins and bisulphite adduct; nucleophilic addition-elimination reactions with alcohols, thiols and nitrogen-based nucleophiles; reactions: benzoin condensation, Cannizzaro and Tischenko reactions, reactions with ylides: Wittig and Corey-Chaykovsky reaction; Rupe rearrangement, oxidations and reductions: Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, Oppenauer, Bouveault-Blanc, acyloin condensation; oxidation of alcohols with PDC and PCC; periodic acid and lead tetraacetate oxidation of 1,2-diols.

Exploitation of acidity of α-H of C=O: formation of enols and enolates; kinetic and thermodynamic enolates; reactions (mechanism with evidence): halogenation of carbonyl compounds under acidic and basic conditions, Hell-Volhard-Zelinsky (H. V. Z.) reaction, nitrosation, SeO_2 (Riley) oxidation; condensations (mechanism with evidence): Aldol, Tollens', Knoevenagel, Claisen-Schmidt, Claisen ester including Dieckmann, Stobbe; Mannich reaction, Perkin reaction, Favorskii rearrangement; alkylation of active methylene compounds; preparation and synthetic applications of diethyl malonate and ethyl acetoacetate; specific enol equivalents (lithium enolates, enamines, aza-enolates and silyl enol ethers) in connection with alkylation, acylation and aldol type reaction.

Elementary ideas of Green Chemistry: Twelve (12) principles of green chemistry; planning of green synthesis; common organic reactions and their counterparts: reactions:

Aldol, Friedel-Crafts, Michael, Knoevenagel, Cannizzaro, benzoin condensation and Dieckmann condensation.

Nucleophilic addition to α,β-unsaturated carbonyl system: general principle and mechanism (with evidence); direct and conjugate addition, addition of enolates (Michael reaction), Stetter reaction, Robinson annulation.

Substitution at sp^2 carbon (C=O system): mechanism (with evidence): $B_{AC}2$, $A_{AC}2$, $A_{AC}1$, $A_{AL}1$ (in connection to acid and ester); acid derivatives: amides, anhydrides & acyl halides (formation and hydrolysis including comparison).

Organometallics
(5 Lectures) Marks: 08

Grignard reagent; Organolithiums; Gilman cuprates: preparation and reactions (mechanism with evidence); addition of Grignard and organolithium to carbonyl compounds; substitution on -COX; directed ortho metalation of arenes using organolithiums, conjugate addition by Gilman cuprates; Corey-House synthesis; abnormal behavior of Grignard reagents; comparison of reactivity among Grignard, organolithiums and organocopper reagents; Reformatsky reaction; Blaise reaction; concept of *umpolung* and base-nucleophile dichotomy in case of organometallic reagents.

Reference Books

1. Clayden, J., Greeves, N., Warren, S. *Organic Chemistry,* Second edition, Oxford University Press 2012.
2. Sykes, P., *A guidebook to Mechanism in Organic Chemistry,* Pearson Education, 2003.
3. Smith, J. G. *Organic Chemistry*, Tata McGraw-Hill Publishing Company Limited.
4. Carey, F. A., Guiliano, R. M. *Organic Chemistry*, Eighth edition, McGraw Hill Education, 2012.
5. Loudon, G. M. *Organic Chemistry*, Fourth edition, Oxford University Press, 2008.
6. Norman, R.O. C., Coxon, J. M. *Principles of Organic Synthesis*, Third Edition, Nelson Thornes, 2003.
7. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
8. Finar, I. L. *Organic Chemistry (Volume 1),* Pearson Education.
9. Graham Solomons, T.W., Fryhle, C. B. *Organic Chemistry*, John Wiley & Sons, Inc.
10. March, J. *Advanced Organic Chemistry*, Fourth edition, Wiley.
11. Jenkins, P. R., *Organometallic Reagents in Synthesis*, Oxford Chemistry Primer, Oxford University Press.
12. Ward, R. S., *Bifunctional Compounds*, Oxford Chemistry Primer, Oxford University Press.
13. Ahluwalia, V. K. *Strategies for Green Organic Synthesis*, ANE Books Pvt. Ltd.

CEMACOR07P: **ORGANIC CHEMISTRY-III LAB**

60 (Lectures/Contact Hours) Marks: 25

Experiment -1: Qualitative Analysis of Single Solid Organic Compounds

A. Detection of special elements (N, S, Cl, Br) by Lassaigne's test

B. Solubility and classification (solvents: H_2O, 5% HCl, 5% NaOH and 5% $NaHCO_3$)

C. Detection of the following functional groups by systematic chemical tests:
aromatic amino ($-NH_2$), aromatic nitro ($-NO_2$), amido ($-CONH_2$, including imide), phenolic –OH, carboxylic acid (-COOH), carbonyl (-CHO and >C=O); only one test for each functional group is to be reported.

D. Melting point of the given compound

E. Preparation, purification and melting point determination of a crystalline derivative of the given compound
F. Identification of the compound through literature survey.

Each student, during laboratory session, is required to carry out qualitative chemical tests for all the special elements and the functional groups with relevant derivatisation in known and unknown (**at leastsix)** organic compounds.

Reference Books

1. Vogel, A. I. *Elementary Practical Organic Chemistry*, Part 2: *Qualitative Organic Analysis*, CBS Publishers and Distributors.
2. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N. University of Calcutta, 2003.
3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009).
4. Furniss, B.S., Hannaford, A.J., Smith, P.W.G., Tatchell, A.R. *Practical Organic Chemistry*, 5th Ed.,Pearson (2012).
5. Clarke, H. T., *A Handbook of Organic Analysis (Qualitative and Quantitative)*, Fourth Edition, CBS Publishers and Distributors (2007).
6. *Practical Workbook Chemistry (Honours), UGBS, Chemistry*, University of Calcutta, 2015.

SEMESTER-IV

CEMACOR08T: **PHYSICAL CHEMISTRY-III**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Application of Thermodynamics – II
(20 lectures) Marks: 18

Colligative properties: Vapour pressure of solution; Ideal solutions, ideally diluted solutions and colligative properties; Raoult's law; Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) Osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution; Abnormal colligative properties

Phase rule: Definitions of phase, component and degrees of freedom; Phase rule and its derivations; Definition of phase diagram; Phase diagram for water, CO_2, Sulphur

First order phase transition and Clapeyron equation; Clausius-Clapeyron equation - derivation and use; Liquid vapour equilibrium for two component systems; Phenolwater system

Three component systems, water-chloroform-acetic acid system, triangular plots

Binary solutions: Ideal solution at fixed temperature and pressure; Principle of fractional distillation; Duhem-Margules equation; Henry's law; Konowaloff's rule; Positive and negative deviations from ideal behavior; Azeotropic solution; Liquidliquid phase diagram using phenol- water system; Solid-liquid phase diagram; Eutectic mixture

Electrical Properties of molecules
(20 Lectures) Marks: 18

Ionic equilibria: Chemical potential of an ion in solution; Activity and activity coefficients of ions in solution; Debye-Huckel limiting law-brief qualitative description of the postulates involved, qualitative idea of the model, the equation (without derivation) for ion-ion atmosphere interaction potential. Estimation of activity coefficient for electrolytes using Debye-Huckel limiting law; Derivation of mean ionic activity coefficient from the expression of ion-atmosphere interaction potential; Applications of the equation and its limitations

Electromotive Force: Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry; Chemical cells, reversible and irreversible cells with examples; Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass and SbO/Sb_2O_3 electrodes

Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers; Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation)

Dipole moment and polarizability: Polarizability of atoms and molecules, dielectric constant and polarisation, molar polarisation for polar and non-polar molecules; Clausius-Mosotti equation and Debye equation (both without derivation) and their application; Determination of dipole moments

Quantum Chemistry
(20 Lectures) Marks: 16

Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component; Properties of angular momentum operators;
Eigenfunctions of L_Z and L_Z^2; Rigid rotator model of rotation of diatomic molecule and Schrödinger equation; Transformation to spherical polar coordinates; Separation of variables; Spherical harmonics; Discussion of solution

Qualitative treatment of hydrogen atom and hydrogen-like ions: Setting up of S.E. in spherical polar coordinates, radial part, quantization of energy (only final energy expression); Plots of polar parts and radial distributions; Wave –function of one electron atoms; Average and most probable distances of electron from nucleus; Setting up of Schrödinger equation for many-electron atoms (He, Li)

LCAO and HF-SCF: Born-Oppenheimer approximation; LCAO-MO treatment of H_2^+;
Bonding and antibonding orbitals; Qualitative extension to H_2; Comparison of LCAOMO and VB treatments of H_2 and their limitations; Covalent bonding, valence bond and molecular orbital approaches, Hartree-Fock method development, SCF and configuration interaction (only basics)

Reference Books

1. Castellan, G. W. *Physical Chemistry*, Narosa
2. Atkins, P. W. & Paula, J. de *Atkins', Physical Chemistry*, Oxford University Press
3. McQuarrie, D. A. &Simons, J. D. *Physical Chemistry: A Molecular Approach*, Viva Press
4. Levine, I. N. *Physical Chemistry*, Tata McGraw-Hill
5. Moore, W. J. *Physical Chemistry*, Orient Longman

6. Mortimer, R. G. *Physical Chemistry*, Elsevier
7. Engel, T. & Reid, P. *Physical Chemistry*, Pearson
8. Levine, I. N. *Quantum Chemistry*, PHI
9. Atkins, P. W. *Molecular Quantum Mechanics*, Oxford
10. Engel, T. & Reid, P. *Physical Chemistry*, Pearson
11. Maron, S.H., Prutton, C. F., *Principles of Physical Chemistry*, McMillan
12. Klotz, I.M., Rosenberg, R. M. *Chemical Thermodynamics:Basic Concepts and Methods* Wiley
13. Rastogi, R. P. & Misra, R.R. An Introduction to Chemical Thermodynamics, Vikas
14. Glasstone, S. An Introduction to Electrochemistry, East-West Press

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CEMACOR08P: **PHYSICAL CHEMISTRY-III LAB**

60 (**Lectures**/Contact Hours) **Marks: 25**

Experiment 1: Determination of solubility of sparingly soluble salt in water, in electrolyte with common ions and in neutral electrolyte (using common indicator)

Experiment 2: Potentiometric titration of Mohr's salt solution against standard $K_2Cr_2O_7$ solution

Experiment 3: Determination of K_{sp} for AgCl by potentiometric titration of $AgNO_3$ solution against standard KCl solution

Experiment 4: Effect of ionic strength on the rate of Persulphate – Iodide reaction

Experiment 5: Study of phenol-water phase diagram

Experiment 6: pH-metric titration of acid (mono- and di-basic) against strong base

Reference Books

1. Viswanathan, B., Raghavan, P.S. *Practical Physical Chemistry* Viva Books (2009)
2. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson
3. Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007)
4. Palit, S.R., De, S. K. *Practical Physical Chemistry* Science Book Agency
5. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta
6. Levitt, B. P. edited *Findlay's Practical Physical Chemistry* Longman Group Ltd.
7. Gurtu, J. N., Kapoor, R., *Advanced Experimental Chemistry* S. Chand & Co. Ltd.

CEMACOR09T: **INORGANIC CHEMISTRY-III**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

General Principles of Metallurgy
(6 Lectures) Marks: 12

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Parting process, van Arkel-de Boer process and Mond's process, Zone refining.

Chemistry of *s* and *p* Block Elements
(30 Lectures) Marks: 26

Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Beryllium hydrides and halides. Boric acid and borates, boron nitrides, borohydrides (diborane) and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, phosphorus, sulphur and chlorine. Peroxo acids of sulphur, sulphur-nitrogen compounds, interhalogen compounds, polyhalide ions, pseudohalogens, fluorocarbons and basic properties of halogens.

Noble Gases:
Occurrence and uses, rationalization of inertness of noble gases, peculiar behaviour of liquid helium, Clathrates; preparation and properties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2 and XeF_4). Xenon-oxygen compounds. Molecular shapes of noble gas compounds (VSEPR theory).

Inorganic Polymers:
Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes.

Coordination Chemistry-I
(24 Lectures) Marks: 12

Coordinate bonding: double and complex salts. Werner's theory of coordination complexes, Classification of ligands, Ambidentate ligands, chelates, Coordination

numbers, IUPAC nomenclature of coordination complexes (up to two metal centers), Isomerism in coordination compounds, constitutional and stereo isomerism, Geometrical and optical isomerism in square planar and octahedral complexes.

Reference Books

1. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles ofStructure and Reactivity 4th Ed.,* Harper Collins 1993, Pearson,2006.
2. Greenwood, N.N. & Earnshaw A. *Chemistry of the Elements*, ButterworthHeinemann, 1997.
3. Cotton, F.A., Wilkinson, G., Murrillo, C. A., Bochmann, M., *Advanced Inorganic Chemistry 6th Ed. 1999.,* Wiley.
4. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry* 4th Ed., Pearson, 2010.
5. Purecell, K.F. and Kotz, J.C., *An Introduction toInorganic Chemistry*, Saunders: Philadelphia, 1980.
6. Mingos, D.M.P., *Essential trends in inorganic chemistry*. Oxford University Press (1998).

CEMACOR09P: **INORGANIC CHEMISTRY-III LAB**

60 (Lectures/Contact Hours) Marks: 25

Complexometric titration

1. Zn(II)
2. Zn(II) in a Zn(II) and Cu(II) mixture.
3. Ca(II) and Mg(II) in a mixture.
4. Hardness of water.

Inorganic preparations

1. $[Cu(CH_3CN)_4]PF_6/ClO_4$
2. *Cis* and *trans* $K[Cr(C_2O_4)_2 (H_2O)_2]$
3. Tetraamminecarbonatocobalt (III) ion
4. Potassium tris(oxalato)ferrate(III)5.Tris-(ethylenediamine) nickel(II) chloride.

6.$[Mn(acac)_3]$ and $Fe(acac)_3]$ (acac= acetylacetonate)

Reference Books

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis* 6th Ed., Pearson, 2009.
2. *Inorganic Synthesis*, Vol. 1-10.

CEMACOR10T: **ORGANIC CHEMISTRY-IV**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Nitrogen compounds

(12 Lectures) Marks: 08

Amines: Aliphatic & Aromatic: preparation, separation (Hinsberg's method) and identification of primary, secondary and tertiary amines; reaction (with mechanism): Eschweiler–Clarke methylation,diazo coupling reaction, Mannich reaction; formation and reactions of phenylenediamines, diazomethane and diazoacetic ester.

Nitro compounds (aliphatic and aromatic): preparation and reaction (with mechanism): reduction under different conditions; Nef carbonyl synthesis, Henry reaction and conjugate addition of nitroalkane anion.

Alkylnitrile and isonitrile: preparation and reaction (with mechanism): Thorpe nitrile condensation, von Richter reaction.

Diazonium salts and their related compounds: reactions (with mechanism) involving replacement of diazo group; reactions: Gomberg, Meerwein, Japp-Klingermann.

Rearrangements

(14 Lectures) Marks: 10

Mechanism with evidence and stereochemical features for the following
Rearrangement to electron-deficient carbon: Wagner-Meerwein rearrangement, pinacol rearrangement, dienone-phenol; Wolff rearrangement in Arndt-Eistert synthesis, benzilbenzilic acid rearrangement, Demjanov rearrangement, Tiffeneau–Demjanov rearrangement.

Rearrangement to electron-deficient nitrogen: rearrangements: Hofmann, Curtius, Lossen, Schmidt and Beckmann.

Rearrangement to electron-deficient oxygen: Baeyer-Villiger oxidation, cumene hydroperoxide-phenol rearrangement and Dakin reaction.

Aromatic rearrangements: Migration from oxygen to ring carbon: Fries rearrangement and Claisen rearrangement.
Migration from nitrogen to ring carbon: Hofmann-Martius rearrangement**,** FischerHepp rearrangement, *N*-azo to *C*-azo rearrangement, Bamberger rearrangement, Orton rearrangement and benzidine rearrangement.

Rearrangement reactions by green approach: Fries rearrangement, Claisen rearrangement, Beckmann rearrangement, Baeyer-Villiger oxidation.

The Logic of Organic Synthesis
(14 Lectures) Marks: 12

Retrosynthetic analysis: disconnections; synthons, donor and acceptor synthons; natural reactivity and *umpolung*; latent polarity in bifunctional compounds: consonant and dissonant polarity; illogical electrophiles and nucleophiles; synthetic equivalents; functional group interconversion and addition (FGI and FGA); C-C disconnections and synthesis: one-group and two-group (1,2- to 1,5-dioxygenated compounds), reconnection (1,6-dicarbonyl);protection-deprotection strategy (alcohol, amine, carbonyl, acid).

Strategy of ring synthesis: thermodynamic and kinetic factors; synthesis of large rings, application of high dilution technique.

Asymmetric synthesis: stereoselective and stereospecific reactions; diastereoselectivity and enantioselectivity (only definition); enantioselectivity: kinetically controlled MPV reduction; diastereoselectivity: addition of nucleophiles to C=O adjacent to a stereogenic centre: Felkin-Anh and Zimmermann-Traxler models.

Organic Spectroscopy
(20 Lectures) Marks: 20

UV Spectroscopy: introduction;types of electronic transitions, end absorption; transition dipole moment and allowed/forbidden transitions; chromophores and auxochromes; Bathochromic and Hypsochromic shifts; intensity of absorptions (Hyper/Hypochromic effects); application of Woodward's Rules for calculation of λ_{max} for the following systems: conjugated diene, *α,β*-unsaturated aldehydes and ketones (alicyclic, homoannular and heteroannular); extended conjugated systems (dienes, aldehydes and

ketones); relative positions of λ_{max} considering conjugative effect, steric effect, solvent effect, effect of pH; effective chromophore concentration: keto-enol systems; benzenoid transitions.

IR Spectroscopy: introduction;modes of molecular vibrations(fundamental and nonfundamental); IR active molecules; application of Hooke's law, force constant; *fingerprint region* and its significance; effect of deuteration; overtone bands; vibrational coupling in IR; characteristic and diagnostic stretching frequencies of C-H, N-H, O-H, C-O, C-N, C-X, C=C (including skeletal vibrations of aromatic compounds), C=O, C=N, N=O, C≡C, C≡N; characteristic/diagnostic bending vibrations are included; factors affecting stretching frequencies: effect of conjugation, electronic effects, mass effect, bond multiplicity, ring-size, solvent effect, H-bonding on IR absorptions; application in functional group analysis.

NMR Spectroscopy: introduction;nuclear spin;NMR active molecules;basic principles of Proton Magnetic Resonance; equivalent and non-equivalent protons; chemical shift and factors influencing it; ring current effect; significance of the terms: up-/downfield, shielded and deshielded protons; spin coupling and coupling constant (1st order spectra); relative intensities of *first-order* multiplets: Pascal's triangle; chemical and magnetic equivalence in NMR ; elementary idea about *non-first-order* splitting; anisotropic effects in alkene, alkyne, aldehydes and aromatics; NMR peak area, integration; relative peak positions with coupling patterns of common organic compounds (both aliphatic and benzenoid-aromatic); rapid proton exchange; interpretation of NMR spectra of simple compounds.
Applications of IR, UV and NMR spectroscopy for identification of simple organic molecules.

Reference Books

1. Finar, I. L. *Organic Chemistry (Volume 1),* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
3. Norman, R.O. C., Coxon, J. M. *Principles of Organic Synthesis*, Third Edition, Nelson Thornes, 2003.
4. Clayden, J., Greeves, N., Warren, S., *Organic Chemistry,* Second edition, Oxford University Press 2012.
5. Silverstein, R. M., Bassler, G. C., Morrill, T. C. *Spectrometric Identification of Organic Compounds*, John Wiley and Sons, INC, Fifth edition.
6. Kemp, W. *Organic Spectroscopy*, Palgrave.
7. Pavia, D. L. *et al. Introduction to Spectroscopy,* 5th Ed. Cengage Learning India Ed. (2015).
8. Dyer, J. *Application of Absorption Spectroscopy of Organic Compounds*, PHI Private Limited
9. March, J. *Advanced Organic Chemistry*, Fourth edition, Wiley.
10. Harwood, L. M., *Polar Rearrangements,* Oxford Chemistry Primer, Oxford University Press.
11. Bailey, Morgan, Organonitrogen Chemistry, Oxford Chemistry Primer, Oxford University Press.

12. Ahluwalia, V. K. *Strategies for Green Organic Synthesis*, ANE Books Pvt. Ltd.
13. Warren, S. *Organic Synthesis the Disconnection Approach*, John Wiley and Sons.
14. Warren, S., *Designing Organic Synthesis*, Wiley India, 2009.
15. Carruthers, W. *Modern methods of Organic Synthesis*, Cambridge University Press.
16. Willis, C. A., Wills, M., *Organic Synthesis*, Oxford Chemistry Primer, Oxford University Press.

CEMACOR10P: **ORGANIC CHEMISTRY-IV LAB**

60 (Lectures/Contact Hours) Marks: 25

Quantitative Estimations: Each student is required to perform all the experiments.

1. Estimation of glycine by Sörensen's formol method
2. Estimation of glucose by titration using Fehling's solution
3. Estimation of sucrose by titration using Fehling's solution
4. Estimation of vitamin-C (reduced)
5. Estimation of aromatic amine (aniline) by bromination (Bromate-Bromide) method
6. Estimation of phenol by bromination (Bromate-Bromide) method
7. Estimation of formaldehyde (Formalin)
8. Estimation of acetic acid in commercial vinegar
9. Estimation of urea (hypobromite method)
10. Estimation of saponification value of oil/fat/ester

Reference Books

1. Arthur, I. V. *Quantitative Organic Analysis*, Pearson
2. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta

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SEMESTER-V

CEMACOR11T: **INORGANIC CHEMISTRY-IV**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Coordination Chemistry-II
(36 Lectures) Marks: 30

VB description and its limitations. Elementary Crystal Field Theory: splitting of d^n configurations in octahedral, square planar and tetrahedral fields, crystal field stabilization energy (CFSE) in weak and strong fields; pairing energy. Spectrochemical series. Jahn-Teller distortion. Octahedral site stabilization energy (OSSE). Metalligand bonding (MO concept, elementary idea), sigma- and pi-bonding in octahedral complexes (qualitative pictorial approach) and their effects on the oxidation states of transitional metals (examples). Magnetism and Colour: Orbital and spin magnetic moments, spin only moments of d^n ions and their correlation with effective magnetic moments, including orbital contribution; quenching of magnetic moment: super exchange and antiferromagnetic interactions (elementary idea with examples only); d-d transitions; L-S coupling; qualitative Orgel diagrams for $3d^1$ to $3d^9$ ions. Racah parameter. Selection rules for electronic spectral transitions; spectrochemical series of ligands; charge transfer spectra (elementary idea).

Chemistry of d- and f- block elements
(24 Lectures) Marks: 20

Transition Elements:
General comparison of 3d, 4d and 5d elements in term of electronic configuration, oxidation states, redox properties, coordination chemistry.

Lanthanoids and Actinoids:
General Comparison on Electronic configuration, oxidation states, colour, spectral and magnetic properties; lanthanide contraction, separation of lanthanides (ion-exchange method only).

Reference Books

1. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles ofStructure and Reactivity 4th Ed.*, Harper Collins 1993, Pearson,2006.

2. Greenwood, N.N. & Earnshaw A. *Chemistry of the Elements*, ButterworthHeinemann. 1997.
3. Cotton, F.A., Wilkinson, G., Murrillo, C. A., Bochmann, M., *Advanced Inorganic Chemistry 6th Ed. 1999.,* Wiley.
4. Atkin, P. *Shriver & Atkins' Inorganic Chemistry* 5th Ed. Oxford University Press (2010).
5. Purecell, K.F. and Kotz, J.C., *An Introduction toInorganic Chemistry*, Saunders: Philadelphia, 1980.
6. Sinha, S. P., Ed., Lanthanide and Actinide Research (Journal, Vol. 1, 1986).
7. Wulfsberg, G., Principles of Descriptive Inorganic Chemistry, Brooks/Cole: Monterey, CA, 1987.

CEMACOR11P: INORGANIC CHEMISTRY-IV LAB

(60 Lectures/Contact Hours) Marks: 25

Chromatography of metal ions

Principles involved in chromatographic separations. Paper chromatographic separation of following metal ions:

1. Ni (II) and Co (II)
2. Fe (III) and Al (III)

Gravimetry

1. Estimation of Ni(II) using Dimethylglyoxime (DMG).
2. Estimation of copper as CuSCN.
3. Estimation of Al(III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminium oxinate).
4. Estimation of chloride.**Spectrophotometry**

1. Measurement of 10Dq by spectrophotometric method.
2. Determination of λ_{max} of $[Mn(acac)_3]$ and $[Fe(acac)_3]$ complexes.

Reference Books

1.Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis* 6th Ed., Pearson, 2009.

CEMACOR12T: **ORGANIC CHEMISTRY-V**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Carbocycles and Heterocycles

(16 Lectures) Marks: 12

Polynuclear hydrocarbons and their derivatives: synthetic methods include Haworth, Bardhan-Sengupta, Bogert-Cook and other useful syntheses (with mechanistic details); fixation of double bonds and Fries rule; reactions (with mechanism) of naphthalene, anthracene, phenanthrene and their derivatives.

Heterocyclic compounds: 5- and 6-membered rings with one heteroatom; reactivity, orientation and important reactions (with mechanism) of furan, pyrrole, thiophene and pyridine; synthesis (including retrosynthetic approach and mechanistic details): pyrrole: Knorr synthesis, Paal-Knorr synthesis, Hantzsch synthesis; furan: Paal-Knorr synthesis, Feist-Benary synthesis and its variation; thiophenes: Paal-Knorr synthesis, Hinsberg synthesis; pyridine: Hantzsch synthesis; benzo-fused 5- and 6-membered rings with one heteroatom: reactivity, orientation and important reactions (with mechanistic details) of indole, quinoline and isoquinoline; synthesis (including retrosynthetic approach and mechanistic details): indole: Fischer, Madelung and Reissert; quinoline: Skraup, Doebner-Miller, Friedlander; isoquinoline: Bischler-Napieralski synthesis.

Cyclic Stereochemistry
(10 Lectures) Marks: 08

Alicyclic compounds: concept of I-strain; conformational analysis: cyclohexane, mono and disubstituted cyclohexane; symmetry properties and optical activity; topomerisation; ring-size and ease of cyclisation; conformation & reactivity in cyclohexane system: consideration of steric and stereoelectronic requirements; elimination (E2, E1), nucleophilic substitution (S_N1, S_N2, S_Ni, NGP), merged substitution-elimination; rearrangements; oxidation of cyclohexanol, esterification, saponification, lactonisation, epoxidation, pyrolytic *syn* elimination and fragmentation reactions.

Pericyclic reactions
(8 Lectures) Marks: 08

Mechanism, stereochemistry, regioselectivity in case of
Electrocyclic reactions: FMO approach involving 4π- and 6π-electrons (thermal and photochemical) and corresponding cycloreversion reactions.
Cycloaddition reactions: FMO approach, Diels-Alder reaction, photochemical [2+2] cycloadditions.

Sigmatropic reactions: FMO approach,sigmatropic shifts and their order; [1,3]- and [1,5]-H shifts and [3,3]-shifts with reference to Claisen and Cope rearrangements.

Carbohydrates
(14 Lectures) Marks: 10

Monosaccharides: Aldoses up to 6 carbons; structure of D-glucose & D-fructose (configuration & conformation); ring structure of monosaccharides (furanose and pyranose forms): Haworth representations and non-planar conformations; anomeric effect (including stereoelectronic explanation); mutarotation; epimerization; reactions (mechanisms in relevant cases): Fischer glycosidation, osazone formation, brominewater oxidation, HNO_3 oxidation, selective oxidation of terminal $–CH_2OH$ of aldoses, reduction to alditols, Lobry de Bruyn-van Ekenstein rearrangement; stepping–up (Kiliani-Fischer method) and stepping–down (Ruff's & Wohl's methods) of aldoses; end-group-interchange of aldoses; acetonide (isopropylidene) and benzylidene protections; ring-size determination; Fischer's proof of configuration of (+)-glucose.

Disaccharides: Glycosidic linkages, concept of glycosidic bond formation by glycosyl donor-acceptor; structure of sucrose, inversion of cane sugar.
Polysaccharides: starch (structure and its use as an indicator in titrimetric analysis).

Biomolecules
(12 Lectures) Marks: 12

Amino acids: synthesis with mechanistic details: Strecker, Gabriel, acetamido malonic ester, azlactone, Bücherer hydantoin synthesis, synthesis involving diketopiperazine; isoelectric point, zwitterions; electrophoresis, reaction (with mechanism): ninhydrin reaction, Dakin-West reaction; resolution of racemic amino acids.

Peptides: peptide linkage and its geometry; syntheses (with mechanistic details) of peptides using *N*-protection & C-protection, solid-phase (Merrifield) synthesis; peptide sequence: *C*-terminal and *N*-terminal unit determination (Edman, Sanger & 'dansyl' methods); partial hydrolysis; specific cleavage of peptides: use of CNBr.

Nucleic acids: pyrimidine and purine bases (only structure & nomenclature); nucleosides and nucleotides corresponding to DNA and RNA; mechanism for acid catalysed hydrolysis of nucleosides (both pyrimidine and purine types); comparison of alkaline hydrolysis of DNA and RNA; elementary idea of double helical structure of DNA (Watson-Crick model); complimentary base–pairing in DNA.

Reference Books

1. Clayden, J., Greeves, N., Warren, S. *Organic Chemistry,* Second edition, Oxford University Press 2012.

2. Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds*, Wiley: London.
3. Nasipuri, D. *Stereochemistry of Organic Compounds,* Wiley Eastern Limited.
4. Fleming, I. *Molecular Orbitals and Organic Chemical reactions*, Reference/Student Edition, Wiley, 2009.
5. Fleming, I. *Pericyclic Reactions*, Oxford Chemistry Primer, Oxford University Press.
6. Gilchrist, T. L. & Storr, R. C. *Organic Reactions and Orbital symmetry*, Cambridge University Press.
7. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
8. Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
9. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
10. Loudon, G. M. *Organic Chemistry*, Fourth edition, Oxford University Press.
11. James, J., Peach, J. M. *Stereochemistry at a Glance*, Blackwell Publishing, 2003.
12. Robinson, M. J. T., *Stereochemistry*, Oxford Chemistry Primer, Oxford University Press, 2005.
13. Davis, B. G., Fairbanks, A. J., *Carbohydrate Chemistry*, Oxford Chemistry Primer, Oxford University Press.
14. Joule, J. A. Mills, K. *Heterocyclic Chemistry*, Blackwell Science.
15. Acheson, R.M. *Introduction to the Chemistry of Heterocyclic compounds*, John Wiely & Sons (1976).
16. Gilchrist, T. L. *Heterocyclic Chemistry*, 3rd edition, Pearson.
17. Davies, D. T., *Heterocyclic Chemistry*, Oxford Chemistry Primer, Oxford University Press.

CEMACOR12P: ORGANIC CHEMISTRY-V LAB

(60 Lectures/Contact Hours) Marks: 25

A. Chromatographic Separations

1. TLC separation of a mixture containing 2/3 amino acids
2. TLC separation of a mixture of dyes (fluorescein and methylene blue)
3. Column chromatographic separation of leaf pigments from spinach leaves
4. Column chromatographic separation of mixture of dyes
5. Paper chromatographic separation of a mixture containing 2/3 amino acids
6. Paper chromatographic separation of a mixture containing 2/3 sugars

B. **Spectroscopic Analysis of Organic Compounds**

1. Assignment of labelled peaks in the ^{1}H NMR spectra of the known organic compounds explaining the relative δ-values and splitting pattern.

2. Assignment of labelled peaks in the IR spectrum of the same compound explaining the relative frequencies of the absorptions (C-H, O-H, N-H, C-O, C-N, C-X, C=C, C=O, N=O, C≡C, C≡N stretching frequencies; **characteristic bending vibrations are included**).

3. The students must record full spectral analysis of **at least 15 (fifteen)** compounds from the following list:

(i) 4′-Bromoacetanilide (ii) 2-Bromo-4'-methylacetophenone (iii) Vanillin (iv) 2′-Methoxyacetophenone (v) 4-Aminobenzoic acid (vi) Salicylamide (vii) 2′Hydroxyacetophenone (viii) 1,3-Dinitrobenzene (ix) *trans*-Cinnamic acid (x) *trans*-4Nitrocinnamaldehyde (xi) Diethyl fumarate (xii) 4-Nitrobenzaldehyde (xiii) 4′Methylacetanilide (xiv) Mesityl oxide (xv) 2-Hydroxybenzaldehyde (xvi) 4Nitroaniline (xvii) 2-Hydroxy-3-nitrobenzaldehyde (xviii) 2,3-Dimethylbenzonitrile (xix) Pent-1-yn-3-ol (xx) 3-Nitrobenzaldehyde (xxi) 3-Ethoxy-4-hydroxybenzaldehyde (xxii) 2-Methoxybenzaldehyde (xxiii) Methyl 4-hydroxybenzoate (xxiv) Methyl 3hydroxybenzoate (xxv) 3-Aminobenzoic acid (xxvi) Ethyl 3-aminobenzoate (xxvii) Ethyl 4-aminobenzoate (xxviii) 3-Nitroanisole (xxix) 5-Methyl-2-nitroanisole

(xxx) 3′-Methylacetanilide

Reference Books

1. *University Hand Book of Undergraduate Chemistry Experiments,* edited by Mukherjee, G. N. University of Calcutta, 2003.
2. *Practical Workbook Chemistry (Honours), UGBS, Chemistry*, University of Calcutta, 2015
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012).
4. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education.

SEMESTER-VI

CEMACOR13T: **INORGANIC CHEMISTRY-V**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Bioinorganic Chemistry
(24 Lectures) Marks: 20

Elements of life: essential and beneficial elements, major, trace and ultratrace elements. Basic chemical reactions in the biological systems and the role of metal ions (specially Na^+, K^+, Mg^{2+}, Ca^{2+}, $Fe^{3+}/^{2+}$, $Cu^{2+}/^{+}$, and Zn^{2+}). Metal ion transport across biological membrane Na^+/ K^+-ion pump. Dioxygen molecule in life. Dioxygen management proteins: Haemoglobin, Myoglobin, Hemocyanine and Hemerythrin. Electron transfer proteins: Cytochromes and Ferredoxins. Hydrlytic enzymes: carbonate bicarbonate buffering system and carbonic anhydrase and carboxyanhydrase A. Biological nitrogen fixation, Photosynthesis: Photosystem-I and Photosystem-II. Toxic metal ions and their effects, chelation therapy (examples only), Pt and Au complexes as drugs (examples only), metal dependent diseases (examples only)

Organometallic Chemistry
(24 Lectures) Marks: 20

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. 18-electron and 16-electron rules (pictorial MO approach). Applications of 18-electron rule to metal carbonyls, nitrosyls, cyanides. General methods of preparation of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls. pi-acceptor behaviour of CO, synergic effect and use of IR data to explain extent of back bonding. Zeise's salt: Preparation, structure, evidences of synergic effect. Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Reactions of organometallic complexes: substitution, oxidative addition, reductive elimination and insertion reactions.

Catalysis by Organometallic Compounds
Study of the following industrial processes
1. Alkene hydrogenation (Wilkinson's Catalyst)
2. Hydroformylation
3. Wacker Process
4. Synthetic gasoline (Fischer Tropsch reaction)
5. Ziegler-Natta catalysis for olefin polymerization.

Reaction Kinetics and Mechanism
(12 Lectures) Marks: 10

Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect and its application in complex synthesis, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes.

Reference Books

1. Lippard, S.J. & Berg, J.M. *Principles of Bioinorganic Chemistry* Panima Publishing Company 1994.
2. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. *Inorganic Chemistry, Principles ofStructure and Reactivity 4th Ed.*, Harper Collins 1993, Pearson,2006.
3. Greenwood, N.N. & Earnshaw A. *Chemistry of the Elements*, ButterworthHeinemann, 1997.
4. Cotton, F.A., Wilkinson, G., Murrillo, C. A., Bochmann, M., *Advanced Inorganic Chemistry 6th Ed. 1999.*, Wiley.
5. Bertini, I., Gray, H. B., Lippard, S.J., Valentine, J. S., Viva, 2007.
6. Basolo, F, and Pearson, R.C. *Mechanisms of Inorganic Chemistry*, John Wiley & Sons, NY, 1967.
7. Purecell, K.F. and Kotz, J.C., *An Introduction toInorganic Chemistry*, Saunders: Philadelphia, 1980.
8. Powell, P. *Principles of Organometallic Chemistry*, Chapman and Hall, 1988.
9. Collman, J. P. *et al. Principles and Applications of Organotransition MetalChemistry*. Mill Valley, CA: University Science Books, 1987.
10. Crabtree, R. H. *The Organometallic Chemistry of the Transition Metals*. New York, NY: John Wiley, 2000.

***CEMACOR13P:*: INORGANIC CHEMISTRY-V LAB**

(60 Lectures/Contact Hours) Marks: 25

Qualitative semimicro analysis of mixtures containing four radicals. Emphasis should be given to the understanding of the chemistry of different reactions and to assign the most probable composition.

Cation Radicals: Na^+,K^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, Al^{3+}, Cr^{3+}, Mn^{2+}/Mn^{4+}, Fe^{3+}, Co^{2+}/Co^{3+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, Pb^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}/Sn^{4+}, As^{3+}/As^{5+}, $Sb^{3+/5+}$, NH_4^+, Mg^{2+}.

Anion Radicals: F^-, Cl^-, Br^-, BrO_3^-, I^-, IO_3^-, SCN^-, S^{2-}, SO_4^{2-}, NO_3^-, NO_2^-, PO_4^{3-}, AsO_4^{3--}, BO_3^{3-}, CrO_4^{2-} / $Cr_2O_7^{2-}$, $Fe(CN)_6^{4-}$, $Fe(CN)_6^{3-}$.

Insoluble Materials: Al_2O_3(ig), Fe_2O_3(ig), Cr_2O_3(ig), SnO_2, $SrSO_4$, $BaSO_4$, CaF_2, $PbSO_4$.

Reference Books

1. Svehla, G., *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.

CEMACOR14T: **PHYSICAL CHEMISTRY- IV**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Molecular Spectroscopy
(25 Lectures) Marks: 20

Interaction of electromagnetic radiation with molecules; Transition between two states and time-dependent S.E.; Transition moment integral and selection rules; Various types of spectra

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies; Diatomic vibrating rotator, P, Q, R branches

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules

Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals

Photochemistry
(15 Lectures) Marks: 14

Lambert-Beer's law: Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients; Laws of photochemistry,

Stark-Einstein law of photochemical equivalence, quantum yield, actinometry, examples of low and high quantum yields

Photochemical Processes: Potential energy curves (diatomic molecules), Frank-Condon principle and vibrational structure of electronic spectra; Bond dissociation and principle of determination of dissociation energy (ground state); Decay of excited states by radiative and non-radiative paths; Pre-dissociation; Fluorescence and phosphorescence, Jablonskii diagram

Rate of Photochemical processes: Photochemical equilibrium and the differential rate of photochemical reactions, Photostationary state; HI decomposition, H_2-Br_2 reaction, dimerisation of anthracene; photosensitised reactions, quenching; Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence

Surface phenomenon
(20 Lectures) Marks: 16

Surface tension and energy: Surface tension, surface energy, excess pressure, capillary rise and surface tension; Work of cohesion and adhesion, spreading of liquid over other surface; Vapour pressure over curved surface; Temperature dependence of surface tension

Adsorption: Physical and chemical adsorption; Freundlich and Langmuir adsorption isotherms; multilayer adsorption and BET isotherm (no derivation required); Gibbs' adsorption isotherm and surface excess; Heterogenous catalysis (single reactant); Zero order and fractional order reactions

Colloids: Lyophobic and lyophilic sols, Origin of charge and stability of lyophobic colloids, Coagulation and Schultz-Hardy rule, Zeta potential and Stern double layer (qualitative idea), Tyndall effect; Electrokinetic phenomena (qualitative idea only); Determination of Avogadro number by Perrin's method; Stability of colloids and zeta potential; Micelle formation

Reference Books

1. Castellan, G. W. Physical Chemistry, Narosa
2. Levine, I. N. Physical Chemistry, Tata McGraw-Hill
3. Atkins, P. W. & Paula, J. de Atkin's, Physical Chemistry, Oxford University Press
4. McQuarrie, D. A. & Simons, J. D. Physical Chemistry: A Molecular Approach, Viva Press
5. Mortimer, R. G. Physical Chemistry, Elsevier
6. Laidler, K. J. Chemical Kinetics, Pearson
7. Banwell, C. N. Fundamentals of Molecular Spectroscopy, Tata-McGraw-Hill
8. Barrow, G. M. Molecular Spectroscopy, McGraw-Hill
9. Hollas, J.M. Modern Spectroscopy, Wiley India
10. McHale, J. L. Molecular Spectroscopy, Pearson Education
11. Wayne, C. E. & Wayne, R. P. Photochemistry, OUP
12. Brown, J. M. Molecular Spectroscopy, OUP

13. Levine, I. N. Quantum Chemistry, PHI
14. Atkins, P. W. Molecular Quantum Mechanics, Oxford

CEMACOR14P: **PHYSICAL CHEMISTRY- IV LAB**

(60 Lectures/Contact Hours) Marks: 25

Experiment 1: Determination of surface tension of a liquid using Stalagmometer

Experiment 2: Determination of CMC from surface tension measurements

Experiment 3: Verification of Beer and Lambert's Law for $KMnO_4$ and $K_2Cr_2O_7$ solution

Experiment 4: Study of kinetics of $K_2S_2O_8$ + KI reaction, spectrophotometrically

Experiment 5: Determination of pH of unknown buffer, spectrophotometrically

Experiment 6: Spectrophotometric determination of CMC

Reference Books

1. Viswanathan, B., Raghavan, P.S. *Practical Physical Chemistry* Viva Books (2009)
2. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson
3. Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007)
4. Palit, S.R., De, S. K. *Practical Physical Chemistry* Science Book Agency
5. *University Hand Book of Undergraduate Chemistry Experiments,* edited by Mukherjee, G. N., University of Calcutta
6. Levitt, B. P. edited *Findlay's Practical Physical Chemistry* Longman Group Ltd.
7. Gurtu, J. N., Kapoor, R., *Advanced Experimental Chemistry* S. Chand & Co. Ltd.

DISCIPLINE SPECIFIC ELECTIVE COURSE (HONOURS) IN CHEMISTRY

CEMADSE01T:
ADVANCED PHYSICAL CHEMISTRY (Credits: Theory-04, Practicals-02)

Theory
(60 Lecturers)
Crystal Structure
(20 Lectures) Marks: 18

Bravais Lattice and Laws of Crystallography: Types of solid, Bragg's law of diffraction; Laws of crystallography; Permissible symmetry axes in crystals; Lattice, space lattice, unit cell, crystal planes, Bravais lattice. Packing of uniform hard sphere, close packed arrangements (fcc and hcp); Tetrahedral and octahedral voids. Void space in p-type, F-type and I-type cubic systems

Crystal planes: Distance between consecutive planes [cubic, tetragonal and orthorhombic lattices]; Indexing of planes, Miller indices; calculation of d_{hkl}; Relation between molar mass and unit cell dimension for cubic system; Laue's diffraction; Bragg's law (derivation)

Determination of crystal structure: Powder method; Structure of NaCl and KCl crystals

Statistical Thermodynamics
(20 Lectures) Marks: 16

Configuration: Macrostates, microstates and configuration; calculation of microstates with harmonic oscillator and tossing of coins; variation of W with E; equilibrium configuration

Boltzmann distribution: Thermodynamic probability, entropy and probability, Boltzmann distribution formula (with derivation); Applications to barometric distribution; Concept of ensemble - canonical ensemble and grand canonical ensembles

Partition function: molecular partition function and thermodynamic properties (U, H, S, C_V, q, P); Partition function correlating – Chemical equilibrium and Maxwell's speed distribution; Gibbs' paradox; Ideal gas equation

Special selected topics
(20 Lectures) Marks: 16

Specific heat of solid: Coefficient of thermal expansion, thermal compressibility of solids; Dulong –Petit's law; Perfect Crystal model, Einstein's theory – derivation from partition function, limitations; Debye's T^3 law – analysis at the two extremes

3rd law: Absolute entropy, Plank's law, Calculation of entropy, Nernst heat theorem
Adiabatic demagnetization: Approach to zero Kelvin, adiabatic cooling, demagnetization, adiabatic demagnetization – involved curves

Polymers: Classification of polymers, nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers; Criteria for synthetic polymer formation; Relationships between functionality, extent of reaction and degree of polymerization; Mechanism and kinetics of step growth and copolymerization; Conducting polymers

Reference Books

1. Castellan, G. W. *Physical Chemistry*, Narosa
2. Levine, I. N. *Physical Chemistry*, Tata McGraw-Hill
3. Moore, W. J. *Physical Chemistry*, Orient Longman
4. Atkins, P. W. & Paula, J. de *Atkins', Physical Chemistry*, Oxford University Press
5. McQuarrie, D. A. & Simons, J. D. *Physical Chemistry*: A Molecular Approach, Viva Press
6. Engel, T. & Reid, P. *Physical Chemistry*, Pearson
7. Nash, L. K. *Elements of Statistical Thermodynamics*, Dover
8. Rastogi, R. P. & Misra, R.R. *An Introduction to Chemical Thermodynamics*, Vikas
9. Zemansky, M. W. & Dittman, R.H. *Heat and Thermodynamics*, Tata-McGraw-Hill
10. Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc.
11. Seymour, R. B. & Carraher, C. E. *Polymer Chemistry: An Introduction*, Marcel Dekker, Inc.
12. Odian, G. *Principles of Polymerization*, Wiley
13. Billmeyer, F. W. *Textbook of Polymer Science*, Wiley Interscience, 1971.

CEMADSE01P: **ADVANCED PHYSICAL CHEMISTRY LAB**

(60 Lectures/Contact Hours) Marks: 25

Computer programs based on numerical methods for

Programming 1: Roots of equations: (e.g. volume of van der Waals gas and comparison with ideal gas, pH of a weak acid)

Programming 2: Numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, potentiometric titrations)

Programming 3: Numerical integration (e.g. entropy/ enthalpy change from heat capacity data), probability distributions (gas kinetic theory) and mean values

Programming 4: Matrix operations (Application of Gauss-Siedel method in colourimetry)

Programming 5: Simple exercises using molecular visualization software

Reference Books

1. McQuarrie, D. A. *Mathematics for Physical Chemistry* University Science Books (2008)
2. Mortimer, R. *Mathematics for Physical Chemistry*. 3rd Ed. Elsevier (2005)
3. Yates, P. *Chemical Calculations*. 2nd Ed. CRC Press (2007)
4. Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007) Chapters 3-5
5. Noggle, J. H. *Physical Chemistry on a Microcomputer.* Little Brown & Co. (1985)

CEMADSE02T: **ANALYTICAL METHODS IN CHEMISTRY**
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures Marks: 50

Qualitative and quantitative aspects of analysis:
(05 Lectures) Marks: 06

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

Optical methods of analysis:
(25 Lectures) Marks: 16

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source,monochromator and detector) for single and double beam instrument;
Basic principles of quantitative analysis: estimation of metal ions from aqueous solution,geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method. *Infrared Spectrometry:* Basic principles of instrumentation (choice of source, monochromator& detector) for single and double beam instrument; sampling techniques.

Structural illustration through interpretation of data, Effect and importance of isotope substitution.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation(choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background

correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

Thermal methods of analysis:
(05 Lectures) Marks: 06

Theory of thermogravimetry (TG), basic principle of instrumentation.

Techniques for quantitative estimation of Ca and Mg from their mixture.

Electroanalytical methods:
(10 Lectures) Marks: 08

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.

Separation techniques:
(15 Lectures) Marks: 14

Solvent extraction: Classification, principle and efficiency of the technique.

Mechanism of extraction: extraction by solvation and chelation.

Technique of extraction: batch, continuous and counter current extractions.

Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media.

Chromatography: Classification, principle and efficiency of the technique.

Mechanism of separation: adsorption, partition & ion exchange.

Development of chromatograms: frontal, elution and displacement methods.

Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.

Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC).

Role of computers in instrumental methods of analysis.

Reference Books

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6thEd.*, Pearson,

2009.

2. Willard, H.H. *et al.*: *Instrumental Methods of Analysis*, 7th Ed. Wardsworth

3.Publishing Company, Belmont, California, USA, 1988. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York,

2004.

4. Harris, D.C.: *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
5. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
6. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
7. Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
8. Ditts, R.V. Analytical Chemistry; Methods of separation, van Nostrand, 1974.

CEMADSE02P: ANALYTICAL METHODS IN CHEMISTRY LAB

(60 Lectures/Contact Hours) Marks: 25

I. Separation Techniques

Chromatography:

(a) Separation of mixtures

Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the R_f values.

(b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.

(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

II. Solvent Extractions:

To separate a mixture of Ni^{2+}& Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex in chloroform, and determine its concentration by spectrophotometry.

Analysis of soil:

(i) Determination of pH of soil.

(ii) Estimation of calcium, magnesium, phosphate

Ion exchange:

Determination of exchange capacity of cation exchange resins and anion exchange resins.

III. Spectrophotometry

1. Determination of pKa values of indicator using spectrophotometry.
2. Determination of chemical oxygen demand (COD).
3. Determination of Biological oxygen demand (BOD).

Reference Books

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6thEd.*, Pearson, 2009.
2. Willard, H.H. *et al.*: *Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, D.C. *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
5. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Edition.
7. Mikes, O. & Chalmes, R.A. *Laboratory Handbook of Chromatographic & AlliedMethods*, Elles Harwood Ltd. London.
8. Ditts, R.V. *Analytical Chemistry: Methods of separation.* Van Nostrand, New York, 1974.

CEMADSE03T: **INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS**

(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures Marks: 50

Introduction to spectroscopic methods of analysis:
(04 Lectures) Marks: 04

Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation.

Molecular spectroscopy:
(16 Lectures) Marks: 12
Infrared spectroscopy:

Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection.

UV-Visible/ Near IR – emission, absorption, fluorescence and photoaccoustic. Excitationsources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags).

Separation techniques:
(16 Lectures) Marks: 12

Chromatography: Gas chromatography, liquid chromatography, supercritical fluids,Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis.

Elemental analysis:
(08 Lectures) Marks: 06

Mass spectrometry (electrical discharges).

Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence.

Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

NMR spectroscopy:
(04 Lectures) Marks: 04
Principle, Instrumentation, Factors affecting chemical shift, Spin-coupling, Applications.

Electroanalytical Methods:

(04 Lectures) Marks: 04

Potentiometry & Voltammetry

Radiochemical Methods:
(04 Lectures) Marks: 04
Elementary idea

X-ray analysis and electron spectroscopy (surface analysis):
(04 Lectures) Marks: 04
Elementary idea

Reference books

1. D.A. Skoog, F.J. Holler & S. Crouch (ISBN 0-495-01201-7) *Principles of InstrumentalAnalysis*, Cengage Learning India Edition, 2007.
2. Willard, Merritt, Dean, Settle, *Instrumental Methods of Analysis*, 7th ed, IBH Book House, New Delhi.
3. Atkins, P.W & Paula, J.D. *Physical Chemistry*, 10th Ed., Oxford University Press (2014).
4. Kakkar, R. *Atomic and Molecular Spectroscopy: Concepts and Applications.*Cambridge University Press, 2015.
5. Castellan, G. W. *Physical Chemistry 4thEd.,* Narosa (2004).
6. Banwell, C. N. & McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed.
7. Smith, B.C. *Infrared Spectral Interpretations: A Systematic Approach.* CRC Press, 1998.
8. Moore, W.J., *Physical Chemistry* Orient Blackswan, 1999.

CEMADSE03T: **INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS LAB**

(60 Lectures/Contact Hours) Marks: 25

1.Safety Practices in the Chemistry Laboratory
2.Determination of the isoelectric pH of a protein.
3. Titration curve of an amino acid.
4. Determination of the void volume of a gel filtration column.
5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water)
7. IR Absorption Spectra (Study of Aldehydes and Ketones)
8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption

9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride) 10.Separation of Carbohydrates by HPLC

11. Determination of Caffeine in Beverages by HPLC

12. Potentiometric Titration of a Chloride-Iodide Mixture

13. Cyclic Voltammetry of the Ferrocyanide/ Ferricyanide Couple

14. Nuclear Magnetic Resonance

15. Use of fluorescence to do "presumptive tests" to identify blood or other body fluids.

16. Use of "presumptive tests" for anthrax or cocaine

17. Collection, preservation, and control of blood evidence being used for DNA testing

18. Use of capillary electrophoresis with laser fluorescence detection for nuclear DNA (Y chromosome only or multiple chromosome)

19. Use of sequencing for the analysis of mitochondrial DNA

20. Laboratory analysis to confirm anthrax or cocaine

21. Detection in the field and confirmation in the laboratory of flammable accelerants or explosives

22. Detection of illegal drugs or steroids in athletes

23. Detection of pollutants or illegal dumping

24. Fibre analysis

At least 10 experiments to be performed.

Reference Books

1. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California,USA, 1988

CEMADSE04T: **GREEN CHEMISTRY**

(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures Marks: 50

Introduction to Green Chemistry:
(04 Lectures) Marks: 06

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry

Principles of Green Chemistry and Designing a Chemical synthesis:
(30 Lectures) Marks: 22

Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following:

- Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products , Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard × exposure; waste or pollution prevention hierarchy.

- Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents.
- Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy.
- Selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups.
- Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.
- Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation.
- Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.

Examples of Green Synthesis/ Reactions and some real world cases:
(16 Lectures) Marks: 12

1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis)
2. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions

in organic solvents Diels-Alder reaction and Decarboxylation reaction

3. Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction
   (Ultrasonic alternative to Iodine)
4 Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments.
5 Designing of Environmentally safe marine antifoulant.
6 Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments.
7 An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.
8 Healthier Fats and oil by Green Chemistry: Enzymatic Inter esterification for production of no Trans-Fats and Oils
9 Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting

Future Trends in Green Chemistry:
(10 Lectures) Marks:10

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal controlled solid state synthesis (C^2S^3); Green chemistry in sustainable development.

Reference Books

1. Anastas, P.T. & Warner, J.K.: *Green Chemistry - Theory and Practical*, Oxford University Press (1998).
2. Matlack, A.S. *Introduction to Green Chemistry*, Marcel Dekker (2001).
3. Cann, M.C. & Connely, M.E. *Real-World cases in Green Chemistry*, American Chemical Society, Washington (2000).
4. Ryan, M.A. & Tinnesand, M. *Introduction to Green Chemistry*, American Chemical Society, Washington (2002).
5. Lancaster, M. *Green Chemistry: An Introductory Text* RSC Publishing, 2nd Edition, 2010.

CEMADSE04P: **GREEN CHEMISTRY LAB**
(60 Lectures/Contact Hours) Marks: 25

1. Safer starting materials

- Preparation and characterization of nanoparticles of gold using tea leaves.

2. Using renewable resources

- Preparation of biodiesel from vegetable/ waste cooking oil.

3.Avoiding waste

Principle of atom economy

- Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.
- Preparation of propene by two methods can be studied

$$\text{Triethylamine ion} + OH^- \rightarrow \text{propene} + \text{trimethylpropene} + \text{water}$$

$$\text{1-propanol} \xrightarrow{H_2SO_4/\Delta} \text{propene} + \text{water}$$

- Other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.

4.Use of enzymes as catalysts

•Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

5.Alternative Green solvents

•Extraction of D-limonene from orange peel using liquid CO2 prepared form dry ice.

Mechanochemical solvent free synthesis of azomethines

6. Alternative sources of energy

- Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).
- Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Reference Books

1. Anastas, P.T & Warner, J.C. *Green Chemistry: Theory and Practice*, Oxford University Press (1998).
2. Kirchoff, M. & Ryan, M.A. *Greener approaches to undergraduate chemistryexperiment*. American Chemical Society, Washington DC (2002).
3. Ryan, M.A. *Introduction to Green Chemistry*, Tinnesand; (Ed), American Chemical Society, Washington DC (2002).
4. Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. *Green Chemistry Experiment:A monograph International Publishing House Pvt Ltd. New Delhi*. Bangalore CISBN978-93-81141-55-7 (2013).

5. Cann, M.C. & Connelly, M. E. *Real world cases in Green Chemistry*, American Chemical Society (2008).

6. Cann, M. C. & Thomas, P. *Real world cases in Green Chemistry*, American Chemical Society (2008).

7. Lancaster, M. *Green Chemistry: An Introductory Text* RSC Publishing, 2nd Edition, 2010.

8. Pavia, D.L., Lampman, G.M., Kriz, G.S. & Engel, R.G. *Introduction to OrganicLaboratory Techniques: A Microscale and Macro Scale Approach*, W.B.Saunders,1995.

CEMADSE05T: **INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE**
(Credits: Theory-06, Practicals-02)

60 Lectures Marks: 50

Silicate Industries:
(16 Lectures) Marks: 12

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses).Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. Hightechnology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

Cements: Classification of cement, ingredients and their role, Manufacture of cement and thesetting process, quick setting cements.

Fertilizers:
(8 Lectures) Marks: 06

Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

Surface Coatings:
(10 Lectures) Marks: 06

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint,

Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

Batteries:
(6 Lectures) Marks: 06

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

Alloys:
(10 Lectures) Marks: 08

Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (Ar and heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

Catalysis:
(6 Lectures) Marks: 06

General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts.

Phase transfer catalysts, application of zeolites as catalysts.

Chemical explosives:
(4 Lectures) Marks: 06

Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

Reference Books

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
4. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.

7. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

CEMADSE05P: **INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE LAB**

(60 Lectures/Contact Hours) Marks: 25

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Electroless metallic coatings on ceramic and plastic material.
5. Determination of composition of dolomite (by complexometric titration).
6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
7. Analysis of Cement.
8. Preparation of pigment (zinc oxide).

Reference Books

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics,*Wiley Publishers, New Delhi.
4. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas
7. Publications, New Delhi.
8. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut (1996).

CEMADSE06T: **POLYMER CHEMISTRY**

(Credits: Theory-06, Practicals-02)

Theory: 60 Lectures Marks: 50

Introduction and history of polymeric materials:

(04 Lectures) Marks: 04

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

Functionality and its importance:
(08 Lectures) Marks: 06

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.

Kinetics of Polymerization:
(08 Lectures) Marks: 06

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Crystallization and crystallinity:
(04 Lectures) Marks: 04

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Nature and structure of polymers:
(04 Lectures) Marks: 04

Structure Property relationships.

Determination of molecular weight of polymers:
(08 Lectures) Marks: 06

(*Mn*,*Mw*, etc) by end group analysis,viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

Glass transition temperature (Tg) and determination of Tg:
(08 Lectures) Marks: 04

Free volume theory, WLFequation, Factors affecting glass transition temperature (Tg).

Polymer Solution:
(08 Lectures) Marks: 06

Criteria for polymer solubility, Solubility parameter, Thermodynamicsof polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

Properties of Polymer:
(10 Lectures) Marks: 10

(Physical, thermal, Flow & Mechanical Properties).

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes,

Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

Reference Books

1.R.B. Seymour & C.E. Carraher: *Polymer Chemistry: An Introduction,* Marcel Dekker, Inc. New York, 1981.

2.3.G. Odian: F.W. Billmeyer: *Principles of PolymerizationTextbook of Polymer Science*, 4th Ed. Wiley, 2004. , 2nd Ed. Wiley Interscience, 1971.

4. P. Ghosh: Polymer Science & Technology, Tata McGraw-Hill Education, 1991.
5. R.W. Lenz: *Organic Chemistry of Synthetic High Polymers.* Interscience Publishers, New York, 1967.

CEMADSE06P: **POLYMER CHEMISTRY LAB**

(60 Lectures/Contact Hours) Marks: 25

1.Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
   a) Purification of monomer
   b) Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bisisobutylonitrile (AIBN)

2. Preparation of nylon 66/6

3. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein

4. Redox polymerization of acrylamide

5. Precipitation polymerization of acrylonitrile

6. Preparation of urea-formaldehyde resin

7. Preparations of novalac resin/ resold resin.

8. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

1. Determination of molecular weight by viscometry:
   (a) Polyacrylamide-aq.$NaNO_2$ solution
   (b) (Poly vinyl proplylidine (PVP) in water
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
4. Testing of mechanical properties of polymers.
5. Determination of hydroxyl number of a polymer using colorimetric method.

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
2. Instrumental Techniques
3. IR studies of polymers
4. DSC analysis of polymers
5. Preparation of polyacrylamide and its electrophoresis

*at least 7 experiments to be carried out.

Reference Books

1. M.P. Stevens, *Polymer Chemistry: An Introduction*, 3rd Ed., Oxford University Press, 1999.
2. H.R. Allcock, F.W. Lampe & J.E. Mark, *Contemporary Polymer Chemistry*, 3rd ed. Prentice-Hall (2003)
3. F.W. Billmeyer, *Textbook of Polymer Science*, 3rd ed. Wiley-Interscience (1984)
4. J.R. Fried, *Polymer Science and Technology*, 2nd ed. Prentice-Hall (2003)
5. P. Munk & T.M. Aminabhavi, *Introduction to Macromolecular Science*, 2nd ed. John Wiley & Sons (2002)
6. L. H. Sperling, *Introduction to Physical Polymer Science*, 4th ed. John Wiley & Sons (2005)
7. M.P. Stevens, *Polymer Chemistry: An Introduction* 3rd ed. Oxford University Press (2005).
8. Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

GENERIC ELECTIVE COURSE (HONOURS) IN CHEMISTRY

CHEMISTRY

Core papers Chemistry (Credit: 06 each) :

SEM-I	SEM-II	SEM-III	SEM-IV
CEMHGEC01	**CEMHGEC02**	**CEMHGEC03**	**CEMHGEC04**

SEMESTER-I

CEMHGEC01T: ATOMIC STRUCTURE, CHEMICAL PERIODICITY, ACIDS AND BASES,REDOX REACTIONS, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Section A: Inorganic Chemistry-I

(30 Lectures) Marks: 25

Atomic Structure (10 Lectures)

Bohr's theory for hydrogen atom (simple mathematical treatment), atomic spectra of hydrogen and Bohr's model, Sommerfeld's model, quantum numbers and their significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many-electron atoms, *Aufbau* principle and its limitations.

Chemical Periodicity (05 Lectures)

Classification of elements on the basis of electronic configuration: general characteristics of s-, p-, d- and f-block elements. Positions of hydrogen and noble gases. Atomic and ionic radii, ionization potential, electron affinity, and electronegativity; periodic and group-wise variation of above properties in respect of s- and p- block elements.

Acids and bases (10 Lectures)

Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process.

Redox reactions (05 Lectures)

Balancing of equations by oxidation number and ion-electron method oxidimetry and reductimetry.

Section B: Organic Chemistry-I

(30 Lectures) Marks: 25

Fundamentals of Organic Chemistry (5 Lectures)

Electronic displacements: inductive effect, resonance and hyperconjugation; cleavage of bonds: homolytic and heterolytic; structure of organic molecules on the basis of VBT; nucleophiles electrophiles; reactive intermediates: carbocations, carbanions and free radicals.

Stereochemistry (8 Lectures)

Different types of isomerism; geometrical and optical isomerism; concept of chirality and optical activity (up to two carbon atoms); asymmetric carbon atom; elements of symmetry (plane and centre); interconversion of Fischer and Newman representations; enantiomerism

and diastereomerism, *meso* compounds; *threo* and *erythro*, D and L, *cis* and *trans* nomenclature; CIP Rules: *R/S* (upto 2 chiral carbon atoms) and *E/Z* nomenclature.

Nucleophilic Substitution and Elimination Reactions (5 Lectures)

Nucleophilic substitutions: S_N1 and S_N2 reactions; eliminations: E1 and E2 reactions (elementary mechanistic aspects); Saytzeff and Hofmann eliminations;elimination *vs* substitution.

Aliphatic Hydrocarbons (12 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structures.

Alkanes:(up to 5 Carbons). *Preparation:* catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* mechanism forfree radical substitution: halogenation.

Alkenes:(up to 5 Carbons). *Preparation:* elimination reactions: dehydration of alcohols and dehydrohalogenation of alkyl halides; *cis* alkenes (partial catalytic hydrogenation) and *trans* alkenes (Birch reduction). *Reactions: cis*-addition (alkaline $KMnO_4$) and *trans*-addition (bromine) with mechanism, addition of HX [Markownikoff's (with mechanism) and antiMarkownikoff's addition], hydration, ozonolysis, oxymercuration-demercuration and hydroboration-oxidation reaction.

Alkynes: (up to 5 Carbons). *Preparation:* acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alkaline $KMnO_4$.

Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in InorganicChemistry*, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry:Principles of Structure and Reactivity*, Pearson Education India, 2006.
5. Sethi, A. *Conceptual Organic Chemistry;* New Age International Publisher.
6. Parmar, V. S. *A Text Book of Organic Chemistry*, S. Chand & Sons.
7. Madan, R. L. *Organic Chemistry*, S. Chand & Sons.
8. Wade, L. G., Singh, M. S., *Organic Chemistry.*
9. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
10. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

11. Eliel, E. L. & Wilen, S. H. *Stereochemistry of Organic Compounds,* Wiley: London, 1994.
12. Sen Gupta, Subrata. *Basic Stereochemistry of Organic molecules.*
13. Kalsi, P. S. *Stereochemistry Conformation and Mechanism*, Eighth edition, New Age International, 2014.
14. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.

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CEMHGEC01P: ATOMIC STRUCTURE, CHEMICAL PERIODICITY, ACIDS AND BASES, REDOX REACTIONS, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS LAB

(60 Lectures/Contact Hours) Marks: 25

Section A: Inorganic Chemistry –LAB ***(30 Lectures)***

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.

2. Estimation of oxalic acid by titrating it with $KMnO_4$.

3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.

5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

Section B: Organic Chemistry- LAB **(30 Lectures)**

Qualitative Analysis of Single Solid Organic Compound(s)
Experiment A: Detection of special elements (N, Cl, and S) in organic compounds.
Experiment B: Solubility and Classification (solvents: H_2O, dil. HCl, dil. NaOH)
Experiment C: Detection of functional groups: Aromatic-NO_2, Aromatic -NH_2, -COOH, carbonyl (no distinction of –CHO and >C=O needed), -OH (phenolic) in solid organic compounds.
Experiments A - C with unknown (at least 6) solid samples containing not more than two of the above type of functional groups should be done.

Reference Books:

1. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.
2. Das, S. C., Chakraborty, S. B., *Practical Chemistry.*
3. Mukherjee, K. S. *Text book on Practical Chemistry*, New Oriental Book Agency.
4. Ghosal, Mahapatra & Nad, *An Advanced course in practical Chemistry,* New Central Book Agency.
5. Vogel, A. I. *Elementary Practical Organic Chemistry*, Part 2: *Qualitative Organic Analysis,* CBS Publishers and Distributors.
6. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
7. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

SEMESTER-II

CEMHGEC02T: STATES OF MATTER & CHEMICAL KINETICS, CHEMICAL BONDING & MOLECULAR STRUCTUR, p-BLOCK ELEMENTS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures **Marks: 50**

Section A: Physical Chemistry-I

(30 Lectures) **Marks: 25**

Kinetic Theory of Gases and Real gases **(10 Lectures)**

Concept of pressure and temperature; Collision of gas molecules; Collision diameter; Collision number and mean free path; Frequency of binary collisions (similar and different molecules); Rate of effusion

Nature of distribution of velocities, Maxwell's distribution of speed and kinetic energy; Average velocity, root mean square velocity and most probable velocity; Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases

Deviation of gases from ideal behavior; compressibility factor; Boyle temperature; Andrew's and Amagat's plots; van der Waals equation and its features; its derivation and application in explaining real gas behaviour; Existence of critical state, Critical constants in terms of van der Waals constants; Law of corresponding states

Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only)

Liquids **(06 Lectures)**

Definition of Surface tension, its dimension and principle of its determination using stalagmometer; Viscosity of a liquid and principle of determination of coefficient of viscosity using Ostwald viscometer; Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)

Solids **(06 Lectures)**

Forms of solids, crystal systems, unit cells, Bravais lattice types, Symmetry elements; Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices; Miller indices of different planes and interplanar distance, Bragg's law; Structures of NaCl, KCl and CsCl (qualitative treatment only); Defects in crystals; Glasses and liquid crystals.

Chemical Kinetics **(08 Lectures)**

Introduction of rate law, Order and molecularity; Extent of reaction; rate constants; Rates of First, second and nth order reactions and their Differential and integrated forms (with derivation); Pseudo first order reactions; Determination of order of a reaction by half-life and differential method; Opposing reactions, consecutive reactions and parallel reactions

Temperature dependence of rate constant; Arrhenius equation, energy of activation; Collision theory; Lindemann theory of unimolecular reaction; outline of Transition State theory (classical treatment)

Reference Books:

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
5. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
6. Chugh, K.L., Agnish, S.L. *A Text Book of Physical Chemistry* Kalyani Publishers7.Bahl, B.S., Bahl, A., Tuli, G.D., *Essentials of Physical Chemistry* S. Chand & Co. ltd.
8. Palit, S. R., *Elementary Physical Chemistry* Book Syndicate Pvt. Ltd.
9. Mandal, A. K. *Degree Physical and General Chemistry* Sarat Book House
10. Pahari, S., *Physical Chemistry* New Central Book Agency
11. Pahari, S., Pahari, D., *Problems in Physical Chemistry* New Central Book Agency

Section B: Inorganic Chemistry-II
(30 Lectures) Marks: 25

Chemical Bonding and Molecular Structure (16 Lectures)

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionicbonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, BornHaber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basisof VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.
MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p*combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods. (including idea of *s- p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches.

Comparative study of p-block elements: (14 Lectures)

Group trends in electronic configuration, modification of pure elements, common oxidation states, inert pair effect, and their important compounds in respect of the following groups of elements:

i)B-Al-Ga-In-Tl
ii)C-Si-Ge-Sn-Pb
iii)N-P-As-Sb-Bi
iv)O-S-Se-Te
v)F-Cl-Br-I

Reference Books:

1. Cotton, F.A. & Wilkinson, G. *Basic Inorganic Chemistry*, Wiley.
2. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
3. Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
4. Rodgers, G.E. *Inorganic & Solid State Chemistry*, Cengage Learning India Ltd., 2008.

CEMHGEC01P: STATES OF MATTER & CHEMICAL KINETICS, CHEMICAL BONDING & MOLECULAR STRUCTUR, p-BLOCK ELEMENTS LAB

(60 Lectures/Contact Hours) Marks: 25

Section A: Physical Chemistry-LAB **(15x2=30 Lectures)**

(Minimum **five** experiments to complete)

(I) Surface tension measurement (use of organic solvents excluded)

a) Determination of the surface tension of a liquid or a dilute solution using a Stalagmometer

b) Study of the variation of surface tension of a detergent solution with concentration

(II) Viscosity measurement (use of organic solvents excluded)

a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer

b) Study of the variation of viscosity of an aqueous solution with concentration of solute

(III) Study the kinetics of the following reactions

a) Initial rate method: Iodide-persulphate reaction

b) Integrated rate method:

(i) Acid hydrolysis of methyl acetate with hydrochloric acid

(ii) Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

Reference Books:

1. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.
2. Palit, S.R., *Practical Physical Chemistry* Science Book Agency
3. Mukherjee, N.G., *Selected Experiments in Physical Chemistry* J. N. Ghose & Sons
4. Dutta, S.K., *Physical Chemistry Experiments* Bharati Book Stall

Section B: Inorganic Chemistry-LAB **(30 Lectures)**

Qualitative semimicro analysis of mixtures containing three radicals. Emphasis should be given to the understanding of the chemistry of different reactions.

Acid Radicals: Cl^-, Br^-, I^-, NO_2^-, NO_3^-,S^{2-}, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, H_3BO_3.
Basic Radicals: Na^+, K^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, Cr^{3+}, Mn^{2+}, Fe^{3+}, Ni^{2+}, Cu^{2+}, NH_4^+.

Reference Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

SEMESTER-III

CEMHGEC03T: **CHEMICAL ENERGETICS, EQUILIBRIA, ORGANIC CHEMISTRY-II**

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures Marks: 50

Section A: Physical Chemistry-II

(30 Lectures) Marks: 25

Chemical Energetics (14 Lectures)

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics; Concept of heat, work, internal energy and statement of first law; enthalpy, H; relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases

Standard states; Heats of reaction; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; Laws of thermochemistry; bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equations and effect of pressure on enthalpy of reactions; Adiabatic flame temperature; explosion temperature

Statement of the second law of thermodynamics; Concept of heat reservoirs and heat engines; Carnot cycle; Physical concept of Entropy; Carnot engine, refrigerator and efficiency; Entropy change of systems and surroundings for various processes and transformations; Auxiliary state functions (G and A) and Criteria for spontaneity and equilibrium.

Chemical Equilibrium: (08 Lectures)

Thermodynamic conditions for equilibrium, degree of advancement; Variation of free energy with degree of advancement; Equilibrium constant and standard Gibbs' free energy change; Definitions of K_P, K_C and K_X and relation among them; van't Hoff's reaction isotherm, isobar and isochore from different standard states; Shifting of equilibrium due to change in external parameters e.g. temperature and pressure; variation of equilibrium constant with addition to inert gas; Le Chatelier's principle

Ionic Equilibria: (08 Lectures)

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water; Ionization of weak acids and bases, pH scale, common ion effect; Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts; Buffer solutions; Solubility and solubility product of sparingly soluble salts – applications of solubility product principle

Reference Books:

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
5. Ekambaram, S. *General Chemistry*, Pearson.
6. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
7. Chugh, K.L., Agnish, S.L. *A Text Book of Physical Chemistry* Kalyani Publishers8.Bahl, B.S., Bahl, A., Tuli, G.D., *Essentials of Physical Chemistry* S. Chand & Co. ltd.
9. Palit, S. R., *Elementary Physical Chemistry* Book Syndicate Pvt. Ltd.
10. Mandal, A. K. *Degree Physical and General Chemistry* Sarat Book House
11. Pahari, S., *Physical Chemistry* New Central Book Agency
12. Pahari, S., Pahari, D., *Problems in Physical Chemistry* New Central Book Agency

Section-B: Organic Chemistry-II
(30 Lectures) Marks: 25

Functional group app roach for the following reactions (preparations & reactions) to be studied in context to their structures.

Aromatic Hydrocarbons 06 Lectures)

Benzene:Preparation: from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. *Reactions*: electrophilic substitution (general mechanism); nitration (with mechanism), halogenations (chlorination and bromination), sulphonation and Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene); side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

Organometallic Compounds (2 Lectures)

Introduction; *Grignard reagents*: *Preparations* (from alkyl and aryl halide); concept of *umpolung;* Reformatsky reaction.

Aryl Halides (3 Lectures)

Preparation: (chloro-, bromo- and iodobenzene): from phenol, Sandmeyer reactions. *Reactions (Chlorobenzene):* nucleophilic aromatic substitution (replacement by –OH group) and effect of nitro substituent (activated nucleophilic substitution).

Alcohols, Phenols and Ethers (11 Lectures)

Alcohols:(up to 5 Carbons). *Preparation:* 1°-, 2°- and 3°- alcohols: using Grignard reagent, reduction of aldehydes, ketones, carboxylic acid and esters; *Reactions:* With sodium, HX (Lucas test), oxidation (alkaline $KMnO_4$, acidic dichromate, concentrated HNO_3);

Oppenauer oxidation;
Diols: Preparation (with OsO_4); pinacol- pinacolone rearrangement (with mechanism) (*with symmetrical diols* only).

Phenols:Preparation: cumene hydroperoxide method, from diazonium salts; acidic nature of phenols; *Reactions:* electrophilic substitution: nitration and halogenations; Reimer -Tiemann reaction, Houben–Hoesch condensation, Schotten –Baumann reaction, Fries rearrangement and Claisen rearrangement.

Ethers:Preparation: Williamson's ether synthesis; *Reaction*: cleavage of ethers with HI.

Carbonyl Compounds (08 Lectures)

Aldehydes and Ketones (aliphatic and aromatic):(Formaldehye, acetaldehyde, acetone and benzaldehyde): *Preparation:* from acid chlorides, from nitriles and from Grignard reagents; general properties of aldehydes and ketones; *Reactions:* with HCN, ROH, $NaHSO_3$, NH_2-G derivatives and with Tollens' and Fehling's reagents; iodoform test; aldol condensation (with mechanism); Cannizzaro reaction (with mechanism), Wittig reaction, benzoin condensation; Clemmensen reduction, Wolff- Kishner reduction and Meerwein-Pondorff-Verley (MPV) reduction.

Reference Books:

1. Sethi, A. *Conceptual Organic Chemistry;* New Age International Publisher.
2. Parmar, V. S. *A Text Book of Organic Chemistry*, S. Chand & Sons.
3. Madan, R. L. *Organic Chemistry*, S. Chand & Sons.
4. Wade, L. G., Singh, M. S., *Organic Chemistry, Pearson.*
5. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
7. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.

CEMHGEC03P: CHEMICAL ENERGETICS, EQUILIBRIA, ORGANIC CHEMISTRY LAB

(60 Lectures/Contact Hours) Marks: 25

Section A: Physical Chemistry-LAB **(15x2=30 Lectures)**

(Minimum **five** experiments to complete)

(I) Thermochemistry (Any **three**)

1. Determination of heat capacity of calorimeter for different volumes
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide
3. Determination of enthalpy of ionization of acetic acid
4. Determination of enthalpy of hydration of copper sulphate

(II) Ionic Equilibria (Any **two**)

a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter and compare it with the indicator method

b) Preparation of buffer solutions and find the pH of an unknown buffer solution by colour matching method (using following buffers)
   (i) Sodium acetate-acetic acid
   (ii) Ammonium chloride-ammonium hydroxide

c)Study of the solubility of benzoic acid in water

Reference Books:

1. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.
2. Palit, S.R., *Practical Physical Chemistry* Science Book Agency
3. Mukherjee, N.G., *Selected Experiments in Physical Chemistry* J. N. Ghose & Sons
4. Dutta, S.K., *Physical Chemistry Experiments* Bharati Book Stall

Section B: Organic Chemistry-LAB

Identification of a pure organic compound

Solid compounds: oxalic acid, tartaric acid, succinic acid, resorcinol, urea, glucose, benzoic acid and salicylic acid.

Liquid Compounds: methyl alcohol, ethyl alcohol, acetone, aniline, dimethylaniline, benzaldehyde, chloroform and nitrobenzene

Reference Books:

1. Bhattacharyya, R. C, *A Manual of Practical Chemistry*.
2. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbookof Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
3. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

SEMESTER-IV

CEMHGEC04T: SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE, ELECTROCHEMISTRY & ANALYTICAL AND ENVIORNMETAL CHEMISTRY-I

(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures Marks: 50

Section A: Physical Chemistry-III
(30 Lectures) Marks: 25

Solutions (06 Lectures)

Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions; Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions; Distillation of solutions; Lever rule; Azeotropes

Critical solution temperature; effect of impurity on partial miscibility of liquids; Immiscibility of liquids- Principle of steam distillation; Nernst distribution law and its applications, solvent extraction

Phase Equilibria (08 Lectures)

Phases, components and degrees of freedom of a system, criteria of phase equilibrium; Gibbs' Phase Rule and its thermodynamic derivation; Derivation of Clausius – Clapeyron equation and its importance in phase equilibria; Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (leadsilver, $FeCl_3$-H_2O and Na-K only)

Conductance (08 Lectures)

Conductance, cell constant, specific conductance and molar conductance; Variation of specific and equivalent conductance with dilution for strong and weak electrolytes; Kohlrausch's law of independent migration of ions; Equivalent and molar conductance at infinite dilution and their determination for strong and weak electrolytes; Ostwald's dilution law; Application of conductance measurement (determination of solubility product and ionic product of water); Conductometric titrations (acid-base)

Transport Number and principles of Hittorf's and Moving-boundary method

Electromotive force (08 Lectures)

Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry; Chemical cells, reversible

and irreversible cells with examples; Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential; Electrochemical series;
Thermodynamics of a reversible cell, calculation of thermodynamic properties: *G*, *H* and *S* from EMF data

Concentration cells with and without transference, liquid junction potential; pH determination using hydrogen electrode and quinhydrone; Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation)

Reference Books:

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
5. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
6. Chugh, K.L., Agnish, S.L. *A Text Book of Physical Chemistry* Kalyani Publishers7.Bahl, B.S., Bahl, A., Tuli, G.D., *Essentials of Physical Chemistry* S. Chand & Co. ltd.
8. Palit, S. R., *Elementary Physical Chemistry* Book Syndicate Pvt. Ltd.
9. Pahari, S., *Physical Chemistry* New Central Book Agency
10. Pahari, S., Pahari, D., *Problems in Physical Chemistry* New Central Book Agency

Section B: Analytical and Environmental Chemistry
(30 Lectures) Marks: 25

Chemical Analysis (15 Lectures)

Gravimetric analysis: solubility product and common ion effect; requirements of gravimetry; gravimetric estimation of chloride, sulphate, lead, barium, nickel, copper and zinc.

Volumetric analysis: primary and secondary standard substances; principles of acid-base, oxidation –reduction and complexometric titrations; indicators: acid-base, redox and metal ion; principles of estimation of mixtures: $NaHCO_3$ and Na_2CO_3 (by acidimetry); iron, copper, manganese and chromium (by redox titration); zinc, aluminum, calcium and magnesium (by complexometric EDTA titration).

Chromatography: chromatographic methods of analysis: column chromatography and thin layer chromatography.

Environmental Chemistry (15 Lectures)

The Atmosphere: composition and structure of the atmosphere; troposphere, stratosphere, mesosphere and thermosphere; ozone layer and its role; major air pollutants: CO, SO_2, NO_x and particulate matters – their origin and harmful effects; problem of ozone layer depletion; green house effect; acid rain and photochemical smog; air pollution episodes: air quality

standard; air pollution control measures: cyclone collector, electrostatic precipitator, catalytic converter.

The Hydrosphere: environmental role of water, natural water sources, water treatment for industrial, domestic and laboratory uses; water pollutants; action of soaps and detergents, phosphates, industrial effluents, agricultural runoff, domestic wastes; thermal pollution, radioactive pollution and their effects on animal and plant life; water pollution episodes: water pollution control measures : waste water treatment; chemical treatment and microbial treatment; water quality standards: DO, BOD, COD, TDS and hardness parameters; desalination of sea water : reverse osmosis, electrodialysis.

The Lithosphere: water and air in soil, waste matters and pollutants in soil, waste classification, treatment and disposal; soil pollution and control measures.

Reference Books:

1. Banerjee, S. P. *A Text Book of Analytical Chemistry*, The New Book Stall.
2. Gangopadhyay, P. K. *Application Oriented Chemistry*, Book Syndicate.
3. Mondal, A. K & Mondal, S. *Degree Applied Chemistry*, Sreedhar Publications.
4. Banerjee, S. P. *A Text Book of Analytical Chemistry*, The New Book Stall.

CEMHGEC04P: SOLUTIONS, PHASE EQUILIBRIA, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL ORGANIC CHEMISTRY-II LAB

(60 Lectures/Contact Hours) Marks: 25

Section A: Physical Chemistry-LAB **(15x2=30 Lectures)**

(Minimum **six** experiments to complete)

(I) Distribution Law (Any **one**)

Study of the equilibrium of **one of the following reactions** by the distribution method:

$$I_2(aq) + I^-(aq) = I_3^-(aq)$$

$$Cu^{2+}(aq) + xNH_2(aq) = [Cu(NH_3)_x]^{2+}$$

(II) Phase equilibria (Any **one**)

a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves

b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it

(III) Conductance

a) Determination of dissociation constant of a weak acid (cell constant, equivalent conductance are also determined)

b) Perform the following conductometric titrations: (Any **one**)
   (i) Strong acid vs. strong base
   (ii) Weak acid vs. strong base

(IV) Potentiometry

Perform the following potentiometric titrations:
   (i) Weak acid vs. strong base
   (ii) Potassium dichromate vs. Mohr's salt

Reference Books:

1. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N., University of Calcutta, 2003.
2. Palit, S.R., *Practical Physical Chemistry* Science Book Agency
3. Mukherjee, N.G., *Selected Experiments in Physical Chemistry* J. N. Ghose & Sons

4. Dutta, S.K., *Physical Chemistry Experiments* Bharati Book Stall

Section B: Analytic and Environmental Chemistry-LAB (30 Lectures)

1. To find the total hardness of water by EDTA titration.
2. To find the PH of an unknown solution by comparing color of a series of HCl solutions + 1 drop of methyl orange, and a similar series of NaOH solutions + 1 drop of phenolphthalein.
3. To determine the rate constant for the acid catalysed hydrolysis of an ester.
4. Determination of the strength of the H_2O_2 sample.
5. To determine the solubility of a sparingly soluble salt, e.g. KHTa (one bottle)

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
2. Ghosal, Mahapatra & Nad, *An Advanced Course in Practical Chemistry*, New Central Book Agency.
3. *University Hand Book of Undergraduate Chemistry Experiments*, edited by Mukherjee, G. N. University of Calcutta, 2003.
4. Das, S. C., Chakraborty, S. B., *Practical Chemistry.*

SKILL ENHANCEMENT COURSE (HONOURS) IN CHEMISTRY

CEMSSEC001– BASIC ANALYTICAL CHEMISTRY
(Credits: 2 Lectures: 30) Marks: 25

Introduction

Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements.
Presentation of experimental data and results, from the point of view of significant figures.

Analysis of soil

Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators 1. Determination of pH of soil samples.
2. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water

Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.
1. Determination of pH, acidity and alkalinity of a water sample.
2. Determination of dissolved oxygen (DO) of a water sample.

Analysis of food products

Nutritional value of foods, idea about food processing and food preservations and adulteration.
1. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.
2. Analysis of preservatives and colouring matter.

Chromatography

Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.
1. Paper chromatographic separation of mixture of metal ion (Fe3+ and Al3+).
2. To compare paint samples by TLC method.

Ion-exchange

Column, ion-exchange chromatography etc.
Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

Analysis of cosmetics

Major and minor constituents and their function
1. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.
2. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration

Suggested Applications (Any one)

1. To study the use of phenolphthalein in trap cases.
2. To analyse arson accelerants.
3. To carry out analysis of gasoline.

Suggested Instrumental demonstrations

1. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
2. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
3. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drinks

Reference Books

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
2. Skoog, D.A., Holler, F.J. & Crouch, S. Principles of Instrumental Analysis, Cengage Learning India Edition, 2007.
3. Skoog, D.A.; West, D.M. & Holler, F.J. Analytical Chemistry: An Introduction 6th
4. Ed., Saunders College Publishing, Fort Worth, Philadelphia (1994).
5. Harris, D. C. Quantitative Chemical Analysis, 9th ed. Macmillan Education, 2016.
6. Dean, J. A. Analytical Chemistry Handbook, McGraw Hill, 2004.
7. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India, 1992.
8. Freifelder, D.M. Physical Biochemistry 2nd Ed., W.H. Freeman & Co., N.Y. USA (1982).
9. Cooper, T.G. The Tools of Biochemistry, John Wiley & Sons, N.Y. USA. 16 (1977).
10. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall, 1996.
11. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.
12. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).
13. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

CEMSSEC002–ANALYTICAL CLINICAL BIOCHEMISTRY
(Credits: 2 Lectures:30) Marks: 25

Review of Concepts from Core Course

Carbohydrates: Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle.
Isolation and characterization of polysachharides.
Proteins: Classification, biological importance; Primary and secondary and tertiary structures of proteins: α-helix and β- pleated sheets, Isolation, characterization, denaturation of proteins. *Enzymes:* Nomenclature, Characteristics (mention of Ribozymes), and Classification; Active site, Mechanism of enzyme action, Stereospecificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Biocatalysis: Importance in "Green Chemistry" and Chemical Industry.
Lipids: Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications.
Lipoproteins: Properties, functions and biochemical functions of steroid hormones. Biochemistry of peptide hormones.
Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, Introduction to Gene therapy.
Enzymes: Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition.

Biochemistry of disease: A diagnostic approach by blood/ urine analysis.

Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.
Urine: Collection and preservation of samples. Formation of urine. Composition and estimation of constituents of normal and pathological urine.

Hands On Practical

Identification and estimation of the following:
1. Carbohydrates – qualitative and quantitative.
2. Lipids – qualitative.
3. Determination of the iodine number of oil.
4. Determination of the saponification number of oil.
5. Determination of cholesterol using Liebermann- Burchard reaction.
6. Proteins – qualitative.
7. Isolation of protein.
8. Determination of protein by the Biuret reaction.
9. Determination of nucleic acids

Reference Books

1. Cooper, T.G. Tool of Biochemistry. Wiley-Blackwell (1977).
2. Wilson, K. & Walker, J. Practical Biochemistry. Cambridge University Press (2009).
3. Varley, H., Gowenlock, A.H & Bell, M.: Practical Clinical Biochemistry, Heinemann, London (1980).
4. Devlin, T.M., Textbook of Biochemistry with Clinical Correlations, John Wiley & Sons, 2010.
5. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.
6. Talwar, G.P. & Srivastava, M. Textbook of Biochemistry and Human Biology, 3rd Ed. PHI Learning.
7. Nelson, D.L. & Cox, M.M. Lehninger Principles of Biochemistry, W.H. Freeman, 2013.
8. O. Mikes, R.A. Chalmers: Laboratory Handbook of Chromatographic Methods, D. Van Nostrand & Co., 1961.

CHOICE BASED CREDIT SYSTEM

B.Sc. HONOURS With Computer Application

Semester			credit
I	CORE	CMAACOR01T: Programming Fundamental using C CMAACOR01P: Programming Fundamental using C CMAACOR02T: Computer Fundamental	4 2 5+1
	GE1	Physics / Math / Electronics / Chemistry / Microbiology / Food & Nutrition Economics / Geography / English / Journalism & Mass-communication / Commerce	/6
	AECC	Environmental Science	2
II	CORE	CMAACOR03T: Data Structure CMAACOR03P: Data Structure CMAACOR04T: Computer System Architecture	4 2 5 + 1
	GE2	Physics / Math / Electronics / Chemistry / Microbiology / Food & Nutrition Economics / Geography / English / Journalism & Mass-communication / Commerce	/6
	AECC	English	2
III	CORE	CMAACOR05T: Database Management Systems CMAACOR05P: Database Management Systems CMAACOR06T: Operating System CMAACOR06P: Operating System CMAACOR07T: Discrete Structure	4 2 4 2 5 +1
	GE3	Physics / Math / Electronics / Chemistry / Microbiology / Food & Nutrition Economics / Geography / English / Journalism & Mass-communication / Commerce	/6
	SEC1	CMSSSEC001:Programming in Python	2
IV	CORE	CMAACOR08T: Multimedia Systems and Internet Technologies CMAACOR08P: Multimedia Systems and Internet Technologies CMAACOR09T: OOP's using JAVA CMAACOR09P: OOP's using JAVA CMAACOR10T: Software Engineering	4 2 4 2 5+1
	GE4	Physics / Math / Electronics / Chemistry / Microbiology / Food & Nutrition Economics / Geography / English / Journalism & Mass-communication / Commerce	/6
	SEC2	CMSSSEC002:R Programming	2
V	CORE	CMAACOR11T: Artificial Intelligence CMAACOR11P: Artificial Intelligence CMAACOR12T: Computer Networks	4 2 5+1
	DSE (Any two)	CMAADSE01T: Introduction to Data Science CMAADSE01P: Introduction to Data Science CMAADSE02T: Visual Programming CMAADSE02P: Visual Programming CMAADSE03T: Data Mining CMAADSE03P: Data Mining	4 2 4 2 4 2
VI	CORE	CMAACOR13T: Design & Analysis of Algorithm CMAACOR13P: Design & Analysis of Algorithm CMAACOR14T: Theory of Computation	4 2 5+1
	DSE (Any two)	CMAADSE04T: Information Security and Cyber Laws CMAADSE05T: Cloud Computing CMAADSE05P: Cloud Computing CMAADSE06P: Project	5+1 4 2 6
Total number of courses		26	140

CORE COURSES BCA (HONOURS)

CMAACOR01T: Programming Fundamentals using C **Theory: 60 Lectures**

1. Introduction to C **(5 Lectures)**
History of C , Overview of Procedural Programming Using main() function, Compiling and Executing Simple Programs in C.

2. Data Types, Variables, Constants, Operators and Basic I/O **(8 Lectures)**
Declaring, Defining and Initializing Variables, Scope of Variables, Using Named Constants, Keywords, Data Types, Casting of Data Types, Operators (Arithmetic, Logical and Bitwise), Using Comments in programs, Character I/O (getc, getchar, putc, putcharetc), Formatted and Console I/O (printf(), scanf(), cin, cout), Using Basic Header Files (stdio.h, conio.h etc).

3. Expressions, Conditional Statements and Iterative Statements **(8 Lectures)**
Simple Expressions in C (including Unary Operator Expressions, Binary Operator Expressions), Understanding Operators Precedence in Expressions, Conditional Statements (if construct, switch-case construct), Understanding syntax and utility of Iterative Statements (while, do-while, and for loops), Use of break and continue in Loops, Using Nested Statements (Conditional as well as Iterative)

4. Functions and Arrays **(15 Lectures)**
Utility of functions, Call by Value, Call by Reference, Functions returning value, Void functions, Inline Functions, Return data type of functions, Functions parameters, Differentiating between Declaration and Definition of Functions, Command Line Arguments/Parameters in Functions, Functions with variable number of Arguments. Creating and Using One Dimensional Arrays (Declaring and Defining an Array, Initializing an Array, Accessing individual elements in an Array, Manipulating array elements using loops), Use Various types of arrays (integer, float and character arrays / Strings) Two-dimensional Arrays (Declaring, Defining and Initializing Two Dimensional Array, Working with Rows and Columns), Introduction to Multi-dimensional arrays

5. Derived Data Types (Structures and Unions) **(3 Lectures)**
Understanding utility of structures and unions, Declaring, initializing and using simple structures and unions, Manipulating individual members of structures and unions, Array of Structures, Individual data members as structures, Passing and returning structures from functions, Structure with union as members, Union with structures as members.

6. Pointers in C **(10 Lectures)**
Understanding a Pointer Variable, Simple use of Pointers (Declaring and Dereferencing Pointers to simple variables), Pointers to Pointers, Pointers to structures, Problems with Pointers, Passing pointers as function arguments, Returning a pointer from a function, using arrays as pointers, Passing arrays to functions. Pointers vs. References, Declaring and initializing references, Using references as function arguments and function return values

7. Memory Allocation in C **(6 Lectures)**
Differentiating between static and dynamic memory allocation, use of malloc, calloc and free functions, use of new and delete operators, storage of variables in static and dynamic memory allocation

8. File I/O, Preprocessor Directives **(5 Lectures)**
Opening and closing a file (use of fstream header file, ifstream, ofstream and fstream classes), Reading and writing Text Files, Using put(), get(), read() and write() functions, Random access in files, Understanding the Preprocessor Directives (#include, #define, #error, #if, #else, #elif, #endif, #ifdef, #ifndef and #undef), Macros

Recommended Books:

1. Programming in ANSI C (TMH) Balaguruswamy
2. The C Programmi9ng languages (prentice Hall) Riche
3. Programming with C (TMH) Gottfried

CMAACOR01P: Programming Fundamentals using C Practical: **60 Lectures**

1. WAP to print the sum and product of digits of an integer.
2. WAP to reverse a number.

3. WAP to compute the sum of the first n terms of the following series S = 1+1/2+1/3+1/4+……
4. WAP to compute the sum of the first n terms of the following series S =1-2+3-4+5…….
5. Write a function that checks whether a given string is Palindrome or not. Use this function to find whether the string entered by user is Palindrome or not.
6. Write a function to find whether a given no. is prime or not. Use the same to generate the prime numbers less than 100.
7. WAP to compute the factors of a given number.
8. Write a macro that swaps two numbers. WAP to use it.
9. WAP to print a triangle of stars as follows (take number of lines from user):

```
*
***
*****
*******
*********
```

10. WAP to perform following actions on an array entered by the user:
i. Print the even-valued elements
ii. Print the odd-valued elements
iii. Calculate and print the sum and average of the elements of array
iv. Print the maximum and minimum element of array
v. Remove the duplicates from the array
vi. Print the array in reverse order
The program should present a menu to the user and ask for one of the options. The menu should also include options to re-enter array and to quit the program.
11. WAP that prints a table indicating the number of occurrences of each alphabet in the text entered as command line arguments.
12. Write a program that swaps two numbers using pointers.
13. Write a program in which a function is passed address of two variables and then alter its contents.
14. Write a program which takes the radius of a circle as input from the user, passes it to another function that computes the area and the circumference of the circle and displays the value of area and circumference from the main() function.
15. Write a program to find sum of n elements entered by the user. To write this program, allocate memory dynamically using malloc() / calloc() functions or new operator.
16. Write a menu driven program to perform following operations on strings:
a) Show address of each character in string
b) Concatenate two strings without using strcat function.
c) Concatenate two strings using strcat function.
d) Compare two strings
e) Calculate length of the string (use pointers)
f) Convert all lowercase characters to uppercase
g) Convert all uppercase characters to lowercase
h) Calculate number of vowels
i) Reverse the string
17. Given two ordered arrays of integers, write a program to merge the two-arrays to get an ordered array.
18. WAP to display Fibonacci series (i)using recursion, (ii) using iteration
19. WAP to calculate Factorial of a number (i)using recursion, (ii) using iteration
20. WAP to calculate GCD of two numbers (i) with recursion (ii) without recursion.
21. Create Matrix class using templates. Write a menu-driven program to perform following Matrix operations (2-D array implementation):
a) Sum b) Difference c) Product d) Transpose
22. Create a structure Student containing fields for Roll No., Name, Class, Year and Total Marks. Create 10 students and store them in a file.
23. Write a program to retrieve the student information from file created in previous question and print it in following format:
Roll No. Name Marks
24. Open the file in question 12 and append 5 more records into the file. Print all records.
25. Write a menu to
    i) Create a sequential file
    ii) Print records
    iii) Add records
26. Copy the contents of one text file to another file, after removing all whitespaces.

27. Write a function that reverses the elements of an array in place. The function must accept only one pointer value and return void.
28. Write a program that will read 10 integers from user and store them in an array. Implement array using pointers. The program will print the array elements in ascending and descending order.

CMAACOR02T: Computer Fundamentals and Digital Principles **Theory: 75 Lectures**

1.Introduction: **(6 Lectures)**
Functional units of a Computer Systems,Different Types of computers, Software and Hardware,Types of software:System s/w and Application s/w,Operating System as user interfaces,Basic functions of OS,different types of OS

2.Data Representation: **(8 Lectures)**
Base or radix, Number systems(Decimal,Binary,Octal and Hexadecimal) ,Conversion from one number system to another, binary arithmetic(addition and subtraction),Integer representation(Signed magnitude,1's complement,2's complement),Character representation and Floating Point representation,

3.Boolean Algebra and Digital Logic: **(14 Lectures)**
Logic Gates:AND,OR & NOT(basic logic gates),NAND & NOR(universal logic gates),XOR,XNOR(graphical symbol,truth table and Boolean expression of all logic gates),Basic laws of Boolean Algebra,De Morgan's theorems,Cannonical expressions,min terms and max terms, SOP and POS expressions and their conversion, Simplifications of expressions by both boolean algebra and K-MAP method(upto 4 variables),Don't-care conditions,Representation of simplified boolean expressions by NAND/NOR gates

4.Combinational and Sequential Logic: **(14 Lectures)**
Sequential logic circuits:Adder(half adder and full adder), Subtractor (half subtractor and full subtractor), Encoder,Decoder, Multiplexer & Demultiplexer Combinational logic circuits:Flip-flops:latch,clocked,Types of flip-flops(RS,JK,D,T):characteristic tables, Excitation table and logic diagram,Registers,shift registers,registers with parallel loads, Counters,Types of counters:synchronous and asynchronous(diagram and explanation of how it counts)

5.Devices: **(6 Lectures)**
Input and output devices (with connections and practical demo),
keyboard, mouse, joystick, scanner, OCR, OMR, bar code reader, web camera,
monitor, printer, plotter

6.Memory: **(6 Lectures)**
Primary, secondary, auxiliary memory, RAM, ROM, cache memory, hard disks, optical disks

7.Computer Organisation and Architecture: **(10 Lectures)**
C.P.U., registers, system bus, , Inside a computer, SMPS, Motherboard, Ports and Interfaces, expansion cards, ribbon cables, memory chips.

8.Overview of Emerging Technologies: **(8 Lectures)**
Bluetooth, cloud computing, big data, data mining, mobile computing and embedded systems.

9.Use of Computers in Education and Research: **(3 Lectures)**
Data analysis, Heterogeneous storage, e-Library, Google Scholar, Domain specific packages such as SPSS, Mathematica etc.

Reference Books:
1. A. Goel, Computer Fundamentals, Pearson Education, 2010.
2. P. Aksoy, L. DeNardis, Introduction to Information Technology, Cengage Learning, 2006
3. P. K.Sinha, P. Sinha, Fundamentals of Computers, BPB Publishers, 2007
4.Peter Nortons-Introduction to Computers,Sixth edition,TMG
5.Morris Mano-Digital Logic and Computer Design,Fourth Edition,Pearson

CMAACOR03T: Data Structures **Theory: 60 Lectures**

1.**Introduction:** **(6 Lectures)**

Data Object, Abstract Data Type (ADT) Data structure, Defination, Types and properties, Data types.

2. **Arrays** **(5 Lectures)**

Single and Multi-dimensional Arrays, Sparse Matrices (Array and Linked Representation)

3.**Stacks** **(5 Lectures)**

Implementing single / multiple stack/s in an Array; Prefix, Infix and Postfix expressions, Utility and conversion of these expressions from one to another; Applications of stack; Limitations of Array representation of stack

4.**Linked Lists** **(8 Lectures)**

Singly, Doubly and Circular Lists (Array and Linked representation); Normal and Circular representation of Stack in Lists; Self Organizing Lists; Skip Lists

5.**Queues** **(5 Lectures)**

Array and Linked representation of Queue, Circular queue, De-queue, Priority Queues

6. **Recursion** **(5 lectures)**

Developing Recursive Definition of Simple Problems and their implementation; Advantages and Limitations of Recursion; Understanding what goes behind Recursion (Internal Stack Implementation)

7.**Trees** **(20 Lectures)**

Introduction to Tree as a data structure; Binary Trees Properties, BST(Insertion, Deletion, Recursive and Iterative Traversals on Binary Search Trees); Threaded Binary Trees (Concept only); Height-Balanced Trees (Various operations on AVL Trees).

8.**Searching and Sorting** **(5 Lectures)**

Linear Search, Binary Search, Comparison of Linear and Binary Search, Selection Sort, Insertion Sort, bubble Sort, Comparison of Sorting Techniques

9.**Hashing** **(5 Lectures)**

Introduction to Hashing, Resolving collusion by Open Addressing, Coalesced Hashing, Separate Chaining, Choosing a Hash Function, Perfect Hashing Function

Recommended Books:

1. Adam Drozdek, "Data Structures and algorithm in C", Third Edition, Cengage Learning, 2012.
2. SartajSahni, Data Structures, "Algorithms and applications in C", Second Edition, Universities Press, 2011.
3. Aaron M. Tenenbaum, Moshe J. Augenstein, YedidyahLangsam, "Data Structures Using C and C:, Second edition, PHI, 2009.
4. Robert L. Kruse, "Data Structures and Program Design in C", Pearson,1999.
5. D.S Malik, Data Structure using C,Second edition, Cengage Learning, 2010.
6. Mark Allen Weiss, "Data Structures and Algorithms Analysis in Java", Pearson Education, 3rd edition, 2011
7. Aaron M. Tenenbaum, Moshe J. Augenstein, YedidyahLangsam, "Data Structures Using Java, 2003.
8. Robert Lafore, "Data Structures and Algorithms in Java, 2/E", Pearson/ Macmillan Computer Pub,2003
9. John Hubbard, "Data Structures with JAVA", McGraw Hill Education (India) Private Limited; 2 edition, 2009
10. Goodrich, M. and Tamassia, R. "Data Structures and Algorithms Analysis in Java", 4th Edition, Wiley,2013
11. Herbert Schildt, "Java The Complete Reference (English) 9th Edition Paperback", Tata McGraw Hill, 2014.
12. 12. D. S. Malik, P.S. Nair, "Data Structures Using Java", Course Technology, 2003.

CMAACOR03P: Data Structures Lab **Practical: 60 Lectures**

1. Write a program to search an element from a list. Give user the option to perform Linear or Binary search. Use Template functions.
2. WAP using templates to sort a list of elements. Give user the option to perform sorting using Insertion sort, Bubble sort or Selection sort.
3. Implement Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list

and concatenate two linked lists (include a function and also overload operator +).
4. Implement Doubly Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
5. Implement Circular Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
6. Perform Stack operations using Linked List implementation.
7. Perform Stack operations using Array implementation. Use Templates.
8. Perform Queues operations using Circular Array implementation. Use Templates.
9. Create and perform different operations on Double-ended Queues using Linked List implementation.
10. WAP to scan a polynomial using linked list and add two polynomial.
11. WAP to calculate factorial and to compute the factors of a given no. (i)using recursion,
(ii) using iteration
12. (ii) WAP to display Fibonacci series (i)using recursion, (ii) using iteration
13. WAP to calculate GCD of 2 number (i) with recursion (ii) without recursion
14. WAP to create a Binary Search Tree and include following operations in tree:
i. Insertion (Recursive and Iterative Implementation)
ii. Deletion by copying
iii. Deletion by Merging
iv. Search a no. in BST
v. Display its preorder, postorder and inorder traversals Recursively
vi. Display its preorder, postorder and inorder traversals Iteratively
vii. Display its level-by-level traversals
viii. Count the non-leaf nodes and leaf nodes
ix. Display height of tree
x. Create a mirror image of tree
xi. Check whether two BSTs are equal or not
15. WAP to convert the Sparse Matrix into non-zero form and vice-versa.
16. WAP to reverse the order of the elements in the stack using additional stack.
17. WAP to reverse the order of the elements in the stack using additional Queue.
18. WAP to implement Diagonal Matrix using one-dimensional array.
19. WAP to implement Lower Triangular Matrix using one-dimensional array.
20. WAP to implement Upper Triangular Matrix using one-dimensional array.
21. WAP to implement Symmetric Matrix using one-dimensional array.
22. WAP to create a Threaded Binary Tree as per inorder traversal, and implement operations like finding the successor / predecessor of an element, insert an element, inorder traversal.
23. WAP to implement various operations on AVL Tree.

CMAACOR04T: Computer System Architecture **Theory: 75Lectures**

1. Introduction **(5 Lectures)**
Combinational logic circuit and sequential logic circuit (basic concepts with example)

2. Data Representation and Basic Computer Arithmetic **(13 Lectures)**
Number systems, complements, fixed and floating point representation, character representation, addition, subtraction, magnitude comparison, multiplication and division algorithms for integers

3. Basic Computer Organization and Design **(15 Lectures)**
Registers, bus system, instruction set, timing and control, instruction cycle, memory reference, input -output and interrupt, Interconnection Structures, Bus Interconnection design of basic computer.

4. Central Processing Unit **(20 Lectures)**
Register organization, arithmetic and logical micro-operations, stack organization, micro programmed control. Instruction formats, addressing modes, instruction codes, machine language, assembly language, input output programming, RISC, CISC architectures, pipelining and parallel architecture.

5. Memory Organization **(12Lectures)**
Main Memory, Auxiliary Memory, Associative memory, Cache memory,mapping.

6. Input-Output Organization **(10 Lectures)**

Input / Output: External Devices, I/O Modules, Programmed I/O, Interrupt-Driven I/O, Direct Memory Access, I/O Channels, I/OP

Recommended Books:

1. M. Mano, Computer System Architecture, Pearson Education, 1992
2. A. J. Dos Reis, Assembly Language and Computer Architecture using C and JAVA, Course Technology, 2004
3. W. Stallings, Computer Organization and Architecture Designing for Performance, 8 Edition, Prentice Hall of India, 2009
4. Carl Hamacher, Computer Organization, Fifth edition, McGrawHill, 2012.

CMAACOR05T: Database Management Systems **Theory: 60 Lectures**

1. Introduction **(6 Lectures)**

Characteristics of database approach, data models, database system architecture and data independence.

2. Entity Relationship(ER) Modeling **(8 Lectures)**

Entity types, relationships, constraints.

3. Relation Data Model **(20 Lectures)**

Relational model concepts, relational constraints, relational algebra, SQLqueries

4. Database Design **(15 Lectures)**

Mapping ER/EER model to relational database, functional dependencies,Lossless decomposition, Normal forms (upto BCNF).

5. Transaction Processing **(3 Lectures)**

ACID properties, concurrency control with locks

6. File Structure and Indexing with application **(8 Lectures)**

Operations on files, File of Unordered and ordered records, overview of File organizations, Indexing structures for files(Primary index, secondary index, clustering index), Multilevel indexing using B and B+ trees.

Recommended Books:

1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems 6th Edition, Pearson Education, 2010.
2. R. Ramakrishanan, J. Gehrke, Database Management Systems 3rd Edition, McGraw-Hill, 2002.
3. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6th Edition, McGraw Hill, 2010.
4. R. Elmasri, S.B. Navathe Database Systems Models, Languages, Design and application Programming, 6th Edition, Pearson Education, 2013.

CMAACOR05P: Database Management Systems Lab **Practical: 60 Lectures**

Create and use the following database schema to answer the given queries.

EMPLOYEE Schema

Field	Type	NULL	KEY	DEFAULT
Eno	Char(3)	NO	PRI	NIL
Ename	Varchar(50)	NO		NIL
Job_type	Varchar(50)	NO		NIL
Manager	Char(3)	Yes	FK	NIL
Hire_date	Date	NO		NIL
Dno	Integer	YES	FK	NIL
Commission	Decimal(10,2)	YES		NIL

Salary	Decimal(7,2)	NO	NIL

DEPARTMENT Schema

Field	Type	NULL KEY	DEFAULT
Dno	Integer	No PRI	NULL
Dname	Varchar(50)	Yes	NULL
Location	Varchar(50)	Yes	New Delhi

Query List

1. Query to display Employee Name, Job, Hire Date, Employee Number; for each employee with the Employee Number appearing first.
2. Query to display unique Jobs from the Employee Table.
3. Query to display the Employee Name concatenated by a Job separated by a comma. Multimedia Systems and Internet Technologies
4. Query to display all the data from the Employee Table. Separate each Column by a comma and name the said column as THE_OUTPUT.
5. Query to display the Employee Name and Salary of all the employees earning more than $2850.
6. Query to display Employee Name and Department Number for the Employee No= 7900.
7. Query to display Employee Name and Salary for all employees whose salary is not in the range of $1500 and $2850.
8. Query to display Employee Name and Department No. of all the employees in Dept 10 and Dept 30 in the alphabetical order by name.
9. Query to display Name and Hire Date of every Employee who was hired in 1981.
10. Query to display Name and Job of all employees who don‘t have a current Manager.
11. Query to display the Name, Salary and Commission for all the employees who earn commission.
12. Sort the data in descending order of Salary and Commission.
13. Query to display Name of all the employees where the third letter of their name is _A‘.
14. Query to display Name of all employees either have two _R‘s or have two _A‘s in their name and are either in Dept No = 30 or their Manger‘s Employee No = 7788.
15. Query to display Name, Salary and Commission for all employees whose Commission Amount is 14 greater than their Salary increased by 5%.
16. Query to display the Current Date.
17. Query to display Name, Hire Date and Salary Review Date which is the 1st Monday after six months of employment.
18. Query to display Name and calculate the number of months between today and the date each employee was hired.
19. Query to display the following for each employee <E-Name> earns < Salary> monthly but wants < 3 * Current Salary >. Label the Column as Dream Salary.
20. Query to display Name with the 1st letter capitalized and all other letter lower case and length of their name of all the employees whose name starts with _J‘, ‘A‘ and _M‘.
21. Query to display Name, Hire Date and Day of the week on which the employee started.
22. Query to display Name, Department Name and Department No for all the employees.
23. Query to display Unique Listing of all Jobs that are in Department # 30.
24. Query to display Name, Dept Name of all employees who have an _A‘ in their name.
25. Query to display Name, Job, Department No. And Department Name for all the employees working at the Dallas location.
26. Query to display Name and Employee no. Along with their Manger‘s Name and the Manager‘s employee no; along with the Employees‘ Name who do not have a Manager.
27. Query to display Name, Dept No. And Salary of any employee whose department No. and salary matches both the department no. And the salary of any employee who earns a commission.
28. Query to display Name and Salaries represented by asterisks, where each asterisk (*) signifies $100.
29. Query to display the Highest, Lowest, Sum and Average Salaries of all the employees
30. Query to display the number of employees performing the same Job type functions.
31. Query to display the no. of managers without listing their names.
32. Query to display the Department Name, Location Name, No. of Employees and the average salary for all employees in that department.
33. Query to display Name and Hire Date for all employees in the same dept. as Blake.
34. Query to display the Employee No. And Name for all employees who earn more than the average salary.

35. Query to display Employee Number and Name for all employees who work in a department with any employee whose name contains a _T‘.
36. Query to display the names and salaries of all employees who report to King.
37. Query to display the department no, name and job for all employees in the Sales department.
38. Basics of Pl/SQL and there use in query management.

CMAACOR06T: Operating Systems **Theory: 60 Lectures**

1. Introduction **(10 Lectures)**
Basic OS functions, resource abstraction, types of operating systems–multiprogramming systems, batch systems , time sharing systems; operating systems for personal computers & workstations, process control & real time systems.

2. Operating System Organization **(6 Lectures)**
Processor and user modes, kernels, system calls and systemprograms.

3. Process Management **(20Lectures)**
System view of the process and resources, process abstraction, processhierarchy, threads, threading issues, thread libraries; Process Scheduling, non-pre-emptive and pre-emptive scheduling algorithms; concurrent and processes, critical section, semaphores, methods for inter-process communication; deadlocks.

4.Memory Management **(8 Lectures)**
Physical and virtual address space; memory allocation strategies -fixedand variable partitions, paging, segmentation, virtual memory

5.File and I/O Management **(8 Lectures)**
Directory structure, file operations, file allocation methods, device management.

6. Application of Protection and Security **(4 Lectures)**
Policy mechanism, Authentication, Internal access Authorization.

7: Case Study of OS : Unix/Linux **(4 Lectures)**

Recommended Books:

1. Silberschatz, P.B. Galvin, G. Gagne, Operating Systems Concepts, 8th Edition, John Wiley Publications 2008.
2. A.S. Tanenbaum, Modern Operating Systems, 3rd Edition, Pearson Education 2007.
3. G. Nutt, Operating Systems: A Modern Perspective, 2nd Edition Pearson Education 1997.
4. W. Stallings, Operating Systems, Internals & Design Principles, 5th Edition, Prentice Hall of India. 2008.
5. M. Milenkovic, Operating Systems- Concepts and design, Tata McGraw Hill 1992.

CMAACOR06P: Operating Systems Lab **Practical: 60 Lectures**

Unix/Linux Commands & Shell Scripts

Solution of standard problem using shell script

1. WRITE A PROGRAM (using fork() and/or exec() commands) where parent and child execute:
a. same program, same code.
b. same program, different code.
c. before terminating, the parent waits for the child to finish its task.
2. WRITE A PROGRAM to report behaviour of Linux kernel including kernel version, CPU type and model. (CPU information)
3. WRITE A PROGRAM to report behaviour of Linux kernel including information on configured memory, amount of free and used memory. (memory information)
4. WRITE A PROGRAM to print file details including owner access permissions, file access time, where file name is given as argument.
5. WRITE A PROGRAM to copy files using system calls.
6. Write program to implement FCFS scheduling algorithm.

7. Write program to implement Round Robin scheduling algorithm.
8. Write program to implement SJF scheduling algorithm.
9. Write program to implement non-preemptive priority based scheduling algorithm.
10. Write program to implement preemptive priority based scheduling algorithm.
11. Write program to implement SRJF scheduling algorithm.
12. Write program to calculate sum of n numbers using thread library.
13. Write a program to implement first-fit, best-fit and worst-fit allocation strategies.

CMAACOR07T: Discrete Structures **Theory: 75 Lectures**

1. Introduction: **(18 Lectures)**
Sets - finite and Infinite sets, functions, relations, Properties of Binary Relations, Closure, Partial Ordering Relations; counting - Pigeonhole Principle, Permutation and Combination; Mathematical Induction, Principle of Inclusion and Exclusion.

2. Growth of Functions: **(12 Lectures)**
Asymptotic Notations, Summation formulas and properties, Bounding Summations, approximation by Integrals

3. Recurrences: **(15 Lectures)**
Recurrence Relations, generating functions, Linear Recurrence Relations with constant coefficients and their solution, Substitution Method, Characteristics, Master Theorem

4. Graph Theory **(15 Lectures)**
Basic Terminology, Models and Types, multigraphs and weighted graphs, Graph Representation, Graph Isomorphism, Connectivity, Euler and Hamiltonian Paths and Circuits, Planar Graphs (concepts only), Trees, Basic Terminology and properties of Trees, Introduction to Spanning Trees

5. Prepositional Logic **(15 Lectures)**
Logical Connectives, Well-formed Formulas, Tautologies, Equivalences, Inference Theory

Recommended Books:

1. C.L. Liu , D.P. Mahopatra, Elements of Discrete mathematics, 2nd Edition , Tata McGraw Hill, 1985,
2. Kenneth Rosen, Discrete Mathematics and Its Applications, Sixth Edition ,McGraw Hill 2006
3. T.H. Coremen, C.E. Leiserson, R. L. Rivest, Introduction to algorithms, 3rd edition Prentice Hall on India, 2009
4. M. O. Albertson and J. P. Hutchinson, Discrete Mathematics with Algorithms , John wiley Publication, 1988
5. J. L. Hein, Discrete Structures, Logic, and Computability, 3rd Edition, Jones and Bartlett Publishers, 2009
6. D.J. Hunter, Essentials of Discrete Mathematics, Jones and Bartlett Publishers, 2008
7. 7. Graph Theoryby N. Deo, PHI

CMAACOR08T:Multimedia Systems and Internet Technologies **(60 Lectures)**

1: Introduction to Computer Graphics & Graphics Systems **(10 Lectures)**
Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table;

2: Multimedia **(6 Lectures)**
Introduction to Multimedia: Concepts, uses of multimedia, hypertext and hypermedia. Image, video and audio standards.

3: Audio **(6 Lectures)**
digital audio, MIDI, processing sound, sampling, compression.

4: Video **(10Lectures)**
MPEG compression standards, compression through spatial and temporal redundancy, inter-frame and intra-frame compression.

5: Animation **(10Lectures)**
types, techniques, key frame animation, utility, morphing. Virtual Reality concepts.Morphing and tweening

6 : History and Evolution of Web **(18 Lectures)**

Web 1.0 to Web 4.0, Concept of Client Server Architecture, 3-tier Web Architecture, Hyper Text Transfer Protocol (HTTP), File Transfer Protocol (FTP), Web Pages, Domain Names, URL, Internet Protocol Address, Website, Web browser, Web Servers, Web Hosting, Cookies.WWW- basic concepts, web-client & web-server, application server Exploring Web Technologies: HTML, XHTML, DHTML, DOM, XML

CMAACOR08P:Multimedia Systems and Internet Technologies **60 Lectures**

PROGRAM 1 : PROCEDURE TO CREATE AN ANIMATION TO REPRESENT THE GROWING MOON.
PROGRAM 2 : PROCEDURE TO CREATE AN ANIMATION TO INDICATE A BALL BOUNCING ON STEPS.
PROGRAM 3 : PROCEDURE TO SIMULATE MOVEMENT OF A CLOUD.
PROGRAM 4 : PROCEDURE TO DRAW THE FAN BLADES AND TO GIVE PROPER ANIMATION.
PROGRAM 5 : PROCEDURE TO DISPLAY THE BACKGROUND GIVEN (FILENAME: TULIP.JPG) THROUGH YOUR NAME.
PROGRAM 6 : procedure to create an animation with the following features.
WELCOME
*Letters should appear one by one
*The fill colour of The text should change to a different colour after the display of the full word.
PROGRAM 7 : PROCEDURE TO SIMULATE A BALL HITTING ANOTHER BALL.
PROGRAM 8 : PROCEDURE TO CREATE AN ANIMATED CURSOR USING STARTDRAG("SS", TRUE); MOUSE.HIDE();
PROGRAM 9 : PROCEDURE TO DESIGN A VISITING CARD CONTAINING ATLEAST ONE GRAPHIC AND TEXT INFORMATION.
PROGRAM 10 : PROCEDURE TO TAKE A PHOTOGRAPHIC IMAGE. GIVE A TITLE FOR THE IMAGE. PUT THE BORDER. WRITE YOUR NAMES. WRITE THE NAME OF INSTITUTION AND PLACE.
PROGRAM 11 : PROCEDURE TO PREPARE A COVER PAGE FOR THE BOOK IN YOUR SUBJECT AREA. PLAN YOUR OWN DESIGN.
PROGRAM 12 :
PROCEDURE TO EXTRACT THE FLOWER ONLY FROM GIVEN PHOTOGRAPHIC IMAGE AND ORGANISE IT ON A BACKGROUND.
PROGRAM 13 : PROCEDURE TO ADJUST THE BRIGHTNESS AND CONTRAST OF THE PICTURE SO THAT IT GIVES AN ELEGANT LOOK.
PROGRAM 14 : PROCEDURE TO POSITION THE PICTURE PREFERABLY ON A PLAIN BACKGROUND OF A COLOUR OF YOUR CHOICE - POSITIONING INCLUDES ROTATION AND SCALING.
PROGRAM 15 : ROCEDURE TO REMOVE THE ARROWS AND TEXT FROM THE GIVEN PHOTOGRAPHIC IMAGE
PROGRAM 16 : PROCEDURE TO TYPE A WORD AND APPLY THE EFFECTS SHADOW EMBOSS
PROGRAM 17 : PROCEDURE TO USE APPROPRIATE TOOL(S) FROM THE TOOLBOX, CUT THE OBJECTS FROM 3 FILES (F1.JPG, F2.JPG & F3.JPG); ORGANISE THEM IN A SINGLE FILE AND APPLY FEATHER EFFECTS.
PROGRAM 18 : PROCEDURE TO DISPLAY THE BACKGROUND GIVEN (FILENAME: GARDEN.JPG) THROUGH YOUR NAME USING MASK.
PROGRAM 19 : PROCEDURE TO MAKE ANYONE OF ONE OF THE PARROTS BLACK & WHITE IN A GIVEN PICTURE.
PROGRAM 20 : PROCEDURE TO CHANGE A CIRCLE INTO A SQURE USING FLASH.

CMAACOR09T: OOP's using Java **Theory: 60 Lectures**

1. Introduction to Java **(4 Lectures)**

Java Architecture and Features, Understanding the semantic and syntax differences between C and Java, Compiling and Executing a Java Program, Variables, Constants, Keywords Data Types, Operators (Arithmetic, Logical and Bitwise) and Expressions, Comments, Doing Basic Program Output, Decision Making Constructs (conditional statements and loops) and Nesting, Java Methods (Defining, Scope, Passing and Returning Arguments, Type Conversion and Type and Checking, Built-in Java Class Methods),

2. Arrays, Strings and I/O **(8 Lectures)**

Creating & Using Arrays (One Dimension and Multi-dimensional), Referencing Arrays Dynamically, Java Strings: The Java

String class, Creating & Using String Objects,
Manipulating Strings, String Immutability & Equality, Passing Strings To & From Methods, String Buffer Classes. Simple I/O using System.out and the Scanner class, Byte and Character streams, Reading/Writing from console and files.

3. Object-Oriented Programming Overview (4 Lectures)
Principles of Object-Oriented Programming, Defining & Using Classes, Controlling Access to Class Members, Class Constructors, Method Overloading, Class Variables & Methods, Objects as parameters, final classes, Object class, Garbage Collection.

4. Inheritance, Interfaces, Packages, Enumerations, Autoboxing and Metadata (14 lectures)
Inheritance: (Single Level and Multilevel, Method Overriding, Dynamic Method Dispatch, Abstract Classes), Interfaces and Packages, Extending interfaces and packages, Package and Class Visibility, Using Standard Java Packages (util, lang, io, net), Wrapper Classes, Autoboxing/Unboxing, Enumerations and Metadata.

5. Exception Handling, Threading, Networking and Database Connectivity (15 Lectures)
Exception types, uncaught exceptions, throw, built-in exceptions, Creating your own exceptions; Multi-threading: The Thread class and Runnable interface, creating single and multiple threads, Thread prioritization, synchronization and communication, suspending/resuming threads. Using java.net package, Overview of TCP/IP and Datagram programming. Accessing and manipulating databases using JDBC.

6. Applets and Event Handling (15 Lectures)
Java Applets:Introduction to Applets, Writing Java Applets, Working with Graphics,
Incorporating Images & Sounds. Event Handling Mechanisms,Listener Interfaces, Adapter and Inner Classes. The design and Implementation of GUIs using the AWT controls, Swing components of Java Foundation Classes such as labels, buttons, textfields, layout managers, menus, events and listeners; Graphic objects for drawing figures such as lines, rectangles, ovals, using different fonts. Overview of servlets.

Recommended Books:

1. Ken Arnold, James Gosling, David Homes, "The Java Programming Language", 4th Edition, 2005.
2. James Gosling, Bill Joy, Guy L Steele Jr, GiladBracha, Alex Buckley"The Java Language Specification, Java SE 8 Edition (Java Series)", Published by Addison Wesley, 2014.
3. Joshua Bloch, "Effective Java" 2nd Edition,Publisher: Addison-Wesley, 2008.
4. Cay S. Horstmann, GaryCornell, "Core Java 2 Volume 1 ,9th Edition,Printice Hall.2012
5. Cay S. Horstmann, Gary Cornell, "Core Java 2 Volume 2 - Advanced Features)", 9th Edition, Printice Hall.2013
6. Bruce Eckel, "Thinking in Java", 3rd Edition, PHI, 2002.
7. E. Balaguruswamy, "Programming with Java", 4th Edition, McGraw Hill.2009.
8. Paul Deitel, Harvey Deitel, "Java: How to Program", 10th Edition, Prentice Hall, 2011.
9. "Head First Java", Orielly Media Inc. 2nd Edition, 2005.
10. David J. Eck, "Introduction to Programming Using Java", Published by CreateSpace Independent Publishing Platform, 2009.
11. John R. Hubbard, "Programming with JAVA", Schaum's Series, 2nd Edition, 2004.

CMAACOR09P: Practical: OOP's Using Java 60 Lectures

1. To find the sum of any number of integers entered as command line arguments
2. To find the factorial of a given number
3. To learn use of single dimensional array by defining the array dynamically.
4. To learn use of .lenth in case of a two dimensional array
5. To convert a decimal to binary number
6. To check if a number is prime or not, by taking the number as input from the keyboard
7. To find the sum of any number of integers interactively, i.e., entering every number from the keyboard, whereas the total number of integers is given as a command line argument
8. Write a program that show working of different functions of String and StringBufferclasss like setCharAt(, setLength(), append(), insert(), concat()and equals().
9. Write a program to create a ―distance‖ class with methods where distance is computed in terms of feet and inches, how to create objects of a class and to see the use of this pointer
10. Modify the ―distance‖ class by creating constructor for assigning values (feet and inches) to the distance object. Create

another object and assign second object as reference variable to another object reference variable. Further create a third object which is a clone of the first object.
11. Write a program to show that during function overloading, if no matching argument is found, then java will apply automatic type conversions(from lower to higher data type)
12. Write a program to show the difference between public and private access specifiers. The program should also show that primitive data types are passed by value and objects are passed by reference and to learn use of final keyword
13. Write a program to show the use of static functions and to pass variable length arguments in a function.
14. Write a program to demonstrate the concept of boxing and unboxing.
15. Create a multi-file program where in one file a string message is taken as input from the user and the function to display the message on the screen is given in another file (make use of Scanner package in this program).
16. Write a program to create a multilevel package and also creates a reusable class to generate Fibonacci series, where the function to generate fibonacii series is given in a different file belonging to the same package.
17. Write a program that creates illustrates different levels of protection in classes/subclasses belonging to same package or different packages
18. Write a program ―DivideByZero‖ that takes two numbers a and b as input, computes a/b, and invokes Arithmetic Exception to generate a message when the denominator is zero.
19. Write a program to show the use of nested try statements that emphasizes the sequence of checking for catch handler statements.
20. Write a program to create your own exception types to handle situation specific to your application (Hint: Define a subclass of Exception which itself is a subclass of Throwable).
21. Write a program to demonstrate priorities among multiple threads.
22. Write a program to demonstrate multithread communication by implementing synchronization among threads (Hint: you can implement a simple producer and consumer problem).
23. Write a program to create URL object, create a URLConnection using the openConnection() method and then use it examine the different components of the URLand content.
24. Write a program to implement a simple datagram client and server in which a message that is typed into the server window is sent to the client side where it is displayed.
25. Write a program that creates a Banner and then creates a thread to scrolls the message in the banner from left to right across the applet‘s window.
26. Write a program to get the URL/location of code (i.e. java code) and document(i.e. html file).
27. Write a program to demonstrate different mouse handling events like mouseClicked(), mouseEntered(), mouseExited(), mousePressed, mouseReleased() and mouseDragged().
28. Write a program to demonstrate different keyboard handling events.
29. Write a program to generate a window without an applet window using main() function.
30. Write a program to demonstrate the use of push buttons.

CMAACOR10T: Software Engineering **Theory:75 Lectures**

1.Introduction **(15 Lectures)**
The Evolving Role of Software, Software Characteristics, Changing Nature of Software, Software Engineering as a Layered Technology, Software Process Framework, Framework and Umbrella Activities, Process Models, Capability Maturity Model Integration (CMMI).

2.Requirement Analysis **(14 Lectures)**
Software Requirement Analysis, Initiating Requirement Engineering Process, Requirement Analysis and Modeling Techniques, Flow Oriented Modeling, Need for SRS, Characteristics and Components of SRS.

3.Software Project Management **(10Lectures)**
Estimation in Project Planning Process, Project Scheduling.

4.Quality Management **(10 Lectures)**
Quality Concepts, Software Quality Assurance, Software Reviews, Metrics for Process and Projects.

5.Design Engineering **(12 Lectures)**
Design Concepts, Architectural
Design Elements, Software Architecture, Data Design at the Architectural Level and Component Level, Mapping of Data

Flow into Software Architecture, Modeling Component Level Design.

6.Testing Strategies & Tactics **(14 Lectures)**

Software Testing Fundamentals, Strategic Approach to Software Testing, Test Strategies for Conventional Software, Validation Testing, System testing, Black-Box Testing, White-Box Testing and their type, Basis Path Testing.

Recommended Books:

1. R.S. Pressman, Software Engineering: A Practitioner's Approach (7th Edition), McGraw-Hill, 2009.
2. P. Jalote, An Integrated Approach to Software Engineering (2nd Edition), Narosa Publishing House, 2003.
3. K.K. Aggarwal and Y. Singh, Software Engineering (2nd Edition), New Age International Publishers, 2008.
4. I. Sommerville, Software Engineering (8th edition), Addison Wesley, 2006.
5. D. Bell, Software Engineering for Students (4th Edition), Addison-Wesley, 2005.
6. R. Mall, Fundamentals of Software Engineering (2nd Edition), Prentice-Hall of India, 2004.

CMAACOR11T: Artificial Intelligence **Theory: 60 Lectures**

1. Introduction **(10 Lectures)**

Introduction to Artificial Intelligence, Background and Applications, Turing Test and Rational Agent approaches to AI, Introduction to Intelligent Agents, their structure, behavior and environment.

2. Problem Solving and Searching Techniques **(20 Lectures)**

Problem Characteristics, Production Systems, Control Strategies, Breadth First Search, Depth First Search, Hill climbing and its Variations, Heuristics Search Techniques: Best First Search, A* algorithm, Constraint Satisfaction Problem, Means-End Analysis, Introduction to Game Playing, Min-Max and Alpha-Beta pruning algorithms.

3. Knowledge Representation **(20 Lectures)**

Introduction to First Order Predicate Logic, Resolution Principle, Unification, Semantic Nets, Conceptual Dependencies, Frames, and Scripts, Production Rules, Conceptual Graphs.
Programming in Logic (PROLOG)

4. Understanding Natural Languages **(10 Lectures)**

Parsing Techniques, Context-Free and Transformational Grammars, Recursive and Augmented Transition Nets.

Recommended Books:

1. DAN.W. Patterson, Introduction to A.I and Expert Systems – PHI, 2007.
2. Russell &Norvig, Artificial Intelligence-A Modern Approach, LPE, Pearson Prentice Hall, 2nd edition, 2005.
3. Rich & Knight, Artificial Intelligence – Tata McGraw Hill, 2nd edition, 1991.
4. W.F. Clocksin and Mellish, Programming in PROLOG, Narosa Publishing House, 3rd edition, 2001.
5. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison-Wesley, Pearson Education, 3rd edition, 2000.

CMAACOR11P: Artificial Intelligence Lab **Practical: 60 Lectures**

1. Write a prolog program to calculate the sum of two numbers.
2. Write a prolog program to find the maximum of two numbers.
3. Write a prolog program to calculate the factorial of a given number.
4. Write a prolog program to calculate the nth Fibonacci number.
5. Write a prolog program, insert_nth(item, n, into_list, result) that asserts that result is the list into_list with item inserted as the n'th element into every list at all levels.
6. Write a Prolog program to remove the Nth item from a list.
7. Write a Prolog program, remove-nth(Before, After) that asserts the After list is the Before list with the removal of every n'th item from every list at all levels.
8. Write a Prolog program to implement append for two lists.
9. Write a Prolog program to implement palindrome (List).
10. Write a Prolog program to implement max(X,Y,Max) so that Max is the greater of two numbers X and Y.
11. Write a Prolog program to implement maxlist(List,Max) so that Max is the greatest number in the list of numbers List.
12. Write a Prolog program to implement sumlist(List,Sum) so that Sum is the sum of a given list of numbers List.

13. Write a Prolog program to implement two predicates evenlength(List) and oddlength(List) so that they are true if their argument is a list of even or odd length respectively.
14. Write a Prolog program to implement reverse(List,ReversedList) that reverses lists.
15. Write a Prolog program to implement maxlist(List,Max) so that Max is the greatest number in the list of numbers List using cut predicate.
16. Write a Prolog program to implement GCD of two numbers.
17. Write a prolog program that implements Semantic Networks/Frame Structures.

CMAACOR12T: Computer Networks **Theory: 75 Lectures**

1. Introduction to Computer Networks **(8 Lectures)**
Network definition; network topologies; network classifications; network protocol; layered network architecture; overview of OSI reference model; overview of TCP/IP protocol suite.

2. Data Communication Fundamentals and Techniques **(12 Lectures)**
Analog and digital signal; data-ratelimits; digital to digital line encoding schemes; pulse code modulation; parallel and serial transmission; digital to analog modulation-; multiplexing techniques- FDM, TDM; transmission media.

3. Networks Switching Techniques and Access mechanisms **(12 Lectures)**
Circuit switching; packet switching- connectionless datagram switching, connection-oriented virtual circuit switching; dial-up modems; digital subscriber line; cable TV for data transfer.

4. Data Link Layer Functions and Protocol **(12 Lectures)**
Error detection and error correction techniques; data-link control- framing and flow control; error recovery protocols- stop and wait ARQ, go-back-n ARQ; Point to Point Protocol on Internet.

5. Multiple Access Protocol and Networks **(5 Lectures)**
CSMA/CD protocols; Ethernet LANS; connecting LAN and back-bone networks- repeaters, hubs, switches, bridges, router and gateways;

6. Networks Layer Functions and Protocols **(12 Lectures)**
Routing; routing algorithms; network layer protocol of Internet- IP protocol, Internet control protocols.

7. Transport Layer Functions and Protocols **(8 Lectures)**
Transport services- error and flow control, Connection establishment and release- three way handshake;

8. Overview of Application layer protocol **(6 Lectures)**
Overview of DNS protocol; overview of WWW &HTTP protocol.

Recommended Books:

1. B. A. Forouzan: Data Communications and Networking, Fourth edition, THM, 2007.
2. A.S. Tanenbaum: Computer Networks, Fourth edition, PHI, 2002

CMAACOR13T: Design and Analysis of Algorithms Lab Theory **60 Lectures**

1. Introduction **(5 Lectures)**
Asymptomatic notation, Master Theoram Basic Design and Analysis techniques of Algorithms, Correctness of Algorithm.

2. Algorithm Design Techniques **(13 Lectures)**
Iterative techniques, Divide and Conquer, Dynamic Programming, Greedy Algorithms. Branch and bound, Backtracking, Basic methods and example.

3. Sorting and Searching Techniques **(20 Lectures)**
Fundamental concepts of sorting techniques, Internal & external Sorting–Bubble Sort, Insertion Sort, Merge Sort, Advanced Sorting techniques - Heap Sort, Quick Sort, Sorting in Linear Time t, Radix Sort and Count Sort, Searching Techniques,

complexity analysis;

4. Lower Bounding Techniques **(5 Lectures)**
Decision Trees

5. Balanced Trees **(7 Lectures)**
Red-Black Trees

7. Graphs **(5 Lectures)**
Graph Algorithms–Breadth First Search, Depth First Search and its Applications, Minimum Spanning Trees.

8. String Processing **(5Lectures)**
String Matching, KMP Technique

Recommended Books:

1. T.H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein Introduction to Algorithms, PHI, 3rd Edition 2009
2. Sarabasse& A.V. Gelder Computer Algorithm – Introduction to Design and Analysis, Publisher – Pearson 3rd Edition 1999
3. Horowitz and Sahani, Fundamentals of Computer Algorithms, 2ND Edition
4. Brassard And Bratley Fundamentals Of Algorithmics, EEE

CMAACOR13P: Design and Analysis of Algorithms Lab **Practical: 60 Lectures**

1. i. Implement Insertion Sort (The program should report the number of comparisons)
   ii.Implement Merge Sort(The program should report the number of comparisons)
2. Implement Heap Sort(The program should report the number of comparisons)
3. Implement Randomized Quick sort (The program should report the number of comparisons)
4. Implement Radix Sort
5. Create a Red-Black Tree and perform following operations on it:
   i. Insert a node
   ii. Delete a node
   iii. Search for a number & also report the color of the node containing this number.
6. Write a program to determine the LCS of two given sequences
7. Implement Breadth-First Search in a graph
8. Implement Depth-First Search in a graph
9. Write a program to determine the minimum spanning tree of a graph

For the algorithms at S.No 1 to 3 test run the algorithm on 100 different inputs of sizes varying from 30 to 1000. Count the number of comparisons and draw the graph. Compare it with a graph of nlogn.

CMAACOR14T: Theory of Computation **Theory: 75 Lectures**

1. Languages **(10 Lectures)**
Alphabets, string, language, Basic Operations on language, Concatenation, Kleene Star

2. Finite Automata and Regular Languages **(25 Lectures)**
Regular Expressions, Transition Graphs, Deterministics and non-deterministic finite automata, NFA to DFA Conversion, Regular languages and their relationship with finite automata, closure properties of regular languages.

3. Context free languages **(30 Lectures)**
Context free grammars, parse trees, ambiguities in grammars and languages, Pushdown automata grammer, types of grammer. Regular grammer CNF, Equivalence of DFA, NDFA, RE & RG.

4. Turing Machines and Models of Computations **(10 Lectures)**
Turing Machine as a model of computation, Universal Turing Machine, Language acceptability,

Recommended Books:

1. Theory of Computer Science by Mishra & Chandreshekharan, PHI
2. Hoperoft, Aho, Ullman, Introduction to Automata theory, Language & Computation –3rd Edition, Pearson Education. 2006
3. P. Linz, An Introduction to Formal Language and Automata 4th edition Publication Jones Bartlett, 2006

Discipline Specific Elective Papers COMPUTER SCIENCE: (Credit: 06 each) (4 papers to be selected) – DSE 1 - 4

CMAADSE01T: Introduction to Data Science **Theory:60 Lectures**

1. Data Scientist's Tool Box **(10 Lectures)**
Turning data into actionable knowledge, introduction to the tools that will be used in building data analysis software: version control, markdown, git, GitHub, R, and Rstudio

2. Basics of R Programming in respect to Data Science **(15 Lectures)**
Overview of R, R data types and objects, reading and writing data, Control structures, functions, scoping rules, dates and times, Loop functions, debugging tools, Simulation, code profiling

3. Getting and Cleaning Data **(15 Lectures)**
Obtaining data from the web, from APIs, from databases and from colleagues in various formats, basics of data cleaning and making data ―tidy

4. Exploratory Data Analysis **(10 Lectures)**
Essential exploratory techniques for summarizing data, applied before formal modeling commences, eliminating or sharpening potential hypotheses about the world that can be addressed by the data, common multivariate statistical techniques used to visualize high-dimensional data.

5. Reproducible Computing **(10 Lectures)**
Concepts and tools behind reporting modern data analyses in a reproducible manner, To write a document using R markdown, integrate live R code into a literate statistical program, compile R markdown documents using knitr and related tools, and organize a data analysis so that it is reproducible and accessible to others.

Recommended Books:

1. D. Cielen, Arno D. B. Meysman, M. Ali, Introducing Data Science, Dreamtech Press
2. Rachel Schutt, Cathy O'Neil, "Doing Data Science: Straight Talk from the Frontiline" by Schroff/O'Reilly, 2013.
3. Foster Provost, Tom Fawcett, "Data Science for Business" What You Need to Know About Data Mining and Data-Analytic Thinking" by O'Reilly, 2013.
Syllabus of BCA (Honours) under CBCS
464. John W. Foreman, "Data Smart: Using data Science to Transform Information into Insight" by John Wiley & Sons, 2013.
5. Ian Ayres, "Super Crunchers: Why Thinking-by-Numbers Is the New Way to Be Smart" Ist Edition by Bantam, 2007.
6. Eric Seigel, "Predictive Analytics: The Power to Predict who Will Click, Buy, Lie, or Die", 1st Edition, by Wiley, 2013.
7. Matthew A. Russel, "Mining the Social Web: Data mining Facebook, Twitter, Linkedln, Goole+, GitHub, and More", Second Edition, by O'Reilly Media, 2013.
8. Michael J. Crawley, The R Book, Wiley

CMAADSE01P: Introduction to Data Science PRACTICAL **60 Lectures**

Students are advised to do laboratory/practical practice not limited to, but including the following types of problems:
1. Write a program that prints „Hello World„ to the screen.
2. Write a program that asks the user for a number n and prints the sum of the numbers 1 to n
3. Write a program that prints a multiplication table for numbers up to 12.
4. Write a function that returns the largest element in a list.
5. Write a function that computes the running total of a list.
6. Write a function that tests whether a string is a palindrome.
7. Implement linear search.
8. Implement binary search.

9. Implement matrices addition , subtraction and Multiplication
10. Fifteen students were enrolled in a course. There ages were:
20 20 20 20 20 21 21 21 22 22 22 22 23 23 23
a. Find the median age of all students under 22 years
b. Find the median age of all students
c. Find the mean age of all students
d. Find the modal age for all students
e. Two more students enter the class. The age of both students is 23. What is now mean, mode and median?
11. Following table gives a frequency distribution of systolic blood pressure. Compute all the measures of dispersio

Midpoint	95.5	105.5	115.5	125.5	135.5	145.5	155.5	165.5	175.5
Number	5	8	22	27	17	9	5	5	2

12. Obtain probability distribution of, where X is number of spots showing when a six-sided symmetric die (i.e. all six faces of the die are equally likely) is rolled. Simulate random samples of sizes 40, 70 and 100 respectively and verify the frequency interpretation of probability.
13. Make visual representations of data using the base, lattice, and ggplot2 plotting systems in R, apply basic principles of data graphics to create rich analytic graphics from available datasets.
14. Use Git / Github software to create Github account. Also, create a repo using Github.

CMAADSE02T: VISUAL PROGRAMMING **Theory:60 Lectures**

1. Introduction to Visual Programming **(10 Lectures)**
Need for Visual Programming, Advantages and Disadvantages of Visual Programming, Event based programming, Introduction to Visual Basic, Visual Basic Editions, Writing Visual Basic Projects,

2. Visual Programming Controls **(10 Lectures)**
Positioning of Controls, Coding with Controls, Code writing mechanics, understanding numbering systems, Coding for controls, focus, setting tab orders.

3. Visual Programming Objects **(10 Lectures)**
coding basics, use of variables and literals, declaring variables, storing and retrieving data in variables, use of constants and operators, creating your own constants, arithmetic operators and expressions, logical operators

4. Introduction Control Structures **(10 Lectures)**
Decision structure, and introduction to looping constructs

5. Arrays **(20 Lectures)**
Types of arrays, adding controls at run time, menus, designing a menu, attaching code to menus, introduction to procedures, event procedures, working with procedures, multiple forms, standard code modules.

Recommended Books:

1. Professional Visual Studio 2017, Bruce Johnson.
2. Programming with MS Visual Basic 2015, Diane Zak.
3. Beginning Visual Basic 2015, Bryan Newsome.
4. Programming in Visual Basic, McBride.
5. Programming in Visual Basic 6, Ivan Bayross.
6. Programming In Microsoft Visual Basic 6.0, Saini and Sharma.
7. Programming in Visual Basic 2010: The Very Beginner's Guide, Jim McKeown

CMAADSE02P – VISUAL PROGRAMMING PRACTICAL **TOTAL-60 Lectures**
1. GUI Environment: (4L)
Introduction to graphical user interface (GUI), programming. Language (procedural, object oriented, event driven), the GUI environment, compiling, debugging, and running the programs.
2. Controls : (8L)
Introduction to controls textboxes, frames, check boxes, option buttons, images, setting borders and styles, the shape control, the line control, working with multiple controls and their properties, designing the user interface, keyboard access, tab controls, default & cancel property, coding for controls.

3. Operations: (2L)
Data types, constants, named & intrinsic, declaring variables, scope of variables, val function, arithmetic operations, formatting data.
4. Decision Making : (4L)
If statement, comparing strings, compound conditions (and, or, 4L not), nested if statements, case structure, using if statements with option buttons & check boxes, displaying message in message box, testing whether input is valid or not.
5. Modular programming: (8L)
Menus, sub-procedures and sub-functions defining / 8L creating and modifying a menu, using common dialog box, creating a new subprocedure, passing variables to procedures, passing argument by value or by reference, writing a function/ procedure.
6. Forms Handling : (6L)
Multiple forms creating, adding, removing forms in project, hide, 6L show method, load, unload statement, me keyword, referring to objects on a different forms
7. Iteration Handling: (6L)
Do/loops, for/next loops, using msgbox function, using string function
8. Arrays and Grouped Data Control: (4L)
Arrays - 1-dimension arrays, initializing an 6L array using for each, user-defined data types, accessing information with user-defined data types, using list boxes with array, two dimensional arrays. lists, loops and printing list boxes & combo boxes, filling the list using property window / additem method, clear method, list box properties, removing an item from a list, list box/ combo box operations.
9. Database Connectivity: (10L)
Database connectivity of forms with back end tool like mysql, populating the data in text boxes, list boxes etc. searching of data in database using forms. Updating/ editing of data based on a criterion.

10. Data Report Generation (8L)

Recommended Books:

1. Professional Visual Studio 2017, Bruce Johnson.
2. Programming with MS Visual Basic 2015, Diane Zak.
3. Beginning Visual Basic 2015, Bryan Newsome.
4. Programming in Visual Basic, McBride.
5. Programming in Visual Basic 6, Ivan Bayross.
6. Programming In Microsoft Visual Basic 6.0, Saini and Sharma.
7. Programming in Visual Basic 2010: The Very Beginner's Guide, Jim McKeown

CMAADSE03T: Data Mining **Theory: 60 lectures**

1. Introduction **(6 Lectures)**
Basic Data Mining Tasks, Data Mining Issues, Data Mining Metrics, Data Mining from a Database Perspective

2. Data Mining Techniques **(10 Lectures)**
A Statistical Perspective on Data Mining, Similarity Measures, Decision Trees, Neural Networks, Genetic Algorithms

3. Classification **(15 Lectures)**
Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms, Neural Network-Based Algorithms, Rule-Based Algorithms, Combining Techniques.

4. Clustering **(12 Lectures)**
Similarity and Distance Measures, Hierarchical Algorithms, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes

5. Association Rules **(12 Lectures)**
Basic Algorithms, Parallel and Distributed Algorithms, Incremental Rules, Advanced Association Rule Techniques, Measuring the Quality of Rules.

6. Advanced Techniques **(5 Lectures)**
Web Mining, Spatial Mining, Temporal Mining.

Recommended Books:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Education.2005.
2. Richard Roiger, Michael Geatz, Data Mining: A Tutorial Based Primer, Pearson Education 2003.
3. G.K. Gupta, Introduction to Data Mining with Case Studies, PHI,2006.
4. Soman K P, Diwakar Shyam, Ajay V Insight Into Data Mining: Theory And Practice, , PHI, 2006
5. Data Mining Techniques, Arun Pujari, Fourth Edition, University Press

CMAADSE03P: Data Mining Lab **Practical: 60 lectures**

Practical exercises based on concepts listed in theory.

CMAADSE04T: Information Security & Cyber Law **Theory: 75 lectures**

1. Introduction to the concept of Information Security **(10 Lectures)**
Need for Security, Security approaches, Principles of Security, Types of Attack.

2. Key Elements of ISM Framework **(5 Lectures)**
Control, Planning, Evaluation, Implementation, Maintenance, Prevention, Reduction, Detection, Repression, Correction

3. Introduction to Cyber Law **(15 Lectures)**
Objective, Emerging Trends, Cyberspace, Cyber Security awareness and its policies

4. Cyber Crime, Nature of Threats, IT Act **(15 Lectures)**

5. Itellectual Property Rights, Cyber Security Strategies **(10 Lectures)**

6. Policies to mitigate cyber risk, Network Security **(10 Lectures)**

7. Digital and Electronic Signatures, Offences and penalties **(10 Lectures)**

CMAADSE05T: Cloud Computing **Theory: 60 lectures**

1.Overview of Computing Paradigm **(8 Lectures)**
Recent trends in Computing : Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing,

2.Introduction to Cloud Computing **(7 Lectures)**
Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Benefits and limitations of Cloud Computing,

3.Cloud Computing Architecture **(20 Lectures)**
Comparison with traditional computing architecture (client/server), Services provided at various levels, Service Models- Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), How Cloud Computing Works, Deployment Models- Public cloud, Private cloud, Hybrid cloud, Community cloud, Case study of NIST architecture.

4.Case Studies **(13 Lectures)**
Case study of Service model using Google App Engine, Microsoft Azure, Amazon EC2 , Eucalyptus.

5.Service Management in Cloud Computing **(7 Lectures)**
Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling.

6.Cloud Security **(5 Lectures)**
Infrastructure Security- Network level security, Host level security, Application level security, Data security and Storage- Data privacy and security Issues, Jurisdictional issues raised by Data location, Authentication in cloud computing.

Recommended Books:

1. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010.
2. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011.
3. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012.
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.
5. Gautam Shroff, Enterprise Cloud Computing Technology Architecture Applications , Adobe Reader ebooks available from eBooks.com,2010.
6. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach ,McGraw Hills, 2010.
7. Dimitris N. Chorafas, Cloud Computing Strategies ,CRC Press, 2010.

CMAADSE05P: Cloud Computing Lab **60 Lectures**

1. Create virtual machines that access different programs on same platform.
2. Create virtual machines that access different programs on different platforms .
3. Working on tools used in cloud computing online-
a. Storage
b. Sharing of data
c. manage your calendar, to-do lists,
d. a document editing tool
4. Exploring Google cloud
5. Exploring microsoft cloud
6. Exploring amazon cloud

CMAADSE06P: Discipline Specific Elective: Dissertation / Project Work

This option to be offered only in 6th Semester.
The students will be allowed to work on any project based on the concepts studied in core / elective or skill based elective courses.

The group size should be maximum of three (03) students.

Each group will be assigned a teacher as a supervisor who will handle both their theory as well lab classes.

A maximum of Four (04) projects would be assigned to one teacher.

Skill Enhancement Courses (any two) (Credit: 02 each) – SEC1 to SEC2 Theory: 01, Labs: 02

CMSSSEC001: Programming in Python **Theory:15 Lectures**

1.Planning the Computer Program: **(2 Lectures)**
Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation.

2.Techniques of Problem Solving **(2 Lectures)**
Flowcharting, decision table, algorithms, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming.

3.Overview of Programming **(3 Lectures)**
Structure of a Python Program, Elements of Python

4.Introduction to Python **(4 Lectures)**
Python Interpreter, Using Python as calculator, Python shell, Indentation. Atoms, Identifiers and keywords, Literals, Strings, Operators(Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator, Increment or Decrement operator).

5.Creating Python Programs **(4 Lectures)**

Input and Output Statements, Control statements(Branching, Looping, Conditional Statement, Exit function, Difference between break, continue and pass.), Defining Functions, default arguments.

Recommended Books:

1. T. Budd, Exploring Python, TMH, 1st Ed, 2011
2. Python Tutorial/Documentation www.python.or 2015
3. Allen Downey, Jeffrey Elkner, Chris Meyers , How to think like a computer scientist : learning with Python, Freely available online.2012
4. http://docs.python.org/3/tutorial/index.html
5. http://interactivepython.org/courselib/static/pythonds
6. http://www.ibiblio.org/g2swap/byteofpython/read/

Software Lab Based on Python:

Section: A (Simple programs)

1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon users choice.
2. WAP to calculate total marks, percentage and grade of a student. Marks obtained in each of the three subjects are to be input by the user. Assign grades according to the following criteria :
Grade A: Percentage >=80
Grade B: Percentage>=70 and <80 Grade C: Percentage>=60 and <70 Grade D: Percentage>=40 and <60 Grade E: Percentage<40
3. Write a menu-driven program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input paramters from user.
4. WAP to display the first n terms of Fibonacci series.
5. WAP to find factorial of the given number.
6. WAP to find sum of the following series for n terms: 1 – 2/2! + 3/3! - - - - - n/n!
7. WAP to calculate the sum and product of two compatible matrices.

Section: B (Visual Python):

All the programs should be written using user defined functions, wherever possible.
1. Write a menu-driven program to create mathematical 3D objects I. curve
II. sphere
III. cone IV. arrow
V. ring
VI. cylinder.
2. WAP to read n integers and display them as a histogram.
3. WAP to display sine, cosine, polynomial and exponential curves.

4. WAP to plot a graph of people with pulse rate p vs. height h. The values of p and h are to be entered by the user.
5. WAP to calculate the mass m in a chemical reaction. The mass m (in gms) disintegrates according to the formula m=60/(t+2), where t is the time in hours. Sketch a graph for t vs. m, where t>=0.
6. A population of 1000 bacteria is introduced into a nutrient medium. The population p grows as follows:
P(t) = (15000(1+t))/(15+ e)
where the time t is measured in hours. WAP to determine the size of the population at given time t and plot a graph for P vs t for the specified time interval.

7. Input initial velocity and acceleration, and plot the following graphs depicting equations of motion:
I. velocity wrt time (v=u+at)
II. distance wrt time (s=u*t+0.5*a*t*t)

III. distance wrt velocity (s=(v*v-u*u)/2*a)
8. WAP to show a ball bouncing between 2 walls. (Optional)

CMSSSEC002: R-Programming (1+2 Labs) **Theory:15 Lectures**

(5 Lectures)

Overview and History of R, Getting Help, Data Types, Subsetting, Vectorized Operations, Reading and Writing Data.

Control Structures, Functions, lapply, tapply, split, mapply, apply, Coding Standards. **(5 Lectures)**

Scoping Rules, Debugging Tools, Simulation, R Profiler. **(5 Lectures)**

Recommended Books:

1. William N. Venables and David M. Smith, An Introduction to R. 2nd Edition. Network Theory Limited.2009
2. Norman Matloff, The Art of R Programming - A Tour of Statistical Software Design, No Starch Press.2011

Software Lab Based on R Programming

1. Write a program that prints _Hello World‘ to the screen.
2. Write a program that asks the user for a number n and prints the sum of the numbers 1 to n
3. Write a program that prints a multiplication table for numbers up to 12.
4. Write a function that returns the largest element in a list.
5. Write a function that computes the running total of a list.
6. Write a function that tests whether a string is a palindrome.
7. Implement the following sorting algorithms: Selection sort, Insertion sort, Bubble Sort
8. Implement linear search.
9. Implement binary search.
10. Implement matrices addition, subtraction and Multiplication

CHOICE BASED CREDIT SYSTEM

B.Sc. Program with Computer Science

Semester			Total credit
I	CORE	CMSGCOR01T: Problem Solving with Computer CMSGCOR01P: Problem Solving with Computer	4 2
	AECC1	ENVS	2
II	CORE	CMSGCOR02T: DBMS CMSGCOR02P: DBMS	4 2
	AECC2	English	2
III	CORE	CMSGCOR03T: OS CMSGCOR03P: LINUX	4 2
	SEC1	CMSSSEC01M:Programming in Python	2
IV	CORE	CMSGCOR04T: Computer System Architecture CMSGCOR04P: Computer System Architecture	4 2
	SEC2	CMSSSEC02M:R Programming	2
V	DSE1 (Any one)	CMSGDSE01T: Programming in JAVA CMSGDSE02T: Discrete Structures	6
VI	DSE2 (Any one)	CMSGDSE03T: Software Engg CMSGDSE04T: Computer Networks	6
Total number of courses		10	

CORE PAPERS:

CMSGCOR01T : Problem Solving with Computer

Computer Fundamentals: Introduction to Computers: Characteristics of Computers, Uses of computers, Types and generations of Computers. (3L)

Basic Computer Organization - Units of a computer, CPU, ALU, memory hierarchy, registers, I/O devices.

Planning the Computer Program: Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation. (3L)

Techniques of Problem Solving: Flowcharting, decision table, algorithms, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming. (4L)

Overview of Programming: Structure of a Python Program, Elements of Python (4L)

Introduction to Python: Python Interpreter, Using Python as calculator, Python shell,Indentation. Atoms, Identifiers and keywords, Literals, Strings, Operators (Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator, Increment or Decrement operator).
(8L)

Creating Python Programs: Input and Output Statements, Control statements (Looping- whileLoop, for Loop , Loop Control, Conditional Statement- if...else, Difference between break, continue
and pass). (10L)

Structures: Numbers, Strings, Lists, Tuples, Dictionary, Date & Time, Modules, Defining Functions, Exit function, default arguments.
(10L)

Introduction to Advanced Python: Objects and Classes, Inheritance, Regular Expressions,Event Driven Programming, GUI Programming.
(14L)

Reference Books:

1. P. K. Sinha & Priti Sinha , "Computer Fundamentals", BPB Publications, 2007.
2. Dr. Anita Goel, Computer Fundamentals, Pearson Education, 2010.
3. T. Budd, Exploring Python, TMH, 1st Ed, 2011
4. Python Tutorial/Documentation www.python.or 2010
5. Allen Downey, Jeffrey Elkner, Chris Meyers , How to think like a computer scientist : learning with Python , Freely available online.2012

6. http://docs.python.org/3/tutorial/index.html
7. http://interactivepython.org/courselib/static/pythonds
8. http://www.ibiblio.org/g2swap/byteofpython/read/

CMSGCOR01P: Problem Solving with Computer

Section: A (Simple programs)

1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.
2. WAP to calculate total marks, percentage and grade of a student. Marks obtained in each of the three subjects are to be input by the user. Assign grades according to the following criteria :
    a. Grade A: Percentage >=80
    b. Grade B: Percentage>=70 and <80
    c. Grade C: Percentage>=60 and <70
    d. Grade D: Percentage>=40 and <60
    e. Grade E: Percentage<40
3. Write a menu-driven program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.
4. WAP to display the first n terms of Fibonacci series.
5. WAP to find factorial of the given number.
6. WAP to find sum of the following series for n terms: 1 – 2/2! + 3/3! - - - - - n/n!
7. WAP to calculate the sum and product of two compatible matrices.

Section: B (Visual Python):

All the programs should be written using user defined functions, wherever possible.

1. Write a menu-driven program to create mathematical 3D objects
    I. curve
    II. sphere
    III. cone
    IV. arrow
    V. ring
    VI. Cylinder.
2. WAP to read n integers and display them as a histogram.
3. WAP to display sine, cosine, polynomial and exponential curves.
4. WAP to plot a graph of people with pulse rate p vs. height h. The values of p and h are to be entered by the user.
5. WAP to calculate the mass m in a chemical reaction. The mass m (in gms) disintegrates according to the formula m=60/(t+2), where t is the time in hours. Sketch a graph for t vs. m, where t>=0.
6. A population of 1000 bacteria is introduced into a nutrient medium. The population p grows as follows:

    $$P(t) = (15000(1+t))/(15+ e)$$

    where the time t is measured in hours. WAP to determine the size of the population at given time t and plot a graph for P vs t for the specified time interval.

7. Input initial velocity and acceleration, and plot the following graphs depicting equationsof motion:
    I. velocity wrt time (v=u+at)
    II. distance wrt time (s=u*t+0.5*a*t*t)
    III. distance wrt velocity (s=(v*v-u*u)/2*a)

CMSGCOR02T: Database Management Systems

Introduction to Database Management Systems: Characteristics of database approach, datamodels, DBMS architecture and data independence.
(10L)

Entity Relationship and Enhanced ER Modeling: Entity types, relationships, SQL-99: Schema Definition , constraints, and object modeling. (15L)

Relational Data Model : Basic concepts, relational constraints, relational algebra, SQLqueries. (15L)

Database design: ER and EER to relational mapping, functional dependencies, normal forms up to third normal form. (20 L)

Books Recommended:

1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems 6th Edition, Pearson Education, 2010.
2. R. Ramakrishanan, J. Gehrke, Database Management Systems 3rd Edition, McGraw-Hill, 2002.
3. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6th Edition, McGraw Hill, 2010.
4. R. Elmasri, S.B. Navathe Database Systems Models, Languages, Design and application Programming, 6th Edition, Pearson Education, 2013.

CMSGCOR02P: Database Management Systems

Note: MyAccess/MySQL may be used.

The following concepts must be introduced to the students:

DDL Commands

- Create table, alter table, drop table

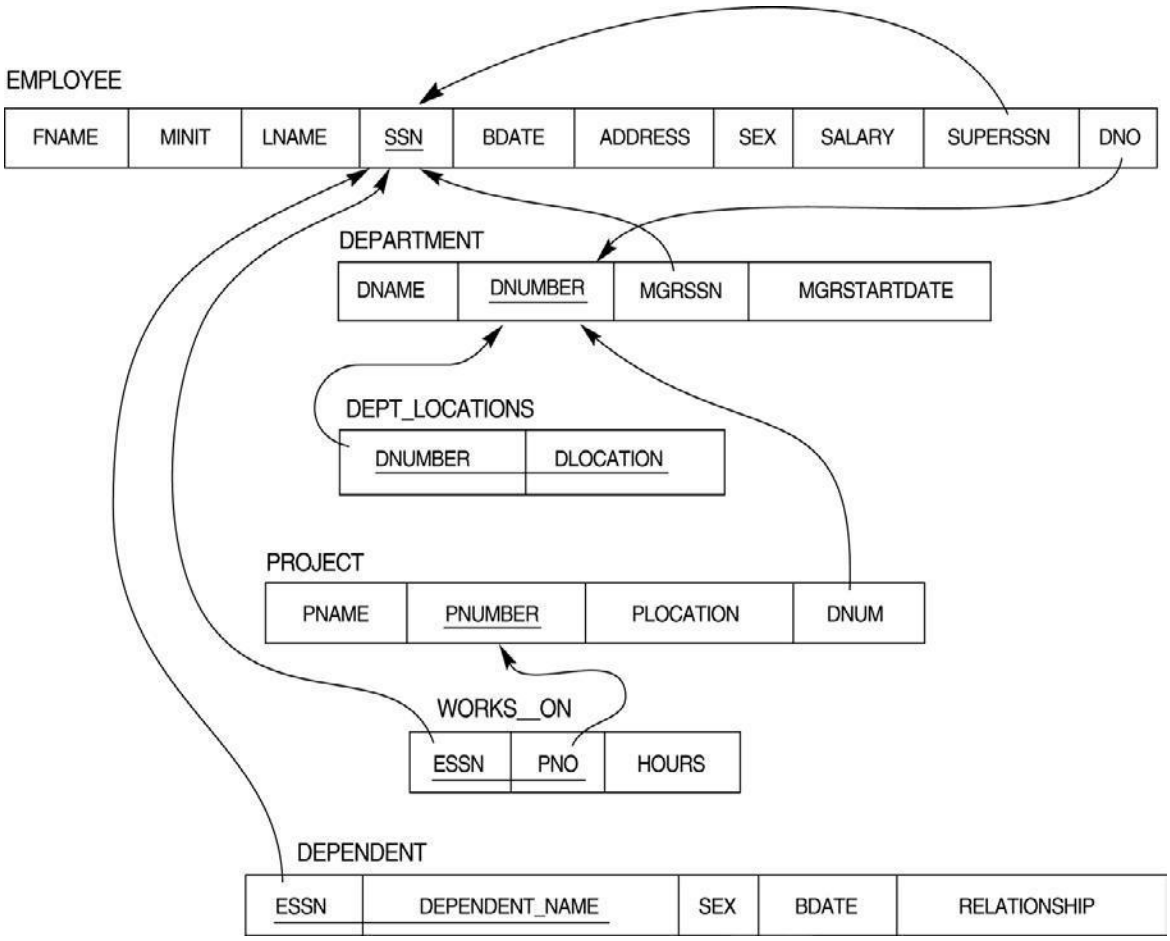
DML Commands

- Select , update, delete, insert statements
- Condition specification using Boolean and comparison operators (and, or, not,=,<>,>,<,>=,<=)
- Arithmetic operators and aggregate functions(Count, sum, avg, Min, Max)
- Multiple table queries (join on different and same tables)
- Nested select statements
- Set manipulation using (any, in, contains, all, not in, not contains,

exists, not exists, union, intersect, minus, etc.)

- Categorization using group by……..having
- Arranging using order by

Relational Database Schema - COMPANY



Questions to be performed on above schema

1. Create tables with relevant foreign key constraints
2. Populate the tables with data
3. Perform the following queries on the database :
    1. Display all the details of all employees working in the company.
    2. Display ssn, lname, fname, address of employees who work in department no 7.
    3. Retrieve the birthdate and address of the employee whose name is 'Franklin T. Wong'
    4. Retrieve the name and salary of every employee
    5. Retrieve all distinct salary values.
    6. Retrieve all employee names whose address is in ‘Bellaire’
    7. Retrieve all employees who were born during the 1950s
    8. Retrieve all employees in department 5 whose salary is between 50,000 and 60,000(inclusive)
    9. Retrieve the names of all employees who do not have supervisors
    10. Retrieve SSN and department name for all employees
    11. Retrieve the name and address of all employees who work for the 'Research' department
    12. For every project located in 'Stafford', list the project number, the controlling department number, and the department manager's last name, address, and birthdate.
    13. For each employee, retrieve the employee's name, and the name of his or her immediate supervisor.
    14. Retrieve all combinations of Employee Name and Department Name
    15. Make a list of all project numbers for projects that involve an employee whose last name is 'Narayan’ either as a worker or as a manager of the department that controls the project.
    16. Increase the salary of all employees working on the 'ProductX' project by 15%. Retrieve employee name and increased salary of these employees.
    17. Retrieve a list of employees and the project name each works in, ordered by the employee's department, and within each department ordered alphabetically by employee first name.
    18. Select the names of employees whose salary does not match with salary of any employee in department 10.
    19. Retrieve the name of each employee who has a dependent with the same first

name and same sex as the employee.
20. Retrieve the employee numbers of all employees who work on project located in Bellaire, Houston, or Stafford.
21. Find the sum of the salaries of all employees, the maximum salary, the minimum salary, and the average salary. Display with proper headings.
22. Find the sum of the salaries and number of employees of all employees of the 'Marketing' department, as well as the maximum salary, the minimum salary, and the average salary in this department.
23. Select the names of employees whose salary is greater than the average salary of all employees in department 10.
24. For each department, retrieve the department number, the number of employees in the department, and their average salary.
25. For each project, retrieve the project number, the project name, and the number of employees who work on that project.
26. Change the location and controlling department number for all projects having more than 5 employees to 'Bellaire' and 6 respectively.
27. For each department having more than 10 employees, retrieve the department no, no of employees drawing more than 40,000 as salary.
28. Insert a record in Project table which violates referential integrity constraint with respect to Department number. Now remove the violation by making necessary insertion in the Department table.
29. Delete all dependents of employee whose ssn is '123456789'.
30. Delete an employee from Employee table with ssn = '12345'(make sure that this employee has some dependents, is working on some project, is a manager of some department and is supervising some employees). Check and display the cascading effect on Dependent and Works on table. In Department table MGRSSN should be set to default value and in Employee table SUPERSSN should be set to NULL
31. Perform a query using alter command to drop/add field and a constraint in Employee table.

CMSGCOR03T: Operating Systems

Introduction: System Software, Resource Abstraction, OS strategies. (2L)
Types of operating systems - Multiprogramming, Batch, Time Sharing, Single user and
Multiuser, Process Control & Real Time Systems. (2L)

Operating System Organization: Factors in operating system design, basic OS functions,implementation consideration; process modes, methods of requesting system services – system

calls and system programs. (10L)

Process Management : System view of the process and resources, initiating the OS, processaddress space, process abstraction, resource abstraction, process hierarchy, Thread model (15L) **Scheduling:** Scheduling Mechanisms, Strategy selection, non-pre-emptive and pre-emptive

strategies. (12L)

Memory Management: Mapping address space to memory space, memory allocation

strategies, fixed partition, variable partition, paging, virtual memory (12L)

Shell introduction and Shell Scripting

(7L)

- What is shell and various type of shell, Various editors present in linux
- Different modes of operation in vi editor
- What is shell script, Writing and executing the shell script
- Shell variable (user defined and system variables)
- System calls, Using system calls
- Pipes and Filters
- Decision making in Shell Scripts (If else, switch), Loops in shell
- Functions
- Utility programs (cut, paste, join, tr , uniq utilities)
- Pattern matching utility (grep)

Books Recommended:

1. A Silberschatz, P.B. Galvin, G. Gagne, Operating Systems Concepts, 8th Edition, John Wiley Publications 2008.
2. A.S. Tanenbaum, Modern Operating Systems, 3rd Edition, Pearson Education 2007.
3. G. Nutt, Operating Systems: A Modern Perspective, 2nd Edition Pearson Education 1997.
4. W. Stallings, Operating Systems, Internals & Design Principles, 5th Edition, Prentice Hall of India. 2008.
5. M. Milenkovic, Operating Systems- Concepts and design, Tata McGraw Hill 1992.

CMSGCOR03P: Software Lab based on Operating Systems

Note: Following exercises can be performed using Linux or Unix

1. Usage of following commands:
   ls, pwd, tty, cat, who, who am I, rm, mkdir, rmdir, touch, cd.
2. Usage of following commands:
   cal, cat(append), cat(concatenate), mv, cp, man, date.
3. Usage of following commands:

chmod, grep, tput (clear, highlight), bc.

4. Write a shell script to check if the number entered at the command line is prime or not.
5. Write a shell script to modify "cal" command to display calendars of the specified months.
6. Write a shell script to modify "cal" command to display calendars of the specified range of months.
7. Write a shell script to accept a login name. If not a valid login name display message – "Entered login name is invalid".
8. Write a shell script to display date in the mm/dd/yy format.
9. Write a shell script to display on the screen sorted output of "who" command along with the total number of users.
10. Write a shell script to display the multiplication table any number,
11. Write a shell script to compare two files and if found equal asks the user to delete the duplicate file.
12. Write a shell script to find the sum of digits of a given number.
13. Write a shell script to merge the contents of three files, sort the contents and then display them page by page.
14. Write a shell script to find the LCD(least common divisor) of two numbers.
15. Write a shell script to perform the tasks of basic calculator.
16. Write a shell script to find the power of a given number.
17. Write a shell script to find the factorial of a given number.
18. Write a shell script to check whether the number is Armstrong or not.
19. Write a shell script to check whether the file have all the permissions or not.
20. Program to show the pyramid of special character "*".

CMSGCOR04T: Computer System Architecture

Introduction: Logic gates, boolean algebra, combinational circuits, circuit simplification, flip-flops and sequential circuits, decoders, multiplexors, registers, counters and memory units. (12L)

Data Representation and basic Computer Arithmetic: Number systems, complements, fixed and floating point representation, character representation, addition, subtraction, magnitude comparison. (8L)

Basic Computer Organization and Design: Computer registers, bus system, instructionset, timing and control, instruction cycle, memory reference, input-output and interrupt.(18L)

Central Processing Unit: Register organization, arithmetic and logical micro-operations, stack organization, micro programmed control. (10L)

Programming the Basic Computer: Instruction formats, addressing modes, instruction codes, machine language, assembly language, input output programming. (8L)

Input-output Organization: Peripheral devices, I/O interface, Modes of data transfer, direct memory access. (4L)

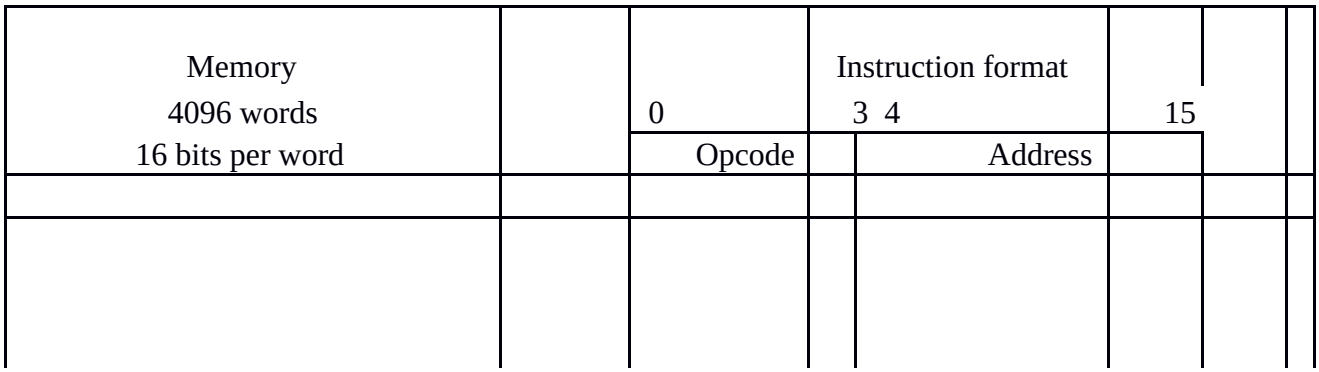
Books Recommended:

1. M. Mano, Computer System Architecture, Pearson Education 1992.
2. A. J. Dos Reis, Assembly Language and Computer Architecture using C++ and JAVA, Course Technology, 2004

3. W. Stallings, Computer Organization and Architecture Designing for Performance, 8th Edition, Prentice Hall of India ,2009
4. Digital Design, M.M. Mano, Pearson Education Asia, 1979

CMSGCOR04P: Computer System Architecture Lab

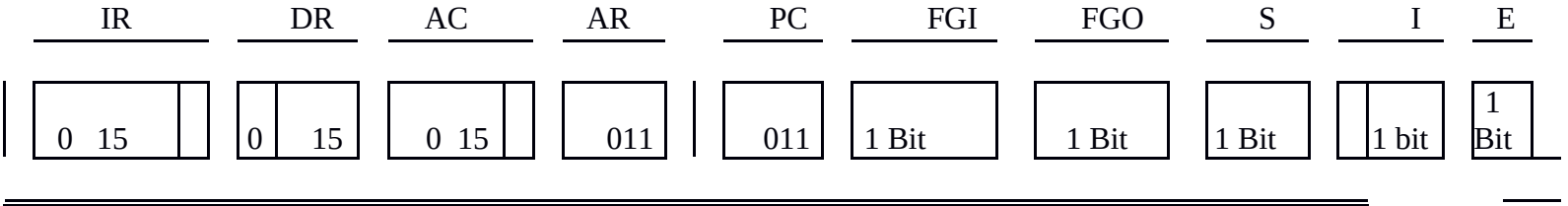
Practical: 60 Lab Periods



Basic Computer Instructions

Memory Reference Register Reference Input-Output

1. Create a machine based on the following architecture: Register Set



Symbol	Hex		Symbol	Hex		Symbol	Hex
							F80
AND	0xxx		CLA	E800		INP	0
							F40
ADD	2xxx		CLE	E400		OUT	0
ISZ	Cxxx		INC	E020			
AND_I	1xxx		SPA	E010			

	ADD_I	3xxx			SNA		E008				
	LDA_I	5xxx	Indirect		SZA		E004				
	STA_I	7xxx	Addressing		SZE		E002				
	BUN_I	9xxx			HLT		E001				
	BSA_I	Bxxx									
	ISZ_I	Dxxx									

Refer to Chapter-5 of Morris Mano for description of instructions.

ii) Create the micro operations and associate with instructions as given in the chapter (except interrupts). Design the register set, memory and the instruction set. Use this machine for the assignments of this section.

iii) Create a Fetch routine of the instruction cycle.

iv) Simulate the machine to determine the contents of AC, E, PC, AR and IR registers in hexadecimal after the execution of each of following register reference instructions:

a. CLA
b. CLE
c. CMA
d. CME
e. CIR
f. CIL
g. INC
h. SPA
i. SNA
j. SZA
k. SZE
l. HLT

Initialize the contents of AC to $(A937)_{16}$, that of PC to $(022)_{16}$ and E to 1.

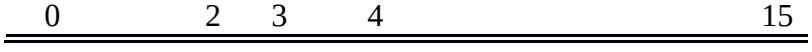
5. Simulate the machine for the following memory-reference instructions with I= 0 and address part = 082. The instruction to be stored at address 022 in RAM. Initialize the memory word at address 082 with the operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.

a. ADD
b. AND
c. LDA
d. STA
e. BUN
f. BSA
g. ISZ

6. Simulate the machine for the memory-reference instructions referred in above question with I= 1 and address part = 082. The instruction to be stored at address 026 in RAM. Initialize the memory word at address 082 with the value 298. Initialize the memory word at address 298 with operand B8F2 and AC with A937. Determine the contents of AC, DR, PC, AR and IR in hexadecimal after the execution.

7. Modify the machine created in Practical 1 according to the following instruction format:

Instruction format



Opcode		I		Address

a. The instruction format contains a 3-bit opcode, a 1-bit addressing mode and a 12-bit address. There are only two addressing modes, I = 0 (direct addressing) and I = 1 (indirect addressing).
b. Create a new register I of 1 bit.
c. Create two new microinstructions as follows :
   i. Check the opcode of instruction to determine type of instruction (Memory Reference/Register Reference/Input-Output) and then jump accordingly.
   ii. Check the I bit to determine the addressing mode and then jump accordingly.

Discipline Specific Elective Papers:

CMSGDSE01T: Programming in Java **75 Lectures**

AdditionalTutorial: 15 Lectures

Introduction to Java: Features of Java, JDK Environment (2L)

Object Oriented Programming Concept Overview of Programming, Paradigm, Classes,Abstraction, Encapsulation, Inheritance, Polymorphism, Difference between C++ and JAVA (12L)

Java Programming Fundamental : Structure of java program, Data types, Variables, Operators,Keywords, Naming Convention, Decision Making (if, switch),Looping(for, while) ,Type Casting (12L)

Classes and Objects: Creating Classes and objects, Memory allocation for objects, Constructor,

Implementation of Inheritance, Implementation of Polymorphism, Method Overloading, Method Overriding, Nested and Inner classes (12L)

Arrays and Strings: Arrays, Creating an array, Types of Arrays, String class Methods, StringBuffer methods. (8L)

Abstract Class, Interface and Packages: Modifiers and Access Control, Abstract classes and methods, Interfaces, Packages Concept, Creating user defined packages (10L)

Exception Handling: Exception types, Using try catch and multiple catch, Nested try, throw, throws and finally, Creating User defined Exceptions. (6L)

File Handling: Byte Stream, Character Stream, File IO Basics, File Operations, Creating file, Reading file, Writing File (6L)

Applet Programming: Int**r**oduction, Types Applet, Applet Life cycle, Creating Applet, Applet tag (7L)

Books Recommended:

1. Ivan Bayross, Web Enabled Commercial Application Development Using Html, Dhtml,javascript, Perl Cgi , BPB Publications, 2009.

2. Cay Horstmann, BIG Java, Wiley Publication , 3rd Edition., 2009
3. Herbert Schildt , Java 7, The Complete Reference, , 8th Edition, 2009.
4. E Balagurusamy , Programming with JAVA, TMH, 2007

CMSGDSE02T: Discrete Structures 75 Lectures

AdditionalTutorial: 15 Lectures

Introduction: Introduction to Sets, Finite and Infinite Sets, Unaccountably Infinite Sets. Introduction to Functions and relations, Properties of Binary relations, Closure, Partial Ordering Relations. (15L)

Unit-II: Pigeonhole Principle, Permutation and Combinations, Mathematical Induction, Principle of Inclusion and Exclusion. (15L)

Unit-III : Asymptotic Notations (5)

Recurrence Relations: Introduction, Generating Functions, Linear Recurrence Relations with constant coefficients and their solution. (15L)

Graphs Theory: Basic Terminology of Graphs, Models and Types, Multigraphs, Weighted Graphs, Graph Representation. Graph Isomorphism Graph Connectivity, Euler and Hamiltonian Paths and Circuits, Planar Graphs, Graph Coloring, Basic Terminology of Trees, Properties of Trees, Spanning Trees. (15L)

Inference Theory: Introduction, Logical Connectives, Well Formed Formulas, Tautologies, Equivalence (10L)

Books Recommended:

1. C. L. Liu and D.P. Mohapatra, Elements of Discrete Mathematics, Third Edition, Tata McGraw Hill , 2008.
2. K. Rosen, Discrete Mathematics and Its Applications, Sixth Edition, Tata McGraw Hill,2007.
3. T.H. Cormen, C.E. Leiserson, R.L. Rivest, Introduction to Algorithms, Third Edition,Prentice Hall of India,2010.
4. J.P. Trembley, R. Manohar, Discrete Mathematical Structures with Application to Computer Science, First Edition, Tata McGraw Hill, 2001.
5. David Gries, Fred B. Schneider, A Logical Approach to Discrete Math, Springer, 2010

Online Reading/Supporting Material:

1. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer- science-fall-2005/

CMSGDSE03T: Software Engineering 75 Lectures

AdditionalTutorial: 15 Lectures

Software Process: Introduction, S/W Engineering Paradigm , life cycle models (water fall,incremental, spiral, evolutionary, prototyping, object oriented) , System engineering, computer based system, verification, validation, life cycle process, development process, system engineering hierarchy. (10L)

Software requirements: Functional and non-functional , user, system, requirement engineeringprocess, feasibility studies, requirements, elicitation, validation and management, software prototyping, prototyping in the software process, rapid prototyping techniques, user interface prototyping, S/W document. Analysis and modeling, data, functional and behavioral models,
structured analysis and data dictionary. (12L)

Design Concepts and Principles: Design process and concepts, modular design, designheuristic, design model and document, Architectural design, software architecture, data design, architectural design, transform and transaction mapping, user interface design, user interface design principles. Real time systems, Real time software design, system design, real time executives, data acquisition system, monitoring and control system. (15L)

Software Configuration Management: The SCM process, Version control, Change control,

Configuration audit, SCM standards. (10L)

Software Project Management: Measures and measurements, S/W complexity and sciencemeasure, size measure, data and logic structure measure, information flow measure. Estimations
for Software Projects, Empirical Estimation Models, Project Scheduling. (12L)

Testing: Taxonomy of software testing, levels, test activities, types of s/w test, black box testingtesting boundary conditions, structural testing, test coverage criteria based on data flow, mechanisms, regression testing, testing in the large. S/W testing strategies, strategic approach and issues, unit testing, integration testing, validation testing, system testing and debugging. (10L)

Trends in Software Engineering: Reverse Engineering and Re-engineering – wrappers – Case Study of CASE tools. (6L)

Books Recommended:

1. Roger S.Pressman, Software engineering- A practitioner's Approach, McGraw-Hill
2. Ian Sommerville, Software engineering, Pearson education Asia, 6th edition, 2000.
3. Pankaj Jalote- An Integrated Approach to Software Engineering, Springer Verlag, 1997.

4. James F Peters and Witold Pedryez, “Software Engineering – An Engineering Approach”, John Wiley and Sons, New Delhi, 2000.
5. Ali Behforooz and Frederick J Hudson, “Software Engineering Fundamentals”, Oxfor University Press, New Delhi, 1996.
6. Pfleeger, ”Software Engineering”, Pearson Education India, New Delhi, 1999.
7. Carlo Ghezzi, Mehdi Jazayari and Dino Mandrioli, “Fundamentals of Software Engineering”, Prentice Hall of India, New Delhi, 1991.

CMSGDSE04:Computer Networks 75 Lectures

AdditionalTutorial: 15 Lectures

Basic concepts : Components of data communication, standards and organizations, NetworkClassification, Network Topologies ; network protocol; layered network architecture; overview
of OSI reference model; overview of TCP/IP protocol suite. (20L)

Physical Layer : Cabling, Network Interface Card, Transmission Media Devices- Repeater, Hub, Bridge, Switch, Router, Gateway. (8L)

Data Link Layer : Framing techniques; Error Control; Flow Control Protocols; Shared media

protocols - CSMA/CD and CSMA/CA. (10L)

Network Layer : Virtual Circuits and Datagram approach, IP addressing methods – Subnetting;

Routing Algorithms (adaptive and non-adaptive) (10L)

Transport Layer: Transport services, Transport Layer protocol of TCP and UDP (8L)

Application Layer : Application layer protocols and services – Domain name system, HTTP,

WWW, telnet, FTP, SMTP (12L)

Network Security : Common Terms, Firewalls, Virtual Private Networks (7L)

Books Recommended:

1. B.A. Forouzan: Data Communication and Networking, 4th Edition, Tata McGraw Hill, 2007.
2. D.E. Comer, Internetworking with TCP/IP, Vol. I, Prentice Hall of India, 1998.
3. W. Stalling, Data & Computer Communication, 8th edition, Prentice Hall of India, 2006.
4. D. Bertsekas, R. Gallager, Data Networks, 2nd edition, Prentice Hall of India, 1992.

Skill Enhancement Courses (Credit: 02 each)

CMSSSEC01M: Programming in Python

Planning the Computer Program: Concept of problem solving, Problem definition, Programdesign, Debugging, Types of errors in programming, Documentation. (2L)

Techniques ofProblem Solving: Flowcharting, decision table, algorithms, Structured programming concepts,Programming methodologies viz. top-down and bottom-up programming.
Overview of Programming : Structure of a Python Program, Elements of (2L)
Python (3L)

Introduction to Python: Python Interpreter, Using Python as calculator, Python shell, Indentation.Atoms, Identifiers and keywords, Literals, Strings, Operators(Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator,
Increment or Decrement operator). (4L)
Creating Python Programs : Input and Output Statements, Control statements(Branching,Looping, Conditional Statement, Exit function, Difference between break, continue and pass.),
Defining Functions, default arguments.
(4L)

Reference Books

1. T. Budd, Exploring Python, TMH, 1st Ed, 2011
2. Python Tutorial/Documentation www.python.or 2015
3. Allen Downey, Jeffrey Elkner, Chris Meyers , How to think like a computer scientist : learning with Python , Freely available online.2012
4. http://docs.python.org/3/tutorial/index.html
5. http://interactivepython.org/courselib/static/pythonds
6. http://www.ibiblio.org/g2swap/byteofpython/read/

Software Lab Based on Python:

Section: A (Simple programs)

1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon users choice.
2. WAP to calculate total marks, percentage and grade of a student. Marks obtained in each of the three subjects are to be input by the user. Assign grades according to the following criteria :

   Grade A: Percentage >=80

   Grade B: Percentage>=70 and <80 Grade C: Percentage>=60 and <70 Grade D:

Percentage>=40 and <60 Grade

1. Percentage<40

1 Write a menu-driven program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input paramters from user.

2 WAP to display the first n terms of Fibonacci series.

3 WAP to find factorial of the given number.

4 WAP to find sum of the following series for n terms: 1 – 2/2! + 3/3! - - - - - n/n!

5 WAP to calculate the sum and product of two compatible matrices.

Section: B (Visual Python):

All the programs should be written using user defined functions, wherever possible.

4. Write a menu-driven program to create mathematical

3D objects I. curve

4. sphere

III. cone

IV. arrow

1. ring

VI. cylinder.

1. WAP to read n integers and display them as a histogram.

2. WAP to display sine, cosine, polynomial and exponential curves.

3. WAP to plot a graph of people with pulse rate p vs. height h. The values of p and h are to be entered by the user.

4. WAP to calculate the mass m in a chemical reaction. The mass m (in gms) disintegrates according to the formula m=60/(t+2), where t is the time in hours. Sketch a graph for t vs. m, where t>=0.

5. A population of 1000 bacteria is introduced into a nutrient medium. The population p grows as follows:

P(t) = (15000(1+t))/(15+ *e)*

where the time t is measured in hours. WAP to determine the size of the population at given time t and plot a graph for P vs t for the specified time interval.

1. Input initial velocity and acceleration, and plot the following graphs depicting equations of motion:

I. velocity wrt time (v=u+at)

II. distance wrt time (s=u*t+0.5*a*t*t)

a. distance wrt velocity (s=(v*v-u*u)/2*a)

1. WAP to show a ball bouncing between 2 walls. (Optional)

CMSSSEC02M:R-Programming

Introduction: Overview and History of R, Getting Help, Data Types, Subsetting, Vectorized **(5L)**
Operations, Reading and Writing Data. **(5L)**

Control Structures, Functions, lapply, tapply, split, mapply, apply, Coding Standards. **(5L)**

Scoping Rules, Debugging Tools, Simulation, R Profiler. **(5L)**

ReferenceBook

1. W. N. Venables, D. M. Smith, An Introduction to R, R-core team, 2015

Software Lab Based on R Programming:

1. Write a program that prints 'Hello World' to the screen.
2. Write a program that asks the user for a number n and prints the sum of the numbers 1 to n
3. Write a program that prints a multiplication table for numbers up to 12.
4. Write a function that returns the largest element in a list.
5. Write a function that computes the running total of a list.
6. Write a function that tests whether a string is a palindrome.
7. Implement the following sorting algorithms: Selection sort, Insertion sort, Bubble Sort
8. Implement linear search.
9. Implement binary search.
10. Implement matrices addition , subtraction and Multiplication

WBSU

CBCS curricula and syllabi for UG 2018

Ability Enhancement Course (AEC): Environmental Sciences

(2 credits = 30 classes)

Unit 1 : Multidisciplinary nature of environmental science **2 class**

- Definition, scope and importance
- Need for public awareness.

Unit 2 : Natural Resources **6 classes**

Renewable and non-renewable resources :

a) Forest resources : Use and over-exploitation, deforestation
b) Water resources : Use and over-utilization of surface and ground water, floods, drought, dams-benefits and problems.
c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources.
d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.
e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources.
f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Unit 3 : Ecosystems **5 classes**

- Concept of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the
- following ecosystem :-
    a) Forest ecosystem
    b) Grassland ecosystem
    c) Desert ecosystem
    d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 4 : Biodiversity and its conservation **5 classes**

- Introduction – Definition : genetic, species and ecosystem diversity.
- Biogeographical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation
- Hot-sports of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity**.**

Unit 5 : Environmental Pollution **5 classes**

- Types, Causes, effects and control measures of :-
    a. Air pollution
    b. Water pollution
    c. Soil pollution
    d. Marine pollution
    e. Noise pollution
    f. Thermal pollution
    g. Nuclear hazards

- Solid waste Management : Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management : floods, earthquake, cyclone and landslides.

Unit 6 : Social Issues and the Environment **4 classes**

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rahabilitation of people; its problems and concerns.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Public awareness.

Unit 7 : Human Population and the Environment **3 classes**

- Population growth, variation among nations.
- Population explosion – Family Welfare Programme.
- Environment and human health.
- Human Rights.
- Value Education.
- HIV/AIDS.
- Women and Child Welfare.
- Role of Information Technology in Environment and human health.

Text Book:

Text Book for Environmental Studies by Erach Bharucha (University Press)

Draft CBCS Syllabus
for
Undergraduate Courses in Geography

TO BE EFFECTIVE FROM THE ACADEMIC SESSION 2018-19

West Bengal State University

March, 2018

Choice Based Credit System (CBCS): Syllabus in Geography

INTRODUCTION: In compliance with recent directives from the University Grants Commission, the undergraduate syllabus for Geography is reframed into Choice Based Credit System following the model syllabus prepared by the West Bengal State Council of Higher Education.

The main objective of this new curriculum is to give the students a holistic understanding of the subject putting equal weightage to the core content and techniques used in Geography. The syllabus tries to give equal importance to the two main branches of Geography: Physical and Human.

The principal goal of the syllabus is to enable the students to secure a job at the end of the undergraduate programme. Keeping this in mind and in tune with the changing nature of Geography, adequate emphasis is rendered on applied aspects of the subject such as emerging techniques of mapping and field-based data generation. The syllabus emphasises on development of basic skills of the subject, so that everyone need not go for higher studies in search of professional engagement or employment.

LEARNING OUTCOMES: This syllabus is designed to impart basic knowledge on geography as a spatial science and train the undergraduates to secure employment in the sectors of geospatial analysis, development and planning, mapping and surveying.

Contents

1. Scheme for CBCS Curriculum for Geography Honours (B.Sc.)
2. Core Courses Syllabus for Geography Honours
3. Department Specific Elective Courses Syllabus for Geography Honours
4. Syllabus of Generic Elective Courses offered by Geography department for other Honours students
5. Scheme for CBCS Curriculum for Geography General (B.Sc.)
6. Core Courses Syllabus for Geography General
7. Department Specific Elective Courses Syllabus for Geography General
8. Skill Enhancement Courses Syllabus common for Honours and General

1. Scheme for the CBCS Curriculum for Geography Honours (B.Sc.)

1.1 Credit Distribution across Courses

Course Type B.Sc. Honours	Total Courses	Credits	
		THEORY + PRACTICAL	THEORY + TUTORIAL*
Core Course: Geography (C)	14	14×4 = 56 14×2 = 28	14×5 = 70 14×1 = 14*
Discipline Specific Electives (DSE)	4	4×4 = 16 4×2 = 08	4×5 = 20 4×1 = 04*
Generic Electives (GE)	4	4×4 = 16 4×2 = 08	4×5 = 20 4×1 =0 4*
Ability Enhancement Compulsory Courses (AECC)	2	2×2 = 04	2 × 2=04
Skill Enhancement Courses (SEC)	2	2×2 = 04	2 × 2=04
Total	26	140	140

*Tutorials of 1 Credit will be conducted in case there is no practical component

1.2 Computation of work-load per week

Type of Course	Credit	Duration of Periods
Tutorial Class	1	1 Theoretical class of 1 hour duration
Theory (T)	1	1 Theoretical class of 1 hour duration
Practical (P)	1	1 Practical class of 2 hour duration
Semester Duration: 15 weeks of direct teaching		

1.3 List of Generic Elective subjects to be offered with Geography Honours

1. Political Science	4. Statistics
2. Economics	5. Zoology
3. Mathematics	6. Anthropology or Computer Science

Any 2 (two) GE subjects to be chosen from the above list and from each subject two courses to be taken.

1.4 Distribution of Courses across semesters for Geography Honours (B.Sc.)

Semester	Course	Course Code	Title	Credit	Marks	Remarks
I	Core	GEOACOR01T	Geotectonics and Geomorphology	04	50	Compulsory
		GEOACOR01P	Geotectonics and Geomorphology (Lab)	02	25	Compulsory
	Core	GEOACOR02T	Cartographic Techniques	04	50	Compulsory
		GEOACOR02P	Cartographic Techniques (lab)	02	25	Compulsory
	GE	XXXHGEC01T		06	75	One course of a subject (Eg. A) chosen from the list of subjects given in section 1.3
	AECC	ENGSAEC01M	Communicative English	02	25	Compulsory
II	Core	GEOACOR03T	Human Geography	06	75	Compulsory
	Core	GEOACOR04T	Cartograms and Thematic Mapping	04	50	Compulsory
		GEOACOR04P	Cartograms and Thematic Mapping (Lab)	02	25	Compulsory
	GE	XXXHGEC02T		06	75	Second course of the same subject (A) taken as XXXHGEC01T
	AECC	ENVSAEC02T	Environment Studies	02	25	Compulsory
III	Core	GEOACOR05T	Climatology	04	50	Compulsory
		GEOACOR05P	Climatology (Lab)	02	25	
	Core	GEOACOR06T	Geography of India	06	75	
	Core	GEOACOR07T	Statistical Methods in Geography	04	50	
		GEOACOR07P	Statistical Methods in Geography Lab	02	25	
	GE	XXXHGEC03T		06	75	One course of a subject (Eg. B) chosen from the list of subjects given in section 1.3
	SEC	GEOSSEC01M	Remote Sensing	02	25	Compulsory

IV	Core	GEOACOR08T	Regional Planning and Development	06	75	Compulsory
	Core	GEOACOR09T	Economic Geography	06	75	Compulsory
	Core	GEOACOR10T	Environmental Geography	04	50	Compulsory
		GEOACOR10P	Environmental Geography (Lab)	02	25	
	GE	XXXAGEC04T		06	75	Second course of the same subject (B) taken as XXXHGEC03T
	SEC	GEOSSEC02M	Advanced Spatial Statistical Techniques	02	25	Compulsory
V	Core	GEOACOR11T	Field Work and Research Methodology	04	50	Compulsory
		GEOACOR11P	Field Work and Research Methodology (Lab)	02	25	
	Core	GEOACOR12T	Remote Sensing and GIS	04	50	Compulsory
		GEOACOR12P	Remote Sensing and GIS (Lab)	02	25	
	DSE	GEOADSE01T	Soil and Biogeography	06	75	Compulsory
	DSE	GEOADSE02T	Settlement Geography	06	75	Students to choose any one of the two courses (02T or 03T)
		GEOADSE03T	Population Geography	06	75	
VI	Core	GEOACOR13T	Evolution of Geographical Thought	06	75	Compulsory
	Core	GEOACOR14T	Disaster Management	04	50	Compulsory
		GEOACOR14P	Disaster Management (Lab)	02	25	Compulsory
	DSE	GEOADSE04T	Hydrology and Oceanography	06	75	Compulsory
		GEOADSE05T	Social Geography	06	75	Students to choose any one of the two courses (05T or 06T)
	DSE	GEOADSE06T	Resource Geography	06	75	

1.5 Core Subjects

Code (Theory)	Code (Practical)	Course name
GEOACOR01T	GEOACOR01P	Geotectonics and Geomorphology
GEOACOR02T	GEOACOR02P	Cartographic Techniques
GEOACOR03T		Human Geography
GEOACOR04T	GEOACOR04P	Cartograms and Thematic Mapping
GEOACOR05T	GEOACOR05P	Climatology
GEOACOR06T		Geography of India
GEOACOR07T	GEOACOR07P	Statistical Methods in Geography
GEOACOR08T		Regional Planning and Development
GEOACOR09T		Economic Geography
GEOACOR10T	GEOACOR10P	Environmental Geography
GEOACOR11T	GEOACOR11P	Field Work and Research Methodology
GEOACOR12T	GEOACOR12P	Remote Sensing and GIS
GEOACOR13T		Evolution of Geographical Thought
GEOACOR14T	GEOACOR14P	Disaster Management

1.6 Choices for Four Discipline Specific Electives

Code	Course name
GEOADSE01T	Soil and Biogeography
GEOADSE02T	Settlement Geography
GEOADSE03T	Population Geography
GEOADSE04T	Hydrology and Oceanography
GEOADSE05T	Social Geography
GEOADSE06T	Resource Geography

1.7 Choices for Four Generic Electives for Honours Students of Other Disciplines

Code	Course name
GEOHGEC01T	Physical Geography
GEOHGEC02T	Human Geography
GEOHGEC03T	General Cartography
GEOAGEC04T	Environmental Geography

1.8 Choices for Two Skill Enhancement Courses

Code	Course name
GEOSSEC01M	Remote Sensing
GEOSSEC02M	Advanced Spatial Statistical Techniques

2. Core Course Syllabus

GEOACOR01T – Geotectonics and Geomorphology ✧

4 Credits, 50 Marks [60 classes]

Unit I: Geotectonics

1. Earth's tectonic and structural evolution with reference to geological time scale
2. Earth's interior with special reference to seismology. Isostasy: Models of Airy and Pratt
3. Plate Tectonics as a unified theory of global tectonics: Processes and landforms at plate margins and hotspots
4. Folds and Faults—origin and types

Unit II: Geomorphology

5. Degradational processes: Weathering, mass wasting and resultant landforms
6. Development of river network and landforms on uniclinal and folded structures
7. Development of landforms on granites, basalts and limestones.
8. Coastal processes and landforms
9. Glacial and glacio-fluvial processes and landforms
10. Aeolian and fluvio-aeolian processes and landforms
11. Models on landscape evolution: Views of Davis, Penck and Hack

Reading List

Billings, M.P. 1971. Structural Geology, Pearson.

Frisch, W., Meschede, M., Blakey, R.C. 2011. Plate Tectonics: Continental Drift and Mountain Building. Springer.

Goudie, A.S. (Ed) 2004. Encyclopaedia of Geomorphology, vol. 1 & 2, Routledge.

Gregory, K.J., Lewin, J. 2014. The Basics of Geomorphology: Key Concepts, Sage.

Harvey, A. 2012.Introducing Geomorphology: A Guide to Landforms and Processes, Dunedin Academic Press.

Kale, V.S., Gupta, A. 2001.Introduction to Geomorphology, Orient Longman.

Kearey, P., Klepeis, K.A., Vine, F.J. 2011. Global Tectonics, 3rd ed, Wiley-India.

Knighton, A.D. 1984. Fluvial Forms and Processes, Edward Arnold.

Selby, M.J. 1986. Earth's Changing Surface, Oxford University Press.

Strahler, A. 2016. Introducing Physical Geography, 6th ed, Wiley.

Summerfield, M.J. 2003. Global Geomorphology: An Introduction to the Study of landforms, Longman.

Thornbury, W.D. 1969. Principles of Geomorphology, 2nd ed, Wiley-India / CBS.

GEOACOR01P – Geotectonics and Geomorphology ✧

2 Credits, 25 Marks [60 classes]

1. Megascopic identification of (a) *mineral samples*: Bauxite, calcite, chalcopyrite, feldspar, galena, gypsum, hematite, magnetite, mica, quartz, talc, tourmaline; and (b) *rock samples*: Granite, basalt, dolerite, laterite, limestone, shale, sandstone, conglomerate, slate, phyllite, schist, gneiss, quartzite, marble
2. Interpretation of geological maps with unconformity and intrusions on uniclinal and folded structures

Reading List

Farndon, J. 2012. The Illustrated Guide to Rocks & Minerals, Southwater.

McCullough, P.K. 1978. Modern Concept in Geomorphology, Oxford University Press.

Pillent, C. 2002. Smithsonian Handbooks: Rocks & Minerals, Dorling Kindersley.

Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan Private Ltd.

Sen, P.K. 1989. Geomorphological Analysis of Drainage Basin: An Introduction to Morphometric and Hydrological Parameters, University of Burdwan.

Sorrell, C.A. Rocks and Minerals: A Guide to Field Identification, St. Martin's Press.

GEOACOR02T – Cartographic Techniques✧

4 Credit, 50 Marks [60 classes]

1. Maps: Classification and types. Components of a map
2. Concept and application of scales: Plain, comparative, diagonal and vernier
3. Survey of India topographical maps: Reference scheme of old and open series. Information on the margin of maps
4. Coordinate systems: Polar and rectangular
5. Concept of generating globe and UTM projection
6. Grids: angular and linear systems of measurement
7. Map projections: Classification, properties and uses

Reading List

Kennedy, M., Kopp, S. 2001. Understanding Map Projections, Esri Press.

Kimerling, A.J., Buckley, A.R., Muehrcke, P.C., Muehrcke, J.O. 2011. Map Use: Reading, Analysis, Interpretation, 7th ed, Esri Press.

Monkhouse, F.J., Wilkinson, H.R. 1971. Maps and Diagrams: Their Compilation and Construction, 3rd ed (2017 reprint), Alphaneumera-Kolkata.

Pearson II, F. 1990. Map Projections: Theory and Applications 2nd ed, CRC Press.

Robinson, A.H., Morrison, J.L., Phillip, C.M., Kimerling, A.J., Guptill, S.C. 1995. Elements of Cartography, 6th ed, Wiley.

Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan Private Ltd.

Singh, R.L., Singh, R.P.B. 2008.Elements of Practical Geography, Kalyani Publishers.

Vaidyanadhan, R., Subbarao, K.V. 2014.Landforms of India from Topomaps and Images, Geological Society of India.

GEOACOR02P – Cartographic Techniques (Lab)✧

2 Credits, 25 Marks [90 classes]

1. Graphical construction of scales: Plain, comparative, diagonal and vernier
2. Construction of projections: Polar Zenithal Stereographic, Simple Conic with two standard parallels, Bonne's, Cylindrical Equal Area, and Mercator's
3. Delineation of drainage basin from Survey of India topographical map. Construction and interpretation of relief profiles (superimposed, projected and composite), relative relief map, slope map (Wentworth), and stream ordering (Strahler) on a drainage basin.
4. Correlation between physical and cultural features from Survey of India topographical maps using transect chart.

Reading List

Kennedy, M., Kopp, S. 2001. Understanding Map Projections, Esri Press.

Kimerling, A.J., Buckley, A.R., Muehrcke, P.C., Muehrcke, J.O. 2011. Map Use: Reading, Analysis, Interpretation, 7th ed, Esri Press.

Monkhouse, F.J., Wilkinson, H.R. 1971. Maps and Diagrams: Their Compilation and Construction, 3rd ed (2017 reprint), Alphaneumera-Kolkata.

Pearson II, F. 1990. Map Projections: Theory and Applications 2nd ed, CRC Press.

Robinson, A.H., Morrison, J.L., Phillip, C.M., Kimerling, A.J., Guptill, S.C. 1995. Elements of Cartography, 6th ed, Wiley.

Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan Private Ltd.

Singh, R.L., Singh, R.P.B. 2008.Elements of Practical Geography, Kalyani Publishers.

GEOACOR03T – Human Geography✧

6 Credits, 75 Marks [90 classes]

Unit I: Nature and Principles

1. Nature, scope and recent trends. Elements of Human Geography
2. Approaches to Human Geography; Resource, Locational, Landscape, Environmental
3. Concept and classification of race; ethnicity
4. Space, society and cultural regions (language and religion)

Unit :II: Society, Demography and Ekistics

5. Evolution of human societies: Hunting and food gathering, pastoral nomadism, subsistence farming and industrial society
6. Human adaptation to environment: Eskimo, Masai and Maori
7. Population growth and distribution, composition; demographic transition
8. Population–Resource regions (Ackerman)
9. Types and patterns of rural settlements
10. Morphology of urban settlements

Reading List

Chandna, R.C. 2016. Geography of Population: Concepts, Determinants and Patterns, Kalyani Publishers.

Fouberg, E.H., Murphy, A.B., de Blij H.J. 2015. Human Geography: People, Place, and Culture, 11th ed, Wiley.

Ghosh, S. 1998. Introduction to Settlement Geography, Sangam Books Ltd.

Gould, W.T.S. 2015.Population and Development, Routledge.

Gregory, D., Johnston, R., Pratt, G., Watts.,Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, 5th ed, Wiley.

Knox, P.L., Marston, S.A. 2014. Human Geography: Places and Regions in Global Context, 6th ed, Pearson Education Limited.

Knox, P.L., McCarthy, L.M. 2011. Urbanization: An Introduction to Urban Geography, 3rd ed, Pearson Educztuion Ltd.

Mandal, R.B. 2001. Introduction to Rural Settlement, 2nd ed, Concept Publishing Company.

Moseley, W.G., Perramond, E., Hapke, H.M., Laris, P. 2013. An Introduction to Human-Environment Geography: Local Dynamics and Global Processes, Wiley-Blackwell.

Norton, W. 2014. Human Geography, 8th ed, Oxford University Press.

Pickering K. and Owen A. A. (1997): An Introduction to Global Environmental Issues, 2nd edition Rutledge, London.

Rubenstein, J.M. 2016. The Cultural Landscape: An Introduction to Human Geography, 12th ed, Pearson Education Limited.

Short, R.J. 2017. Human Geography: A Short Introduction, 2nd ed, Oxford University Press.

GEOACOR04T – Cartograms and Thematic Mapping ✧

4 Credits, 50 Marks [60 classes]

1. Concepts of rounding, scientific notation, logarithm and anti-logarithm, natural and log scales
2. Diagrammatic representation of data: Line, Bar, Isopleths
3. Representation of area data: Dots and spheres, proportional circles and Choropleth
4. Preparation and interpretation of land use land cover maps
5. Preparation and interpretation of socio-economic maps
6. Bearing: Magnetic and true, whole-circle and reduced
7. Basic concepts of surveying and survey equipment: Prismatic Compass, Dumpy Level, Theodolite

Reading List

Basak, N.N. 2017. Surveying and Levelling, 2nd ed, McGraw Hill Education.

Bolton. T. 2009 (reprint). Geological Maps: Their Solution and Interpretation, Cambridge University Press.

Kanetkar, T.P., Kulkatni, S.V. 1988. Surveying and Levelling, Part I, Pune VidyarthiGrihaPrakashan.

Monkhouse, F.J., Wilkinson, H.R. 1971. Maps and Diagrams: Their Compilation and Construction, 3rd ed (2017 reprint), Alphaneumera-Kolkata.

Robinson, A.H., Morrison, J.L., Phillip, C.M., Kimerling, A.J., Guptill, S.C. 1995. Elements of Cartography, 6th ed, Wiley.

Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan Private Ltd.

Singh, R.L., Singh, R.P.B. 2008.Elements of Practical Geography, Kalyani Publishers.

Subramanian, R. 2012. Surveying and Levelling, 2nd ed, Oxford University Press

GEOACOR04P – Cartograms and Thematic Mapping (Lab) ✧

2 Credits, 25 Marks [60 classes]

1. Thematic maps:
   - Choropleth showing density of population
   - Dots and Spheres diagram showing distribution of rural and urban population.
   - Proportional pie-diagrams representing economic data and land use data
2. Traverse survey using prismatic compass

Profile survey using dumpy Level

Reading List

Basak, N.N. 2017. Surveying and Levelling, 2nd ed, McGraw Hill Education.

Bolton. T. 2009 (reprint). Geological Maps: Their Solution and Interpretation, Cambridge University Press.

Kanetkar, T.P., Kulkatni, S.V. 1988. Surveying and Levelling, Part I, Pune VidyarthiGrihaPrakashan.

Monkhouse, F.J., Wilkinson, H.R. 1971. Maps and Diagrams: Their Compilation and Construction, 3rd ed (2017 reprint), Alphaneumera-Kolkata.

Robinson, A.H., Morrison, J.L., Phillip, C.M., Kimerling, A.J., Guptill, S.C. 1995. Elements of Cartography, 6th ed, Wiley.

Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan Private Ltd.

Singh, R.L., Singh, R.P.B. 2008.Elements of Practical Geography, Kalyani Publishers.

Subramanian, R. 2012. Surveying and Levelling, 2nd ed, Oxford University Press

GEOACOR05T – Climatology✧

4 Credits, 50 Marks [60 classes]

Unit I: Elements of the Atmosphere

1. Nature, composition and layering of the atmosphere
2. Insolation: controlling factors. Heat budget of the atmosphere
3. Temperature: horizontal and vertical distribution. Inversion of temperature: types, causes and consequences
4. Greenhouse effect and importance of ozone layer

Unit II: Atmospheric Phenomena and Climatic Classification

5. Condensation: Process and forms. Mechanism of precipitation: Bergeron-Findeisen theory, collision and coalescence. Forms of precipitation
6. Air mass: Typology, origin, characteristics and modification
7. Fronts: warm and cold; frontogenesis and frontolysis
8. Weather: stability and instability; barotropic and baroclinic conditions
9. Circulation in the atmosphere: Planetary winds, jet stream, index cycle
10. Tropical and mid-latitude cyclones
11. Monsoon circulation and mechanism with reference to India
12. Climatic classification after Köppen, Thornthwaite (1955) and Oliver

Reading List

BOOKS

Ahrens, C.D. 2012. Essentials of Meteorology: An Invitation to the Atmosphere. 9th Ed, Cengage Learning.

Barry R. G. and Carleton A. M., 2001: Synoptic and Dynamic Climatology, Routledge, UK.

Barry, R.G, Chorley R.J. 2009.Atmosphere Weather and Climate. 9th Ed, Routledge.

Critchfield, H. J. 1983. General Climatology. Prentice Hall India Ltd (2010 Reprint).

Lal, D.S. 2012. Climatology. Sharda PustakBhawan.

Lutgens, F.K., Tarbuck, E.J. 1998. The Atmosphere : An Introduction to Meteorology, 9th Ed, Prentice-Hall Inc.

Oliver, J.E., Hidore J.J. 2002. Climatology: An Atmospheric Science, Pearson Education India

GEOACOR05T – Climatology✧

2 Credits, 25 Marks [60 classes]

1. Interpretation of daily weather map of India (any two): Pre-Monsoon, Monsoon and Post-Monsoon
2. Construction and interpretation ofhythergraph andclimograph (G. Taylor)
3. Construction and interpretation of wind rose
4. A Project File, comprising of one exercise from each of the following is to be prepared and submitted

Reading List

Monkhouse, F.J., Wilkinson, H.R. 1971. Maps and Diagrams: Their Compilation and Construction, 3rd ed (2017 reprint), Alphaneumera-Kolkata.

Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan.

Singh, R.L., Singh, R.P.B. 2008.Elements of Practical Geography, Kalyani Publishers.

GEOACOR06T – Geography of India ✧

6 Credits, 75 Marks [90 classes]

Unit I: Geography of India

1. Tectonic and stratigraphic provinces, physiographic divisions
2. Climate, soil and vegetation: Characteristics and classification
3. Population: Distribution, growth, structure and policy
4. Tribes of India with special reference to Gaddi, Toda, Santal and Jarwa
5. Agricultural regions. Green revolution and its consequences
6. Mineral and power resources distribution and utilisation of iron ore, coal, petroleum and natural gas
7. Industrial development: Automobile and information technology
8. Regionalisation of India: Physiographic (R.L. Singh) and economic (P. Sengupta)

Unit II: Geography of West Bengal

9. Physical perspectives: Physiographic divisions, forest and water resources
10. Resources: Agriculture, mining, and industry
11. Population: Growth, distribution and human development
12. Regional Issues: Darjeeling Hills and Sundarban

Reading List

Bandyopadhyay, S., Kar, N.S., Das, S., Sen, J. 2014. River system and water resources of West Bengal: A Review. In: Vaidyanadhan, R. (Ed) Rejuvenation of Surface Water Resources of India: Potential, Problems and Prospects, Geological Society of India Special Publication.

Dhara, M.K., Basu, S.K., Bandyopadhyay, R.K., Roy, B., Pal, A.K. (Eds.) 1999. Geology and Mineral Resources of the States of India, Part-1: West Bengal. Geological Survey of India Miscellaneous Publication.

Ghurey, G.S. 1963. The Scheduled Tribes of India, 1980 reprint, Transaction Books.

Johnson, B.L.C. (Ed) 2001. Geographical Dictionary of India, Vision Books.

Khullar, D.R. 2011. India: A Comprehensive Geography, Kalyani Publishers

Mandal, H., Mukherjee, S., Datta, A. 2002. India: An Illustrated Atlas of Tribal World, Anthropological Survey of India.

Pathak, C.R. 2003. Spatial Structure and Processes of Development in India, Regional Science Association-Kolkata.

Sharma, T.C. 2012.Economic Geography of India, Rawat Publications.

Singh, J. 2003. India-A Comprehensive & Systematic Geography, GyanodayaPrakashan.

Singh, R.L. 1971. India: A Regional Geography, National Geographical Society of India.

Spate, O.H.K., Learmonth, A.T.A. 1967. India and Pakistan: A General and Regional Geography, Methuen.

Tiwari, R.C. 2007.Geography of India, PrayagPustakBhawan.

Valdiya, K.S. 2010. The Making of India: Geodynamic Evolution, Macmillan Pubishers India Ltd.

GEOACOR07T – Statistical Methods in Geography✧

4 Credits, 40 Marks [60 classes]

Unit I: Frequency Distribution and Sampling

1. Importance and significance of statistics in Geography
2. Discrete and continuous data, population and samples, scales of measurement (nominal, ordinal, interval and ratio),
3. Sources of geographical data for statistical analysis
4. Collection of data and formation of statistical tables
5. Sampling: Need, types, and significance and methods of random sampling
6. Theoretical distribution: frequency, cumulative frequency, normal and probability

Unit II: Numerical Data Analysis

7. Central tendency: Mean, median, mode, partition values
8. Measures of dispersion range: mean deviation, standard deviation, coefficient of variation
9. Association and correlation: Rank correlation, product moment correlation
10. Regression: Linear and non-linear
11. Time series analysis: Moving average

Reading List

Acevedo, M.F. 2012. Data Analysis and Statistics for Geography, Environmental Science and Engineering, CRC Press.

Harris, R., Jarvis, C. 2011. Statistics for Geography and Environmental Science, Prentice Hall.

McGrew Jr., J.C., Lembo Jr., A.J.,Monroe, C.B. 2014. An Introduction to Statistical Problem Solving in Geography, 3rd ed, Waveland Press.

Pal S. K., 1998. Sstatistics for Geoscientists: Techniques and Applications, Concept Pub Co.

Rogerson, P.A. 2015. Statistical Methods for Geography: A Student's Guide, 4th ed, Sage.

Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan.

GEOACOR07P – Statistical Methods in Geography (Lab)✧

2 Credits, 25 Marks [60 classes]

1. Construction of data matrix with each row representing an areal unit (districts / blocks / *mouzas* / towns) and corresponding columns of relevant attributes
2. Based on the above, a frequency table, measures of central tendency and dispersion would be computed and interpreted using histogram and frequency curve
3. From the data matrix a sample set (20%) would be drawn using, random, systematic and stratified methods of sampling and locate the samples on a map with a short note on methods used
4. Based on the sample set and using two relevant attributes, a scatter diagram and linear regression line would be plotted and residual from regression would be mapped with a short interpretation

Reading List

Acevedo, M.F. 2012. Data Analysis and Statistics for Geography, Environmental Science and Engineering, CRC Press.

Harris, R., Jarvis, C. 2011. Statistics for Geography and Environmental Science, Prentice Hall.

McGrew Jr., J.C., Lembo Jr., A.J.,Monroe, C.B. 2014. An Introduction to Statistical Problem Solving in Geography, 3rd ed, Waveland Press.

Pal S. K., 1998. Statistics for Geoscientists: Techniques and Applications, Concept Pub Co.

Rogerson, P.A. 2015. Statistical Methods for Geography: A Student's Guide, 4th ed, Sage.

Sarkar, A. 2015. Practical Geography: A Systematic Approach, 3rd ed, Orient Blackswan.

GEOACOR08T – Regional Planning and Development✧

6 Credits, 75 Marks [90 classes]

Unit I: Regional Planning

1. Concept of regions: Types of regions and their delineation
2. Regional Planning: Types, principles, objectives, tools and techniques
3. Need for regional planning in India, multi- level planning in India
4. Metropolitan concept and urban agglomerations

Unit I: Regional Development

5. Concepts of growth and development, growth versus development
6. Indicators of development: Economic, social and environmental
7. Human development: Concept and measurement
8. Theories and models for regional development: Cumulative causation (Myrdal)
9. Theories and models for regional development: Stages of development (Rostow), growth pole model (Perroux).
10. Concept and causes of underdevelopment
11. Regional development in India: Disparity and diversity
12. Need and measures for balanced development in India

Reading List

Bhargava, G. 2001. Development of India's Urban, Rural, and Regional Planning in 21st Century: Policy Perspective, Gyan Publishing House.

Chand, M., Puri, V.K. 2000. Regional Planning In India, Allied Publishers Ltd.

Chandana, R.C. 2016. Regional Planning and Development, 6th ed, Kalyani Publishers.

Glasson, J. 2017. Contemporary Issues in Regional Planning, Routledge.

Gore, C. 2011. Regions in Question: Space, Development Theory, and Regional Policy, Routledge.

Gregory, D., Johnston, R., Pratt, G., Watts.,Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, 5th ed, Wiley.

Hall, P., Tewdwr-Jones, M. 2010.Urban and Regional Planning, Routledge.

Higgins, B., Savoie, D.J. 2017. Regional Development: Theories and Their Application, Routledge.

Kulshetra, S.K. 2012. Urban and Regional Planning in India: A Handbook for Professional Practioners, Sage Publication.

Kumar, A., Meshram, D.S., Gowda, K. (Eds) 2016. Urban and Regional Planning Education: Learning for India, Springer.

Misra, R.P. 1992. Regional Planning: Concepts, Techniques , Policies and Case Studies, Concept Publishing.

Ray, J. 2001. Introduction to Development & Regional Planning, Orient Blackswan.

GEOACOR09T — Economic Geography✧

6 Credits, 75 Marks [90 classes]

Unit I: Concepts

1. Meaning and approaches to Economic Geography.
2. Concepts in Economic Geography: Goods and services, production, exchange and consumption
3. Concept of economic man, theories of choices
4. Economic distance and transport costs

Unit II: Economic Activities

5. Concept and classification of economic activities
6. Factors affecting location of economic activity with special reference to agriculture (Von Thünen), and industry (Weber).
7. Primary activities: Agriculture, forestry, fishing and mining
8. Secondary activities: Manufacturing (cotton textile, iron and steel), concept of manufacturing regions, special economic zones and technology parks
9. Tertiary activities: Transport, trade and services
10. Agricultural systems: Case studies of tea plantation in India and mixed farming in Europe
11. Transnational sea-routes, railways and highways with reference to India
12. International trade and economic blocs: WTO, GATT and BRICS: Evolution, structure and functions

Reading List

Alexander J. W., 1963: Economic Geography, Prentice-Hall Inc., Englewood Cliffs, New Jersey

Aoyama, Y., Murphy, J.T., Hanson, S. 2010.Key Concepts in Economic Geography, Sage.

Coe N. M., Kelly P. F. and Yeung H. W., 2007: Economic Geography: A Contemporary Introduction, Wiley-Blackwell.

Combes P., Mayer T. and Thisse J. F., 2008: Economic Geography: The Integration of Regions and Nations, Princeton University Press.

Wheeler, J.O., Muller, P.O., Thrall, G.I., Fik, T.J. 1998. Economic Geography, 3rd ed, Wiley.

Willington D. E., 2008: Economic Geography, Husband Press.

Wood, A., Roberts, A. 2010. Economic Geography: Places, Networks and Flows, Routledge.

GEOACOR10T—Environmental Geography✧

4 Credits, 50 Marks [60 classes]

Concepts

1. Geographers' approach to environmental studies
2. Concept of holistic environment and systems approach
3. Ecosystem: Concept, structure and functions
4. Space–time hierarchy of Environmental problems: Local, regional and global

Environmental problems and policies

5. Environmental pollution and degradation: Land, water and air
6. Urban environmental issues with special reference to waste management
7. Environmental policies – National Environmental Policy, 2006, Earth Summits (Stockholm, Rio, Johannesburg)
8. Global initiatives for environmental management (special reference to Montreal Protocol, Kyoto Protocol, Paris Climate Summit)

Reading List

Basu, R. and Bhaduri, S. (Eds) 2007. Contemporary Issues and Techniques in Geography, Progressive Publishers.

Chandna, R.C. 2002. Environmental Geography, Kalyani Press.

Chapman, J.L., Reiz, M.J. 1993. Ecology: Principle and Applications, Cambridge University Press.

Cunninghum, W.P., Cunninghum, M.A. 2004. Principals of Environmental Science: Inquiry and Applications, Tata Macgraw Hill.

Gilpin, A., 1994. Environmental Impact Assessment: Cutting Edge for the 21st Century, Cambridge University Press.

Goudie, A. 2001. 2013. The Human Impact on the Natural Environment: Past, Present, and Future, 7th ed, Wiley-Blackwell.

Miller, G.T. 2004. Environmental Science: Working with the Earth, Thomson Brooks.

Odum, E.P.,Barrett, G.W. 2005.Fundamentals of Ecology, Ceneage Learning.

Raven, P.H., Hassenzahl, D.M., Hager, M.C., Gift, N.Y., Berg, L.R. 2015. Environment, 9th ed, Wiley.

Sharma, P.D. 2011. Ecology and Environment, Rastogi Publications.

Singh, S. 2013. Environmental Geography, PrayagPustakBhawan.

Withgott, J.H., Laposata, M. 2017. Environment: The Science behind the Stories, 6th ed, Pearson.

GEOACOR10P—Environmental Geography✧

2 Credits, 25 Marks [60 classes]

1. Preparation of questionnaire for perception survey on environmental problems
2. Preparation of check-list for Environmental Impact Assessment of an urban / industrial project
3. Interpretation of air quality using CPCB / WBPCB data

Reading List

Gilpin, A., 1994. Environmental Impact Assessment: Cutting Edge for the 21st Century, Cambridge University Press.

WEBSITES:

BBC – Science & Environment: www.bbc.com/news/science_and_environment

Central Pollution Control Board: www.cpcb.nic.in

Centre for Science and Environment: www.cseindia.org

Ministry of Environment, Forest and Climate Change: www.envfor.nic.in

The Energy and Resources Institute: www.teriin.org

The World Bank – Environment: www.worldbank.org/en/topic/environment

United Nations Environment Programme: www.unenvironment.org

West Bengal Pollution Control Board: www.wbpcb.gov.in

GEOACOR**11T – Fieldwork and Research Methodology**✧

4 Credits, 50 Marks [60 classes]

Unit I: Research Methodology

1. Research in Geography: Meaning, types and significance
2. Literature review and formulation of research design
3. Defining research problem, objectives and hypothesis.
4. Research materials and methods
5. Techniques of writing scientific reports: Preparing notes, references, bibliography, abstract and keywords

Unit II: Fieldwork

6. Fieldwork in Geographical studies: Role and significance. Selection of study area and objectives. Pre-field academic preparations. Ethics of fieldwork
7. Field techniques and tools: Observation (participant, non participant), questionnaires (open, closed, structured, non-structured). Interview
8. Field techniques and tools: Landscape survey using transects and quadrants, constructing a sketch, photo and video recording.
9. Positioning and collection of samples. Preparation of inventory from field data.
10. Post-field tabulation, processing and analysis of quantitative and qualitative data

Reading List

Clifford, N., Cope, M., Gillespie, T.W., French, S. (Eds) 2016. Key Methods in Geography, 3rd ed, Sage.

Gomes, B., Jones III, J.P. (Eds) 2010. Research Methods in Geography: A Critical Introduction, Wiley-Blackwell.

Lenon, B., Cleves, P. 2015. Geography Fieldwork and Skills, Harper-Collins.

Montello , D.R, Sutton, P. 2012. An Introduction to Scientific Research Methods in Geography and Environmental Studies, 2nd ed, Sage.

Murthy , K.LN. 2004. Research Methodology in Geography: A Text Book, Concept Publishing Co.

Northey, N., Draper, D., Knight, D.B. 2015. Making Sense in Geography and Environmental Sciences: A Student's Guide to Research and Writing, 6th ed, Oxford University Press.

Parsons, T., Knight, P.G. 2015. How To Do Your Dissertation in Geography and Related Disciplines, 3rd ed, Routledge.

Phillips, R., Johns, J. 2012. Fieldwork for Human Geography, Sage.

Riordan, D. 2013. Technical Report Writing Today, 10th ed, Wadsworth Publishing.

Thornbush, M.J., Allen, C.D., Fitzpatrick, F.A. (Eds) 2014. Geomorphological Fieldwork, Elsevier.

GEOACOR11P – Fieldwork and Research Methodology (Lab)✧

2 Credits, 25 Marks [60 classes]

Every student needs to participate in fieldwork and prepare a field report according to the following guideline, failing which he/she will not be evaluated for Core P11.

1. Each student will prepare a report based on primary data collected from field survey and secondary data collected from different sources.
2. Students will select either one rural area (*mouza*) or an urban area (municipal ward) for the study, with the primary objective of evaluating the relation between physical and cultural landscape.
3. The fieldwork should be completed within seven days.
4. The report should be handwritten in English on A4 size paper in candidate's own words within 5,000 words (Introductory Chapter: 1000 words; Physical Aspects: 1500 words; Socio-economic Aspects: 1500 words; Concluding Chapter: 500 words, approximately) excluding tables, photographs, maps, diagrams, references and appendices.
5. Maps and diagrams should not exceed 15 pages.
6. All sections of the report should contain relevant maps, diagrams and photographs using primary and secondary data, clearly citing sources.
7. A copy of the bound report, duly signed by the concerned teacher, will be submitted during examination.

GEOACOR12T – Remote Sensing and GIS✧

4 Credits, 50 Marks [60 classes]

Unit I: Remote Sensing

1. Principles of Remote Sensing (RS): Types of RS satellites and sensors
2. Sensor resolutions and their applications with reference to IRS and Landsat missions
3. Preparation of False Colour Composites from IRS LISS-3 and Landsat TM and OLI data.
4. Principles of image correction and interpretation. Preparation of inventories of landuse land cover (LULC) features from satellite images**.**

Unit II: Geographical Information Systems and Global Navigation Satellite System

5. Concept of GIS and its applicability ; GIS data structures: types: spatial and non-spatial, raster and vector
6. Principles of preparing attribute tables and data manipulation and overlay analysis
7. Principles of GNSS positioning and waypoint collection
8. Transferring waypoints to GIS. Area and length calculations from GNSS data.

Reading List

Bhatta, B. 2011. Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass and Others, CRC Press.

Bhatta, B. 2011. Remote Sensing and GIS, 2nd ed, Oxford Univ. Press.

Bolstad, P. 2016. GIS Fundamentals: A First Text on Geographic Information Systems, 5th ed, XanEdu Publishing.

Brewer, C.A. 2015. Designing Better Maps: A Guide for GIS Users, 2nd ed, Esri Press.

Harvey, F. 2015. A Primer of GIS: Fundamental Geographic and Cartographic Concepts, 2nd ed, The Guilford Press.

Jensen, J.R., 2013. Remote Sensing of the Environment: An Earth Resource Perspective, Pearson Education India.

Joseph, G. and Jegannathan, C. 2018. Fundamentals of Remote Sensing, 3rd ed, Universities Press.

Lillesand, T.M., Kiefer, R.W. and Chipman, J.W., 2015. Remote Sensing and Image Interpretation, 7th ed, Wiley.

Sarkar, A. 2015. Practical Geography: A Systematic Approach. 2nd ed, Orient Black Swan Private Ltd.

GEOACOR12P – Remote Sensing and GIS✧

2 Credits, 25 Marks [60 classes]

1. Georeferencing of maps and images using Open Source software
2. Preparation of FCC and identification of features using standard FCC and other band combinations
3. Digitisation of features. Data attachment, overlay and preparation of annotated thematic maps (choropleth, pie chart and bar graphs).
4. Note: All exercises to be done using QGIS (2.10 and above)

Reading List

WEBSITES:

International Society for Photogrammetry and Remote Sensing: www.isprs.org

NASA Landsat Science: www.landsat.gsfc.nasa.gov

National Remote Sensing Centre: www.nrsc.gov.in

USGS Global Visualization Viewer: www.glovis.usgs.gov

GEOACOR13T – Evolution of Geographical Thought✧

6 Credits, 75Marks [90 classes]

Unit I: Nature of Pre Modern Geography

1. Development of Geography: Contributions of Greek and Chinesegeographers
2. Impact of 'Dark Age' in Geography and Arab contributions
3. Geography during the age of 'Discovery' and 'Exploration' (contributions of Columbus, Vasco da Gama, Magellan, Thomas Cook)
4. Transition from cosmography to scientific Geography (contributions of Bernard Varenius and Immanuel Kant). Dualism and Dichotomies (Ideographic vs. Nomothetic, Physical vs. Human, Regional vs. Systematic, Determinism vs. Possibilism,)

Unit II: Foundations of Modern Geography and Recent Trends

5. Evolution of Geographical thoughts in Germany, France, Britain and United States of America
6. Contributions of Humboldt and Ritter
7. Contributions of Richthofen, Hettner, Ratzel and Vidal deLaBlaché
8. Trends of geography in the post-World War-II period: Quantitative Revolution, systems approach.
9. Evolution of Critical Geography: Behavioural, humanistic and radical.
10. Changing concept of time-space in geography in the 21st Century

Reading List

Adhikari, S. 2015. Fundamentals of Geographical Thought, Orient Blackswan.

Clifford, N. Holloway S.L., Rice, S.P., Valentine, G. 2009. Key Concepts in Geography, 2nd ed, Sage.

Couper, P. 2015. A Student's Introduction to Geographical Thought: Theories, Philosophies, Methodologies, Sage.

Cresswell, T. 2013. Geographic Thought: A Critical Introduction, Wiley-Blackwell.

Dikshit, R.D. 2004. Geographical Thought: A Contextual History of Ideas, Prentice Hall India.

Holt-Jensen, A. 2011. Geography: History and Concepts: A Student's Guide, Sage.

Husain, M. 2015. Evolution of Geographical Thought, 6th ed, Rawat Publications.

Gregory, D., Johnston, R., Pratt, G., Watts.,Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, 5th ed, Wiley.

Pete, R. 1998. Modern Geographical Thought, Wiley-Blackwell.

GEOACOR14T – Disaster Management✧

4 Credits, 50 Marks [60 classes]

Unit I: Concepts

1. Classification of hazards and disasters.
2. Approaches to hazard study: Risk perception and vulnerability assessment. Hazard paradigms.
3. Responses to hazards: Preparedness, trauma and aftermath. Resilience and capacity building.
4. Hazards mapping: Data and geospatial techniques (for hazards enlisted in Unit II and Core 14P)

Unit II: Hazard-specific Study with focus on India

5. Earthquake: Factors, vulnerability, consequences and management
6. Landslide: Factors, vulnerability, consequences and management
7. Tropical Cyclone: Factors, vulnerability, consequences and management
8. Riverbank erosion: Factors, vulnerability, consequences and management
9. Radioactive fallout: Factors, vulnerability, consequences and management

Reading List

Coch, N.K. 1994. Geohazards: Natural and Human, Pearson College.

Coenraads, R. (Ed.) 2006. Natural Disasters and How We Cope, Millennium House.

Cutter, S.L. 2006. Hazards Vulnerability and Environmental Justice, Routledge

Government of India. 1997. Vulnerability Atlas of India, Revised ed, Building Materials & Technology Promotion Council, Ministry of Urban Development.

Hyndman,D., Hyndman, D. 2016. Natural Hazards and Disasters, 5th ed, Brooks Cole.

Kapur, A. 2010. Vulnerable India: A Geographical Study of Disasters, Sage.

Keller. E.A., DeVecchio, D.E. 2014. Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes, 4th ed, Routledge.

Pine, J.C. 2014. Hazards Analysis: Reducing the Impact of Disasters, 2nd ed, CRC Press.

Robbins, P., Hintz, J., Moore, S.A. 2014. Environment and Society: A Critical Introduction 2nd ed, Wiley.

Smith, K. 2013. Environmental Hazards: Assessing Risk and Reducing Disaster, 6th ed, Routledge.

Websites:

AGU landslide Blog: blogs.agu.org/landslideblog

Disaster News Network: secure.disasternews.net

India Meteorological Department Cyclone Page: www.rsmcnewdelhi.imd.gov.in/index.php?lang=en

USGS Earthquake Hazards Programme: www.earthquake.usgs.gov

GEOACOR14P – Disaster Management✧

2 Credits, 25 Marks [60 classes]

An individual Project Report is to be prepared and submitted based on any one case study among the following disasters of West Bengal incorporating a preparedness plan

1. Thunderstorm
2. Landslide
3. Flood
4. Coastal / riverbank erosion
5. Fire
6. Industrial accident
7. Structural collapse

One case study will be done by a group of five students. Different groups may choose different case studies from any one or different types of disasters. The report should be prepared on secondary data and handwritten on A4 page in candidates' own words not exceeding 2000 words excluding references. The report should contain a proper title. The report should incorporate relevant tables, maps, diagrams and references not exceeding five pages. Photographs are not required. A copy of the stapled report in a transparent front file, duly signed by the concerned teacher, will be submitted during examination. Without the report the candidates will not be evaluated for Core P14.

3. Department Specific Elective Subjects Syllabus

GEOADSE01T– Soil and Biogeography✧

6 Credit, 75 Marks [90 classes]

Unit I: Soil Geography

1. Factors of soil formation. Man as an active agent of soil transformation.
2. Soil profile. Origin and profile characteristics of Lateritic, Podzol and Chernozem soils
3. Definition and significance of soil properties: Texture, structure and moisture,
4. Definition and significance of soil properties: pH, organic matter and NPK
5. Soil erosion and degradation: Factors, processes and mitigation measures
6. Principles of soil classification: Genetic and USDA. Concept of land capability and its classification.

Unit II: Biogeography

7. Concepts of biosphere, ecosystem, biome, ecotone, community, niche, succession and ecology
8. Concepts of trophic structure, food chain and food web. Energy flow in ecosystems
9. Geographical extent and characteristic features of: Tropical rain forest, Taiga and Grassland biomes
10. Bio-geochemical cycles with special reference to carbon dioxide and nitrogen
11. Spatial distribution of world fauna.
12. Measures for conservation of bio-diversity in India: Man and Biosphere Programme

Reading List

Chapman J.L., Reiz, M.J. 1993. Ecology: Principle and Applications, Cambridge University Press.

Chiras, D.D., Reganold, J.P. 2009. Natural Resource Conservation: Management for a Sustainable Future. Pearson.

Cox, B., Moore, P.D., Ladle, R. 2016. Biogeography: An Ecological and Evolutionary Approach, Wiley-Blackwell.

Daji, J.A., Kadam, J.R., Patil, N.D. 1996.A Textbook of Soil Science, Media Promoters and Publishers Pvt Ltd.

Dash, M.C., 2001. Fundamental of Ecology, 2nd edition, Tata McGrawHill, New Delhi

Dey, N. K., Ghosh.P. 1993. India: A Study in Soil Geography, Sribhumi Publishing Company.

Franzmeier, D.P., McFee, W.W., Graveel, J.G., Kohnke, H. 2016. Soil Science Simplified, 5th ed, Waveland Press.

Huggett, R. 1998. Fundamentals of Biogeography, Routledge, London:

Lomolino, M.V., Riddle, B.R., Whittaker, R.J. 2016. Biogeography, 5th ed, Oxford University Press.

MacDonald, G.2001. Biogeography: Introduction to Space, Time, and Life, Wiley

Morgan, R.P.C. 1995. Soil Erosion and Conservation, 2nd edition, Longman.

Santra. A. 2006. Handbook on Wild and Zoo Animals, International Book Distributing Co.

Sharma, P.D. 2011. Ecology and Environment, Rastogi Publications.

Weil, R.R. and Brady, N.C. 2016.The Nature and Properties of Soil, 15th edition, Pearson.

White, R. 2006. Principles and Practice of Soil Science: The Soil as a Natural Resource, Blackwell.

GEOADSE02T –Settlement Geography ✧

6 Credit, 75 Marks [90 classes]

Unit I Rural Settlement

1. Scope and content of Settlement Geography; rural, urban and peri-urban areas
2. Rural Settlement: Definition, nature and characteristics
3. Morphology of rural settlements: site and situation, layout-internal and external
4. Rural house types with reference to India, Social segregation in rural areas; Census categories of rural settlements.
5. Problems and policies related to rural infrastructure with reference to India

Unit II Urban Settlement

6. Urban Settlements :Census definition (Temporal) and categories in India
7. Urban morphology: Classical models: Burgess, Homer Hoyt, Harris and Ullman Metropolitan concept.
8. City-region and Conurbation , Functional classification of cities: Harris, Nelson and McKenzie
9. Aspects of urban places: Location, site and situation, Size and spacing of cities: the rank size rule, the law of the primate city
10. Urban hierarchies : Central Place Theory; August Löch's theory of market centres

Reading List

Banerjee Guha, S. (Ed.) 2004. Space, Society and Geography, Rawat Publication.

Bjelland, M.D., Montello, D.R., Fellmann, J.D., Getis, A., Getis, J. 2000. Human Geography: Landscape of Human Activity, McGraw Hill.

Carter, H. 1995. The Study of Urban Geography, 4th ed, Arnold.

Dhanagare, D.N. 2004. Themes and Perspectives in Indian Sociology, Rawat Publication.

Fern, R.L. 2002. Nature, God and Humanity, Cambridge University Press.

Fouberg, E.H., Murphy, A.B., de Blij H.J. 2015. Human Geography: People, Place, and Culture, 11th ed, Wiley

Ghosh, S. 1998. Introduction to Settlement Geography, Sangam Books Ltd.

Gottdiener, M., Budd, M. Lehtovuori, P. 2016. Key Concepts in Urban Studies, 2nd ed, Sage.

Gregory, D., Johnston, R., Pratt, G., Watts., Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, Wiley.

Hudson, F.S. 1970. Geography of Settlements, Macdonald and Evans Ltd.

Hussain, M. 2007. Models in Geography, Rawat Publication.

Jordan,T., Rowntree, L. 1990. Human Mosaic, Harper Collins Publishers.

Knox, P., Pinch, S. 2000. Urban Social Geography, Pearson Education.

Mandal, R.B. 2001. Introduction to Rural Settlement, 2nd ed, Concept Publishing Company.

Mitchell, D. 2000. Cultural Geography: A Critical Introduction, Blackwell.

Singh, R.Y. 2000. Geography of Settlements, Rawat Publication.

GEOADSE03T – Population Geography ✧

75 Marks 6 Credits

Unit I: Population Dynamics

1. Development of Population Geography as a field of specialization. Relation between population geography and demography. Sources of population data, their level of reliability and problems of mapping.
2. Population distribution: density and growth. Classical and modern theories in population distribution and growth, Demographic transition model.
3. World patterns determinants of population distribution and growth. Concept of optimum population.
4. Population distribution, density and growth profile in India.

Unit II: Population and Development

5. Concepts of Age-Sex Composition; Rural and Urban Composition; Literacy and education
6. Measurements of fertility and mortality. Concept of cohort and life table
7. Population composition of India: Urbanisation and Occupational structure.
8. Migration: Causes and types
9. National and international patterns of migration with reference to India.
10. Population and development: population-resource regions. Concept of human development index and its components.
11. Population policies in developed and less developed countries. India's population policies, population and environment, implication for the future.
12. Contemporary Issues – Ageing of Population; Declining Sex Ratio; Population and environment dichotomy, HIV/AIDS.

Reading List

Barrett, H.R. 1995. Population Geography, Oliver and Boyd.

Bartram, D. Poros, M. Monforte, P. 2014. Key Concepts in Migration, Sage.

Binde, N., Kanitkar, H. 2000. The Principle of Population Studies, Himalaya Publications.

Chandna, R.C. 2016. Geography of Population: Concepts, Determinants and Patterns, Kalyani Publishers.

Dyson,T. 2011. Population and Development: The Demographic Transition, Rawat Publications.

Gregory, D., Johnston, R., Pratt, G., Watts.,Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, 5th ed, Wiley.

Hassan, M.I. 2005.Population Geography, Rawat publications.

Hussain, M. 1994. Human Geography, Rawat publications.

Jhingan, M.L., Bhatt, B.K., Desai, J.N. 2014.Demography, Vrinda Publications.

Jones, H. R. 2000. Population Geography, 3rd ed, Chapman.

Lutz, W., Warren, C.S., Scherbov, S. 2004. The End of the World Population Growth in the 21st Century, Earthscan.

Majumdar, P.K. 2013. India's Demography: Changing Demographic Scenario in India, Rawat Publications.

Mukherji, S. 2013. Migration in India: Links to Urbanization, Regional Disparities and Development Policies, Rawat Publications

Newbold, K.B. 2017. Population Geography: Tools & Issues, 3rd ed, Rowman & Littlefield Publishers.

Pacione, M. 2012. Population Geography: Progress and Prospect, Routledge.

GEOADSE04T – Hydrology and Oceanography✧

6 Credits, 75 Marks [90 classes]

Unit-I: Hydrology

1. Systems approach in hydrology. Global hydrological cycle: Its physical and biological role
2. Run off: controlling factors. Infiltration and evapotranspiration. Run off cycle
3. Drainage basin as a hydrological unit. Principles of water harvesting and watershed management
4. Groundwater: Occurrence and storage. Factors controlling recharge, discharge and movement

Unit-II: Oceanography

5. Major relief features of the ocean floor: characteristics and origin according to plate tectonics
6. Physical and chemical properties of ocean water
7. Water mass, T–S diagram
8. Ocean temperature and salinity: Distribution and determinants
9. Marine resources: Classification and sustainable utilisation
10. Sea level change: Types and causes

Reading List

Dingman, S.L. 2015. Physical Hydrology, 3rd ed, Macmillan Publishing Co.

Fitts, C.R. 2002. Groundwater Science, Elsevier.

Garrison, T. 2016. Oceanography: An Invitation to Marine Science, 9th ed, Cengage Learning.

Kearey, P., Klepeis, K.A., Vine, F.J. 2011. Global Tectonics, 3rd ed, Wiley-India.

Karanth, K.R., 1988: Ground Water: Exploration, Assessment and Development, Tata- McGraw Hill, New Delhi.

Pinet, P.R. 2014. Invitation to Oceanography. 7th ed, Jones and Barlett Publishers.

Pinneker, E.V. 2010. General Hydrogeology, Cambridge University Press.

Pugh, D., Woodworth, P. 2014. Sea-Level Science: Understanding Tides, Surges, Tsunamis and Mean Sea-Level Changes, 2nd ed, Cambridge University press.

Raghunath, H.M. 2006. Hydrology: Principles, Analysis, Design, 3rd ed, New Age International Publishers.

Reddy, P.J.R. 2014. A Textbook of Hydrology, University of Science Press.

Subramanya, K. 2013. Engineering Hydrology, McGraw Hill Education.

Sverdrup, K.A., Armrest, E.V. 2010. An Introduction to the World Oceans, 10th ed, McGraw Hill.

Todd, D.K., Larry, W.M. 2004.Groundwater Hydrology, John Wiley & Sons.

Ward, A.D., Trimble, S.W., Burckhard, S.R., Lyon, J.G. 2016. Environmental Hydrology, 3rd ed, CRC Press.

GEOADSE05T – Social Geography✧

6 Credits, 75 Marks [90 classes]

Unit I: Society, Identity and Crisis

1. Social Geography: Concept, Origin, Nature and Scope
2. Concept of Space, Social differentiation and stratification; social processes
3. Social Categories: Caste, Class, Religion, Race and Gender and their Spatial distribution
4. Basis of Social region formation; Evolution of social-cultural regions of India
5. Peopling Process of India: Technology and Occupational Change; Migration.
6. Social groups, social behaviour and contemporary social environmental issues with special reference to India

Unit II: Social Wellbeing and Planning

7. Concept of Social Well-being, Quality of Life, Gender and Social Well-being
8. Measures of Social Well-being: Healthcare, Education, Housing, Gender Disparity
9. Social Geographies of Inclusion and Exclusion, Slums, Gated Communities, Communal Conflicts and Crime.
10. Social Planning during the Five Year Plans in India
11. Social Policies in India: Education and Health
12. Social Impact Assessment (SIA): Concept and importance

Reading List

Ahmed A., 1999. Social Geography, Rawat Publications.

Casino, V. J. D., Jr., 2009. Social Geography: A Critical Introduction, Wiley Blackwell.

Cater, J. and Jones T., 2000: Social Geography: An Introduction to Contemporary Issues, Hodder Arnold.

Gregory, D., Johnston, R., Pratt, G., Watts.,Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, 5th ed, Wiley.

Holt, L., 2011. Geographies of Children, Youth and Families: An International Perspective, Taylor & Francis.

Majumdar, P.K. 2013. India's Demography: Changing Demographic Scenario in India, Rawat Publications.

Mukherji, S. 2013. Migration in India: Links to Urbanization, Regional Disparities and Development Policies, Rawat Publications

Panelli, R., 2004. Social Geographies: From Difference to Action, Sage.

Rachel, P., Burke, M., Fuller, D., Gough, J., Macfarlane, R. and Mowl, G. 2001. Introducing Social Geographies, Oxford University Press.

Smith, D. M., 1994.Geography and Social Justice, Blackwell, Oxford.

Smith, S.J., Pain, R., Marston, S. A., Jones, J. P., 2009. The SAGE Handbook of Social Geographies, Sage Publications.

Valentine, G. 2014. Social Geographies: Space and Society, Routledge.

GEOADSE06T – Resource Geography ✧

75 Marks, 6 Credits [90 classes]

Unit I: Resource and Development

1. Natural Resources: Concept and classification
2. Approaches to Resource Utilization: Utilitarian, Conservational, Community based adaptation
3. Significance of Resources: Backbone of Economic growth and development
4. Pressure on resources. Appraisal and Conservation of Natural Resources
5. Problems of resource depletion—global scenario (forest, water, fossil fuels).
6. Sustainable Resource Development

Unit II: Resource Conflict and Management

7. Distribution, Utilisation, Problems and Management of Mineral Resources: Bauxite and Iron Ore.
8. Distribution, Utilisation, Problems and Management of Energy Resources: Conventional and Non-Conventional
9. Contemporary Energy Crisis and Future Scenario
10. Limits to Growth and Sustainable Use of Resources; Concept of Resource sharing: Water

Reading List

Chiras, D.D., Reganold, J.P. 2009. Natural Resource Conservation: Management for a Sustainable Future, 10th ed, Pearson.

Cutter, S.N., Renwich, H.L., Renwick, W. 1991. Exploitation, Conservation, and Preservation: A Geographical Perspective on Natural Resources Use, John Wiley and Sons.

Gadgil, M., Guha, R. 2005. The Use and Abuse of Nature: Incorporating This Fissured Land: An Ecological History of India and Ecology and Equity, Oxford University Press.

Gregory, D., Johnston, R., Pratt, G., Watts.,Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, 5th ed, Wiley.

Holechek, J.L.C., Richard, A., Fisher, J.T., Valdez, R. 2003. Natural Resources: Ecology, Economics and Policy, Prentice Hall.

Jones, G., Hollier, G. 1997. Resources, Society and Environmental Management, Paul Chapman.

Klee, G. 1991. Conservation of Natural Resources, Prentice Hall.

Mather, A.S., Chapman, K. 1995. Environmental Resources, John Wiley and Sons.

Mitchell, B. 1997.Resource and Environmental Management, Longman Harlow.

Owen, S., Owen, P.L. 1991.Environment, Resources and Conservation, Cambridge University Press.

Rees, J. 1990. Natural Resources: Allocation, Economics and Policy, Routledge.

4. Generic Elective Subjects Syllabus for Honours Students of Other Disciplines

GEOHGEC01T– Physical Geography ✧

6 Credit, 75 Marks [90 classes]

Unit I: Geotectonics and Geomorphology

1. Physical Geography – Definition and Scope, Components of Earth System.
2. Internal Structure of Earth based on Seismic Evidence, Plate Tectonics and its associated Features.
3. Influence of rocks on topography**:** Limestone and Granite
4. Evolution of landforms under fluvial process, Normal Cycle of Erosion of Davis
5. Formation of erosional and depositional landforms by coastal and aeolian processes

Unit II: Climatology and Oceanography

6. Insolation and Heat Balance.
7. Horizontal and Vertical distribution of temperature and pressure
8. Planetary wind system, characteristics of Monsoon and Tropical Cyclone
9. Climatic Classification: Köppen
10. Hydrological Cycle, Ocean Bottom Relief Features, ocean currents.

Reading List

Conserva H. T., 2004: Illustrated Dictionary of Physical Geography, Author House, USA.
Gabler R. E., Petersen J. F. and Trapasso, L. M., 2007: Essentials of Physical Geography (8th Edition), Thompson, Brooks/Cole, USA.
Garrett N., 2000: Advanced Geography, Oxford University Press.
Goudie, A., 1984: The Nature of the Environment: An Advanced Physical Geography, Basil Blackwell Publishers, Oxford.
Hamblin, W. K., 1995: Earth's Dynamic System, Prentice Hall, N.J.
Husain M., 2002: Fundamentals of Physical Geography, Rawat Publications, Jaipur.

Monkhouse, F. J. 2009: Principles of Physical Geography, Platinum Publishers, Kolkata.

Strahler A. N. and Strahler A. H., 2008: Modern Physical Geography, John Wiley & Sons, New York.

GEOHGEC02T – Human Geography ✧

6 Credit, 75 Marks [90 classes]

Unit I Population and Social Geography

1. Factors of Growth and distribution of world population. Demographic Transition Theory.
2. World Population Composition: Age, Gender and Literacy.
3. Migration**:** Types, causes and consequences.
4. Space and Society: Cultural Regions; Race; Religion and Language
5. Contemporary social issues: Illiteracy and Poverty

Unit II Economic and Settlement Geography

6. Sectors of the economy: primary, secondary, tertiary and quaternary
7. Types of agriculture**:** Intensive subsistence rice farming, Plantation agriculture (Tea and Coffee)
8. Location, problems and prospects of Indian industries — Cotton textile, Petroleum refining, Locomotive
9. Types and Patterns of Rural Settlements
10. Classification of Urban Settlements; Trends and Patterns of World Urbanization

Reading List

Chandna, R.C. (2010) Population Geography, Kalyani Publisher.

Daniel, P.A. and Hopkinson, M.F. (1989) The Geography of Settlement, Oliver & Boyd, London.

Ghosh, S. (2015) Introduction to settlement geography. Orient Black Swan Private Ltd., Kolkata

Hussain, Majid (2012) Human Geography. Rawat Publications, Jaipur

Johnston R; Gregory D, Pratt G. et al. (2008) The Dictionary of Human Geography, Blackwell Publication.

Jordan-Bychkov et al. (2006) The Human Mosaic: A Thematic Introduction to Cultural Geography. W. H. Freeman and Company, New York.

Kaushik, S.D. (2010) Manav Bhugol, Rastogi Publication, Meerut.

Maurya, S.D. (2012) Manav Bhugol, Sharda Pustak Bhawan. Allahabad.

GEOHGEC03T – General Cartography ✧

4 Credits, 50 Marks [60 classes]

Cartographic Techniques

1. Concept of map scale: Types and Application. Reading distances on a map.
2. Map Projections: Criteria for choice of projections. Attributes and properties of: Zenithal Gnomonic Polar Case, Zenithal Stereographic Polar Case, Cylindrical Equal Area, Mercator's Projection, Bonne's Projection. Concept of UTM projection
3. Survey of India topographical maps: Reference scheme of old and open series. Information on the margin of maps.
4. Representation of Data – Symbols, Dots, Choropleth, Isopleth and Flow Diagrams, Interpretation of Thematic Maps.

Reading List

Dent B. D., 1999: *Cartography: Thematic Map Design*, (Vol. 1), McGraw Hill.

Gupta K. K and Tyagi V. C., 1992: *Working with Maps*, Survey of India, DST, New Delhi.

Mishra R. P. and Ramesh A., 1989: *Fundamentals of Cartography*, Concept Publishing.

Robinson A., 1953: *Elements of Cartography*, John Wiley.

Sharma J. P., 2010: *Prayogic Bhugol*, Rastogi Publishers.

Singh R. L. and Singh R. P. B., 1999: *Elements of Practical Geography*, Kalyani Publishers

Singh R. L., 1998: *Prayogic Bhoogol Rooprekha*, Kalyani Publications.

Steers J. A., 1965: *An Introduction to the Study of Map Projections*, University of London.

GEOHGEC03P – General Cartography ✧

2 Credits, 25 Marks [60 classes]

Cartographic Techniques

1. Graphical construction of scales: Plain and comparative. [10]
2. Construction of projections: Zenithal Gnomonic Polar Case, Zenithal Stereographic Polar Case, Cylindrical Equal Area, Mercator's Projection, Bonne's Projection. [30]
3. Construction and interpretation of relief profiles from Survey of India topographical map — superimposed, projected and composite, relative relief map, slope map (Wentworth), and Correlation between physical and cultural features from Survey of India topographical maps using transect chart.

GEOHGEC04T – Environmental Geography ✧

6 Credits, 75 Marks [90 classes]

Concepts

1. Environmental Geography: Concepts and Approaches;
2. Human-Environment Relationship in equatorial, desert, mountain and coastal regions
3. Concept of holistic environment and system approach
4. Ecosystem: Concept, structure and functions

Environmental problems and policies

5. Environmental Problems and Management: Air Pollution; Water pollution; Biodiversity Loss; Solid and Liquid Waste.
6. Environmental problems and management: Desertification and soil erosion
7. Environmental Programmes and Policies: Developed Countries; Developing Countries.
8. New Environmental Policy of India.

Reading List

Casper J.K. (2010) Changing Ecosystems: Effects of Global Warming. Infobase Pub. New York.

Hudson, T. (2011) Living with Earth: An Introduction to Environmental Geology, PHI Learning Private Limited, New Delhi.

Miller, G.T. (2007) Living in the Environment: Principles, Connections, and Solutions, Brooks/ Cole Cengage Learning, Belmont.

Singh, R.B. (1993) Environmental Geography, Heritage Publishers, New Delhi.

UNEP (2007) Global Environment Outlook: GEO4: Environment For Development, United Nations Environment Programme. University Press, Cambridge.

Wright R. T. and Boorse, D. F. (2010) Toward a Sustainable Future, PHI Learning Pvt Ltd, New Delhi.

Singh, R.B. and Hietala, R. (Eds.) (2014) Livelihood security in Northwestern Himalaya:

Case studies from changing socio-economic environments in Himachal Pradesh, India. Advances in Geographical and Environmental Studies, Springer

1. Scheme for the CBCS Curriculum for Geography General (B.Sc.)

1.1 Credit Distribution across Courses

Course Type B.Sc. General	Total Papers	Credits	
		THEORY + PRACTICAL	THEORY + TUTORIAL*
Core Course: 04 courses from each of the 03 disciplines of choice	12	12×4 = 48 12×2 = 24	12×5 = 60 12×1 = 12*
Elective Courses: 02 papers from each discipline of choice	6	6×4 = 24 6×2 = 12	6×5 = 30 6×1 = 06*
Ability Enhancement Courses: 02 papers of 02 credits	2	2×2 = 04	2 × 2=04
Skill Enhancement Courses: 04 papers of 02 credits each	4	4×2 = 08	4 × 2=08
		120	120

*Tutorials of 1 Credit will be conducted in case there is no practical component

1.2 Computation of work-load per week

Type of Course	Credit	Duration of Periods
Tutorial Class	1	1 Theoretical class of 1 hour duration
Theory (T)	1	1 Theoretical class of 1 hour duration
Practical (P)	1	1 Practical class of 2 hour duration
Semester Duration: 15 weeks of direct teaching		

1.3 List of subjects to be offered with Geography General

1. Political Science	4. Statistics
2. Economics	5. Zoology
3. Mathematics	6. Anthropology or Computer Science

Any 2 (two) subjects to be chosen from the above list and from each subject four papers to be taken as Core Course and two papers as Elective Course as mentioned in Table 3.2.

1.4 Distribution of Courses across semesters for Geography General (B.Sc.)

Semester	Course	Course Code	Title	Credit	Marks	Remarks
I	Core (DSC 1A)	GEOGCOR01T	Physical Geography	06	75	From Geography
	Core (DSC 2A)	XXXGCOR01T		06	75	Subject 2 apart from Geography
	Core (DSC 3A)	XXXGCOR01T		06	75	Subject 3 apart from Geography
	AECC	ENGSAEC01M	Communicative English	02	25	Shared course
II	Core (DSC 1B)	GEOGCOR02T	Human Geography	06	75	From Geography
	Core (DSC 2B)	XXXGCOR02T		06	75	Subject 2 apart from Geography
	Core (DSC 3B)	XXXGCOR02T		06	75	Subject 3 apart from Geography
	AECC	ENVSAEC02T	Environment Studies	02	25	Shared course
III	Core (DSC 1C)	GEOGCOR03T	General Cartography	04	50	From Geography
		GEOGCOR03P	General Cartography (Lab)	02	25	
	Core (DSC 2C)	XXXGCOR03T		04	50	Subject 2 apart from Geography
	Core (DSC 3C)	XXXGCOR03T		06	75	Subject 3 apart from Geography
	SEC1	XXXSSEC01M	Remote Sensing	02	25	Shared course

IV	Core (DSC 1D)	GEOGCOR04T	Environmental Geography	06	75	From Geography
	Core (DSC 2D)	XXXGCOR04T		06	75	Subject 2 apart from Geography
	Core (DSC 3D	XXXGCOR04T		06	75	Subject 3 apart from Geography
	SEC2	XXXSSEC02M	Advanced Spatial Statistical Techniques	06	75	Shared course
V	DSE1A	GEOGDSE01T	A. Soil and Biogeography			Any one course among A, B and C from Geography
		GEOGDSE02T	B. Regional Development			
		GEOGDSE03T	C. Disaster Management			
	DSE2A	XXXGDSE01T				Subject 2 apart from Geography
	DSE3A	XXXGDSE01T				Subject 3 apart from Geography
	SEC3					Shared course
VI	DSE1B	GEOGDSE04P	Project Report Based on Field Work	06	75	Compulsory from Geography
	DSE2B	XXXGDSE01T		02	25	Subject 2 apart from Geography
	DSE3B	XXXGDSE01T		06	75	Subject 3 apart from Geography
	SEC3			06	75	Shared course

1.5 Core Subjects

Code (Theory)	Code (Practical)	Course Name
GEOGCOR01T		Physical Geography
GEOGCOR02T		Human Geography
GEOGCOR03T	GEOGCOR03P	General Cartography
GEOGCOR04T		Environmental Geography

1.6 Choices for Two Discipline Specific Electives

Code (Theory)	Course Name
GEOGDSE01T	A. Soil and Biogeography
GEOGDSE02T	B. Regional Development
GEOGDSE03T	C. Disaster Management
GEOGDSE04P	Project Report Based on Field Work

1.7 Choices for Two Skill Enhancement Courses

Code (Theory)	Course Name
XXXSSEC01M	Remote Sensing
XXXSSEC02M	Advanced Spatial Statistical Techniques

2. Core Course Syllabus

(4 compulsory papers)

GEOGCOR01T– Physical Geography ✧

6 Credit, 75 Marks [90 classes]

Unit I: Geotectonics and Geomorphology

6. Physical Geography – Definition and Scope, Components of Earth System.
7. Internal Structure of Earth based on Seismic Evidence, Plate Tectonics and its associated Features.
8. Influence of rocks on topography**:** Limestone and Granite
9. Evolution of landforms under fluvial process, Normal Cycle of Erosion of Davis
10. Formation of erosional and depositional landforms by coastal and aeolian processes

Unit II: Climatology and Oceanography

11. Insolation and Heat Balance.
12. Horizontal and Vertical distribution of temperature and pressure
13. Planetary wind system, characteristics of Monsoon and Tropical Cyclone
14. Climatic Classification: Köppen
15. Hydrological Cycle, Ocean Bottom Relief Features, ocean currents.

Reading List

Conserva H. T., 2004: Illustrated Dictionary of Physical Geography, Author House, USA.

Gabler R. E., Petersen J. F. and Trapasso, L. M., 2007: Essentials of Physical Geography (8th Edition), Thompson, Brooks/Cole, USA.

Garrett N., 2000: Advanced Geography, Oxford University Press.

Goudie, A., 1984: The Nature of the Environment: An Advanced Physical Geography, Basil Blackwell Publishers, Oxford.

Hamblin, W. K., 1995: Earth's Dynamic System, Prentice Hall, N.J.

Husain M., 2002: Fundamentals of Physical Geography, Rawat Publications, Jaipur.

Monkhouse, F. J. 2009: Principles of Physical Geography, Platinum Publishers, Kolkata.

Strahler A. N. and Strahler A. H., 2008: Modern Physical Geography, John Wiley & Sons, New York.

GEOGCOR02T – Human Geography ✧

6 Credit, 75 Marks [90 classes]

Unit I Population and Social Geography

1. Factors of Growth and distribution of world population. Demographic Transition Theory.
2. World Population Composition: Age, Gender and Literacy.
11. Migration**:** Types, causes and consequences.
12. Space and Society: Cultural Regions; Race; Religion and Language
13. Contemporary social issues: Illiteracy and Poverty

Unit II Economic and Settlement Geography

14. Sectors of the economy: primary, secondary, tertiary and quaternary
15. Types of agriculture**:** Intensive subsistence rice farming, Plantation agriculture (Tea and Coffee)
16. Location, problems and prospects of Indian industries — Cotton textile, Petroleum refining, Locomotive
17. Types and Patterns of Rural Settlements
18. Classification of Urban Settlements; Trends and Patterns of World Urbanization

Reading List

Chandna, R.C. (2010) Population Geography, Kalyani Publisher.

Daniel, P.A. and Hopkinson, M.F. (1989) The Geography of Settlement, Oliver & Boyd, London.

Ghosh, S. (2015) Introduction to settlement geography. Orient Black Swan Private Ltd., Kolkata

Hussain, Majid (2012) Manav Bhugol. Rawat Publications, Jaipur

Johnston R; Gregory D, Pratt G. et al. (2008) The Dictionary of Human Geography, Blackwell Publication.

Jordan-Bychkov et al. (2006) The Human Mosaic: A Thematic Introduction to Cultural Geography. W. H. Freeman and Company, New York.

Kaushik, S.D. (2010) Manav Bhugol, Rastogi Publication, Meerut.

Maurya, S.D. (2012) Manav Bhugol, Sharda Pustak Bhawan. Allahabad.

GEOGCOR03T – General Cartography ✧

4 Credits, 50 Marks [60 classes]

Cartographic Techniques

4. Concept of map scale: Types and Application. Reading distances on a map.
5. Map Projections: Criteria for choice of projections. Attributes and properties of: Zenithal Gnomonic Polar Case, Zenithal Stereographic Polar Case, Cylindrical Equal Area, Mercator's Projection, Bonne's Projection. Concept of UTM projection
6. Survey of India topographical maps: Reference scheme of old and open series. Information on the margin of maps.
5. Representation of Data – Symbols, Dots, Choropleth, Isopleth and Flow Diagrams, Interpretation of Thematic Maps.

Reading List

Dent B. D., 1999: *Cartography: Thematic Map Design*, (Vol. 1), McGraw Hill.

Gupta K. K and Tyagi V. C., 1992: *Working with Maps*, Survey of India, DST, New Delhi.

Mishra R. P. and Ramesh A., 1989: *Fundamentals of Cartography*, Concept Publishing.

Robinson A., 1953: *Elements of Cartography*, John Wiley.

Singh R. L. and Singh R. P. B., 1999: *Elements of Practical Geography*, Kalyani Publishers

Steers J. A., 1965: *An Introduction to the Study of Map Projections*, University of London.

GEOGCOR03P – General Cartography ✧

2 Credits, 25 Marks [60 classes]

Cartographic Techniques

4. Graphical construction of scales: Plain and comparative. [10]
5. Construction of projections: Zenithal Gnomonic Polar Case, Zenithal Stereographic Polar Case, Cylindrical Equal Area, Mercator's Projection, Bonne's Projection. [30]
6. Construction and interpretation of relief profiles from Survey of India topographical map — superimposed, projected and composite, relative relief map, slope map (Wentworth), and Correlation between physical and cultural features from Survey of India topographical maps using transect chart.

GEOGCOR04T – Environmental Geography ✧

6 Credits, 75 Marks [90 classes]

Concepts

9. Environmental Geography: Concepts and Approaches
10. Human-Environment Relationship in equatorial, desert, mountain and coastal regions
11. Concept of holistic environment and system approach
12. Ecosystem: Concept, structure and functions

Environmental problems and policies

13. Environmental Problems and Management: Air Pollution; Water pollution Biodiversity Loss; Solid and Liquid Waste.
14. Environmental problems and management: Desertification and soil erosion
15. Environmental Programmes and Policies: Developed Countries; Developing Countries.
16. New Environmental Policy of India.

Reading List

Casper J.K. (2010) Changing Ecosystems: Effects of Global Warming. Infobase Pub. New York.

Hudson, T. (2011) Living with Earth: An Introduction to Environmental Geology, PHI Learning Private Limited, New Delhi.

Miller, G.T. (2007) Living in the Environment: Principles, Connections, and Solutions, Brooks/ Cole Cengage Learning, Belmont.

Singh, R.B. (1993) Environmental Geography, Heritage Publishers, New Delhi.

UNEP (2007) Global Environment Outlook: GEO4: Environment For Development, United Nations Environment Programme. University Press, Cambridge.

Wright R. T. and Boorse, D. F. (2010) Toward a Sustainable Future, PHI Learning Pvt Ltd, New Delhi.

Singh, R.B. and Hietala, R. (Eds.) (2014) Livelihood security in Northwestern Himalaya:

Case studies from changing socio-economic environments in Himachal Pradesh, India. Advances in Geographical and Environmental Studies, Springer

3. Discipline Specific Elective

(2 Compulsory papers)

GEOGDSE01T – Soil and Biogeography

6 Credits, 75 Marks [90 classes]

Unit I: Soil Geography

1. Factors of soil formation.
2. Soil profile. Origin and profile characteristics of Lateritic and Chernozem soils
3. Definition and significance of soil properties: Texture, structure and moisture, pH and organic matter
4. Principles of soil classification: Genetic and USDA. Concept of land capability and its classification.

Unit II: Biogeography

5. Concepts of biosphere, ecosystem, biome, ecotone, community, niche and succession.
6. Concepts of food chain and food web. Energy flow in ecosystems
7. Geographical extent and characteristic features of: Tropical rain forest and Grassland biomes
8. Bio-geochemical cycles with special reference to carbon dioxide and nitrogen.

Reading List

Biswas, T.D. and Mukherjee, S.K. 1997: Textbook of Soil Science, TataMcGraw Hill,

Brady, N.C. and Weil, R.R. 1996. The Nature and Properties of Soil, 11th edition, Longman, London :

Chapman J.L. and Reiss, M.J. 1993. Ecology: Principle and Applications, Cambridge University Press, Cambridge:

Dash, M.C., 2001. Fundamental of Ecology, 2nd edition, Tata McGrawHill, New Delhi

Huggett, R. 1998. Fundamentals of Biogeography, Routledge, London:

Kormondy, E.J. 1996. Concept of Ecology, 4th edition, Prentice- Hall, India, New Delhi

Myers, A. A. and Giller, P.S. (editors) 1988. Analytical Biogeography: an Integrated Approach to the Study of Animal and Plant Distribution. Chapman and Hall, London

GEOGDSE02T – Regional Development

6 Credits, 75 Marks [90 classes]

Concepts of Regions and Regional Planning

1. Definition of Region. Types and Need of Regional planning:
2. Choice of a Region for Planning: Characteristics of an Ideal Planning Region; Delineation of Planning Region
3. Regionalization of India for Planning (Agro Ecological Zones)
4. Strategies/Models for Regional Planning: Growth Pole Model of Perroux; Growth Centre Model in Indian Context.
5. Problem Regions and Regional Planning: Backward Regions and Special Area Development Plans in India.

Regional Development

6. Changing concept of development and underdevelopment;
7. Indicators of development: Economic, social and environmental. Concept of human development
8. Development and regional disparities in India since Independence: Disparities in agricultural development andindustrial development
9. Development and regional disparities in India since independence : Disparities in human resource development in terms of education and health

Reading List

Bhargava, G. 2001. Development of India's Urban, Rural, and Regional Planning in 21st Century: Policy Perspective, Gyan Publishing House.

Bhatt, L.S. 1976 Micro Level Planning in India. KB Publication, Delhi

Chand,M., Puri, V.K. 2000. Regional Planning In India, Allied Publishers Ltd.

Chandana, R.C. 2016. Regional Planning and Development, 6th ed, Kalyani Publishers.

Deshpande C. D., 1992: *India: A Regional Interpretation*, ICSSR, New Delhi.

Glasson, J. 2017. Contemporary Issues in Regional Planning, Routledge.

Gregory, D., Johnston, R., Pratt, G., Watts., Whatmore, S. (Eds) 2009. The Dictionary of Human Geography.

Hall, P., Tewdwr-Jones, M. 2010. Urban and Regional Planning, Routledge.

Higgins, B., Savoie, D.J. 2017. Regional Development: Theories and Their Application, Routledge.

Kulshetra, S.K. 2012. Urban and Regional Planning in India: A Handbook for Professional Practioners, Sage Pub.

Kumar, A., Meshram, D.S., Gowda, K. (Eds) 2016. Urban and Regional Planning Education: Learning for India, Springer.

Misra, R.P. 1992. Regional Planning: Concepts, Techniques , Policies and Case Studies, Concept Publishing.

Rapley, J. 2007. Understanding Development: Theory and Practice in the Third World, Lynne Rienner.

Rapley, John (2007) Understanding Development: Theory and Practice in the 3rd World. Lynne Raza, M., Ed. (1988). Regional Development. Contributions to Indian Geography. New Delhi,

Ray, J. 2001. Introduction to Development & Regional Planning, Orient Black swan.

Raza, M. (Ed.) 1988. Regional Development: Contributions to Indian Geography, Heritage Publishers.

GEOGDSE03T – Disaster Management

6 Credits, 75 Marks [90 classes]

Unit I: Concepts

1. Hazards, risk, vulnerability and disasters: definition and concepts.
2. Approaches to hazard study: risk perception and vulnerability assessment. Hazard paradigms.
3. Response and mitigation to disasters: mitigation and preparedness, NDMA and NIDM; indigenous knowledge and community-based disaster management; do's and don'ts during disasters.

Unit II: Hazard-specific Study with focus on India

4. Disasters in india: (a) causes, impact, distribution and mapping: flood, drought and cyclone
5. Disasters in india: (b) causes, impact, distribution and mapping: earthquake, tsunami and landslide
6. Human induced disasters: causes, impact, distribution and mapping: radioactive fallout.

Reading List

Government of India. (1997) Vulnerability Atlas of India. New Delhi, Building Materials & Technology Promotion Council, Ministry of Urban Development, Government of India.

Kapur, A. (2010) Vulnerable India: A Geographical Study of Disasters, Sage Publication, New Delhi.

Modh, S. (2010) Managing Natural Disaster: Hydrological, Marine and Geological Disasters, Macmillan, Delhi.

Singh, R.B. (2005) Risk Assessment and Vulnerability Analysis, IGNOU, New Delhi. Chapter 1, 2 and 3

Singh, R. B. (ed.), (2006) Natural Hazards and Disaster Management: Vulnerability and Mitigation, Rawat Publications, New Delhi.

Sinha, A. (2001). Disaster Management: Lessons Drawn and Strategies for Future, New United Press, New Delhi.

Stoltman, J.P. et al. (2004) International Perspectives on Natural Disasters, Kluwer Academic Publications. Dordrecht.

Singh Jagbir (2007) "Disaster Management Future Challenges and Oppurtunities", 2007. Publisher- I.K. International Pvt. Ltd. S-25, Green Park Extension, Uphaar Cinema Market, New Delhi, India (www.ikbooks.com).

GEOGDSE04P – Project Report based on Field Work

6 Credits, 75 Marks

Project work is compulsory for completing B.Sc Course in Geography. Project Work is intended to provide an opportunity to the candidate to field test the learning.

The Project report should be based on field work on some specified topics as suggested by the Department.

Each student will prepare an individual report based on primary and secondary data collected during field work.

The duration of the field work should not exceed 10 days.

The word count of the report should be about **8000** excluding figures, tables, photographs, maps, references and appendices.

The report should include an introduction, literature review, project aims and objectives, methodology, results and discussion and references.

It should not exceed 20 to 25 pages (A4 pages) including maps, diagrams, and photographs etc.

One copy of the report on A 4 size paper should be submitted prior to examination.

4. Skill Enhancement Course Syllabus

(For both Honours and General courses)

GEOSSEC01M – Remote Sensing✧

2 Credits, 25 Marks [30 classes]

1. Principles of Remote Sensing (RS): Classification of RS satellites and sensors
2. Sensor resolutions and their applications with reference to IRS and Landsat missions, image referencing schemes and data acquisition.
3. Preparation of False Colour Composites from IRS LISS-3 and Landsat TM and OLI data. Principles of image rectification and enhancement.
4. Principles of image interpretation and feature extraction. Preparation of inventories of land use land cover features from satellite images.

A project file consisting of four exercises on the above themes is to be submitted

Reading List

Bhatta, B. 2011. Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass and Others, CRC Press.

Jensen, J.R., 2013. Remote Sensing of the Environment: An Earth Resource Perspective, Pearson Education India.

Joseph, G. and Jegannathan, C. 2018. Fundamentals of Remote Sensing, 3rd ed, Universities Press.

Lillesand, T.M., Kiefer, R.W. and Chipman, J.W., 2015. Remote Sensing and Image Interpretation, 7th ed, Wiley.

WEBSITES:

International Society for Photogrammetry and Remote Sensing: www.isprs.org

NASA Landsat Science: www.landsat.gsfc.nasa.gov

National Remote Sensing Centre: www.nrsc.gov.in

USGS Global Visualization Viewer: www.glovis.usgs.gov

GEOSSEC02M – Advanced Spatial Statistical Techniques ✧

2 Credits, 25 Marks [30 classes]

1. Probability theory, probability density functions with respect to Normal, Binomial and Poisson distributions and their geographical applications.
2. Sampling: Sampling plans for spatial and non-spatial data, sampling distributions. Sampling estimates for large and small samples tests involving means and proportions.
3. Correlation and Regression Analysis: Rank order correlation and product moment correlation; linear regression, residuals from regression, and simple curvilinear regression. Introduction to multi-variate analysis.
4. Time Series Analysis: Time Series processes; Smoothing time series; Time series components.

Any statistical Software Package (e.g., SPSS, MS Excel, R, etc.) may be used for practice. A project file consisting of four exercises on the above themes is to be submitted.

Reading List

Acevedo, M.F. 2012. Data Analysis and Statistics for Geography, Environmental Science and Engineering, CRC Press.

Harris, R., Jarvis, C. 2011. Statistics for Geography and Environmental Science, Prentice Hall.

McGrew Jr., J.C., Lembo Jr., A.J.,Monroe, C.B. 2014. An Introduction to Statistical Problem Solving in Geography, 3rd ed, Waveland Press.

Pal S. K., 1998. Statistics for Geoscientists: Techniques and Applications, Concept Pub Co.

Rogerson, P.A. 2015. Statistical Methods for Geography: A Student's Guide, 4th ed, Sage.

WEST BENGAL STATE UNIVERSITY

HISTORY GENERAL CBCS COURSE STRUCTURE (2018-19)

Semester I

Course Code	Course Title	Course Type	Credit	Marks
HISGCOR01T	Paper I: History of India from the Earliest Times upto 300 CE	Core-1 DSC1A	6	75
	Other Discipline	Core DSC 2A	6	75
	English	Core	6	75
	Environmental Science	AECC	2	25
		Semester Total	**20**	**250**

Semester II

Course Code	Course Title	Course Type	Credit	Marks
HISGCOR02T	Paper II: History of India from. c.300to1206 CE	Core DSC1B	6	75
	Other Discipline	Core DSC2B	6	75
	English	Core	6	75
	English/MIL Communication	AECC	2	25
		Semester Total	**20**	**250**

Semester III

Course Code	Course Title	Course Type	Credit	Marks
HISGCOR03T	Paper III: History of India from c.1206 to1707 CE	Core DSC 1C	6	75
	Other Discipline	Core DSC 2C	6	75
	MIL	Core	6	75
HISSSEC01M	Paper I: Museums and Archives in India	SEC1	2	25
		Semester Total	**20**	**250**

Semester IV

Course Code	Course Title	Course Type	Credit	Marks
HISGCOR04T	Paper IV: History of India c.1707-1950 CE	Core DSC1D	6	75
	Other Discipline	Core DSC2D	6	75
	MIL	Core	6	75
HISSSEC02M	Paper II: Understanding Indian Art	SEC2	2	25
		Semester Total	**20**	**250**

Semester V

Course Code	Course Title	Course Type	Credit	Marks
HISGDSE01T	Paper-I: Society and Economy of Modern Europe: c.15th – 18th Century	DSE DSE1A (Any one)	6	75
HISGDSE02T	Paper II: Patterns of Capitalism in Europe: c.16th Century to early 20th Century		6	
	Other Discipline	DSE DSE2A	6	75
HISGGEC01T	Paper I: History of Indian Journalism : Colonial and Post Colonial Period	GE 1	6	75
HISSSEC03M	Paper III - An Introduction to Archaeology	SEC3	2	25
		Semester Total	**20**	**250**

Semester VI

Course Code	Course Title	Course Type	Credit	Marks
HISGDSE03T	Paper III: Political History of Modern Europe: c.15th -18th Century	DSE DSE1B (Any one)	6	75
HISGDSE04T	Paper IV: Some Aspects of European History: c.1780-1939 CE		6	
	Other Discipline	DSE DSE2B	6	75
HISGGEC02T	Paper II: Some Perspectives on Women's Rights in India	GE2	6	75
HISSSEC04M	Paper IV: Understanding Popular Culture	SEC4	2	25
		Semester Total	**20**	**250**

Total Credits: 120

Total Marks: 1500

WEST BENGAL STATE UNIVERSITY

HISTORY GENERAL CBCS SYLLABUS (2018-19)

CORE COURSE (CC):4

Paper I: History of India from the Earliest Times upto c.300 CE
Paper II: History of India from c.300 to 1206 CE
Paper III: History of India from 1206 to1707CE
Paper IV: History of India from 1707 to 1950 CE

DISCIPLINE SPECIFIC ELECTIVE (DSE): 2

(Any one from Papers I & II and Any one from Papers III & IV)

Paper I: Society and Economy of Modern Europe: 15th – 18th Century
Paper II: Patterns of Capitalism in Europe: 16th Century to early 20th Century
Paper-III: Political History of Modern Europe: 15th -18th Century
Paper IV: Some Aspects of European History: c.1780-1939 CE

GENERIC ELECTIVE(GE): 2

Paper I: History of Indian Journalism: Colonial and Post Colonial Period
Paper II: Women Studies in India

SKILL ENHANCEMENT COURSE(SEC): 4

Paper I: Archives and Museums in India
Paper II: An Introduction to Archaeology
Paper III: Understanding Indian Art
Paper IV: Understanding Popular Culture

ABILITY ENHANCEMENT COURSE(AECC): 2

Environmental Science
English/MIL Communication

DETAILED SYLLABUS

CORE COURSE(CC): 4

Core Course

DSC 1A

Paper I: History of India from Earliest Times up to 300 CE

Semester: 1
Course Code: HISGCOR01T
Credits: 6
Marks: 75

Paper I: History of India from Earliest Times up to 300 CE

I. Sources & Interpretation

II. A broad survey of Palaeolithic, Mesolithic and Neolithic Cultures.

III. Harappan Civilization; Origin, Extent, dominant features &decline, Chalcolithic age.

IV. The Vedic Period: Polity, Society, Economy and Religion, Iron age with reference to PGW and Megaliths.

V. Territorial States and the rise of Magadha, Conditions for the rise of Mahajanpadas and the Causes of Magadha's success

VI. Iranian and Macedonian Invasions, Alexander's Invasion and impact

VII. Jainism and Buddhism: Causes, Doctrines, Spread, Decline and Contributions

VIII. The Satvahanas Phase; Aspects of Political History, Material Culture, Administration, Religion

IX. Emergence and Growth of Mauryan Empire; State, Administration, Econoy, Ashoka's Dhamma, Art & Architecture

X. The Sangam Age: Sangam Literature, The three Early Kingdoms, Society & the Tamil language xi. The age of Shakas: Parthians andKushanas,

Aspects of Polity, Society, Religion, Arts &Crafts, Coins, Commerce and Towns.

REFERENCES

D.P. Agrawal, *The Archaeology of India*
A.L. Basham, *The Wonder That was India*
D.K.,Chakrabarti, *Archaeology of Ancient Indian Cities*
Suvira Jaiswal, *Caste: Origin, Function and Dimensions*
N. Subramanian, *Sangam Polity*
Romila Thapar, *History of Early India*
F.R. Allchin and Bridget Allchin, *Origins of a Civilization: The Prehistory and Early Archaeology of South Asia*
A.L. Basham, *The Wonder That was India*
D.N. Jha, *Ancient India in Historical Outline*
D.D. Kosambi, *Culture and Civilization of Ancient India*
H.P. Ray, *Monastery and Guild India in Historical Outline*
K.A.N. Sastri, *A History of South India*
R.S. Sharma*, India's Ancient Past*
Niharanjan Ray, *Maurya and Post Maurya Art*
R.S. Sharma, *Aspects of Political Ideas and Institutions in Ancient India*
G. Yazdani, *Early History of Deccan Aspects of Political Ideas and Institutions in Ancient India*
Romila Thapar, *Ashoka and the Decline of the Mauryas*
G. Yazdani, *Early History of Deccan*
Ranabir Chakraborty, *Bharat ItihaserAdiparba* (in Bengali)
Dilip Kumar Chakraborty, *BharatbarsherPrakitihas*
Narendranath Bhattacharya, *PrachinBharatiyaSamaj*
Narendranath Bhattacharya, *Prachin Bharat; Rashtrachinta o Rashtrabyabastha*
Bhaskar Chattapadhyay, *Bharat Artha-samajik o Rashtriyabyabastha*
Bhaskar Chattopadhyay, *Gour Banger itihas o sanskriti (vol1*)
Niharanjan Ray, *BangalirItihas*
RomilaThapar, *BharaterItihas*

Core Course

DSC 1B

Paper-II: History of India from. c. 300 to 1206 CE

Semester: 2
Course Code: HISGCOR02T
Credits: 6
Marks: 75

Paper-II: History of India from. C. 300 to 1206 CE

I. The Rise & Growth of the Guptas: Administration, Society, Economy, Religion, Art, Literature, and Science &Technology.

II. Harsha & His Times: Harsha's Kingdom, Administration, Buddhism & Nalanda

III. South India: Polity, Society, and Economy and Culture

IV. Towards the Early Medieval: Changes in Society, Polity Economy and Culture with reference to the Pallavas, Chalukayas and Vardhanas..

V. Evolution of Political structures of Rashtakutas, Pala &Pratiharas.

VI. Emergence of Rajput States in Northern India: Polity, Economy andSociety.

VII. Arabs in Sindh: Polity, Religion &Society.

VIII. Struggle for power in Northern India and establishment of Sultanate.

REFERENCES

R. S. Sharma, *Indian Feudalism -India's Ancient Past*
B. D. Chattopadhaya, *Making of Early Medieval India*
Derryl N. Maclean, *Religion and Society in Arab Sindh*
K. M. Ashraf, *Life and Conditions of the People of Hindustan*
M. Habib and K.A. Nizami, *A Comprehensive History of India. Vol. V*
Tapan Ray Chaudhary and Irfan Habib (ed.), *The Cambridge Economic History of India, Vol. I*
Peter Jackson, *Delhi Sultanate: A Political and Military History*
Tara Chand, *Influence of Islam on Indian Culture*
Satish Chandra, *A History of Medieval India, 2 Volumes*
Percy Brown, *Islamic Architecture*
Ranabir Chakraborty, *Bharat ItihaserAdiparba*
Ranabir Chakraborty, *PrachinBharaterArthanaitikitihasersandhane* (in Bengali)
Dilip Kumar Chakraborty, *BharatbarsherPrakitihas*
Narendranath Bhattacharya, *PrachinBharatiyaSamaj*
Narendranath Bhattacharya, *Prachin Bharat: Rashtrachinta o Rashtrabyabastha,*
Bhaskar Chattapadhyay, *Bharat Artha-samajik o Rashtriyabyabastha*
Bhaskar Chattopadhyay, *Gour Banger itihas o sanskriti*(vol 1)
Niharanjan Ray, *BangalirItihas*
Romila Thapar, *BharatbarsherItihas*

Core Course

DSC 1C

Paper III: History of India from 1206 CE to1707 CE

Semester: 3
Course Code: HISGCOR03T
Credits: 6
Marks: 75

Paper III: History of India from 1206 CE to1707 CE

I. Foundation, Expansion &consolidation of the Delhi Sultanate; Nobility &Iqta system.

II. Miltary, administrative &economic reforms under the Khiljis&the Tughlaqs.

III. Bhakti &Sufi Movements.

IV. Provincial kingdoms: Mewar, Bengal, Vijaynagar and Bahamani.

V. Second Afghan State.

VI. Emergence and consolidation of Mughal State, C.16th century to mid 17th century.

VII. Akbar to Aurangzeb: administrative structure. Mansab and Jagirs, State &Religion, Socio-Religious Movements.

VIII. Economy, Society and Culture under the Mughals.

IX. Emergence of Maratha Power.

REFERENCES

Irfan Habib, *The Agrarian System of Mughal India 1556-1707*
Irfan Habib (ed.), *Madhya Kaleen Bharat*, (in Hindi), 8 Volumes
M. Athar Ali, *Mughal Nobility under Aurangzeb*
Shireen Moosvi, *The Economy of the Mughal Empire*
S.A.A. Rizvi, *Muslim Revivalist Movements in Northern India during 16th and 17th Centuries*
R.P. Tripathi, *The Rise and Fall of the Mughal Empire*, 2 vol.

I. H. Siddiqui,*Some Aspects of Afghan Despotism*
KesvanVeluthat, *Political Structure of Early Medieval South India*
P.J. Marshall, *The Eighteenth Century in Indian History*
Stewart Gordon, *The Marathas 1600-1818*
Percy Brown, *Islamic Architecture*

Core Course

DSC 1D

Paper-IV: History of India (1707-1950 CE.)

Semester: 4
Course Code: HISGCOR04T
Credits: 6
Marks: 75

Paper-IV: History of India (1707-1950 CE.)

I. Interpreting the 18th Century.

II. Emergence of Independent States &establishment of Colonial power.

III. Expansion &consolidation of Colonial Power upto 1857.

IV. Uprising of 1857: Causes, Nature &Aftermath.

V. Colonial economy: Agriculture, Trade & Industry.

VI. Socio-Religious Movements in the 19th century.

VII. Emergence &Growth of Nationalism with focus on Gandhian nationalism.

VIII. Communalism: Genesis, Growth and partition of India.

IX. Advent of Freedom: Constituent Assembly, establishment of Republic.

REFERENCES

Sugata Bose and Ayesha Jalal, *Modern South Asia: History, Culture, Political Economy*
Sekhar Bandyopadhyay, *From Plassey to Partition*
Barbara D. Metcalf and T.R. Metcalf, *A Concise History of India*

C.A. Bayly, *An Illustrated History of Modern India 1600 - 1947*
Sumit Sarkar, *Modern India 1885 - 1947*
Mushirul Hasan, *John Company to the Republic: A story of Modern India*
R.P. Dutt, *India Today*
Thomas Metcalf, *Ideologies of the Raj*
R. Jeffery and J. Masseloss, *From Rebellion to the Republic*
Bipan Chandra, *Nationalism and Colonialismin Modern India*
Urvashi Butalia,*The Other side of Silence*
Francine Frankel, *India's Political Economy 1947- 1977*
Paul Brass, *The Politics of India since Independence*
Lloyd and Susan Rudolph, *In Pursuit of Laxmi: the Political Economy of the Indian State*
Bipan Chandra et al. *India After Independence*
Gail Omvedt, *Dalits and Democratic Revolution*
Ramachandra Guha, *The Fissured Land*
K.G. Subramanian, *The Living Tradition: Perspectives on Modern Indian Art*
Radha Kumar, *A History of Doing*
Stanly Wolpert, *A New History of India*
Amalesh Tripathi, *SwadinataSangrameBharaterJatiyo Congress*
Mrinal Kanti Chattopadhyay, *Jyatiyotabadi Jinnah: ChintarKromobibartan.*

DISCIPLINE SPECIFIC ELECTIVE(DSE) :2

DSE 1A

Any One between Paper I and Paper II

Paper-I: Society and Economy of Modern Europe: c.15th – 18th century

Semester: 5
Course Code: HISGDSE01T
Credits: 6
Marks: 75

Paper- I: Society and Economy of Modern Europe: c.15th - 18 Century

1: Historiographical Trends

II. Feudal Crisis: Main strands

III. Renaissance: Origin, Spread &Dominant Features

IV. European Reformation: Genesis, nature & Impact

V. Beginning of the era of colonization: motives; mining and plantation; the African slaves

VI. Economic developments of the sixteenth century; Shift of economic balance from the

Mediterranean to the Atlantic

VII. Transition from Feudalism to Capitalism: Industrial Revolution in England

REFERENCES

P S Gupta, *AadhunikPaschimKaUday*
J H Plumb, *The Pelican Book of the Renaissance*
G. R. Elton, *Reformation Europe 1517-1559*
Ralph Davis, *The Rise of the Atlantic Economies*
Arvind Sinha, *Europe in Transition*
Rodney Hilton, *The Transition from Feudalism to Capitalism*
Fernand Braudel, *Civilization and Capitalism, Vols. I, II, III*
Herbert Butterfield, *The Origins of Modern Science.Vol. 90507*
Bhaskar Chakrabarti, Subhasranjan Chakrabarti and Kingshuk Chattopadhyay, *EuroperJugantar*
Rila Mukherjee, *Rupantorito Europe*

Paper-II: Patterns of Capitalism in Europe: 16th Century to early 20th Century

Semester: 5
Course Code: HISGDSE02T
Credits: 6
Marks: 75

Paper II: Patterns of Capitalism in Europe: c.16th Century to early 20th Century

I. Definitions & Concepts

II. Commercial Capitalism: 1500-1700

III. Industrial Revolution in England: Causes and Nature

IV. Industrial Capitalism in France: Genesis and Nature

V. Growth of Industries in Germany

VI. Impact of Industrial Revolution on European Society, Polity & Economy.

REFERENCES

Jerry Müller, *The Mind and the Market*
Karl Polany, *The Great Transformation*
Joseph Schumpeter, *Capitalism, Socialism and Democracy*

I. Wallerstein, *World System Analysis: An Introduction*
Carlo M. Cipolla, *Fontana Economic History of Europe*, VOL I and II
Christopher Hill, *From Reformation to Industrial Revolution*
Jan De Vries, *The Industrial Revolution &the IndustriousRevolution*

DSE 1B

Any One between Paper III and Paper IV

Paper-III: Political History of Modern Europe: c. 15th – 18th century

Semester: 6

Course Code: HISGDSE03T

Credits: 6

Marks: 75

Paper-III: Political History of Modern Europe: c.15th -18th Century

I. Europe in the 15th Century: Political dimensions of feudal crisis.
II. From City States to emergence of Absolutist States: Case studies of Italy, Spain, France, England and Russia.
III. Constitutional Conflict in 17th Century England: Causes, Nature and results.
IV. Thirty Year War: Causes, nature and impact
V. Absolutist State in 18th Century: Case Studies of Prussia, Russia & England.
VI. Crisis of the Absolutist State in France

References:
1. Arvind Sinha Europe in Transition, Delhi, 2010
2. Rodney Hilton. The Transition from Feudalism to Capitalism, Delhi (2006).
3. Perry Anderson. Lineages of the Absolutist State, Verso London 2013.
4. John Merriman, A History of Modern Europe New York 2010

Paper-IV: Some Aspects of European History: c.1780-1939 CE

Semester: 6
Course Code: HISGDSE04T
Credits: 6
Marks: 75

Paper IV: Some Aspects of European History: c.1780-1939 CE

I. The French Revolution: Genesis Nature & Consequences

II. Napoleonic Era and aftermath.

III. Revolutions of 1830 & 1848.

IV. Unification of Italy &Germany.

V. Social and economic Changes.

VI. Imperialist Conflicts: W.W I

VII. Rise of Fascism and Nazism.

VIII. Origin of W.W.II

REFERENCES

E.J. Hobsbawn, *The Age of Revolution*
Lynn Hunt: Politics, *Culture and Class in the French Revolution*
Andrew Porter, *European Imperialism* 1870 -1914
E.J. Hobsbawm, *The Age of Extremes* 1914 - 1991
Carter V. Findley and John Rothey, *Twentieth-Century World*

GENERIC ELECTIVE (GE) : 2

GE 1

Paper I: History of Indian Journalism: Colonial and Post Colonial Period

Semester: 5
Course Code: HISGGEC01T
Credits: 6
Marks: 75

Paper I: History of Indian Journalism: Colonial and Post Colonial Period

I. Pre-colonial History of written records & modalities of dissemination

II. Advent of Print media :Imperialist Ideologies

III. Nationalism and Print Culture in Bengal: Selective study of prominent newspapers: *Amrita Bazar Patrika, Ananda Bazar Patrika* and *Hindusthan Standard*

IV. Writing and Reporting

REFERENCES

J. Natrajan, *History of Indian Journalism,* Vol. II of Press Commission Report
J. Natrajan, *A History of the Press in India*
ParthasarathuRangaswami, Journalism in India
Hamendra Prasad Ghosh, *Newspapers in India*
The History and Culture of the Indian People, General Editor R.C. Majumdar, Vols. IX, X, X
B.N. Ahuja and S.S. Chhabra, *Reporting*
Benoy Ghosh, *SamayikPatreBanglarSamaj Chitra* (1840-1905)
Benoy Ghosh, *SambadPatreBanglarSamaj*
Partha Chattopadhyay, *Bharatiya Sangbad PotrerRuprekha*
Nandalal Bhattacharya, *Sangbad patrerEtibityo*
Partha Chattopadhyay, *Sangbad Bidya*
Partha Chattopadhyay, *Freelance Sangbadikota o Lekhalekhi*

GE 2

Paper-II: Some Perspectives of Women's Rights in India

Semester: 6
Course Code: HISGGEC02T
Credits: 6
Marks: 75

Paper II: Some Perspectives on Women's Rights in India

I. Definition of Human Rights: UN Conventions &Indian Context

II. Indian Constitution and Women's Rights

III. Preventive Acts: Minimum Wage Act,1948, Family Courts Act,1986, Dowry

Prohibition Act, 1961,Immoral Traffic Prevention Act,1986, Domestic Violence Act, PNDT Act,1994,latest measures

IV. Issues of violence against women and remedial measures

V. Role of Non Government Institutions

VI. Present Status: Issues of enabling &empowering modalities.

REFERENCES

Bina Agarwal, *Field of Her Own*
Urvashi Butalia and T. Sarkar, (ed.), *Women & Hindu Rights*
Zoya Hasan (ed.), *Forging Identities: Gender, Communities &Patriarchies*, EPW,
BasabiChkraborti (ed.), *ProsongoManabibidya*
BasabiChkraborti (ed.), *NariPrithibi: Bahussar*

SKILL ENHANCEMENT COURSE (SEC) : 4

SEC 1

Paper-I: Archives and Museums in India
Semester: 3
Course Code: HISSSEC01M
Credits: 2
Marks: 25

Paper I: Archives and Museums in India

This course introduces students to the institutions that house and maintain documentary, visual and material remains of the past. Museums and archives are among the most important such repositories and this course explains their significance and how they work. Students will be encouraged to undertake collection, documentation and exhibition of such materials in their localities and colleges. Visit to Archives and/or Museumsis an integral part of the course.

I. Definition and history of development (with special reference to India)

II. Types of archives and museums: Understanding the traditions of preservation in India Collection policies, ethics and procedures Collection: field exploration, excavation, purchase, gift and bequests, loans and deposits, exchanges, treasure trove confiscation and others. Documentation: accessioning, indexing, cataloguing,

digital documentation and de-accessioning Preservation: curatorial care, preventive conservation, chemical preservation and restoration

III. Museum Presentation and Exhibition

IV. Museums, Archives and Society: (Education and communication Outreach activities

REFERENCES

Saloni Mathur, *India By Design: Colonial History and Cultural Display*
S. Sengupta, *Experiencing History Through Archives*
Tapati Guha Thakurta, *Monuments, Objects, Histories: Institution of Art in Colonial India*
Y. P. Kathpalia, *Conservation and Restoration of Archive Materials*,
R.D. Choudhary, *Museums of India and their maladies*
S.M. Nair, *Bio-Deterioration of Museum Materials*
O.P. Agrawal, *Essentials of Conservation and Museology*

SEC 2

Paper III- Understanding Indian Art

Semester: 4
Course Code: HISSSEC02M
Credits: 2
Marks: 25

Paper III: Understanding Indian Art

The purpose of this course is to introduce students to Indian art, from ancient to contemporary times, in order to understand and appreciate its diversity and its aesthetic richness. The course will equip students with the abilities to understand art as a medium of cultural expression. It will give students direct exposure to Indian art through visualsand projects.

I. Prehistoric and protohistoric art: Rock art; Harappan arts and crafts

II. Indian art (c. 600 BCE – 600 CE): Notions of art and craft. Canons of Indian paintings. Major developments in stupa, cave, and temple art and architecture Early Indian sculpture: style and iconography. Numismatic art

III. Indian Art (c. 600 CE – 1200 CE): Temple forms and their architectural features. Early illustrated manuscripts and mural painting traditions Early medieval sculpture: style and iconography Indian bronzes or metal icons

IV. Indian art and architecture (c. 1200 CE – 1800 CE): Sultanate and Mughal architecture. Miniature painting traditions: Mughal, Rajasthani, Pahari Introduction to fort, palace and haveli Architecture

V. Modern and Contemporary Indian art and Architecture: The Colonial Period. Art movements: Bengal School of Art, Progressive Artists Group, etc. Major artists and their artworks. Popular art forms (folk art traditions)

REFERENCES

Tomory, *History of Fine Arts in India*
Erwin Neumayer, *Lines of Stone: The pre-historic rock-art of India*
B.N. Goswamy ,*Essence of Indian Art, Asian Art Museum of San Francisco*
Susan Huntington, *The Art of Ancient India: Hindu, Buddhist, Jain*
Tapati Guha Thakurta, *The making of a new modern Indian art: Aesthetics and nationalism in Bengal, 1850-1920*
ParthaMitter, *Indian Art*, Oxford History of Art series
Parul Pandya Dhar (ed.), *Indian Art History Changing Perspectives* (Introduction)
M.C. Beach, *The New Cambridge History of India I: 3, Mughal and Rajput Painting*
Niharranjan Ray, *An Approach to Indian Art*
World Heritage Site Managers, UNESCO World Heritage Manuals [can be downloaded/ accessed at *www.unesco.org*]

SEC 3

Paper-II: An Introduction to Archaeology

Semester: 5
Course Code: HISSSEC03M
Credits: 2
Marks: 25

Paper II: An Introduction to Archaeology

I. Definition and Components
II. Historiographical Trends
III. Research Methodologies
IV. Definition of Historical Sites &Explorations
V. Field Work and Tools of research

VI. Documentation, Codification, Classification, Analysis of findings and publications

REFERENCES

John. A. Bintliff, *A Companion to Archaeology*
D.R. Chakrabarti, *A History of Indian Archaeology: From the Beginning to 1947*
M. Hall &W. Silliman, *Historical Archaeology*
Mathew Johnson, *Archaeological Theory: An Introduction*

SEC 4

Paper IV- Understanding Popular Culture

Semester: 6
Course Code: HISSSEC04M
Credits: 2
Marks: 25

Paper IV: Understanding Popular Culture

I. Introduction a. Defining elite and popular culture b. Differences in their forms, contents and patterns of presentations c. Changing traditions of Folk songs, music, literature and dances

II. a. Visual Expressions a. Folk Art, Calendar Art, Photography. b. Audio-visual mode of presentation cinema & television. c. Expressions of popular culture in dance , drama, films and painting

III. Performance and Participations: a. Theatre, music, folk songs and jatra: b. Identifying themes, functionality, anxieties. c. Fairs, Festivals and Rituals, Disentangling mythological stories, patronage, regional variations.

IV. Popular Culture in a globalized world. The impact of the internet and audio-visual media on popular culture

REFERENCES

W. Dissanayake and K. M. Gokul Singh, *Indian Popular Cinema*
John Storey, *Cultural Theory and Popular Culture*
Patricia Oberoi, *Freedom and Destiny: Gender, Family and Popular Culture in India*
Camera Indica, *The Social Life of Indian Photographs*

Pankaj Rag, *DhunokeYatri*, Rajkamal,
A.K. Ramanujan, *Folktales from India: A Selection of Oral Tales from Twenty-two Languages* (Only Introduction).
V. Ramaswamy, 'Women and 60 the 'Domestic' in Tamil Folk Songs' in Kumkum Sangari and Uma Chakravarti, (eds.), *From Myths to Markets: Essays on Gender*
Lata Singh (ed.), *Theatre in Colonial India: Playhouse of Power*
Mihir Kamilya Chowdhury, *RarherJanajati O Lokosanskriti*
Probodh Kumar Bhowmick, *Socio-Cultural Profile of Frontier Bengal*
D.D. Kosambi, *Myth and Reality*
Debiprasad Chattopadhyay, *Lokayata*
Amalendu Mitra, *RarherSanskriti O DharmaRajthakur*
Amiyo Kumar Bandyopadhyay, *Bankurar Mandir*
BinoyGhosh, *PaschimbanglarSanskriti*
Niharanjan Roy, *BangalirItihas*
Sudhir Kumar Karan, *SimantaBanglarLokojan*
TarapadaSantra, *PaschimbangerLokoshilpa O Shilpi Samaj*
Debiprasad Chattopadhyay, *Lokayata Darshan*
Asutosh Bhattacharya, *BanglarLokosruti*

WEST BENGAL STATE UNIVERSITY

B.A. HISTORY HONOURS CBCS, 2018-19

Semester 1

Course Code	Course Title	Course Type	Credit	Marks
HISACOR01T	Paper I: History of India-I (From Earliest Times to c.300 BCE)	Core-1	6	75
HISACOR02T	Paper II: Social Formations and the Cultural Patterns of the Ancient World	Core – 2	6	75
HISHGEC01T	Paper I: History of India from the Earliest Times uptoc.300 CE	**Generic Elective – 1	6	75
	Environmental Science	Ability Enhancement Compulsory Course – 1	2	25
		Semester Total	**20**	**250**

** Generic Elective (GE): Students of History Honours should take Generic Elective –1 from other disciplines. However, Honours students belonging to other disciplines have to take the given General Elective-1 if they choose History as Generic Elective

Semester II

Course Code	Course Title	Course Type	Credit	Marks
HISACOR03T	Paper III: History of India- II (From c.300BCE – 750CE)	Core–3	6	75
HISACOR04T	Paper IV: Social Formations & the Cultural Patterns of the Medieval World	Core – 4	6	75
HISHGEC02T	Paper II: History of India fromc.300 CE to1206 CE	**Generic Elective – 2	6	75
	English/MIL Communication	Ability Enhancement Compulsory Course – 2	2	25
		Semester Total	**20**	**250**

** Generic Elective (GE): Students of History Honours should take Generic Elective –2 from other disciplines. However, Honours students belonging to other disciplines have to take the given General Elective-2 if they choose History as Generic Elective

Semester III

Course Code	Course Title	Course Type	Credit	Marks
HISACOR05T	Paper V: History of India -III (750 CE-1206 CE)	Core-5	6	75
HISACOR06T	Paper VI: Rise of the Modern West- I	Core – 6	6	75
HISACOR07T	Paper VII: History of India-IV (1206 CE–1526 CE)	Core- 7	6	75
HISHGEC03T	Paper III: History of India from c.1206 to1707 CE	**Generic Elective – 3	6	75
HISSSEC01M	Paper I: Archives and Museums in India	Skill Enhancement Course – 1	2	25
		Semester Total	**26**	**325**

** Generic Elective (GE): Students of History Honours should take Generic Elective –3 from other disciplines. However, Honours students belonging to other disciplines have to take the given General Elective-3 if they choose History as Generic Elective

Semester IV

Course Code	Course Title	Course Type	Credit	Marks
HISACOR08T	Paper VIII:Rise of theModern West-II	Core- 8	6	75
HISACOR09T	Paper IX:History of India-V(1526 CE-1757 CE)	Core – 9	6	75
HISACOR10T	Paper X:History of India-VI (1757 CE-1857 CE)	Core- 10	6	75
HISHGEC04T	Paper IV: History of India c.1707 CE-1950 CE	**Generic Elective – 4	6	75
HISSSEC02M	Paper II: Understanding Indian Art	Skill Enhancement Course – 2	2	25
		Semester Total	**26**	**325**

** Generic Elective (GE): Students of History Honours should take Generic Elective – 4 from other disciplines. However, Honours students belonging to other disciplines have to take the given General Elective-1 if they choose History as Generic Elective

Semester V

Course Code	Course Title	Course Type	Credit	Marks
HISACOR11T	Paper XI: History of Modern Europe (1789 CE– 1919 CE)	Core-11	6	75
HISACOR12T	Paper XII: History of India-VII (1858 CE-1947CE)	Core – 12	6	75
HISADSE01T	Paper I: Aspects of the History of Modern South East Asia I	Discipline Specific Elective – 1 Discipline Specific Elective – 2 (Any two)	6	75x2
HISADSE02T	Paper II:Aspects of the History of Modern South East Asia II		6	
HISADSE03T	Paper III:History of the United States of America I (1776 CE-1864 CE)		6	
		Semester Total	**24**	**300**

Semester VI

Course Code	Course Title	Course Type	Credit	Marks
HISACOR13T	Paper XIII: History of India VIII (India since 1947 CE)	Core-13	6	75
HISACOR14T	Paper XIV: Trends in World Politics (1919CE-2001 CE)	Core – 14	6	75
HISADSE04T	Paper V:History of Modern East Asia I (1839 CE-1919 CE)	Discipline Specific Elective – 3 Discipline Specific Elective – 4 (Any two)	6	75x2
HISADSE05T	Paper VI:History of Modern East Asia II (1919 CE-1939 CE)		6	
HISADSE06T	History of the United States of America II (1865 CE-1945 CE)		6	
		Semester Total	**24**	**300**

Total credits: 140

Total marks: 1750

WEST BENGAL STATE UNIVERSITY

HISTORY HONOURS CBCS SYLLABUS (2018-19)

CORE COURSE(CC): 14

Paper I: History of India-I (From Earliest Times to c.300 BCE)
Paper II: Social Formations and Cultural Patterns of the Ancient World
Paper III: History of India-II (From c.300 BCE – c.750CE)
Paper IV: Social Formations and Cultural Patterns of the Medieval World
Paper V: History of India- III (c.750 CE -1206 CE)
Paper VI: Rise of the Modern West- I
Paper VII: History of India-IV (1206 CE– 1526 CE)
Paper VIII: Rise of the Modern West-II
Paper IX: History of India-V (1526 CE - 1757 CE)
Paper X: History of India-VI (c.1757 CE - 1857 CE)
Paper XI: History of Modern Europe (1789 CE– 1919 CE)
Paper XII: History of India-VII (1858 CE-1947 CE)
Paper XIII: History of India- VIII (India since 1947 CE)
Paper XIV: Trends in World Politics (1919 CE-2001 CE)

DISCIPLINE SPECIFIC ELECTIVE(DSE): 4
(*Any Two from Papers I, II, III and Any Two from Papers IV, V, VI*)

Paper I: Aspects of the History of Modern South East Asia- I
Paper II: Aspects of the History of Modern South East Asia- II
Paper III: History of the United States of America I (1776 CE-1864 CE)
Paper IV: History of Modern East Asia I (1839 CE-1919 CE)
Paper V: History of Modern East Asia II (1919 CE-1939 CE)
Paper VI: History of the United States of America II (1865 CE-1945 CE)

GENERIC ELECTIVE (GE) : 4

Paper I: History of India from the Earliest Times upto c.300 CE
Paper II: History of India from c.300 to 1206 CE
Paper III: History of India from 1206 to1707CE
Paper IV: History of India from 1707 to 1950 CE

SKILL ENHANCEMENT COURSES (SEC) - 2

Paper I: Archives and Museums in India
Paper II: Understanding Indian Art

ABILITY ENHANCEMENT COMPULSORY COURSE (AECC) : 2

Environmental Science
English/ MIL

DETAILED SYLLABUS

CORE COURSE (CC):14

Core1 (C1)

Paper I: History of India- I (From Earliest Times to c. 300 BCE)

Semester - I
Course Code – HISACOR01T
Credits - 6
Marks – 75

Paper 1:History of India – I(From Earliest Times to c.300 BCE)

I. Reconstructing Ancient Indian History (a) Early Indian notions of History. (b) Sources and tools of historical reconstruction. (c) Historical interpretations (with special reference to gender, environment, technology, and regions).

II. Pre-historic hunter-gatherers (a) Paleolithic cultures- sequence and distribution; stone industries and other technological developments. (b) Mesolithic cultures- regional and chronological distribution; new developments in technology and economy; rock art.

III. The advent of food production: Understanding the regional and chronological distribution of the Neolithic and Chalcolithic cultures: subsistence, and patterns of exchange

IV. The Harappan civilization Origins; settlement patterns and town planning; agrarian base; craft productions and trade; social and political organization; religious beliefs and practices; art; the problem of urban decline and the late/post-Harappan traditions.

V. Cultures in transition Settlement patterns, technological and economic developments; social stratification; political relations; religion and philosophy; the Aryan Problem. (a) North India (circa 1500 BCE-300 BCE) (b) Central India and the Deccan (circa 1000 BCE - circa 300 BCE) (c) Sangam Age: society, language and literature, Megaliths, Tamilagan

REFERENCES

R.S. Sharma, *India's Ancient Past*

R.S. Sharma, *Material Culture and Social Formations in Ancient India*
R.S. Sharma, *Looking for the Aryas*
D. P. Agrawal, *The Archaeology of India*
Bridget & F. Raymond Allchin, *The Rise of Civilization in India and Pakistan*
A. L. Basham, *The Wonder that Was India*
D. K. Chakrabarti, *The Archaeology of Ancient Indian Cities*
D. K. Chakrabarti, *The Oxford Companion to Indian Archaeology*
H. C. Raychaudhuri, *Political History of Ancient India*, Rev. ed. with Commentary by B. N. Mukherjee
K. A. N. Sastri (ed.), *History of South India*
Upinder Singh, *A History of Ancient and Early Medieval India*
Romila Thapar, *Early India from the Beginnings to 1300*
Irfan Habib, *A People's History- Vol. -1. Pre-History&Vol.-2,Indus Civilization: Including Other Copper Age Cultures and the History of Language Change till 155 B.C.*
Uma Chakravarti, *The Social Dimensions of Early Buddhism*.
RajanGurukkal, *Social Formations of Early South India*
R. Champakalakshmi, *Trade. Ideology and urbanization: South India 300 BC- AD 1300*
D. N. Jha, *Ancient India in Historical Outline*
R. M. Wheeler, *The Indus Civilization*
D.K. Chakrabarti, *India, an Archaeological History, Paleolithic Beginnings to Early Historic Foundations*
B.D. Chattopadhyay, *A Survey of Historical Geography of Ancient India*
Kumkum Roy, 'Of Tribes, Hunters and Barbarians: Forest Dwellers in the Mauryan Period', *Studies in History*, Vol.X1V, No.1
SukumariBhattacharji, *ItihaserAalokeVaidikSahitya* (in Bengali)
D.K. Chakrabarti, *BharatbarsherPragitihas* (in Bengali)
Ranabir Chakraborty, *Bharat ItihaserAdiparba*
Ranabir Chakraborty, *PrachinBharaterArthanaitikItihaserSandhane* (in Bengali)
Irfan Habib, *Pre-History* (*Prak-Itihas* in Bengali)
Irfan Habib, *The Indus Civilization* (*Sindhu Savyata* in Bengali)
D.D. Kosambi, *An Introduction to the Study of Indian History* (*Bharat-ItihasCharchar Bhumika* in Bengali)
B.N. Mukherjee,*ItihaserAloke Arya Samasya* (in Bengali)
Shereen Ratnagar, *The Harappan Civilization*
Shireen Ratnagar, *Harappa SavyatarSandhane* (in Bengali).
H. C. Raychaudhuri, *Political History of Ancient India* (*PrachinbharaterRajnaitikItihas*in Bengali).
R. S. Sharma, *Perspectives in Economic and Social History of Early India* (*PrachinBharaterSamajik o ArthanaitikItihas*(in Bengali).
R.S. Sharma, *BharaterPrachinAtit*, New Delhi
R.S. Sharma, *PrachinBharaterSamajik O ArthanikItihas*(in Bengali)
R.S. Sharma, *PrachinBharaterBostugataSanskriti O SamajGathan*(in Bengali)
Romila Thapar, *BharatbarsherItihas*(in Bengali).
A.L. Basham, *Atiter Ujjwal Bharat* (in Bengali)

Core 2 (C2)

Paper II: Social Formations and Cultural Patterns of the Ancient World

Semester - I
Course Code – HISACOR02T
Credits - 6
Marks – 75

Paper II - Social Formations and the Cultural Patterns of the Ancient World

I. Evolution of humankind; Paleolithic and Mesolithic cultures.

II. Food production: Beginnings of agriculture and animal husbandry.

III. Bronze Age Civilizations, with reference to any one of the following: i) Egypt (Old Kingdom); ii) Mesopotamia (up to the Akkadian Empire); iii) China (Shang); IV) Eastern Mediterranean (Minoan) economy, social stratification, state structure, religion.

IV. Nomadic groups in Central and West Asia; Debate on the advent of iron and its implications

V. Slave society in ancient Greece: Agrarian economy, urbanization, trade.

VI. Polis in ancient Greece: Athens and Sparta; Greek Culture.

REFERENCES

Burns and Ralph. *World Civilizations*
Cambridge History of Africa, Vol. I
Gordon Childe, *What Happened in History*
G. Clark, *World Prehistory: A New Perspective*
B. Fagan, *People of the Earth*
Amar Farooqui, *Early Social Formations*
M. I. Finley, *The Ancient Economy*
Jacquetta Hawkes, *First Civilizations*
G. Roux, *Ancient Iraq*
Bai Shaoyi, *An Outline History of China*
H. W. F. Saggs, *The Greatness that was Babylon*
B. Trigger, *Ancient Egypt: A Social History*
UNESCO Series: *History of Mankind*, Vols. I - III./ or New ed. *History of Humanity*
R. J. Wenke, *Patterns in Prehistory*
G. E. M. Ste Croix, *Class Struggles in the Ancient Greek World*
J. D. Bernal, *Science in History*, Vol. I, V.

Gordon Childe, *Social Evolution*
Glyn Daniel, *First Civilizations*
Hauser, *A Social History of Art*, Vol. I.
Gitashri Bandana Sengupta, *Peloponesiyojuddha* (in Bengali)
Sujato Bhadra and Kunal Chattopadhyay, *PrachinGreecerSamaj o Sanskriti*
Supratim Das, *GreecerItihas*

Core 3 (C 3)

Paper III: History of India- II (c.300 BCE to 750CE)

Semester - II
Course Code – HISACOR03T
Credits- 6
Marks – 75

Paper III: History of India- II (c.300 BCE to 750CE)

I. Economy and Society (circa 300 BCE to circa CE 300): (a) Expansion of agrarian economy: production relations. (b) Urban growth: north India, central India and the Deccan; Craft Production: trade and trade routes; coinage. (c) Social stratification: class, varna, jati, untouchability; gender; marriage and property relations

II. Changing political formations (circa 300 BCE to circa CE 300): (a) The Mauryan Empire. (b) Post-Mauryan Polities with special reference to the Kushanas and the Satavahanas; GanaSanghas.

III. Towards early medieval India (circa CE fourth century to CE 750): (a) Agrarian expansion: land grants, changing production relations; graded Land rights and peasantry. (b) The problem of urban decline: patterns of trade, currency, and urban Settlements. (c) Varna, proliferation of jatis: changing norms of marriage and property. (d) The nature of polities: the Gupta empire and its contemporaries: post- Gupta polities - Pallavas, Chalukyas, and Vardhanas

IV. Religion, philosophy and society (circa 300 BCE- CE 750): (a) Consolidation of the brahmanical tradition: dharma, Varnashram, Purusharthas, samskaras. (b) Theistic cults (from circa second century BC): Mahayana; the Puranic tradition. (c) The beginnings of Tantricism

V. Cultural developments (circa 300 BCE - CE 750): (a) A brief survey of Sanskrit, Pali, Prakrit and Tamil literature. Scientific and technical treatises. (b) Art and architecture & forms and patronage; Mauryan, post-Mauryan, Gupta, post-Gupta.

REFERENCES

B. D. Chattopadhyaya, *The Making of Early Medieval India*

D. P. Chattopadhyaya, *History of Science and Technology in Ancient India*
D. D. Kosambi, *An Introduction to the Study of Indian History*
S. K. Maity, *Economic Life in Northern India in the Gupta Period*
B. P. Sahu, ed. *Land System and Rural Society in Early India*
K. A. N. Sastri, *A History of South India*
R. S. Sharma, *Indian Feudalism*
R. S. Sharma, *Urban Decay in India, c.300- c.1000*
Romila Thapar, *Asoka and the Decline of the Mauryas*
Susan Huntington, *The Art of Ancient India: Buddhist, Hindu, and Jain*
N. N. Bhattacharya, *Ancient Indian Rituals and Their Social Contents*
J. C. Harle, *The Art and Architecture of the Indian Subcontinent*
P. L. Gupta, *Coins*
KesavanVeluthat, *The Early Medieval in South India*
H. P. Ray, *Winds of Change*
Romila Thapar, *Early India: From the Origins to 1300* A.D.
D. N. Jha, *Ancient India in Historical Outline*.
Ranabir Chakraborty, *PrachinBharaterArthanaitikItihasherSandhan*
Ranabir Chakraborty, ed. *Samaj-sanskritirItihas* (in Bengali)
SukumariBhattacharji, *ItihaserAalokeVaidikSahitya* (in Bengali)

Core 4 (C4)

Paper IV: Social Formations and Cultural Patterns of the Medieval World

Semester - II
Course Code –HISACOR04T
Credits - 6
Marks – 75

Paper IV: Social Formations and Cultural Patterns of the Medieval World

I. Roman Republic, Participate and Empire &slave society in ancient Rome: Agrarian economy, urbanization, trade.

II. Religion and culture in ancient Rome.

III. Crises of the Roman Empire.

IV. Economic developments in Europe from the 7th to the 14th centuries: Organization of production, towns and trade, technological developments. Crisis of feudalism.

V. Religion and culture in medieval Europe

VI. Societies in Central Islamic Lands: (a) The tribal background, ummah, Caliphal state; rise of Sultanates (b) Religious developments: the origins of shariah, Mihna, Sufism (c)Urbanization and trade

REFERENCES

Perry Anderson, *Passages from Antiquity to Feudalism*
Marc Bloch, *Feudal Society*, 2 Vols.
Cambridge History of Islam, 2 Vols.
Georges Duby, *The Early Growth of the European Economy*
Fontana Economic History of Europe, Vol. I
P. K. Hitti, *History of the Arabs*
P. Garnsey and Saller, *The Roman Empire*
S. Ameer Ali, *The Spirit of Islam*
J. Barrowclough, *The Medieval Papacy*
Encyclopedia of Islam, 1st ed., 4 vols.
M. G. S. Hodgson, *The Venture of Islam*

Core 5 (C 5)

Paper V : History of India-III (c.750 CE- 1206 CE)

Semester - III
UG Course Code – HISACOR05T
Credits - 6
Marks – 75

Paper V: History of India-III (c.750 CE- 1206 CE)

I. Studying Early Medieval India: Historical geography Sources: texts, epigraphic and numismatic data Debates on Indian feudalism, rise of the Rajputs and the nature of the state

II. Political Structures: (a) Evolution of political structures: Rashtrakutas, Palas, Pratiharas, Rajputs and Cholas (b) Legitimization of kingship; brahmanas and temples; royal genealogies and rituals (c) Arab conquest of Sindh: nature and impact of the new set-up; Ismaili dawah (d) Causes and consequences of early Turkish invasions: Mahmud of Ghazna; Shahab-ud-Din of Ghur

III. Agrarian Structure and Social Change: (a) Agricultural expansion; crops (b) Landlords and peasants (c) Proliferation of castes; status of untouchables (d) Tribes as peasants and their place in the Varna order

IV. Trade and Commerce: (a) Inter-regional trade (b) Maritime trade (c) Forms of exchange (d) Process of urbanization (e) Merchant guilds of South India

V. Religious and Cultural Developments: (a) Bhakti, Tantrism, Puranic traditions; Buddhism and Jainism; Popular religious cults (b) Islamic intellectual traditions: Al-Biruni; Al-Hujwiri (c) Regional languages and literature (d) Art and architecture: Evolution of regional styles

REFERENCES

R.S. Sharma, *Indian Feudalism (circa 300 - 1200)*
B.D. Chattopadhyaya, *The Making of Early Medieval India*
R.S. Sharma and K.M. Shrimali, eds, *Comprehensive History of India*, Vol. IV (A & B)
Mohammad Habib and K.A. Nizami, eds, *Comprehensive History of India*, Vol. V, *The Delhi Sultanate*
Hermann Kulke, ed., *The State in India (AD 1000 - AD 1700)*
N. Karashima, *South Indian History and Society (Studies from Inscriptions, AD 850 -1800*)
Derryl N. Maclean, *Religion and Society in Arab Sindh*
Irfan Habib, *Medieval India: The Study of a Civilization*
Richard Davis, *Lives of Indian Images*
Romila Thapar, *Somanatha: The Many Voices of a History*
John S. Deyell, *Living Without Silver: The Monetary History of Early Medieval North India*
Vijaya Ramaswamy, *Walking Naked: Women, Society, and Spirituality in South India*
Burton Stein, *Peasant State and Society in Medieval South India*
R. Champakalakshmi, *Trade, Ideology and Urbanization: South India, 300 BC to 1300 AD*
Al. Beruni's India, NBT edition.
Ali Hujwiri, *KashfulMahjoob*, Trnsl. R.Nicholson.
S. C. Mishra, *Rise of Muslim Communities in Gujarat*
J. Schwartzberg, *Historical Atlas of South Asia*
Sukumari Bhattacharya, *Prachinbharat,Samaj o sahitya*, Ananda, 2001 (in Bengali)
Bratindranath Mukhopadhyay, *Banga, Bangla o Bharat* (in Bengali)
Niharanjan Ray, *BangalirItihas*(in Bengali)

Core6 (C6)

Paper VI: Rise of the Modern West-I

Semester - III

UG Course Code – HISACOR06T
Credits - 6
Marks – 75
Paper VI: Rise of the Modern West-I

I. Transition from feudalism to capitalism: problems and theories.

II. Early colonial expansion: motives, voyages and explorations; the conquests of the Americas: beginning of the era of colonization; mining and plantation; the African slaves.

III. Renaissance: its social roots, city-states of Italy; spread of humanism in Europe; Art.

IV. Origins, course and results of the European Reformation in the 16th century.

V. Economic developments of the sixteenth century: Shift of economic balance from the Mediterranean to the Atlantic; Commercial Revolution; Influx of American silver and the Price Revolution.

VI. Emergence of European state system: Spain; France; England; Russia.

REFERENCES

T.S. Aston and C. H. E. Philpin (eds.), *The Brenner Debate*
H. Butterfield, *The Origins of Modern Science*
Carlo M. Cipolla, *Fontana Economic History of Europe*, Vols. II and III.
Carlo M. Cipolla, *Before the Industrial Revolution, European Society and Economy. 1000 - 1700*. 3rd ed. (1993)
D. C. Coleman (ed.), *Revisions in Mercantilism*
Ralph Davis, *The Rise of the Atlantic Economics*
Maurice Dobb, *Studies in the Development of Capitalism*
J. R. Hale, *Renaissance Europe*
R. Hall, *From Galileo to Newton*
Christopher Hill, *A Century of Revolutions*
Rodney Hilton, *Transition from Feudalism to Capitalism*
H. G. Koenigsberger and G. L. Mosse, *Europe in the Sixteenth Century*
Stephen J. Lee, *Aspects of European History, 1494 - 1789*
G. Parker, *Europe in Crisis, 1598- 1648*
G. Parker and L. M. Smith, *General Crisis of the Seventeenth Century*
J. H. Parry, *The Age of Reconnaissance*
MeenaxiPhukan, *Rise of the Modern West: Social and Economic History of Early Modern Europe*
V. Poliensiky, *War and Society in Europe, 1618 - 48*
Theodore K. Rabb, *The Struggle for Stability in Early Modern Europe*

V. Scammell, *The First Imperial Age: European Overseas Expansion, 1400 - 1715*
Jan de Vries, *Economy of Europe in an Age of Crisis, 1600- 1750*
M. S. Anderson, *Europe in the Eighteenth Century*
Perry Anderson, *The Lineages of the Absolutist State*
Stuart Andrews, *Eighteenth Century Europe*
B. H. Slicher von Bath, *The Agrarian History of Western Europe. AD. 500 - 1850*.
The Cambridge Economic History of Europe. Vol. I - VI.
James B. Collins, *The State in Early Modern France: New Approaches to European History*
G. R. Elton, *Reformation Europe, 1517 to 1559*
M. P. Gilmore, *The World of Humanism. 1453 -1517*
Peter Kriedte, *Peasants, Landlords and Merchant Capitalists*
J. Lynch, *Spain under the Hapsburgs*
Peter Mathias, *First Industrial Revolution*
Harry Miskimin, *The Economy of Later Renaissance Europe: 1460 û 1600*
Charles A. Nauert, *Humanism and the Culture of the Renaissance*
The New Cambridge Modern History of Europe, Vols. I -VII.
L. W. Owie, *Seventeenth Century Europe*
D. H. Pennington, *Seventeenth Century Europe*
F. Rice, *The Foundations of Early Modern Europe*
Amalesh Tripathi, *Italir Renaissance BangaliSanskriti* (in Bengali)
Rila Mukherjee, *Rupantarito Europe (900-1800)* (in Bengali)
Bhaskar Chakraborty, Subhashranjan Chakraborty, Kingshuk Chattopadhyay, *EuroperJugantar* (in Bengali)

Core7 (C7)

Paper VII – History of India-IV (1206 CE– 1526 CE)

Semester - III
UG Course Code –HISACOR07T
Credits - 6
Marks – 75

Paper VII: History of India- IV (1206 CE– 1526 CE)

I. Sources for studying/Interpreting the Delhi Sultanate Survey of sources: Persian tarikh tradition; vernacular histories; epigraphy

II. Sultanate Political Structures
Foundation, expansion and consolidation of the Sultanate of Delhi; The Khaljis and the Tughluqs; Mongol threat and Timur's invasion; The Lodis: Conquest of Bahlul and Sikandar;

Ibrahim Lodi and the battle of Panipat Theories of kingship;
Ruling elites; Sufis, ulama and the political authority; imperial monuments and coinage

III. Regional Political structures
Emergence of provincial dynasties: Bahamanis, Vijayanagar and Bengal Consolidation of regional identities; regional art, architecture and literature

IV. Sultanate Society and Economy-1 Iqta and the revenue-free grants Agricultural production

V. Sultanate Society and Economy-2
Changes in rural society; revenue systems
Monetization; market regulations; growth of urban centers; trade and commerce; Indian Ocean trade

VI. Religion and Culture
Sufi silsilas: Chishtis and Suhrawardis; doctrines and practices; social roles; Bhakti movements and monotheistic traditions in South and North India; Women Bhaktas; Nathpanthis; Kabir, Nanak and the Sant tradition

REFERENCES

Mohammad Habib and K.A. Nizami, eds, *Comprehensive History of India*, Vol. V, *The Delhi Sultanate*
Satish Chandra, *Medieval India* I
Peter Jackson, *The Delhi Sultanate*
Catherine Asher and Cynthia Talbot, *India Before Europe*
Tapan Raychaudhuri and Irfan Habib, eds, *Cambridge Economic History of India*, Vol. I.
K.A. Nizami, *Religion and Politics in the Thirteenth Century*
W.H. McLeod, KarineSchomer, et al, eds, *The Sants*
S.A.A. Rizvi, *A History of Sufism in India*
Mohibul Hasan, *Historians of Medieval India*
Cynthia Talbot, *Pre-colonial India in Practice*
Simon Digby, *War Horses and Elephants in the Delhi Sultanate*
I.H. Siddiqui, *Afghan Despotism*
Burton Stein, *New Cambridge History of India: Vijayanagara*
Richard M. Eaton, ed. *India's Islamic Traditions*
Vijaya Ramaswamy, *Walking Naked: Women, Society, and Spirituality in South India*
Sheldon Pollock, *Languages of the Gods in the World of Men*
Pushpa Prasad, *Sanskrit Inscriptions of the Delhi Sultanate*
Andre Wink, *Al-Hind*, Vols. I-III
Aniruddha Ray, *MadhyajugerBharaterItihas: Sultani Amal* (in Bengali)

Core8 (C8)

Paper VIII: Rise of the Modern West - II

Semester – 4
UG Course Code – HISACOR08T
Credits - 6
Marks – 75

Paper VIII: Rise of the Modern West - II

I. 17th century European crisis: economic, social and political dimensions.

II. The English Revolution: major issues; political and intellectual currents.

III. Rise of modern science in relation to European society from the Renaissance to the 17th century.

IV. Mercantilism and European economics; 17th and 18th centuries.

V. European politics in the 18th century: parliamentary monarchy; patterns of Absolutism in Europe.

VI. Political and economic issues in the American Revolution.

VII. Prelude to the Industrial Revolution.

REFERENCES

T.S. Aston and C.H.E. Philpin (eds.) *The Brenner Debate*
H. Butterfield, *The Origins of Modern Science*
Carlo M. Cipolla, *Fontana Economic History of Europe*, Vols. II and III
Carlo M. Cipolla, *Before the Industrial Revolution, European Society and Economy, 1000 - 1700*
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The New Cambridge Modern History of Europe, Vols. I - VII
L. W. Owie, *Seventeenth Century Europe*
D. H. Pennington, *Seventeenth Century Europe*
F. Rice, *The Foundations of Early Modern Europe*
Vandana Joshi, *Social Movements and Cultural Currents 1789–1945 : Themes in Modern European History*
Rila Mukherjee, *Rupantarito Europe (900-1800)* (in Bengali)
Bhaskar Chakraborty, Subhashranjan Chakraborty, Kingshuk Chattopadhyay, *Europer Jugantar* (in Bengali)

Core9 (C9)

Paper IX: History of India- V (1526 CE– 1757 CE)

Semester – 4
UG Course Code – HISACOR09T
Credits -6
Marks – 75

Paper IX: History of India- V (1526 CE– 1757 CE)

I. Sources and Historiography Persian literary culture; translations. Literature in regional languages

II. Establishment of Mughal rule

Babur's invasion of India - Struggle for Empire in North India –significance of Babar and Humayun's reign - Significance of Afghan despotism and rise of Sher Shah to power. His administrative and revenue reforms

III. Akbar and Consolodation of Mughal Empire

Akbar's Conquests - his Rajput Policy & administrative and religious reforms, Reign of Jahangir, Nurjahan- her role in imperial politics; The Mughals and the North Western frontier and central Asia.Making of a new imperial system and administration, the Mughal nobility, Mansab and Jagir.

IV. Mughal Empire Under Aurangazeb

State and religion under Aurangzeb; issues in the war of success ion; policies regarding Religious groups and Institutions - Conquests and limits of expansion - Beginning of the crisis: contemporary perceptions; agrarian and Jagir crises; revolts. Inland and ocean trade network.

V. Mughal Art, Architecture & Painting

VI. Patterns of Regional Politics

Rajput political culture and state formation -Rise of Maratha power under Shivaji, and expansion under the Peshwas - emergence of regional powers – case studies of Maharashtra, Awadh and Bengal; Bengal Nawabs and the rise of the English East India Company in Bengal.Debate of the 18th Century on the decline of the Mughal Empire

REFERENCES

A.C. Banerjee, *New History of Medieval India*
Irfan Habib, *Medieval India: The Study of a Civilization*
Irfan Habib, *Akbar and His India*
Faruqui, *Aurangzeb and His Times*
Irfan Habib and Tapan Roy Choudhury (ed.), *Cambridge Economic History of India*, Vol. I
Irfan Habib, *Agrarian System of the Mughals*
A. Nurul Hasan, *Thoughts on Agrarian Relations in Mughal India*
W. H. Moreland, *Agrarian System in Moslem India*
Aniruddha Roy, *Some Aspects of Mughal Administration*
Athar Ali, *The Apparatus of Empire: Awards of Ranks and Titles to the Mughal Nobility*
Satish Chandra, *Parties and Politics at the Mughal Court*
M. Athar Ali, *Mughal Nobility under Aurangzeb*
D.E. Streusand, *Formation of the Mughal Empire*
Muzaffar Alam and Sanjay Subramaniyam (ed.), *The Mughal State*
Seema Alavi (ed.), *The Eighteen Century in India*
P. Marshall (ed.), *The Eighteen Century in India*
Muzaffar Alam, *The Crisis of Empire in Mughal North India: Awadh and Punjab*
M. Athar Ali, *Mughal India: Studies in Polity, Ideas, Society and Culture*
S. R. Sharma, *Religious Policy of the Mughal Emperors*
R.M. Eaton, *Essays on Islam and Indian history*

R. M. Eaton (ed.), *India's Islamic Tradition*
Ashin Dasgupta and M.N. Pearson (eds.), *India and the Indian Ocean (1500-1800)*
K. N. Choudhuri, *Trading World of Asia and the English East India Company (1660-1760)*
J. F. Richards (ed.), *The Imperial Monetary System and Mughal India*
J. N. Sarkar, *Shivaji and his Times*
Stuart Gordon, *The Marathas*
Sumit Sarkar, *A Critique of Colonial India*
P.J. Marshall, *East India Fortunes*
N. K. Sinha, *Economic History of Bengal*, 3 Vols.
Amiya Bagchi, *Private Investment in India*
Sugata Bose, *Agrarian Bengal*
Ranajit Guha, *Rule of Property in Bengal*
Laxmi Subramanian,*History of India 1707 - 1857*
Goutam Bhadra, *MughulJuge Krishi Arthaniti O KrishokBidroha* (in Bengali)
BinoyBhusan Choudhury, *Banglar Krishi SamajerGathan* (in Bengali)
Hirendranath Mukhopadhyay, *BharatbarsherIthihas* (in Bengali)
J. N. Sarkar, *MughulArthanithi: SangathanEbongKarjakram*(in Bengali)
Anirudha Roy, *Mughal JugerArthanaitikIthihas* (in Bengali)
S. K. Mukhopadhyay, *MadhyajugerBharaterAdhunik Jiban*. (in Bengali)

Core 10 (C 10)

Paper X - History of India-VI (1757 CE -1857 CE)

Semester – 4
UG Course Code – HISACOR10T
Credits - 6
Marks – 75

Paper X - History of India-VI (1757 CE -1857 CE)

I. Foundations of Company's Rule
Early contestations between the Dutch, French and the British East India
The emergence of the English East India Company as a political power; Bengal as the 'British bridgehead';
Company Bengal Nawabs and the battle of Plassey, Buxar and the grant of Dewani, (Anglo Mysore; Anglo Maratha and Anglo Sikh relations.The Subsidiary alliance and the Doctrine of Lapse.

II. Legitimization of Company's rule in India
Regulating Act; Pitt's India Act; Charter Acts of 1813, 1833 and 1853
Administrative, Military, Police and Educational Reforms

III. Rural Economy and Society
Land revenue systems. Permanent settlement, Rayatwari and Mahalwari Commercialization of agriculture and indebtedness.
Rural society: change and continuity, Famines.

IV. Trade and Industry De industrialization
Trade and fiscal policy
Drain of Wealth
Growth of modern industry

V. Renaissance and Reforms
Bengal Renaissance and Socio-religious Reforms:Rammohan Roy (Brahma Samaj), Young Bengal, Vidyasagar and others
Educational Reforms initiated by the Company

VI. Popular Resistance Santhal uprising (1855-57); Sanyasi Uprising, KolBhumijuprisisng, Wahabi Faraizi and Santhal Uprising, Revolt of 1857: causes and nature

REFERENCES

Laxmi Subramaniyam, *History of India, 1707 – 1857*
Bipan Chandra, *History of Modern India*
Sekhar Bandyopadhyay (ed.), *Nationalist Movement in India*
C. A. Bayly, *Indian Society and the Making of the British Empire*
Bipan Chandra, *Rise and Growth of Economic Nationalism in India*
Suhash Chakravarty, *The Raj Syndrome: A Study in Imperial Perceptions*
J.S. Grewal, *The Sikhs of the Punjab*
Ranajit Guha (ed.), *Subaltern Studies: A Reader*
Dharma Kumar and Tapan Raychaudhuri (eds.), *The Cambridge Economic History of India*, Vol. II
P.J. Marshall, *Bengal: The British Bridgehead*
R.C. Majumdar (ed.), *History and Culture of Indian People*, Vols. IX and X. *British Paramountcy and Indian Renaissance*
Rajat K. Ray (ed.), *Entrepreneurship and Industry in India, 1800-1947*
Eric Stokes, *English Utilitarians and India*.
Sushil Chaudhury, *From Prosperity to Decline: Eighteenth Century Bengal*
Sekhar Bandyopadhyay, *From Plassey to Partition A History of Modern India*
Ratnalekha Roy, *Change in Bengal Agrarian Society C 1769-1850*
David Arnold and Ramchandra Guha (eds.), *Nature, Culture and Imperialism*
Amiya Bagchi, *Private Investment in India*
Bipan Chandra et al., *India's Struggles for Independence*
A.R. Desai, *Peasant Struggles in India*
R.P. Dutt, *India Today*
M.J. Fisher (ed.), *Politics of Annexation*
Ranajit Guha, *Elementary Aspects of Peasant Insurgency in Colonial India*

P.C. Joshi, *Rebellion 1857: A Symposium*
DadabhaiNaroji, *Poverty and Un-British Rule in India*
Sumit Sarkar, *A Critique of Colonial India*
P.J. Marshall, *East India Fortunes*
N. K. Sinha, *Economic History of Bengal*, 3 Vols
Sugata Bose, *Agrarian Bengal*
Ranajit Guha, *Rule of Property in Bengal*
David Kopf, *British Orientalism and the Bengal Renaissance*
Pradip Sinha, *19th Century Bengal: Calcutta in Urban History*
1857: Essays from Economic and Political Weekly
Sabyasachi Bhattacharya (eds.), *Rethinking 1857*
S. N. Sen, *1857*
Rajat K Roy, *PalashirSarayantra* (in Bengali)
Sushil Chaudhury, *PalashirAjanaKahini* (in Bengali)
Sekhar Bandopadhyay, *Palashitheke Partition* (in Bengali)

Core 11 (C11)

Paper XI: History of Modern Europe -I (1789 CE-1919 CE)

Semester – 5
UG Course Code – HISACOR11T
Credits - 6
Marks – 75

Paper XI: History of Modern Europe -I (1789 CE-1919 CE)

I. The French Revolution and its European repercussions Crisis of Ancien regime ---- Political, social, economic and intellectualbackground (role of Philosophers) of the French Revolution The revolution in the making – the Aristocratic Revolt and the consolidation of the Third Estate. The Constituent Assembly; Radicalization of the Revolution; the reign of Terror and the Thermedorian reaction; social base of the Revolution- Sans culottes, peasants and women; the directory and its achievements and failures.

II. Napoleon Bonaparte and the French Revolution Rise of Napoleon; Napoleonic reforms, Napoleonic Empire and Europe Fall of Napoleon: The Continental System; The Spanish Ulcer; The Moscow campaign. Assessment of Napoleon: Character of the French Revolution; Impact of French Revolution on Europe and abroad.

III. Restoration and Revolution (1815-1848) Vienna Congress; Concert of Europe; Metternich system Greek War of Independence, Revolution of 1830 &1848, & their Impact

IV. Industrialization and socio economic transformation Industrial Revolution; Definition and characteristics ; Pre Industrial society; Industrial Revolution in Britain; Impact on society, economy and polities . Industrialization in the continents, case study of France, Germany and Russia. Emergence of working class and its movements; early Utopian socialist thoughts.

V. Age of Nationalism Unification of Italy and Germany Specificities of economic development, political and administrative re organization – Italy and Germany The second Empire in France and Louis Napoleon

VI. The Eastern Question : The Crimean War; Treaty of Paris, Balkan Nationalism

VII. Imperial Expansion: Bismarck's diplomacy and the new balance of power; Kaiser WilliamII and Welt Politik; new course in German foreign policy; the eastern question of the late 19th century, Balkan wars

VIII. First World War and its aftermath: Outbreak of the first world war, emergence of the two armed camps; impact of the first world; the Russian revolution, the peace settlements of 1919, the League of nations.

REFERENCES

Vandana Joshi, *Social Movements and Cultural Currents 1789-1945: Themes in Modern European History*
Mason, *Concise History of Modern Europe*
Gerald Brennan, *The Spanish Labyrinth: An Account of the Social and Political Background of the Civil War*
C.M. Cipolla, *Fontana Economic History of Europe*, Volume III: *The Industrial Revolution*
Norman Davies, *Europe*
J. Evans, *The Foundations of a Modern State in 19th Century Europe*
T.S. Hamerow, *Restoration, Revolution and Reaction: Economics and Politics in Germany [1815 - 1871]*
E.J. Hobsbawm, *The Age of Revolution*
Lynn Hunt, *Politics, Culture and Class in the French Revolution*
James Joll, *Europe Since 1870*
David Landes: *Prometheus Unbound*
Georges Lefebvre, *Coming of the French Revolution*
George Lichtheim, *A Short History of Socialism*
Peter Mathias, *First Industrial Revolution*
Phyllis Deane, *The First Industrial Revolution*
Alec Nove, *An Economic History of the USSR*
Andrew Porter, *European Imperialism, 18760-1914*
Anthony Wood, *History of Europe, 1815-1960*
Stuart Woolf, *History of Italy, 1700-1860*

Fernand Braudel, "History and the Social Science", in M. Aymard and G. Mukhia, (ed.), *French Studies in History*, Vol. I
Maurice Dobb, *Soviet Economic Development Since 1917*
M. Perrot and G. Duby (eds.), *A History of Women in the West*, Vols 4 and 5
H. J. Hanham, *Nineteenth Century Constitution, 1815 - 1914*
E. J. Hobsbawm, *Nations and Nationalism*
Charles and Barbara Jelavich, *Establishment of the Balkan National States, 1840-1920*
James Joll, *Origins of the First World War*
Jaon B. Landes, *Women and the Public Sphere in the Age of the French Revolution*
David Lowenthal, *The Past is a Foreign Country*
Colin Licas, *The French Revolution and the Making of Modern Political Culture*
Nicholas Mansergh, *The Irish Question, 1840 -1921*
K.O. Morgan, *Oxford Illustrated History of Britain*, Vol. 3 [1789 - 1983]
R. P. Morgan, *German Social Democracy and the First International*
N.V. Riasanovsky, *A History of Russia*
J. M. Robert, *Europe 1880-1985*
J. J. Roth (ed.), *World War I: A Turning Point in Modern History*
Albert Soboul, *History of the French Revolution* (in two volumes).
Lawrence Stone, *History and the Social Sciences in the Twentieth Century: The Past and the Present*
Dorothy Thompson, *Chartists: Popular Politics in the Industrial Revolution*
E.P. Thompson, *Making of the English Working Class*
Michel Vovelle, *Fall of the French Monarchy*
Raymond Williams, *Culture and Society*
David Thomson, *Europe Since Napoleon*
George Rude, *Revolutionary Europe*
Stephen J. Lee, *Aspects of European History*
L.C.B. Seaman, *From Vienna to Versailles*
Gordon Craig, *Germany 1871-1945*
Geoffery Barraclough, *The Origins of Modern Germany*
Alfred Cobban, *A History of France*, Vols. I-III
E. H. Carr, *The History of Soviet Russia*, Vols. I-III
Hugh Seton Watson, *The Decline of Imperial Russia, 1815-1914*
W.L. Langer, *Diplomacy of Imperialism*
L. Kochan, *The Making of Imperial Russia*
Ralph Finley, *Modern German History*
A. J. P. Taylor, *The Course of German History*
A. J. P. Taylor, *The Struggle for Mastery over Europe*

Core 12 (C 12)

Paper XII- History of- History of India-VII (1858 CE -1947 CE)

Semester – 5
UG Course Code – HISACOR12T
Credits - 6
Marks – 75

Paper XII - History of India-VII (1858 CE-1947CE)

I. The aftermath of 1857
Queen's Proclamation; The Indigo rebellion, The Deccan Riots, The growth of the new middle class; the age of associations, The Aligarh movement, The Arya and the PrarthanaSamaj

II. The early phase of Indian Freedom Movement
Historiography of Indian Nationalism; Birth of Indian National Congress, The Moderates and the Extremists, Partition of Bengal, the Swadeshi movement, Muslim League, Morle Minto Reforns; Revolutionaries in India and abroad, the Lucknow pact

III. The Gandhian era
Gandhi's rise to power, Rowlatt Satyagraha, Montagu Chelmsford reforms; Khilafat and Non-co-operation movement, The Swarajya party, Poona Pact, Civil Disobedience Movement, Quit India Movement

IV. Towards freedom
Government of India Act 1935, The rise of the leftist movements, The Peasant and Working class movements, Cripps Mission, Subhas Bose and INA, RIN mutiny; Wavell Plan, Cabinet Mission; Tebhaga and Telengana movements

V. Communal Politics and Partition of India
Demand for Pakistan; Lahore session of the Muslim League, rise of Hindu Mahasabha and the RSS; Akali Dal, Partition and its consequences.

REFERENCES

Bipan Chandra, *History of Modern India*
Sumit Sarkar, *Writing Social History*
Bipan Chandra, *Nationalism and Colonialism in Modern India*
Bipan Chandra, *Rise and Growth of Economic Nationalism in India*
D.A.Low (ed.), *Congress and the Raj*
Eleanor Zelliot, *From Untouchable to Dalit: Essays on the Ambedkar Movement*
Gyanendra Pandey, *The Construction of Communalism in colonial North India*
Jawaharlal Nehru, *An Autobiography*
John R. McLane, *Indian Nationalism and the EarlyCongress*
Judith Brown, *Gandhi's Rise to Power, 1915-22*

M. K. Gandhi, *An Autobiography or The Story of My Experimentswith Truth*
Mushirul Hasan (ed.), *India's Partition*
Paul Brass, *The Politics of India Since Independence*
Peter Hardy, *Muslims of British India*
Ranajit Guha (ed.), *A Subaltern Studies Reader*
Sumit Sarkar, *Modern India, 1885-1947*
A. Jalal, *The Sole Spokesman. Jinnah, the Muslim League, and the Demand for Pakistan*
Anil Seal, *Emergence of Indian Nationalism*
A.R. Desai, *Peasant Struggles in India*
R. Desai, *Social Background of Indian Nationalism*
Chandra et. al., *India after Independence*
B.D. & T.R. Metcalf, *A Concise History of India*
B. Stein (ed.), *The Making of Agrarian Policy in British India*
B.R. Nanda (ed.), *Indian foreign Policy: The Nehru Years*
B. Shiva Rao, *The Arming of India's Constitution - A Study*Bipan Chandra, *Communalism in Modern India*
D. Chakrabarty, *Rethinking Working Class History*
D. Hardiman, *Peasant Resistance in India*
D. Kopf, *Brahmo Samaj and the Shaping of the Modern Indian Mind*
F. Hutchins, *Spontaneous Revolution*
Francine Frankel, *India's Political Economy, 1947-77*
G. Forbes, *Women in Modern India*
G. Prakash (ed.), *The World of the Rural Labourer in Colonial India*
G. Karlekar, *India. The First Fifty Years*
J. Brown, *Gandhi's Rise to Power*
J. R. McLane, *Indian Nationalism and the Early Congress*
J. Krishnamurti, *Women in Colonial India*
J.M. Kaul, *Problems of National Integration*
Judith Brown et al., *Gandhi, A Prisoner of Hope*
K. Roy (ed.), *Partition of India*
J.W. Jones, *Socio-Religious Reform Movements in British India*
M. Fisher (ed.), *India's Partition*
N. K. Sinha (ed.), *History of Bengal*
R. K. Ray, *Social Conflict and social Unrest in Bengal*
R. Kshirasagara, *Dalit Movements in India and its Leaders*
Ramchandra Guha, *India after Gandhi*
S. & T. Sarkar (eds.), *Women and Social Reform in Modern India*
S. Bandopadhyay (ed.), *Bengal: Rethinking Historiography*
S. Bhattacharya (ed.), *Approaches to History*
S. Bose & A. Jalal, *Modern South Asia*
Sumit Sarkar, *The Swadeshi Movement in Bengal*
S. Sen, *The Working Class in India*
Srikumar Deb, *Problems and Policies of Bengal Government: 1874-1882*
V.C. Joshi (ed.), *Rammohan Roy and the process of Modernization in India*
V.P. Menon, *Integration of the Indian States*
Sekhar Bandopadhyay, *PalashiTheke Partition* (in Bengali)

S. Sen and A. Ghosh, *Adhunik Bharat (1885-1964)* (in Bengali)
Sumit Sarkar, *Adhunik Bharat* (in Bengali)
S. Bhattacharya, *OupanibeshikBharaterArthaneeti* (in Bengali)
Bipan Chandra et. al., *BharaterSwadhinata Sangram* (in Bengali)
Amales Tripathi, *SwadhinataSangrameBharaterJatiya Congress* (in Bengali)
Amales Tripathi, *Bharater Mukti SangrameCharampanthiParba* (in Bengali)

Core 13 (C 13)

Paper XIII- History of India - VIII (India since 1947 CE)

Semester – 6
UG Course Code – HISACOR13T
Credits - 6
Marks – 75

Paper XIII - History of India -VIII (India since 1947 CE)

I. The Nehru era: Internal policy between 1947 to 1964- movements for social justice, the new constitution, integration of the princely states, growth of parliamentary democracy, Five years' plan

II. Towards Independence and Emergence of the New State Government of India Act 1935Working of the GOI Act. Negotiations for Independence and Popular Movements

III. Partition: Riots and Rehabilitation

IV. Making of the Republic The Constituent Assembly; Drafting of the Constitution Integration of Princely States

V. Indian Democracy at Work c1950- 1970s Language, Region, Caste and Religion. Electoral Politics and the Changing Party System; Regional Experiences India and the World; Non Aligned Movement

VI. Economy, Society and Culture c 1950-1970s The Land Question, Planned Economy, Industry and Labour Science and Education. The Women's Question: Movements and Legislation. Cultural Trends: Institutions and Ideas, Literature, Media, Arts

REFERENCES

Granville Austin, *Indian Constitution: Cornerstone of a Nation*
Francine Frankel, *India's Political Economy, 1947-2004*
Paul Brass, *The Politics of India Since Independence*
Ram Chandra Guha, *India after Gandhi: The History of the World's Largest Democracy*
Bipan Chandra, et al.*India after Independence*
Appadurai, *Domestic Roots of India's Foreign Policy 1947-1972*
Rajni Kothari, *Politics in India*
Joya Chatterji, *The Spoils of Partition: Bengal and India, 1947-67*
Sunil Khilnani, *The Idea of India*

Core 14 (C 14)

Paper XIV- Trends in World Politics (1919 CE-2001 CE)

Semester – 6
UG Course Code – HISACOR14T
Credits - 6
Marks – 75

Paper XIV- Trends in World Politics (1919 CE -2001 CE)

I. Challenges to the new European order: Consolidation and Development of power of the Soviet State, French search for security, Rise of Fascism in Italy and Nazism in Germany, World Economic depression of 1929, the Crisis of the Inter War European Order

II. The Road to 2nd World War; Germany's aggressive foreign policy; the role of the war economy, Spanish civil war, Mussolini's foreign policy and Abyssinian crisis, formation of the Rome Berlin Tokyo Axis – Grand Alliance and the Second World War - Impact of the War

III. United Nations Organization: its origin and functions

IV. Cold War and the emergence of bipolar politics – Rise of Communist China – Cold War in Asia: Korea, Cuba, Vietnam, Middle East – Third World and Non Aligned Movement

V. Détente and disintegration of the Soviet Bloc– Iranian Revolution – Afghanistan in turmoil

VI. Globalization and its impact – Rise of Terrorism – 9/11 and Its impact

REFERENCES

Gerald Brennan, *The Spanish Labyrinth: An Account of the Social and Political Background of the Civil War*

C.M. Cipolla, *Fontana Economic History of Europe*, Volume III*: The Industrial Revolution*

Norman Davies, *Europe*

J. Evans, *The Foundations of a Modern State in 19th Century Europe*

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David Landes, *Prometheus Unbound*

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Alec Nove, *An Economic History of the USSR*

Andrew Porter, *European Imperialism, 18760-1914*

Anthony Wood, *History of Europe, 1815 -1960*

Stuart Woolf, *History of Italy, 1700-1860*

G. Barrowclough, *An Introduction to Contemporary History*

Fernand Braudel, "History and the Social Science" in M. Aymar and Maurice Dobb (eds.), *Soviet Economic Development Since 1917*

M. Perrot and G. Duby (eds.), A History of Women in the West, Volumes 4 and 5

H.J. Hanham, *Nineteenth Century Constitution, 1815 - 1914*

E.J. Hobsbawm, *Nations and Nationalism*

Charles and Barbara Jelavich, *Establishment of the Balkan National States, 1840-1920*

James Joll, *Origins of the First World war* (1989)

Jaon B. Landes, *Women and the Public Sphere in the Age of the French Revolution*

David lowenthal, *The Past is a Foreign Country*

Nicholas Mansergh, *The Irish Question, 1840-1921*

K.O. Morga, *Oxford Illustrated History of Britain*, Volume 3 *1789 - 1983*

R.P. Morga, *German Social Democracy and the First International*

N.V. Riasanovsky, *A History of Russia*

J.M. Robert, *Europe 1880- 1985*

J.J. Roth (ed.), *World War I : A Turning Point in Modern History*

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E.P. Thompson, *Making of the English WorkingClass*

Michel Vovelle, *Fall of the French Monarchy*

H. Seton Watson, *The Russian Empire*

Raymond Williams, *Culture and Society*

P. Calvocoressi, *World Politics since 1945*

C.J. Bartlett, *International Politics: States, power and conflict since 1945*

Joan Spero, *The Politics of International Economic Relations*

Hans J. Morgenthou, *Politics among Nations*

J.L. Gaddis, *The United States and the origins of the Cold War*

D.F. Fleming, *The Cold War and Its Origins*
Walter La Febar, *America, Russia and the Cold War*
Garo Alprovitz, *Atomic Diplomacy: Hiroshima and Potsdam*
Joyce and Gabriel Kolko, *The Politics of War*
----------, *The Limits of Power: The World and US Foreign Policy*
Thomas J. Patterson, *Soviet-American Confrontation: Post-War Reconstruction and the Origins of the Cold War*
L.J. Halle, *The Cold War as History*
Peter Lowe, *The Origins of the Korean War*
Gung-Wu Wang, *China and the World since 1949*
Herbert Ellison, ed. *The Sino-Soviet Conflict: A Global Perspective*
J. Gittings, *Survey of the Sino-Soviet Dispute*
C.F. Fitzerland, *The Chinese View of their place in the world*
D. Rees, *A Short History of Modern Korea*
R.E.M. Irving, *The First Indo-China War: French and American Policy, 1945-54*
L.J. Mathews and D.E. Brown, (eds)*Assessing the Vietnam War*
Nikki R. Keddiie, *Roots of Revolution: An interpretative history of modern Iran*
Fiona Venn, *Oil Diplomacy in the Twentieth Century*
Carl L. Brown, *International Politics in the Middle East*
R. Ovendale, *The Origins of the Arab-Israeli Wars*
E. Said, *The Question of Palestine*
B.D. Nossiter, *The Global Struggle for more: Third World Conflicts with rich nations*
Susan George, *How the other Half Dies*
----------, *A Fate Worse than Debt: Third World Conflicts with rich nations*
Z. Brzezinski, *The Soviet Block: Unity and Conflict*
William A. Williams, *Empire as Way of Life*
G. Ionesku, *The Breakup of the Soviet Empire in Eastern Europe*
Adam Ullam, *Stalin*
Roy Medvedev, *On Stalin and Stalinism*
Raymond Garthoff, *The Great Transition, American-Soviet Relations and the End of the Cold War*
M.S. Rajan, *Studies on Non-alignment and the Non-aligned Movement*
Malabika Banerjee, *The Non-aligned Movement*
Uma Vasudev, ed. *Issues before Non-alignment: Past and Future*
Joseph S. Nye, Jr. *Bound to Lead: The Changing Nature of American Power*
----------, *Soft Power: The Means to Success in World Politics*
Shashi Tharoor, *Pax Indica: India and the World of the 21st Century*

DISCIPLINE SPECIFIC ELECTIVE (DSE) : 4

DISCIPLINE SPECIFIC ELECTIVE (DSE) offered: 4
Any Two from Papers I, II & III
Any Two from Papers IV, V & VI

DSE 1 and DSE 2
(Any Two from Papers I, II & III)

Paper I: Aspects of the History of Modern South East Asia - I

Semester – 5
UG Course Code – HISADSE01T
Credits - 6
Marks – 75

Paper I: Aspects of the History of Modern South East Asia -I

I. Historical writings on Southeast Asia in the early 20th century – Debates on the question of 'Indianisation' – Post-War historiography and the 'autonomy' of Southeast Asia.

II. (a) Growth of early European interests in Southeast Asia: 16th to 18th centuries – Colonial penetration and indigenous response: interaction and accommodation, collaboration and resistance. (b) Establishment of the colonial regimes in the 19th century: Stamford Raffles in Java, British forward movement in Malaya, foundation of Singapore, French colonial system in Indochina, British annexation of Burma, British movement in Borneo and the Brookes in Sarawak.

III. (a) Pre-colonial polity, society, economy and culture in Southeast Asia – a brief survey. (b) Colonial impact on society: growth of Western education; changing position of women and the gender question under colonial rule; social anomalies and eradication efforts; colonial science; Western medicine and public health. (c) Independent modernisation of Siam from Mongkut to Vajiravudh.

IV. Economic impact of colonialism: (a) Dutch domination in Indonesia – from the Culture system to the Liberal system. (b) Colonial policy and land question in Indochina – communication and plantation economy. (c) British economic policy in Burma – agricultural expansion. (d) Development of plantation economy in Malay. (e) Singapore as a strategic defence centre and its growing significance in international economy

V. Nationalism in Indonesia: Sarekat Islam, PKI, PNI and other political parties – Japanese impact during the World War II – Birth of Indonesian Republic and the constitution of 1945 – Indonesian National Revolution, 1945-50.

REFERENCES

Nicholas Tarling (ed.), *The Cambridge History of Southeast Asia*

----------, *A Concise History of Southeast Asia*
D.G.E. Hall, *A History of South East Asia*
G.M.T. Kahin, *Government and Politics of Southeast Asia*
J.F. Cady, *Southeast Asia: Its Historical Development*
Roff, W.R., *A History of Malaysia*
J.C. Van Leur, *Indonesian Trade and Society*
G.M.T. Kahin, (ed.),*Nationalism and Revolution in Indonesia*
Robert Van Niel, *The Emergence of Modern Indonesian Nationalism*
Anthony J.S. Reid, *Indonesian Nationalist Revolution*
W.M. Wertheinil, *Indonesian Society in Transition*
David K. Watt, *Thailand: A Short History*
----------, *Studies in Thai History*
David A. Wilson, *Politics in Thailand*
Craig Reynolds, *National Identity and Its Defenders: Thailand, 1939-89*
John D. Legge, *Indonesia*

Paper II: Aspects of the History of Modern South East Asia II

Semester – 5
UG Course Code – HISADSE02T
Credits - 6
Marks – 75

Paper II: Aspects of the History of Modern South East Asia - II

I. Early nationalist protest movement against French rule in Indochina – Rise of HoChih Minh and birth of Communist party – Vietminh and the August Revolution (1945) – The First Indochina war and Geneva Agreements – the nature of American participation.

II. Nationalism and religion in Burma: the Pongyis and the Sayasan Rebellion – the Thakin movement – Second World War, the struggle for independence and the transfer of power.

III. Growth of anti-Spanish sentiments in the Philippines – Dr. Jose Rizal and the propaganda movement – the anti-Spanish revolution of 1898 – the U.S. intervention and the road to self-government – Transfer of power and birth of a republic (1946).

IV. Growth of nationalism in British Malaya – National liberation movement – Malaya Union Plan.

V. Decolonisation and cold war politics – Regional cooperation initiatives: SEATO, ASA, ASEAN and NAM

REFERENCES:

Nicholas Tarling (ed.),*The Cambridge History of Southeast Asia*
----------, *A Concise History of Southeast Asia*
D.G.E. Hall, *A History of South East Asia*
G.M.T. Kahin, *Government and Politics of Southeast Asia*
J.F. Cady, *Southeast Asia: Its Historical Development*
Swapna Bhattacharya (Chakraborti), *India-Myanmar Relations: 1886-1948*
Frank N. Trager, *Burma from Kingdom to Republic*
Robert H. Taylor, *The State in Myanmar*
Michael W. Charney, *A History of Modern Burma*
C.D. Cowan, *Nineteenth Century Malay*
W.R. Roff, *The Origin of Malay Nationalism*
D.R. Sardesai, *A History of Vietnam*
Joseph Buttinger, *The Smaller Dragon: A Political History of Vietnam*
Helen B. Lamb, *Vietnam's Will to Live*
NI. Wright, *Revolution in the Philippines*
M.K. Kaul, *The Philippines and Southeast Asia*
J.V. Abueva and R.P.DeGuziian, eds. *Foundations and Dynamics of Filipino Government and Politics*
J.F. Cady, *A History of Modern Burma*

Paper III: History of The United States Of America (1776 CE -1864 CE)

Semester – 5
UG Course Code – HISADSE03T
Credits - 6
Marks – 75

Paper III: History of The United States Of America (1776 CE -1864 CE)

I The Background: [a] The land and the aborigines. [b] European settlement and colonization. [c] Early colonial society and politics; indentured labour: White and Black.

II Independence and making of the Republic: [a] Sources of conflict: Revolutionary groups, Ideology: The War of Independence and its historical interpretations. [b] Constitution making: Historical debates and interpretations.

III Evolution of American Democracy: [a] Federalists: Jeffersonianism to Jacksonianism, Rise of political parties; judiciary and the Supreme Court.

[b] Expansion of Frontier: Turner's Thesis; Marginalization, displacement and decimation of native Americans; Case histories of Tecumseh; Shawnee Prophet. [c] Limits of democracy: Blacks and women.

IV Early Capitalism: [a] Beginnings of Industrialization. [b] Immigrants and changing composition of Labour; Early Labour movements and associations

V Foreign Policy: Isolationism and involvement; War of 1812: Monroe Doctrine: Manifest Destiny.

VI Slavery to Civil War: [a] Plantation economy and slave society. [b] Abolitionism and Sectionalism: Issues and interpretations. [c] Republicanism, Emancipation and Lincoln.

REFERENCES

Bernard Bailyn, *The Great Republic*
Bernard Bailyn, *The Ideological Origins of the American Revolution*
Charles Beard, *An Economic Interpretation of the American Constitution*
Dee Brown, Bury My Heart at Wounded Knee, *An Indian History of the American West*
Peter Carroll and David Noble, *Free and Unfree: A New History of the United States*
David B. Davis, *The Problem of Slavery in the Age of Revolution*
U. Faulkner, *American Economic History*
Robert Fogel, *Railroads and American Economic Growth*
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John Hope Franklin, *From Slavery to Freedom*
Gerald N. Grobb and George A. Billias, *Interpretations of American History: Patterns and Perspectives, 2 Vols.*
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David M. Potter, *The Impending Crisis*
W. Pratt, *A History of the United states Foreign Policy*
James Randail, *The Civil War and Reconstruction*
J. G. Randall and David Donald, *The Civil War and Reconstruction*
Kenneth Stampp, *The Peculiar Institution, Slavery in the Antebellum South*
Federick Jackson Turner, *The Frontier in American History*
Robert Wiebe, *The Search for Order*
Lee Benson, *The Concept of Jackson Democracy*
Ray A. Billington, *Westward Expansion*
Paul Boyer, Harvard Sitkoff, Nancy Woloch, *The Enduring Vision: A History of the American People, Vols. I and 2*
Thomas Cochran, *The Inner Revolution*
A. O. Craven, *The Growth of Southern Nationalism, 1848 - 1861*
Lance E. Davis (ed.), *American Economic Growth*

Carl N. Degler, *At Odds:Women and Family in America from the Revolution to the Present*
Fogel and Engerman?Time on the Cross-. Lewis L. Gould (ed.), The Progressive Era.
John D. Hicks, *The Federal Union: A History of USA Since 1865*
R.P. Kaushik, *Significant Themes in American History*
David M. Kennedy, Thomas Bailey and Mel Piehl, *The Brief American Pageant*
Irving Kristol, Gordon Wood and others, *America's Continuing Revolution*
Richard W. Leopold, *The Growth of American Foreign Policy*
Perry Miller, *From Colony to Province*
Gary Nash (ed.), *Retracing the Past*
Henry Pelling, *American Labor*
Edward Pessen, *Jacksonian Panorama*
Charles Sellers, Henry May and Neil McMillen, *A Synopsis of American History; 2 Vols*
Donald Shihan, *The Making of American History: The Emergence of the Nation, Vols. I & II*
Dwijendra Tripathi and S.C. Tiwari, *Themes and Perspectives in American History*
James Weinstein, *The Corporate Ideal in the Liberal state*

DSE 3 and DSE 4
(Any Two from Papers IV, V&VI)

Paper IV: History of Modern East Asia I (1839 CE -1919 CE)

Semester – 6
UG Course Code – HISADSE04T
Credits - 6
Marks – 75

Paper IV: History of Modern East Asia-1 (1839 CE -1919 CE)

I. Pre-colonial China (a) Nature and structure of the traditional Chinese society.(b)The peasantry and gentry; Government bureaucracy and central control. (C) The Confucian value system. (d) China's pre-modern economy.

II. Anglo Chinese relations till the Opium War (a) The Tribute system; the Canton trade and its collapse. (b) First & Second Opium Wars—the unequal treaties. (c)Financial Imperialism: Open Door policy.

III. Rebellion, Restoration and Nationalism (a)The Taiping Rebellion: causes, nature and failure. (b) Tung- Chih Restoration; the Hundred Days' Reform and the Self – Strengthening Movement. (c) Boxer Uprising: causes, nature and failure. (d) The

Revolution of 1911: background and causes, nature and significance; role of Dr Sun Yat-Sen; principles and polities, formation of the Republic; Yuan Shih-kai and warlordism; the rise of the Kuomintang.

IV. Pre-Meji Japan (a) Tokugawa Shogunate: the feudal society and the government; Shintoism. (b) Economic condition. (c) Encounter with the West: the Perry Mission; the opening of the Japan to the west. (d) The crisis and fall of the Shogunate.

V. Meiji Restoration (a) Causes and nature of Restoration. (b)Transformation of Japan: process of modernization. (c) Meiji Constitution

VI. Expansion of Japan up to the First World War (a) Sino–Japanese war (1894-95). (b) The Anglo-Japanese Alliance (1902). (c) Contest for Korea and the Russo-Japanese war (1904-05). (d) Japan and the First World War.

REFERENCES

G.Allen, *A short Economic History of Japan*
W.G. Beasley, *The Modern History of Japan Backmann*
M.George ,*The Making of the Meiji Constitution*
H. Borton ,*Japan since 1931*
J.B. Jansen (ed), *The Cambridge History of Japan vols V-VI*
J.K.Fairbank, (ed),*The Cambridge History of China vol-X*
J. Gray, *Rebellions and Revolutions*
C.Y.I. Hsu, *The rise of Modern China*
N. Peffer, *The Far East: A Modern History*
S. L. Roy, *A short History of the Far East*
E.Snow, *Red Star over China*
S.Richard, *A History of Modern Japan*
H. Vinacke, *A History of the Far East in Modern Times*
L. Bianco, *Origins of the Chinese Revolutions 1915-1949*
Victor Pucell, *The Boxer Uprising: A Background study*
J.Chesneaux, *China from Opium War to 1911 Revolution*
C.P. Fitzjerald, *Birth of Communist China*
A. Gordon, *A Modern History of Japan From Tokugawa Timesto Present*
J. Holliday, *A Political History of Japanise Capitalism*
E. H. Norman, *Japan's Emergence as Modern State*
G. Sansom, *The Western world and Japan*
C.T. Tung, *The May Fourth Movement: intellectual Revolution in Modern China*
M.C. Wright, *China in Revolution: The first Phase 1900-1913*
Amit Bhattacharya, *Transformation of China 1840-1969*
E.J.Hobsbawm, *Age of Extremes: The short Twentieth Century* 1941-1991
I.H. Nish, *Japan's Foreign policy: 1869-1942*
Deboprasad Choudhury, *AdhnikJugePurba Asia-r SankhiptaItihas*

HaraprasadChattopadhyay, *JapanerItihas*
HaraprasadChattopadhay, *ChinerItihas*
MrinalKantiChattopadhyay, *Chin o JapanerItihas*
SridharthaGuharoy, *AdhunikPurba Asia: Chin o JapanerItihas*
J Sen, *E juger Chin Khata*
Subodh Kumar Mukhopadhyay, *AdhunukPurba Asia*
Amit Bhattacharya, *Chinerrupantareritihas 1840-1969*
Amit Bhattacharya,*Japanerrupantareritihas 1600-1945*

Paper V: History of Modern East Asia II (1919 CE-1939 CE)

Semester – 6
UG Course Code – HISADSE05T
Credits - 6
Marks – 75

Paper V: History of Modern East Asia II (1919 CE-1939 CE)

I. Nationalism in China
[a] Emergence of the Republic and Yuan Shih Kai: Warlordism.
[b] May 4th Movement: origin, nature and significance.

II. The Kuomintang and the Nationalist government
[a] The rise of the Kuomintang Party: Political crisis in the 1920s; The First United Front
[b] Chiang Kai-shek: the KMT-CCP conflict.
[c] Ten Years of Nanking Government.

III. The Communist Victory in China
[a] Background of the foundation of the Communist Party.
[b] CCP under Mao Tse-tung: the making of the Red Army; the Second United Front; Long March.
[c] The Yenan experiment;
[d] The Chinese Revolution (1949): Ideology, causes and significance; the establishment of the Peoples' Republic of China.

IV. Rise of modern Japan
[a] Process of modernization: social, military, political and educational; popular and democratic movement;
[b] Rise of Political Parties, abolition of feudalism and economic growth.
[c] Industrialization and the role of the state; the Zaibatsu.

V. Imperial Japan

[a] Japan and World war I: Twenty-one Demands.
[b] Washington Conference.
[c] Manchurian crisis: role of the League of Nations.
[d] Failure of the Democratic system and the rise of militarism in the 1930s and the 1940s.

VI. Japan and World War II
[a] Japan's bid for supremacy and defeat.
[b] Post war Japan under General Douglas MacArthur.

REFERENCES

G Allen, *A short Economic History of Japan*
W.G. Beasley, *The Modern History of Japan Backmann*
M George, *The Making of the Meiji Constitution*
H. Borton, *Japan since 1931*
J.B. Jansen (ed.) ,*The Cambridge History of Japan vols V-VI*
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HaraprasadChattopadhyay, *JapanerItihas*
HaraprasadChattopadhay,*ChinerItihas*
Mrinal KantiChattopadhyay, *Chin o JapanerItihas*

Paper VI: History of The United States Of America (1865 CE-1945 CE)

Semester – 5
UG Course Code – HISADSE06T
Credits - 6
Marks – 75

Paper VI: History of The United States Of America (1865 CE-1945 CE)

I. Reconstruction: [a] Conservative and Radical phases. [b] The New South: Participants and Reactions, Carpetbaggers; Scalawags, Blacks, Ku Klux Klan.

II. Industrial America: [a] Growth of Capitalism and Big Business. [b] Business cycles; Depression.

III. Resistance and Reform: [a] Labour movements and Unionization. [b] Agrarian crises and populism; Urban corruption and progressivism. [c] New Deal.

IV. The U.S.A. becomes a world power: [a] Spanish-American War [b] Expansion in the Far East and Latin America [c] World War I, Fourteen Points and Isolationism [d] USA and World War II

V. Afro-American and Women's Movements: [a] Black Movements: Booker T. Washington, W.E.B. Dubois; NAACP and Marcus Garvey. [b] Abolitionists and Women's rights [c] Suffrage [d] Afro-American Women

VI. Religious,Cultural and Intellectual Trends: [a] Religious movements; Early Revivalism; Puritans, Quakers; Mormons; Temperance. [b] Mass culture (circa 1900 - 1945) [c] Major literary trends (circa 1900 - 1945).

REFERENCES

Bernard Bailyn, *The Great Republic*
Bernard Bailyn, *The Ideological Origins of the American Revolution*
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James Weinstein, *The Corporate Ideal in the Liberal state*

GENERIC ELECTIVE (GE): 4

GENERIC ELECTIVE offered:
Paper I
Paper II
Paper III
Paper IV

General Elective – 1 (GE 1)

Paper I: History of India from Earliest Times up to 300 CE

Semester – 1
UG Course Code – HISHGEC01T
Credits - 6
Marks – 75

Paper I: History of India from Earliest Times up to 300 CE

I. Sources & Interpretation

II. A broad survey of Palaeolithic, Mesolithic and Neolithic Cultures.

III. Harappan Civilization; Origin, Extent, dominant features &decline, Chalcolithic age.

IV. The Vedic Period: Polity, Society, Economy and Religion, Iron age with reference to PGW and Megaliths.

V. Territorial States and the rise of Magadha, Conditions for the rise of Mahajanpadas and the Causes of Magadha's success

VI. Iranian and Macedonian Invasions, Alexander's Invasion and impact

VII. Jainism and Buddhism: Causes, Doctrines, Spread, Decline and Contributions

VIII. The Satvahanas Phase; Aspects of Political History, Material Culture, Administration, Religion

IX. Emergence and Growth of Mauryan Empire; State, Administration, Econoy, Ashoka's Dhamma, Art & Architecture

X. The Sangam Age: Sangam Literature, The three Early Kingdoms, Society & the Tamil language xi. The age of Shakas: Parthians andKushanas, Aspects of Polity, Society, Religion, Arts &Crafts, Coins, Commerce and Towns.

REFERENCES

D.P. Agrawal, *The Archaeology of India*
A.L. Basham, *The Wonder That was India*
D.K.,Chakrabarti, *Archaeology of Ancient Indian Cities*
Suvira Jaiswal, *Caste: Origin, Function and Dimensions*
N. Subramanian, *Sangam Polity*
Romila Thapar, *History of Early India*

F.R. Allchin and Bridget Allchin, *Origins of a Civilization: The Prehistory and Early Archaeology of South Asia*
A.L. Basham, *The Wonder That was India*
D.N. Jha, *Ancient India in Historical Outline*
D.D. Kosambi, *Culture and Civilization of Ancient India*
H.P. Ray, *Monastery and Guild India in Historical Outline*
K.A.N. Sastri, *A History of South India*
R.S. Sharma, *India's Ancient Past*
Niharanjan Ray, *Maurya and Post Maurya Art*
R.S. Sharma, *Aspects of Political Ideas and Institutions in Ancient India*
G. Yazdani, *Early History of Deccan Aspects of Political Ideas and Institutions in Ancient India*
Romila Thapar, *Ashoka and the Decline of the Mauryas*
G. Yazdani, *Early History of Deccan*
Ranabir Chakraborty, *Bharat ItihaserAdiparba* (in Bengali)
Dilip Kumar Chakraborty, *BharatbarsherPrakitihas*
Narendranath Bhattacharya, *PrachinBharatiyaSamaj*
Narendranath Bhattacharya, *Prachin Bharat; Rashtrachinta o Rashtrabyabastha*
Bhaskar Chattapadhyay, *Bharat Artha-samajik o Rashtriyabyabastha*
Bhaskar Chattopadhyay, *Gour Banger itihas o sanskriti (vol1*)
Niharanjan Ray, *BangalirItihas*
RomilaThapar, *BharaterItihas*

General Elective – 2 (GE 2)

Paper II- History of India from. C. 300 to 1206 CE

Semester – 2
UG Course Code – HISHGEC02T
Credits - 6
Marks – 75

Paper-II: History of India from. C. 300 to 1206 CE

I. The Rise & Growth of the Guptas: Administration, Society, Economy, Religion, Art, Literature, and Science &Technology.

II. Harsha & His Times: Harsha's Kingdom, Administration, Buddhism & Nalanda

III. South India: Polity, Society, and Economy and Culture

IV. Towards the Early Medieval: Changes in Society, Polity Economy and Culture with reference to the Pallavas, Chalukayas and Vardhanas..

V. Evolution of Political structures of Rashtakutas, Pala &Pratiharas.

VI. Emergence of Rajput States in Northern India: Polity, Economy andSociety.

VII. Arabs in Sindh: Polity, Religion &Society.

VIII. Struggle for power in Northern India and establishment of Sultanate.

REFERENCES

R. S. Sharma, *Indian Feudalism -India's Ancient Past*
B. D. Chattopadhaya, *Making of Early Medieval India*
Derryl N. Maclean, *Religion and Society in Arab Sindh*
K. M. Ashraf, *Life and Conditions of the People of Hindustan*
M. Habib and K.A. Nizami, *A Comprehensive History of India. Vol. V*
Tapan Ray Chaudhary and Irfan Habib (ed.), *The Cambridge Economic History of India, Vol. I*
Peter Jackson, *Delhi Sultanate: A Political and Military History*
Tara Chand, *Influence of Islam on Indian Culture*
Satish Chandra, *A History of Medieval India, 2 Volumes*
Percy Brown, *Islamic Architecture*
Ranabir Chakraborty, *Bharat ItihaserAdiparba*
Ranabir Chakraborty, *PrachinBharaterArthanaitikitihasersandhane* (in Bengali)
Dilip Kumar Chakraborty, *BharatbarsherPrakitihas*
Narendranath Bhattacharya, *PrachinBharatiyaSamaj*
Narendranath Bhattacharya, *Prachin Bharat: Rashtrachinta o Rashtrabyabastha,*
Bhaskar Chattapadhyay, *Bharat Artha-samajik o Rashtriyabyabastha*
Bhaskar Chattopadhyay, *Gour Banger itihas o sanskriti*(vol 1)
Niharanjan Ray, *BangalirItihas*
Romila Thapar, *BharatbarsherItihas*

General Elective – 3 (GE 3)

Paper III- History of India from 1206 CE to1707 CE

Semester – 3
UG Course Code – HISHGEC03T
Credits - 6
Marks – 75

Paper III: History of India from 1206 CE to1707 CE

I. Foundation, Expansion &consolidation of the Delhi Sultanate; Nobility &Iqta system.

II. Miltary, administrative &economic reforms under the Khiljis&the Tughlaqs.

III. Bhakti &Sufi Movements.

IV. Provincial kingdoms: Mewar, Bengal, Vijaynagar and Bahamani.

V. Second Afghan State.

VI. Emergence and consolidation of Mughal State, C.16th century to mid 17th century.

VII. Akbar to Aurangzeb: administrative structure. Mansab and Jagirs, State &Religion, Socio-Religious Movements.

VIII. Economy, Society and Culture under the Mughals.

IX. Emergence of Maratha Power.

REFERENCES

Irfan Habib, *The Agrarian System of Mughal India 1556-1707*
Irfan Habib (ed.), *Madhya Kaleen Bharat*, (in Hindi), 8 Volumes
M. Athar Ali, *Mughal Nobility under Aurangzeb*
Shireen Moosvi, *The Economy of the Mughal Empire*
S.A.A. Rizvi, *Muslim Revivalist Movements in Northern India during 16th and 17th Centuries*
R.P. Tripathi, *The Rise and Fall of the Mughal Empire*, 2 vol.
I. H. Siddiqui,*Some Aspects of Afghan Despotism*
KesvanVeluthat, *Political Structure of Early Medieval South India*
P.J. Marshall, *The Eighteenth Century in Indian History*
Stewart Gordon, *The Marathas 1600-1818*
Percy Brown, *Islamic Architecture*

Generic Elective – 4 (GE 4)
Paper IV: History of India (1707-1950 CE.)

Semester – 4
UG Course Code – HISHGEC04T
Credits - 6
Marks – 75

Paper-IV: History of India (1707-1950 CE.)

I. Interpreting the 18th Century.

II. Emergence of Independent States &establishment of Colonial power.

III. Expansion &consolidation of Colonial Power upto 1857.

IV. Uprising of 1857: Causes, Nature &Aftermath.

V. Colonial economy: Agriculture, Trade & Industry.

VI. Socio-Religious Movements in the 19th century.

VII. Emergence &Growth of Nationalism with focus on Gandhian nationalism.

VIII. Communalism: Genesis, Growth and partition of India.

IX. Advent of Freedom: Constituent Assembly, establishment of Republic.

REFERENCES

Sugata Bose and Ayesha Jalal, *Modern South Asia: History, Culture, Political Economy*
Sekhar Bandyopadhyay, *From Plassey to Partition*
Barbara D. Metcalf and T.R. Metcalf, *A Concise History of India*
C.A. Bayly, *An Illustrated History of Modern India 1600 - 1947*
Sumit Sarkar, *Modern India 1885 - 1947*
Mushirul Hasan, *John Company to the Republic: A story of Modern India*
R.P. Dutt, *India Today*
Thomas Metcalf, *Ideologies of the Raj*
R. Jeffery and J. Masseloss, *From Rebellion to the Republic*
Bipan Chandra, *Nationalism and Colonialismin Modern India*
Urvashi Butalia,*The Other side of Silence*
Francine Frankel, *India's Political Economy 1947- 1977*
Paul Brass, *The Politics of India since Independence*
Lloyd and Susan Rudolph, *In Pursuit of Laxmi: the Political Economy of the Indian State*
Bipan Chandra et al. *India After Independence*
Gail Omvedt, *Dalits and Democratic Revolution*
Ramachandra Guha, *The Fissured Land*
K.G. Subramanian, *The Living Tradition: Perspectives on Modern Indian Art*
Radha Kumar, *A History of Doing*
Stanly Wolpert, *A New History of India*

Amalesh Tripathi, *SwadinataSangrameBharaterJatiyo Congress*
Mrinal Kanti Chattopadhyay, *Jyatiyotabadi Jinnah: ChintarKromobibartan.*

SKILL ENHANCEMENT COURSE (SEC): 2

Skill Enhancement Course Offered:

Paper I
Paper II

Paper I:Archives and Museums in India

Skill Enhancement Course-1 (SEC 1)
Semester – 3
UG Course Code – HISSSEC01M
Credits – 2
Marks – 25

Paper I:Archives and Museums in India

This course introduces students to the institutions that house and maintain documentary, visual and material remains of the past. Museums and archives are among the most important such repositories and this course explains their significance and how they work. Students will be encouraged to undertake collection, documentation and exhibition of such materials in their localities and colleges. Visit to Archives and/or Museumsis an integral part of the course.

I. Definition and history of development (with special reference to India)

II. Types of archives and museums: Understanding the traditions of preservation in India Collection policies, ethics and procedures Collection: field exploration, excavation, purchase, gift and bequests, loans and deposits, exchanges, treasure trove confiscation and others. Documentation: accessioning, indexing, cataloguing, digital documentation and de-accessioning Preservation: curatorial care, preventive conservation, chemical preservation and restoration

III. Museum Presentation and Exhibition

IV. Museums, Archives and Society: (Education and communication Outreach activities

REFERENCES

Saloni Mathur, *India By Design: Colonial History and Cultural Display*
S. Sengupta, *Experiencing History Through Archives*
Tapati Guha Thakurta, *Monuments, Objects, Histories: Institution of Art in Colonial India*
Y. P. Kathpalia, *Conservation and Restoration of Archive Materials*,
R.D. Choudhary, *Museums of India and their maladies*
S.M. Nair, *Bio-Deterioration of Museum Materials*
O.P. Agrawal, *Essentials of Conservation and Museology*

Paper II: Understanding Indian Art

Skill Enhancement Course-2(SEC 2)
Semester – 4
UG Course Code – HISSSEC02M
Credits – 2
Marks – 25

Paper II: Understanding Indian Art

The purpose of this course is to introduce students to Indian art, from ancient to contemporary times, in order to understand and appreciate its diversity and its aesthetic richness. The course will equip students with the abilities to understand art as a medium of cultural expression. It will give students direct exposure to Indian art through visuals, and visits to sites and museums.

I. Prehistoric and protohistoric art: Rock art; Harappan arts and crafts

II. Indian art (c. 600 BCE – 600 CE): World Heritage Site Managers, UNESCO World Heritage Manuals [can be downloaded/ accessed at www.unesco.org] Notions of art and craft Canons of Indian paintings. Major developments in stupa, cave, and temple art and architecture Early Indian sculpture: style and iconography. Numismatic art

III. Indian Art (c. 600 CE – 1200 CE): Temple forms and their architectural features Early illustrated manuscripts and mural painting traditions Early medieval sculpture: style and iconography Indian bronzes or metal icons

IV. Indian art and architecture (c. 1200 CE – 1800 CE): Sultanate and Mughal architecture Miniature painting traditions: Mughal, Rajasthani, Pahari Introduction to fort, palace and haveli Architecture

V. Modern and Contemporary Indian art and Architecture: The Colonial Period_Art movements: Bengal School of Art, Progressive Artists Group, etc. Major artists and their artworks. Popular art forms (folk art traditions)

REFERENCES

Erwin Neumayer, *Lines of Stone: The pre-historic rock-art of India*
B.N.Goswamy, *Essence of Indian Art*
Susan Huntington, *The Art of Ancient India: Hindu, Buddhist, Jain*
TapatiGuha Thakurta, *The making of a new modern Indian art: Aesthetics and nationalism in Bengal, 1850-1920*
ParthaMitter, *Indian Art*, Oxford History of Art series
Parul Pandya Dhar(ed.), 2011, *Indian Art History Changing Perspectives*
M.C. Beach, *The New Cambridge History of India Mughal and Rajput Painting*
Niharranjan Ray, *An Approach to Indian Art*

SYLLABUS FOR B.SC. (General)

IN

MATHEMATICS

Under Choice Based Credit System (CBCS)

Effective from 2018-2019

West Bengal State University
Barasat
Kolkata-700 126
West Bengal

B.Sc. Mathematics General Course Structure

Semester	Core Course (12)	Discipline Specific Elective (DSE)(6)	Ability Enhancement Course	
			AECC (2)	SEC (4)
I	**MTMGCOR01T (Mathematics)** Other **TWO CORE** Courses to be offered by Other discipline		AECC1	
II	**MTMGCOR02T (Mathematics)** Other **TWO CORE** Courses to be offered by Other discipline		AECC2	
III	**MTMGCOR03T (Mathematics)** Other **TWO CORE** Courses to be offered by Other discipline			**SEC-1**
IV	**MTMGCOR04T (Mathematics)** Other **TWO CORE** Courses to be offered by Other discipline			**SEC-2**

V		**MTMGDSE01T** **Or** **MTMGDSE02T** **(Mathematics)** Other **TWO DSE** Courses to be offered by Other discipline		**SEC-3**
VI		**MTMGDSE03T** **Or** **MTMGDSE04T** **(Mathematics)** Other **TWO DSE** Courses to be offered by Other discipline		**SEC-4**

Core Courses of Mathematics :

Semester	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs./week	Marks	Credit
I	CORE	**MTMGCOR01T**	Differential Calculus	5:1:0	6	75	6
II	CORE	**MTMGCOR02T**	Differential Equations	5:1:0	6	75	6
III	CORE	**MTMGCOR03T**	Real Analysis	5:1:0	6	75	6
IV	CORE	**MTMGCOR04T**	Algebra	5:1:0	6	75	6

Discipline Specific Electives (DSE)

Choices for DSE in Semester V (Choose any one)

Semester	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs./week	Marks	Credit
V	DSE	**MTMGDSE01T**	Matrices	5:1:0	6	75	6
	DSE	**MTMGDSE02T**	Mechanics	5:1:0	6	75	6

Choices for DSE in Semester VI (Choose any one)

Semester	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs./week	Marks	Credit
VI	DSE	**MTMGDSE03T**	Numerical Methods	5:1:0	6	75	6
	DSE	**MTMGDSE04T**	Linear Programming	5:1:0	6	75	6

Following Two Skill Enhancement Courses (SEC) offered by the Dept. of Mathematics

Semester	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs./week	Marks	Credit
III & V	SEC	**MTMSSEC01M**	C-Programming Language	2:0:0	2	25	2
IV & VI	SEC	**MTMSSEC02M**	Logic and Sets	2:0:0	2	25	2

Course : MTMGCOR01T

Differential Calculus (Marks : 75)

Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.

Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, e^x, log(l+x), $(l+x)^n$, Maxima and Minima, Indeterminate forms.

Books Recommended:

1. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, 2007.

Course : MTMGCOR02T

Differential Equations (Marks : 75)

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties.
Solving a differential equation by reducing its order.

Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.
Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Books Recommended:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.
2. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition,1967.

Course : MTMGCOR03T

Real Analysis (Marks : 75)

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test(Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.

Sequences and series of functions, Pointwise and uniform convergence. M_n-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.

Books Recommended :

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. R.G. Bartle and D. R Sherbert, *Introduction to Real Analysis,* John Wiley and Sons (Asia) P.Ltd., 2000.
3. E. Fischer, *Intermediate Real Analysis*, Springer Verlag, 1983.
4. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series*- Undergraduate Texts in Mathematics, Springer Verlag, 2003.

Course : MTMGCOR04T

Algebra (Marks : 75)

Equivalence relations and partitions, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set. Definition and examples of groups, examples of abelian and non-abelian groups, the group Z_n of integers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group $GL_n(n,R)$, groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle,(iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions.

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.

Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Z_n the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Z_p, Q, R, and C. Field of rational functions.

Books Recommended:

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002**.**
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa, 1999.
4. George E Andrews, *Number Theory*, Hindustan Publishing Corporation, 1984.

Course : MTMGDSE01T
Matrices (Marks : 75)

R, R_2, R_3 as vector spaces over R. Standard basis for each of them. Concept of Linear Independence and examples of different bases. Subspaces of R_2, R_3.

Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. Interpretation of eigen values and eigen vectors for such transformations and eigen spaces as invariant subspaces.

Types of matrices. Rank of a matrix. Invariance of rank under elementary transformations. Reduction to normal form, Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four.

Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. Rank of matrix. Solutions of a system of linear equations using matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.

Books Recommended :

1. A.I. Kostrikin, *Introduction to Algebra*, Springer Verlag, 1984.
2. S. H. Friedberg, A. L. Insel and L. E. Spence, *Linear Algebra*, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
3. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill, 1989.

Course : MTMGDSE02T
Mechanics (Marks : 75)

Conditions of equilibrium of a particle and of coplanar forces acting on a rigid Body, Laws of friction, Problems of equilibrium under forces including friction, Centre of gravity, Work and potential energy. Velocity and acceleration of a particle along a curve: radial and transverse components (plane curve), tangential and normal components (space curve), Newton's Laws of motion, Simple harmonic motion, Simple Pendulum, Projectile Motion.

Books Recommended :

1. A.S. Ramsay, *Statics*, CBS Publishers and Distributors (Indian Reprint), 1998.
2. A.P. Roberts, *Statics and Dynamics with Background in Mathematics*, Cambridge University Press, 2003.

Course : MTMGDSE03T
Numerical Methods (Marks : 75)

Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method, Secant method, LU decomposition, Gauss-Jacobi, Gauss-Siedel and SOR iterative methods.

Lagrange and Newton interpolation: linear and higher order, finite difference operators. Numerical differentiation: forward difference, backward difference and central Difference. Integration: trapezoidal rule, Simpson's rule, Euler's method for solving ordinary differential equations..

Books Recommended :

1. B. Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 5th Ed., New age International Publisher, India, 2007.

Course : MTMGDSE04T
Linear Programming (Marks : 75)

Linear Programming Problems, Graphical Approach for solving some Linear Programs. Convex Sets, Supporting and Separating Hyperplanes. Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

Duality, formulation of the dual problem, primal- dual relationships, economic interpretation of the dual, sensitivity analysis.

Books Recommended :

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear programming and Network Flows*, 2nd Ed., John Wiley and Sons, India, 2004.
2. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research*, 8th Ed., Tata McGrawHill, Singapore, 2004.
3. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice-Hall India, 2006.

Skill Enhancement Courses (SEC)

Course : MTMSSEC01M

C-Programming Language (Marks : 25)

Unit 1 : Basics of Computer Programming:

Definition, Requirement of programming language, Machine language, high-level programming languages, machine code of a program: compilation process, Problem solving approaches: algorithm and flowchart

Unit 2 : Fundamentals of Programming:

Built in Data Types: int, float, double, char; Constants and Variables; first program: printf(), scanf(), compilation etc., keywords, Arithmetic operators: precedence and associativity, Assignment Statements: post & pre increment/decrement, logical operators: and, or, not

Unit 3 : Statements:

Relational operators, if-else statement,

Iterative Statements: for loop, while loop and do-while loop; controlling loop execution: break and continue, nested loop

Unit 4 : Arrays:

Definition & requirement, declaration & initialization, indexing, one dimensional array: finding maximum, minimum, simple sorting and searching.

Unit 5 : Multi-dimensional arrays:

Matrix Manipulations (Addition, Multiplication, Transpose)

Arrays and Pointers, Memory allocation and deallocation: *malloc()* and *free()* functions

Unit 6 : Functions:

Why?, How to declare, define and invoke a function, Variables' scope, local& global variables and function parameters, Pointers, arrays as function parameters, *return* statement, Header files and their role. Illustrate different examples like swapping values, compute n!, nCr, find max/min from a list of elements, sort a set of numbers, matrix addition/multiplication etc.

Books Recommended :

- B. W. Kernighan and D. M. Ritchi : The C-Programming Language, 2nd Edi.(ANSI Refresher), Prentice Hall, 1977.
- Y. Kanetkar : Let Us C ; BPB Publication, 1999.
- C. Xavier : C-Language and Numerical Methods, New Age International.

Course : MTMSSEC02M

Logic and Sets (Marks : 25)

Unit 1 : Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Unit 2 : Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.

Unit 3 : Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set. Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation. Partial ordering relations, n- ary relations.

Books Recommended :

- R.P. Grimaldi, Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998.
- P.R. Halmos, Naive Set Theory, Springer, 1974.

E. Kamke, Theory of Sets, Dover Publishers, 1950.

SYLLABUS FOR B.SC. (HONOURS)
IN
MATHEMATICS

Under Choice Based Credit System (CBCS)

Effective from 2018-2019

West Bengal State University
Barasat
Kolkata-700 126
West Bengal

Outlines of Course Structures

The main components of this syllabus are as follows :

1. **Core Course**
2. **Elective Course**
3. **Ability Enhancement Course**

1. **Core Course :**

   A course, that should compulsorily be studied by a candidate as a core requirement, is termed as a core course.

2. **Elective Course**

   2.1 Discipline Specific Elective (DSE) Course : A course, which may be offered by the main discipline/subject of study, is referred to as Discipline Specific Elective.

   2.2 Generic Elective (GE) Course : An elective course, chosen generally from an unrelated discipline/subject of study with intention to seek an exposure, is called a Generic Elective Course.

3. **Ability Enhancement Course (AEC)**

   The Ability Enhancement Course may be of two kinds :

   3.1 Ability Enhancement Compulsory Course (AECC)

   3.2 Skill Enhancement Course (SEC)

Course Structure: Honours

Category	No of Courses	Credit of each course	Total credit in this category
Core	14	6	84
Discipline Specific Elective, DSE	4	6	24
Generic Elective, GE	4	6	24
Ability Enhancement Compulsory Courses (EVS/English), AECC	2	2	4
Skill Enhancement Courses, SEC (Department specific)	2	2	4
		Total	140

Semester wise Course Structures

Semester	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs. /week	Marks	Credit
I	CORE	MTMACOR01T	Calculus, Geometry and Ordinary Differential Equation	5:1:0	6	75	6
		MTMACOR02T	Algebra	5:1:0	6	75	6
	AECC		Environmental Science	2:0:0	2	25	2
	GE		**To be offered by other discipline.**			75	6
II	CORE	MTMACOR03T	Real Analysis	5:1:0	6	75	6
		MTMACOR04T	Ordinary Differential Equations and Vector Calculus	5:1:0	6	75	6
	AECC		English/MIL Communication	2:0:0	2	25	2
	GE		**To be offered by other discipline.**			75	6
III	CORE	MTMACOR05T	Theory of Real Functions	5:1:0	6	75	6
		MTMACOR06T	Group Theory I	5:1:0	6	75	6
		MTMACOR07T	Numerical Methods	4:0:0	4	50	4
		MTMACOR07P	Numerical Methods Lab	0:0:2	4	25	2
		Choose the following SEC or from any other discipline.					
	SEC	MTMSSEC01M	C-Programming Language	2:0:0	2	25	2
	GE		**To be offered by other discipline.**			75	6
IV	CORE	MTMACOR08T	Riemann Integration and Series of Functions	5:1:0	6	75	6
		MTMACOR09T	Multivariate Calculus	5:1:0	6	75	6
		MTMACOR10T	Ring Theory and Linear Algebra I	5:1:0	6	75	6
		Choose the following SEC or from any other discipline.					
	SEC	MTMSSEC02M	Logic and Sets	2:0:0	2	25	2
	GE		**To be offered by other discipline.**			75	6

Semester	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs. /week	Marks	Credit
V	CORE	MTMACOR11T	Partial Differential Equations, Applications of Ordinary Differential Equations	5:1:0	6	75	6
		MTMACOR12T	Group Theory II	5:1:0	6	75	6
	Choose any two from the following courses for Discipline Specific Electives.						
	DSE	MTMADSE01T	Linear Programming	5:1:0	6	75	6
		MTMADSE02T	Number Theory	5:1:0	6	75	6
		MTMADSE03T	Probability & Statistics	5:1:0	6	75	6
VI	CORE	MTMACOR13T	Metric Spaces and Complex Analysis	5:1:0	6	75	6
		MTMACOR14T	Ring Theory and Linear Algebra II	5:1:0	6	75	6
	Choose any two from the following courses for Discipline Specific Electives.						
	DSE	MTMADSE04T	Theory of Equations	5:1:0	6	75	6
		MTMADSE05T	Boolean Algebra and Automata Theory	5:1:0	6	75	6
		MTMADSE06T	Mechanics	5:1:0	6	75	6

Detailed Syllabus

Course : MTMACOR01T

Calculus, Geometry & Ordinary Differential Equations (Marks : 75)

Unit -1: Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$, concavity and inflection points, envelopes, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.

Unit-2 : Reduction formulae, derivations and illustrations of reduction formulae for the integration of $\sin^n x$, $\cos^n x$, $\tan^n x$, $\sec^n x$, $(\log x)^n$, $\sin^n x \sin^m x$, parametric equations, parametrizing a curve, arc length, arc length of parametric curves, area of surface of revolution.

Techniques of sketching conics.

Unit -3: Reflection properties of conics, translation and rotation of axes and second degree equations, classification of conics using the discriminant, polar equations of conics.

Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, Generating lines, classification of quadrics, Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

Unit – 4: Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.

Graphical Demonstration (Teaching Aid)

1. *Plotting of graphs of function e^{ax+b}, log(ax + b), 1/(ax + b), sin(ax + b), cos (ax + b), |ax + b| and to illustrate the effect of a and b on the graph*
2. *Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.*
3. *Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid).*
4. *Obtaining surface of revolution of curves.*
5. *Tracing of conics in Cartesian coordinates/polar coordinates.*
6. *Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, and hyperbolic paraboloid using Cartesian coordinates.*

Books Recommended :

- G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
- M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.
- H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.
- R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer- Verlag, New York, Inc., 1989.
- S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
- Murray, D., Introductory Course in Differential Equations, Longmans Green and Co.
- G.F.Simmons, Differential Equations, Tata Mcgraw Hill.
- T. Apostol, Calculus, Volumes I and II.
- S. Goldberg, Calculus and Mathematical analysis.

Course : MTMACOR02T

Algebra (Marks : 75)

Unit -1 : Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications.

Theory of equations: Relation between roots and coefficients, Transformation of equation, Descartes rule of signs, Cubic (Cardan's method) and biquadratic equations (Ferrari's method).

Inequality: The inequality involving AM≥GM≥HM, Cauchy-Schwartz inequality.

Unit -2 : Equivalence relations and partitions, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set. Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm. Congruence relation between integers. Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

Unit -3: Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, linear independence.

Unit 4: Matrix, inverse of a matrix, characterizations of invertible matrices. Rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix.

Books Recommended :

- Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006.
- Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.
- David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
- K.B. Dutta, Matrix and linear algebra.
- K. Hoffman, R. Kunze, Linear algebra.
- W.S. Burnstine and A.W. Panton, Theory of equations.

Course : MTMACOR03T

Real Analysis (Marks : 75)

Unit-1: Review of Algebraic and Order Properties of $\mathbb{R}$, ε-neighbourhood of a point in $\mathbb{R}$. Idea of countable sets, uncountable sets and uncountability of $\mathbb{R}$. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets. Suprema and Infima.Completeness Property of $\mathbb{R}$ and its equivalent properties. The Archimedean Property, Density of Rational (and Irrational) numbers in $\mathbb{R}$, Intervals. Limit points of a set, Isolated points, Open set, closed set, derived set, Illustrations of Bolzano-Weierstrass theorem for sets, compact sets in $\mathbb{R}$, Heine-Borel Theorem.

Unit-2 : Sequences, Bounded sequence, Convergent sequence, Limit of a sequence, liminf, lim sup. Limit Theorems. Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria. Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.

Unit-3 : Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Integral test. Alternating series, Leibniz test. Absolute and Conditional convergence.

Graphical Demonstration (Teaching Aid)

1. Plotting of recursive sequences.
2. Study the convergence of sequences through plotting.
3. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot**.**
4. Study the convergence/divergence of infinite series by plotting their sequences of partial sum**.**
5. Cauchy's root test by plotting nth roots.
6. Ratio test by plotting the ratio of nth and (n+1)th term.

Books Recommended :

- R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
- Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
- Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
- S.K. Berberian, a First Course in Real Analysis, Springer Verlag, New York, 1994.
- Tom M. Apostol, Mathematical Analysis, Narosa Publishing House
- Courant and John, Introduction to Calculus and Analysis, Vol I, Springer
- W. Rudin, Principles of Mathematical Analysis, Tata McGraw-Hill
- Terence Tao, Analysis I, Hindustan Book Agency, 2006
- S. Goldberg, Calculus and mathematical analysis.

Course : MTMACOR04T

Differential Equation and Vector Calculus (Marks : 75)

Unit-1 : Lipschitz condition and Picard's Theorem (Statement only). General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.

Unit -2 : System of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients,

Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions.

Unit-3 : Equilibrium points, Interpretation of the phase plane, Power series solution of a differential equation about an ordinary point, solution about a regular singular point.

Unit- 4 : Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions.

Graphical Demonstration (Teaching Aid) :

1. Plotting of family of curves which are solutions of second order differential equation.
2. Plotting of family of curves which are solutions of third order differential equation.

Books Recommended :

- Belinda Barnes and Glenn R. Fulford, Mathematical Modeling with Case Studies, A Differential Equation Approach using Maple and Matlab, 2nd Ed., Taylor and Francis group, London and New York, 2009.
- C.H. Edwards and D.E. Penny, Differential Equations and Boundary Value problems Computing and Modeling, Pearson Education India, 2005.
- S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
- Martha L Abell, James P Braselton, Differential Equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.
- Murray, D., Introductory Course in Differential Equations, Longmans Green and Co.
- Boyce and Diprima, Elementary Differential Equations and Boundary Value Problems, Wiley.
- G.F.Simmons, Differential Equations, Tata McGraw Hill
- Marsden, J., and Tromba, Vector Calculus, McGraw Hill.
- Maity, K.C. and Ghosh, R.K., Vector Analysis, New Central Book Agency (P) Ltd. Kolkata (India).
- M.R. Speigel, Schaum's outline of Vector Analysis

Course : MTMACOR05T

Theory of Real Functions (Marks : 75)

Unit -1: Limits of functions (ε - δ approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.

Unit -2 : Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum, theorem. Rolle's theorem. Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials.

Unit-3: Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, $\ln(1 + x)$, $1/ax+b$ and $(1 +x)^n$. Application of Taylor's theorem to inequalities.

Books Recommended :

1. R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003.
2. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.
3. A, Mattuck, Introduction to Analysis, Prentice Hall, 1999.
4. S.R. Ghorpade and B.V. Limaye, a Course in Calculus and Real Analysis, Springer, 2006.
5. Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, 2002.
6. R. Courant and F. John, Introduction to Calculus and Analysis, Vol II, Springer, 1999.
7. W. Rudin, Principles of Mathematical Analysis, Tata McGraw-Hill, 2017.
8. Terence Tao, Analysis II, Hindustan Book Agency, 2006
9. Satish Shirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006
10. S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
11. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 2004.

Course : MTMACOR06T

Group Theory–I (Marks : 75)

Unit-1 : Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (through matrices), elementary properties of groups.

Unit-2: Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.

Unit-3 : Properties of cyclic groups, classification of subgroups of cyclic groups, Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.

Unit-4: External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

Unit-5: Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.

.**Books Recommended :**

- John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
- M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
- Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., 1999.
- Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Ed., 1995.
- I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.
- D.S. Malik, John M. Mordeson and M.K. Sen, Fundamentals of Abstract Algebra, 1997.

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Course : MTMACOR07T

Numerical Methods (Marks : 50)

Unit-1: Algorithms, Convergence, Errors: Relative, Absolute. Round off, Truncation.

Unit-2 : Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Rate of convergence of these methods.

Unit -3 : System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis, LU Decomposition

Unit-4: Interpolation: Lagrange and Newton's methods, Error bounds, Finite difference operators. Gregory forward and backward difference interpolations.

Numerical differentiation: Methods based on interpolations, methods based on finite differences.

Unit – 5 : Numerical Integration: Newton Cotes formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpsons 3/8th rule, Weddle's rule, Boole's rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpson's 1/3rd rule, Gauss quadrature formula.

The algebraic eigenvalue problem: Power method.

Unit – 6: Ordinary Differential Equations: The method of successive approximations, Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.

Course : MTMACOR07P

Numerical Methods Lab (Marks : 25)

List of practical (using C programming)

1. Calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + …. + 1/ N.
2. Enter 100 integers into an array and sort them in an ascending order.
3. Solution of transcendental and algebraic equations by
    a. Bisection method
    b. Newton Raphson method.
    c. Secant method.
    d. Regula Falsi method.
4. Solution of system of linear equations
    a. LU decomposition method
    b. Gaussian elimination method
    c. Gauss-Jacobi method
    d. Gauss-Seidel method
5. Interpolation
    a. Lagrange Interpolation
    b. Newton Interpolation
6. Numerical Integration
    a. Trapezoidal Rule
    b. Simpson's one third rule
    c. Weddle's Rule
    d. Gauss Quadrature
7. Method of finding Eigenvalue by Power method
8. Fitting a Polynomial Function
9. Solution of ordinary differential equations
    a. Euler method

b. Modified Euler method

c. Runge Kutta method

Books Recommended :

- Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
- M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering, 2012.
- Computation, 6th Ed., New age International Publisher, India, 2007.
- C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
- Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.
- John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.
- Scarborough, James B., Numerical Mathematical Analysis, Oxford and IBH publishing co, 1966.
- Atkinson, K. E., An Introduction to Numerical Analysis, John Wiley and Sons, 1978.
- Yashavant Kanetkar, Let Us C , BPB Publications, 2016.

Course : MTMACOR08T

Riemann Integration and Series of Functions (Marks : 75)

Unit -1 : Riemann integration: inequalities of upper and lower sums, Darbaux integration, Darbaux theorem, Riemann conditions of integrability, Riemann sum and definition of Riemann integral through Riemann sums, equivalence of two Definitions.

Riemann integrability of monotone and continuous functions, Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions.

Intermediate Value theorem for Integrals, Fundamental theorem of Integral Calculus.

Unit-2 : Improper integrals, Convergence of Beta and Gamma functions.

Unit-3 : Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions, Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

Unit 4: Fourier series: Definition of Fourier coefficients and series, Reimann Lebesgue lemma, Bessel's inequality, Parseval's identity, Dirichlet's condition.

Examples of Fourier expansions and summation results for series.

Unit – 5: Power series, radius of convergence, Cauchy Hadamard Theorem.
Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.

Books Recommended :

- K.A. Ross, Elementary Analysis, The Theory of Calculus, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
- R.G. Bartle and D.R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
- Charles G. Denlinger, Elements of Real Analysis, Jones & Bartlett (Student Edition), 2011.
- S. Goldberg, Calculus and Mathematical analysis.
- Santi Narayan, Integral calculus, S Chand, 2005.
- T. Apostol, Calculus I, II, Wiley, 2007.

Course : MTMACOR09T

Multivariate Calculus (Marks : 75)

Unit-1 : Functions of several variables, limit and continuity of functions of two or more variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of gradient, tangent planes, Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems

Unit-2 : Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical coordinates. Change of variables in double integrals and triple integrals.

Unit-3 : Definition of vector field, divergence and curl. Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path.

Unit-4 : Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

Books Recommended :

- G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
- M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
- E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005.
- James Stewart, Multivariable Calculus, Concepts and Contexts, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001
- Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, 2nd Ed.,2002
- Courant and John, Introduction to Calculus and Analysis, Vol II, Springer New York, 2012
- W. Rudin, Principles of Mathematical Analysis, Tata McGraw-Hill, 3rd Ed.,2013
- Marsden, J., and Tromba, Vector Calculus, McGraw Hill, 6th revised international Ed, 2012
- Maity, K.C. and Ghosh, R.K. Vector Analysis, New Central Book Agency (P) Ltd. Kolkata (India).
- Terence Tao, Analysis II, Hindustan Book Agency, 3rd Ed., 2015
- M.R. Speigel, Schaum's outline of Vector Analysis. Tata McGraw-Hill, 2009 .

Course : MTMACOR10T

Ring Theory and Linear Algebra I (Marks : 75)

Unit 1: Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

Unit 2 : Ring homomorphisms, properties of ring homomorphisms. Isomorphism theorems I, II and III, field of quotients.

Unit 3 : Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

Unit 4 : Introduction to linear transformations, Subspaces, dimension of subspaces, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms. Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

Books Recommended

- John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.

- M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
- Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
- Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
- S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
- Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
- S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999
- Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
- D.A.R. Wallace, Groups, Rings and Fields, Springer Verlag London Ltd., 1998.
- D.S. Malik, John M. Mordeson and M.K. Sen, Fundamentals of Abstract Algebra,1997.

Course : MTMACOR11T

Partial Differential Equations, Applications of Ordinary Differential Equations

(Marks : 75)

Unit 1: Partial Differential Equations – Basic concepts and Definitions. Mathematical Problems. First- Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations. Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first order partial differential equations.

Unit 2: Derivation of Heat equation, Wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms.

Unit 3: The Cauchy problem, Cauchy-Kowalewskaya theorem, Cauchy problem of an infinite string, Initial Boundary Value Problems. Semi-Infinite String with a fixed end, Semi-Infinite String with a Free end. Equations with non-homogeneous boundary conditions. Non-Homogeneous Wave Equation. Method of separation of variables, Solving the Vibrating String Problem. Solving the Heat Conduction problem

Unit 4: Central force. Constrained motion, varying mass, tangent and normal components of acceleration, modelling ballistics and planetary motion, Kepler's second law.

Graphical Demonstration (Teaching Aid)

1. Solution of Cauchy problem for first order PDE.

2. Finding the characteristics for the first order PDE.

3. Plot the integral surfaces of a given first order PDE with initial data.

4. Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions:

(a) $u(x,0) = \phi(x)$, $u_x(x,0) = \psi(x)$, $x \in R$, $t > 0$.

(b) $u(x,0) = \phi(x)$, $u_x(x,0) = \psi(x)$, $u(0, t) = 0$ $x \in (0,\infty)$, $t > 0$.

5. Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions:

(a) $u(x,0) = \phi(x)$, $u(0, t) = a$, $u(l, t) = b$, $0 < x < l$, $t > 0$.

(b) $u(x,0) = \phi(x)$, $x \in R$, $0 < t < T$.

Books Recommended :

- Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4th Edition, Springer, Indian reprint, 2006.
- S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
- Martha L Abell, James P Braselton, Differential equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.
- Sneddon, I. N., Elements of Partial Differential Equations, McGraw Hill,2013.
- Miller, F. H., Partial Differential Equations, John Wiley and Sons,2013.
- Loney, S. L., An Elementary Treatise on the Dynamics of particle and of Rigid Bodies, Loney Press,2007.

Course : MTMACOR12T

Group Theory II (Marks : 75)

Unit 1: Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties.

Unit 2 : Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups.

Unit 3 : Group actions, stabilizers and kernels, permutation representation associated with a given group action. Applications of group actions. Generalized Cayley's theorem. Index theorem.

Unit 4 : Groups acting on themselves by conjugation, class equation and consequences, conjugacy in Sn, p-groups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of A_n for $n \geq 5$, non-simplicity tests.

Books Recommended:

- John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
- M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
- Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., 1999.
- David S. Dummit and Richard M. Foote, Abstract Algebra, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2004.
- J.R. Durbin, Modern Algebra, John Wiley & Sons, New York Inc., 2000.
- D. A. R. Wallace, Groups, Rings and Fields, Springer Verlag London Ltd., 1998
- D.S. Malik, John M. Mordeson and M.K. Sen, Fundamentals of Abstract Algebra, Tata McGraw Hill,1997.
- I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.

Course : MTMACOR13T

Metric Spaces and Complex Analysis (Marks : 75)

Unit-1 : Metric spaces: Definition and examples. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, subspaces, dense sets, separable spaces. Sequences in Metric Spaces, Cauchy sequences. Complete Metric Spaces, Cantor's theorem.

Unit 2 : Continuous mappings, sequential criterion and other characterizations of continuity, Uniform continuity, Connectedness, connected subsets of R.

Compactness: Sequential compactness, Heine-Borel property, Totally bounded spaces, finite intersection property, and continuous functions on compact sets.

Homeomorphism, Contraction mappings, Banach Fixed point Theorem and its application to ordinary differential equation.

Unit 3 : Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings.

Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Unit 4 : Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, and definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.

Unit 5 : Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series,

Taylor series and its examples.

Unit 6 : Laurent series and its examples, absolute and uniform convergence of power series.

Books Recommended :

- Satish Shirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006.
- S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
- G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 2004.
- James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 8th Ed., McGraw – Hill International Edition, 2009.
- Joseph Bak and Donald J. Newman, Complex Analysis, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., NewYork, 1997.
- S. Ponnusamy, Foundations of omplex Analysis, Alpha Science International, 2005.
- E.M.Stein and R. Shakrachi, Complex Analysis, Princeton University Press, 2010.

Course : MTMACOR14T

Ring Theory and Linear Algebra II (Marks : 75)

Unit 1 : Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, and unique factorization in Z [x]. Divisibility in integral domains, irreducible, primes, unique factorization domains, Euclidean domains.

Unit 2 : Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms.

Unit 3 : Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

Books Recommended :

- John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
- M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
- Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, 1999.
- Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
- S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.

- Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
- S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.
- Kenneth Hoffman and Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
- S.H. Friedberg, A.L. Insel and L.E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., 2004.

Skill Enhancement Courses (SEC)

Course : MTMSSEC01M

C-Programming Language (Marks : 25)

Unit 1 : Basics of Computer Programming:

Definition, Requirement of programming language, Machine language, high-level programming languages, machine code of a program: compilation process, Problem solving approaches: algorithm and flowchart

Unit 2 : Fundamentals of Programming:

Built in Data Types: int, float, double, char; Constants and Variables; first program: printf(), scanf(), compilation etc., keywords, Arithmetic operators: precedence and associativity, Assignment Statements: post & pre increment/decrement, logical operators: and, or, not

Unit 3 : Statements:

Relational operators, if-else statement,

Iterative Statements: for loop, while loop and do-while loop; controlling loop execution: break and continue, nested loop

Unit 4 : Arrays:

Definition & requirement, declaration & initialization, indexing, one dimensional array: finding maximum, minimum, simple sorting and searching.

Unit 5 : Multi-dimensional arrays:

Matrix Manipulations (Addition, Multiplication, Transpose)

Arrays and Pointers, Memory allocation and deallocation: *malloc()* and *free()* functions

Unit 6 : Functions:

Why?, How to declare, define and invoke a function, Variables' scope, local& global variables and function parameters, Pointers, arrays as function parameters, *return* statement, Header files and their role. Illustrate different examples like swapping values, compute n!, nCr, find max/min from a list of elements, sort a set of numbers, matrix addition/multiplication etc.

Books Recommended :

- B. W. Kernighan and D. M. Ritchi : The C-Programming Language, 2nd Edi.(ANSI Refresher), Prentice Hall, 1977.
- Y. Kanetkar : Let Us C ; BPB Publication, 1999.
- C. Xavier : C-Language and Numerical Methods, New Age International.

Course : MTMSSEC02M

Logic and Sets (Marks : 25)

Unit 1 : Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Unit 2 : Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.

Unit 3 : Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections. Relation: Product set. Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation. Partial ordering relations, n- ary relations.

Books Recommended :

- R.P. Grimaldi, Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998.
- P.R. Halmos, Naive Set Theory, Springer, 1974.
- E. Kamke, Theory of Sets, Dover Publishers, 1950.

Discipline Specific Elective (DSE)

Course : MTMADSE01T

Linear Programming (Marks : 75)

Unit 1 : Introduction to linear programming problem. Theory of simplex method, graphical solution, convex sets, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method. Big-M method and their comparison.

Unit 2 : Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual. Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Unit 3 : Game theory: Formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

Books Recommended :

- Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004.
- F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, 9th Ed., Tata McGraw Hill, Singapore, 2009.
- Hamdy A. Taha, Operations Research, An Introduction, 8th Ed., Prentice-Hall India, 2006.
- G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.

Course : MTMADSE02T

Number Theory (Marks : 75)

Unit 1 : Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruences, complete set of residues, Chinese Remainder theorem, Fermat's Little theorem, Wilson's theorem.

Unit 2 : Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius Inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues. Some properties of Euler's phi-function.

Unit 3 : Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruences with composite moduli, Public key encryption, RSA encryption and decryption, the equation $x^2 + y^2 = z^2$, Fermat's Last theorem.

Books Recommended :

- David M. Burton, Elementary Number Theory, 6th Ed., Tata McGraw-Hill, Indian reprint, 2007.
- Neville Robinns, Beginning Number Theory, 2nd Ed., Narosa Publishing House Pvt. Ltd., Delhi, 2007

Course : MTMADSE03T

Probability and Statistics (Marks : 75)

Unit 1 : Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

Unit 2 : Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

Unit 3 : Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers. Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

Unit 4 : Random Samples, Sampling Distributions, Estimation of parameters, Testing of hypothesis.

Books Recommended :

- Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia, 2007.
- Irwin Miller and Marylees Miller and John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006.
- Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007.
- Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, Introduction to the Theory of Statistics, 3rd Ed., Tata McGraw- Hill, Reprint 2007
- A. Gupta, Ground work of Mathematical Probability and Statistics, Academic publishers, 1983.

Course : MTMADSE04T

Theory of Equations (Marks : 75)

Unit 1 : General properties of polynomials, Graphical representation of a polynomial, maximum and minimum values of a polynomials, General properties of equations, Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.

Unit 2 : Symmetric functions. Applications of symmetric function of the roots. Transformation of equations. Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic (Cardan's method) and biquadratic (Ferrari's method). Properties of the derived functions.

Unit 3 : Symmetric functions of the roots, Newton's theorem on the sums of powers of roots, homogeneous products, limits of the roots of equations.

Unit 4 : Separation of the roots of equations, Strums theorem. Applications of Strum's theorem, Conditions for reality of the roots of an equation. Solution of numerical equations.

Books Recommended :

- W.S. Burnside and A.W. Panton, The Theory of Equations, Dublin University Press, 1954.
- C. C. MacDuffee, Theory of Equations, John Wiley & Sons Inc., 1954.

Course : MTMADSE05T

Boolean Algebra and Automata Theory (Marks : 75)

Unit 1 : Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms.

Unit 2 : Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal and maximal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, Logic Gates, switching circuits and applications of switching circuits.

Unit 3 : Introduction: Alphabets, strings, and languages. Finite Automata and Regular Languages: deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

Unit 4 : Context Free Grammars and Pushdown Automata: Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages; normal forms, pumping lemma, closure properties, decision properties.

Unit 5 : Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence.

Unit 6 : Undecidability: Recursively enumerable and recursive languages, undecidable problems about Turing machines: halting problem. Post Correspondence Problem, and undecidability problems about CFGs.

Books Recommended :

- B A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990.
- Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, (2nd Ed.), Pearson Education (Singapore) P.Ltd., Indian Reprint 2003.
- Rudolf Lidl and Günter Pilz, Applied Abstract Algebra, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
- J. E. Hopcroft, R. Motwani and J. D. Ullman, Introduction to Automata Theory, Languages, and Computation, 2nd Ed., Addison-Wesley, 2001.
- H.R. Lewis, C.H. Papadimitriou and C. Papadimitriou, Elements of the Theory of Computation, 2nd Ed., Prentice-Hall, NJ, 1997.
- J.A. Anderson, Automata Theory with Modern Applications, Cambridge University Press, 2006.

Course : MTMADSE06T

Mechanics (Marks : 75)

Unit 1 : Co-planar forces. Astatic equilibrium. Friction. Equilibrium of a particle on a rough curve. Virtual work. Forces in three dimensions. General conditions of equilibrium. Centre of gravity for different bodies. Stable and unstable equilibrium.

Unit 2 : Equations of motion referred to a set of rotating axes. Motion of a projectile in a resisting medium. Stability of nearly circular orbits. Motion under the inverse square law. Slightly disturbed orbits. Motion of artificial satellites. Motion of a particle in three dimensions. Motion on a smooth sphere, cone, and on any surface of revolution.

Unit 3 : Degrees of freedom. Moments and products of inertia. Momental Ellipsoid. Principal axes. D'Alembert's Principle. Motion about a fixed axis. Compound pendulum. Motion of a rigid body in two dimensions under finite and impulsive forces. Conservation of momentum and energy.

Books Recommended :

- I.H. Shames and G. Krishna Mohan Rao, Engineering Mechanics: Statics and Dynamics, 2006. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009.
- R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics, 11th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2010.
- Chorlton, F., Textbook of Dynamics CBS Publishers & Distributors, 2005.
- Loney, S. L., An Elementary Treatise on the Dynamics of particle and of Rigid Bodies, 2017
- Loney, S. L., Elements of Statics and Dynamics I and II, 2004.
- Ghosh, M. C, Analytical Statics.
- Verma, R. S., A Textbook on Statics, Pothishala, 1962 .
- Matiur Rahman, Md., Statics, New Central Book Agancy (P) Ltd, 2004.
- Ramsey, A. S., Dynamics (Part I), Cambridge University Press, 1952.

SYLLABUS FOR

GENERIC ELECTIVES OF MATHEMATICS

(For Other Honours Discipline)

Semester	Course Type	Course Code	Name of the Course	Credit Pattern (L:T:P)	Total class hrs./week	Marks	Credit
I	GE	MTMHGEC01T	Differential Calculus	5:1:0	6	75	6
II	GE	MTMHGEC02T	Differential Equations	5:1:0	6	75	6
III	GE	MTMHGEC03T	Real Analysis	5:1:0	6	75	6
IV	GE	MTMHGEC04T	Algebra	5:1:0	6	75	6

Course : MTMHGEC01T

Differential Calculus (Marks : 75)

Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions.

Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, e^x, log(l+x), $(l+x)^n$, Maxima and Minima, Indeterminate forms.

Books Recommended:

1. H. Anton, I. Birens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2002.

2. G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, 2007.

Course : MTMHGEC02T

Differential Equations (Marks : 75)

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. Methods for solving higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties.

Solving a differential equation by reducing its order.

Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations.

Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.

Books Recommended:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.

2. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition,1967.

Course : MTMHGEC03T

Real Analysis (Marks : 75)

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test(Tests of Convergence without proof). Definition and examples of absolute and conditional convergence.

Sequences and series of functions, Pointwise and uniform convergence .M_n-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.

Books Recommended :

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.

2. R.G. Bartle and D. R Sherbert, *Introduction to Real Analysis,* John Wiley and Sons (Asia) P.Ltd., 2000.

3. E. Fischer, *Intermediate Real Analysis*, Springer Verlag, 1983.

4. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series*- Undergraduate Texts in Mathematics, Springer Verlag, 2003.

Course : MTMHGEC04T

Algebra (Marks : 75)

Equivalence relations and partitions, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set. Definition and examples of groups, examples of abelian and non-abelian groups, the group Z_n of integers under addition modulo n and the group U(n) of units under multiplication modulo n.Cyclic groups from number systems, complex roots of unity, circle group, the general linear group $GL_n(n,R)$, groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle,(iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions.

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.

Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Z_n the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Z_p, Q, R, and C. Field of rational functions.

Books Recommended:

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002**.**

2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.

3. Joseph A Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa, 1999.

4. George E Andrews, *Number Theory*, Hindustan Publishing Corporation, 1984.

WEST BENGAL STATE UNIVERSITY

CBCS DRAFT SYLLABUS

FOR

THREE-YEAR MICROBIOLOGY HONOURS

DEGREE COURSE OF STUDIES

Structure of B. Sc. Honours Microbiology under CBCS

Core Course

MCBACOR01T/P: Introduction to Microbiology and Microbial Diversity
MCBACOR02T/P: Bacteriology
MCBACOR03T/P: Biochemistry
MCBACOR04T/P: Environmental Microbiology
MCBACOR05T/P: Microbial Physiology and Metabolism
MCBACOR06T/P: Cell Biology
MCBACOR07T/P: Molecular Biology
MCBACOR08T/P: Microbial Genetics
MCBACOR09T/P: Virology
MCBACOR10T/P: Food and Dairy Microbiology
MCBACOR11T/P: Industrial Microbiology
MCBACOR12T/P: Immunology
MCBACOR13T/P: Medical Microbiology
MCBACOR14T/P: Recombinant DNA Technology

Discipline Specific Elective (Any Four)(out of 3 any 2 to be taken in each semester)

MCBADSE01T/P: Advances in Microbiology – Semester V
MCBADSE02T/P: Biomathematics and Biostatistics - Semester V
MCBADSE03T/P: Inheritance Biology - Semester V
MCBADSE04T/P: Microbes in Sustainable Agriculture and Development- Semester VI
MCBADSE05T/P: Biosafety and Intellectual Property Rights – Semester VI
MCBADSE06T/P: Instrumentation and Biotechniques – Semester VI

Skill Enhancement Elective Courses

MCBSSEC01M: Food fermentation techniques
MCBSSEC02M: Microbiological Analysis of Air and Water

[Generic Electives: ONLY FOR THE STUDENTS PURSUING HONOURS COURSE OTHER THAN MICROBIOLOGY]

MCBHGEC01T/P: Bacteriology and Virology
MCBHGEC02T/P: Industrial and Food Microbiology
MCBHGEC03T/P: Microbial genetics and molecular biology
MCBHGEC04T/P: Medical Microbiology and Immunology

Microbiology (Hons.) Semester I

Course Code	Course Title	Credit	Marks	
			Internal Assessment	End Sem Examination
MCBACOR01T	Introduction to Microbiology and Microbial Diversity (Theory)	4	10	40
MCBACOR01P	Introduction to Microbiology and Microbial Diversity (Practical)	2	15	10
MCBACOR02T	Bacteriology (Theory)	4	10	40
MCBACOR02P	Bacteriology (Practical)	2	15	10
Total in semester I		**12**	**150**	

Besides this, a student has to complete **one Generic Elective course (6 credits/ 75 marks)** from the Departments other than Microbiology and **one Ability enhancement Compulsory Course (2 credit/25 marks)**

- **Therefore, a student covers a total of 20 credits (12+6+2) in Semester I**

Microbiology (Hons.) Semester II

Course Code	Course Title	Credit	Marks	
			Internal Assessment	End Sem Examination
MCBACOR03T	Biochemistry (Theory)	4	10	40
MCBACOR03P	Biochemistry (Practical)	2	15	10
MCBACOR04T	Environmental Microbiology (Theory)	4	10	40
MCBACOR04P	Environmental Microbiology (Practical)	2	15	10
Total in semester II		**12**	**150**	

Besides this, a student has to complete **one Generic Elective course (6 credits/75 marks)** from the Departments other than Microbiology and **one Ability enhancement Compulsory Course (2 credit/25 marks)**

- **Therefore, a student covers a total of 20 credits (12+6+2) in Semester II**

Microbiology (Hons.) Semester III

Course Code	Course Title	Credit	Marks	
			Internal Assessment	End Sem Examination
MCBACOR05T	Microbial Physiology and Metabolism (Theory)	4	10	40
MCBACOR05P	Microbial Physiology and Metabolism (Practical)	2	15	10
MCBACOR06T	Cell Biology (Theory)	4	10	40
MCBACOR06P	Cell Biology (Practical)	2	15	10
MCBACOR07T	Molecular Biology (Theory)	4	10	40
MCBACOR07P	Molecular Biology (Practical)	2	15	10
MCBSSEC01M	Food fermentation techniques	2	05	20
Total in semester III		**20**	**250**	

Besides this, a student has to complete **one Generic Elective course (6 credits/75 marks)** from the Departments other than Microbiology.

- **Therefore, a student covers a total of 26 credits (20+6) in Semester III**

Microbiology (Hons.) Semester IV

Course Code	Course Title	Credit	Marks	
			Internal Assessment	End Sem Examination
MCBACOR08T	Microbial Genetics (Theory)	4	10	40
MCBACOR08P	Microbial Genetics (Practical)	2	15	10
MCBACOR09T	Virology (Theory)	4	10	40
MCBACOR09P	Virology (Practical)	2	15	10
MCBACOR10T	Food and Dairy Microbiology (Theory)	4	10	40
MCBACOR10P	Food and Dairy Microbiology (Practical)	2	15	10

MCBSSEC02M	Microbiological Analysis of Air and Water	2	05	20
Total in semester IV		**20**	**250**	
Besides this, a student has to complete **one Generic Elective course (6 credits/75 marks)** from the Departments other than Microbiology. **Therefore, a student covers a total of 26 credits (20+6) in Semester IV**				

Microbiology (Hons.) Semester V

Course Code	Course Title	Credit	Marks	
			Internal Assessment	Examination
MCBACOR11T	Industrial Microbiology (Theory)	4	10	40
MCBACOR11P	Industrial Microbiology (Practical)	2	15	10
MCBACOR12T	Immunology (Theory)	4	10	40
MCBACOR12P	Immunology (Practical)	2	15	10
MCBADSE01T/ MCBADSE02T/ MCBADSE03T	Advances in Microbiology / Biomathematics and Biostatistics / Inheritance Biology **(ANY TWO)**	2x4	10x2	40x2
MCBADSE01P/ MCBADSE02P/ MCBADSE03P	Advances in Microbiology / Biomathematics and Biostatistics / Inheritance Biology (Practical) **(ANY TWO)**	2x2	15x2	10x2
Total in semester V		**24**	**300**	

Microbiology (Hons.) Semester VI

Course Code	Course Title	Credit	Marks	
			Internal Assessment	Examination
MCBACOR13T	Medical Microbiology (Theory)	4	10	40
MCBACOR13P	Medical Microbiology (Practical)	2	15	10
MCBACOR14T	Recombinant DNA Technology (Theory)	4	10	40
MCBACOR14P	Recombinant DNA Technology (Practical)	2	15	10
MCBADSE04T/ MCBADSE05T/ MCBADSE06T	Microbes in sustainable Agriculture and Development/ Biosafety and Intellectual Property Rights/ Instrumentation and Biotechniques (Theory) **(ANY TWO)**	2x4	10x2	40x2
MCBADSE04P/ MCBADSE05P/ MCBADSE06P	Microbes in sustainable Agriculture and Development/ Biosafety and Intellectual Property Rights/ Instrumentation and Biotechniques (Practical) **(ANY TWO)**	2x2	15x2	10x2
Total in semester VI		**24**	**300**	

TOTAL CREDIT = 140

TOTAL MARKS = 1750

B.Sc (HONOURS) MICROBIOLOGY (CBCS STRUCTURE)

MCBACOR01T: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY (THEORY)
SEMESTER –I

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 History of Development and scope of Microbiology **No. of Hours: 8**

Development of Microbiology as a discipline, spontaneous generation *vs*. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology, Development of the field of soil microbiology: Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A.Waksman

Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner

Unit 2 Microscopy: Basic principles & application **No. of Hours: 10**

Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Confocal microscopy, Scanning and Transmission Electron Microscope

Unit 3 Diversity of Microbial World **No. of Hours: 42:**

A. Systems of classification

Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms

Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers, rRNA oligonucleotide sequencing, signature sequences, and protein sequences. Differences between eubacteria and archaebacteria

B. General characteristics of different groups: **Acellular** microorganisms (Viruses, Viroids, Prions) and **Cellular** microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

• Algae

History of phycology with emphasis on contributions of Indian scientists; General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Different types of life cycles in algae with suitable examples: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles. Applications of algae in agriculture, industry, environment and food

• Fungi

Historical developments in the field of Mycology including significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism.

Economic importance of fungi with examples in agriculture, environment, Industry, medicine, food, biodeterioration and mycotoxins.

• Protozoa

General characteristics with special reference to *Amoeba, Paramecium, Plasmodium, Leishmania and Giardia*

MCBACOR01P: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY (PRACTICALS) SEMESTER –I

TOTAL HOURS: 60 **CREDITS: 2**

1. Microbiology Good Laboratory Practices and safety measures.
2. To study the principle and applications of important instruments (Laminar Air Flow, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
3. Preparation of Czapekdox Agar slant/plate for fungal cultivation.
4. Sterilization of medium using Autoclave and assessment for sterility
5. Inoculation of fungi (*Penicillium*, *Aspergillus)* in Czapekdox medium
6. Staining of fungi (*Rhizopus*, *Penicillium*, *Aspergillus*) using Lactophenol-Cotton blue

SUGGESTED READING

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition
3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited
4.Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
5. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.
6. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
7. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.

MCBACOR02T: BACTERIOLOGY (THEORY) SEMESTER –I

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Cell organization **No. of Hours: 18**

Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaebacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, and plasmids(definition and types), Endospore: Structure, formation, stages of sporulation.

Unit 2 Bacteriological techniques **No. of Hours: 6**

Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, non-culturable bacteria. Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media

Unit 3 Staining methods **No. of Hours: 6**

Stain and dye, acidic and basic dyes, mordant, Simple staining, Gram staining, Negative staining, Acid fast staining, Basic mechanism of Gram staining, endospore and capsule staining, Basic mechanism of Lactophenol-cotton blue staining

Unit 4 Microbial Growth and Effect of Environment on Microbial Growth

No. of Hours: 18

Definitions of growth, Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve Microbial growth in response to environment -Temperature, pH, solute and water activity, Oxygen, high pressure. Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph.

Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation

Chemical methods of microbial control: Acid, alkali, alcohol, detergent, phenol & phenolics, heavy metals: types and mode of action, disinfectants and antiseptics; basic concept of antibiotics.

Unit 5 Important archaeal and eubacterial groups **No. of Hours: 12**

Archaebacteria: General characteristics, phylogenetic overview, genera belonging to Nanoarchaeota (*Nanoarchaeum*), Crenarchaeota (*Sulfolobus*, *Thermoproteus*) and Euryarchaeota [Methanogens (*Methanobacterium*, *Methanocaldococcus*), thermophiles (*Thermococcus*, *Pyrococcus*, *Thermoplasma*), and Halophiles (*Halobacterium*, *Halococcus*)]

Eubacteria:

Gram Negative:

Non proteobacteria: General characteristics with suitable examples
Alpha proteobacteria: General characteristics with suitable examples
Beta proteobacteria: General characteristics with suitable examples
Gamma proteobacteria: General characteristics with suitable examples
Delta proteobacteria: General characteristics with suitable examples
Epsilon proteobacteria: General characteristics with suitable examples
Zeta proteobacteria: General characteristics with suitable examples

Gram Positive:

Low G+ C (Firmicutes): General characteristics with suitable examples
High G+C (Actinobacteria): General characteristics with suitable examples

***Cyanobacteria*:** Introductory idea with suitable example

MCBACOR02P: BACTERIOLOGY (PRACTICAL)
SEMESTER –I

TOTAL HOURS: 60 **CREDITS: 2**

1. Preparation of different media: Nutrient Agar & broth, Luria broth
2. Simple staining
3. Negative staining
4. Gram staining
5. Endospore staining.

6. Isolation of pure cultures of bacteria by streaking method.
7. Study and plot the growth curve of *E. coli* by turbidometric method.
8. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data
9. Estimation of CFU count by spread plate method/pour plate method.

SUGGESTED READINGS

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.
2. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall
3. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International, Inc.
4. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.
5. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers,Dordrecht
6. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
9. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited

MCBACOR03T: BIOCHEMISTRY (THEORY)

SEMESTER –II

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Bioenergetics **No. of Hours: 8**

First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy,and Entropyand mathematical relationship among them, Standard free energy change and equilibrium constant Coupled reactions and additive nature of standard free energy change, Standard Free Energy Change of coupled reactions, Energy rich compounds: Phosphoenolpyruvate, 1,3- Bisphosphoglycerate, Thioesters, ATP, . Numerical problems on calculations of Standard Free Energy Change and Equilibrium constant

Unit 2 Carbohydrates **No. of Hours: 12**

Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses. Stereo isomerism of monosaccharides, epimers, Mutarotation and anomers of glucose. Furanose and pyranose forms of glucose and fructose, Haworth projection formulae for glucose; chair and boat forms of glucose, Sugar derivatives, glucosamine, galactosamine, muramic acid, N- acetyl neuraminic acid, Disaccharides; concept of reducing and non-reducing sugars, occurrence and Haworth projections of maltose, lactose, and sucrose, Polysaccharides, storage polysaccharides, starch and glycogen. Structural Polysaccharides, cellulose, peptidoglycan and chitin

Unit 3 Lipids **No. of Hours: 12**

Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties. Saponification Structural lipids. Phosphoglycerides: Building blocks, General structure, functions and properties. Structure of phosphatidylethanolamine and

phosphatidylcholine, Sphingolipids.

Unit 4 Proteins **No. of Hours: 12**

Functions of proteins, Primary structures of proteins: Amino acids, the building blocks of proteins. General formula of amino acid and concept of zwitterion. Concept of pH and buffers and related numerical problems, Titration curve of amino acid and its Significance, Classification, biochemical structure and notation of standard protein amino acids Ninhydrin reaction. Secondary structure of proteins: Peptide unit and its salient features. The alpha helix, the beta pleated sheet and their occurrence in proteins, Tertiary and quaternary structures of proteins.
Forces holding the polypeptide together. Human haemoglobin structure, Quaternary structures of proteins

Unit 5. Enzymes **No. of Hours: 16**

Structure of enzyme: Apoenzyme and cofactors, prosthetic group-TPP, coenzyme NAD,metal cofactors, Classification of enzymes, Mechanism of action of enzymes: active site, transition state complex and activation energy. Lock and key hypothesis, and Induced Fit hypothesis. Significance of hyperbolic, double reciprocal plots of enzyme activity, Km, and allosteric mechanism Definitions of terms – enzyme unit, specific activity and turnover number, Multienzyme complex :pyruvate dehydrogenase; isozyme: lactate dehydrogenase, Effect of pH and temperature on enzymeactivity. Enzyme inhibition: competitive- sulfa drugs; non-competitive-heavy metal salts

MCBACOR03P: BIOCHEMISTRY (PRACTICALS)
SEMESTER –II

TOTAL HOURS: 60 **CREDITS: 2**

1.Preparation of buffers and numerical problems to explain the concepts
2. Qualitative/Quantitative tests for carbohydrates, reducing sugars, non reducing sugars
3. Qualitative/Quantitative tests for proteins: Biuret & Lowry's method
4. Formol titration of glycine
5. Study of enzyme kinetics – calculation of *V*max , Km, Kcat values
6. Study effect of temperature, pH and Heavy metals on enzyme activity

SUGGESTED READING

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company,
6. Willey MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein's Microbiology by. 9th Ed., McGrawHill
7. Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons,

MCBACOR04T: ENVIRONMENTAL MICROBIOLOGY (THEORY)
SEMESTER –II

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Microorganisms and their Habitats **No. of Hours: 14**

Structure and function of ecosystems-Terrestrial Environment: Soil profile and soil microflora Aquatic Environment: Microflora of fresh water and marine habitats Atmosphere: Aeromicroflora and dispersal of microbes Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Microbial succession in decomposition of plant organic matter

Unit 2 Microbial Interactions **No. of Hours: 12**

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism,predation Microbe-Plant interaction: Symbiotic and non symbiotic interactions Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria

Unit 3 Biogeochemical Cycling **No. of Hours: 12**

Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction Phosphorus cycle: Phosphate immobilization and solubilisation. Sulphur cycle: Microbes involved in sulphur cycle.

Unit 4 Waste Management **No. of Hours: 12**

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill) Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment

Unit 5 Microbial Bioremediation **No. of Hours: 5**

Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants

Unit 6 Water Potability **No. of Hours: 5**

Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

MCBACOR04P: ENVIRONMENTAL MICROBIOLOGY (PRACTICAL)
SEMESTER –II

TOTAL HOURS: 60 **CREDITS: 2**.

1.Isolation of microbes (bacteria & fungi) from soil.
2. Isolation of microbes from rhizosphere and phyllosphere.
3. Assessment of microbiological quality of water.
4. Determination of BOD of waste water sample.
5. Study of amylase production by soil bacteria (qualitative).

SUGGESTED READINGS

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York
5. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
7. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
8. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
9. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. NewYork & London.
10. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press,Cambridge, England.
11. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.
12. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition.McGraw Hill Higher Education.

MCBACOR05T: MICROBIAL PHYSIOLOGY AND METABOLISM (THEORY)
SEMESTER –III

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Nutrient uptake and Transport **No. of Hours: 10**

Passive and facilitated diffusion Primary and secondary active transport, concept of uniport, symport and antiport Group translocation Iron uptake

Unit 2 Chemoheterotrophic Metabolism - Aerobic Respiration No. of Hours: 16
Concept of aerobic respiration, anaerobic respiration and fermentation Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway TCA cycle Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors

Unit 3 Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation No. of Hours:12
Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction) Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of mixed acid fermentation.

Unit 4 Chemolithotrophic and Phototrophic Metabolism No. of Hours: 16
Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction) Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic *vs.* oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria

Unit 5 Nitrogen Metabolism - an overview No. of Hours: 6
Introduction to biological nitrogen fixation Ammonia assimilationAssimilatory nitrate reduction, dissimilatory nitrate reduction, denitrification

MCBACOR05P: MICROBIAL PHYSIOLOGY AND METABOLISM (PRACTICAL)
SEMESTER –III

TOTAL HOURS: 60 **CREDITS: 2**

1. Effect of temperature on growth of *E. coli*
2. Effect of pH on growth of *E. coli*
3. Effect of carbon and nitrogen sources on growth of *E.coli*
4. Effect of salt on growth of *E. coli*
5. Demonstration of alcoholic fermentation

SUGGESTED READINGS

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

MCBACOR06T: CELL BIOLOGY (THEORY)
SEMESTER –III

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Structure and organization of Eukaryotic Cell **No. of Hours: 14**

Cell Organization – Eukaryotic (Plant and animal cells)
Cell Wall: Eukaryotic cell wall, Extra cellular matrix and cell matrix interactions, Cell-Cell
Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata (only structural aspects) Mitochondria, chloroplasts and peroxisomes
Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules

Unit 2 Nucleus **No. of Hours: 6**

Nuclear envelope, nuclear pore complex and nuclear lamina Chromatin – Molecular organization Nucleolus

Unit 3 Basics of Protein Sorting and Transport **No. of Hours: 12**

Ribosomes, Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, smooth ER, export of proteins to Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus, Lysosomes

Unit 4 Introduction to Cell Signalling **No. of Hours: 13**

Signalling molecules and their receptors Function of cell surface receptors Pathways of intra-cellular receptors – Cyclic AMP pathway, cyclic GMP

Unit 5 Cell Cycle **No. of Hours: 15**

Eukaryotic cell cycle and its regulation, Mitosis and Meiosis Development of cancer, causes and types Programmed cell death.

MCBACOR06P: CELL BIOLOGY (PRACTICAL)
SEMESTER –III

TOTAL HOURS: 60 **CREDITS: 2**

1. Study a representative plant (Allium cepa or any other suitable plant material) and animal (squamous epithelial cells) cell by microscopy.
2.Cytochemical staining of DNA – Feulgen
3. Demonstration of the presence of mitochondria in striated muscle cells/ cheek epithelial cell using vital stain Janus Green B
4. Study of different stages of Mitosis.
5.Study of different stages of Meiosis.

SUGGESTED READING

1. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell. 8th edition. Pearson.
2. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
3. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

MCBACOR07T: MOLECULAR BIOLOGY (THEORY)

SEMESTER –III

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Structures of DNA and RNA / Genetic Material **No. of Hours: 12**

DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves. DNA topology - linking number, topoisomerases; Organization of DNA Prokaryotes,Viruses, Eukaryotes.RNA Structure, Organelle DNA -- mitochondria and chloroplast DNA.

Unit 2 Replication of DNA (Prokaryotes and Eukaryotes) **No. of Hours: 10**

Bidirectional and unidirectional replication, semi- conservative, semi discontinuous replication Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase, telomerase – for replication of linear ends, Various models of DNA replication including rolling circle, D- loop (mitochondrial), Θ (theta) mode of replication and other accessory protein.

Unit 3 Transcription **No. of Hours: 8**

Transcription in prokaryotes: Definition, difference from replication, promoter - concept and strength of promoter RNA Polymerase and the transcription unit
Transcription in Eukaryotes: RNA polymerases, general Transcription factors (outline only)

Unit 4 Basic concept of Post-Transcriptional Processing **No. of Hours: 8**

Split genes, concept of introns and exons, RNA splicing, spliceosome machinery**,** concept of alternative splicing, Polyadenylation and capping, Processing of rRNA, RNA interference: si RNA, miRNA and its significance

Unit 5 Translation **No. of Hours: 10**

Prokaryotic Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides. Fidelity of translation, Inhibitors of protein synthesis in prokaryotes. Difference between eukaryotic and prokaryotic translation

Unit 6 Regulation of gene Expression **No. of Hours:12**

Principles of transcriptional regulation, regulation at initiation with examples from *lac* and *trp* operons, Sporulation in *Bacillus,* Changes in Chromatin Structure - DNA methylation and Histone Acetylation mechanisms.

MCBACOR07P: MOLECULAR BIOLOGY (PRACTICAL)

SEMESTER –III

TOTAL HOURS: 60 **CREDITS: 2**

1. Estimation of DNA using colorimeter (diphenylamine reagent) or UV spectrophotometer (A260 measurement)
2. Estimation of RNA using colorimeter (orcinol reagent) or UV spectrophotometer (A260 measurement)
3. Isolation of genomic DNA from *E. coli*
4. Determination of Purity of isolated DNA
5. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
6. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE): Demonstration only.

SUGGESTED READINGS

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication

2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
6. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
7. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India

MCBACOR08T: MICROBIAL GENETICS (THEORY)

SEMESTER –IV

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Genome Organization, Mutation & DNA repair **No. of Hours: 22**

Genome organization: *E. coli*, Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of mutations Reversion and suppression: True revertants; Intra- and inter-genic suppression; Ames test; Mutator genes, Repair: phoreactivation, NER, SOS, mismatch.

Unit 2 Plasmids **No. of Hours: 10**

Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast- 2 μ plasmid, Plasmid replication and partitioning, Host range,

plasmid-incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids

Unit 3 Mechanisms of Genetic Exchange **No. of Hours: 20**

Transformation - Discovery, mechanism of natural competence Conjugation - Discovery, mechanism, Hfr and F' strains, Interrupted mating technique and time of entry mapping Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers

Unit 4 Transposable elements **No. of Hours: 8**

Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Uses of transposons and transposition

MCBACOR08P: MICROBIAL GENETICS (PRACTICAL) SEMESTER –IV

TOTAL HOURS: 60 **CREDITS: 2**

1. Preparation of Master and Replica Plates
2. Effect of ultraviolet (UV) light exposure on bacterial survival
3. Isolation of Plasmid DNA from *E.coli*
4. Study different conformations of plasmid DNA through Agaraose gel electrophoresis.
5. Bacterial Conjugation

SUGGESTED READING

1. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings
2. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
3. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning
4. Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings
5. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
6. Russell PJ. (2009). *i* Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
7. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
8. Maloy SR, Cronan JE and Friefelder D(2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers

MCBACOR09T: VIROLOGY (THEORY) SEMESTER –IV

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Nature and Properties of Viruses **No. of Hours: 12**

Introduction: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin

Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses Isolation, purification and cultivation of viruses
Viral taxonomy: Classification and nomenclature of different groups of viruses: Baltimore classification, ICTV classification

Unit 2 Bacteriophages & phage genetics **No. of Hours**: **10**

Diversity, classification, one step multiplication curve, lytic and lysogenic phages (λ phage) concept of early and late proteins, regulation of transcription in λ phage

Unit 3 Viral Transmission, Salient features of viral nucleic acids and Replication
No. of Hours: **22**

Modes of viral transmission: Persistent, non-persistent, vertical and horizontal
Salient features of viral Nucleic acid : Unusual bases (TMV,T4 phage), overlapping genes (ϕX174, Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B), long terminal repeats (retrovirus), segmented (Influenza virus), and non-segmented genomes (picornavirus), capping and tailing (TMV), Viral multiplication and replication strategies, Viral Assembly, maturation and release (Adeno virus and influenza virus as example)

Unit 4 Viruses and Cancer **No. of Hours: 6**

Introduction to oncogenic viruses Types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes

Unit 5 Prevention & control of viral diseases **No. of Hours: 10**

Antiviral compounds and their mode of action Interferon and their mode of action General principles of viral vaccination, Mechanism of action of Amantadine, Acyclovir, Azidothymidine

MCBACOR09P: VIROLOGY (PRACTICAL)

SEMESTER –IV

TOTAL HOURS: 60 **CREDITS: 2**

1. Plaque assay of bacteriophages from standard teaching kit
2. Isolation and enumeration of bacteriophages (PFU) from water/sewage/cow dung sample using double agar layer technique (demonstration only)

SUGGESTED READING

1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
2. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.
3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition, ASM press Washington DC.
4. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.
5. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.
6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
7. Nayudu MV. (2008). Plant Viruses. Tata McGraw Hill, India.
8. Bos L. (1999) Plant viruses-A text book of plant virology by. Backhuys Publishers.
9. Versteeg J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.

MCBACOR10T: FOOD & DAIRY MICROBIOLOGY (THEORY)

SEMESTER –IV

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Foods as a substrate for microorganisms **No. of Hours: 8**

Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.

Unit 2 Microbial spoilage of various foods **No. of Hours: 10**

Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods

Unit 3 Principles and methods of food preservation **No. of Hours: 12**

Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins

Unit 4 Fermented foods **No. of Hours: 12**

Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

Unit 5 Food borne diseases (causative agents, foods involved, symptoms and preventive measures) **No. of Hours: 12**

Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins; Food infections: *Bacillus cereus*, *Vibrio parahaemolyticus*, *Escherichia coli*, Salmonellosis, Shigellosis, *Yersinia enterocolitica*, *Listeria monocytogenes* and *Campylobacter jejuni*

Unit 6 Food sanitation and control **No. of Hours: 6**

HACCP, Indices of food sanitary quality and sanitizers

MCBACOR10P: FOOD & DAIRY MICROBIOLOGY (PRACTICAL)

SEMESTER –IV

TOTAL HOURS: 60 **CREDITS: 2**

1. MBRT of milk samples and their standard plate count.
2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3. Isolation of any food borne bacteria from food products.
4. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
5. Isolation of spoilage microorganisms from bread.

SUGGESTED READINGS

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.
4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.
5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
6. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.
7. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India.
8. Lund BM, Baird Parker AC, and Gould GW. (2000). The Microbiological Safety and Quality of Foods. Vol. 1-2, ASPEN Publication, Gaithersberg, MD.
9. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.

MCBACOR11T: INDUSTRIAL MICROBIOLOGY (THEORY)

SEMESTER –V

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Introduction to industrial microbiology **No. of Hours: 2**

Brief history and developments in industrial microbiology

Unit 2 Isolation of industrially important microbial strains and fermentation media **No. of Hours: 12**

Sources of industrially important microbes and methods for their isolation, preservation and maintenance of industrial strains, strain improvement, Crude and synthetic media; molasses, corn- steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates

Unit 3 Types of fermentation processes, bio-reactors and measurement of fermentation parameters **No. of Hours: 14**

Types of fermentation processes - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch (eg. baker's yeast) and continuous fermentations Components of a typical bio-reactor, Types of bioreactors-Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters, Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration

Unit 4 Down-stream processing **No. of Hours: 6**

Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying

Unit 5 Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses) **No. of Hours: 20**

Citric acid, ethanol, penicillin, glutamic acid, Vitamin B12 Enzymes (amylase, protease, lipase) Wine, beer

Unit 6 Enzyme immobilization **No. of Hours: 6**

Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase)

MCBACOR11P: INDUSTRIAL MICROBIOLOGY (PRACTICAL)
SEMESTER –V

TOTAL HOURS: 60 **CREDITS: 2**

1. Microbial fermentations for the production and estimation (qualitative and quantitative) of (a) Enzymes: Amylase
(b) Organic acid: Citric acid/Lactic acid
(c) Alcohol: Ethanol
2. A visit to any industry to see industrial fermentation and other downstream processing operations.

SUGGESTED READINGS

1. Patel A.H. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited
2. Okafor N. (2007). Modern Industrial Microbiology and Biotechnology. 1st edition. Bios Scientific Publishers Limited. USA
3. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001). Industrial Microbiology: An Introduction. 1st edition. Wiley – Blackwell
4. Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1st edition. W.H. Freeman and Company
5. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
7. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

MCBACOR12T: IMMUNOLOGY (THEORY)
SEMESTER –V

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Introduction **No. of Hours: 4**

Concept of Innate and Adaptive immunity; Contributions of following scientists to the development of field of immunology - Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa

Unit 2 Immune Cells and Organs **No. of Hours: 7**

Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Function of Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen

Unit 3 Antigens **No. of Hours: 4**

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T& B cell epitopes); T-dependent and T-independent antigens; Adjuvants

Unit 4 Antibodies **No. of Hours: 6**

Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); Monoclonal and Chimeric antibodies

Unit 5 Major Histocompatibility Complex **No. of Hours: 5**

Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways)

Unit 6 Complement System **No. of Hours: 4**

Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement Activation

Unit 7 Generation of Immune Response **No. of Hours: 10**

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance

Unit 8 Immunological Disorders and Tumor Immunity **No. of Hours: 10**

Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), tumor antigens

Unit 9 Immunological Techniques **No. of Hours: 10**

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluoresence, Flow cytometry

MCBACOR12P: IMMUNOLOGY (PRACTICAL)
SEMESTER –V

TOTAL HOURS: 60 **CREDITS: 2**

1. Identification of human blood groups.
2. Single Radial Immuno Diffusion
3. Immunodiffusion by Ouchterlony method.
4. DOT ELISA (Demonstration)
5. Immunoelectrophoresis.

SUGGESTED READINGS

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition Wiley- Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.

MCBACOR13T: MEDICAL MICROBIOLOGY (THEORY)
SEMESTER –VI

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Normal microflora of the human body and host pathogen interaction
No. of Hours: 8

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract

Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS

Unit 2 Sample collection, transport and diagnosis **No. of Hours: 5**

Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).

Unit 3 Bacterial diseases **No. of Hours: 15**

List of diseases of various organ systems and their causative agents. The following diseases with Symptoms, mode of transmission, prophylaxis and control

Respiratory Diseases: *Haemophilus influenzae, Mycobacterium tuberculosis* Gastrointestinal Diseases: *Escherichia coli, Salmonella typhi, Vibrio cholerae, Helicobacter pylori* Others: *Staphylococcus aureus, Bacillus anthracis, Clostridium tetani*

Unit 4 Viral diseases **No. of Hours: 14**

List of diseases of various organ systems and their causative agents. The following diseases with Symptoms, mode of transmission, prophylaxis and control

Polio, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis

Unit 5 Protozoan diseases **No. of Hours: 5**

List of diseases of various organ systems and their causative agents. The following diseases with Symptoms, mode of transmission, prophylaxis and control

Malaria, Kala-azar

Unit 6 Fungal diseases **No. of Hours: 5**

Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention Cutaneous mycoses: Tinea pedis (Athlete's foot) Systemic mycoses: Histoplasmosis Opportunistic mycoses: Candidiasis

Unit 7 Antimicrobial agents: General characteristics & mode of action
No. of Hours: 8

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin, Antibiotic resistance, MDR, XDR, MRSA, NDM-1

MCBACOR13P: MEDICAL MICROBIOLOGY (PRACTICAL)
SEMESTER –VI

TOTAL HOURS: 60 **CREDITS: 2**

1. Identify bacteria (any three of *E. coli*, *Staphylococcus*, *Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
2. Antibacterial sensitivity test by agar cup assay
3. Antibacterial sensitivity test by Kirby-Bauer method
4. Determination of minimal inhibitory concentration (MIC) of an antibiotic.

SUGGESTED READING

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition

MCBACOR14T: RECOMBINANT DNA TECHNOLOGY (THEORY)
SEMESTER –VI

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Introduction to Genetic Engineering **No. of Hours: 2**

Milestones in genetic engineering and biotechnology

Unit 2 Molecular Cloning- Tools and Strategies **No. of Hours: 20**

Restriction modification systems: Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligasesCloning Vectors: Definition and Properties Plasmid vectors: pBR and pUC series Bacteriophage lambda and M13 based vectors Cosmids, BACs, YACs Use of linkers and adaptors Expression vectors: *E.coli* lac and T7 promoter-based vectors, yeast YIp, YEp and YCp vectors, Baculovirus based vectors, mammalian SV40-based expression vectors

Unit 3 Methods in Molecular Cloning **No. of Hours: 16**

Transformation of DNA: Chemical method, Electroporation, Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral-mediated delivery, *Agrobacterium* - mediated delivery DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern - blotting techniques, dot blot, DNA microarray analysis, SDS-PAGE and Western blotting.

Unit 4 DNA Amplification and DNA sequencing No. of Hours: 10

PCR: Basics of PCR, RT-PCR, Real-Time PCR Sanger's method of DNA Sequencing: traditional and automated sequencing Primer walking and shotgun sequencing

Unit 5 Construction and Screening of Genomic & cDNA libraries No. of Hours: 6

Genomic and cDNA libraries: Preparation and uses, Screening of libraries: Colony hybridization and colony PCR, Chromosome walking and chromosome jumping

Unit 6 Applications of Recombinant DNA Technology No. of Hours: 6

Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, Bt transgenic - cotton, brinjal, Gene therapy, recombinant vaccines and site directed mutagensis

MCBACOR14P: RECOMBINANT DNA TECHNOLOGY (PRACTICAL) SEMESTER –VI

TOTAL HOURS: 60 CREDITS: 2

1. Preparation of competent cells for transformation
2. Bacterial Transformation and calculation of transformation efficiency.
3. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis
4. Ligation of DNA fragments
5. Cloning of DNA insert and Blue white screening of recombinants.

SUGGESTED READING

1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA
3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
4. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
5. Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
6. Brown TA. (2007). Genomes-3. Garland Science Publishers
7. Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.

B.Sc (HONOURS) MICROBIOLOGY (CBCS STRUCTURE)

MCBADSE01T: ADVANCES IN MICROBIOLOGY (THEORY)

TOTAL HOURS: 60
CREDITS: 4

Unit 1 Evolution of Bacterial Genomes **No. of Hours: 15**

Basic concept of bacterial genome evolution, Horizontal gene transfer (HGT), Evolution of bacterial virulence - Genomic islands, Pathogenicity islands (PAI) and their characteristics

Unit 2 Metagenomics **No. of Hours: 15**

Development of metagenomics, Understanding bacterial diversity using metagenomic approach. Basic knowledge of viral metagenome, metatranscriptomics, metaproteomics and metabolomics.

Unit 3 Molecular Basis of Host-Microbe Interactions **No. of Hours: 15**

Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Biofilms: types of microorganisms, molecular aspects and significance in environment, health care, virulence and antimicrobial resistance.

Unit 4 Systems and Synthetic Biology **No. of Hours: 15**

Networking in biological systems: Quorum sensing in bacteria, Co-ordinated regulation of bacterial virulence factors. Introduction and implications of synthetic biology with respect to bacteria and viruses

MCBADSE01P: ADVANCES IN MICROBIOLOGY (PRACTICAL)

TOTAL HOURS: 60
CREDITS: 2

1. Extraction and purification genomic DNA from *E.coli* using phenol chloroform method.
2. Performing PCR amplification by using suitable DNA
3. Isolation of antibiotic resistant bacteria from soil and study of multiple antibiotic resistance, using at least three(3) antibiotics.

SUGGESTED READING

1. Fraser CM, Read TD and Nelson KE. Microbial Genomes, 2004, Humana Press
2. Miller RV and Day MJ. Microbial Evolution- Gene establishment, survival and exchange, 2004, ASM Press
3. Bull AT. Microbial Diversity and Bioprospecting, 2004, ASM Press
4. Sangdun C. Introduction to Systems Biology, 2007, Humana Press
5. Klipp E, Liebermeister W. Systems Biology – A Textbook, 2009, Wiley
6. Caetano-Anolles G. Evolutionary Genomics and Systems Biology, 2010, John Wiley and Sons
7. Madigan MT, Martink JM, Dunlap PV and Clark DP (2014) Brook's Biology of Microorganisms, 14th edition, Pearson-Bejamin Cummings
8. Wilson BA, Salyers AA Whitt DD and Winkler ME (2011)Bacterial Pathogenesis- A molecular Approach, 3rd edition, ASM Press,

9. Bouarab K, Brisson and Daayf F (2009) Molecular Plant-Microbe interaction CAB International
10. Voit EO (2012) A First Course in Systems Biology, Ist edition,Garland Science

MCBADSE02T: BIOMATHEMATICS AND BIOSTATISTICS (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Biomathematics — No of Hours: 30

Reaction Kinetics: Zero order, first order, second order kinetics with examples; Michaelis-Menten equation; Coupled reactions, Application in fermentation technique: Mathematical expression in batch culture, continious culture, steady state condition, logarithm: Application in Henderson-Hesselbatch equation, problems related to buffer solution, Free energy: Mathematical expression and related problems, Differentiation and Integration: Radioactive decay, Half life, problems related to radioactivity, Decimal reduction time: mathematical expression and related problems

Unit 2 Biostatistics — No of Hours: 30

Measures of central tendency, Measures of dispersion; skewness, kurtosis; Elementary Probability and basic laws; Discrete and Continuous Random variable, Mathematical Expectation; Curve Fitting; Correlation and Regression. Emphasis on examples from Biological Sciences; Poisson and Normal distribution

Statistical methods: Principles of statistical analysis of biological data. Sampling parameters. Difference between sample and Population, Sampling Errors: Standard Error, Testing of Hypothesis, Level of Significance and Degree of Freedom; t-test, Z- test and F test; Confidence Interval; Chi-square test

MCBADSE02P: BIOMATHEMATICS AND BIOSTATISTICS (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Mean, Median, Mode from grouped and ungrouped Data set
2. Determination of Standard Deviation and standard error in laboratory experiment data
3. Graphical representation of Standard Deviation and standard error
4. Testing of Hypothesis- Normal Distribution, t-test and Chi-Square-test
5. Determination of Confidence Interval by MPN test of water sample

SUGGESTED READINGS

1. H. S. Bear: Understanding Calculus, John Wiley and Sons (Second Edition); 2003.
2. E. Batschelet : Introduction to Mathematics for Life Scientists,Springer Verlag, International Student Edition, Narosa Publishing House, New Delhi (1971, 1975)
3. A. Edmondson and D. Druce : Advanced Biology Statistics, Oxford University Press; 1996.
4. W. Danial : Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004.

MCBADSE03T: INHERITANCE BIOLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Introduction to Genetics **No. of Hours: 5**

Historical development, Model organisms in genetic analyses and experimentation: *Escherichia coli, Saccharomyces cerevisiae, Drosophila melanogaster, Arabidopsis thaliana*

Unit 2 Mendelian Principles **No. of Hours: 13**

Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, Incomplete dominance and co-dominance, Multiple alleles, Epistasis, penetrance and expressivity

Unit 3 Linkage and Crossing over **No. of Hours: 6**

Linkage and recombination of genes, Cytological basis of crossing over, Crossing over at four-strand stage, Molecular mechanism of crossing over.

Unit 4 Extra-Chromosomal Inheritance **No. of Hours: 9**

Extra nuclear inheritance in bacteria: Plasmid and episome, Organelle heredity – Chloroplast, Mitochondria,

Unit 5 Characteristics of Chromosomes **No. of Hours: 8**

Structural organization of chromosomes - centromeres, telomeres and repetitive DNA, Packaging DNA molecules into chromosomes, Concept of euchromatin and heterochromatin, Chromosome banding, Giant chromosomes: Polytene and lampbrush chromosomes,

Unit 6 Recombination **No. of Hours: 7**

Homologous and non-homologous recombination, including transposition, site-specific recombination.

Unit 7 Human genetics **No. of Hours: 12**

Pedigree analysis, lod score for linkage testing, karyotypes, Variations in chromosome structure: Deletion, duplication, inversion and translocation, Variation in chromosomal number and structural abnormalities - Klinefelter syndrome, Turner syndrome, Down syndrome.

MCBADSE03P: INHERITANCE BIOLOGY (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Chi-Square Analysis of Mendelian monohybrid/dihybrid cross
2. Study of polytene chromosomes using temporary mounts of salivary glands of *Chiromonas / Drosophila* larvae
3. Study of pedigree analysis: problems

SUGGESTED READING

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
2. Snustad DP, Simmons MJ (2011). Principles of Genetics. 6th Ed. John Wiley and Sons Inc.
3. Weaver RF, Hedrick PW (1997). Genetics. 3rd Ed. McGraw-Hill Education
4. Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics. 10th Ed. Benjamin Cummings
5. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis. 9th Ed. W.H.Freeman and Co., New York
6. Hartl DL, Jones EW (2009). Genetics: Analysis of Genes and Genomes. 7th Ed, Jones and Bartlett Publishers
7. Russell PJ. (2009). *i* Genetics - A Molecular Approach. 3rd Ed, Benjamin Cummings

MCBADSE04T: MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Soil Microbiology **No of Hours: 9**
Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil

Unit 2 Microbial Activity in Soil and Green House Gases **No of Hours: 6**
Carbon dioxide, methane, nitrous oxide, nitric oxide – production and control

Unit 3 Microbial Control of Soil Borne Plant Pathogens **No of Hours: 9**
Biocontrol mechanisms and ways, Microorganisms used as biocontrol agents against Microbial plant pathogens, Insects.

Unit 4 Biofertilization, Phytostimulation, Bioinsecticides **No of Hours: 16**
Plant growth promoting bateria, biofertilizers – symbiotic (*Bradyrhizobium, Rhizobium, Frankia*), Non Symbiotic (*Azospirillum, Azotobacter*, Mycorrhizae), Phosphate solubilizers.

Unit 5 Secondary Agriculture Biotechnology **No of Hours: 12**
Biomanure, biogas, biofuels – general concepts and advantages

Unit 6 Genetically Modified crops **No of Hours: 8**
Bt crops, golden rice, transgenic animals, advantages, social and environmental aspects.

MCBADSE04P: MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Study of microflora of rhizospheric soils
2. Isolation and characterization of phosphate solubilizing bacteria from soil
3. Isolation and characterization of Nitrogen fixing bacteria from soil
4. Isolation of *Rhizobium* from root nodules
5. Soil dehydrogenase assay

SUGGESTED READINGS

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.
3. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
5. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
7. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Altman A (1998). Agriculture Biotechnology, Ist edition, Marcel decker Inc.
10. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
11. Reddy, S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
12. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG

MCBADSE05T: BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 **No of Hours: 16**

Concept of IPR, Designs, trademarks, trade secrets, domain names, geographical indications, copyright, Evolution of patent laws, hist ory of Indian patent system, Agreements and Treaties: GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms; UPOV & Brene conventions; Patent Co-operation Treaty (PCT); Indian Patent Act 1970 & recent amendments. Classification of patents in India,

Unit 2 **No of Hours: 12**

classification of patents by WIPO, categories of patent, special patents, patenting biological products, Patentable inventions in India and abroad, non patentable inventions in India and abroad, Rights of patent holder and co-owners, transfer of patent rights, limitations of patent rights, Patent and economy, patent management, patent growth, patenting of life forms, biodiversity and IPR, Study of famous case study between Diamond and Chakraborty

Unit 3 **No of Hours: 12**

Overview of biosafety, risk assessment, cartagena protocol on biosafety, capacity building, GMOs Transgenic technology, future opportunities and challenges, Regulatory measures for biosafety, biosafety guidelines in India evolved by DBT.

Unit 4 **No of Hours: 12**

Prevention food adulteration act, food and safety standard bill and seed policy, rules for the manufacture and storage of hazardous, biosafety management, Some of the products development from RDT and their biosafety issues, biosafety and Gene therapy, ecological safety assessment of recombinant organisms

Unit 5 **No of Hours: 8**

Bioethics and its scope, different approaches to ethics, biological weapons and their social and ethical implications, Importance of good laboratory practices, general good laboratory practices

MCBADSE05P: BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

Standardization of contamination free environment in laboratory practices. Biochemical and Microbiological analysis of Foods. Food adulteration and its Testing / Anlysis

Suggested Reading

1. Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.

2. Goel D & Prashar S (2013). IPR, Biosafety and Bioethics. Pearson

MCBADSE06T: INSTRUMENTATION AND BIOTECHNIQUES (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Microscopy **No. of Hours: 10**

Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy).

Unit 2 Chromatography **No. of Hours: 14**

Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection, Gel filtration chromatography, ion- exchange chromatography and affinity chromatography, GLC, HPLC.

Unit 3 Electrophoresis **No. of Hours: 14**

Principle and applications of native polyacrylamide gel electrophoresis, SDS-polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

Unit 4 Spectrophotometry **No. of Hours: 10**

Principle and use of study of absorption spectra of biomolecules, Analysis of biomolecules using UV and visible range, Colorimetry and turbidometry

Unit 5 Centrifugation **No. of Hours: 12**

Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation

MCBADSE06P : INSTRUMENTATION AND BIOTECHNIQUES (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Separation of amino acid mixtures by thin layer chromatography.
2. Separation of protein mixtures by any form of chromatography.
3. Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).
4. Determination of λ_{max} for an unknown sample and calculation of extinction coefficient.
5. Separation of components of a given mixture using a laboratory scale centrifuge.

SUGGESTED READINGS

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.

2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 9th Ed., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.

MCBSSEC01M: FOOD FERMENTATION TECHNIQUES

TOTAL HOURS: 30 **CREDITS: 2**

Unit 1 Fermented Foods **No of Hours: 4**

Definition, types, advantages and health benefits

Unit 2 Milk Based Fermented Foods **No of Hours: 8**

Dahi, Yogurt, Buttermilk (Chach) and cheese: Preparation of inoculums, types of microorganisms and production process

Unit 3 Grain Based Fermented Foods **No of Hours: 6**

Soy sauce, Bread, Idli and Dosa: Microorganisms and production process

Unit 4 Vegetable Based Fermented Foods **No of Hours: 4**

Pickels, Saeurkraut: Microorganisms and production process

Unit 5 Fermented Meat and Fish **No of Hours: 4**

Types, microorganisms involved, fermentation process

Unit 6 Probiotic Foods **No of Hours: 4**

Definition, types, microorganisms and health benefits

Suggested Readings

1. Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS (2004) Handbook of food and fermentation technology, CRC Press
2. Holzapfel W (2014) Advances in Fermented Foods and Beverages, Woodhead Publishing.
3. Yadav JS, Grover, S and Batish VK (1993) A comprehensive dairy microbiology, Metropolitan
4. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer

MCBSSEC02M: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

TOTAL HOURS: 30 **CREDITS: 2**

Unit 1 Aeromicrobiology **No of Hours: 4**

Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens

Unit 2 Air Sample Collection and Analysis **No of Hours: 7**

Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics

Unit 3 Control Measures **No of Hours: 4**

Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration

Unit 4 Water Microbiology **No of Hours: 4**

Water borne pathogens, water borne diseases

Unit 5 Microbiological Analysis of Water **No of Hours: 7**

Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

Unit 6 Control Measures **No of Hours: 4**

Precipitation, chemical disinfection, filtration, high temperature, UV light

Suggested Reading

1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and WaterA Laboratory Manual, CRC Press
2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3rd edition, ASM press edition, ASM press

MCBHGEC01T/ MCBGCOR01T(For General Students):

BACTERIOLOGY AND VIROLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Cell organization **No. of Hours: 10**

Cell size, shape and arrangements, capsule, flagella and pili, Composition and detailed structure of gram- positive and gram- negative cell wall. Structure, chemical composition and functions of bacterial cell membranes, Ribosomes, inclusions, nucleoid, plasmids, structure of endospore.

Unit 2 Bacterial growth and control **No. of Hours: 8**

Culture media: Components of media, Synthetic or defined media, Complex media, enriched media, selective media, differential media, enrichment culture media, Pure culture isolation: Streaking, serial dilution and plating methods, cultivation, maintenance and stocking of pure cultures, phases of growth

Unit 3 Bacterial Systematics and Taxonomy **No. of Hours: 8**

Taxonomy, nomenclature, systematics, types of classifications, Morphology, ecological significance and economic importance of Gram negative and Gram positive bacteria.

Unit 4 Introduction to Viruses **No. of Hours: 12**

Properties of viruses; general nature and important features Subviral particles; viroids, prions and their importance Isolation and cultivation of viruses

Unit 5 Structure, and multiplication of viruses **No. of Hours: 12**

Morphological characters: Capsid symmetry and different shapes of viruses with examples
Viral multiplication in the Cell: Lytic and lysogenic cycle
Description of important viruses: salient features of the viruses infecting different hosts - Bacteriophages (T4 & Lambda); Plant (TMV & Cauliflower Mosaic Virus), Human (HIV & Hepatitis viruses)

Unit 6 Role of Viruses in Disease and its prevention **No. of Hours: 10**

Viruses as pathogens: Role of viruses in causing diseases, Prevention and control of viruses: Viral vaccines, interferons and antiviral compounds

MCBHGEC01P/ MCBGCOR01P (For General Students):

BACTERIOLOGY AND VIROLOGY (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Preparation of different media: Nutrient agar, Nutrient broth
2. To perform Gram's staining of the bacterial smear
3. To perform spore staining
4. Isolation of pure cultures of bacteria by streaking method
5. Enumeration of colony forming units (CFU) count by spread plate method/pour plate

SUGGESTED READING

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP (2014). Brock Biology of Micro-organisms. 14th edition. Pearson Education, Inc.
3. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition. McMillan
4. Carter J and Saunders V(2007). Virology; principles and Applications. John Wiley and Sons
5. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR Skalka, AM (2004) Principles of Virology, Molecular Biology, Pathogenesis and Contro*l*.2nd edition.ASM Press

MCBHGEC02T/ MCBGCOR02T(For General Students)**:**

INDUSTRIAL & FOOD MICROBIOLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Introduction to Industrial microbiology **No. of Hours: 10**
Types of fermentation processes - solid state, liquid state, batch, fed-batch and continuous, Types of fermenters – laboratory, pilot-scale and production fermenters, Components of a typical continuously stirred tank bioreactor

Unit 2 Isolation of Industrial Strains and Fermentation Medium **No. of Hours: 8**
Primary and secondary screening, Preservation and maintenance of industrial strains, Ingredients used in fermentation medium - molasses, corn steep liquor, whey & Yeast extract

Unit 3 Microbial fermentation processes **No. of Hours: 12**
Downstream processing - filtration, centrifugation, cell disruption, solvent extraction. Microbial production of industrial products - citric acid, ethanol and penicillin, Industrial production and uses of the enzymes - amylases, proteases.

Unit 4 Food as a substrate for microbial growth **No. of Hours: 9**
Intrinsic and extrinsic parameters that affect microbial growth in food, Microbial spoilage of food - milk, egg, bread and canned foods

Unit 5 Principles and methods of food preservation and food sanitation **No. of Hours: 9**
Physical methods - high temperature, low temperature, irradiation, aseptic packaging Chemical methods - salt, sugar, benzoates, citric acid, ethylene oxide, nitrate and nitrite Food sanitation and control – HACCP

Unit 6 Dairy products, probiotics and Food-borne Diseases **No. of Hours: 12**
Fermented dairy products - yogurt, acidophilus milk, dahi and cheese, Probiotics definition, examples and benefits, Food intoxication by *Clostridium botulinum* and *Staphylococcus aureus*, Food infection by *Salmonella* and *E.coli*

MCBHGEC02P/ MCBGCOR02P (For General Students)**:**

INDUSTRIAL AND FOOD MICROBIOLOGY (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Isolation of amylase producing bacteria from soil
2. Determination of the microbiological quality of milk sample by MBRT
3. Isolation of fungi from spoilt bread/fruits/vegetables
4. Preparation of Yogurt/Dahi

SUGGESTED READING

1. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd Edition. Panima Publishing Company, New Delhi
2. Patel AH. (1996). Industrial Microbiology .1st Edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India
3. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An introduction.9th Edition. Pearson Education

MCBHGEC03T/ MCBGCOR03T (For General Students)**:**

MICROBIAL GENETICS AND MOLECULAR BIOLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Structures of DNA and RNA / Genetic Material **No. of Hours: 6**
DNA structure, Salient features of double helix, Types of DNA, denaturation and renaturation, topoisomerases; Organization of DNA in Prokaryotes.

Unit 2 Replication of DNA **No. of Hours: 6**
Bidirectional and unidirectional replication, semi- conservative, semi- discontinuous replication Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase.

Unit 3 Transcription **No. of Hours: 6**
Transcription: Definition, promoter - concept and strength of promoter. Transcriptional Machinery and Mechanism of transcription.

Unit 4 Translation **No. of Hours: 6**
Genetic code, Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides.

Unit 5 Regulation of gene Expression **No. of Hours: 3**
Principles of transcriptional regulation, regulation at initiation with examples from *lac* operon.

Unit 6 Mutations **No. of Hours: 8**
Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens.

Unit 7 Modes of Genetic Exchange in bactetia **No. of Hours: 10**
Transformation - Discovery, mechanism of natural competence Conjugation - Discovery, mechanism, Hfr and F' strains. Transduction - Generalized transduction, specialized transduction

Unit 8 Introduction to genetic engineering **No. of Hours: 15**
Restriction modification systems: Type II restriction enzymes in genetic engineering, DNA modifying enzymes: DNA polymerases, Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases.
Cloning Vectors: Definition and Properties Plasmid vectors: pBR and pUC series
PCR: Basics of PCR.

MCBHGEC03P/ MCBGCOR03P (For General Students)**:**

MICROBIAL GENETICS & MOLECULAR BIOLOGY (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Demonstration of transformation experiment in *E.coli*
2. Demonstration of Bacterial conjugation

MCBHGEC04T/ MCBGCOR04T (For General Students)**:**
MEDICAL MICROBIOLOGY AND IMMUNOLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Normal microflora of the human body and host pathogen interaction

No. of Hours: 10

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract, Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection

Unit 2 Bacterial diseases **No. of Hours: 4**

List of diseases of various organ systems and their causative agents. (Meningitis, tuberculosis, leprosy, cholera, diphtheria, whooping cough, tetanus)

Unit 3 Viral diseases **No. of Hours: 3**

List of diseases of various organ systems and their causative agents. (polio, influenza, pox, mumps, measles, rubella)

Unit 4 Protozoan diseases **No. of Hours: 2**

List of diseases of various organ systems and their causative agents.(Amoebic dysentery, malaria)

Unit 5 Fungal diseases **No. of Hours: 3**

Brief description of various types of mycoses.

Unit 6 Antimicrobial agents: General characteristics and mode of action

No. of Hours:10

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism, Antifungal agents: Amphotericin B, Griseofulvin, Antiviral agents: Amantadine, Acyclovir, Azidothymidine

Unit 7 Immune Cells and Organs **No. of Hours: 8**

Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus.

Unit 8 Antigens and Antibodies **No. of Hours: 8**

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T& B cell epitopes), Adjuvants, Structure, Types and Functions of antibodies.

Unit 9 Generation of Immune Response **No. of Hours: 6**

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response

Unit 10 Immunological Techniques **No. of Hours: 6**

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA

MCBHGEC04P/ MCBGCOR04P (For General Students)**:**
MEDICAL MICROBIOLOGY AND IMMUNOLOGY (PRACTICAL)
TOTAL HOURS: 60 CREDITS: 2

1. Identify bacteria on the basis of biochemical characteristics: IMViC, nitrate reduction, urease production and catalase tests
2. Perform antibacterial sensitivity by Kirby-Bauer method
3. Identification of human blood groups.
4. To perform immunodiffusion by Ouchterlony method.

SUGGESTED READING

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology, 9th edition. McGraw Hill Higher Education

WEST BENGAL STATE UNIVERSITY

CBCS DRAFT SYLLABUS

FOR

THREE-YEAR MICROBIOLOGY GENERAL

DEGREE COURSE OF STUDIES

Distribution of courses in different semesters for Undergraduate course in **MICROBIOLOGY GENERAL**

Semester	Core	DSE	GE	AECC	SEC	Total credit
I	MCBGCOR01T/P			Environmental Science		20
II	MCBGCOR02T/P			English/MIL Communicatior		20
III	MCBGCOR03T/P				MCBSSEC01M	20
IV	MCBGCOR04T/P				MCBSSEC02M	20
V		MCBGDSE01T/P MCBGDSE02T/P **(Any one)**			XSSEC03M	20
VI		MCBGDSE03T/P MCBGDSE04T/P **(Any one)**			XSSEC04M	20
Total number of courses	12	6	0	2	4	120

X – FROM OTHER DISCIPLINE

MCBGCOR01T(For General Students):

BACTERIOLOGY AND VIROLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Cell organization **No. of Hours: 10**

Cell size, shape and arrangements, capsule, flagella and pili, Composition and detailed structure of gram- positive and gram- negative cell wall. Structure, chemical composition and functions of bacterial cell membranes, Ribosomes, inclusions, nucleoid, plasmids, structure of endospore.

Unit 2 Bacterial growth and control **No. of Hours: 8**

Culture media: Components of media, Synthetic or defined media, Complex media, enriched media, selective media, differential media, enrichment culture media, Pure culture isolation: Streaking, serial dilution and plating methods, cultivation, maintenance and stocking of pure cultures, phases of growth

Unit 3 Bacterial Systematics and Taxonomy **No. of Hours: 8**

Taxonomy, nomenclature, systematics, types of classifications, Morphology, ecological significance and economic importance of Gram negative and Gram positive bacteria.

Unit 4 Introduction to Viruses **No. of Hours: 12**

Properties of viruses; general nature and important features Subviral particles; viroids, prions and their importance Isolation and cultivation of viruses

Unit 5 Structure, and multiplication of viruses **No. of Hours: 12**

Morphological characters: Capsid symmetry and different shapes of viruses with examples
Viral multiplication in the Cell: Lytic and lysogenic cycle
Description of important viruses: salient features of the viruses infecting different hosts - Bacteriophages (T4 & Lambda); Plant (TMV & Cauliflower Mosaic Virus), Human (HIV & Hepatitis viruses)

Unit 6 Role of Viruses in Disease and its prevention **No. of Hours: 10**

Viruses as pathogens: Role of viruses in causing diseases, Prevention and control of viruses: Viral vaccines, interferons and antiviral compounds

MCBGCOR01P (For General Students):

BACTERIOLOGY AND VIROLOGY (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Preparation of different media: Nutrient agar, Nutrient broth
2. To perform Gram's staining of the bacterial smear
3. To perform spore staining
4. Isolation of pure cultures of bacteria by streaking method
5. Enumeration of colony forming units (CFU) count by spread plate method/pour plate

SUGGESTED READING

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP (2014). Brock Biology of Micro-organisms. 14th edition. Pearson Education, Inc.
3. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition. McMillan
4. Carter J and Saunders V(2007). Virology; principles and Applications. John Wiley and Sons
5. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR Skalka, AM (2004) Principles of Virology, Molecular Biology, Pathogenesis and Contro*l*.2nd edition.ASM Press

MCBGCOR02T(For General Students)**:**

INDUSTRIAL & FOOD MICROBIOLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Introduction to Industrial microbiology **No. of Hours: 10**

Types of fermentation processes - solid state, liquid state, batch, fed-batch and continuous, Types of fermenters – laboratory, pilot-scale and production fermenters, Components of a typical continuously stirred tank bioreactor

Unit 2 Isolation of Industrial Strains and Fermentation Medium **No. of Hours: 8**

Primary and secondary screening, Preservation and maintenance of industrial strains, Ingredients used in fermentation medium - molasses, corn steep liquor, whey & Yeast extract

Unit 3 Microbial fermentation processes **No. of Hours: 12**

Downstream processing - filtration, centrifugation, cell disruption, solvent extraction. Microbial production of industrial products - citric acid, ethanol and penicillin, Industrial production and uses of the enzymes - amylases, proteases.

Unit 4 Food as a substrate for microbial growth **No. of Hours: 9**

Intrinsic and extrinsic parameters that affect microbial growth in food, Microbial spoilage of food - milk, egg, bread and canned foods

Unit 5 Principles and methods of food preservation and food sanitation **No. of Hours: 9**

Physical methods - high temperature, low temperature, irradiation, aseptic packaging Chemical methods - salt, sugar, benzoates, citric acid, ethylene oxide, nitrate and nitrite Food sanitation and control – HACCP

Unit 6 Dairy products, probiotics and Food-borne Diseases **No. of Hours: 12**

Fermented dairy products - yogurt, acidophilus milk, dahi and cheese, Probiotics definition, examples and benefits, Food intoxication by *Clostridium botulinum* and *Staphylococcus aureus*, Food infection by *Salmonella* and *E.coli*

MCBGCOR02P (For General Students)**:**

INDUSTRIAL AND FOOD MICROBIOLOGY (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Isolation of amylase producing bacteria from soil
2. Determination of the microbiological quality of milk sample by MBRT
3. Isolation of fungi from spoilt bread/fruits/vegetables
4. Preparation of Yogurt/Dahi

SUGGESTED READING

1. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd Edition. Panima Publishing Company, New Delhi

2. Patel AH. (1996). Industrial Microbiology .1st Edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India

3. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An introduction.9th Edition. Pearson Education

MCBGCOR03T (For General Students)**:**

MICROBIAL GENETICS AND MOLECULAR BIOLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Structures of DNA and RNA / Genetic Material **No. of Hours: 6**
DNA structure, Salient features of double helix, Types of DNA, denaturation and renaturation, topoisomerases; Organization of DNA in Prokaryotes.

Unit 2 Replication of DNA **No. of Hours: 6**
Bidirectional and unidirectional replication, semi- conservative, semi- discontinuous replication Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase.

Unit 3 Transcription **No. of Hours: 6**
Transcription: Definition, promoter - concept and strength of promoter. Transcriptional Machinery and Mechanism of transcription.

Unit 4 Translation **No. of Hours: 6**
Genetic code, Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides.

Unit 5 Regulation of gene Expression **No. of Hours: 3**
Principles of transcriptional regulation, regulation at initiation with examples from *lac* operon.

Unit 6 Mutations **No. of Hours: 8**
Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens.

Unit 7 Modes of Genetic Exchange in bactetia **No. of Hours: 10**
Transformation - Discovery, mechanism of natural competence Conjugation - Discovery, mechanism, Hfr and F' strains. Transduction - Generalized transduction, specialized transduction

Unit 8 Introduction to genetic engineering **No. of Hours: 15**
Restriction modification systems: Type II restriction enzymes in genetic engineering, DNA modifying enzymes: DNA polymerases, Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases.
Cloning Vectors: Definition and Properties Plasmid vectors: pBR and pUC series
PCR: Basics of PCR.

MCBGCOR03P (For General Students)**:**

MICROBIAL GENETICS & MOLECULAR BIOLOGY (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Demonstration of transformation experiment in *E.coli*
2. Demonstration of Bacterial conjugation

MCBGCOR04T (For General Students)**:**
MEDICAL MICROBIOLOGY AND IMMUNOLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Normal microflora of the human body and host pathogen interaction

No. of Hours: 10

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract, Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection

Unit 2 Bacterial diseases **No. of Hours: 4**

List of diseases of various organ systems and their causative agents. (Meningitis, tuberculosis, leprosy, cholera, diphtheria, whooping cough, tetanus)

Unit 3 Viral diseases **No. of Hours: 3**

List of diseases of various organ systems and their causative agents. (polio, influenza, pox, mumps, measles, rubella)

Unit 4 Protozoan diseases **No. of Hours: 2**

List of diseases of various organ systems and their causative agents.(Amoebic dysentery, malaria)

Unit 5 Fungal diseases **No. of Hours: 3**

Brief description of various types of mycoses.

Unit 6 Antimicrobial agents: General characteristics and mode of action

No. of Hours:10

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism, Antifungal agents: Amphotericin B, Griseofulvin, Antiviral agents: Amantadine, Acyclovir, Azidothymidine

Unit 7 Immune Cells and Organs **No. of Hours: 8**

Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus.

Unit 8 Antigens and Antibodies **No. of Hours: 8**

Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T& B cell epitopes), Adjuvants, Structure, Types and Functions of antibodies.

Unit 9 Generation of Immune Response **No. of Hours: 6**

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response

Unit 10 Immunological Techniques **No. of Hours: 6**

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA

MCBGCOR04P (For General Students)**:**
MEDICAL MICROBIOLOGY AND IMMUNOLOGY (PRACTICAL)
TOTAL HOURS: 60 CREDITS: 2

1. Identify bacteria on the basis of biochemical characteristics: IMViC, nitrate reduction, urease production and catalase tests
2. Perform antibacterial sensitivity by Kirby-Bauer method
3. Identification of human blood groups.
4. To perform immunodiffusion by Ouchterlony method.

SUGGESTED READING

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology, 9th edition. McGraw Hill Higher Education

DSE FOR B.Sc. GENERAL PROGRAMME:

MCBGDSE01T: INSTRUMENTATION AND BIOTECHNIQUES (THEORY)

TOTAL HOURS: 60 CREDITS: 4

Unit 1 Microscopy No. of Hours: 10

Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy).

Unit 2 Chromatography No. of Hours: 14

Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection, Gel filtration chromatography, ion- exchange chromatography and affinity chromatography, GLC, HPLC.

Unit 3 Electrophoresis No. of Hours: 14

Principle and applications of native polyacrylamide gel electrophoresis, SDS-polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

Unit 4 Spectrophotometry No. of Hours: 10

Principle and use of study of absorption spectra of biomolecules, Analysis of biomolecules using UV and visible range, Colorimetry and turbidometry

Unit 5 Centrifugation **No. of Hours: 12**

Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation

MCBGDSE01P : INSTRUMENTATION AND BIOTECHNIQUES (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Separation of amino acid mixtures by thin layer chromatography.
2. Separation of protein mixtures by any form of chromatography.
3. Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).
4. Determination of λ_{max} for an unknown sample and calculation of extinction coefficient.
5. Separation of components of a given mixture using a laboratory scale centrifuge.

SUGGESTED READINGS

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 9th Ed., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.

MCBGDSE02T: INHERITANCE BIOLOGY (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Introduction to Genetics **No. of Hours: 5**

Historical development, Model organisms in genetic analyses and experimentation: *Escherichia coli, Saccharomyces cerevisiae, Drosophila melanogaster, Arabidopsis thaliana*

Unit 2 Mendelian Principles **No. of Hours: 13**

Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, Incomplete dominance and co-dominance.

Unit 3 Linkage and Crossing over **No. of Hours: 6**

Linkage and recombination of genes, Cytological basis of crossing over.

Unit 4 Extra-Chromosomal Inheritance **No. of Hours: 9**

Extra nuclear inheritance in bacteria: Plasmid and episome, Organelle heredity – Chloroplast, Mitochondria,

Unit 5 Characteristics of Chromosomes **No. of Hours: 8**

Structural organization of chromosomes - centromeres, telomeres and repetitive DNA, Packaging DNA molecules into chromosomes, Concept of euchromatin and heterochromatin, Chromosome banding, Giant chromosomes: Polytene and lampbrush chromosomes,

Unit 6 Recombination **No. of Hours: 7**

Homologous and non-homologous recombination, including transposition, site-specific recombination.

Unit 7 Human genetics **No. of Hours: 12**

Karyotyping and genetic disorders: Variations in chromosome structure: Deletion, duplication, inversion and translocation, Variation in chromosomal number and structural abnormalities - Klinefelter syndrome, Turner syndrome, Down syndrome.

MCBGDSE02P: INHERITANCE BIOLOGY (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Chi-Square Analysis of Mendelian monohybrid/dihybrid cross
2. Study of polytene chromosomes using temporary mounts of salivary glands of *Chiromonas / Drosophila* larvae

SUGGESTED READING

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
2. Snustad DP, Simmons MJ (2011). Principles of Genetics. 6th Ed. John Wiley and Sons Inc.
3. Weaver RF, Hedrick PW (1997). Genetics. 3rd Ed. McGraw-Hill Education

4. Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics. 10th Ed. Benjamin Cummings
5. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis. 9th Ed. W.H.Freeman and Co., New York
6. Hartl DL, Jones EW (2009). Genetics: Analysis of Genes and Genomes. 7th Ed, Jones and Bartlett Publishers
7. Russell PJ. (2009). *i* Genetics - A Molecular Approach. 3rd Ed, Benjamin Cummings

MCBGDSE03T: MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (THEORY)

TOTAL HOURS: 60 **CREDITS: 4**

Unit 1 Soil Microbiology **No of Hours: 9**
Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil

Unit 2 Microbial Activity in Soil and Green House Gases **No of Hours: 6**
Carbon dioxide, methane, nitrous oxide, nitric oxide – production and control

Unit 3 Microbial Control of Soil Borne Plant Pathogens **No of Hours: 9**
Biocontrol mechanisms and ways, Microorganisms used as biocontrol agents against Microbial plant pathogens, Insects.

Unit 4 Biofertilization, Phytostimulation, Bioinsecticides **No of Hours: 16**
Plant growth promoting bateria, biofertilizers – symbiotic (*Bradyrhizobium, Rhizobium, Frankia*), Non Symbiotic (*Azospirillum, Azotobacter*, Mycorrhizae), Phosphate solubilizers.

Unit 5 Secondary Agriculture Biotechnology **No of Hours: 12**
Biomanure, biogas, biofuels – general concepts and advantages

Unit 6 Genetically Modified crops **No of Hours: 8**
Bt crops, golden rice, transgenic animals, advantages, social and environmental aspects.

MCBGDSE03P: MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (PRACTICAL)

TOTAL HOURS: 60 **CREDITS: 2**

1. Study of microflora of rhizospheric soil different types of soils
2. Isolation and characterization of phosphate solubilizing bacteria from soil
3. Isolation and characterization of Nitrogen fixing bacteria from soil
4. Isolation of *Rhizobium* from root nodules
5. Soil dehydrogenase assay

SUGGESTED READINGS

1. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
2. Singh RS. (1998). Plant Diseases Management. 7th edition. Oxford & IBH, New Delhi.
3. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
5. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA
7. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
8. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
9. Altman A (1998). Agriculture Biotechnology, Ist edition, Marcel decker Inc.
10. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
11. Reddy, S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
12. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG

MCBGDSE04T: BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (THEORY)

TOTAL HOURS: 60
CREDITS: 4

Unit 1 **No of Hours: 16**

Concept of IPR, Designs, trademarks, trade secrets, domain names, geographical indications, copyright, Evolution of patent laws, hist ory of Indian patent system, Agreements and Treaties: GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement;

WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms;

UPOV & Brene conventions; Patent Co-operation Treaty (PCT); Indian Patent Act 1970 & recent

amendments. Classification of patents in India,

Unit 2 **No of Hours: 12**

classification of patents by WIPO, categories of patent, special patents, patenting biological products, Patentable inventions in India and abroad, non patentable inventions in India and abroad, Rights of patent holder and co-owners, transfer of patent rights, limitations of patent rights.

Unit 3 **No of Hours: 12**

Overview of biosafety, risk assessment, cartagena protocol on biosafety, capacity building, GMOs Transgenic technology, future opportunities and challenges, Regulatory measures for biosafety, biosafety guidelines in India evolved by DBT.

Unit 4 **No of Hours: 12**

Prevention food adulteration act, food and safety standard bill and seed policy, rules for the manufacture and storage of hazardous, biosafety management, Some of the products development from RDT and their biosafety issues, biosafety and Gene therapy, ecological safety assessment of recombinant organisms

Unit 5 **No of Hours: 8**

Bioethics and its scope, different approaches to ethics, biological weapons and their social and ethical implications, Importance of good laboratory practices, general good laboratory practices

MCBGDSE04P: BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (PRACTICAL)

TOTAL HOURS: 60

CREDITS: 2

Standardization of contamination free environment in laboratory practices. Biochemical and Microbiological analysis of Foods. Food adulteration and its Testing / Anlysis

Suggested Reading

1. Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.

2. Goel D & Prashar S (2013). IPR, Biosafety and Bioethics. Pearson

SEC COURSES FOR B.SC GENERAL PROGRAMME IN MICROBIOLOGY

MCBSSEC01M: FOOD FERMENTATION TECHNIQUES

TOTAL HOURS: 30
CREDITS: 2

Unit 1 Fermented Foods **No of Hours: 4**

Definition, types, advantages and health benefits

Unit 2 Milk Based Fermented Foods **No of Hours: 8**

Dahi, Yogurt, Buttermilk (Chach) and cheese: Preparation of inoculums, types of microorganisms and production process

Unit 3 Grain Based Fermented Foods **No of Hours: 6**

Soy sauce, Bread, Idli and Dosa: Microorganisms and production process

Unit 4 Vegetable Based Fermented Foods **No of Hours: 4**

Pickels, Saeurkraut: Microorganisms and production process

Unit 5 Fermented Meat and Fish **No of Hours: 4**

Types, microorganisms involved, fermentation process

Unit 6 Probiotic Foods **No of Hours: 4**

Definition, types, microorganisms and health benefits

Suggested Readings

1. Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS (2004) Handbook of food and fermentation technology, CRC Press

2. Holzapfel W (2014) Advances in Fermented Foods and Beverages, Woodhead Publishing.

3. Yadav JS, Grover, S and Batish VK (1993) A comprehensive dairy microbiology, Metropolitan

4. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer

MCBSSEC02M: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

TOTAL HOURS: 30 **CREDITS: 2**

Unit 1 Aeromicrobiology **No of Hours: 4**

Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens

Unit 2 Air Sample Collection and Analysis **No of Hours: 7**

Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics

Unit 3 Control Measures **No of Hours: 4**

Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration

Unit 4 Water Microbiology **No of Hours: 4**

Water borne pathogens, water borne diseases

Unit 5 Microbiological Analysis of Water **No of Hours: 7**

Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

Unit 6 Control Measures **No of Hours: 4**

Precipitation, chemical disinfection, filtration, high temperature, UV light

Suggested Reading

1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and WaterA Laboratory Manual, CRC Press

2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA

3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press

4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3rd edition, ASM press edition, ASM press

WEST BENGAL STATE UNIVERSITY

B.Sc. with Physics (Hons)
&
B.Sc. (General) with Physics

Choice Based Credit System Syllabus

First Draft
(With updated paper codes)

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- PHSACOR02T – Mechanics 14
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- PHSACOR03T - Electricity and Magnetism 17
- PHSACOR03P – Electricity and Magnetism Lab 19
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- PHSACOR04P – Wave and Optics Lab 22
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- PHSACOR05P – Mathematical Physics II Lab 25
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- PHSACOR07P – Digital Systems and Applications Lab 32
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- PHSACOR08P – Mathematical Physics III Lab 36
- PHSACOR09T - Elements of Modern Physics 38

- PHSACOR09P – Elements of Modern Physics Lab 40
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- PHSACOR14P – Statistical Mechanics Lab 59

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1. List of Papers from Physics

- **For B.Sc. Honours in Physics**

  - **Core Papers**

Semester	Paper Code	Paper Name	Credit		Remarks
I	PHSACOR01T	Mathematical Physics - I	4	6	Compulsory
	PHSACOR01P	Mathematical Physics - I Lab	2		
	PHSACOR02T	Mechanics	4	6	
	PHSACOR02P	Mechanics Lab	2		
II	PHSACOR03T	Electricity and Magnetism	4	6	Compulsory
	PHSACOR03P	Electricity and Magnetism Lab	2		
	PHSACOR04T	Waves and Optics	4	6	
	PHSACOR04P	Waves and Optics Lab	2		
III	PHSACOR05T	Mathematical Physics - II	4	6	Compulsory
	PHSACOR05P	Mathematical Physics – II Lab	2		
	PHSACOR06T	Thermal Physics	4	6	
	PHSACOR06P	Thermal Physics Lab	2		
	PHSACOR07T	Digital Systems and Applications	4	6	
	PHSACOR07P	Digital Systems and Applications Lab	2		
IV	PHSACOR08T	Mathematical Physics - III	4	6	Compulsory
	PHSACOR08P	Mathematical Physics – III Lab	2		
	PHSACOR09T	Elements of Modern Physics	4	6	
	PHSACOR09P	Elements of Modern Physics Lab	2		
	PHSACOR10T	Analog Systems and Applications	4	6	
	PHSACOR10P	Analog Systems and Applications Lab	2		
V	PHSACOR11T	Quantum Mechanics and Applications	4	6	Compulsory
	PHSACOR11P	Quantum Mechanics and Applications Lab	2		
	PHSACOR12T	Solid State Physics	4	6	
	PHSACOR12P	Solid State Physics Lab	2		
VI	PHSACOR13T	Electromagnetic Theory	4	6	Compulsory
	PHSACOR13P	Electromagnetic Theory Lab	2		
	PHSACOR14T	Statistical Mechanics	4	6	
	PHSACOR14P	Statistical Mechanics Lab	2		

Discipline Specific Elective Papers

Semester	Paper Code	Paper Name	Credit		Remarks
V	PHSADSE01T	Advanced Mathematical Physics - I	4	6	Student has to choose 2 among these 3 courses of six credit each
	PHSADSE01P	Advanced Mathematical Physics – I Lab	2		
	PHSADSE02T	Advanced Dynamics	5+ 1*	6	
	PHSADSE03T	Nuclear and Particle Physics	5+ 1*	6	
VI	PHSADSE04T	Advanced Mathematical Physics - II	5+ 1*	6	Student has to choose 2 among these 3 courses of six credit each
	PHSADSE05T	Astronomy and Astrophysics	5+ 1*	6	
	PHSADSE06T	Communication Electronics	4	6	
	PHSADSE06P	Communication Electronics Lab	2		

* Tutorials of 1 Credit will be conducted in case there is no practical component

For B.Sc. General with Physics

Core Papers

Semester	Paper Code	Paper Name	Credit		Remarks
I	PHSGCOR01T	Mechanics	4	6	Compulsory
	PHSGCOR01P	Mechanics Lab	2		
II	PHSGCOR02T	Electricity and Magnetism	4	6	Compulsory
	PHSGCOR02P	Electricity and Magnetism Lab	2		
III	PHSGCOR03T	Thermal Physics and Statistical Mechanics	4	6	Compulsory
	PHSGCOR03P	Thermal Physics and Statistical Mechanics Lab	2		
IV	PHSGCOR04T	Waves and Optics	4	6	Compulsory
	PHSGCOR04P	Waves and Optics Lab	2		

▶ Discipline Specific Elective Papers

Semeste	Paper Code	Paper Name	Credit		Remarks
V	PHSGDSE01T	Digital, Analog Circuits and Instrumentation	4	6	Student has to choose 1 between these 2 courses of six credit each
	PHSGDSE01P	Digital, Analog Circuits and Instrumentation Lab	2		
	PHSGDSE02T	Perspectives of Modern Physics	5+ 1*	6	
VI	PHSGDSE03T	Solid State Physics	4	6	Student has to choose 1 between these 2 courses of six credit each
	PHSGDSE03P	Solid State Physics Lab	2		
	PHSGDSE04T	Nuclear and Particle Physics	5+ 1*	6	

• For B.Sc. Honours in Subjects Other than Physics

▶ Generic Elective Papers

Semester	Paper Code	Paper Name	Credit		Remarks
I	PHSHGEC01T	Mechanics	4	6	Elective
	PHSHGEC01P	Mechanics Lab	2		
II	PHSHGEC02T	Electricity and Magnetism	4	6	Elective
	PHSHGEC02P	Electricity and Magnetism Lab	2		
III	PHSHGEC03T	Thermal Physics and Statistical Mechanics	4	6	Elective
	PHSHGEC03P	Thermal Physics and Statistical Mechanics Lab	2		
IV	PHSHGEC04T	Waves and Optics	4	6	Elective
	PHSHGEC04P	Waves and Optics Lab	2		

• Skill Enhancement Courses to be Offered from PHYSICS

Semester	Paper Code	Paper Name	Credit	Remarks
Odd	PHSSSEC01M	Basic Instrumentation Skills	2	Elective
Even	PHSSSEC02M	Computational Physics Skills	2	Elective

2. Scheme for CBCS Curriculum of B.Sc. in Physics (Honours)

- **Semester-wise Curriculum**

Semester	Course Name	Course Detail	Credits
I	Ability Enhancement Compulsory Course – I	English communication / Environmental Science	2
	Core course – I **PHSACOR01T**	Mathematical Physics-I	4
	Core course – I Practical **PHSACOR01P**	Mathematical Physics-I Lab	2
	Core course – II **PHSACOR02T**	Mechanics	4
	Core course – II Practical **PHSACOR02P**	Mechanics Lab	2
	Genetic Elective – 1	TBD	4
	Generic Elective – 1 Practical	TBD	2
II	Ability Enhancement Compulsory Course – II	English communication / Environmental Science	2
	Core course – III **PHSACOR03T**	Electricity and Magnetism	4
	Core course – III Practical **PHSACOR03P**	Electricity and Magnetism Lab	2
	Core course – IV **PHSACOR04T**	Waves and Optics	4
	Core course – IV Practical **PHSACOR04P**	Waves and Optics Lab	2
	Generic Elective – 2	TBD	4
	Generic Elective – 2 Practical	TBD	2

III	Core course – V **PHSACOR05T**	Mathematical Physics-II	4
	Core course – V Practical **PHSACOR05P**	Mathematical Physics-II Lab	2
	Core course – VI **PHSACOR06T**	Thermal Physics	4
	Core course – VI Practical **PHSACOR06P**	Thermal Physics Lab	2
	Core course – VII **PHSACOR07T**	Digital Systems and Applications	4
	Core course – VII Practical **PHSACOR07P**	Digital Systems & Applications Lab	2
	Skill Enhancement Course – 1	TBD	2
	Generic Elective – 3	TBD	4
	Generic Elective – 3 Practical	TBD	2
IV	Core course – VIII **PHSACOR08T**	Mathematical Physics III	4
	Core course – VIII Practical **PHSACOR08P**	Mathematical Physics-III Lab	2
	Core course – IX **PHSACOR09T**	Elements of Modern Physics	4
	Core course – IX Practical **PHSACOR09P**	Elements of Modern Physics Lab	2
	Core course – X **PHSACOR10T**	Analog Systems and Applications	4
	Core course – X Practical **PHSACOR10P**	Analog Systems & Applications Lab	2
	Skill Enhancement Course-2	TBD	2
	Generic Elective – 4	TBD	4
	Generic Elective – 4 Practical	TBD	2

V	Core course – XI **PHSACOR11T**	Quantum Mechanics & Applications	4
	Core course – XI Practical **PHSACOR11P**	Quantum Mechanics Lab	2
	Core course – XII **PHSACOR12T**	Solid State Physics	4
	Core course – XII Practical **PHSACOR12P**	Solid State Physics Lab	2
	Discipline Specific Elective – 1	TBD	4
	Discipline Specific Elective – 1 Practical	TBD	2
	Discipline Specific Elective – 2	TBD	4
	Discipline Specific Elective – 2 Practical	TBD	2
VI	Core course – XIII **PHSACOR13T**	Electro-magnetic Theory	4
	Core course – XIII Practical **PHSACOR13P**	Electro-magnetic Theory Lab	2
	Core course – XIV **PHSACOR14T**	Statistical Mechanics	4
	Core course – XIV Practical **PHSACOR14P**	Statistical Mechanics Lab	2
	Discipline Specific Elective – 3	TBD	4
	Discipline Specific Elective – 3 Practical	TBD	2
	Discipline Specific Elective – 4	TBD	4
	Discipline Specific Elective – 4 Practical	TBD	2

*TBD: To be decided by the student among the available choices mentioned below.

3. Syllabi of Core Papers for B.Sc. Honours in Physics

- ## PHSACOR01T – Mathematical Physics-I

Mathematical Physics - I	
60 Lectures	**4 Credits**
Calculus	**20 Lectures**
Recapitulation: Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions. Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only). Convergence condition of Taylor series and corresponding tests. First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous and Inhomogeneous second order differential equations with constant coefficients, particular integral. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.	
Vector Calculus	**30 Lectures**
Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities using Kronecker delta and Levi-civita symbols. Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs). Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.	
Introduction to probability	**10 Lectures**
Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance. Dependent events: Conditional Probability. Bayes' Theorem.	

Reference Books

- Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
- Mathematical methods in the Physical Sciences, M. L. Boas, 2005, Wiley.
- Vector Analysis with an Intro. to Tensor Analysis: Schaum's Outline Series. M.R. Spiegel, McGraw Hill.
- Introduction to Mathematical Physics. C. Harper, 1989, PHI.
- An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
- Differential Equations, George F. Simmons, 2007, McGraw Hill.
- Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
- Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
- Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
- Mathematical Physics, Goswami, 1st edition, Cengage Learning
- Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
- Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
- Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press

- ## PHSACOR01P – Mathematical Physics -I Lab

Mathematical Physics -I	
60 class hours	**2 credits**

General Topics

Computer architecture and organization, memory and Input/output devices.

Basics of scientific computing: Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow &overflow-emphasize the importance of making equations in terms of dimensionless variables, Iterative methods.

Errors and error Analysis: Truncation and round off errors, Absolute and relative errors, Floating point computations.

Introduction to plotting graphs with QtiPlot (or equivalent)

Basic 2D and 3D graph plotting - plotting functions and datafiles, fitting data using qtiplot's fit function, polar and parametric plots, modifying the appearance of graphs, Surface and contour plots, exporting plots.

Introduction to programming in python:

- Python as a number calculator
- algebraic calculation through python interactively
- help searching
- standard I/O statements
- program with formula crunching
- string, list, tuple and the corresponding methods
- Control structures

Programs as applications

- finite series summation
- Taylor series summation with a given precision

File handling in Python

- File I/O statements

Least square fitting

- Linear and linearised Least square fitting with supplied data

User defined functions in Python

- User defined function, default argument.

synthetic data generation and plotting

- synthetic data generation and plotting with QtiPlot (or equivalent).

Finding largest and smallest values within a dataset

- Finding largest and smallest values over a time-series data.
- Estimating largest and smallest values of a function within an interval using fixed step size.

Solution of Algebraic and Transcendental equations

- Root finding: Bisection & Newton-Raphson Method (Initial guess to be determined by plotting) for non-linear equations.
- Applications in simple physical problems (including those of mathematical Physics)

Reference Books

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn. , 2012, PHI Learning Pvt. Ltd.
- Mathematical Methods. M.C. Potter and J. Goldberg, 2000, PHI.
- Learning Scientific Programming with Python. C. Hill, 2016, Chambridge.
- Learning with Python-how to think like a computer scientist, J. Elkner, C. Meyer, and A. Downey, 2015, Dreamtech Press.
- Introduction to computation and programming using Python, J. Guttag, 2013, Prentice Hall India.
- Effective Computation in Physics- Field guide to research with Python, A. Scopatz and K.D. Huff, 2015, O'Rielly
- A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
- Elementary Numerical Analysis, K.E. Atkinson, 3 rd Edn . , 2007, Wiley India Edition.
- Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
- An Introduction to computational Physics, T.Pang, 2nd Edn., 2006,Cambridge Univ. Press
- Computational Physics, Darren Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.

- **PHSACOR02T – Mechanics**

Mechanics	
60 Lectures	**4 Credits**
Fundamentals of Dynamics	**5 Lectures**
Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable- mass system: motion of rocket. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.	
Work and Energy	**4 Lectures**
Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. Qualitative study of one dimensional motion from potential energy curves. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.	
Collisions	**3 Lectures**
Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.	
Rotational Dynamics	**10 Lectures**
Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Perpedicular axes theorem and parallel axes theorem and their applications in calculations of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.	
Elasticity	**6 Lectures**
Relation between Elastic constants. Twisting torque on a Cylinder or Wire. Bending of a beam – internal bending moment.	
Fluid Motion	**4 Lectures**
Kinematics of Moving Fluids: Equation of continuity. Idea of streamiline and turbulent flow, Reynold's number. Poiseuille's Equation for Flow of a viscous Liquid through a Capillary Tube.	
Gravitation and Central Force Motion	**9 Lectures**
Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to	

spherical shell and solid sphere.

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

Oscillations	**7 Lectures**

SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonances, sharpness of resonance; power dissipation and Quality Factor.

Non-Inertial Systems:	**4 Lectures**

Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications.

Special Theory of Relativity	**8 Lectures**

Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Relativistic Doppler effect.

Reference Books

- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
- Classical Dynamics of Particles and Systems. S.T. Thornton and J. B. Marion, 2009, Brooks/Cole.
- Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
- Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
- University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
- Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
- General Properties of Matter. F.H. Newman and V.H.L. Searle, 1957, Hodder and Stoughton.
- General Properties of Matter. B. Brown, 1969, Springer Science.
- A Degree Physics Part 1: The General Properties of Matter. C.J. Smith, 1960, Arnold.
- Classical Mechanics and General Properties of Matter. S.N. Maiti and D.P. Raychaudhuri, New Age
- Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
- Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
- Special Relativity (MIT Introductory Physics). A.P. French, 2018, CRC Press.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.

Additional Books for Reference

- Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
- Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning

- **PHSACOR02P – Mechanics Lab**

Mechanics	
60 class hours	**2 Credits**

General Topic

Discussion on random errors in observations. Measurement principles of length (or diameter) using vernier caliper, screw gauge and travelling microscope. Discussion on the parts of Sextant.

List of Practical

1. To study the random error in observations of time period of some oscillation using chronometer.
2. To determine the Moment of Inertia of a regular body using another auxiliary body and a cradle suspended by a metallic wire.
3. To determine g and velocity for a freely falling body using Digital Timing Technique
4. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
5. To determine the Young's Modulus by flexure method.
6. To determine the Modulus of Rigidity of a wire by a torsional pendulum.
7. To determine the height of a building using a Sextant.
8. To determine the elastic constants of a wire by Searle's method.
9. To determine the value of g using Bar Pendulum.
10. To determine the value of g using Kater's Pendulum.
11. To study the Motion of Spring and calculate, (a) Spring constant, (b) g and (c) Modulus of rigidity.

Reference Books

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
- Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt. Ltd.
- Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

- **PHSACOR03T - Electricity and Magnetism**

Electricity and Magnetism	
60 class hours	**4 Credits**
Electric Field and Electric Potential	**15 Lectures**
Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Charge density of a point charge – Definition of Dirac delta function. Properties of Dirac delta function. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. Potential and Electric Field of a dipole. Force and Torque on a dipole. Uniqueness theorem. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Energy stored in Electrostatic field.	
Dielectric Properties of Matter	**8 Lectures**
Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics. Boudary conditions at the interface of two media.	
Magnetic Field	**10 Lectures**
Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) infinite straight wire, (2) infinite planar surface current, and (3) solenoid. Properties of B: curl and divergence. . Axial vector property of B and its consequences. Vector Potential. Calculation of vector potential and magnetic induction in simple cases – straight wire, magnetic field due to small current-loop. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform magnetic field.	
Magnetic Properties of Matter	**5 Lectures**
Magnetization vector (M). Magnetic Intensity (H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis. Boundary conditions at the interface of two	

media.

Electromagnetic Induction	**6 Lectures**

Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance, calculation in simple cases (e.g. circular loops, solenoids). Reciprocity Theorem. Energy stored in a Magnetic Field.

Electrical Circuits	**10 Lectures**

Charge Conservation – equation of continuity. Transients in D.C.:Growth and decay of current, charging and discharging of capacitors in CR, LR & LCR circuits; oscillatory discharge; time constant; time variation of total energy in LCR cicuit.

AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Phasor diagram. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit

Network theorems	**6 Lectures**

Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits

Reference Books

- Foundations of Electromagnetic Theory. J.R. Reitz, F.J. Milford and R.W. Christy, 2010, Pearson.
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Electromagnetism. I.S. Grant and W.R. Phillips, 2013, Wiley.
- Classical Electromagnetism. J. Franklin, 2008, Pearson Education.
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw

- **PHSACOR03P – Electricity and Magnetism Lab**

Electricity and Magnetism	
60 class hours	**2 Credits**

General topic

Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances (e) Checking electrical fuses and (f) circuit continuity check**.** Demonstartion on Carey Foster's bridge, potentiometer, resistance box, inductor coil, moving coil galvanometer (in dead beat and ballistic mode), etc. Use of computers for plotting of experimental results and corresponding fitting of curves using numerical methods learnt in the last semester, are to be encouraged with evidences in laboratory notebooks

List of Practicals

1. To determine an unknown Low Resistance using Carey Foster's Bridge.
2. To verify the Thevenin and Norton theorems.
3. To verify the Superposition and Maximum Power Transfer theorems.
4. To determine self-inductance of a coil by Anderson's bridge.
5. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
6. To study the response curve of a parallel LCR circuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q.
7. To study the characteristics of a series RC Circuit.
8. To determine an unknown Low Resistance using Potentiometer.
9. To determine the resistance of a galvanometer using Thomson's method.
10. Measurement of field strength B and its variation in a solenoid (determine dB/dx)

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

- **PHSACOR04T - Waves and Optics**

Waves and Optics	
60 Lectures	**4 Credits**
Superposition of Collinear Harmonic oscillations	**4 Lectures**
Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.	
Superposition of two perpendicular Harmonic Oscillations	**3 Lectures**
Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.	
Wave Motion	**4 Lectures**
Plane and Spherical Waves. Longitudinal and Transverse Waves. Progressive (Travelling) Wave and its differential equation. phase and group velocities for harmonic waves. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves	
Velocity of Waves	**5 Lectures**
Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.	
Superposition of Two Harmonic Waves	**7 Lectures**
Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Changes of wavefunction with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.	
Wave Optics	**4 Lectures**
Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. Characteristics of Laser light.	
Interference	**9 Lectures**

Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

Interferometer	**4 Lectures**

Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.

Diffraction and Holography	**20 Lectures**

Kirchhoff's Integral Theorem and Fresnel-Kirchhoff's Integral formula (Statement and Qualitative discussion on consequences only).

Fraunhofer diffraction: Single slit, rectangular aperture. Resolving Power of an optical instrument – Rayleigh's criteria. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms.

Reference Books

- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Vibrations and Waves. A.P. French, 2003, CBS.
- Vibrations & Waves. G.C. King, 2009, Wiley.
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- Optics. E. Hecht, 2003, Pearson Education.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
- Basic Optics: Principles and Concepts. A. Lahiri, 2016, Elsevier.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
- Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

- **PHSACOR04P – Wave and Optics Lab**

Wave and Optics	
60 class hours	**2 Credits**

General Topic

Discussion on the working principles of electric tuning fork, sodium and mercury vapour lamps, CRO etc. Demonstrations on adjustments of spectrometer, Fresnel biprism, Newton's ring apparatus etc. Measurement principle on the circular scale in a spectrometer. Use of computers for plotting of experimental results and corresponding fitting of curves using numerical methods learnt in the last semester, are to be encouraged with evidences in laboratory notebooks

List of Practical

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law.
2. To determine refractive index of the Material of a prism using sodium source.
3. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
4. To determine wavelength of sodium light using Fresnel Biprism.
5. To determine wavelength of sodium light using Newton's Rings.
6. To determine dispersive power and resolving power of a plane diffraction grating.
7. To study Lissajous Figures to determine the phase difference between two harmonic oscillations.
8. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
9. Familiarization with: Schuster`s focusing; determination of angle of prism.
10. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
11. To investigate the motion of coupled oscillators.
12. To determine the wavelength of sodium source using Michelson's interferometer.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

- **PHSACOR05T - Mathematical Physics-II**

Mathematical Physics – II	
60 Lectures	**4 Credits**
Fourier Series	**10 Lectures**
Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Euler relation -- Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity.	
Frobenius Method and Special Functions	**25 Lectures**
Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Multipole expansion in Electrostatics. Orthonormality of Hermite and Laguerre polynomials (statements only). Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions (Jo(x) and J1(x))and Orthogonality. Airy's disc for Fraunhofer diffraction through circular aperture, resolving power of a telescope.	
Some Special Integrals	**4 Lectures**
Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).	
Variational calculus in physics	**5 Lectures**
Idea of functionals. Euler-Lagrange equation from calculus of variation. Idea of constraints (holonomic only), degrees of freedom and generalised co-ordinates. Hamilton's principle and Lagrange's equation from it.	
Analytical Dynamics	**10 Lectures**
Applications of Lagrange's equation in simple problems. Canonically cojugate momentum. Idea of cyclic co-ordinate and conservation principles from different symmetries. Idea of Legendre transformation. Its application in mechanics and thermodynamics. Definition of Hamiltonian. Canonical equations of motion. Poisson bracket and its properties. Time variation of a dynamical variable in	

terms of Poisson bracket and the condition related to the constants of motion.

Partial Differential Equations	**6 Lectures**

Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular symmetry. Wave equation and its solution for vibrational modes of a stretched string.

Reference Books

- Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
- Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
- Mathematical Methods. M. C. Potter and J. Goldberg, 2000, PHI.
- Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
- Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
- Differential Equations. S. L. Ross, 1984, Wiley.
- Classical Mechanics: Systems of Particles and Hamiltonian Dynamics. W. Greiner, 2004, Springer.
- Classical Mechanics. J.R. Taylor, 2005, University Science Books.
- Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
- Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
- Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books
- Mathematical Physics, P. K. Chattopadhyay, 2014, New Academic Science.

- **PHSACOR05P – Mathematical Physics II Lab**

Mathematical Physics II	
60 class hours	**2 Credits**
General Topics: Introduction to the python numpy module. Arrays in numpy, array operations, array item selection, slicing, shaping arrays. Introduction to online graph plotting using matplotlib. Use scipy to generate Legendre Polynomials and Bessel function and then plot those using matplotlib. Detailed discussion on the underlying theory of the following numerical methods including efficiency of the method in each case. Simple physical problems based on these methods are to be introduced.	
Sorting:	
• bubble sort • insertion sort	
Statistical Calculations :	
• mean, median and standard deviation for a set of discrete data points	
Interpolation:	
• Newton-Gregory forward & backward formula	
Numerical differentiation	
• Forward and Backward difference formula	
Numerical Integration	
• By trapezoidal rule. • By Simpson's 1/3 rd rule.	
Integration by stochastic method	
• Monte Carlo random dot method	
Solution of ODE First order Differential equation	
• Euler Method	
Reference Books	

- Learning Scientific Programming with Python. C. Hill, 2016, Chambridge.
- A Friendly Introduction to Numerical Analysis. B. Bradie, 2007, Pearson.
- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
- Complex Variables, A.S. Fokas & M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
- Numpy beginners guide, Idris Alba, 2015, Packt Publishing
- Computational Physics, D.Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.

- **PHSACOR06T - Thermal Physics**

Thermal Physics	
60 Lectures	**4 Credits**
Introduction to Thermodynamics	**25 Lectures**
Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient. Second Law of Thermodynamics: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.	
Thermodynamic Potentials	**15 Lectures**
Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization (basic principle only), First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.	
Kinetic Theory of Gases	**20 Lectures**
Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS and	

Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases.

Molecular Collisions: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule- Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule- Thomson Cooling.

Reference Books

- Thermodynamics. E. Fermi, 1956, Dover.
- Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford Univ Press.
- Principles of Thermodynamics. M. Kaufman, 2002, Marcel Dekker.
- Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
- Thermodynamics, Kinetic Theory, and Statistical Thermodynamics. F. W. Sears and G.L. Salinger, 1998, Narosa.
- A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
- Basic Thermodynamics. E. Guha, 2010, Narosa.
- Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
- Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
- Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
- Thermodynamics and an introduction to thermostatistics, H. B. Callen, 1985, Wiley.
- Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

- **PHSACOR06P – Thermal Physics Lab**

Thermal Physics	
60 class hours	**2 Credits**

General Topics:

Discussion on logscale plot to study power law dependence, decay constant etc. Discussion on the properties of PRT, thermocouple, diode sensor etc.

List of Practical

1. Verification of Stefan's law using a torch bulb.
2. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
3. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT) using constant current source
4. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions to find 'a' and 'b' coefficients by null method.
5. To calibrate a thermocouple to measure temperature in a specified Range by Null Method using a potentiometer.
6. To calibrate a thermocouple to measure temperature in a specified Range by direct measurement using Op-Amp differential amplifier and to determine Neutral Temperature
7. Mesuring unknown temperature using a diode sensor.
8. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
9. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
10. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.

Reference Books

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D. P. Khandelwal, 1985, Vani Pub.

- **PHSACOR07T - Digital Systems and Applications**

Digital Systems and Applications	
60 Lectures	**4 Credits**
Introduction	**4 Lectures**
Electronic Components and Measuring devices (which are generally used for studying the following circuits) and their general Characteristics, Cathode-Ray Oscilloscope(CRO), Block diagram of CRO. Electron Gun. Deflection System and Time Base. Deflection Sensitivity. Applications of CRO:1)Study of waveform, 2) Measurement of Voltage , Current, Frequency and Phase difference.	
Integrated Circuits	**5 Lectures**
Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs.	
Digital Circuits	**16 Lectures**
Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. De Morgan's Theorems. Boolean Laws. AND, OR and NOT Gates (realization using Diodes and Transistor). Simplification of Logic Circuit using Boolean Algebra. NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers. Fundamental Products. Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.	
Arithmetic circuits	**5 Lectures**
Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor.	
Data processing circuits	**5 Lectures**
Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders.	
Sequential circuits	**6 Lectures**
SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop. M/S JK Flip-Flop, Combinational logic for the	

development of sequential circuit.	
Timers	**4 Lectures**
IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator.	
Registers	**4 Lectures**
Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).	
Counters (4 bits)	**4 Lectures**
Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.	
Computer Organization	**7 Lectures**
Input/Output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map.	

Reference Books

- Digital Principles and Applications, A.P. Malvino, D. P. Leach and Saha, 7th Ed., 2011, TMH
- Digital Computer Electronics. A.P. Malvino and J.A. Brown, 2005, TMH.
- Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Digital Electronics G K Kharate ,2010, Oxford University Press
- Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning
- Logic circuit design, Shimon P. Vingron, 2012, Springer.
- Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
- Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill
- Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.

- **PHSACOR07P – Digital Systems and Applications Lab**

Digital Systems and Applications	
60 class hours	**2 Credits**

1) In the Beginning of practical course a *brief history of development of electronics* should be introduced.
2) In continuation of the previous topic, physically introduce the Valve, Transformer, Resistance, Capacitor, Potentiometer etc. and also Impotant measuring instruments (viz. digital & analog multimeter, power supply, function generator, Oscilloscope) to be used in the following experiments. Describe their characteristics with an explanation of their working principle).
3) In rest of the all practical classes: Approximately 25% of the class period should be used in introducing the perspectives and importance of the experiments to be done; details of the experiments and discussion on the observations of last class.1. a) To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.

List of Practical

1. a) To measure (i) Voltage, and (ii) Time period of a periodic waveform using CRO.

   b) To test a Diode and Transistor using a Multimeter.
2. a) To design a switch (NOT gate) using a transistor.

   b) To verify and design AND, OR, NOT and XOR gates using NAND gates.
3. For a given truth table find logic equation, minimize and design the circuit using logic gate ICs.
4. Half Adder, Full Adder and 4-bit binary Adder.
5. To build Flip-Flop (RS, D-type and JK) circuits using NAND gates.
6. To design an astable multivibrator of given specifications using 555 Timer.
7. To design a monostable multivibrator of given specifications using 555 Timer.
8. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
9. To build JK Master-slave flip-flop using Flip-Flop ICs

10. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.
11. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-Flop ICs.

Reference Books

- Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill.
- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.

- **PHSACOR08T - Mathematical Physics III**

Mathematical Physics III	
60 Lectures	**4 Credits**
Complex Analysis	**20 Lectures**
Euler's formula. De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals.	
Integrals Transforms	**15 Lectures**
Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.	
Boundary Value Problems	**10 Lectures**
Solutions of Laplaces equation in problems with cyldically and spherically symmetric boundary conditions. Examples from Electrostatics. Solutions of heat diffusion equation with boundary conditions of rectangular symmetry.	
Matrices	**7 Lectures**
Hermitian conjugate of a Matrix. Hermitian and Skew- Hermitian Matrices with properties. Singular and Non-Singular matrices. Orthogonal and Unitary Matrices. Trace of a Matrix. Inner Product of matrices.	
Eigen-values and Eigenvectors	**8 Lectures**
Eigenvalues and eigenvectors – calculation, charateristic equation. Cayley- Hamiliton Theorem. Similarity transformation with properties. Diagonalization of Matrices. Solutions of Coupled Linear Ordinary Differential Equations. Functions of a Matrix.	
Reference Books	
► Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.	

- Mathematical methods in the Physical Sciences, M. L. Boas, 2005, Wiley.
- Mathematical Methods of Physics. J. Mathews and R.L. Walker, 2004, Pearson.
- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
- Mathematics for Physicists, P. Dennery and A.Krzywicki, 1967, Dover Publications
- Complex Variables, A.S.Fokas & M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
- Complex Variables, A.K. Kapoor, 2014, Cambridge Univ. Press
- Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill
- First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett

- **PHSACOR08P – Mathematical Physics III Lab**

Mathematical Physics III	
60 class hours	**2 Credits**

General Topics: Detailed discussion on the underlying theory of the following numerical methods including efficiency of the method in each case. Simple physical problems based on these methods are to be introduced.

List of Practical

1. ODE initial value problems by RK2 & RK4
2. Solution of Linear system of equations by Gauss elimination method, determinant by Gauss Jordan method.
3. Inverse of a matrix by Gauss-Seidal iterative method.
4. Gram-Schmidt orthogonalisation method with 3 vectors.
5. Explicit calculation of largest eigenvalue calculation by power iterative method for real symmetric matrix and corresponding eigenvector
6. Eigen vectors, eigen values problems (by numpy.linalg)
7. Boudary value problems (by finite difference method with fixed grid size):
    a. Laplace eqn in 1D with Dirichlet boundary condition
    b. 1D Fourier heat equation with Dirichlet boundary condition
    c. Poisson equations
    d. Wave equation
8. Find square roots, cube roots of a complex number using two dimensional Newton-Raphson method.
9. Integral transform: FT of $\exp(-kx^2)$
10. Dirac Delta Function: Evaluate $\frac{1}{\sqrt{2\pi\sigma^2}}\int e^{\frac{-(x-2)^2}{2\sigma^2}}(x+3)dx$, for σ=1, .1, .01 and show it tends to 5

Octave:

- Introduction of Octave with its basic features.
- Few examples of solving (a) differential equations and (b) matrix eigenvalue problems -- are to be performed using Octave

Reference Books

- Learning Scientific Programming with Python. C. Hill, 2016, Chambridge.
- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
- A Friendly Introduction to Numerical Analysis. B. Bradie, 2007, Pearson.
- An Introduction to Numerical Analysis. Prasad, 2012, Narosa.

- Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications
- Scientific Computing with MATLAB and Octave. A. Quarteroni and F. Saleri, 2006, Springer.
- Numerical Methods using MATLAB. J.H. Mathews and K.D. Fink, 2009, PHI.
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896
- https://web.stanford.edu/~boyd/ee102/laplace_ckts.pdf
- https://ocw.nthu.edu.tw/ocw/upload/12/244/12handout.pdf

- **PHSACOR09T - Elements of Modern Physics**

Elements of Modern Physics	
60 Lectures	**4 Credits**
Relativistic Dynamics	**12 Lectures**
Invariance of space-time interval under Lorentz transformation. Idea of 4-vector – contravariant and covariant components, metric. 4-scalar. Space-like, time-like and light-like separation, causality in relativity. Proper time. 4-velocity and 4-momentum. Conservation law of 4- momentum. Relativistic mass. Relativistic energy. Rest energy. Equivalence of mass & energy. Applications in two body decay of a particle, two body collisions.	
Collection of Identical Entities – Classical Approach	**6 Lectures**
Large collection of identical entities in an enclosure at thermal equilibrium. Idea of averaging over the collection, relation with bulk variables. Boltzmann weight factor. Law of equipartition of energy for single entity. Example: Cavity radiation and black body, classical theory of blackbody radiation, Rayleigh-Jeans law. Ultraviolet catastrophe.	
Emergence of Quantum Theory	**20 Lectures**
Planck's quantum postulate to avoid ultraviolet catastrophe, Planck's constant and Planck's ditribution law for blackbody Radiation. Photo-electric effect and Compton scattering. Light as a collection of photons; Wilson-Sommerfield quantization rule unifying Planck's quantization rule and Bohr's angular momentum quantization rule. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Position measurement- gamma ray microscope thought experiment; Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables) as a consequence of wave description. Estimating minimum energy of a confined particle using uncertainty principle. Energy-time uncertainty principle- application to virtual particles and range of an interaction. Two-Slit interference experiment with electrons and photons. Wave-particle duality, Bohr's complementarity principle. Matter waves and wave function, linear superposition principle as a consequence; Born's probabilistic interpretation of wave function bridging between wave description and particle description.	
Lasers	**4 Lectures**
Lasers: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser. Basic	

lasing.

Nuclear Physics	**18 Lectures**

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers.

Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.

Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions).

Reference Books

- Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
- Relativity. W. Rindler, 2006, Oxford.
- Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles. R. Eisberg and R. Resnick, 1985, Wiley.
- Perspectives of Modern Physics. A. Beiser, 1969, McGraw-Hill.
- Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
- Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
- Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
- Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
- An Introduction to Nuclear Physics. W. N. Cottingham and D.A. Greenwood, 2004, Chambridge.
- Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

Additional Books for Reference

- Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
- Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
- Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
- Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.
- Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, 2003, McGraw Hill

- **PHSACOR09P – Elements of Modern Physics Lab**

Elements of Modern Physics	
60 class hours	**2 Credits**

General Topics:

Discussion on properties rotational spectra of iodine, working principles of tunnel diode, vacuum diode, discharge tube.

List of Practical

1. To determine the wavelength of H-alpha emission line of Hydrogen atom.
2. To determine the absorption lines in the rotational spectrum of Iodine vapour.
3. To determine the value of e/m by Bar magnet.
4. To determine the wavelength of laser source using diffraction of double slits.
5. To determine wavelength using He-Ne/ solid state laser using plane diffraction grating
6. To determine angular spread of He-Ne/ solid state laser using plane diffraction grating
7. To determine work function of material of filament of directly heated vacuum diode.
8. To show the tunneling effect in tunnel diode using I-V characteristics.
9. Measurement of Planck's constant using black body radiation and photo-detector
10. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
11. To determine the Planck's constant using LEDs of at least 4 different colours.
12. To determine the ionization potential of mercury.
13. To setup the Millikan oil drop apparatus and determine the charge of an electron.
14. To determine the wavelength of laser source using diffraction of single slit.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011,Kitab Mahal

- **PHSACOR10T - Analog Systems and Applications**

Analog Systems and Applications	
60 Lectures	**4 Credits**
History of the development of electronics	**3 Lectures**
Valve circuits and advantages of using semiconductor devices in modern electronic systems.	
Semiconductor Diodes	**7 Lectures**
P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Derivation for Barrier Potential, Barrier Width and Current for Step Junction.	
Two-terminal Devices and their Applications	**7 Lectures**
Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter & π- filter(qualitative, expression only), Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode and (3) Solar Cell.	
Bipolar Junction transistors	**8 Lectures**
n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Physical Mechanism of Current Flow (unbiased).Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Active, Cutoff and Saturation Regions.	
Field Effect transistors	**3 Lectures**
Basic principle of operation of JFET, JFET parameters and CS characteristics	
Amplifiers	**8 Lectures**
Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers.	

Coupled Amplifier	**3 Lectures**
Two stage RC-coupled amplifier and its frequency response.	
Feedback in Amplifiers	**4 Lectures**
Concept of feedback, Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.	
Sinusoidal Oscillators	**4 Lectures**
Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.	
Operational Amplifiers (Black Box approach)	**4 Lectures**
Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground.	
Applications of Op-Amps	**7 Lectures**
Linear - (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator. Non-linear – (1) inverting and non-inverting comparators, (2) Schmidt triggers.	
Conversion	**2 Lectures**
Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation)	

Reference Books

- Electronic Devices and Circuit Theory. R.L. Boylested and L. Nashelsky, 2012, Pearson.
- Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
- Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
- Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning
- Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
- Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
- Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
- Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India

- Microelectronic Circuits, M.H. Rashid, 2nd Edition, Cengage Learning
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

- **PHSACOR10P – Analog Systems and Applications Lab**

Analog Systems and Applications	
60 class hours	**2 Credits**
General Topics: Discussion on the operational principles of the relevant circuits used in the experiments.	
List of Practical	

1. To study V-I characteristics of PN junction diode and Light emitting diode (LED) (using both current and voltage source).
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
3. Study of V-I & power curves of Solar Cells and find maximum power point and efficiency.
4. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
5. To study the frequency response of voltage gain of a RC – coupled transistor amplifier.
6. To design inverting, non- inverting and buffer amplifiers using Op-amp (741/351) for dc voltage.
7. To design a Wien bridge oscillator for given frequency using a Op-Amp.
8. To add dc voltages using Op-amp in inverting and non-inverting mode.
9. a) To investigate the use of an op-amp as an Integrator.

   b) To investigate the use of an op-amp as a Differentiator.
10. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
11. To study the various biasing configurations of BJT for normal class A operation.
12. To design a Phase Shift Oscillator of given specification using Op-Amp.
13. To study the Colpitt's Oscillator.
14. To design a digital to analog converter (DAC) of given specifications.
15. To study the analog to digital converter (ADC) IC.
16. To design a precision Differential amplifier of given I/O specification using Op-Amp.
17. To design a circuit to simulate the solution of a $1^{st}/2^{nd}$ order differential equation.
18. To design inverting amplifier using Op-amp (741/351) and study its frequency response

19. To design non-inverting amplifier using Op-amp (741/351) & study its frequency response

20. To study the zero – crossing detector and comparator.

21. Using Schmitt trigger and associated circuit (with OPAMP) generate different wave forms.

Reference Books

- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
- Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
- Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson

- **PHSACOR11T - Quantum Mechanics and Applications**

Quantum Mechanics and Applications	
60 Lectures	**4 Credits**

Basic Formalism	**12 Lectures**

Departure from matter wave description. Quantum mechanics as a new framework to describe the rules of the microscopic world. Postulates of quantum mechanics: State as a vector in a complex vector space, inner product, its properties using Dirac bra-ket notation. Physical observables as Hermitian operators on state space – eigenvalues, eigenvectors and completeness property of the eigenvectors – matrix representation. Measurement statistics. Unitary time-evolution. Demonstration of the rules in 2-level systems.

Wave-function as the probability amplitude distribution of a state for the observables with continuous eigenvalues. Position representation and momentum representation of wave-functions and operators. Position, momentum and Hamiltonian operators. Non-commuting observables and incompatible measurement, uncertainty relation. Position-momentum uncertainty principle as an example.

Commuting observables and degeneracy; complete set of commuting observables.

Schrodinger Equation	**12 Lectures**

Time dependent Schrodinger equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for physical acceptability of Wave Functions. Normalization and Linear Superposition Principles of the solutions of Schoedinger equation. Wave Function of a Free Particle. Explanation of wave-particle duality in two slit experiment with microscopic particles from the above formalism.

Time independent Schrodinger equation-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wave-function; consistency with position-momentum uncertainty principle.

Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier. Tunnelling effect in the case of alpha decay and in scanning tunnel microscopes (qualitative discussion only).

Bound states in an arbitrary potential	**8 Lectures**

Bound states – continuity of wave function, boundary condition and emergence of discrete energy levels.

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; generalisation for three dimension and degeneracy of energy levels. Quantum dot as example.

Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions; Hermite polynomials; ground state, zero point energy & uncertainty principle. Raising-lowering operator and their applications.

Quantum theory of hydrogen-like atoms	**10 Lectures**

Time independent Schrodinger equation in spherical polar coordinates with spherically symmetric potential; separation of variables for second order partial differential equation; angular momentum operators, commutation relations, ladder operators & quantum numbers; spherical co-ordinate representation of angular momentum operators. Radial wavefunctions for Coulomb potential; shapes of the probability densities for ground & first excited states. Commuting observables and degeneracy of energy levels. Orbital angular momentum quantum numbers l and m; s, p, d,shells-subshells. Applications for Hydrogen atom, He^+ ion, positronium and alikes.

Applications of Quantization Rules in Atomic Physics	**18 Lectures**

Absence of exact stationary state solutions for relativistic effects and for multi-electron atoms. Approximate description by semi-classical vector model of atoms.

Electron angular momentum quantization rules. Space quantization. Orbital Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr magneton. Electron Spin as relativistic quantum effect (qualitative discussion only), Spin Angular Momentum. Spin Magnetic Moment. Stern-Gerlach Experiment. Larmor Precession.

Multi-electron atoms. Pauli's Exclusion Principle (statement only). Spectral Notations for atomic States. Aufbau principle, $n+l$ rule (qualitative discussion only). Periodic table.

Spin orbit interaction. Addition of angular momentum (statement only). Total angular momentum of electron. Total energy level correction due to relativistic effects and spin-orbit interaction (statement only). Fine structure splitting.

Normal and Anomalous Zeeman Effect, Lande g factor, Paschen Back effect. Stark Effect (Qualitative Discussion only).

Spin-orbit coupling in atoms – L-S and J-J coupling schemes. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.). Mosley's law and its explanation from Bohr theory.

Reference Books

- Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education.
- Quantum Mechanics: Theory and Experiment. M. Beck, 2012, Oxford University Press.
- A Modern Approach to Quantum Mechanics. J.S. Townsend, 2010, Viva Books (Indian Edn.).
- The Principles of Quantum Mechanics. P.A.M. Dirac, 2006, Oxford.
- A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010,

McGraw Hill

- Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
- Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
- Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
- Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
- Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer
- Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press

Additional Books for Reference

- Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
- Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer

- **PHSACOR11P – Quantum Mechanics and Applications Lab**

Quantum Mechanics and Applications	
60 class hours	**2 Credits**

General Topics: Detailed discussion on the underlying theory of the following numerical methods including efficiency of the method in each case.

List of Practical

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

$$\frac{d^2y}{dr^2} = A(r)u(r), \qquad A(r) = \frac{2\mu}{\hbar^2}[V(r) - E] \text{ where } V(r) = -\frac{e^2}{r}$$

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is -13.6 eV. Take e = 3.795 $(eVÅ)^{1/2}$, ħc = 1973 (eVÅ) and m = 0.511x10^6 eV/c^2.

2. Solve the s-wave radial Schrodinger equation for an atom:

$$\frac{d^2y}{dr^2} = A(r)u(r), \qquad A(r) = \frac{2\mu}{\hbar^2}[V(r) - E]$$

where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential

$$V(r) = -\frac{e^2}{r}e^{-\frac{r}{a}}.$$

Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take e = 3.795 $(eVÅ)^{1/2}$, m = 0.511x106 eV/c2, and a = 3 Å, 5 Å, 7 Å. In these units ħc = 1973 (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m:

$$\frac{d^2y}{dr^2} = A(r)u(r), \qquad A(r) = \frac{2\mu}{\hbar^2}[V(r) - E]$$

For the anharmonic oscillator potential

$$V(r) = \frac{1}{2}kr^2 + \frac{1}{3}br^3,$$

for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c^2, k = 100 MeV fm^{-2}, b = 0, 10, 30 MeV fm^{-3} In these units, cħ = 197.3 MeV fm. The ground state energy I expected to lie between 90 and

110 MeV for all three cases.

4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:

$$\frac{d^2y}{dr^2} = A(r)u(r), \qquad A(r) = \frac{2\,\mu}{\hbar^2}[V(r) - E]$$

Where μ is the reduced mass of the two-atom system for the Morse potential

$$V(r) = D\left(e^{-2ar'} - e^{-ar'}\right), \qquad r' = \frac{r - r_0}{r}$$

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of

three significant digits. Also plot the corresponding wave function. Take: m = 940x106eV/C^2, D = 0.755501 eV, α = 1.44, r_o = 0.131349 Å

Reference Books

- An introduction to computational Physics, T.Pang, 2nd Edn.,2006, Cambridge Univ.Press
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific &
- Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer.

- **PHSACOR12T - Solid State Physics**

Solid State Physics	
60 Lectures	**4 Credits**
Crystal Structure	**12 Lectures**
Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Laue's condition and Bragg's Law. Structure Factor.	
Elementary Lattice Dynamics	**10 Lectures**
Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, its limitations. Einstein's theories of specific heat of solids, its limitations.	
Magnetic Properties of Matter	**8 Lectures**
Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia– and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.	
Dielectric Properties of Materials	**8 Lectures**
Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena.	
Ferroelectric Properties of Materials	**6 Lectures**
Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop.	
Drude's theory	**6 Lectures**
Free electron gas in metals, effective mass, drift current, mobility and conductivity, Hall effect in metals. Thermal conductivity. Lorentz number, limitation of Drude's theory	
Elementary band theory	**10 Lectures**

Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (04 probe method) & Hall coefficient.

Superconductivity	**6 Lectures**

Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect.

Reference Books

- The Oxford Solid State Basics. S. H. Simon, 2013, Oxford.
- Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
- Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
- Elements of Solid State Physics, J.P. Srivastava, 4th Edition, 2015, Prentice-Hall of India
- Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
- Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
- Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
- Solid State Physics, Rita John, 2014, McGraw Hill
- Solid State Physics, M.A. Wahab, 2011, Narosa Publications

- **PHSACOR12P – Solid State Physics Lab**

Solid State Physics	
60 class hours	**2 Credits**

General Topics: Discussion on the operation of the relevant circuits used for the different studies in the following experiments.

List of Practical

1. To determine the Coupling Coefficient of a Piezoelectric crystal.
2. To measure the Dielectric Constant of a dielectric Materials with frequency
3. To study the characteristics of a Ferroelectric Crystal.
4. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
5. To measure the resistivity of a semiconductor (Ge) with temperature by reverse bias characteristics of Ge diode (room temperature to 80 oC) and to determine its band gap.
6. To determine the Hall coefficient of a semiconductor sample.
7. To study temperature coefficient of a semiconductor (NTC thermistor)
8. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
9. To measure the Magnetic susceptibility of Solids.
10. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR)
11. To determine the refractive index of a dielectric layer using SPR

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

- **PHSACOR13T - Electromagnetic Theory**

Electromagnetic Theory	
60 Lectures	**4 Credits**
Maxwell Equations	**12 Lectures**
Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density. Momentum Density and Angular Momentum Density (statement only).	
EM Wave Propagation in Unbounded Media	**10 Lectures**
Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.	
EM Wave in Bounded Media	**10 Lectures**
Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence).	
Polarization of Electromagnetic Waves	**17 Lectures**
Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light Rotatory Polarization: Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. Laurent's half-shade polarimeter.	

Wave guides	**8 Lectures**
Planar optical wave guides. Planar dielectric wave guide. Condition of continuity at interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field energy and Power transmission.	
Optical Fibres	**3 Lectures**
Numerical Aperture. Step and Graded Indices (Definitions Only). Single and Multiple Mode Fibres (Concept and Definition Only).	

Reference Books

- Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
- Optics, E. Hecht, 2016, Pearson.
- Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
- Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
- Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
- Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
- Engineering Electromagnetic, Willian H. Hayt, 8th Edition, 2012, McGraw Hill.
- Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

Additional Books for Reference

- Electromagnetic Fields & Waves, P.Lorrain & D.Corson, 1970, W.H.Freeman & Co.
- Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
- Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004,Cambridge University Press

- **PHSACOR13P – Electromagnetic Theory Lab**

Electromagnetic Theory	
60 class hours	**2 Credits**

General Topics: Discussion on the working principles of polaroids, polarimeter, photometers etc.

List of Practical

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
4. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
5. To verify Fresnel's formula for reflection of polarized light incident on a dielectric interface
6. To determine the Boltzmann constant using V-I characteristics of PN junction diode.
7. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
9. To study the reflection, refraction of microwaves
10. To study Polarization and double slit interference in microwaves.
11. To analyze elliptically polarized Light by using a Babinet's compensator.
12. To study dependence of radiation on angle for a simple Dipole antenna.
13. To verify the Stefan`s law of radiation and to determine Stefan's constant.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

- **PHSACOR14T – Statistical Mechanics**

Statistical Mechanics	
60 Lectures	**4 Credits**
Classical Statistical Mechanics	**20 Lectures**
Macrostate & Microstate, concept of time averaging in a macroscopic measurement. Ergodic hypothesis (statement only). Elementary Concept of Ensemble, Liouville's theorem. Microcanonical ensemble, Phase Space, postulate of equal a priori probability, Entropy and Thermodynamic Probability, Canonical ensemble, Partition Function, Density of states: for ideal gas, for standing waves in a cavity. Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature. Grand canonical ensemble and chemical potential. Equivalence of microcanonical, canonical and grand canonical ensemble for large systems (qualitative discussion only).	
Chemical Equilibrium	**5 Lectures**
Chemical potential and chemical reaction. Law of chemical equilibrium. Chemical potential for ideal gas, for photon gas. Ionisation potential. Saha's Ionization Formula.	
Theory of Blackbody Radiation	**6 Lectures**
Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Recapitulation of Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law.	
System of identical particles	**6 Lectures**
Collection of non-interacting identical particles. Classical approach and quantum approach: Distinguishability and indistinguishability. Occupation number and MB distribution, emergence of Boltzmann factor. Composite system postulate and symmetry postulate of quantum mechanics (for a pair of particles only). Bosons and Fermions. Spin statistics theorem (statement only). Pauli exclusion principle for Fermions.	
Bose-Einstein Statistics:	**12 Lectures**
B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic	

functions of photon gas. Bose derivation of Planck's law. Phonon gas. Debye theory of specific heat of solids. T3 law

Fermi-Dirac Statistics:	**11 Lectures**

Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Fermi temperature, Fermi momentum, Sommerfield correction to free electron theory in a Metal. Specific Heat of Metals, Wiedemann-Franz law,

Reference Books

- Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford Univ. Press.
- Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
- Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed.,1996, Oxford University Press.
- Statistical Mechanics – an elementary outline, A. Lahiri, 2008 (Revised Edition), CRC Press.
- Intermediate Statistical Mechanics. J. Bhattacharjee and D. Banerjee, 2017, World Scientific (HBA).
- An Introductory Course of Statistical Mechanics. P.B. Pal, 2008, Narosa.
- Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
- Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
- Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
- An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press

- **PHSACOR14P – Statistical Mechanics Lab**

Statistical Mechanics	
60 Class Hours	**2 Credits**

General Topics: Detailed discussion on the underlying theory of the following numerical methods including efficiency of the method in each case.

List of Practical

1. Computational analysis of the behaviour of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, varying the total number of particles N and the initial conditions:
   a) Study of local number density in the equilibrium state (i) average; (ii) fluctuations
   b) Study of transient behaviour of the system (approach to equilibrium)
   c) Relationship of large N and the arrow of time
   d) Computation of the velocity distribution of particles for the system and comparison with the Maxwell velocity distribution
   e) Computation and study of mean molecular speed and its dependence on particle mass
   f) Computation of fraction of molecules in an ideal gas having speed near the most probable speed
2. Computation of the partition function Z(β) for examples of systems with a finite number of single particle levels (e.g., 2 level, 3 level, etc.) and a finite number of non-interacting particles N under Maxwell-Boltzmann, Fermi-Dirac and Bose- Einstein statistics:
   a) Study of how Z(β), average energy <E>, energy fluctuation ΔE, specific heat at constant volume C_V, depend upon the temperature, total number of particles N and the spectrum of single particle states.
   b) Ratios of occupation numbers of various states for the systems considered above
   c) Computation of physical quantities at large and small temperature T and comparison of various statistics at large and small temperature T.
3. Plot Planck's law for Black Body radiation and compare it with Raleigh-Jeans Law at high temperature and low temperature.
4. Plot Specific Heat of Solids (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature and low temperature and compare them for these two cases.
5. Plot the following functions with energy at different temperatures
   a) Maxwell-Boltzmann distribution
   b) Fermi-Dirac distribution
   c) Bose-Einstein distribution

Reference Books

- Elementary Numerical Analysis, K.E.Atkinson, 3 rd Edn . 20 07 , Wiley India Edition
- Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
- Introduction to Modern Statistical Mechanics, D. Chandler, Oxford University Press, 1987
- Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
- Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
- Statistical and Thermal Physics with computer applications, Harvey Gould and Jan Tobochnik, Princeton University Press, 2010.
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896

4. Syllabi of Department Specific Elective Papers for B.Sc. Honours in Physics

- **PHSADSE01T - Advanced Mathematical Physics I**

Advanced Mathematical Physics I	
60 Lectures	**4 Credits**
Laplace Transform	**15 Lectures**
Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of 1st and 2nd order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2nd order Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits, Coupled differential equations of 1st order. Solution of heat flow along infinite bar using Laplace transform.	
Linear Vector Spaces	**15 Lectures**
Abstract Systems. Binary Operations and Relations. Introduction to Groups and Fields. Vector Spaces and Subspaces. Linear Independence and Dependence of Vectors. Basis and Dimensions of a Vector Space. Change of basis. Homomorphism and Isomorphism of Vector Spaces. Linear Transformations. Algebra of Linear Transformations. Non-singular Transformations. Representation of Linear Transformations by Matrices. Inner products. Gram-Schmidt orthogonalization. Orthogonal and unitary transformations and their matrix representations.	
Cartesian Tensors	**20 Lectures**
Transformation of Co-ordinates. Einstein's Summation Convention. Relation between Direction Cosines. Tensors. Algebra of Tensors. Sum, Difference and Product of Two Tensors. Contraction. Quotient Law of Tensors. Symmetric and Anti- symmetric Tensors. Invariant Tensors: Kronecker and Alternating Tensors. Association of Antisymmetric Tensor of Order Two and Vectors. Vector Algebra and Calculus using Cartesian Tensors: Scalar and Vector Products, Scalar and Vector Triple Products. Differentiation. Gradient, Divergence and Curl of Tensor Fields. Vector Identities. Tensorial Formulation of Analytical Solid Geometry: Equation of a Line. Angle Between Lines. Projection of a Line on another Line. Condition for Two Lines to be Coplanar. Foot of the Perpendicular from a Point on a Line. Rotation Tensor (No Derivation). Isotropic Tensors. Tensorial Character of Physical Quantities. Moment of Inertia Tensor. Stress and Strain Tensors: Symmetric	

Nature. Elasticity Tensor. Generalized Hooke's Law. Maxwell' s stress tensor.

General Tensors	**10 Lectures**

Transformation of Co-ordinates. Minkowski Space. Contravariant & Covariant Vectors. Contravariant, Covariant and Mixed Tensors. Kronecker Delta and Permutation Tensors. Algebra of Tensors. Sum, Difference & Product of Two Tensors. Contraction. Quotient Law of Tensors. Symmetric and Anti-symmetric Tensors. Metric Tensor.

Reference Books

- Mathematical Tools for Physics, James Nearing, 2010, Dover Publications
- Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, and F.E. Harris, 1970, Elsevier.
- Mathematical Methods. S. Hassani, 2009, Springer Science.
- Modern Mathematical Methods for Physicists and Engineers, C.D. Cantrell, 2011, Cambridge University Press
- Introduction to Matrices and Linear Transformations, D.T. Finkbeiner, 1978, Dover Pub.
- Linear Algebra, W. Cheney, E.W.Cheney & D.R.Kincaid, 2012, Jones & Bartlett Learning
- Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole
- A Basic Course of Tensor Analysis. S. Mukhopadhyay, 2017, Academic Publishers.
- Matrices and Tensors. A. W. Joshi,
- Mathematical Methods for Physicis & Engineers, K.F.Riley, M.P.Hobson, S.J.Bence, 3rd Ed., 2006, Cambridge University Press

- **PHSADSE01P – Advanced Mathematical Physics I Lab**

Advanced Mathematical Physics I	
60 Class Hours	**2 Credits**

List of Practical

1. Linear algebra:
   a. Multiplication of two 3 x 3 matrices.
   b. Eigenvalue and eigenvectors of

$$\begin{pmatrix} 2 & 1 & 1 \\ 1 & 3 & 2 \\ 3 & 1 & 4 \end{pmatrix}; \begin{pmatrix} 1 & -i & 3+4i \\ +i & 2 & 4 \\ 3-4i & 4 & 3 \end{pmatrix}; \begin{pmatrix} 2 & -i & 2i \\ +i & 4 & 3 \\ -2i & 3 & 5 \end{pmatrix}$$

2. Orthogonal polynomials as eigen functions of Hermitian differential operators.
3. Determination of the principal axes of moment of inertia through diagonalization.
4. Vector space of wave functions in Quantum Mechanics: Position and momentum differential operators and their commutator, wave functions for stationary states as eigenfunctions of Hermitian differential operator.
5. Lagrangian formulation in Classical Mechanics with constraints.
6. Study of geodesics in Euclidean and other spaces (surface of a sphere, etc).
7. Estimation of ground state energy and wave function of a quantum system.

Reference Books

► Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896

- **PHSADSE02T – Advanced Dynamics**

Advanced Dynamics	
75 Lectures	**6 Credits**
Lagrangian & Hamiltonian Dynamics	**15 Lectures**
Lagrange's equation for the cases with semi-holonomic constraints. Evaluation of constraint forces in general. Simple problems with both time-dependent and time independent constraints. Idea of canonical transformations. Generating functions. Properties of canonical transformation. Invariance of Poisson bracket. Use of canonical transformations in solving Hamilton's equations; harmonic oscillator problem as test case.	
Rigid Body Mechanics	**10 Lectures**
Definition of rigid body. General motion as combination of translation and rotation. Rotation of rigid body and the relation between its angular momentum and angular velocity. Moment of inertia and product of inertia. Kinetic energy of rotation. Principal axis transformation and principal moments of inertia, application in simple cases. Euler equations for free top and their solutions describing the motion of symmetric bodies.	
Small Amplitude Oscillations	**10 Lectures**
Minima of potential energy and points of stable equilibrium, expansion of the potential energy around a minimum, small amplitude oscillations about the minimum, normal modes of oscillations example of N identical masses connected in a linear fashion to (N -1) - identical springs.	
Dynamical Systems	**25 Lectures**
Definition of a continuous dynamical system. The idea of phase space, flows and trajectories. Autonomous and non-autonomous systems, dimensionality. Linear stability analysis to study the behaviour of an 1-dimensional autonomous system. Illustration of the method using the single particle system described by v=f(x) and comparing it with the exact analytical solution. Extension of the method for simple mechanical systems as 2-dimensional dynamical systems, categorisation of equilibrium/fixed points : illustrations for the free particle, particle under uniform gravity, simple and damped harmonic oscillator (both under-damped and over-damped). Sketching flows and trajectories in phase space; sketching variables as functions of time, relating the equations and pictures to the underlying physical intuition. Study on the behaviour of the quartic oscillator with an attractive or repulsive quadratic term in the potential; idea of bifurcation. Phase space	

diagram for the general motion of a pendulum and its behaviour. Oscillator with non-linear damping, Van-der-Pol oscillator as the example, behaviour in large damping limit, idea of limit cycle.

Discrete time dynamical systems, examples. Description by iterative map. Logistic map: Dynamics from time series. Cobweb iteration (using calculator or simple programs only). Fixed points. Parameter dependence- steady, periodic and chaos states. Idea of chaos and Lyapunov exponent.

Fluid Dynamics	**15 Lectures**

Basic physics of fluids: The continuum hypothesis- concept of fluid element or fluid parcel; Definition of a fluid- shear stress; Fluid properties- viscosity, thermal conductivity, mass diffusivity, other fluid properties and equation of state; Flow phenomena- flow dimensionality, steady and unsteady flows, uniform & non-uniform flows, viscous & inviscid flows, incompressible & compressible flows, laminar and turbulent flows, rotational and irrotational flows. Euler equation and Navier-Stokes equation, qualitative description of turbulence, Reynolds number.

Reference Books

- Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
- Classical Mechanics: A Course of Lectures. A.K. Raychaudhuri, 1983, Oxford University Press.
- Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon.
- Classical Mechanics, P.S. Joag, N.C. Rana, 1st Edn., McGraw Hall.
- Classical Mechanics, R. Douglas Gregory, 2015, Cambridge University Press.
- Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer.
- Chaos and Non-linear Dynamics. R.C. Hilborn, 2000, Oxford Univ. Press.
- Nonlinear Dynamics and Chaos.S.H. Strogartz.
- Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press

- **PHSADSE03T - Nuclear and Particle Physics**

Nuclear and Particle Physics	
75 Lectures	**6 Credits**
General Properties of Nuclei	**10 Lectures**
Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.	
Nuclear Models	**12 Lectures**
Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.	
Radioactivity decay	**10 Lectures**
(a) Alpha decay: basics of α-decay processes, theory of α- emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) □-decay: energy kinematics for □-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion.	
Nuclear Reactions	**8 Lectures**
Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scattering (Rutherford scattering).	
Interaction of Nuclear Radiation with matter	**8 Lectures**
Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.	
Detector for Nuclear Radiations	**8 Lectures**
Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor	

Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector.

Particle Accelerators	**5 Lectures**

Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons.

Particle physics	**14 Lectures**

Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons.

Reference Books

- Nuclear Physics. J.S. Lilley, 2001, John Wiley & Sons.
- Nuclear and Particle Physics. B.R. Martin, 2006, John Wiley & Sons.
- Nuclear and Particle Physics, W.F. Burcham and M. Jobes, 1995, Pearson.
- An Introduction to Nuclear Physics. W. N. Cottingham and D.A. Greenwood, 2004, Chambridge.
- Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
- Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
- Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
- Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
- Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
- Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
- Basic ideas and concepts in Nuclear Physics - An Introductory Approach by
- K. Heyde (IOP- Institute of Physics Publishing, 2004).
- Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
- Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).
- Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., 1991)

- **PHSADSE04T - Advanced Mathematical Physics II**

Advanced Mathematical Physics II	
75 Lectures	**6 Credits**
Partial Differential Equations:	**20 Lectures**
Existence and uniqueness theorem for soutions of partial differential equations (PDE). Categorisation of PDE's. Solution method for one homogeneous example of each type. Inhomogeneous PDE. Green's function. General solution in terms of Green's function. Solution of Poisson's equation by Green's function method.	
Group Theory	**30 Lectures**
Review of sets, Mapping and Binary Operations, Relation, Types of Relations. Groups: Elementary properties of groups, uniqueness of solution, Subgroup, Centre of a group, Co-sets of a subgroup, cyclic group, Permutation/Transformation. Homomorphism and Isomorphism of group. Normal and conjugate subgroups, Completeness and Kernel. Some special groups with operators. Matrix Representations: Reducible and Irreducible representations. Schur's lemma. Orthogonality theorems. Character tables and their uses. Application to small vibrations. Continuous groups: Generator of Lie group. Rotation group and angular momentum as its generator. Homomorphism between SO(3) and SU(2).	
Advanced Probability Theory:	**25 Lectures**
Fundamental Probability Theorems. Conditional Probability, Bayes' Theorem, Repeated Trials, Binomial and Multinomial expansions. Random Variables and probability distributions, Expectation and Variance, Special Probability distributions: The binomial distribution, The Poisson distribution, Continuous distribution: The Gaussian (or normal) distribution, The principle of least squares.	
Reference Books	
► Lectures on Partial Differential Equation. V.I. Arnold, 2004, Springer-Verlag. ► Mathematical Methods for Physicists: Weber and Arfken, 2005, Academic Press. ► Mathematical Methods. S. Hassani, 2009, Springer Science. ► Mathematical Methods for Physicists: A Concise Introduction: Tai L. Chow, 2000, Cambridge Univ. Press. ► Elements of Group Theory for Physicists by A. W. Joshi, 1997, John Wiley. ► Group Theory. P. Ramond, 2010, Chambrdge Univerity Press. ► Group Theory and its Applications to Physical Problems by Morton Hamermesh, 1989, Dover	

- Introduction to Mathematical Physics: Methods & Concepts: Chun Wa Wong, 2012, Oxford University Press
- Introduction to Mathematical Probability, J. V. Uspensky, 1937, Mc Graw-Hill.

- **PHSADSE05T - Astronomy and Astrophysics**

Astronomy and Astrophysics	
75 Lectures	**6 Credits**
Astronomical Scales	**24 Lectures**
Astronomical Distance, Mass and Time, Scales, Brightness, Radiant Flux and Luminosity, Measurement of Astronomical Quantities Astronomical Distances, Stellar Radii, Masses of Stars, Stellar Temperature. Basic concepts of positional astronomy: Celestial Sphere, Geometry of a Sphere, Spherical Triangle, Astronomical Coordinate Systems, Geographical Coordinate Systems, Horizon System, Equatorial System, Diurnal Motion of the Stars, Conversion of Coordinates. Measurement of Time, Sidereal Time, Apparent Solar Time, Mean Solar Time, Equation of Time, Calendar. Basic Parameters of Stars: Determination of Distance by Parallax Method; Brightness, Radiant Flux and Luminosity, Apparent and Absolute magnitude scale, Distance Modulus; Determination of Temperature and Radius of a star; Determination of Masses from Binary orbits; Stellar Spectral Classification, Hertzsprung-Russell Diagram.	
Astronomical techniques	**5 Lectures**
Basic Optical Definitions for Astronomy (Magnification Light Gathering Power, Resolving Power and Diffraction Limit, Atmospheric Windows), Optical Telescopes (Types of Reflecting Telescopes, Telescope Mountings, Space Telescopes, Detectors and Their Use with Telescopes (Types of Detectors, detection Limits with Telescopes)	
Physical principles	**4 Lectures**
Gravitation in Astrophysics (Virial Theorem, Newton versus Einstein), Systems in Thermodynamic Equilibrium.	
The sun and solar family	**11 Lectures**
The sun (Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere. Corona, Solar Activity, Basics of Solar Magneto-hydrodynamics. Helioseismology). The solar family (Solar System: Facts and Figures, Origin of the Solar System: The Nebular Model, Tidal Forces and Planetary Rings, Extra-Solar Planets. Stellar spectra and classification Structure (Atomic Spectra Revisited, Stellar Spectra, Spectral Types and Their Temperature Dependence, Black Body Approximation, H R Diagram, Luminosity Classification). Main sequence, red giants and white dwarfs, Chandrashekhar mass limit.	

The milky way	**14 Lectures**
Basic Structure and Properties of the Milky Way, Nature of Rotation of the Milky Way (Differential Rotation of the Galaxy and Oort Constant, Rotation Curve of the Galaxy and the Dark Matter, Nature of the Spiral Arms), Stars and Star Clusters of the Milky Way, Properties of and around the Galactic Nucleus.	
Galaxies	**7 Lectures**
Galaxy Morphology, Hubble's Classification of Galaxies, Elliptical Galaxies (The Intrinsic Shapes of Elliptical, de Vaucouleurs Law, Stars and Gas). Spiral and Lenticular Galaxies (Bulges, Disks, Galactic Halo) The Milky Way Galaxy, Gas and Dust in the Galaxy, Spiral Arms	
Large scale structure & expanding universe	**10 Lectures**
Cosmic Distance Ladder (An Example from Terrestrial Physics, Distance Measurement using Cepheid Variables), Hubble's Law (Distance- Velocity Relation), Clusters of Galaxies (Virial theorem and Dark Matter).	

Reference Books

- Astrophysicsfor Physicists. Arnab Rai Choudhuri, 2010, Chambridge Univ. Press.
- Fundamental of Astronomy (Fourth Edition), H. Karttunen et al. Springer
- Modern Astrophysics, B.W. Carroll & D.A. Ostlie, Addison-Wesley Publishing Co.
- Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory,4th Edition, Saunders College Publishing.
- The physical universe: An introduction to astronomy, F.Shu, Mill Valley: University Science Books.
- K.S. Krishnasamy, 'Astro Physics a modern perspective,' Reprint, New Age International (p) Ltd, New Delhi,2002.
- Baidyanath Basu, 'An introduction to Astro physics', Second printing, Prentice - Hall of India Private limited, New Delhi, 2001.
- Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, Narosa Publication

- **PHSADSE06T - Communication Electronics**

Communication Electronics	
60 Lectures	**4 Credits**
Electronic communication	**8 Lectures**
Introduction to communication – means and modes. Need for modulation. Block diagram of an electronic communication system. Brief idea of frequency allocation for radio communication system in India (TRAI). Electromagnetic communication spectrum, band designations and usage. Channels and base-band signals. Concept of Noise, signal-to-noise (S/N) ratio.	
Analog Modulation	**12 Lectures**
Amplitude Modulation, modulation index and frequency spectrum. Generation of AM (Emitter Modulation), Amplitude Demodulation (diode detector), Concept of Single side band generation and detection. Frequency Modulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM using VCO, FM detector (slope detector), Qualitative idea of Super heterodyne receiver	
Analog Pulse Modulation	**10 Lectures**
Channel capacity, Sampling theorem, Basic Principles- PAM, PWM, PPM, modulation and detection technique for PAM only, Multiplexing.	
Digital Pulse Modulation	**10 Lectures**
Need for digital transmission, Pulse Code Modulation, Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding. Concept of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), and Binary Phase Shift Keying (BPSK).	
Introduction to Communication and Navigation systems:	**10 Lectures**
Satellite Communication– Introduction, need, Geosynchronous satellite orbits geostationary satellite advantages of geostationary satellites. Satellite visibility, transponders (C - Band), path loss, ground station, simplified block diagram of earth station. Uplink and downlink.	
Mobile Telephony System:	**10 Lectures**
Mobile Telephony System – Basic concept of mobile communication, frequency bands used in mobile communication, concept of cell sectoring and cell splitting, SIM number, IMEI number, need for data	

encryption, architecture (block diagram) of mobile communication network, idea of GSM, CDMA, TDMA and FDMA technologies, simplified block diagram of mobile phone handset, 2G, 3G and 4G concepts (qualitative only).

GPS navigation system (qualitative idea only)

Reference Books

- Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.
- Advanced Electronics Communication Systems- Tomasi, 6th edition, Prentice Hall.
- Electronic Communication systems, G. Kennedy, 3rd Edn, 1999, Tata McGraw Hill.
- Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill
- Communication Systems, S. Haykin, 2006, Wiley India
- Electronic Communication system, Blake, Cengage, 5th edition.
- Wireless communications, Andrea Goldsmith, 2015, Cambridge University Press

- **PHSADSE06P – Communication Electronics Lab**

Communication Electronics Lab	
60 Class Hours	**2 Credits**

List of Practical

1. To design an Amplitude Modulator using Transistor
2. To study envelope detector for demodulation of AM signal
3. To study FM - Generator and Detector circuit
4. To study AM Transmitter and Receiver
5. To study FM Transmitter and Receiver
6. To study Time Division Multiplexing (TDM)
7. To study Pulse Amplitude Modulation (PAM)
8. To study Pulse Width Modulation (PWM)
9. To study Pulse Position Modulation (PPM)
10. To study ASK, PSK and FSK modulators

Reference Books

- Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hill.
- Electronic Communication system, Blake, Cengage, 5th edition.

4 Scheme for CBCS Curriculum B.Sc. (General) Program with *Physics* as one of the disciplines

- **Scheme for CBCS Curriculum**

Semester	Course Name	Course Detail	Credits
I	Ability Enhancement Compulsory Course – I	English communication / Environmental Science	2
	Core course – I (from Physics)	**PHSGCOR01T** : Mechanics	4
		PHSGCOR01P : Mechanics Lab	2
	Core course – II	DSC 2A (from Discipline 2)	6
	Core course – III	DSC 3A (from Discipline 3)	6
II	Ability Enhancement Compulsory Course – II	English communication / Environmental Science	2
	Core course – IV (from Physics)	**PHSGCOR02T** : Electricity and Magnetism	4
		PHSGCOR02P : Electricity and Magnetism Lab	2
	Core course – V	DSC 2B (from Discipline 2)	6
	Core course – VI	DSC 3B (from Discipline 3)	6
III	Core course – VII (from Physics)	**PHSGCOR03T** : Thermal Physics and Statistical Mechanics	4
		PHSGCOR03P : Thermal Physics and Statistical Mechanics Lab	2
	Core course – VIII	DSC 2C (from Discipline 2)	6
	Core course – IX	DSC 3C (from Discipline 3)	6
	Skill Enhancement Course – 1	TBD	2
IV	Core course – X (from Physics)	**PHSGCOR04T** : Waves and Optics	4
		PHSGCOR04P : Waves and Optics Lab	2
	Core course – XI	DSC 2D (from Discipline 2)	6
	Core course – XII	DSC 3D (from Discipline 3)	6
	Skill Enhancement Course-2	TBD	2
V	Skill Enhancement Course-3	TBD	2

	Discipline Specific Elective – 1	TBD (from Physics)	6
	Discipline Specific Elective – 2	TBD (from Discipline 2)	6
	Discipline Specific Elective – 3	TBD (from Discipline 3)	6
VI	Skill Enhancement Course-4	TBD	2
	Discipline Specific Elective – 4	TBD (from Physics)	6
	Discipline Specific Elective – 5	TBD (from Discipline 2)	6
	Discipline Specific Elective – 6	TBD (from Discipline 3)	6

*TBD: To be decided by the student among the available choices mentioned below.

5. Syllabi of Core Papers (from Physics) for B.Sc. General with Physics

- **PHSGCOR01T - Mechanics**

Mechanics	
60 Lectures	**4 Credits**
Mathematical Methods	**10 Lectures**
Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. Ordinary Differential Equations: 1^{st} order homogeneous differential equations. 2^{nd} order homogeneous and inhomogeneous differential equations with constant coefficients.	
Particle Dynamics	**21 Lectures**
Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum.	
Gravitation	**8 Lectures**
Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).	
Oscillations	**6 Lectures**
Oscillations: Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. Forced harmonic oscillations, resonance.	
Elasticity	**8 Lectures**
Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion –	

Torsional pendulum.- Bending of beam.

Special Theory of Relativity	**7 Lectures**

Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.

Reference Books

- Classical Mechanics. T.W.B. Kibble and F.H. Berkshire, 2004, Imp. Col. Press, World Scientific.
- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
- Classical Dynamics of Particles and Systems. S.T. Thornton and J. B. Marion, 2009, Brooks/Cole.
- Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
- Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
- University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
- Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
- Classical Mechanics and General Properties of Matter. S.N. Maiti and D.P. Raychaudhuri, New Age
- Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
- Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
- Special Relativity (MIT Introductory Physics). A.P. French, 2018, CRC Press.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.

- **PHSGCOR01P – Mechanics Lab**

Mechanics	
60 class hours	**2 Credits**

General Topic

Discussion on random errors in observations. Measurement principles of length (or diameter) using vernier caliper, screw gauge and travelling microscope. Discussion on the parts of Sextant.

List of Practical

1. To study the random error in observations of time period of some oscillation using chronometer.
2. To determine the Moment of Inertia of a regular body using another auxilary body and a cradle suspeded by a metalic wire.
3. To determine g and velocity for a freely falling body using Digital Timing Technique
4. To determine the Young's Modulus by flexure method.
5. To determine the Modulus of Rigidity of a Wire by a torsional pendulum.
6. To determine the height of a building using a Sextant.
7. To determine the elastic Constants of a wire by Searle's method.
8. To determine the value of g using Bar Pendulum.
9. To determine the value of g using Kater's Pendulum.
10. To study the Motion of Spring and calculate, (a) Spring constant, (b) g and (c) Modulus of rigidity.

Reference Books

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
- Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt. Ltd.
- Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

- **PHSGCOR02T - Electricity and Magnetism**

Electricity and Magnetism	
60 Lectures	**4 Credits**
Vector Analysis	**12 Lectures**
Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).	
Electrostatics	**18 Lectures**
Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field. Electric potential due to an electric dipole. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.	
Magnetism	**10 Lectures**
Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.	
Electromagnetic Induction	**6 Lectures**
Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.	
Linear Network	**5 Lectures**
Impedance of L, C, R and their combinations. Thevenin & Norton’s Theorem. Maximum power transfer theorem and superposition theorem. Anderson’s bridge.	
Maxwell`s Equations and Electromagnetic Wave Propagation	**9 Lectures**
Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy	

density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Reference Books

- Foundations of Electromagnetic Theory. J.R. Reitz, F.J. Milford and R.W. Christy, 2010, Pearson.
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Electromagnetism. I.S. Grant and W.R. Phillips, 2013, Wiley.
- Classical Electromagnetism. J. Franklin, 2008, Pearson Education.
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw

- **PHSGCOR02P – Electricity and Magnetism Lab**

Electricity and Magnetism	
60 class hours	**2 Credits**

General topic

Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances (e) Checking electrical fuses and (f) circuit continuity check**.** Demonstration on Carey Foster's bridge, potentiometer, resistance box, inductor coil, moving coil galvanometer (in dead beat and ballistic mode), etc.

List of Practicals

1. To determine an unknown Low Resistance using Carey Foster's Bridge.
2. To verify the Thevenin and Norton theorems.
3. To verify the Superposition and Maximum power transfer theorems.
4. To determine self-inductance of a coil by Anderson's bridge.
5. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
6. To study the response curve of a parallel LCR circuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q.
7. To study the characteristics of a series RC Circuit.
8. To determine an unknown Low Resistance using Potentiometer.
9. To determine the resistance of a galvanometer using Thomson's method.
10. Measurement of field strength B and its variation in a solenoid (determine dB/dx)

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

- **PHSGCOR03T - Thermal Physics and Statistical Mechanics**

Thermal Physics and Statistical Mechanics	
60 Lectures	**4 Credits**
Laws of Thermodynamics	**22 Lectures**
Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.	
Thermodynamic Potentials	**10 Lectures**
Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations.	
Kinetic Theory of Gases	**10 Lectures**
Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.	
Theory of Radiation	**6 Lectures**
Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.	
Statistical Mechanics	**12 Lectures**
Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics (qualitative discussion only) - Fermi-Dirac distribution law (statement only) - electron gas as an example of Fermi gas - Bose-Einstein distribution law (statement only) - photon gas as an example of Bose gas- comparison of three statistics.	
Reference Books	
► Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford Univ Press.	

- Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
- Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
- Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
- Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears and
- G.L. Salinger. 1988, Narosa
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications.

- **PHSGCOR03P – Thermal Physics and Statistical Lab**

Thermal Physics and Statistical	
60 class hours	**2 Credits**

List of Practical

1. Verification of Stefan's law using a torch bulb.
2. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
3. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).using constant current source
4. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
5. To calibrate a thermocouple to measure temperature in a specified Range by Null Method using a potentiometer.
6. To calibrate a thermocouple to measure temperature in a specified Range by direct measurement using Op-Amp differential amplifier and to determine Neutral Temperature
7. Measurement of unknown temperature using Diode sensor.
8. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
9. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
10. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.

Reference Books

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.

- **PHSGCOR04T - Waves and Optics**

Waves and Optics	
60 Lectures	**4 Credits**
Superposition of Two Collinear Harmonic oscillations	**4 Lectures**
Linearity & Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats).	
Superposition of Two Perpendicular Harmonic Oscillations	**2 Lectures**
Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.	
Waves Motion- General	**7 Lectures**
Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.	
Fluids	**6 Lectures**
Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature. Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. Qualitative discussion on water waves.	
Sound	**6 Lectures**
Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.	
Wave Optics	**3 Lectures**
Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.	
Interference	**10 Lectures**

Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index.

Michelson's Interferometer	**3 Lectures**

Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index, and Visibility of fringes.

Diffraction	**14 Lectures**

Fraunhofer diffraction- Single slit; Double Slit. Multiple slits and Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

Polarization	**5 Lectures**

Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

Reference Books

- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Vibrations and Waves. A.P. French, 2003, CBS.
- Vibrations & Waves. G.C. King, 2009, Wiley.
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- General Properties of Matter. B. Brown, 1969, Springer Science.
- Classical Mechanics and General Properties of Matter. S.N. Maiti and D.P. Raychaudhuri, New Age
- Optics. E. Hecht, 2003, Pearson Education.
- Fundamentals of Optics, F.A Jenkins and H.E White, 1976, McGraw-Hill
- Principles of Optics, B.K. Mathur, 1995, Gopal Printing
- Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publications
- University Physics. F.W. Sears, M.W. Zemansky and H.D. Young. 13/e, 1986. Addison-Wesley

- ## PHSGCOR04P – Waves and Optics Lab

Waves and Optics	
60 class hours	**2 Credits**

List of Practical

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law.
2. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
3. To determine refractive index of the Material of a prism using sodium source.
4. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
5. To determine wavelength of sodium light using Fresnel Biprism.
6. To determine wavelength of sodium light using Newton's Rings.
7. To determine dispersive power and resolving power of a plane diffraction grating.
8. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
9. Familiarization with: Schuster`s focusing; determination of angle of prism.
10. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
11. To investigate the motion of coupled oscillators.
12. To determine the wavelength of sodium source using Michelson's interferometer.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

6. Syllabi of Department Specific Electives Papers (from Physics) for B.Sc. General with Physics

- **PHSGDSE01T - Digital, Analog Circuits and Instrumentation**

Digital, Analog Circuits and Instrumentation	
60 Lectures	**4 Credits**
Digital Circuits	**15 Lectures**
Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates. De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map Binary Addition. Binary Subtraction using 2's Complement Method). Half Adders and Full Adders and Subtractors, 4-bit binary Adder-Subtractor.	
Semiconductor Devices and Amplifiers	**15 Lectures**
Semiconductor Diodes: P and N type semiconductors. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle and structure of (1) LEDs, (2) Photodiode, (3) Solar Cell Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cutoff & Saturation regions Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line & Q- point. Voltage Divider Bias Circuit for CE Amplifier. H-parameter, Equivalent Circuit. Analysis of single-stage CE amplifier using hybrid Model. Input & output Impedance. Current, Voltage and Power gains. Class A, B & C Amplifiers.	
Operational Amplifiers (Black Box approach)	**14 Lectures**
Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop and closed- loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero crossing detector. Sinusoidal Oscillators: Barkhausen's Criterion for Self-sustained Oscillations. Determination of Frequency of RC Oscillator	

Instrumentations	**16 Lectures**

Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference.

Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation.

Timer IC: IC 555 Pin diagram and its application as Astable and Monostable Multivibrator.

Reference Books

- Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
- Electronic devices & circuits, S. Salivahanan & N.S. Kumar, 2012, Tata Mc-Graw Hill
- Microelectronic Circuits, M.H. Rashid, 2nd Edn., 2011, Cengage Learning.
- Modern Electronic Instrumentation and Measurement Tech., Helfrick and Cooper, 1990, PHI Learning
- Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha, 7th Ed., 2011, Tata McGraw Hill
- Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
- Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
- OP-AMP & Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.

- **PHSGDSE01P – Digital, Analog Circuits and Instrumentation Lab**

Digital, Analog Circuits and Instruments	
60 class hours	**2 Credits**

List of Practical

1. To measure (a) Voltage, and (b) Frequency of a periodic waveform using CRO
2. To verify and design AND, OR, NOT and XOR gates using NAND gates.
3. To minimize a given logic circuit.
4. Half adder, Full adder and 4-bit Binary Adder.
5. Adder-Subtractor using Full Adder I.C.
6. To design an astable multivibrator of given specifications using 555 Timer.
7. To design a monostable multivibrator of given specifications using 555 Timer.
8. To study IV characteristics of PN diode, Zener and Light emitting diode
9. To study the characteristics of a Transistor in CE configuration.
10. To design a CE amplifier of given gain (mid-gain) using voltage divider bias.
11. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response.
12. To design a non-inverting amplifier of given gain using Op-amp 741 and study its Frequency Response.
13. To study Differential Amplifier of given I/O specification using Op-amp.
14. To investigate a differentiator made using op-amp.
15. To design a Wien Bridge Oscillator using an op-amp.

Reference Books

- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
- Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
- OP-Amps & Linear Integrated Circuit, R.A. Gayakwad, 4th Edn, 2000, Prentice Hall.
- Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.

- **PHSGDSE02T - Perspectives of Modern Physics**

Perspectives of Modern Physics	
75 Lectures	**6 Credits**
Relativistic Dynamics	**8 Lectures**
Brief summary of Lorentz transformation and time dilation, length contraction, velocity addition etc. (no derivation required). Elastic collision between two particles as observed from two inertial frames with relative velocity, idea of relativistic momentum and relativistic mass. Mass-energy equivalence.	
Quantum Theory of Light	**5 Lectures**
Review on the limitations of classical theory of electromagnetic radiation within a cavity and its solution by Planck's quantum hypothesis (no derivation required). Statement of Planck's law of black body radiation. Photoelectric effect. Einstein's postulate on light as a stream of photons. Compton's scattering and its explanation.	
Bohr's model	**4 Lectures**
Limitations of Ruherford's model of atomic structure. Bohr's model, its successes and limitations.	
Wave-particle Duality	**6 Lectures**
De Broglie's hypothesis – wave particle duality. Davisson-Germer experiment. Connection with Einstein's postulate on photons and with Bohr's quantization postulate for stationary orbits. Heisenberg's uncertainty relation as a consequence of wave-particle duality. Demonstration by γ-ray microscope thought experiment. Estimating minimum energy of a confined particle using uncertainty principle.	
Wave-function Description	**7 Lectures**
Two slit interference experiment with photons, atoms & particles; linear superposition principle of associated wave functions as a consequence; Departure from matter wave interpretation and probabilistic interpretation of wave function; Schroedinger equation for non-relativistic particles; Momentum and Energy operators; stationary states. Properties of wave function. Probability and probability current densities in one dimension.	
Stationary State Problems	**5 Lectures**
One Dimensional infinitely rigid box, energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example. Quantum mechanical scattering and tunnelling in one dimension - across a step potential and	

across a rectangular potential barrier (qualitative discussion with statements of end results only).

Atomic Physics	**15 Lectures**

Quantization rules energy and orbital angular momentum from Hydrogen and Hydrogen like atoms (no derivation); s, p, d,shells-subshells. Space quantization. Orbital Magnetic Moment and Magnetic Energy of electron, Gyromagnetic Ratio and Bohr magneton. Zeeman effect.

Electron Spin as relativistic quantum effect (qualitative discussion only), Spin Angular Momentum. Spin Magnetic Moment. Stern-Gerlach Experiment. Larmor Precession. Spin-orbit interaction. Addition of angular momentum (statement only). Energy correction due to relativistic effect and spin-orbit ineraction (statement only). Fine-structure splitting.

Multi-electron atoms. Pauli's Exclusion Principle (statement only). Spectral Notations for atomic States. Aufbau principle, $n+l$ rule (qualitative discussion only). Periodic table.

Nuclear Physics	**15 Lectures**

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph. Binding energy curve.

Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay, beta decay, gamma emission – basic characteristics.

Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Basic principle of a nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and basic principle of thermonuclear reactions

X-ray and Crystal Structure of Solids	**10 Lectures**

Generation of X-ray. Mosley's law, explanation from Bohr's theory. Amorphous and crystalline solids. Lattice structure of crystalline (no categorisation required). Unit cell and basis vectors of a lattice. Diffraction of X-ray by crystalline solid. Bragg's law.

Reference Books

- Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles. R. Eisberg and R. Resnick, 1985, Wiley.
- Perspectives of Modern Physics. A. Beiser, 1969, McGraw-Hill.
- Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
- Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
- Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
- Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill

- **PHSGDSE03T – Solid State Physics**

Solid State Physics	
60 Lectures	**4 Credits**
Preliminary Topics	**4 Lectures**
Review on Schroedinger equation in one dimension, stationary states. Maxwell-Boltzman distribution law.	
Crystal Structure	**12 Lectures**
Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.	
Elementary Lattice Dynamics	**8 Lectures**
Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein theories of specific heat of solids. Debye correction (qualitative idea), T3 law (statement only).	
Magnetic Properties of Matter	**12 Lectures**
Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.	
Dielectric Properties of Materials	**9 Lectures**
Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena.	
Elementary band theory	**10 Lectures**
Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.	
Superconductivity	**5 Lectures**

Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors.

Reference Books

- The Oxford Solid State Basics. S. H. Simon, 2013, Oxford.
- Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
- Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
- Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
- Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
- Solid State Physics, Rita John, 2014, McGraw Hill
- Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
- Solid State Physics, M.A. Wahab, 2011, Narosa Publications

- **PHSGDSE03P – Solid State Physics Lab**

Solid State Physics	
60 class hours	**2 Credits**

List of Practical

1. To determine the Coupling Coefficient of a Piezoelectric crystal.
2. To measure the Dielectric Constant of a dielectric Materials with frequency
3. To study the characteristics of a Ferroelectric Crystal.
4. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
5. To measure the resistivity of a semiconductor (Ge) with temperature by reverse bias characteristics of Ge diode (room temperature to 80 oC) and to determine its band gap.
6. To determine the Hall coefficient of a semiconductor sample.
7. To study temperature coefficient of a semiconductor (NTC thermistor)
8. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
9. To measure the Magnetic susceptibility of Solids.
10. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR)
11. To determine the refractive index of a dielectric layer using SPR

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn., 2011, Kitab Mahal
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

- **PHSGDSE04T - Nuclear and Particle Physics**

Nuclear And Particle Physics	
75 Lectures	**6 Credits**
Preliminary Topics	**3 Lectures**
Review of mass-energy equivalence, quantum tunnelling. Qualitative discussion on properties of semiconductors.	
General Properties of Nuclei	**9 Lectures**
Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.	
Nuclear Models	**11 Lectures**
Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.	
Radioactivity decay	**10 Lectures**
(a) Alpha decay: basics of α-decay processes, theory of α- emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) -decay: energy kinematics for□-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion.	
Nuclear Reactions	**8 Lectures**
Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering(Rutherford scattering).	
Interaction of Nuclear Radiation with matter	**8 Lectures**
Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction	

with matter.

Detector for Nuclear Radiations	**7 Lectures**

Basic principles of ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector.

Particle Accelerators	**5 Lectures**

Linear accelerator, Cyclotron, Synchrotrons.

Particle physics	**14 Lectures**

Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons.

Reference Books

- Nuclear Physics. J.S. Lilley, 2001, John Wiley & Sons.
- Nuclear and Particle Physics. B.R. Martin, 2006, John Wiley & Sons.
- Nuclear and Particle Physics, W.F. Burcham and M. Jobes, 1995, Pearson.
- An Introduction to Nuclear Physics. W. N. Cottingham and D.A. Greenwood, 2004, Chambridge.
- Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
- Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
- Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
- Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
- Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
- Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
- Basic ideas and concepts in Nuclear Physics - An Introductory Approach by
- K. Heyde (IOP- Institute of Physics Publishing, 2004).
- Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
- Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).

7 Syllabi of Generic Elective Papers (from Physics) for B.Sc. Honours in Subjects Other than Physics

Syllabus for **PHSHGEC01T: Mechanics** is identical with that of **PHSGCOR01T: Mechanics** offered for B.Sc. General with Physics
Syllabus for **PHSHGEC01P : Mechanics Lab** is identical with that of **PHSGCOR01P : Mechanics Lab** offered for B.Sc. General with Physics
Syllabus for **PHSHGEC02T: Electricity and Magnetism** is identical with that of **PHSGCOR02T: Electricity and Magnetism** offered for B.Sc. General with Physics
Syllabus for **PHSHGEC02P: Electricity and Magnetism Lab** is identical with that of **PHSGCOR02P: Electricity and Magnetism Lab** offered for B.Sc. General with Physics
Syllabus for **PHSHGEC03T: Thermal Physics and Statistical Mechanics** is identical with that of **PHSGCOR03T : Thermal Physics and Statistical Mechanics** offered for B.Sc. General with Physics
Syllabus for **PHSHGEC03P: Thermal Physics and Statistical Mechanics Lab** is identical with that of **PHSGCOR03P: Thermal Physics and Statistical Mechanics Lab** offered for B.Sc. General with Physics
Syllabus for **PHSHGEC04T: Waves and Optics** is identical with that of **PHSGCOR04T : Waves and Optics** offered for B.Sc. General with Physics
Syllabus for **PHSHGEC04P: Waves and Optics Lab** is identical with that of **PHSGCOR04P : Waves and Optics Lab** offered for B.Sc. General with Physics

8 Skill Enhancement Courses

• PHSSSEC01M - Basic Instrumentation Skills

Basic of Measurement	
30 class hours	**2 Credits**

Basic of Measurement

Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

Electronic Voltmeter

Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter: Type of AC millivoltmeters: Amplifier-rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.

Cathode Ray Oscilloscope

Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.

Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.

Signal Generators and Analysis Instruments

Block diagram, explanation and specifications of low frequency signal generators. Pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.

Impedance Bridges & Q-Meters

Block diagram of bridge: working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q- Meter. Digital LCR bridges.

Digital Instruments

Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.

Digital Multimeter

Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.

The test of lab skills will be of the following test items:

1. Use of an oscilloscope.
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter/VTVM for measuring voltages
5. Circuit tracing of Laboratory electronic equipment,
6. Winding a coil / transformer.
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit
9. Balancing of bridges

Laboratory Exercises

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. To measure Q of a coil and its dependence on frequency, using a Q- meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/ frequency counter.
6. Measurement of rise, fall and delay times using a CRO.
7. Measurement of distortion of a RF signal generator using distortion factor meter.
8. Measurement of R, L and C using a LCR bridge/ universal bridge.

Open Ended Experiments

1. Using a Dual Trace Oscilloscope
2. Converting the range of a given measuring instrument (voltmeter, ammeter)

Reference Books

- A text book in Electrical Technology - B L Theraja - S Chand and Co.
- Performance and design of AC machines - M G Say ELBS Edn.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.

- Logic circuit design, Shimon P. Vingron, 2012, Springer.
- Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
- Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
- Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
- Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

- **PHSSSEC02M - Computational Physics Skills**

Computational Physics	
30 class hours	**2 Credits**

Introduction

Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor. Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin(x) as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

Scientific Programming

Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN/ C++, Basic elements of FORTRAN 90/95 or C++: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran 90/95 or C++ Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.

Control Statements

Types of Logic (Sequential, Selection, Repetition), Branching Statements, Looping Statements, Jumping Statements, Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems.

Programming

1. Exercises on syntax on usage of FORTRAN 90/95 or C++
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN 90/95 or C++.
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.

5. Calculating Euler number using exp(x) series evaluated at x=1

Scientific word processing: Introduction to LaTeX

TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. Equation representation: Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors.

Visualization

Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot

Hands on exercises

1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate sum of finite series and the area under a curve.
3. To find the product of two matrices
4. To find a set of prime numbers and Fibonacci series.
5. To write program to open a file and generate data for plotting using Gnuplot.
6. Plotting trajectory of a projectile projected horizontally.
7. Plotting trajectory of a projectile projected making an angle with the horizontally.
8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
9. To find the roots of a quadratic equation.
10. Motion of a projectile using simulation and plot the output for visualization.
11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
12. Motion of particle in a central force field and plot the output for visualization.

Reference Books

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
- Computer Programming in Fortran 90 and 95. V. Rajaraman, 1997 (Publisher: PHI).
- Object Oriented Programming with C++. E. Balaguruswamy, 2017. McGraw Hill, India.
- LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
- Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)

- Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
- Computational Physics: An Introduction, R.C. Verma, et al. New Age International Publishers, New Delhi(1999)
- A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning
- Elementary Numerical Analysis, K.E. Atkinson, 3 rd Edn., 2007, Wiley India Edition.

Syllabus of Choices Offered by Physiology Discipline for B.Sc. Program under Choice Based Credit System (CBCS)

West Bengal State University

Course Curriculum for Physiology General under Choice Based Credit System

- All general courses will have3subjects/disciplines of interest. Student will select4corecourseseachfrom discipline of choice including Physiology as one of the disciplines.
- Student will select 2 elective courses each from discipline of choice including Physiology as one of the disciplines.
- Student may also choose skill enhancement courses in Physiology.

Summary of the Syllabus

Semester I

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses (+2 from allied disciplines)	**PHYGCOR01T** Nutrition, Metabolism & Gastrointestinal Functions	4	**PHYGCOR01P** Nutrition, Metabolism & Gastrointestinal Functions	2	6 X 3 =18(Including allied disciplines)
Ability Enhancement Courses	**ENVSAEC01T** Environmental Science	2			2
					20

Semester II

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses (+2 from allied disciplines)	**PHYGCOR02T**Circulation, Respiration & Excretion	4	**PHYGCOR02P** Circulation, Respiration & Excretion	2	6 X 3 =18
Ability Enhancement Courses	**ENGSAEC02M** English/MIL Communication	2			2
					20

Semester III

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses (+2 from allied disciplines)	**PHYGCOR03T** Nervous System & Special Senses	4	**PHYGCOR03P** Nervous System & Special Senses	2	6 X 3 =18
Skill Enhancement Courses	**PHYSSEC01M** Haematological techniques (OR FROM OTHER DISCIPLINES)	2	**PHYSSEC01M** Haematological techniques (OR FROM OTHER DISCIPLINES)		2
					20

Semester IV

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses (+2 from allied disciplines)	**PHYGCOR04T** Endocrinology &Reproduction	4	**PHYGCOR04P** Endocrinology & Reproduction	2	6 X 3 =18
Skill Enhancement Courses	**PHYSSEC02M** Diet Survey(OR FROM OTHER DISCIPLINES)	2	**PHYSSEC02M** Diet Survey(OR FROM OTHER DISCIPLINES)		2
					20

Semester V

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Skill Enhancement Courses	**PHYSSEC01M** Hematological Techniques(OR FROM OTHER DISCIPLINES)		**PHYSSEC01M** Hematological Techniques(OR FROM OTHER DISCIPLINES)		2
Discipline Specific Elective Course (ANY ONE) (+2 from allied disciplines)	**PHYGDSE01T** Biological Statistics	4	**PHYGDSE01P** Biological Statistics	2	6 X 3 =18
	PHYGDSE02T SportsandExercisePhysiology	4	**PHYGDSE02P** SportsandExercisePhysiology	2	
					20

Semester VI

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits

Skill Enhancement Courses	**PHYSSEC02M** Diet Survey(OR FROM OTHER DISCIPLINES)		**PHYSSEC02M** Diet Survey(OR FROM OTHER DISCIPLINES)		**2**
Discipline Specific Elective Course (ANY ONE) (+2 from allied disciplines)	**PHYGDSE03T** Community Nutrition andPublicHealth	**4**	**PHYGDSE01P**Communit y Nutrition andPublicHealth	**2**	**6**
	PHYGDSE04T Environme ntal Pollution and HumanHealth	**4**	**PHYGDSE04P**Environme ntal Pollution and HumanHealth	**2**	
					20

CoursesofB.Sc.GeneralPhysiologyunderCBCS

Core Courses

1. Nutrition, Metabolism & Gastrointestinal Functions
2. Circulation, Respiration &Excretion
3. Nervous System & Special Senses
4. Endocrinology & Reproduction

Ability EnhancementCourse(AEC) (Compulsory)

1. Environmental Science

2.English/MILCommunication/Bengali

ElectiveCourse (EC)(anytwo)

Discipline Specific Electives (GDSE)	1. Biological Statistics 2. Community Nutrition & Public Health 3. SportsandExercisePhysiology 4. Environmental Pollution and HumanHealth
SkillEnhancementCourse(SEC) 1. Hematological Techniques 2.DietSurvey andformulation ofDietChart	

Summary of the Syllabus

1. Eachsemesterwillconsistof15-18weeksofacademicworkequivalentto90actualteaching days.
2. OneCreditisequivalenttoone(1)hourofteaching(lecture)ortwohoursofPracticalwork perweek.

Total creditsin SemesterI:6 (forPhysiology)+2(Compulsory)=(6+2)=8=(8—2)=6 forPhysiology only
3.Numbersinparentheses indicatevalueofcredit.

Details of Courses:

Components of Core Courses

PHYGCOR01T: Nutrition, Metabolism & Gastrointestinal Functions	4 Credits

Enzymes :(6 hours)

Classification, coenzymes, cofactor, Prosthetic Groups. Mechanism of enzyme action: activation energy, enzyme-substrate complex, transition state. Michaelis constant, Michaelis-Menten equation, Hyperbolic kinetics, Significance of Km and Vmax. Enzyme Inhibition: Competitive, noncompetitive, uncompetitive. Factors regulating enzyme activities: substrate concentration, enzyme concentration, pH and temperature. Isoenzymes, Allosteric enzymes, Ribozymes, Abzymes, Concept of Rate limiting enzymes.

Chemistry of Biomolecules: (14 hours)

Classification, structure, Properties and Functions of Carbohydrates, Proteins and lipids. Structure, types and Function of DNAs and RNAs.

Nutrition& Metabolism: (20 hours)

Carbohydrate metabolism. Protein metabolism. Fat metabolism. Nutrition – BMR, RQ, RDA, SDA, NPU, Biological value of proteins. Vitamins: A, C, D, E, K, B12. Minerals: Sodium, Potassium, Calcium, Iron, Iodine, Fluorine.

Gastrointestinal Functions: (20 hours)

1. **Digestion & aborption** Introduction, carbohydrates, Proteins & Nucleic Acids, Lipids.
2. **Regulation of Gastrointestinal Function**
   General Considerations, Gastrointestinal hormones, Mouth & Esophagus, Stomach, Digestive Function of the Stomach. Exocrine Portion of the Pancreas, Liver & Biliary System, Small Intestine, Colon.

PHYGCOR01P: Nutrition, Metabolism & Gastrointestinal Functions Lab	2 Credits

Biological Chemistry:

Qualitative tests for the identification of physiologically important substances: Hydrochloric acid, lactic Acid, Uric Acid, Glucose, Galactose, Fructose, Sucrose, Lactose, Albumin, Gelatin, Peptone, Starch, Dextrin, Urea, Glycerol, Bile salts.

Biochemical Estimation:

Quantitative estimation of glucose and sucrose by Benedict's method. Quantitative estimation of amino nitrogen [Sorensen's formol titration method (percentage as well as total quantity to be done)]. Estimation of percentage quantity of lactose in milk by Benedict's method.

Demonstration:Dale's Experiments : Kymographic recording of normal movements of rat's intestine in Dale's apparatus. Effects of hypoxia, acetylcholine and adrenaline on normal intestinal movements.

AbilityEnhancementCourse(AEC) (Compulsory)

1. Environmental science
2. English/MILcommunication

SEMESTER-II

PHYGCOR02T **Circulation, Respiration & Excretion**	**4 Credits**

Circulation (25 hours)

1. **Origin of the Heartbeat & the Electrical Activity of the heart** Introduction,
   Origin & Spread of Cardiac Excitation, The Electrocardiogram, Cardiac Arrhythmias, Hypertrophy and cardiac myopathy.
2. **The Heart as a Pump** Introduction,
   Mechanical Events of the Cardiac Cycle, Cardiac Output.
3. **Dynamics of Blood & Lymph Flow** Introduction,
   Introduction, Blood, Bone Marrow, White Blood Cells, Platelets, Red Blood Cells, Hemostasis: factors, mechanism. Hemoglobin. Anatomic Considerations: artery, vein, capillaries. Lymphatic Circulation & Interstitial Fluid Volume.
4. **Cardiovascular regulatory Mechanisms** Introduction,
   Local Regulatory Mechanisms, Regulation by Hormones, Systemic Regulation by the Nervous System.
5. **Circulation Through Special Regions** Introduction,
   Coronary Circulation, Circulation of the skin, Placental & Fetal Circulation.

Respiration (20 Hours)

1. **Pulmonary Function**
   Anatomy of the Lungs, Mechanics of breathing, Gas Exchange in the lungs, Pulmonary Circulation, Other Functions of the Respiratory System.
2. **Gas Transport Between the Lungs & the Tissues**
   Introduction, Oxygen Transport, Carbon Dioxide Transport,
   Respiratory acidosis and alkalosis.
3. **Regulation of Respiration**

Neural control of Breathing, Chemical Control of Breathing.

4. **Respiratory Adjustments in Health & Disease**
   Forms of Hypoxia, Hypercapnia & Hypocapnia,Artificial Respiration.

Excretion (15 hours)

Renal Function & Micturition Introduction,
Juxta Glomerular Apparatus, Function of Malpighian corpuscles and renal tubule, counter-current mechanism, Water Excretion, Acidification of the Urine & Bicarbonate Excretion, Regulation of Na+ & Cl- Excretion, Renal Circulation, Disorders of Renal Functions, Filling of the Bladder, Emptying of the Bladder, Non-excretory function of kidney.

PHYGCOR02P Circulation, Respiration & Excretion Lab	2 Credits

Circulation: Sphygmomanometric measurement of arterial blood pressure at rest and after exercise. Modified Harvard step test and determination of physical fitness. Recording of recovery heart-rate after standard exercise and graphical plotting.

Respiration: Pneumographic recording of effects of talking, drinking, laughing, coughing, exercise, hyperventilation and breath - holding.
Demonstration: Measurement of oxygen saturation by pulse oxymeter before and after exercise.Measurement of peak expiratory flow rate. Measurement of forced expiratory volume (FEV) in first second. **Cardiovascular Experiments:** Preparation of Amphibian Ringer solution. Kymographic recording of the movements of perfused heart of toad. Study of the effects of changes in perfusion fluid pressure, changes in temperature, excess calcium and potassium ion concentration, acetylcholine, adrenaline on the movement of heart. **Renal biochemistry:** Identification of normal and abnormal constituents of urine.**Hematological Experiments:**Differential count of WBC.Total count of RBC and WBC.Preparation and staining of bone marrow.Measurement of diameter of megakaryocyte.Reticulocyte staining.

AbilityEnhancementCourse(AEC) (Compulsory)

1. Environmental science
2. English/MILcommunication

SEMESTER-III

PHYGCOR03T: Nervous system & Special senses	4 Credits

Nerve & Muscle (20 hours)

1. **Excitable Tissue: Nerve** Introduction,
   Nerve Cells, Excitation & Conduction, Measurement of Electrical Events, Ionic Basis of Excitation & Conduction, Properties of Mixed Nerves, Nerve Fiber Types
2. **Excitable Tissue: Muscle** Introduction,
   Skeletal Muscle: Morphology, Electrical Phenomena & Ionic Fluxes, Contractile Responses, Properties.
   Cardiac Muscle: Morphology, Electrical Properties, Mechanical Properties Pacemaker Tissue,
   Smooth Muscle: Morphology.
3. **Synaptic & Junctional Transmission** Introduction,
   Synaptic Transmission: Functional Anatomy, Electrical Events at Synapses, Inhibition & Facilitation at Synapses, Chemical Transmission of Synaptic Activity.
4. **Initiation of Impulses in Sense Organs** Introduction,
   Sense Organs & Receptors, The Senses, Electrical & Ionic Events in Receptors, "Coding" of Sensory Information.

Nervous system (25 hours)

1. **Reflexes** Introduction, Monosynaptic Reflexes: The Stretch Reflex,
   Polysynaptic Reflexes: The Withdrawal Reflex, General Properties of Reflexes.
2. **Cutaneous, Deep & Visceral Sensation** Introduction,
   Pathways Touch, Proprioception, Temperature, Pain.
3. **Arousal Mechanisms, Sleep, & the Electrical Activity of the Brain**
   The Reticular Formation & the Reticular Activating System, The Thalamus & the Cerebral Cortex: structure & functions. The Electroencephalogram, Physiological Basis of the EEG & Sleep, Interpretation of abnormal EEG pattern.
4. **Control of Posture & Movement** Introduction, General Principles,
   Basal Ganglia & Cerebellum: Structure & functions. Movement disorders.
5. **The Autonomic Nervous System** Introduction,
   Anatomic Organization of Autonomic Outflow, Chemical Transmission at autonomic Junctions.
6. **Central Regulation of Visceral Function** Introduction,
   Hypothalamus: Anatomic Considerations, Hypothalamic Function, Relation to Autonomic Function, Relation to Sleep, Hunger, Thirst, Control of Posterior Pituitary Secretion, Control of Anterior pituitary Secretion, Temperature Regulation, fever.
7. **Neural Basis of Instinctual Behavior & Emotions** Introduction,
   Limbic system: Anatomic Considerations, Functions - Sexual Behavior, Fear & Rage, Motivation,

Special sense (15 hours)

Vision: Anatomic Considerations, The Image-Forming Mechanism (accommodation and visual acuity), The Photoreceptor Mechanism: Genesis of Electrical Responses, Visual Pathways and effects of lesions of these pathways, Color Vision, Errors in visual process.
Hearing & Equilibrium: Introduction, Anatomic considerations, Hair cells, Mechanism of hearing, Vestibular function.

Smell & Taste: Introduction, Smell: Receptors & Pathways. Taste: Receptor Organs & Pathways.

PHYGCOR03P Nervous system & Special Senses Lab	2 Credits

Histological Study, Experiment of Nerve and Muscle:

Isolation and Staining of nerve fibres with node(s) of Ranvier ($AgNO_3$) and muscle fibres (H and E).

Measurement of grip strength. Determination of visual acuity by Snellen's chart / Landolt's C chart. Determination of colour blindness by Ishihara chart.

Demonstration: Study of Kymograph, Induction coil, Key and other instruments used to study mechanical responses of skeletal muscle. Kymographic recording of mechanical responses of gastrocnemius muscle to a single stimulus and two successive stimuli. Kymographic recording of the effects of variations of temperature and load (after-load) on single muscle twitch. Calculation of work done by the muscle. Determination of nerve conduction velocity. **Neurological experiments:** Experiments on superficial (plantar) and deep (knee jerk) reflex. Reaction time by stick drop test. Short term memory test (shape, picture word). Two point discrimination test. Principles of fixation and staining, Staining and identification of fixed endocrine glands and nervous tissue.

Skill Enhancement Course (SEC)

PHYSSEC01M Hematological Techniques	2 Credits

Preparation of blood smear and identification of blood cells. Preparation of haemin crystal. Bleeding time, clotting time. Measurement of haemoglobin in blood. Preparation of serum, Blood group determination.

SEMESTER-IV

PHYGCOR04T: Endocrinology & Reproduction	4 Credits

Endocrinology:(30 hours)

1. **The Thyroid Gland** Introduction, Anatomic Considerations,
   Formation & Secretion of Thyroid Hormones, Transport of Thyroid Hormones, Effects of Thyroid Hormones, Clinical Correlates.
2. **Endocrine Functions of the Pancreas & the Regulation of Carbohydrate Metabolism** Introduction,
   Islet Cell Structure, Structure, Biosynthesis, & Secretion of Insulin, Effects of Insulin, Insulin Excess,Glucagon, Hypoglycemia & Diabetes Mellitus in Humans.
3. **The Adrenal Medulla & Adrenal Cortex** Introduction,
   Adrenal Morphology, Adrenal Medulla, Structure & Function of Medullary Hormones, Adrenal Cortex, Structure & Biosynthesis of Adrenocortical Hormones, Effects of

Adrenal Androgens & Estrogens, Physiologic Effects of Glucocorticoids, Effects of Mineralocorticoids, Summary of the effects of Adrenocortical Hyper & Hypofunction in Humans.

4. **Hormonal Control of Calcium Metabolism & the Physiology of Bone** Introduction, The Parathyroid Glands: Structure, hormone, functions. Calcitonin. Role on Calcium & Phosphate Metabolism,
5. **The Pituitary Gland** Introduction, Morphology, Posterior pituitary hormones, Growth Hormone, Pituitary Hyper- and hypo-function.
6. **Endocrine Functions of the Kidneys, Heart, & Pineal Gland** Introduction, The Renin-Angiotensin System, Erythropoietin, The Endocrine Function of the Heart: Atrial Natriuretic Peptide.

Reproduction: (30 hours)

The male reproductive System: Structure, Gametogenesis, Endocrine Function of the Testes, Control of Testicular Function, Abnormalities of Testicular Function, The Female Reproductive system: The Menstrual Cycle, Ovarian Hormones, Control of Ovarian Function, Abnormalities of Ovarian Function, Pregnancy: Physiological changes during pregnancy. Placenta: Structure & functions. Puberty, Precocious & Delayed Puberty, Menopause, Pituitary Gonadotropins & Prolactin,

PHYGCOR04P: Endocrinology & Reproduction Lab	2 Credits

Histology

Study and Identification of Stained Sections of Different Mammalian Tissues and Organs:

Trachea, Lungs, Spleen, Lymph gland, Esophagus, Stomach, Duodenum, Ileum, Jejunum, large Intestine, Liver, Kidney, Salivary glands, Pancreas, Adrenal gland, Thyroid gland, Testes, Ovary, Spinal Cord, Cerebral cortex, Cerebellum, Skin, Cardiac muscle, Skeletal muscle, Smooth muscle, Artery, Vein, Tongue.

Demonstration: Study of the effects of oxytocin on uterine contraction. Study of the effects of adrenaline on intestinal / uterine movements. Study of estrous cycle. Staining and identification of kidney and ureters. Estimation of estrogen by spectrophotometric method. Pregnancy test from human urine by kit method.

Skill Enhancement Course (SEC)

PHYSSEC02M: Diet survey and Formulation of diet chart	2 Credits

Survey of dietary status of people in the nearby area by the students, analysis of survey results, and, formulation of diet chart.

SEMESTER-V

Skill Enhancement Course (SEC)

PHYSSEC01M Hematological Techniques	2 Credits

Preparation of blood smear and identification of blood cells. Preparation of haemin crystal. Bleeding time, clotting time. Measurement of haemoglobin in blood. Preparation of serum, Blood group determination.

PHYADSE01T : Biological Statistics	4 Credits

Scope of statistics – Principles of statistical analysis of biological data. Basic concepts – variable, parameter, statistics. Sampling. Presentation of data-frequency distribution, frequency polygon, histogram, bar diagram and pie diagram. Parameters. Different classes of statistics- mean, median, mode, mean deviation, variance, standard deviation, standard error of mean. Standard score.Degrees of freedom. Probability. Normal distribution. Student's t-distribution. Testing of hypothesis - Null hypothesis, errors of inference, levels of significance, Students' 't' test and z score for significance of difference. Distribution-free test - Chi-square test.

PHYADSE01T : Biological Statistics Lab	2 Credits

Computation of mean, median, mode, standard deviation and standard error of the mean with physiological data like body temperature, pulse rate, respiratory rate, height and weight of human subjects. Graphical representation of data in frequency polygon and histogram. Student's 't' test for significance of difference between means. Demonstration: Statistical analysis and graphical representation of biological data with computer using One way ANOVA etc.

PHYADSE02T Sports and Exercise Physiology	4 Credits

Importance of regular exercise in health and wellbeing. Basic concept of Bioenergetics, Energy sources during exercise (Phosphagen, Anaerobic system and Aerobic system). Cardio-respiratory responses during different grades of exercise. Concept of excess post exercise oxygen consumption (EPOC), physiological fatigue and recovery. Aerobic work Capacity: Measurement, physiological factors and applications. Training: Principles of physical training, Training to improve aerobic and anaerobic power. Effect of overtraining and detraining. Nutritional supplements and ergogenic aids.Sports injury and its' management. Basic idea sports rehabilitation and sports medicine.

PHYADSE02P Sports and Exercise Physiology Lab	2 Credits

Measurement of blood pressure before and after different grades of exercise. Recording of recovery heart-rate after standard exercise. Determination of VO2max by queen college step test. Measurement of body fat percentage.Six minute walk test. Determination of endurance time by hand grip dynamometer.

SEMESTER-VI

Skill Enhancement Course (SEC)

PHYSSEC02M: Diet survey and Formulation of diet chart	2 Credits

Survey of dietary status of people in the nearby area by the students, analysis of survey results, and, formulation of diet chart.

Discipline Specific Electives (DSE) (Any one)

PHYADSE03T Community Nutrition and Public Health	4 Credits

Principles of human nutrition – relationship between nutrition, health & disease.
Balanced diet, Diet survey, Concept of ACU,Nutritional classification, Digestive absorption, metabolism of carbohydrates, proteins and lipids.
Composition and nutritional value of common Indian foodstuff, rice, wheat, pulses, egg, meat, fish and milk. Dietary fibers. Calorie requirement.
Principles of formulation of balanced diets for growing child, adult man and woman, pregnant and lactating woman.
Diet management of obese, diabetic, hypertensive person and athlete. Basic idea on PCM, marasmus, kwashiorkor and their prevention.

Recommended dietary allowances, malnutrition and chronic energy, LBW, PEM, Xerophthalmia, IDD, Iron and iodine deficiency, micronutrient disorders.
Food toxicity,
Effect of processing on nutritive values of foods
Socioecology of nutrition, Habitual diets in India and their adequacy
Basic idea about community health and public health issues.
Sound pollution as a community health issue; definition, concept of noise, source of extraordinary sound, effects of sound pollution on human health, noise index (noise standards).

PHYADSE03T Community Nutrition and Public Health Lab	2 Credits

Qualitative assessment of noise, survey on the status of dietary intake in the surrounding area through visits, etc.

PHYADSE06T: Environmental Physiology	4 Credits

Environmental Pollutions and Health Hazards

Definition: hygiene, health and public health.
Air, Water, Food Borne Diseases: causes, symptoms and control.
Food Additives and Adulterants: definition, examples and human health hazards.
Vector Borne Epidemic Diseases: Malaria and Plague-etiology and control.

Air Pollution: definition, sources, air pollutants, effects of air pollution on human health, concept of ozone hole, green house effects and global warming.
Water Pollution: definition, types, health hazards, water pollutants, biochemical oxygen demand (BOD), thermal pollution, concept of safe drinking water standards.
Soil Pollution:causes, health hazards, solid waste management, bioremediation, phytoremediation.
Sound Pollution: definition, concept of noise, source of sound pollution, effects of sound pollution on human health, noise index (noise standards).
Radionuclide Pollution: ionizing radiations, effects of ionizing radiation on human health, permissible doses.

Arsenic Pollution: sources, sources of arsenic in ground water, drinking water standard forarsenic (WHO, USEPA), health effects of chronic arsenic poisoning.

Environmental management

Environmental ethics.

Conservation of topsoil, ground water and wild lives; rain water harvesting; sanctuary, national park, biosphere reserve, wildlife (conservation) Act, 1992.

PHYADSE06P: Environmental Physiology Lab	**2 Credits**

Determination of sound levels by sound level meter and noise index.

Determination of dissolve oxygen in the supplied water samples-supplied water, ground water extracted by shallow and deep tube wells, stream waters, pond water etc. Detection of food additives in different food samples.

Demonstration of kymographic recording of the effects of food additives on the movement of perfused heart of toad and intestinal movements of rat in Dale's bath.

Biochemical estimation of serum glucose, total proteins, SGPT and SGOT

Syllabus for Physiology Honours

Choice Based Credit System

(CBCS)

West Bengal State University

Framework of CBCS in Physiology Honours (B.Sc., Hons. in Physiology)

	Core course (14)	**Ability Enhancement Compulsory Course (AECC) (2)**	**Skill Enhancement Course (SEC) (2)**	**Elective: Discipline Specific (DSE) (4)**	**Elective for Hons: Generic Course (GEC) (4)**
I	**PHYACOR01** **PHYACOR02**	Environmental Sciences			**PHYHGEC01**
II	**PHYACOR03** **PHYACOR04**	(English /MIL)			**PHYHGEC02**
III	**PHYACOR05** **PHYACOR06** **PHYACOR07**		**PHYSSEC01M**		**PHYHGEC03**
IV	**PHYACOR08** **PHYACOR09** **PHYACOR10**		**PHYSSEC02M**		**PHYHGEC04**
V	**PHYACOR11** **PHYACOR12**			**PHYADSE01** **PHYADSE02** **PHYADSE03** (any two)	
VI	**PHYACOR13** **PHYACOR14**			**PHYADSE04** **PHYADSE05** **PHYADSE06** (any two)	

Courses of B.Sc. Honours Physiology under CBCS

Core Courses	1. Cellular Basis of Physiology 2. Biological Physics and Enzymes 3. Physiology of Nerve and Muscle Cells 4. Chemistry of Biomolecules 5. Circulating Body Fluids 6. Circulation 7. Functions of Nervous system 8. Energy Balance, Metabolism and Nutrition 9. Gastrointestinal Function 10. Respiration 11. Special Senses 12. Endocrinology 13. Reproductive Function 14. Formation and Excretion of Urine
Ability Enhancement Course (AEC) (Compulsory)	1. Environmental Science 2. English/MIL Communication
Generic Elective Course (HGEC)	1. Nutrition, Metabolism & Gastrointestinal Functions Circulation, Respiration, Excretion 2. Nervous system & Special senses 3. Endocrinology & Reproduction ~~4.~~

Skill Enhancement Course (SEC) (two)	1. Hematological Techniques 2. Diet Survey and formulation of Diet Chart
Discipline Specific Elective Course (ADSEC) (Any Four)	1. Biological Statistics 2. Microbiology and Immunology 3. Sports and Exercise Physiology 4. Human Nutrition and Dietetics 5. Genetics and Molecular Biology 6. Environmental Physiology

Summary of the Syllabus

Semester 1

(A) Core Courses (COR)

Theoretical (T)	Practical (P)
PHYACOR01T. Cellular Basis of Physiology (4) **PHYACOR02T**. Biological Physics and Enzymes (4)	**PHYACOR01P** Cellular Basis of Physiology (2) **PHYACOR02P**. Biological Physics and Enzymes (2)

(B) Ability Enhancement Courses (AEC)

ENVSAEC01T Environmental Science (2)

(C) Generic Elective Course for Hons (HGEC)

From Related Discipline

1. Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days.
2. One Credit is equivalent to one (1) hour of teaching (lecture) or two hours of Practical work per week.
   Total credits in Semester I: [(4X2)]+(2X2)]+(2X1)+(4+2)=[8+4]+2+6 =20
3. Numbers in parentheses indicate value of credit.

Semester II

(A) Core Courses (COR)

Theoretical (T)	Practical (P)
PHYACOR03T. Physiology of Nerve and Muscle Cells (4) **PHYACOR04T**. Chemistry of Biomolecules (4)	**PHYACOR03P**. Physiology of Nerve and Muscle Cells(2) **PHYACOR04P**. Chemistry of Biomolecules (2)

(B) Ability Enhancement Courses (AEC)

ENGSAEC02M English/MIL Communication (1)

(C) Generic Elective Course for Hons (HGEC)

From related discipline
Total credits: [(4X2)]+(2X2)]+(2X1)+(4+2)=[8+4]+2+6=20

Semester III

(A) Core Courses (COR)

Theoretical (T)	Practical (P)
PHYACOR05T Circulating Body Fluids (4) **PHYACOR06T**. Circulation (4) **PHYACOR07T**. Functions of Nervous System (4)	**PHYACOR05P.** Circulating Body Fluids (2) **PHYACOR06P**. Circulation (2) **PHYACOR07P.** Functions of Nervous System (2)

(B) Skill Enhancement Courses (SEC)

PHYSSEC01M Haematological techniques (1)

(C) Generic Elective Course for Hons (HGEC)

From related discipline
Total credits:[12+6]+2+(4+2) =26

Semester IV

(A) Core Courses (COR)

Theoretical (T)	Practical (P)
PHYACOR08T. Energy Balance, Metabolism and Nutrition (4) **PHYACOR09T**. Gastrointestinal Function (4)	**PHYACOR08P**. Energy Balance, Metabolism and Nutrition (2) **PHYACOR09P**. Gastrointestinal Function (2)
PHYACOR10T. Respiration (4)	**PHYACOR10P**.. Respiration (2)

(B) Skill Enhancement Courses (SEC)

PHYSSEC002 ……..Diet Survey (1)

(C) Generic Elective Course for Hons (HGEC)

From related discipline
Total credits:[12+6]+2+(4+2) =26

Semester V

(A) Core Courses (COR)

Theoretical (T)	Practical (P)
PHYACOR11T. Special Senses (4) **PHYACOR12T**. Endocrinology (4)	**PHYACOR11P**.. Special Senses (2) **PHYACOR12P**.. Endocrinology (2)

(B) Discipline Specific Elective for Honours (ADSE) (any two)

Theoretical (T)	Practical (P)
PHYADSE01T. Biological Statistics (4) PHYADSE02T Microbiology and Immunology (4) PHYADSE03T Sports and Exercise Physiology	PHYADSE01P …. Biological Statistics (2) PHYADSE02P Microbiology and Immunology (2) PHYADSE03P Sports and Exercise Physiology

Total credits:[8+4]+(6X2) =24

Semester VI

(A) Core Courses (COR)

Theoretical (T)	Practical (P)
PHYACOR13T. Reproductive Function (4) **PHYACOR14T**. Formation and Excretion of Urine (4)	**PHYACOR13P**.. Reproductive Function (2) **PHYACOR14P**.. Formation and Excretion of Urine (2)

(B) Discipline Specific Elective for Honours (ADSE) (Any two)

Theoretical (T)	Practical (P)
PHYADSE04T Human Nutrition and Dietetics (4) **PHYADSE05T** Genetics and Molecular Biology (4) **PHYADSE06T**Environmental Physiology	**PHYADSE04P** Human Nutrition and Dietetics (2) **PHYADSE05P** Genetics and Molecular Biology (2) **PHYADSE06P**Environmental Physiology (2)

Total credits:[8+4]+(6X2) =24

Summary of the Syllabus

Semester I

Courses/ Papers	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses	**PHYACOR01T** Cellular Basis of Physiology	4	**PHYACOR01P** Cellular Basis of Physiology	2	6
	PHYACOR02T Biological Physics and Enzymes	4	**PHYACOR02P.** Biological Physics and Enzymes	2	6
Ability Enhancement Course	**ENVSAEC01T** Environmental Science	2			2
Generic Elective	**From related discipline**				6
					20

Semester II

Courses/ Papers	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses	**PHYACOR03T** Physiology of Nerve and Muscle Cells	4	**PHYACOR03P** Physiology of Nerve and Muscle Cells	2	6
	PHYACOR04T Chemistry of Biomolecules	4	**PHYACOR04P** Chemistry of Biomolecules	2	6
Ability Enhancement Courses					
	ENGSAEC02M English/MIL Communication	2			2
Generic Elective	**From related discipline**				6
					20

Semester III

Courses/Papers	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses	**PHYACOR05T** Circulating Body Fluids	4	**PHYACOR05P** Circulating Body Fluids	2	6
	PHYACOR06T Circulation	4	**PHYACOR06P**Circulation	2	6

	PHYACOR07T Functions of Nervous System	**4**	**PHYACOR07P** Functions of Nervous System	**2**	**6**
Skill Enhancement Courses	**PHYSSEC01M** Haematological techniques		**PHYSSEC01M** Haematological techniques		**2**
Generic Elective	**From related discipline**				**6**
					26

Semester IV

Courses/Papers	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses	**PHYACOR08T** Energy Balance, Metabolism and Nutrition	**4**	**PHYACOR08P** Energy Balance, Metabolism and Nutrition	**2**	**6**
	PHYACOR09T Gastrointestinal Function	**4**	**PHYACOR09P** Gastrointestinal Function	**2**	**6**
	PHYACOR10T Respiration	**4**	**PHYACOR10P** Respiration	**2**	**6**
Skill Enhancement Courses	**PHYSSEC002M** Diet Survey		**PHYSSEC002M** Diet Survey		**2**
Generic Elective	**From related discipline**				**6**
					26

Semester V

Courses/Papers	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses	**PHYACOR11T** Special Senses	**4**	**PHYACOR11P** Special Senses	**2**	**6**
	PHYACOR12T Endocrinology	**4**	**PHYACOR12P** Endocrinology	**2**	**6**
Discipline Specific Electives (Any two)	**PHYADSE01T** Biological Statistics	**4**	**PHYADSE01P** Biological Statistics	**2**	**6**
	PHYADSE02T Microbiology and Immunology	**4**	**PHYADSE02P**Microbiology and Immunology	**2**	**6**

	PHYADSE03T Sports and Exercise Physiology	**4**	**PHYADSE03P** Sports and Exercise Physiology	**2**	**6**
					24

Semester VI

Courses/Papers	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses	**PHYACOR13T** Reproductive Function	**4**	**PHYACOR13P** Reproductive Function	**2**	**6**
	PHYACOR14T Formation and Excretion of Urine	**4**	**PHYACOR14P** Formation and Excretion of Urine	**2**	**6**
Discipline Specific Electives (Any two)	**PHYADSE04T** Human Nutrition and Dietetics	**4**	**PHYADSE04P** Human Nutrition and Dietetics	**2**	**6**
	PHYADSE05T Genetics and Molecular Biology	**4**	**PHYADSE05P** Genetics and Molecular Biology	**2**	**6**
	PHYADSE06T Environmental Physiology	**4**	**PHYADSE06P** Environmental Physiology	**2**	**6**
					24

Details of Courses :

Components of Core Courses

PHYACOR01T: Cellular Basis of Physiology	4 Credits

Introduction,
Body Fluid Components,
Organ Systems, Tissues, and Cells,
Functional Morphology of Cell,
Transport Across cell Membranes,
Cell Signaling
Capillary Wall,
Intercellular Communication,
Cell Cycle,
Cell Division- Mitosis,
Meiosis
Homeostasis,
Aging.

PHYACOR01P: Cellular Basis of Physiology Lab	2 Credits

Histology:

Study and Identification of Stained Sections of Different Mammalian Tissues and Organs:

Bone, Cartilage, Trachea, Lungs, Spleen, Lymph gland, Esophagus, Stomach, Duodenum, Ileum, Jejunum, large Intestine, Liver, Kidney, Ureter, Salivary glands, Pancreas, Adrenal gland, Thyroid gland, Testes, Ovary, Spinal Cord, Cerebral cortex, Cerebellum, Skin, Cardiac muscle, Skeletal muscle, Smooth muscle, Artery, Vein, Tongue, Uterus.

PHYACOR02T: Biological Physics and Enzymes	4 Credits

A study of units for Measuring Concentration of solutes: Moles, Equivalents, Osmoles; Principles of dilution, pH, Buffers, Bonds and Forces in Biomolecules, Colloids: Properties, Importance, Surface tension, Specific Gravity,

Viscosity and Resistance,
Acids, Bases, Buffers, and pH,
Flow and Pressure,

Dialysis and Ultracentrifugation,
Chromatography,
Electrophoresis,
Autoradiography,

Cell Fractionation and Tracer Techniques,
Nanoparticles and its application in Physiology,
Laminar and Streamline flow, Poiseuille-Hagen
Formula,
Laws of Laplace,

Thermodynamics :
- Laws ,
- Application in Physiology,

Osmosis and Diffusion,
Enzymes :
- Structure, coenzymes, Prosthetic Groups,
  Mechanism of enzyme action,
- Kinetics, Michaelis
  constant, Enzyme
  Inhibition,

Modulation of Enzymes Activities,
Factors regulating enzyme activities,

Isoenzymes, Allosteric enzymes,
Pro- enzymes,
Ribozymes, Abzymes,
Concept of Rate limiting enzymes.

PHYACOR02P: Biological Physics and Enzymes Lab	2 Credits

Biological Physics and Enzymes :

Determination of oncotic pressure of colloidal solutions; Determination of Systolic, Diastolic, Pulse and Mean Blood Pressure by non-invasive methods (Auscultatory Methods).
Determination of enzyme activities (e.g., SOD, CAT, Amylase, Transaminases etc.).

PHYACOR03T: Physiology of Nerve & Muscle Cells	4 Credits

1. **Excitable Tissue: Nerve**
   Introduction,
   Nerve Cells,
   Excitation & Conduction, Measurement of Electrical Events, Ionic Basis of Excitation & Conduction, Properties of Mixed Nerves,
   Nerve Fiber Types & Function,
   Neurotrophins, Glia.
2. **Excitable Tissue: Muscle**
   Introduction,
   Skeletal Muscle
   Morphology,
   Electrical Phenomena & Ionic Fluxes,
   Contractile Responses,
   Energy Sources & Metabolism,
   Properties of Muscle in the Intact Organism,
   Cardiac Muscle
   Morphology, Electrical Properties, Mechanical Properties , Metabolism,
   Pacemaker Tissue,
   Smooth Muscle
   Morphology,
   Visceral Smooth Muscle,
   Multi-Unit Smooth Muscle.
3. **Synaptic & Junctional Transmission**
   Introduction,
   Synaptic Transmission: Functional Anatomy, Electrical Events at Synapses,
   Inhibition & Facilitation at Synapses,
   Chemical Transmission of Synaptic Activity,
   Principal Neurotransmitter Systems,
   Synaptic Plasticity & Learning,
   Neuromuscular Transmission,
   Neuromuscular Junction, Denervation Hypersensitivity.
4. **Initiation of Impulses in Sense Organs**
   Introduction,
   Sense Organs & Receptors,
   The Senses,
   Electrical & Ionic Events in Receptors,
   "Coding" of Sensory Information.
5. **Clinical Aspect of Nerve and Muscle Physiology**

PHYACOR03P: Physiology of Nerves and Muscle Cells Lab	2 Credits

Histological Study, Experiment of Nerve and Muscle:

Isolation and Staining of nerve fibres with node(s) of Ranvier ($AgNO_3$) and muscle fibres (H and E).
Preparation of sciatic nerve innervated gastrocnemius muscle of toad.
Study of Kymograph, Induction coil, Key and other instruments used to study mechanical responses of skeletal muscle.

Kymographic recording of mechanical responses of gastrocnemius muscle to a single stimulus and two successive stimuli.

Kymographic recording of the effects of variations of temperature and load (after-load) on single muscle twitch.

Calculation of work done by the muscle.

Determination of nerve conduction velocity.

PHYACOR04T: Chemistry of Biomolecules	**4 Credits**

Classification, structure, Properties and Functions of Carbohydrates, Proteins and lipids. Structure, types and Function of DNAs and RNAs.

PHYACOR04 P: Chemistry of Biomolecules Lab	**2 Credits**

Biological Chemistry:

Qualitative tests for the identification of physiologically important substances: Hydrochloric acid, lactic Acid, Uric Acid, Glucose, Galactose, Fructose, Sucrose, Lactose, Albumin, Gelatin, Peptone, Starch, Dextrin, Urea, Glycerol, Bile salts.

PHYACOR05T: Circulating Body Fluids	**4 Credits**

Introduction, Blood, Bone Marrow, White Blood Cells, Immune Mechanisms, Platelets, Red Blood Cells, Blood Types, Plasma, Hemostasis, Lymph, Clinical Implications. Hemoglobin.

PHYACOR05P: Circulating Body Fluids Lab	**2 Credits**

Hematological Experiments:

Preparation and staining of blood film with Leishman's stain.

Identification of the blood corpuscles.

Differential count of WBC.

Total count of RBC and WBC.

Bleeding time and clotting time.

Hemoglobin estimation.

Preparation of haemin crystal.

Preparation and staining of bone marrow.

Measurement of diameter of megakaryocyte.

Reticulocyte staining.

Blood group determination.

PHYACOR06T Circulation	**4 Credits**

1. **Origin of the Heartbeat & the Electrical Activity of the heart**
   Introduction,
   Origin & Spread of Cardiac Excitation,
   Electrocardiogram,
   Cardiac Arrhythmias,
   Electrocardiographic Findings in Other Cardiac & Systemic Diseases, hypertrophy and cardiac myopathy.
2. **The Heart as a Pump**
   Introduction,
   Mechanical Events of the Cardiac Cycle, Cardiac Output.
3. **Dynamics of Blood & Lymph Flow**
   Introduction,
   Anatomic Considerations,
   Biophysical Considerations, Arterial
   & Arteriolar Circulation, Capillary
   Circulation,
   Lymphatic Circulation & Interstitial Fluid Volume,
   Venous Circulation.
4. **Cardiovascular regulatory Mechanisms**
   Introduction,
   Local Regulatory Mechanisms, Substances
   Secreted by the Endothelium, Systemic
   Regulation by Hormones,
   Systemic Regulation by Nervous System.

5. **Circulation Through Special Regions**
   Introduction, Cerebral Circulation,
   Anatomic Considerations, Cerebrospinal fluid,
   The Blood-Brain barrier, Cerebral Blood Flow,
   Regulation of Cerebral Circulation,
   Brain Metabolism & Oxygen Requirements, Coronary Circulation ,
   Splanchnic Circulation, Circulation of the skin, Placental & Fetal Circulation.
6. **Cardiovascular Homeostasis in Health & Disease**
   Introduction,
   Compensation for Gravitational Effects, Exercise,
   Inflammation & Wound Healing, Shock,
   Hypertension, Heart Failure, stroke.

PHYACOR06P: Circulation Lab	**2 Credits**

Cardiovascular Experiments:

Preparation of Amphibian Ringer solution.

Kymographic recording of the movements of perfused heart of toad.

Study of the effects of changes in perfusion fluid pressure, changes in temperature, excess calcium and potassium ion concentration, acetylcholine, adrenaline on the movement of heart.

PHYACOR07T: Functions of the Nervous System	**4 Credits**

1. **Reflexes**
   Introduction,
   Monosynaptic Reflexes: The Stretch Reflex,
   Polysynaptic Reflexes: The Withdrawal Reflex,
   General Properties of Reflexes.
2. **Cutaneous, Deep & Visceral Sensation**
   Introduction,
   Pathways Touch,
   Proprioception,
   Temperature,

Pain, Other Sensations.

3. **Arousal Mechanisms, Sleep, & the Electrical Activity of the Brain**
   Introduction,
   The Reticular Formation & the Reticular Activating System,
   The Thalamus & the Cerebral Cortex,
   Evoked Cortical Potentials, The
   Electroencephalogram,
   Physiological Basis of the EEG, Consciousness, & Sleep,
   Interpretation of abnormal EEG pattern.
4. **Control of Posture & Movement**
   Introduction, General
   Principles,
   Corticospinal & Corticobulbar System,
   Anatomy & Function,
   Posture and its regulation,
   Basal Ganglia, Cerebellum,
   Movement disorders.
5. **The Autonomic Nervous System**
   Introduction,
   Anatomic Organization of Autonomic Outflow,
   Chemical Transmission at autonomic Junctions,
   Responses of Effector Organs to Autonomic Nerve Impulses,
   Cholinergic and Adrenergic Discharge.
6. **Central Regulation of Visceral Function**
   Introduction, Medulla
   Oblongata,
   Hypothalamus,
   Anatomic Considerations,
   Hypothalamic Function, Relation
   to Autonomic Function, Relation
   to Sleep,
   Relation to Cyclic Phenomena,
   Hunger,
   Thirst,
   Control of Posterior Pituitary Secretion,
   Control of Anterior pituitary Secretion,
   Temperature Regulation, fever.
7. **Neural Basis of Instinctual Behavior & Emotions**
   Introduction,
   Anatomic Considerations,
   Limbic Functions, Sexual
   Behavior,
   Fear & Rage,
   Motivation,
8. **Higher Functions of the Nervous System: Conditioned Reflexes , Learning, & Related Phenomena**
   Introduction,
   Methods,
   Learning & Memory, Functions
   of the Neocortex,
   Disorders relating learning and memory.
9. **Clinical Aspect of Nervous System**

PHYACOR07P: Functions of the Nervous System Lab	**2 Credits**
Neurological Experiments:	

Experiments on superficial (plantar) and deep (knee jerk) reflex.
Measurement of grip strength.
Reaction time by stick drop test.
Short term memory test (shape, picture word).
Two point discrimination test.

PHYACOR08T: Energy Balance, Metabolism, and Nutrition	**4 Credits**

Introduction. Energy metabolism.
Carbohydrate metabolism.
Protein metabolism.
Fat and cholesterol metabolism.
Integration of carbohydrate, fat and protein metabolism.
Nutrition – BMR, RQ, RDA, SDA, NPU, Biological value of proteins, vitamins and minerals.

PHYACOR08P: Energy Balance, Metabolism, and Nutrition Lab	**2 Credits**

Biochemical Estimation:
Quantitative estimation of glucose and sucrose by Benedict's method.
Quantitative estimation of amino nitrogen [Sorensen's formol titration method (percentage as well as total quantity to be done)].
Estimation of percentage quantity of lactose in milk by Benedict's method.

PHYACOR09T: Gastrointestinal Function	**4 Credits**

1. **Digestion & Absorption**
   Introduction,
   Carbohydrates, Proteins & Nucleic Acids, Lipids,
   Absorption of Water & Electrolytes,
   Absorption of Vitamins & Minerals
2. **Regulation of Gastrointestinal Function**
   Introduction,
   General Considerations,
   Gastrointestinal hormones,
   Mouth & Esophagus,
   Stomach, Digestive Function of the Stomach.
   Exocrine Portion of the Pancreas,
   Liver & Biliary System,
   Small Intestine, Colon.
3. **Gastrointestinal Dysfunctions**

PHYACOR09P: Gastrointestinal Function Lab	**2 Credits**

Dale's Experiments :
Kymographic recording of normal movements of rat's intestine in Dale's apparatus.
Effects of hypoxia, acetylcholine and adrenaline on normal intestinal movements.

PHYACOR10T: Respiration	**4 Credits**

1. **Pulmonary Function**
   Introduction, Properties of Gases, Anatomy of the Lungs, Mechanics of breathing,
   Gas Exchange in the lungs,
   Pulmonary Circulation,

Other Functions of the Respiratory System.

2. **Gas Transport Between the Lungs & the Tissues**
   Introduction,
   Oxygen Transport,
   Carbon Dioxide Transport,
   Respiratory acidosis and alkalosis.
3. **Regulation of Respiration**
   Introduction,
   Neural control of Breathing,
   Chemical Control of Breathing,
   Nonchemical Influences on Respiration.
4. **Respiratory Adjustments in Health & Disease**
   Introduction,
   Effects of Exercise,
   Other Forms of Hypoxia,
   Oxygen Treatment,
   Hypercapnia & Hypocapnia,
   Other Respiratory Abnormalities,
   Effects of Increased Barometric Pressure,
   Artificial Respiration.

PHYACOR10P: Respiration Lab	**2 Credits**

Respiratory Human Experiments:
Measurement of peak expiratory flow rate.
Measurement of oxygen saturation by pulse oxymeter before and after exercise.
Measurement of forced expiratory volume (FEV) in first second.

PHYACOR11T: Special Senses	**4 Credits**

1. **Vision**
   Introduction,
   Anatomic Considerations,
   The Image-Forming Mechanism (accommodation and visual acuity),
   The Photoreceptor Mechanism: Genesis of Electrical Responses,
   Visual Pathways and effects of lesions of these pathways,
   Color Vision,
   Other Aspects of Visual Function,
   Eye Movements, Errors in visual process.
2. **Hearing & Equilibrium**
   Introduction,
   Anatomic considerations,
   Hair cells,
   Mechanism of hearing,
   Vestibular function,
   Loss of hearing.
3. **Smell & Taste**
   Introduction,
   Smell,
   Receptors & Pathways,
   Physiology of Olfaction,
   Taste,
   Receptor Organs & Pathways,
   Physiology of Taste.
4. **Clinical Aspect of Special Senses**

PHYACOR11P: Special Senses Lab	**2 Credits**

Histological and Human Experiments:

Principles of fixation and staining, Staining and identification of fixed endocrine glands and nervous tissue. Determination of visual acuity by Snellen's chart / Landolt's C chart.
Determination of colour blindness by Ishihara chart.

PHYACOR12T: Endocrinology	**4 Credits**

1. **The Thyroid Gland**
   Introduction,
   Anatomic Considerations,
   Formation & Secretion of Thyroid Hormones,
   Transport of Thyroid Hormones,
   Effects of Thyroid Hormones,
   Regulation of Thyroid Secretion,
   Clinical Correlates.
2. **Endocrine Functions of the Pancreas & the Regulation of Carbohydrate Metabolism**
   Introduction,
   Islet Cell Structure,
   Structure, Biosynthesis, & Secretion of Insulin,
   Effects of Insulin,
   Mechanism of action,
   Insulin Excess,
   Regulation of Insulin Secretion,
   Glucagon,
   Other Islet Cell Hormones,
   Hypoglycemia & Diabetes Mellitus in Humans.
3. **The Adrenal Medulla & Adrenal Cortex**
   Introduction, Adrenal
   Morphology, Adrenal
   Medulla,
   Structure & Function of Medullary Hormones,
   Regulation of Adrenal Medullary Secretion,
   Adrenal Cortex,
   Structure & Biosynthesis of Adrenocortical Hormones,
   Effects of Adrenal Androgens & Estrogens, Physiologic
   Effects of Glucocorticoids,
   Pharmacologic & Pathologic Effects of Glucocorticoids,
   Regulation of Glucocorticoid Secretion,
   Effects of Mineralocorticoids, Regulation
   of Aldosterone Secretion,
   Summary of the effects of Adrenocortical Hyper & Hypofunction in Humans.
4. **Hormonal Control of Calcium Metabolism & the Physiology of Bone**
   Introduction,
   Calcium & Phosphate Metabolism,
   Bone Physiology,
   Vitamin D & the Hydroxycholecalciferols,
   The Parathyroid Glands,
   Calcitonin,
   Effects of Other Hormones & Humoral Agents on Calcium Metabolism.
5. **The Pituitary Gland**
   Introduction,
   Morphology,
   Posterior pituitary hormones,
   Growth Hormone, Physiology
   of Growth, Pituitary
   Insufficiency,
   Pituitary Hyperfunction in Humans.

6. **Endocrine Functions of the Kidneys, Heart, & Pineal Gland**
   Introduction,
   The Renin-Angiotensin System,
   Erythropoietin,
   The Endocrine Function of the Heart: Atrial Natriuretic Peptide, Pineal Gland.
7. **Human chronobiology**
   Biological rhythms; basic concepts and implications.

PHYACOR12P: Endocrinology Lab	**2 Credits**

Endocrinological assay / Experiments related to experimental Physiology:
Study of the effects of oxytocin on uterine contraction.
Study of the effects of adrenaline on intestinal / uterine movements.

PHYACOR13T: Reproductive Function	**4 Credits**

Introduction,
Sex Differentiation & Development,
Chromosomal Sex,
Embryology of the Human Reproductive System,
Aberrant Sexual Differentiation,
Puberty,
Precocious & Delayed Puberty,
Menopause,
Pituitary Gonadotropins & Prolactin,
The male reproductive System:
Structure,
Gametogenesis & Ejaculation,
Endocrine Function of the Testes,
Control of Testicular Function,
Abnormalities of Testicular Function,
The Female Reproductive system:
The Menstrual Cycle,
Ovarian Hormones,
Control of Ovarian Function,
Abnormalities of Ovarian Function,
Pregnancy,Placenta
Breast development and Lactation,
Physiological concepts for a planned family.

PHYACOR13P: Reproductive Function Lab	**2 Credits**

Reproductive Histology and Biochemistry:
Study of estrous cycle.
Staining and identification of kidney and ureters. Estimation of estrogen by spectrophotometric method. Pregnancy test from human urine by kit method.

PHYACOR14T: Formation and Excretion of Urine	**4 Credits**

1. **Renal Function & Micturition**
   Introduction,
   Juxta Glomerular Apparatus
   Function of Malpighian corpuscles and renal tubule, counter-current mechanism,
   Water Excretion,
   Acidification of the Urine & Bicarbonate Excretion,
   Regulation of Na^+& Cl^- Excretion,
   Renal Circulation,
   Diuretics,
   Disorders of Renal Functions,

Filling of the Bladder,
Emptying of the Bladder,
Non-excretory function of kidney.

PHYACOR14P: Formation and Excretion of Urine Lab	2 Credits

Renal Biochemistry:
Identification of normal and abnormal constituents of urine

Ability Enhancement Course (AEC)(Compulsory)

1. Environmental science
2. English/MIL communication

ENVSAEC01T: Environmental Science

ENGSAEC01M: English/MIL Communication

Discipline Specific Electives (DSE)(Four)

1. Biological Statistics
2. Microbiology and Immunology
3. Sports and Exercise Physiology
4. Human Nutrition and Dietetics
5. Genetics and Molecular Biology
6. Environmental Physiology

PHYADSE01T : Biological Statistics	4 Credits

Scope of statistics – Principles of statistical analysis of biological data. Basic concepts – variable, parameter, statistics. Sampling.

Presentation of data-frequency distribution, frequency polygon, histogram, bar diagram and pie diagram.
Parameters.

Different classes of statistics- mean, median, mode, mean deviation, variance, standard deviation, standard error of mean.

Standard score.
Degrees of freedom.
Probability. Normal
distribution.
Student's t-distribution.

Testing of hypothesis - Null hypothesis, errors of inference, levels of significance, Students' 't' test and z score for significance of difference. Distribution-free test - Chi-square test.

PHYADSE01P: Biological Statistics Lab	2 Credits

Computation of mean, median, mode, standard deviation and standard error of the mean with physiological data like body temperature, pulse rate, respiratory rate, height and weight of human subjects.

Graphical representation of data in frequency polygon and histogram. Student's 't' test for significance of difference between means.

Demonstration: Statistical analysis and graphical representation of biological data with computer using One way ANOVA etc.

PHYADSE02T: Microbiology and Immunology	4 Credits

Bacteria - structure & morphological classification.

Gram positive, gram negative, pathogenic & nonpathogenic bacteria. Sterilization, pasteurization, brief idea about antibiotics.

Bacterial growth curve.

Elementary idea of bacteriostatic and bacteriocidal agents.

Bacterial genetics.

Viruses - Structure and types, Lytic and lysogenic cycle.

Prions – basic ideas and prion diseases.

Overview of immune system.

Idea about innate and acquired immunity.

Immuno-competent cells.

Humoral and cell mediated immunity.

Antigen-antibody interaction.

Immunoglobulin - classification, basic structure and function.

Antigen presentation.

Major Histocompatibility Complex (MHC).

Cytokines. Hypersensitivity Complement system.

Vaccination - principles and importance of immunization.

Basic principles of immunological detection of pregnancy.

Immunization program - immunization against Polio, Hepatitis-B, Tetanus, Measles,

Whooping cough, Tuberculosis, Rabies through vaccine, AIDS- causative virus, mode of transmission, effects on human body, preventive measures, and principles of diagnostic test for AIDS (ELISA).

Immunopathology - basic principles of autoimmune disease and transplantation immunology.

PHYADSE02P: Microbiology and Immunology Lab	2 Credits

Gram staining of bacteria and identification of Gram positive and Gram negative bacteria
Demonstration: Spore Staining, Radial immuno-diffusion.

PHYADSE03T: Sports and Exercise Physiology	4 Credits

Importance of regular exercise in health and wellbeing.
Basic concept of Bioenergetics, Energy sources during exercise (Phosphagen, Anaerobic system and Aerobic system).
Cardio-respiratory responses during different grades of exercise.
Concept of excess post exercise oxygen consumption (EPOC), physiological fatigue and recovery. Aerobic work Capacity: Measurement, physiological factors and applications.
Training: Principles of physical training, Training to improve aerobic and anaerobic power. Effect of overtraining and detraining.
Nutritional supplements and ergogenic aids.
Sports injury and its' management.
Basic idea sports rehabilitation and sports medicine.

PHYADSE03P: Sports and Exercise Physiology Lab	2 Credits

Measurement of blood pressure before and after different grades of exercise.
Recording of recovery heart-rate after standard exercise.
Determination of Physical Fitness Index by Harvard Step Test (Modified).
Determination of VO_{2max} by queen college step test.
Measurement of body fat percentage. Six
minute walk test.
Determination of endurance time by hand grip dynamometer.
Pneumographic recording of effect of talking, laughing, coughing, breath holding and hyperventilation.

PHYADSE04T: Human nutrition and dietetics	4 Credits

Constituents of food and their significance.
Basal metabolic rate -factors, determination by Benedict-Roth apparatus. Respiratory quotient
Specific dynamic action.
Basic concept of energy and units.
Calorific value of foods.
Body calorie requirements – adult consumption unit.
Dietary requirements of carbohydrate, protein, lipid and other nutrients. Balanced diet and principles of formulation of balanced diets for growing child, adult man and woman, pregnant woman and lactating woman. Nitrogen balance, essential amino acids, biological value of proteins. Supplementary value of protein. Protein efficiency ratio and net protein utilization of dietary proteins.
Dietary fibres.
Vitamins.
Principle of diet survey.
Composition and nutritional value of common food stuffs.
Physiology of starvation and obesity. Sources and physiological significances of vitamins and minerals.
Space nutrition.

PHYADSE04P: Human nutrition and dietetics Lab	2 Credits

Nutrition and Dietetics - Diet Survey (Field Study Record):

a) Diet survey report (hand-written) of a family (as per ICMR specification): Each student has to submit a report.
b) A report (hand-written) on the basis of field survey from ONE of the followings: (1) Physiological parameters of human (at least three parameters). (2) Anthropometric measurements on human (at

least three parameters). (3) Epidemiological studies on human.

PHYADSE05T: Genetics and Molecular Biology	4 Credits

Genetics:

Basic principles of Mendelian genetics - monohybrid and dihybrid, test and back crosses, Bacterial genetics-transformation, transduction, conjugation (mention of F+ /F- , Hfr strain, function of pillus).

Extension of Mendelism - Epistasis and its different types present in plants and animals.

Penetrance, expressivity, pleiotropism.

Crossing over and Gene mapping.

Numerical and Structural variations in chromosome - basic concepts of aneuploids and polyploids. Human Cytogenetics - human karyotype, banding technique, use of human cytogenetics in medical science, inborn errors of metabolism, aneuploidy in humans.

Sex determination and sex linkage.

Molecular Biology:

Genes - definition.

DNA- structure, DNA replication, transcription of RNA in prokaryotes, Genetic code– properties and wobble hypothesis, translation in prokaryotes, regulation of gene expression – operon concept: lac operon, gene mutation, DNA repairing processes.

Basic idea of Recombinant DNA technology and its applications, Polymerase chain reaction (PCR) - basic concepts.

PHYADSE05P: Genetics and Molecular Biology Lab	2 Credits

DNA gel electrophoresis (agarose gel).

Paper chromatography and Thin Layer Chromatography

PHYADSE06T: Environmental Physiology	4 Credits

Environmental Pollutions and Health Hazards

Definition: hygiene, health and public health.

Air, Water, Food Borne Diseases: causes, symptoms and control.

Food Additives and Adulterants: definition, examples and human health hazards.

Vector Borne Epidemic Diseases: Malaria and Plague-etiology and control.

Air Pollution: definition, sources, air pollutants, effects of air pollution on human health, concept of ozone hole, green house effects and global warming.

Water Pollution: definition, types, health hazards, water pollutants, biochemical oxygen demand (BOD), thermal pollution, concept of safe drinking water standards.

Soil Pollution:causes, health hazards, solid waste management, bioremediation, phytoremediation.

Sound Pollution: definition, concept of noise, source of sound pollution, effects of sound pollution on human health, noise index (noise standards).

Radionuclide Pollution: ionizing radiations, effects of ionizing radiation on human health, permissible doses.

Arsenic Pollution: sources, sources of arsenic in ground water, drinking water standard forarsenic (WHO, USEPA), health effects of chronic arsenic poisoning.

Environmental management

Environmental ethics.

Conservation of topsoil, ground water and wild lives; rain water harvesting; sanctuary, national park, biosphere reserve, wildlife (conservation) Act, 1992.

PHYADSE06P: Environmental Physiology Lab	2 Credits

Determination of sound levels by sound level meter and noise index.

Determination of dissolve oxygen in the supplied water samples-supplied water, ground water extracted by shallow and deep tube wells, stream waters, pond water etc. Detection of food additives in different food samples.

Demonstration of kymographic recording of the effects of food additives on the movement of perfused heart of toad and intestinal movements of rat in Dale's bath.

Biochemical estimation of serum glucose, total proteins, SGPT and SGOT

Recommended Text and Reference Books for Physiology (Honours)

- Best and Taylor's Physiological basis of Medical Practices, by B.K. Brobecks. The William and Wilkins Co.
- Review of Medical Physiology, by W.F. Ganong, Lange Medical Book. Pretices- Hall International. Mc Graw Hill.
- Harper's illustrated Biochemistry, by R.K. Murray and others. Lange Medical Book, International edition, Mc Graw Hill.
- Text book of Medical Physiology, by A.C. Guyton. W.B. Saunders Co.
- Lehninger's Principles of Biochemistry, by D.L. Nelson and M.M. Cox, Worth Publishers Inc.
- Text book of Biochemistry, by E.S. West; W.R.Todd; H.S. Mason; J.T Van Bruggen. The Macmillan Company.
- Biochemistry, by D Das. Academic Publishers.
- Biophysics and Biophysical Chemistry, by D.Das. Academic Publishers.
- Physiology, by R.M. Berne and M.N. Levy, C.V Mosby Co.
- Essential Immunology, by I.M. Roitt, Blackwell Scientific Publications.
- Cellular and Molecular Biology, by E.D.P. De Robertis and E.M.F. De Robertis; Lea and Febiger.
- Molecular Biology of gene, by J.D. Watson; H.N. Nancy and other; Benjamin-Cummings.
- Human Physiology, by Rhoades and Pflanger, Saunder College Publishing.
- Neurobiology, by G.M.Shepherd. Oxford University Press.
- Biochemistry, by L. Stryer, W.H. Freeman and Co.
- The Physiological Basis of Physical Education and Athletics, by W.D. McArdle, F. Katch and V.L Katch. Williams and Wilkins.
- The Text Book of Environmental Physiology, by C. Edger Folk Jr. Lea and Febiger.
- The Text Book of Work Physiology by P.O. Astrand and K. Rodhal. McGraw-Hill Books Co.
- Human factors in Engineering and Design, by E.O. McCormick and M. Sanders. Tata McGraw Hill.
- Sports Physiology, by E.L. Fox, Saunders College Publishing Holt-Saunders.
- The Physiology of Reproduction, Volumes I and II, by, E. knobil and J.D. Neil. Raven Press.
- Practice Biochemistry in Medicine, by Srinivas Rao, Academic Publishers.
- Ross and Wilson Anatomy and Physiology in Health and Illness, by A. Waugh and A. Grant. International Edition, Churchill Livigstone Elesvier.
- Human Physiology, by Stuart Ira Fox, McGraw Hill International edition.

B.A. POLITICAL SCIENCE GENERAL(Discipline Specific Core)

(For pure General students)

(The Syllabus for Semester 2 to Semester 6 may be slightly modified later)

LIST OF PAPERS AND COURSES

A) PLSGDSC- DISCIPLINE SPECIFIC CORE COURSE (4)

Semester – 1

1. **PLSGCOR01T** - Paper I - Introduction to Political Theory

Semester - 2

2. **PLSGCOR02T -** Paper-II - Indian Government and Politics

Semester – 3

3. **PLSGCOR03T -** Paper-III- Comparative Government and Politics

Semester – 4

4. **PLSGCOR04T -** Paper-IV- Introduction to International Relations

B) CORE/ FOUNDATION (Compulsory) (4)
ENGLISH (2)
MIL (2)

C) ABILITY ENHANCEMENT (COMPULSORY) (2)

ENGLISH/MIL (Communication)
ENVIRONMENTAL SCIENCE

C) **PLSGDSE - DISCIPLINE SPECIFIC ELECTIVE – 2 (any two)** Semester 5 and 6 (For General Students)
Semester 5
College will offer both but a student will select any one

1. **PLSGDSE01T -** Reading Gandhi

2. **PLSGDSE02T -** Women, Power and Politics

Semester 6

College will offer both but a student will select any one

3. **PLSGDSE03T -** Understanding Global Politics

4.**PLSGDSE04T -** Public Policy in India

E) PLSSSEC - SKILL ENHANCEMENT COURSE (Skill Based)

Semester –odd (Same as Honours)

1. **PLSSSEC01M -** Democratic Awareness with Legal Literacy

Semester - even (Same as Honours)

PLSSSEC02M - Public Opinion and Survey Research

F)PLSGEC - GENERIC ELECTIVE -

Semester 5

PLSGGECO1T - Human Rights in a Comparative Perspective

Semester 6

2. **PLSGGECO1T -** Governance: Issues and Challenges

DISCIPLINE SPECIFIC CORE COURSE(4)

BA POLITICAL SCIENCE

PLSGCOR	**Semester I**			
Course Code	**Paper – I** **Introduction to Political Theory**	Lectures	Credits (Theory+Tutorial) X **15 weeks**	Marks
PLSGCOR01T	**Module I. Introducing the subject** **a.** What is Politics? b. What is Political Theory and what is its relevance? **Module II. Concepts:** Democracy, Liberty, Equality, Justice, Rights, Gender, Citizenship, Civil Society and State **Module III. Debates in Political Theory:** a. Is democracy compatible with economic growth? b. On what grounds is censorship justified and what are its limits? c. Does protective discrimination violate principles of fairness? d. Should the State intervene in the institution of the family?	**10** **30** **35**	5+1	75

PLSGCOR02T	**Semester – 2** **<u>Paper - II</u>** **<u>Indian Government and Politics</u>** **Structure, Process, Behaviour.** 1.**Evolution:** Making of the Constitution by the Constitutional Advisor, the Drafting Committee and finally the Constituent assembly **2.Constituion of India(Article-wise)** a)Preamble b)Fundamental Rights c)Directive Principles of State Policy d)Federalism **3.Constitution of India** a)Union Government: Executive(total as it is in the constitution)Legislature(total, according to the Constitution) Judiciary(total, following the articles of the constitution with two additional dimensions: landmark decisions and PIL b)State Government: Executive, Legislature, Judiciary (In the same way as the Union government is to be studied) c)Public Services: Union Service, State service, All India Services(total that includes recruitment, training, service conditions) c)Public service Commission(UPSC and PSC)	**20** **20** **35**	5+1	75

PLSGCOR	**Semester III**			
Course Code	**Paper – III** **Comparative Government and Politics**	Lectures	Credits (Theo +Tutorial)X **15 weeks**	Marks
PLSGCOR03T	**I**. **Understanding Comparative Politics** a. Nature and scope b. Going beyond Eurocentrism **II. Historical context of modern government** a. Capitalism: meaning and development: globalization b. Socialism: meaning, growth and development c. Colonialism and decolonization: meaning, context, forms of colonialism; anti-colonialism struggles and process of decolonization III. **Themes for comparative analysis** A comparative study of constitutional developments and political economy in the following countries: Britain, Brazil and China.	**15** **35** **25**	5+1	75

PLSGCOR	Semester IV			
Course Code	**Paper – IV** **Introduction to International Relations**	**Lectures**	**Credits (Theo +Tutorial)X 15 weeks**	**Marks**
PLSGCOR04T	**I. Studying International Relations** a. How do you understand International Relations: Levels of Analysis b. History and IR: Emergence of the International State System **II. Theoretical Perspectives** a. Classical Realism & Neo-Realism b. Liberalism & Neo-liberalism c. Marxist Approaches d. Feminist Perspectives **III. An Overview of Twentieth Century IR History** a. World War I: Causes and Consequences b. Significance of the Bolshevik Revolution c. Rise of Fascism / Nazism d. World War II : Causes and Consequences e. Cold War: Different Phases f. Emergence of the Third World g. Collapse of the USSR and the End of the Cold War h. Post Cold War Developments and Emergence of Other Power Centers of Power i. Indian as an Emerging Power Indian Foreign Policy	**15** **20** **35**	**5+1**	**75**

READING LIST

PLSGC0R01T - Paper I- Introduction to Political Theory

Bhargava, R. (2008) 'What is Political Theory', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.* New Delhi: Pearson Longman, pp. 2-17.

Bhargava, R. (2008) 'Why Do We Need Political Theory', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.* New Delhi: Pearson Longman, pp. 18-37.

Sriranjani, V. (2008) 'Liberty', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.*New Delhi: Pearson Longman, pp. 40-57.

Acharya, A. (2008) 'Equality', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.*New Delhi: Pearson Longman, pp. 58-73.

Menon, K. (2008) Justice', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.*New Delhi: Pearson Longman, pp. 74-82.

Talukdar, P.S. (2008) 'Rights', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.*New Delhi: Pearson Longman, pp. 88-105.

Srinivasan, J. (2008) 'Democracy', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.*New Delhi: Pearson Longman, pp. 106-128.

Roy, A. 'Citizenship', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.* New Delhi: Pearson Longman, pp. 130-147.

Das, S. (2008) 'State', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.* New Delhi:Pearson Longman, pp. 170-187.
Singh, M. (2008) 'Civil Society', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.*New Delhi: Pearson Longman, pp. 188-205.

Menon, N. (2008) 'Gender', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.*New Delhi: Pearson Longman, pp. 224-235.

Sen, A. (2003) 'Freedom Favours Development,' in Dahl, R., Shapiro, I. and Cheibub, A. J. (eds.) *TheDemocracy Sourcebook.* Cambridge, Massachusetts: MIT Press, pp. 444-446.

Prezowrski, A., et al. (2003) 'Political Regimes and Economic Growth,' in Dahl, R., Shapiro, I. andCheibub, A. J. (eds.) *The Democracy Sourcebook.* Cambridge, Massachusetts: MIT Press, pp. 447-454.

Sethi, A. (2008) 'Freedom of Speech and the Question of Censorship', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.* New Delhi: Pearson Longman, pp. 308-319.

Acharya, A. (2008) 'Affirmative Action', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.* New Delhi: Pearson Longman, pp. 298-307.

Jha, M. (2001) 'Ramabai: Gender and Caste', in Singh, M.P. and Roy, H. (eds.) *Indian Political Thought: Themes and Thinkers,* New Delhi: Pearson

PLSGC0R02T - Paper-II - Indian Government and Politics

Abbas, H., Kumar, R. &Alam, M. A. (2011) *Indian Government and Politics.*New Delhi: Pearson, 2011.

Chandhoke, N. &Priyadarshi, P. (eds.) (2009) *Contemporary India: Economy, Society, Politics.*New Delhi: Pearson.

Chakravarty, B. &Pandey, K. P. (2006) *Indian Government and Politics.*New Delhi: Sage.

Chandra, B., Mukherjee, A. & Mukherjee, M. (2010) *India After Independence.* New Delhi: Penguin.

Singh, M.P. &Saxena, R. (2008) *Indian Politics: Contemporary Issues and Concerns.* New Delhi: PHI Learning.

Vanaik, A. &Bhargava, R. (eds.) (2010) *Understanding Contemporary India: Critical Perspectives.*New Delhi: Orient Blackswan.

Menon, N. and Nigam, A. (2007) *Power and Contestation: India Since 1989.* London: Zed Book.

Austin, G. (1999) *Indian Constitution: Corner Stone of a Nation.* New Delhi: Oxford University Press.

Austin, G. (2004) *Working of a Democratic Constitution of India.*New Delhi: Oxford University Press.

Jayal, N. G. &Maheta, P. B. (eds.) (2010) *Oxford Companion to Indian Politics.* New Delhi: Oxford University Press.

PLSGC0R03T - Paper-III- Comparative Government and Politics

Bara, J & Pennington, M. (eds.). (2009) *Comparative Politics.*New Delhi: Sage.

Caramani, D. (ed.). (2008) *Comparative Politics.* Oxford: Oxford University Press.

Hague, R. and Harrop, M. (2010) *Comparative Government and Politics: An Introduction.* (Eight Edition). London: Palgrave McMillan.

Ishiyama, J.T. and Breuning, M. (eds.). (2011) *21st Century Political Science: A Reference Book.*Los Angeles: Sage.

Newton, K. and Deth, Jan W. V. (2010) *Foundations of Comparative Politics: Democracies of The Modern World.*Cambridge: Cambridge University Press.
O'Neil, P. (2009) *Essentials of Comparative Politics.*(Third Edition). New York: WW. Norton & Company, Inc.

Palekar, S.A. (2009) *Comparative Government and Politics.* New Delhi: PHI Learning Pvt. Ltd

Blondel, J. (1996) 'Then and Now: Comparative Politics', *Political Studies. Vol. 47, Issue 1*, pp. 152-160

Chandhoke, N. (1996) 'Limits of Comparative Political Analysis', *Economic and Political Weekly.*vol. 31, No. 4, (January 27), pp. PE 2-PE8.

PLSGC0R04T - Paper-IV- Introduction to International Relations

William, P., Goldstein, D. M. and Shafritz, J. M. (eds.) (1999) *Classic Readings of International Relations*. Belmont: Wadsworth Publishing Co, pp. 30-58; 92-126.

Art, R. J. and Jervis, R. (eds.) (1999) *International Political Enduring: Concepts and Contemporary Issues.*5th Edition. New York: Longman, pp. 7-14; 29-49; 119-126.

Jackson, R. and Sorenson, G. (2008) *Introduction to International Relations: Theories and Approaches*. New York: Oxford University Press, pp. 59-96.

Goldstein, J. and Pevehouse, J.C. (2009) *International Relations.*New Delhi: Pearson, pp. 81-111.

Tickner, J. A. (2001) *Gendering World Politics: Issues and Approaches in the Post-Cold War Era.*Columbia University Press.

Baylis, J. and Smith, S. (eds.) (2011) *The Globalization of World Politics: An Introduction to International Relations.*Fifth Edition. Oxford: Oxford University Press, pp. 90-123; 142-159; 262-277.

Wenger, A. and Zimmermann, D. (eds.) (2003) *International Relations: From the Cold World War to the Globalized World.*London: Lynne Rienner, pp. 54-89.

Appadorai and Rajan, M. S. (eds.) (1985) *India's Foreign Policy and Relations.* New Delhi:

South Asian Publishers.

Mewmillians, W.C. and Piotrowski, H. (2001) *The World Since 1945: A History of International Relations*.Fifth edition. London: Lynne Rienner Publishers.

Smith, M., Little, R. and Shackleton, M. (eds.) (1981) *Perspectives on World Politics*.London: Croom Helm.

Indian Foreign Service Institute. (1997, 1998) *India's Foreign Policy: An Agenda for the 21st Century* Vols. 1 & 2, New Delhi: Konark Publishers, pp. 3-41; 102-119.

Ganguly, S. (ed.) (2009) *India's Foreign Policy: Retrospect and Prospect.* New Delhi: Oxford University Press.

Vanaik, A. (1995) *India in a Changing World: Problems, Limits and Successes of Its Foreign Policy.*New Delhi: Orient Longman. pp. 19-41; 63-67; 102-114; 118-124; 132-134.

Basu, Rumki (ed)(2012) *International Politics: Concepts theories and Issues*, New Delhi, Sage Publications India Pvt Ltd.

DISCIPLINE SPECIFIC ELECTIVE – 1(For General Students)

Any Two[Any one in semester V]

DISCIPLINE SPECIFIC ELECTIVE – 1

PLSGDSE	**Semester V**			
Course Code	**Reading Gandhi**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSGDSE01T	**Module 1**. Gandhi on Modern Civilization and Modern Industrialisation based on Large and Heavy Industries and Alternative Modernity ; critique of development **Module 2.** Gandhian Thought: Theory and Action: a. Theory of Satyagraha b. Satyagraha in Action : Peasant Satyagraha: Kheda and the Idea of Trusteeship c. Gandhi on all-inclusive Development- Sarvodaya – on Untouchability and Dalit emancipation **Module 3.** **a.** Gandhi on Women's Development and on Women's Movement **b.** Gandhi on peace and Preservation of Nature	**25** **30** **20**	5+1	75

DISCIPLINE SPECIFIC ELECTIVE – 2

PLSGDSE	**Semester V**			
Course Code	**Women, Power and Politics**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSGDSE02T	**Module 1. Approaches to understanding Patriarchy** • Feminist theorising of the sex/gender distinction. Biologism versus social constructivism • Understanding Patriarchy and Feminism **Module 2.** Liberal, Socialist, Marxist, Radical feminism, New Feminist Schools/Traditions **Module 3. The Indian Experience** • Traditional Historiography and Feminist critiques. Social Reforms Movement and position of women in India. History of Women's struggle in India • Family in contemporary India - patrilineal and matrilineal practices. Gender Relations in the Family, Patterns of Consumption: Intra Household Divisions, entitlements and bargaining, Property Rights • Understanding Woman's Work and Labour	**25** **30** **20**	5+1	75

DISCIPLINE SPECIFIC ELECTIVE – 3

Any Two[Any one in semester VI]

PLSGDSE	**Semester VI**			
Course Code	**Understanding Global Politics**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSGDSE03T	**I. Globalization: Conceptions and Perspectives** a. Understanding Globalization and its Alternative Perspectives b. Political: Debates on Sovereignty and Territoriality c. Global Economy: Its Significance and Anchors of Global Political Economy: IMF, World Bank, WTO, TNCs **II. Identity and Culture** **III. What Drives the World Apart?** a. Global Inequalities b. Violence: Conflict, War and Terrorism **IV. Why We Need to Bring the World Together?** a. Global Environment : Ecological Issues: Historical Overview of International Environmental Agreements, Climate Change, Global Commons Debate b. Global Civil Society : Proliferation of Nuclear Weapons ; International Terrorism: Non-State Actors and State Terrorism; Post 9/11 developments ; Migration ; Human Security	**25** **10** **15** **25**	5+1	75

PLSADSE	**Semester VI**			
Course Code	**Paper - IV** **Public Policy in India**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSADSE04T	**Module . I. Introduction to Policy Analysis** a. The Analysis of Policy in the Context of Theories of State b. Political Economy and Policy: Interest Groups and Social Movements. **Module II.Models of Policy Decision-Making** **Module III. Ideology and Policy: Nehruvian Vision, Economic Liberalisation and recentdevelopments**	**30** **20** **25**	5+1	75

GENERIC ELECTIVE 1(FOR General students)

PLSGGEC	**Semester**			
Course Code	**Human Rights in a Comparative Perspective**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSGGEC01T	**I. Human Rights: Theory and Institutionalization** a. Understanding Human Rights: Three Generations of Rights b. Institutionalization: Universal Declaration of Human Rights c. Rights in National Constitutions: South Africa and India **II. Issues** a. Torture: USA and India b. Surveillance and Censorship: China and India c. Terrorism and Insecurity of Minorities: USA and India **III. Structural Violence** a. Caste and Race: South Africa and India b. Gender and Violence: India and Pakistan c. Adivasis/Aboriginals and the Land Question: Australia and India	**25** **25** **25**	5+1	75

GENERIC ELECTIVE 2(FOR General students)

PLSGGEC	**Semester IV**			
Course Code	**Governance: Issues and Challenges**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSGGEC02T	**Module 1. GOVERNMENT AND GOVERNANCE: CONCEPTS** Role of State In the era Of Globalisation State, Market and Civil Society **Module 2. ENVIRONMENTAL GOVERNANCE** Human-Environment Interaction Green Governance: Sustainable Human Development **Module -3. GOOD GOVERNANCE INITIATIVES IN INDIA: BEST PRACTICES** • Public Service Guarantee Acts • Electronic Governance • Citizens Charter & Right to Information • Corporate Social Responsibility	**20** **20** **35**	5+1	75

(D) PLSSSEC - Skill Enhancement Courses – Two

Semester – 3
Credit – 2
Class – 2Hours/week

PLSSSEC01M - Democratic Awareness with Legal Literacy

Course Objective: The Proposed course aims to acquaint student with the structure andmanner of functioning of the legal system in India.

Course Content:
Unit I

- Outline of the Legal system in India

- System of courts/tribunals and their jurisdiction in India - criminal and civil courts,Writ jurisdiction, specialized courts such as juvenile courts, Mahila courts andTribunals.

- Role of the police and executive in criminal law administration.

- Alternate dispute mechanisms such as LokAdalats, non- formal mechanisms.

Unit II

- Brief understanding of the laws applicable in India

- Constitution - fundamental rights, fundamental duties, other constitutional rightsand their manner of enforcement, with emphasis on public interest litigation and theexpansion of certain rights under Article 21 of the Constitution.

- Laws relating to criminal jurisdiction - provision relating to filing an FIR, arrest, bailsearch and seizure and some understanding of the questions of evidence andprocedure in Cr. P.C. and related laws, important offences under the IndianPenalCode, offences against women, juvenile justice, prevention of atrocities onScheduled Castes and Scheduled Tribes.

- Concepts like Burden of Proof, Presumption of Innocence, Principles of Natural Justice, Fair comment under Contempt laws.

- Personal laws in India : Pluralism and Democracy

- Laws relating to contract, property and tenancy laws.

- Laws relating to dowry, sexual harassment and violence against women

 Laws relating to consumer rights

 Laws relating to cyber crimes

 Anti-terrorist laws: implications for security and human rights

 Practical application: Visit to either a (I) court or (ii) a legal aid centre set up by the

 Legal Services Authority or an NGO or (iii) a LokAdalat, and to interview a litigant or person being counselled. Preparation of a case history.

Unit III

Access to courts and enforcement of rights

 Critical Understanding of the Functioning of the Legal System

 Legal Services Authorities Act and right to legal aid, ADR systems

Practical application :

What to do if you are arrested ; if you are a consumer with a grievance; if you are avictim of sexual harassment; domestic violence, child abuse, caste, ethnic andreligious discrimination; filing a public interest litigation. How can you challengeadministrative orders that violate rights, judicial and administrative remedies

Using a hypothetical case of (for example) child abuse or sexual harassment or anyother violation of a right, preparation of an FIR or writing a complaint addressed tothe appropriate authority.

 Suggested exercises for students

1. Discuss the debates around any recent Ordinance, Bill or Act in Parliament.
2. How to file an FIR? In case there has been a theft in the neighbourhood, how wouldyou file the first Hand Information Report?
3. Under what circumstances can detention and arrest become illegal?
4. Discuss any contemporary practice or event that violates the equality and protectionagainst discrimination laws.
5.. Your friend has shared with you an incident of unwelcome verbal remarks on her by aperson of higher authority in your college, what would you do?
6. You have seen a lady in your neighbourhood being beaten up by her husband. Identifythe concerned Protection Officer in case you want to provide information about thisincident.
7.Read the Vishakha Guidelines as laid down by the Supreme Court and the Act against sexual harassment at the workplace. Discuss what constitutes sexual harassment andthe mechanisms available for its redressal in your institution. Use and Abuse of the mechanism.

8. What is the procedure to file an RTI? Use and Abuse of RTI. Exemptions to RTI
10. You bought a product from a nearby shop which was expired, the shop keeperrefused to return it. Use your knowledge of Consumer Protection Act to decide what youdo next?
11. What must you keep in mind as a consumer while making a purchase that may laterhelp you make use of Consumer Protection Act? (Hint- Should you ask for a Bill?)
12. In your surroundings have you witnessed any incident that would be consideredoffensive under the SC and ST Act? Make a class- room presentation on it.

(D) PLSSSEC - Skill Enhancement Courses – Two

Semester – 4
Credit – 2
Class – 2Hours/week

PLSSSEC02M - Public Opinion and Survey Research

Course Objective: this course will introduce the students to the debates, principles andpractices of public opinion polling in the context of democracies, with special reference toIndia. It will familiarize the students with how to conceptualize and measure public opinionusing quantitative methods, with particular attention being paid to developing basic skillspertaining to the collection, analysis and utilization of quantitative data.

I. Introduction to the course
Definition and characteristics of public opinion, conceptions and characteristics, debatesabout its role in a democratic political system, uses for opinion poll

II. Measuring Public Opinion with Surveys: Representation and sampling

a. What is sampling? Why do we need to sample? Sample design.
b. Sampling error and non-response
c. Types of sampling: Non random sampling (quota, purposive and snowball sampling); random sampling: simple and stratified
d**.** Interviewing: Interview techniques pitfalls, different types of and forms of interview
e. Questionnaire: Question wording; fairness and clarity.

III. Quantitative Data Analysis

a. Introduction to quantitative data analysis
b. Basic concepts: correlational research, causation and prediction, descriptive andInferential Statistics

WEST BENGAL STATE UNIVERSITY

CHOICE BASED CREDIT SYSTEM

LIST OF PAPERS AND COURSES

B.A (HONOURS) POLITICAL SCIENCE

(The Syllabus for Semester 2 to Semester 6 may be slightly modified later)

CODES

- **PLSACOR** denotes Political Science HONOURS(CORE)
- **PLSHGEC** denotes Political Science GENERIC ELECTIVE (For Honours in other subjects)
- **PLSADSE** denotes Political Science DISCIPLINE SPECIFIC ELECTIVE(For Honours in Political Science)
- **PLSSSEC** denotes Political Science SKILL ENHANCEMENT COURSE (For Honours/general in Political Science)

- ✓ **PLSGCOR** denotes Political Science GENERAL(CORE)
- ✓ **PLSGDSE** denotes Political Science DISCIPLINE SPECIFIC ELECTIVE((For pure General students with Political Science as one of the subjects)
- ✓ **PLSGGEC** denotes Political Science GENERIC ELECTIVE((For General students not having Political Science as one of the core subjects)

- PLSA /PLSG – SUBJECT ABBREVIATIONS MADE BY THE UNIVERSITY

CREDIT/MARKS DISTRIBUTION

Core course – CC – 14 Core courses – 6 Credits/Paper

Generic Elective – GE – 4 courses - 6 Credits/Paper

Discipline Specific Elective – DSE -4 courses - 6 Credits/Paper

Ability Enhancement Compulsory Course – AECC – 2 courses – 2 Credits/paper

Skill Enhancement Courses - SEC – 2 Courses – 2 Credits/paper

Total : CC 84 + GE 24 + DSE 24 + AECC 4 + SEC 4 = 140 CREDITS

A) CORE COURSE (14) – COURSE TITLES

Semester - I

PLSACOR01T – CC1.1- Paper I- Understanding Political Theory

PLSACOR02T – CC1.2 -Paper II- Constitutional Government and Democracy in India

Semester - II

PLSACOR03T - CC2.1 Paper III – Political Theory-Concepts and Debates

PLSACOR04T - CC 2.2 Paper IV- Political Process in India

Semester - III

PLSACOR05T - CC3.1 Paper V- Introduction to Comparative Government and Politics

PLSACOR06T - CC3.2 Paper VI –Perspectives on Public Administration

PLSACOR07T - CC3.3 Paper VII- Perspectives on International Relations and World History

Semester - IV

PLSACOR08T - CC4.1 Paper VIII- Political Processes and Institutions in Comparative Perspective

PLSACOR09T - CC4.2 Paper IX- Public Policy and Administration in India

PLSACOR10T - CC4.3 Paper X- Global Politics

Semester - V

PLSACOR11T - CC5.1 Paper XI- Classical Political Philosophy

PLSACOR12T - CC5.2 Paper XII- Indian Political Thought-I

Semester - VI

PLSACOR13T - CC6.1 Paper XIII- Modern Political Philosophy

PLSACORT4T - CC6.2 Paper XIV- Indian Political Thought-II

B) GENERIC ELECTIVE-(GE-Interdisciplinary): (Sem. I, II, III, IV)

[For the Honours students with subjects other than Political Science]

1. **PLSHGEC01T –** GE Paper I - Introduction to Political Theory - Semester - 1
2. **PLSHGEC02T** – GE Paper-II - Indian Government and Politics – Semester -2
3. **PLSHGEC03T –** GE Paper-III- Comparative Government and Politics – Semester- 3
4. **PLSHGEC04T –** GE Paper-IV- Introduction to International Relations – Semester – 4

C) PLSSSEC - SKILL ENHANCEMENT COURSE: Any Two (Sem.–3 & 4)

Semester – III

1. **PLSSSEC01M** Democratic Awareness with Legal Literacy

Semester – IV

2. **PLSSSEC02M** Public Opinion and Survey Research

D) PLSADSE - DISCIPLINE SPECIFIC ELECTIVE(DSE): Any Four (Sem.–V and VI)

Semester – V(Any two)

1. **PLSADSE01T** Reading Gandhi

2. **PLSADSE02T** Women, Power and Politics

3. **PLSADSE03T** Understanding Global Politics

Semester – VI (Any two)

4. **PLSADSE04T** Public Policy in India

5. **PLSADSE05T** Human Rights in a Comparative Perspective

6. **PLSADSE06T** Governance: Issues and Challenges

E) ABILITY ENHANCEMENT COURSE (COMPULSORY) :ANY TWO

1. Language-MIL/ENGLISH

2. Environmental Science

COURSE OBJECTIVES(HONOURS/CORE COURSE - 14)

Paper – 1 Understanding Political Theory

This course introduces the students to the idea of political theory, its history and approaches, and an assessment of its critical and contemporary trends and is designed to reconcile political theory and practice through reflections on the ideas and practices related to democracy.

Paper – 2 Constitutional Government and Democracy in India

This course acquaints students with the constitutional design of state structures and institutions, and their actual working over time. It further encourages a study of state institutions in their mutual interaction, and in interaction with the larger extra-constitutional environment.

Paper – 3 Political Theory-Concepts and Debates

This course helps the student familiarize with the basic normative concepts of political theory. Each concept is related to a crucial political issue that requires analysis with the aid of our conceptual understanding. This exercise is designed to encourage critical and reflective analysis and interpretation of social practices through the relevant conceptual toolkit. It further introduces the students to the important debates in the subject.

Paper – 4 Political Process in India

This course maps the working of 'modern' institutions, premised on the existence of an individuated society, in a context marked by communitarian solidarities, and their mutual transformation thereby. It also familiarizes students with the working of the Indian state, paying attention to the contradictory dynamics of modern state power.

Paper 5 Introduction to Comparative Government and Politics

This is a foundational course in comparative politics. The purpose is to familiarize students with the basic concepts and approaches to the study of comparative politics. More specifically the course will focus on examining politics in a historical framework while engaging with various themes of comparative analysis in developed and developing countries.

Paper 6 Perspectives on Public Administration

The course provides an introduction to the discipline of public administration. This paper encompasses public administration in its historical context with an emphasis on the various classical and contemporary administrative theories. The course also explores some of the recent trends, including feminism and ecological conservation and how the call for greater democratization is restructuring public administration.

The course will also attempt to provide the students a comprehensive understanding on contemporary administrative developments.

Paper 7 Perspectives on International Relations and World History

This paper seeks to equip students with the basic intellectual tools for understanding International Relations. It introduces students to some of the most important theoretical approaches for studying international relations. The course begins by historically contextualizing the evolution of the international state system; then the students are introduced to different theories in International Relations. It provides a fairly comprehensive overview of the major political developments and events starting from the twentieth century. Students are expected to learn about the key milestones in world history and equip them with the tools to understand and analyze the same from different perspectives. A key objective of the course is to make students aware of the implicit Euro - centricism of International Relations by highlighting certain specific perspectives from the Global South.

Paper 8 Political Processes and Institutions in Comparative Perspective

In this course students will be trained in the application of comparative methods to the study of politics. The course is comparative in both what we study and how we study. In the process the course aims to introduce undergraduate students to some of the range of issues, literature, and methods that cover comparative political arena

Paper-9 Public Policy and Administration in India

The paper seeks to provide an introduction to the interface between public policy and administration in India. The essence of public policy lies in its effectiveness in translating the governing philosophy into programs and policies and making it a part of the community living. It deals with issues of decentralization, financial management, citizens and administration and social welfare from a non-western perspective.

Paper 10 Global Politics

This course introduces students to the key debates on the meaning and nature of globalization by addressing its political, economic, social, cultural and technological dimensions. It imparts an understanding of the working of the world economy, while analyzing the changing nature of relationship between the state and trans-national actors and networks. The course also offers insights into key contemporary global issues.

Paper 11 Indian Political Thought-I

This course introduces the specific elements of Indian Political Thought spanning over two millennia. The basic focus of study is on individual thinkers whose ideas are however framed by specific themes. The course as a whole is meant to provide a sense of the broad streams of Indian thought while encouraging a specific knowledge of individual thinkers and texts. Selected extracts from some original texts are also given to discuss in class.

Paper 12 Modern Political Philosophy

Philosophy and politics are closely intertwined. We explore this convergence by identifying four main tendencies here. Students will be exposed to the manner in which the questions of politics have been posed in terms that have implications for larger questions of thought and existence.

Paper 13 Modern Political Philosophy

Philosophy and politics are closely intertwined. We explore this convergence by identifying four main tendencies here. Students will be exposed to the manner in which the questions of politics have been posed in terms that have implications for larger questions of thought and existence.

Paper 14 Indian Political Thought-II

Based on the study of individual thinkers, the course introduces a wide span of thinkers and themes that defines the modernity of Indian political thought. The objective is to study general themes that have been produced by thinkers from varied social and temporal contexts. Selected extracts from original texts are also given to discuss in the class. The list of essential readings are meant for teachers as well as the more interested students.

PLSACOR	**Semester I**			
Course Code	**Paper – I** **Course Title –Understanding Political Theory**	Lectures	Credits (Th+Tut) X15 weeks	Marks
PLSACOR01T	**Introducing the subject** **Module 1**. What is Political and what is political Science **Module 2**.Approaches to the study: a)Traditional b) Marxist c)Behavioral d)Post Behavioral **Module 3. Models of studying Political Theory** a) Authority Models(Weber) b) Systems Analysis c) Structural functional Model d) Post Modernism(to be studied at the backdrop of the current debates)	**10** **20** **45**	**5+1**	**75**
PLSACOR02T	**<u>Paper - II</u>** **<u>Constitutional Government and Democracy in India</u>** **Module 1.Constituion of India(Article-wise)** a)Preamble b)Fundamental Rights c)Directive Principles of State Policy **Module** 2. Federalism **Module 3.Constitution of India: Structure, Process, Behaviour** a)Union Government: Executive(total as it is in the constitution)Legislature(total, according to the Constitution) Judiciary(total, following the articles of the constitution with two additional dimensions: landmark decisions and PIL b)State Government: Executive, Legislature, Judiciary (In the same way as the Union government is to be studied)	**30** **10** **35**	**5+1**	**75**

Semester II

PLSACOR	**Paper – III**			
Course Code	**Course Title -Political Theory-Concepts and Debates**	Lect	Credits (Th+Tut) X 15 wks	Marks

PLSACOR03T	**Module – 1. Core political concepts:** i. Nationalism and nation state ii. Sovereignty: Monism, Pluralism **Module – 2. Core Concepts and Debates:** i. Rights, Liberty, Equality ii. Justice: Plato,Rawls **Module – 3. Theories of State** **a)**Idealist Theory b)Liberal and Neo-liberal Theories	**20** **20** **35**	**5+1**	**75**
PLSACOR04T	**Paper – IV** **Course Title - Political Process in India** **Module – 1. Structure and process of election system** a)Party system in India: features and trends; coalition Governments b) Electoral process: Election Commission— Composition and Functions **Module 2.Issues in contemporary politics** a) Regionalism in India b) Role of religion ,caste, Dalits, Women **Module 3.The concerns** a) Corruption and politics: Measures to curb corruption in Indian politics b) Media and politics	**25** **25** **25**		

PLSACOR	**Semester III**			
Course Code	**Paper – V** **Course Title - Introduction to Comparative Government and Politics**	Lectures	Credits (Theory +Tutorial)X 15 weeks	Marks

PLSACOR05T	**Module – 1. Understanding Comparative Politics** a. Nature and scope b. Going beyond Eurocentrism **Module – 2. Historical context of modern government** a. Capitalism: meaning and development: globalization b. Socialism: meaning, growth and development c. Colonialism and decolonization: meaning, context, forms of colonialism; anti-colonialism struggles and process of decolonization **Module – 3.. Themes for comparative analysis** A comparative study of constitutional developments and political economy in the following countries: Britain, Brazil and China.	**15** **35** **25**	**5+1**	**75**

PLSACOR	**Semester III**			
Course Code	**Paper – VI** **Course Title - Perspectives on Public Administration**	Lectures	Credits (Theo +Tut)X 15	Marks

			weeks	
PLSACOR06T	**I. Public Administration as a Discipline** a. Meaning, Dimensions and Significance of the Discipline b. Public and Private Administration c. Evolution of Public Administration **II. Theoretical Perspectives** a. CLASSICAL THEORIES • Scientific management (F.W. Taylor) • Administrative Management (Gullick, Urwick and Fayol) • Ideal-type bureaucracy (Max Weber) b. NEO-CLASSICAL THEORIES • Human relations theory (Elton Mayo) • Rational decision-making (Herbert Simon) c. CONTEMPORARY THEORIES • Ecological approach (Fred Riggs) • Innovation and Entrepreneurship (Peter Drucker) **III. Major Approaches In Public Administration** • New Public Administration • New Public Management • New Public Service Approach • Good Governance • Feminist Perspectives	**15** **40** **20**	**5+1**	**75**

PLSACOR	**Semester III**			
Course Code	**Paper – VII** **Course Title - Perspectives on International Relations and World History**	Lectures	Credits (Theo +Tut)X 15 weeks	Marks

PLSACOR07T	**I. Studying International Relations** a. How do you understand International Relations: Levels of Analysis b. History and IR: Emergence of the International State System c. Pre-Westphalia and Westphalia d. Post-Westphalia **II. Theoretical Perspectives** a. Classical Realism & Neo-Realism b. Liberalism & Neo-liberalism c. Marxist Approaches d. Feminist Perspectives e. Eurocentricism and Perspectives from the Global South **III. An Overview of Twentieth Century IR History** a. World War I: Causes and Consequences b. Significance of the Bolshevik Revolution c. Rise of Fascism / Nazism d. World War II : Causes and Consequences e. Cold War: Different Phases f. Emergence of the Third World g. Collapse of the USSR and the End of the Cold War h. Post Cold War Developments and Emergence of other Power Centers of Power	**15** **25** **35**	**5+1**	**75**

PLSACOR	**Semester IV**			
Course Code	**Paper – VIII** **Course Title - Political Processes and**	Lectures	Credits (Theo	Marks

	Institutions in Comparative Perspective		+Tut)X 15 weeks	
PLSACOR08T	**Module I. Approaches to Studying Comparative Politics** a. Political Culture b. New Institutionalism **Module II**. a. **Nation-state**: What is nation–state? Historical evolution in Western Europe and postcolonial contexts 'Nation' and 'State': debates b. Process of democratization in postcolonial, post- authoritarian and post-communist countries **III. Module III** **a. Federalism:** Historical context Federation and Confederation: debates around territorial division of power: USA, CANADA, INDIA **b. Nature of Party System** : i. Historical contexts of emergence of the party system and types of parties ii. Nature of party System: USA, UK, China	**15** **25** **20** **15**	**5+1**	**75**

PLSACOR	**Semester IV**			
Course Code	**Paper – IX** **Course Title – Public Policy and Administration in India**	Lectures	Credits (Theo +Tut)X 15	Marks

			weeks	
PLSACOR09T	**Module I. Public Policy** a. Concept, relevance and approaches b. Definition, characteristics and models c. Public Policy Process in India d. Formulation, implementation and evaluation e. Social Welfare Policies: Education: Right To Education, National Education Policy, Kothari Commission. Health: National Health Mission . Food: Right To Food Security a. Employment: JNNURM, MNREGA **Module II.** **a. Decentralization** i. Meaning, significance and approaches and types ii. Local Self Governance: Rural and Urban – With Special Reference to West Bengal b. **Citizen and Administration Interface** a. Public Service Delivery b. Redressal of Public Grievances: RTI, Lokpal, Citizens' Charter and E-Governance **Module III**. **Budget** a. Concept and Significance of Budget b. Budget Cycle in India c. Various Approaches and Types Of Budgeting, Vote on Account, Zero Base Budgeting, Performance Budgeting	**35** **25** **10**	**5+1**	**75**

PLSACOR	**Semester IV**			
Course Code	**Paper X** **Global Politics**	Lectures	Credits (Theo +Tut)X 15	Marks

			weeks	
PLSACOR10T	**I. Globalization: Conceptions and Perspectives** a. Understanding Globalization and its Alternative Perspectives b. Political: Debates on Sovereignty and Territoriality c. Global Economy: Its Significance and Anchors of Global Political Economy: IMF, World Bank, WTO, TNCs d. Cultural and Technological Dimension e. Global Resistances (Global Social Movements and NGOs) **II. Contemporary Global Issues** a. Ecological Issues: Historical Overview of International Environmental Agreements, Climate Change, Global Commons Debate b. Proliferation of Nuclear Weapons c. International Terrorism: Non-State Actors and State Terrorism; Post 9/11 developments d. Migration e. Human Security **III. Global Shifts: Power and Governance**	**35** **30** **10**	**5+1**	**75**

PLSACOR	**Semester V**			
Course Code	**Paper XI**	Lectures	Credits	Marks

	Classical Political Philosophy		(Theo +Tutorial) X 15 weeks	
PLSACOR11T	**Module I. Antiquity** **Plato:** Philosophy and Politics, Theory of Forms, Justice, Philosopher King/Queen, Communism**;** Critique of Democracy; Women and Guardianship, Censorship **Aristotle:** Virtue, Citizenship, Justice, State and Household - Classification of governments; man as zoon politikon **Module II. Interlude:** **Machiavelli:** Virtue, Religion, Republicanism, morality and statecraft; vice and virtue **Module IV. Hobbes , Locke and Rousseau** a. **Hobbes**: Human nature, State of Nature, Social Contract, State; Social Contract; Leviathan; atomistic individuals. **b. Locke :** Laws of Nature, Natural Rights, Property, Natural rights; right to dissent; justification of property **c. Rousseau:** State of Nature, Social Contract, General Will	**15** **15** **10** **15** **10** **10**	**5+1**	**75**

PLSACOR	**Semester V**	

Course Code	**Paper XII** **Indian Political Thought - I**	Lectures	Credits (Theo +Tutorial)X **15 weeks**	Marks
PLSACOR12T	**Module I. Traditions of Pre-colonial Indian Political Thought** a. Brahmanic and Shramanic b. Islamic and Syncretic. **Module II.** **Outline of ancient Indian Political Thought** a. Ved Vyasa (Shantiparva): Rajadharma b. Manu: Social Laws c. Kautilya: Theory of State , Saptanga, Danda, Law d. Aggannasutta (Digha Nikaya): Theory of kingship **Module III. Outline of Islamic and Syncretic Thought** **a. Barani: Ideal Polity** **b. Abul Fazal: Monarchy** **c. Kabir: Syncretism**	**20** **30** **25**	**5+1**	**75**

PLSACOR	**Semester VI**			
Course Code	**Paper XIII** **Modern Political Philosophy**	Lectures	Credits (Theory +Tutorial) X 15 weeks	Marks

PLSACOR13T	**Module I Modernity and its discourse(Two essential readings)** a. Kant. (1784) 'What is Enlightenment?,' b. George Wilhelm Friedrich Hegel: Civil Society and State **Module II. Faminist Discourse** a. Mary Wollstonecraft: 'Vindication of Rights of Women' b. Betty Friedan: 'The Faminique Mistique' **Module III. Liberal socialist and Radicals** a. **John Stuart Mill**: Liberty, suffrage and subjection of women, right of minorities; utility principle b. **Karl Marx**: Alienation; Dialectical materialism, Historical Materialism, Class and class struggle c. **Antonio Gramsci:** Civil Society and Hegemony	**25** **20** **30**	**5+1**	**75**

PLSACOR

Semester VI

Course Code	**Paper XIV** **Indian Political Thought - II**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSACOR14T	**Module I. Introduction to Modern Indian Political Thought** a. Rammohan Roy: Rights b. Pandita Ramabai: Gender c. Vivekananda: Ideal Society **Module - II** a. Gandhi: Swaraj b. Ambedkar: Social Justice c. Tagore: Critique of Nationalism **Module III** a. Iqbal: Community b. Savarkar: Hindutva c. Nehru: Secularism **d.** Lohia: Socialism	**05** **10** **8** **10** **10** **05** **06** **06** **05** **05** **05**	**5+1**	**75**

READING LIST

PLSACOR01T

1. Bhargava, R. (2008) 'What is Political Theory', in Bhargava, R and Acharya, A. (eds.) Political Theory: An Introduction. New Delhi: Pearson Longman, pp. 2-16.
2. Bellamy, R. (1993) 'Introduction: The Demise and Rise of Political Theory', in Bellamy, R. (ed.) Theories and Concepts of Politics. New York: Manchester University Press, pp. 1-14.
3. Charlesworth(ed)(1967), Contemporary Political Analysis, New York , Free Press Glaser, D. (1995) 'Normative Theory', in Marsh, D. and Stoker, G. (eds.) Theory and Methods in Political Science. London: Macmillan
4. Hacker Andrew(1961), Political theory: Philosophy, Ideology, science. New York, Macmillan
5. Easton, David(1953), The Political System, New York, Alfred Knopf.
6. Easton, David(1965), A Framework for Political Analysis, New Jersey, Prentice Hall
7. Easton, David(1966), Varieties of Political Theories, New Jersey, Prentice Hall
8. *Joad C.E.M. (1924), Introduction to Modern Political Theory,OUP*
9. Sanders, D. (1995) 'Behavioral Analysis', in Marsh, D. and Stoker, G. (eds.) *Theory and Methods in Political Science.* London: Macmillan
10. Chapman, J. (1995) 'The Feminist Perspective', in Marsh, D. and Stoker, G. (eds.) *Theory and Methods in Political Science.* London: Macmillan
11. Bharghava, R, 'Why Do We Need Political Theory', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.* New Delhi: Pearson Longman
12.

PLSACOR02T

1. Constitution of India, Government of India
2. Austin G., (2010) 'The Constituent Assembly: Microcosm in Action', in *The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, 15th print
3. Basu D., (2012) *Introduction to the Constitution of India,* New Delhi: Lexis Nexis.
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20. Fazl, (1873) *The Ain-i Akbari* (translated by H. Blochmann), Calcutta: G. H. Rouse, pp. 47-57.
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21. V.Savarkar, 'Hindutva is Different from Hinduism', available at http://www.savarkar.org/en/hindutva-/essentials-hindutva/hindutva-different-hinduism,
22. J. Sharma, (2003) *Hindutva: Exploring the Idea of Hindu Nationalism*, Delhi: Penguin, pp.124-172
23. J. Nehru, (1991) 'Selected Works', in S. Hay (ed.), *Sources of Indian Tradition, Vol. 2*, Second Edition, New Delhi: Penguin, pp. 317-319. R. Pillai, (1986) 'Political thought of Jawaharlal Nehru', in Th. Pantham, and K. Deutsch (eds.), *Political Thought in Modem India*, New Delhi: Sage, pp. 260- 274.
24. P. Chatterjee, (1986) 'The Moment of Arrival: Nehru and the Passive Revolution', in *Nationalist Thought and the Colonial World: A Derivative Discourse?* London: Zed Books, pp.131-166
25. S. Sinha, (2010) 'Lohia's Socialism: An underdog's perspective', in *Economic and Political Weekly*, Vol. XLV (40) pp. 51-55.
26. A. Kumar, (2010) 'Understanding Lohia's Political Sociology: Intersectionality of Caste, Class, Gender and Language Issue', in *Economic and Political Weekly*, Vol. XLV (40), pp. 64-70.

GENERIC ELECTIVE – 1

Interdisciplinary

For Honours students, other than Political Science

PLSHGEC	**Semester I**			
Course Code	**Paper – I** **Introduction to Political Theory**	Lectures	Credits (Theory+ Tutorial) X **15 weeks**	Marks
PLSHGEC01T	**Module I. Introducing the subject** **a.** What is Politics? b. What is Political Theory and what is its relevance? **Module II. Concepts:** Democracy, Liberty, Equality, Justice, Rights, Gender, Citizenship, Civil Society and State **Module III. Debates in Political Theory:** a. Is democracy compatible with economic growth? b. On what grounds is censorship justified and what are its limits? c. Does protective discrimination violate principles of fairness? d. Should the State intervene in the institution of the family?	**10** **30** **35**	**5+1**	**75**

GENERIC ELECTIVE – 2

PLSHGEC	**Semester II**			
Course Code	**Paper - II** **Indian Government and Politics**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSHGEC02T	**Structure, Process, Behaviour.** **Module I..Evolution:** Making of the Constitution by the Constitutional Advisor, the Drafting Committee and finally the Constituent assembly **Module II.Constituion of India(Article-wise)** a)Preamble b)Fundamental Rights c)Directive Principles of State Policy d)Federalism **Module III. Constitution of India** a)Union Government: Executive(total as it is in the constitution)Legislature(total, according to the Constitution) Judiciary(total, following the articles of the constitution with two additional dimensions: landmark decisions and PIL b)State Government: Executive, Legislature, Judiciary (In the same way as the Union government is to be studied) c)Public Services: Union Service, State service, All India Services(total that includes recruitment, training, service conditions) c)Public service Commission(UPSC and PSC)	**20** **20** **35**	**5+1**	**75**

GENERIC ELECTIVE – 3

PLSHGEC	**Semester III**			
Course Code	**Paper – III** **Comparative Government and Politics**	Lectures	Credits (Theo +Tutorial)X **15 weeks**	Marks
PLSHGEC03T	**Module I**. **Understanding Comparative Politics** a. Nature and scope b. Going beyond Eurocentrism **Module II. Historical context of Modern Government** a. Capitalism: meaning and development: globalization b. Socialism: meaning, growth and development c. Colonialism and decolonization: meaning, context, forms of colonialism; anti-colonialism struggles and process of decolonization **Module III**. **Themes for comparative analysis** A comparative study of constitutional developments and political economy in the following countries: Britain, Brazil and China.	**15** **35** **25**	**5+1**	**75**

GENERIC ELECTIVE – 4

PLSHGEC	Semester IV			
Course Code	**Paper – IV** **Introduction to International Relations**	**Lectures**	**Credits (Theo +Tutorial)X 15 weeks**	**Marks**
PLSHGEC04T	**I. Studying International Relations** a. How do you understand International Relations: Levels of Analysis b. History and IR: Emergence of the International State System **II. Theoretical Perspectives** a. Classical Realism & Neo-Realism b. Liberalism & Neo-liberalism c. Marxist Approaches d. Feminist Perspectives **III. An Overview of Twentieth Century IR History** a. World War I: Causes and Consequences b. Significance of the Bolshevik Revolution c. Rise of Fascism / Nazism d. World War II : Causes and Consequences e. Cold War: Different Phases f. Emergence of the Third World g. Collapse of the USSR and the End of the Cold War **h.** Post Cold War Developments and Emergence of Other Power Centers of Power **i.** Indian as an Emerging Power Indian Foreign Policy	**15** **25** **35**	**5+1**	**75**

READING LIST

PLSHGEC01T - Paper I- Introduction to Political Theory

Bhargava, R. (2008) 'What is Political Theory', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.* New Delhi: Pearson Longman, pp. 2-17.

Bhargava, R. (2008) 'Why Do We Need Political Theory', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.* New Delhi: Pearson Longman, pp. 18-37.

Sriranjani, V. (2008) 'Liberty', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.*New Delhi: Pearson Longman, pp. 40-57.

Acharya, A. (2008) 'Equality', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.*New Delhi: Pearson Longman, pp. 58-73.

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Srinivasan, J. (2008) 'Democracy', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.*New Delhi: Pearson Longman, pp. 106-128.

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Das, S. (2008) 'State', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.* New Delhi:Pearson Longman, pp. 170-187.
Singh, M. (2008) 'Civil Society', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.*New Delhi: Pearson Longman, pp. 188-205.

Menon, N. (2008) 'Gender', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.* New Delhi: Pearson Longman, pp. 224-235.

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Prezowrski, A., et al. (2003) 'Political Regimes and Economic Growth,' in Dahl, R., Shapiro, I. and Cheibub, A. J. (eds.) *The Democracy Sourcebook.* Cambridge, Massachusetts: MIT Press, pp. 447-454.

Sethi, A. (2008) 'Freedom of Speech and the Question of Censorship', in Bhargava, R. and Acharya, A. (eds.) *Political Theory: An Introduction.* New Delhi: Pearson Longman, pp. 308-319.

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Jha, M. (2001) 'Ramabai: Gender and Caste', in Singh, M.P. and Roy, H. (eds.) *Indian Political Thought: Themes and Thinkers,* New Delhi: Pearson

PLSHGEC02T - Paper-II - Indian Government and Politics

Abbas, H., Kumar, R. & Alam, M. A. (2011) *Indian Government and Politics.* New Delhi: Pearson, 2011.

Chandhoke, N. & Priyadarshi, P. (eds.) (2009) *Contemporary India: Economy, Society, Politics.* New Delhi: Pearson.

Chakravarty, B. & Pandey, K. P. (2006) *Indian Government and Politics.* New Delhi: Sage.

Chandra, B., Mukherjee, A. & Mukherjee, M. (2010) *India After Independence.* New Delhi: Penguin.

Singh, M.P. & Saxena, R. (2008) *Indian Politics: Contemporary Issues and Concerns.* New Delhi: PHI Learning.

Vanaik, A. & Bhargava, R. (eds.) (2010) *Understanding Contemporary India: Critical Perspectives.* New Delhi: Orient Blackswan.

Menon, N. and Nigam, A. (2007) *Power and Contestation: India Since 1989.* London: Zed Book.

Austin, G. (1999) *Indian Constitution: Corner Stone of a Nation.* New Delhi: Oxford University Press.

Austin, G. (2004) *Working of a Democratic Constitution of India.* New Delhi: Oxford University Press.

Jayal, N. G. & Maheta, P. B. (eds.) (2010) *Oxford Companion to Indian Politics.* New Delhi: Oxford University Press.

PLSHGEC03T - Paper-III- Comparative Government and Politics

Bara, J & Pennington, M. (eds.). (2009) *Comparative Politics.* New Delhi: Sage.

Caramani, D. (ed.). (2008) *Comparative Politics*. Oxford: Oxford University Press.

Hague, R. and Harrop, M. (2010) *Comparative Government and Politics: An Introduction.* (Eight Edition). London: Palgrave McMillan.

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Newton, K. and Deth, Jan W. V. (2010) *Foundations of Comparative Politics: Democracies of The Modern World.* Cambridge: Cambridge University Press.
O'Neil, P. (2009) *Essentials of Comparative Politics.* (Third Edition). New York: WW. Norton & Company, Inc.

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Blondel, J. (1996) 'Then and Now: Comparative Politics', *Political Studies. Vol. 47, Issue 1,* pp. 152-160

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PLSHGEC04T - Paper-IV- Introduction to International Relations

William, P., Goldstein, D. M. and Shafritz, J. M. (eds.) (1999) *Classic Readings of International Relations*. Belmont: Wadsworth Publishing Co, pp. 30-58; 92-126.

Art, R. J. and Jervis, R. (eds.) (1999) *International Political Enduring: Concepts and Contemporary Issues.*5th Edition. New York: Longman, pp. 7-14; 29-49; 119-126.

Jackson, R. and Sorenson, G. (2008) *Introduction to International Relations: Theories and Approaches*. New York: Oxford University Press, pp. 59-96.

Goldstein, J. and Pevehouse, J.C. (2009) *International Relations.* New Delhi: Pearson, pp. 81-111.

Tickner, J. A. (2001) *Gendering World Politics: Issues and Approaches in the Post-Cold War Era.* Columbia University Press.

Baylis, J. and Smith, S. (eds.) (2011) *The Globalization of World Politics: An Introduction to International Relations.* Fifth Edition. Oxford: Oxford University Press, pp. 90-123; 142-159; 262-277.

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Appadorai and Rajan, M. S. (eds.) (1985) *India's Foreign Policy and Relations.* New Delhi:

South Asian Publishers.

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Ganguly, S. (ed.) (2009) *India's Foreign Policy: Retrospect and Prospect.* New Delhi: Oxford University Press.

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Basu, Rumki (ed)(2012) *International Politics: Concepts theories and Issues*, New Delhi, Sage Publications India Pvt Ltd.

DISCIPLINE SPECIFIC ELECTIVE – 1(Interdisciplinary) for Honours students

(Any two in Semester - V)

PLSADSE	**Semester V**			
Course Code	**Paper I** **Reading Gandhi**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSADSE01T	**Module I**. Gandhi on Modern Civilization and Modern Industrialisation based on Large and Heavy Industries and Alternative Modernity ; critique of development **Module II.** Gandhian Thought: Theory and Action: a. Theory of Satyagraha b. Satyagraha in Action : Peasant Satyagraha: Kheda and the Idea of Trusteeship c. Gandhi on all-inclusive Development Sarvodaya – on Untouchability and Dalit emancipation **Module III.** **a.** Gandhi on Women's Development and on Women's Movement **b.** Gandhi on peace and Preservation of Nature	**25** **30** **20**	**5+1**	**75**

READING LIST

1. B. Parekh, (1997) 'The Critique of Modernity', in Gandhi: A Brief Insight, Delhi: Sterling Publishing Company, pp. 63-74.
2. K. Ishii, (2001) 'The Socio-economic Thoughts of Mahatma Gandhi: As an Origin of Alternative Development', Review of Social Economy. Vol. 59 (3), pp. 297-312.
3. R Iyer, (ed) (1993) 'Chapter 4' in The Essential Writings of Mahatma Gandhi, New Delhi: Oxford University Press.
4. R. Iyer, (1993) The Essential Writings of Mahatma Gandhi, New Delhi: Oxford University Press, pp. 299-344; 347-373.
5. R. Ramashray, (1984) 'Liberty Versus Liberation', in Self and Society: A Study in Gandhian Thought, New Delhi: Sage Publication.
6. P. Chatterjee, (1986) 'The Moment of Maneuver', in Nationalist Thought and the Colonial World: A derivative discourse?, Delhi: Zed Books.
7. S. Sarkar, (1982) Modern India 1885-1947, New Delhi: Macmillan, pp. 432-39.
8. R. Iyer, (2001) The Moral and Political Thought of Mahatma Gandhi, New Delhi: Oxford University Press. pp. 344-358.
9. R. Mukharjee, (ed) (1995), The Penguin Gandhi Reader, New Delhi: Penguin.
10. Reading of primary texts:- M K Gandhi Chapter VI and XIII " Hind Swaraj" Navjeevan Trust, Ahmedabad, 1910

DISCIPLINE SPECIFIC ELECTIVE – 2(Any two in Semester - V)

PLSADSE	**Semester V**			
Course Code	**Paper II** **Women, Power and Politics**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSADSE02T	**Module 1. Approaches to understanding Patriarchy** • Feminist theorising of the sex/gender distinction. Biologism versus social constructivism • Understanding Patriarchy and Feminism **Module 2. Schools of Feminism** Liberal, Socialist, Marxist, Radical feminism, New Feminist Schools/Traditions **Module 3. The Indian Experience** • Traditional Historiography and Feminist critiques. Social Reforms Movement and position of women in India. History of Women's struggle in India • Family in contemporary India - patrilineal and matrilineal practices. Gender Relations in the Family, Patterns of Consumption: Intra Household Divisions, entitlements and bargaining, Property Rights • Understanding Woman's Work and Labour	**25** **30** **20**	**5+1**	**75**

READING LIST

PLSADSE02T - Women, Power and Politics

1. T. Shinde, (1993) 'Stree Purusha Tulna', in K. Lalitha and Susie Tharu (eds), *Women Writing in India,* New Delhi, Oxford University Press, pp. 221-234

2. U. Chakravarti, (2001) 'Pitrasatta Par ek Note', in S. Arya, N. Menon & J. Lokneeta (eds.) *Naarivaadi Rajneeti: Sangharsh evam Muddey,* University of Delhi: Hindi Medium Implementation Board, pp.1-7
3. V Geetha, (2002) *Gender,* Kolkata, Stree, pp. 1-20
4. M. Kosambi, (2007) *Crossing the Threshold,* New Delhi, Permanent Black, pp. 3-10; 40-46
5. N. Menon, (2008) 'Power', in R. Bhargava and A. Acharya (eds), *Political Theory: An Introduction,* Delhi: Pearson, pp.148-157
6. B. Hooks, (2010) 'Feminism: A Movement to End Sexism', in C. Mc Cann and S. Kim (eds), *The Feminist Reader: Local and Global Perspectives,* New York: Routledge
7. K. Millet, (1968) *Sexual Politics,* Available at http://www.marxists.org/subject/women/authors/millett-kate/sexual-politics.htm
8. S. de Beauvoir (1997) *Second Sex,* London: Vintage
9. Agnihotri and V. Mazumdar, (1997) 'Changing the Terms of Political Discourse: Women's Movement in India, 1970s-1990s', *Economic and Political Weekly*, 30 (29), pp. 1869-1878.
10. R. Kapur, (2012) 'Hecklers to Power? The Waning of Liberal Rights and Challenges to Feminism in India', in A. Loomba *South Asian Feminisms,* Durham and London: Duke University Press, pp. 333-355
11. P. Swaminathan,(2012)'Introduction', in *Women and Work,* Hyderabad: Orient Blackswan, pp.1-17

DISCIPLINE SPECIFIC ELECTIVE – 3 (Any two in Semester - V)

PLSADSE	**Semester V**			
Course Code	**Paper III** **Understanding Global Politics**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSADSE03T	**Module I. Globalization: Conceptions and Perspectives** a. Understanding Globalization and its Alternative Perspectives b. Political: Debates on Sovereignty and Territoriality c. Global Economy: Its Significance and Anchors of Global Political Economy: IMF, World Bank, WTO, TNCs **Module II. Identity and Culture : Crisis of Coexistance** a. Global Inequalities b. Violence: Conflict, War and Terrorism c. Global Civil Society : Proliferation of Nuclear Weapons ; International Terrorism: Non-State Actors and State Terrorism; Post 9/11 developments ; Migration ; Human Security **Module III. Global Environment** Ecological Issues: Historical Overview of International Environmental Agreements, Climate Change, Global Commons Debate	**25** **25** **25**	5+1	75

READING LIST

PLSADSE03T - Understanding Global Politics

1. S. Elden, (2009) 'Why Is The World Divided Territorially?', in J. Edkins and M. Zehfuss (eds.) Global Politics: A New Introduction, New York: Routledge, pp. 192-219.
2. M. Shapiro, (2009) 'How Does The Nation- State Work?', in J. Edkins and M. Zehfuss (eds.) Global Politics: A New Introduction, New York: Routledge, pp. 220-243.
3. A. Narlikar, (2005) The World Trade Organization: A Very Short Introduction, New Delhi: Oxford University Press.
4. J. Goldstein, (2006) International Relations, New Delhi: Pearson, pp. 327-368.
5. Y. Isar, (2012) 'Global Culture', in B. Chimni and S. Mallavarapu (ed.) International Relations: Perspectives For the Global South, New Delhi: Pearson, pp. 272-285.
6. M. Duffield, (2011) Development and Security the Unending War: Governing the World of Peoples, Cambridge: Polity Press.
7. N. Adams, (1993) World Apart: The North-South Divide and the International System, London: Zed.
8. M. Dillon, (2009) 'What Makes The World Dangerous?' in J. Edkins And M. Zehfuss (eds.) Global Politics: A New Introduction, New York: Routledge, pp. 397-426.
9. A. Heywood, (2011) 'Global Environmental Issues', in Global Politics, London: Palgrave, 2011, pp. 383-411.
10. N. Carter, (2007) The Politics of Environment: Ideas, Activism, Policy, 2nd edition, Cambridge: Cambridge University Press, pp 13-81
11. N. Chandhoke, (2011) 'The Limits of Global Civil Society,' Available at www.gcsknowledgebase.org/wp-content/uploads/2002chapter2.pdf
12. G. Lexter and S. Halperin (eds.), (2003) Global Civil Society And Its Limits, New York: Palgrave, pp. 1-21.

DISCIPLINE SPECIFIC ELECTIVE 4(Any two in Semester - VI)

PLSADSE	**Semester VI**			
Course Code	**Paper - IV** **Public Policy in India**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSADSE04T	**Module . I. Introduction to Policy Analysis** a. The Analysis of Policy in the Context of Theories of State b. Political Economy and Policy: Interest Groups and Social Movements. **Module II. Models of Policy Decision-Making** **Module III. Ideology and Policy: Nehruvian Vision, Economic Liberalisation and recent developments**	**30** **20** **25**	5+1	75

READING LIST

PLSADSE04T- PUBLIC POLICY IN INDIA

1. Jenkins, B. (1997) 'Policy Analysis: Models and Approaches' in Hill, M. (1997) *The Policy Process: A Reader* (2nd Edition). London: Prentice Hall, pp. 30-40.

2. Dye, T.R. (2002) *Understanding Public Policy*. Tenth Edition. Delhi: Pearson, pp.1-9, 32-56 and 312-329.

3. Sapru, R.K.(1996) *Public Policy : Formulation, Implementation and Evaluation*. New Delhi: Sterling Publishers, pp. 26-46.

4. Dunleavy, P. and O'Leary, B. (1987) *Theories of the State*. London: Routledge.McClennan, G. (1997) 'The Evolution of Pluralist Theory' in Hill, M. (ed.) *The Policy Process: A Reader.* 2nd Edition. London: Prentice Hall, pp. 53-61.

5. Dye, T.R. (2002) *Understanding Public Policy*. 10th Edition. Delhi: Pearson, pp.11-31.

6. Lukes, S. (1986) *Power.* Basil: Oxford , pp. 28-36.

7. Lukes, S. (1997) 'Three Distinctive Views of Power Compared', in Hill, M. (ed.), *The PolicyProcess: A Reader.* 2nd Edition. London: Prentice Hall, pp. 45-52.

8. Giddens, A. (1998) *The Third Way: The Renewal of Social Democracy.* Cambridge: Polity Press, pp. 27-64 and 99-118.

9. Hogwood, B. & Gunn, L. (1984) *Policy Analysis for the Real World.* U.K: Oxford University Press, pp. 42-62.

10. Sabatier, P.L. & Mazmanian, D. (1979) 'The Conditions of Effective Policy Implementation', in *Policy Analysis*, vol. 5, pp. 481-504.

11. Basu Rumki (2015) Public Administration in India Handates, Performance and Future Perspectives, New Delhi, Sterling Publishers

12. Self, P. (1993) *Government by the Market? The Politics of Public Choice*. Basingstoke: MacMillan, pp. 1-20,70-105,113-146,198-231 and 262-277.

13. Girden,E.J.(1987) 'Economic Liberalisation in India: The New Electronics Policy' in *Asian Survey*. California University Press. Volume 27, No.11. Available at - www.jstor.org/stable/2644722.

DISCIPLINE SPECIFIC ELECTIVE 5(Any two in Semester - VI)

PLSADSE	**Semester VI**			
Course Code	**Paper - V** **Human Rights in a Comparative Perspective**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSADSE05T	**I. Human Rights: Theory and Institutionalization** a. Understanding Human Rights: Three Generations of Rights b. Institutionalization: Universal Declaration of Human Rights c. Rights in National Constitutions: South Africa and India **II. Issues** a. Torture: USA and India b. Surveillance and Censorship: China and India c. Terrorism and Insecurity of Minorities: USA and India **III. Structural Violence** a. Caste and Race: South Africa and India b. Gender and Violence: India and Pakistan c. Adivasis/Aboriginals and the Land Question: Australia and India	**25** **25** **25**	5+1	75

READING LIST

PLSADSE05T - HUMAN RIGHTS IN A COMPARATIVE PERSPECTIVE

1. J. Hoffman and P. Graham, (2006) 'Human Rights', *Introduction to Political Theory*, Delhi,Pearson, pp. 436-458.
2. SAHRDC (2006) 'Introduction to Human Rights'; 'Classification of Human Rights: An Overview of the First, Second, and Third Generational Rights', in *Introducing Human Rights*, New Delhi: Oxford University Press.
3. The Constitution of the Republic of South Africa, Chapter 2: Bill of Rights.
4. The Constitution of India, Chapter 3: Fundamental Rights
5. M. Lippman, (1979) 'The Protection of Universal Human Rights: The Problem of Torture'*Universal Human Rights*, Vol. 1(4), pp. 25-55
6. J. Lokaneeta, (2011) 'Torture in the TV Show 24: Circulation of Meanings'; 'Jurisprudence on Torture and Interrogations in India', in *Transnational Torture Law, Violence, and State Power in the United States and India*, Delhi: Orient Blackswan,
7. D. O'Byrne, (2007) 'Torture', in *Human Rights: An Introduction*, Delhi: Pearson, pp. 164-197.
8. E. Scarry, (2010) 'Resolving to Resist', in *Rule of Law, Misrule of Men*, Cambridge: Boston Review Books, MIT, pp.1-53.
9. U. Singh, (2007) 'The Unfolding of Extraordinariness: POTA and the Construction of Suspect Communities', in *The State, Democracy and Anti-terror Laws in India*, Delhi: Sage Publications, pp.165-219
10. A. Pinto, (2001) 'UN Conference against Racism: Is Caste Race?', in *Economic and Political Weekly*, Vol. 36(30)
11. A. Khan and R. Hussain, (2008), 'Violence Against Women in Pakistan: Perceptions and Experiences of Domestic Violence', *Asian Studies Review*, Vol. 32, pp. 239 – 253
12. K. Kannabiran (2012) 'Rethinking the Constitutional Category of Sex', in *Tools of Justice: Non-Discrimination and the Indian Constitution*, New Delhi, Routledge, pp.425-443
13. N. Menon (2012) 'Desire', *Seeing Like a Feminist*, New Delhi: Zubaan/Penguin, pp. 91-146
14. M. Ishay, (2004) *The History of Human Rights: From Ancient Times to the Globalization Era*, Delhi: Orient Blackswan.
15. Text of UDHR available at http://www.un.org/en/documents/udhr/index.shtml

16. U. Baxi, (1989) 'From Human Rights to the Right to be Human: Some Heresies', in S. Kothari and H. Sethi (eds.), *Rethinking Human Rights*, Delhi: Lokayan, pp.181-166

DISCIPLINE SPECIFIC ELECTIVE 6 (Any two in Semester - Vi)

PLSADSE	**Semester VI**			
Course Code	**Paper VI** **Governance: Issues and Challenges**	Lectures	Credits (Theo +Tutorial) X **15 weeks**	Marks
PLSADSE06T	**Module 1. GOVERNMENT AND GOVERNANCE: CONCEPTS** Role of State In the era of Globalisation State, Market and Civil Society **Module 2. ENVIRONMENTAL GOVERNANCE** Human-Environment Interaction Green Governance: Sustainable Human Development **Module -3. GOOD GOVERNANCE INITIATIVES IN INDIA: BEST PRACTICES** • Public Service Guarantee Acts • Electronic Governance • Citizens Charter & Right to Information • Corporate Social Responsibility	**20** **20** **35**	5+1	75

READING LIST

PLSADSE06T - GOVERNANCE: ISSUES AND CHALLENGES

1. B. Chakrabarty and M. Bhattacharya, (eds.) *The Governance Discourse.* New Delhi: Oxford University Press,1998

2. Surendra Munshi and Biju Paul Abraham [eds.] , *Good Governance, Democratic Societies And Globalisation,* Sage Publishers, 2004

3. United Nation Development Programme , *Reconceptualising Governance,* New York, 1997

4. Carlos Santiso, *Good Governance and Aid Effectiveness: The World Bank and Conditionality* Johns Hopkins University, The Georgetown Public Policy Review ,Volume VII, No.1, 2001

5. Vasudha Chotray and Gery Stroker , Governance Theory: A Cross Disciplinary Approach , Palgrave Macmillan ,2008

6. J. Rosenau, 'Governance, Order, and Change in World Politics', in J. Rosenau, and E. Czempiel (eds.) *Governance without Government: Order and Change in World Politics,* Cambridge: Cambridge University Press ,1992

7. B. Nayar (ed.), *Globalization and Politics in India*. Delhi: Oxford University Press, 2007 pp. 218-240.

8. P. Bardhan, 'Epilogue on the Political Economy of Reform in India', in *The Political Economy of Development in India*. 6th edition, Delhi: Oxford University Press, 2005

9. J. Dreze and A. Sen, *India: Economic Development and Social Opportunity*. New Delhi: Oxford University Press, 1995

10. Niraja Gopal Jayal[ed.], *Democracy in India,* Oxford University Press, 2007
11. Ramachandra Guha, *Environmentalism: A Global History*, Longman Publishers, 1999 J.P. Evans, *Environmental Governance,* Routledge , 2012

12. Emilio F. Moran, *Environmental Social Science: Human - Environment interactions and Sustainability*, Wiley-Blackwell, 2010

13. Burns H Weston and David Bollier, *Green Governance: Ecological Survival, Human Rights, and the Law of the Commons,* Cambridge University Press, 2013

14. **A**. Heywood, *Global Politics,* New York: Palgrave, 2011, pp. 383-411.

15. N. Carter, *The Politics of Environment: Ideas, Activism, Policy*, Cambridge: Cambridge University Press, 2007, pp. 13-81.

16. Pranab Bardhan and Dilip Mookherjee, *Decentralization And Local Governance In Developing Countries: A Comparative Perspective*, MIT Press, 2006

17. Niraja Gopal Jayal , *Democracy and the State: Welfare, Secularism, and Development in Contemporary India*, Oxford University Press, 1999

18. K. Vijaya Kumar, *Right to Education Act 2009: Its Implementation as to Social Development in India*, Akansha Publishers, 2012

19. Amartya Sen and Jean Dreze, *Omnibus: Poverty and Famines, Hunger and Public Action, India-Economic Development and Social Opportunity*, Oxford University Press, 1998

20. Jean Dreze and Amartya Sen, *An Uncertain Glory: India And Its Contradictions*, Princeton University Press, 2013

(D) PLSSSEC - Skill Enhancement Courses – Two

Semester – 3
Credit – 2
Class – 2Hours/week

1. PLSSSEC01M Democratic Awareness with Legal Literacy

Course Objective: The Proposed course aims to acquaint student with the structure and manner of functioning of the legal system in India.

Course Content:
Unit I

 Outline of the Legal system in India

 System of courts/tribunals and their jurisdiction in India - criminal and civil courts,Writ jurisdiction, specialized courts such as juvenile courts, Mahila courts and Tribunals.

 Role of the police and executive in criminal law administration.

 Alternate dispute mechanisms such as Lok Adalats, non- formal mechanisms.

Unit II

 Brief understanding of the laws applicable in India

 Constitution - fundamental rights, fundamental duties, other constitutional rights and their manner of enforcement, with emphasis on public interest litigation and the expansion of certain rights under Article 21 of the Constitution.

 Laws relating to criminal jurisdiction - provision relating to filing an FIR, arrest, bail search and seizure and some understanding of the questions of evidence and procedure in Cr. P.C. and related laws, important offences under the Indian PenalCode, offences against women, juvenile justice, prevention of atrocities on Scheduled Castes and Scheduled Tribes.

 Concepts like Burden of Proof, Presumption of Innocence, Principles of Natural Justice, Fair comment under Contempt laws.

 Personal laws in India : Pluralism and Democracy

 Laws relating to contract, property and tenancy laws.

 Laws relating to dowry, sexual harassment and violence against women

 Laws relating to consumer rights

 Laws relating to cyber crimes

 Anti-terrorist laws: implications for security and human rights

 Practical application: Visit to either a (I) court or (ii) a legal aid centre set up by the

 Legal Services Authority or an NGO or (iii) a Lok Adalat, and to interview a litigant or person being counselled. Preparation of a case history.

Unit III

Access to courts and enforcement of rights

 Critical Understanding of the Functioning of the Legal System

 Legal Services Authorities Act and right to legal aid, ADRsystems

Practical application :

What to do if you are arrested ; if you are a consumer with a grievance; if you are a victim of sexual harassment; domestic violence, child abuse, caste, ethnic and religious discrimination; filing a public interest litigation. How can you challenge administrative orders that violate rights, judicial and administrative remedies

Using a hypothetical case of (for example) child abuse or sexual harassment or any other violation of a right, preparation of an FIR or writing a complaint addressed tothe appropriate authority.

 Suggested exercises for students

1. Discuss the debates around any recent Ordinance, Bill or Act in Parliament.
2. How to file an FIR? In case there has been a theft in the neighbourhood how would you file the first Hand Information Report?
3. Under what circumstances can detention and arrest become illegal?
4. Discuss any contemporary practice or event that violates the equality and protection against discrimination laws.
5.. Your friend has shared with you an incident of unwelcome verbal remarks on her by a person of higher authority in your college, what would you do?
6. You have seen a lady in your neighbourhood being beaten up by her husband. Identify the concerned Protection Officer in case you want to provide information about this incident.
7.Read the Vishakha Guidelines as laid down by the Supreme Court and the Act against sexual harassment at the workplace. Discuss what constitutes sexual harassment and the mechanisms available for its redressal in your institution. Use and Abuse of the mechanism.
8. What is the procedure to file an RTI? Use and Abuse of RTI. Exemptions to RTI
10. You bought a product from a nearby shop which was expired, the shop keeper refused to return it. Use your knowledge of Consumer Protection Act to decide what you do next?
11. What must you keep in mind as a consumer while making a purchase that may later help you make use of Consumer Protection Act? (Hint- Should you ask for a Bill?)
12. In your surroundings have you witnessed any incident that would be considered offensive under the SC and ST Act? Make a class- room presentation on it.

Semester – 4
Credit – 2
Class – 2Hours/week

PLSSSEC02M - 2. Public Opinion and Survey Research

Course Objective: this course will introduce the students to the debates, principles and practices of public opinion polling in the context of democracies, with special reference to India. It will familiarize the students with how to conceptualize and measure public opinion using quantitative methods, with particular attention being paid to developing basic skills pertaining to the collection, analysis and utilization of quantitative data.

I. Introduction to the course
Definition and characteristics of public opinion, conceptions and characteristics, debates about its role in a democratic political system, uses for opinion poll

II. Measuring Public Opinion with Surveys: Representation and sampling (6 lectures)

a. What is sampling? Why do we need to sample? Sample design.
b. Sampling error and non-response

c. Types of sampling: Non random sampling (quota, purposive and snowball sampling); random sampling: simple and stratified
d. Interviewing: Interview techniques pitfalls, different types of and forms of interview
e. Questionnaire: Question wording; fairness and clarity.

III. Quantitative Data Analysis

a. Introduction to quantitative data analysis
b. Basic concepts: correlational research, causation and prediction, descriptive and Inferential Statistics

Syllabus under CBCS

FOR

THREE YEARS B.A.SANSKRIT (HONOURS)

WEST BENGAL STATE UNIVERSITY

BARASAT

NORTH 24 PARGANAS

PIN - 700126

DETAILS OF COURSE STRUCTURE

Distribution of courses in different semesters for B.A. (Honours) Sanskrit

Semester	Core	DSE	GE	AECC	SEC	Total credit
I	C1 C2		GE1	Environmental Science		20
II	C3 C4		GE2	English/MIL Communication		20
III	C5 C6 C7		GE3		SEC1	26
IV	C8 C9 C10		GE4		SEC2	26
V	C11 C12	DSE1 DSE2				24
VI	C13 C14	DSE3 DSE4				24
Total number of courses	14	4	4	2	2	140

West Bengal State University

Syllabus under CBCS

FOR

B.A. Honours in Sanskrit

(6 Semesters Pattern)

There will be six semesters in the three-year B.A. Honours in Sanskrit. The Curriculum consists of 14 Core Courses (C), 2 Ability Enhancement Compulsory Courses (AECC), 2 Skill Enhancement Courses (SEC) and 4 Discipline Specific Elective (DSE) Courses and 4 Generic Elective (GE) courses.

- All questions will be set in Sanskrit Language with Devnagari Script.
- 60% of Questions are to be answered compulsorily in Sanskrit with Devanagari script in 1st and 2nd Semesters.
- 80% of Questions are to be answered compulsorily in Sanskrit with Devanagari script in 3rd and 4th Semesters.
- 100% Questions are to be answered compulsorily in Sanskrit with Devanagari script in 5th and 6th Semesters.

		Semester I			Marks		
Course Code	**Course Type**	**Course Title & Topics**	Credits	Lec +Tu	IA	ESE	Total
SANACORO1T	**Core Course 1**	**Classical Sanskrit Literature (Poetry)**	6	5 + 1	25 (5+20)	50	75
		Section 'A' (10 Classes) Raghuvaṁśam: Canto-I (Verse: 1-25) **Section 'B' (18 Classes)** Kumārasambhavam: Canto-V (Verse: 1-30) **Section 'C' (22 Classes)** Kirātārjunīyam - Canto I (1-25 Verses) **Section 'D' (15 Classes)** Nītiśatakam (1-20 Verses, 1st two Paddhatis)-M. R. Kale Edition. **Section 'E' (10 Classes)** Origin and Development of Mahākāvya and Gītikāvya					
SANACORO2T	**Core Course 2**	**Critical Survey of Sanskrit Literature**	6	5 + 1	25 (5+20)	50	75
		Section 'A' (20 Classes) Vedic Literature Saṁhitā (Ṛk, Yajuḥ, Sāma, Atharva) time, subject– matter, religion & Philosophy, social life Brāhmaṇa, Āraṇyaka, Upaniṣad, Vedāṅga (Brief Introduction) **Section 'B'(10 Classes)** Rāmāyaṇa Rāmāyaṇa-time, subject–matter, Rāmāyaṇa as an Ādikāvya. Rāmāyaṇa as a Source Text and its Cultural Importance. **Section 'C'(10 Classes)** Mahābhārata Mahābhārata and its Time, Development, and subject matter Mahābhārata : Encyclopaedic nature, as a Source, Text, Cultural Importance. **Section 'D'(10 Classes)** Purāṇas Purāṇas : Subject matter, Characteristics Purāṇas : Social, Cultural and Historical Importance					

		Section 'E'(25 Classes) General Introduction to Vyākaraṇa, Darśana and Sāhityaśāstra *General Introduction to Vyākaraṇa:* Brief History of Vyākaraṇaśāstra *General Introduction to Darśana:* Major schools of Indian Philosophy Cārvāka, Bauddha, Jaina, Sāṅkhya-yoga, Nyāya-Vaiseśika, Pūrva- mīmāṁsā and Uttara mīmāṁsā. *General Introduction to Poetics:* Six major Schools of Indian Poetics-Rasa, Alaṁkāra, Rīti, Dhvani,Vakrokti and Aucitya					
	Generic Elective Course 1	Interdisciplinary(Any Discipline other than Sanskrit) (75 classes)	6	5 + 1	25 (5+20)	50	75
ENVSAEC01T	AECC	ENVS	2	2	5	20	25

		Semester II			Marks		
Course Code	**Course Type**	**Course Title & Topics**	Credits	Lec +Tu	IA	ESE	Total
SANACORO3T	**Core Course 3**	**Classical Sanskrit Literature (Prose)**	6	5 + 1	25 (5+20)	50	75
		Section 'A'(30 Classes) Śukanāsopadeśa **Section 'B'(23 Classes)** Viśrutacaritam (Uchhvāsa VIII) **Section 'C'(22 Classes)** Origin and development of prose, Important prose romances and fables Origin and development of prose, important prose romances and fables (i) Subandhu, Daṇḍin, Bāṇa, Ambikādatta Vyāsa. (ii)Paṅcatantra,Hitopadeśa, Vetālapaṅcaviṁśatikā, Siṁhāsanadvātriṁśikā, Puruṣaparīkṣā, Śukasaptati					
SANACORO4T	**Core Course 4**	**Self Management in the Gītā**	6	5 + 1	25 (5+20)	50	75
		Section 'A'(23 Classes) Gītā: Cognitive and emotive apparatus III.42; XV. 7, XIII. 5-6; XIV.5-8, 11-13; XIV.17, VII.4 XV.7; XV.9 **Section 'B'(30 Classes)** Gītā: Controlling the mind I.1; IV.16; I.45; II.6.41.60.67, III.36-39, XVI.21, II.3; IV.5, VI.34-35;					

		, VI.11-14, III.8; VI.16-17, XVII. 8-10, XVII. 14-19, VI., III.25, IV.42, XVIII.30-32, XVIII.63, II.59, 64, XVIII .13-16; V.8-9, II.48; II.55, II. 52 ; IV.38-39 **Section 'C'(22 Classes)** Gītā: Self management through devotion XII.11; XII.13-19, II.47, VII.21, IV.11, IX.26, II.7 ; IX.27; VIII.7; XI.55					
	Generic Elective Course 2	Interdisciplinary(Any Discipline other than Sanskrit) (75 classes)	6	5 + 1	25 (5+20)	50	75
SANSAEC01M	**AECC/MIL**	ENGLISH/ Bengali/ **Sanskrit** *Declension :* Nara, Muni, Sādhu, Pitri, Latā, Mati, Madhu, Marut, Nadī, Dhenu, Badū, Phala, Vāri, Asmad, Yusmad, Tat, Yat *Conjugation :* Pat, Pac, Gam, Kri, Bhū, Ad, As, Han, Hū, Dib, Tan, Tud, Su, Krī, Sev, Chur Kāraka vibhakti Rules, ktva, tumun, Shatri, Shanach, nistha, kritya Comprehension	2	2	5	20	25

		Semester III			Marks		
Course Code	**Course Type**	**Course Title & Topics**	Credits	Lec +Tu	IA	ESE	Total
SANACORO5T	**Core Course 5**	**Classical Sanskrit Literature (Drama)** **Section 'A'(25 Classes)** Svapnavāsavadattam– Bhāsa **Section 'B'(50 Classes)** Abhijñānaśākuntalam	6	5 + 1	25 (5+20)	50	75
SANACORO6T	**Core Course 6**	**Poetics and literary criticism** **Section 'A'(10 Classes)** Introduction to Sanskrit poetics *Introduction to poetics:* Origin and development of Sanskrit poetics, its various names- kriyākalpa, alaôkāraśāstra sāhityaśāstra, saundryaśāstra. Definition (lakṣaṇa), objectives (prayojana) and causes (hetu) of poetry. (according to kāvyaprakāśa) **Section 'B' (15 Classes)** Forms of Kāvya-Literature *Forms of poetry* : dṛśya, śravya, miśra, (campū) Mahākāvya, khaṇḍakāvya, gadya-kāvya: kathā, ākhyāyikā (according to Sāhityadarpaṇa) **Section 'C'(20 Classes)** Śabda-śakti (Power of Word) and rasa-sūtra *Power/Function of word and meaning (according to kāvyaprakāśa):* abhidhā (expression/ denotative meaning), lakṣaṇā (indication/ indicative meaning) and vyañjanā (suggestion/ suggestive meaning). *Rasa:* rasa-sūtra of Bharata and its prominent expositions: utpattivāda, anumitivāda, bhuktivāda and abhivyaktivāda, alaukikatā (transcendental nature) of rasa (as discussed in Kāvyaprakāśa **Section 'D'(30 Classes)** Alaṁkāra(figures of speech) – According to Sahityadarpanaand Chandasa (metres) – According to Chandomanjari *Figures of speech:* anuprāsa, yamaka, śleṣa, upamā, rūpaka, sandeha, bhrāntimān, apahnuti, utprekṣā, atiśayokti, tulyayogitā, dīpaka, dṛṣṭānta, nidarśanā, vyatireka, samāsokti, svabhāvokti, aprastutaprasaṁsā, arthāntaranyāsa, kāvyaliṅga, vibhāvanā.	6	5 + 1	25 (5+20)	50	75

		Metres: anuṣṭup, āryā, indravajrā, upendravajrā, drutavilambita, upajāti, vasantatilakā, mālinī, mandākrāntā, śikhariṇī, śārdūlavikrīḍita, sragdharā					
SANACORO7T	**Core Course 7**	**Indian Social Institutions and Polity**	6	5 + 1	25 (5+20)	50	75
		Section 'A'(15 Classes) Indian Social Institutions : Nature and Concepts *Indian Social Institutions : Definition and Scope:* Sociological Definition of Social Institutions. Trends of Social Changes, Sources of Indian Social Institutions (Vedic Literature, Sūtra Literature, Purāṇas, Rāmāyaṇa , Mahābhārata ,Dharmaśāstras, Buddhist and Jain Literature, Literary Works, Inscriptions, Memoirs of Foreign Writers) *Social Institutions and Dharmaśāstra Literature:* Dharmaśāstra as a special branch of studies of Social Institutions, sources of Dharma (Manusmṛti, 2,12; Yājñavalkyasmṛti,1.7). Different kinds of Dharma in the sense of Social Ethics Manusmṛti, 10,63; Viṣṇupurāṇa 2.16-17); Six kinds of Dharma in the sense of Duties (Mitākṣarāṭīkā on Yājñavalkyasmṛti,1.1). Tenfold Dharma as Ethical Qualities (Manusmṛti,6.92); Fourteen-Dharmasthānas (Yājñavalkyasmṛti,1.3) **Section 'B'(20 Classes)** Structure of Society and Value of Life Varṇa-System and Caste System : Four-fold division of Varṇa System, (Ṛgveda, 10.90.12), Mahābhārata, Śāntiparva,72.3-8); Division of Varṇa according to Guṇa and Karma (Bhagvadgīta , 4.13, 18.41-44). Origin of Caste-System from Inter-caste Marriages (Mahābhārata, Anuśāsanaparva, 48.3-11); Emergence of non-Aryan tribes in Varṇa-System (Mahābhārata, Śāntiparva, 65.13-22). Social rules for up-gradation and down-gradation of Caste System (Āpastambadharmasūtra, 2.5.11.10-11, Baudhāyanadharmasūtra, 1.8.16.13-14, Manusmṛti, 10,64, Yājñavalkyasmṛti, 1.96) *Position of Women in the Society :* Brief survey of position of women in different stages of Society. Position of women in Mahābhārata (Anuśāsanaparva, 46.5-11, Sabhāparva, 69.4-13. Praise of women in The Bṛhatsaṁhitā of Varāhamihira (Strīprasaṁsā, chapter-74.1-10) *Social Values of Life :* Social Relevance of Indian life style with special reference to Sixteen Saṁskāras. Four aims of life 'Puruṣārtha Catuṣṭaya'- Dharma, 2. Artha, 3. Kāma, 4. Mokṣa. Four Āśramas- 1. Brahmacarya, 2. Gṛhastha, Vānaprastha, 4. Saṁnyāsa					

		Section 'C'(25 Classes) Indian Polity : Origin and Development *Initial stage of Indian Polity (from Vedic period to Buddhist period).* Election of King by the people: 'Viśas' in Vedic priod(Ṛgveda,10.173;10.174;Atharvaveda,3.4.2; Parliamentary Institutions:'Sabhā,'Samiti' and 'Vidatha' in Vedic period (Atharvaveda,7.12.1;12.1.6 ; Rgveda ,10.85.26); King-maker 'Rājakartāraḥ' Council in Atharvaveda(3.5.6-7),Council of 'Ratnis' in Satapathabrāhmaṇa(5.2.5.1); Satapathabrāhmaṇa (51.1.8-13; 9.4.1.1-5) Republic States in the Buddhist Period (Digghnikāya, Mahāparinibbaṇa Sutta, Aṅguttaranikāya,1.213;4.252,256) Later Stages of Indian Polity (From Kauṭilya to Mahatma Gandhi). Concept of Welfare State in Arthaśāstra of Kauṭilya (Arthaśāstra, 1.13 :'matsyanyāyābhibhuṭḥ' to 'yo' asmāngopāyatīti'); Essential Qualities of King (Arthaśāstra,6.1.16-18: 'sampādayatyasampannaḥ' to 'jayatyeva na hīyate'); State Politics 'Rajadharma' Mahābhārata , Śāntiparva,120.1-15; Manusmṛti, 7.1-15; Śukranīti,1.1-15); Constituent Elements of Jain Polity in Nitivākyāmṛta of Somadeva Suri, (Daṇḍanīti- samuddeśa, 9.1.18 and Janapada- samuddeśa, 19.1.10). Relevance of GandhianThought in Modern Period with special reference to 'Satyāgraha' Philosophy ('Satyāgrahagītā' of Panditā Kṣamārāva and 'Gandhi Gītā', 5.1-25 of Prof. Indra) **Section 'D'(15 Classes)** Cardinal Theories and Thinkers of Indian Polity *Cardinal Theories of Indian Polity:* *'Saptāṅga' Theory of State:* 1.Svāmi, 2. Amātya, 3.Janapada 4. Pura, 5. Kośa, 6. Daṇḍa and Mitra(Arthaśāstra, 6.1. Mahābhārata, Śāntiparva, 56.5, Śukranīti, 1.61-62). '*Maṇḍala'Theory of Inter-State Relations:* 1.Ari, 2.Mitra, 3. Ari-mitra,4.Mitra- mitra, 5.Ari-mitra-mitra; (According to Manusamhita) *'Śāḍgunya'Policy of War and Peace :* 1.Sandhi, 2. Vigraha, 3. Yāna, 4. Āsana, Saṁśraya 6.Dvaidhibhāva.(According to Manusamhita) *'CaturvidhaUpāya'for Balancing the power* 1.Sāma 2.Dāma,3.Daṇḍa.4.Bheda; (According to Manusamhita) *Three Types of State Power: Śakti':* śakti,2.Mantra-śakti, 3. Utsāha-śakti. *Important Thinkers on Indian Polity:* Manu, Kautilya, Kāmandaka, Śukrācārya, SomadevaSuri, Mahatma Gandhi.					
	Generic Elective Course 3	Interdisciplinary (Any Discipline other than Sanskrit) (75 classes)	6	5 + 1	25 (5+20)	50	75
SANSSEC01M	SEC1 (Skill Based)	**Basic Sanskrit** Translation (From Bengali/English to Sanskrit) (20 Classes) Paragraph Writing (5 Classes) Letter Writing (5 Classes)	2	2	5	20	25

		Semester IV			Marks		
Course Code	**Course Type**	**Course Title & Topics**	Credits	Lec +Tu	IA	ESE	Total
SANACORO8T	**Core Course 8**	**Indian Epigraphy, Paleography and Chronology**	6	5 + 1	25 (5+20)	50	75
		Section 'A' (20 Classes) Epigraphy *Introduction to Epigraphy and Types of Inscriptions* Importance of Indian Inscriptions in the reconstruction of Ancient Indian History and Culture *History of Epigraphical Studies in India* History of Decipherment of Ancient Indian Scripts (Contribution of Scholars in the field of epigraphy): Fleet, Cunninghum, Princep, Buhler, Ojha, D.C.Sircar **Section 'B'(20 Classes)** Paleography *Antiquity of the Art of Writing* Writing Materials, Inscribers and Library Introduction to Ancient Indian Scripts. **Section 'C'(25 Classes)** *Study of selected inscriptions* Aśoka's Giranāra Rock Edict-1 , Aśoka's Sāranātha Pillar Edict Girnāra Inscription of Rudradāman, Eran Pillar Inscription of Samudragupta, Mehrauli Iron Pillar Inscription of Candra, Delhi Topra Edict of Bīsaladeva **Section 'D'(10 Classes)** *Chronology* General Introduction to Ancient Indian Chronology System of Dating the Inscriptions (Chronograms) Main Eras used in Inscriptions - Vikrama Era, Śaka Era and Gupta Era					
SANACORO9T	**Core Course 9**	**Modern Sanskrit Literature**	6	5 + 1	25 (5+20)	50	75
		Section 'A'(35 Classes) Survey of Modern Sanskrit Literature in Bengal **Section 'B'(40 Classes)** *GadyaKāvya and Rūpaka* Śivarājavijayam, Niśwāsa-I Bharatavivekam – Yatindravimal Choudhury Chipitakacharvanam - Srijiv Nyayatirtha					

SANACOR10T	Core Course 10	**Sanskrit and World Literature**	6	5 + 1	25 (5+20)	50	75
		Section 'A' (30 Classes) *Sanskrit Studies in West:* - William Jones, Charles Wilkins, H.Wilson, Max Muller, J.G.Buhler, Mac donell, Weber, W.T.Whitney **Section 'B' (45 Classes)** *Sanskrit Studies in East:* Swami Vivekananda, Sri Aurobindo, DayānandaSarasvatī, HaridāsaSiddhāntavāgīśa, ŚrījīvaNyāyatīrtha, Kshitish Chandra Chatterji, Roma Chaudhuri, PañcānanaTarkaratna &Ramaranjan Mukherji)					
	Generic Elective Course 4	Interdisciplinary (Any Discipline other than Sanskrit) (75 classes)	6	5 + 1	25 (5+20)	50	75
SANSSEC02M	SEC2 (Skill Based)	**Spoken Sanskrit & Computer Awareness for Sanskrit(** Basic Computer Awareness, Typing in Unicode for Preservation and Digitalization of Sanskrit Text Web Publishing**)**	2	2	5	20	25

		Semester V			Marks		
Course Code	**Course Type**	**Course Title & Topics**	Credits	Lec +Tu	IA	ESE	Total
SANACOR11T	Core Course 11	**Vedic Literature**	6	5 + 1	25 (5+20)	50	75
		Section 'A' (30 Classes) *Saṁhitā and Brāhmaṇa* Ṛgveda- Agni- 1.1, Uṣas- 3.61, Akṣa 10.34, Hiraṇyagarbha- 10.121 Yajurveda- Śivasaṁkalpa Sūkta- 34.1-6 Atharvaveda- Sāmmanasyam- 3.30, Bhūmi-12.1-12 Sunahśepākhyāna of Aitereyabrahmana **Section 'B' (20 Classes)** Vedic Grammar *Declensions (śabdarūpa),* Subjunctive Mood (leṭ), Gerunds (ktvārthaka, Tumarthaka), Vedic Accent and Padapāṭha **Section 'C' (25 Classes)** Muṇḍakopaniṣad					
SANACOR12T	Core Course 12	**Sanskrit Grammar**	6	5 + 1	25 (5+20)	50	75
		Section 'A' (5 Classes) *The Concept of the following Saṃjñās:* Sūtra,Vārtika,Bhāṣya,Karmapravacanīya,Nipāta,Gati, Upasarga,Guṇa,Vṛddhi,Ṭi,Ghi,Ghu,Nadī,Upadhā and Samprasāraṇa					

		Section 'B' (10 Classes) *General introduction on Philology:* i) Classification of Languages ii) Production and Classification of Sounds iii) Phonetic Laws iv) Vedic and Classical Sanskrit v) Ablaut vi) Phonetic Tendencies vii) Semantics **Section 'C'(30 Classes)** Karakaprkaranam – Vaiyakaranasiddhantakoumudi **Section 'D'(30 Classes**) Samasaprakaranam - Vaiyakaranasiddhantakoumudi					
		Choose Any Two from SANADSE01T, SANADSE02T, SANADSE03T					
SANADSE01T	**Discipline Specific Elective 1**	**Veda & Vyakarana**	6	5 + 1	25 (5+20)	50	75
		i) Śuklayajurveda : Rudrādhyāy ii) Manumatsyakathā of Śatapatha Brāhmana iii) Kavirahasyam iv) Taittiriyopanisad Shikshabvalli : (Adhyaya-1st, Anuvaka : 1-12), v) Aitareya Brāhmana - Nabhānediṣṭhopākhyānam (22.9) vi) Siddhantakoumudi (Stripratyaya)					
SANADSE02T	**Discipline Specific Elective 2**	**Darshana**	6	5 + 1	25 (5+20)	50	75
		i) Saptapadarthi ii) Brihadarnnyakopanishad – Ch –IV.4 & 5 Bramhanas.					
SANADSE03T	**Discipline Specific Elective 3**	**Kavya**	6	5 + 1	25 (5+20)	50	75
		i) Sahityadarpana- 1-3 Chapters ii) Śiśupālavadham: Canto-I (Verse: 1-30) iii) Yugajivanam– Roma Chowdhury					

		Semester VI			Marks		
Course Code	**Course Type**	**Course Title & Topics**	Credits	Lec +Tu	IA	ESE	Total
SANACOR13T	**Core Course 13**	**Ontology and Epistemology**	6	5 + 1	25 (5+20)	50	75
		Section 'A'(15 Classes) *Essentials of Indian Philosophy* Meaning and purpose of darśana, general classification of philosophical schools in classical Indian philosophy Realism (yathārthavāda or vastuvāda) and Idealism (pratyayavāda), Monism (ekattvavāda), Dualism (dvaitavavāda) & Pluralism (bahuttvavāda); dharma (property)-dharmi (substratum) Causation (kāryakāraṇavāda) naturalism (svabhāvavāda), doctrine of pre-existence of effect (satkāryavāda),					

		doctrine of real transformation (pariṇāmavāda), doctrine of illusory transformation (vivartavāda), doctrine of non prexistence of effect in cause (asatkāryavāda and ārambhavāda) **Section 'B'(30 Classes)** *Ontology (Based on Tarkasaṁgraha)* Concept of padārtha, three dharmas of padārthas, definition of Dravya, Sāmānya, Viśeṣa, Samavāya, Abhāva. Definitions of first seven dravyas and their examination; Ātma and its qualities, manas. Qualities (other than the qualities of the ātman) Five types of Karma **Section 'C'(30 Classes)** *Epistemology (Based on Tarkasaṁgraha)* Buddhi(jñāna) – nature of jñāna in Nyāya vaiśeṣika; smriti-anubhava; yathārtha and ayathārtha Karaṇa and kāraṇa, definitions and types of pramā, kartā-kārana-vyāpāra-phala,					
SANACOR14T	**Core Course 14**	**Sanskrit Composition and Communication**	6	5 + 1	25 (5+20)	50	75
		Section 'A'(25 Classes) Vibhaktyartha, Voice and Kṛt **Section 'B'(25 Classes)** *Translation and Communication* Translation Bengali/English to Sanskrit **Section 'C'(25 Classes)** Essay					
		Chose Any Two from SANADSE04T, SANADSE05T, SANADSE06T					
SANADSE04T	**Discipline Specific Elective 4**	**Veda & Vyakarana**	6	5 + 1	25 (5+20)	50	75
		i)Vedic Culture & Vedic studies in West Bengal ii)Computational linguistics iii)VaidikaVyakhyapaddhati (Indian & Western) iv) Bhattikavyam (2nd Sarga)					
SANADSE05T	**Discipline Specific Elective 5**	**Darshana**	6	5 + 1	25 (5+20)	50	75
		i) Bangiyadarshanachinta: Ramakrishna-Vivekananda darshan, GouriyaVaishnabdarshan Shaktadarshan ii) Comparative Studies – Indian & Western logic &Nyaya studies in West Bengal					
SANADSE06T	**Discipline Specific Elective 6**	**Kavya**	6	5 + 1	25 (5+20)	50	75
		i) Kavyalankarasutravritti- 1-4 Chapters ii) Bhattikavyam (2nd Sarga)					

Generic Elective Course (Honours)

- ❖ **All questions will be set in Sanskrit Language with Devnagari Script.**
- ❖ **20% of Questions are to be answered compulsorily in Sanskrit with Devanagari script in 1st and 2nd Semesters.**
- ❖ **30% of Questions are to be answered compulsorily in Sanskrit with Devanagari script in 3rd and 4th Semesters.**
- ❖ **40% Questions are to be answered compulsorily in Sanskrit with Devanagari script in 5th and 6th Semesters.**

		Semester I			Marks		
Course Code	Course Type	**Course Title & Topics**	Credits	Lec +Tu	IA	ESE	Total
SANHGEC01T	Generic Elective Course	**Sanskrit Poetry**	6	5 + 1	25	50	75
		Section 'A' (20 Classes) Raghuvaṁśam: Canto-I (Verse: 1-25) **Section 'B' (18 Classes)** Kumārasambhavam: Canto-V (Verse: 1-30) **Section 'C' (22 Classes)** Nītiśatakam (1-20 Verses, 1st two Paddhatis)-M. R. Kale Edition. **Section 'D' (15 Classes)** History of Sanskrit Poetry					
		Semester II			Marks		
Course Code	Course Type	**Course Title & Topics**	Credits	Lec +Tu	IA	ESE	Total
SANHGEC02T	Generic Elective Course	**Sanskrit Prose**	6	5 + 1	25	50	75
		Section 'A' (15 Classes) Śukanāsopadeśa **Section 'B' (30 Classes)** Śivarājavijayam, Niśwāsa-I **Section 'C' (30 Classes)** Survey of Sanskrit Literature- Prose					

		Semester III			Marks		
Course Code	Course Type	**Course Title & Topics**	Credits	Lec +Tu	IA	ESE	Total
SANHGEC03T	Generic Elective Course	**Sanskrit Drama**	6	5 + 1	25	50	75
		Section 'A' (25 Classes) Svapnavāsavadattam– Bhāsa **Section 'B' (50 Classes)** Abhijānaśākuntalam					
		Semester IV			Marks		
Course Code	Course Type	**Course Title & Topics**	Credits	Lec +Tu	IA	ESE	Total
SANHGEC04T	Generic Elective Course	**Sanskrit Grammar**	6	5 + 1	25	50	75
		Section 'A' (25 Classes) Laghusiddhāntakaumudī : Samjyāprakaran **Section 'B' (50 Classes)** Laghusiddhāntakaumudī : Sandhiprakaraa **Section 'C' (30 Classes)** Laghusiddhāntakaumudī: Vibhakti prakaran					

QUESTION PATTERN

B. A. (Honours) in Sanskrit

SEMESTER – I

Core Corse – 1

Full Marks – 75

End Semester Full Marks - 50

Section –A	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – B	-	One long answer type question	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
Section – C	-	One long answer type question	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
Section – E	-	Two Short Notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10

Internal Assessment Full Marks - 25

Section – D	-	Project (In Sanskrit Language with Devanagari Script)	10
		Short Questions (Any one should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

Core Corse – 2

Full Marks – 75

End Semester Full Marks - 50

Section –A	-	One long answer type question	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
Section – D	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		Two Short Notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10
Section – E	-	One long answer type question	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5

Internal Assessment Full Marks - 25

Section – B	--	Project (In Sanskrit Language with Devanagari Script)	10
Section – C	--	Short Questions (Any one should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

SEMESTER – II

Core Corse – 3

Full Marks – 75

End Semester Full Marks - 50

Section –A	-	One long answer type question	1x10 = 10
		Three Short notes/Explanations (In Sanskrit Language with Devanagari Script)	3x5 = 15
Section – B	-	One long answer type question	1x10 = 10
		Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – C	-	One Short None/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5

Internal Assessment Full Marks - 25

Section – C	-	Project (In Sanskrit Language with Devanagari Script)	10
		Short Questions (Any one should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

Core Corse – 4

Full Marks – 75

End Semester Full Marks - 50

Section –A	-	One long answer type question	1x10 = 10
		Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – B	-	One long answer type question	1x10 = 10
		Three Short notes/Explanations (In Sanskrit Language with Devanagari Script)	3x5 = 15
Section – C	-	One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5

Internal Assessment Full Marks - 25

Section – C	-	Project (In Sanskrit Language with Devanagari Script)	10
		Short Questions (Any one should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

AECC/MIL

Full Marks – 25

Only Internal Assessment Full Marks - 25

Multiple Choice Based Questions	20
Attendance -	5

SEMESTER – III

Core Corse – 5

Full Marks – 75

End Semester Full Marks - 50

Section –A	-	One long answer type question	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
		Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – B	-	One long answer type question (In Sanskrit Language with Devanagari Script)	1x10 = 10
		Three Short notes/Explanations (In Sanskrit Language with Devanagari Script)	3x5 = 15

Internal Assessment Full Marks - 25

Section – B	-	Project (In Sanskrit Language with Devanagari Script)	10
		Short Questions (Any three should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

Core Corse – 6

Full Marks – 75

End Semester Full Marks - 50

Section – B	-	One long answer type question	1x10 = 10
Section – C	-	One long answer type question (In Sanskrit Language with Devanagari Script)	1x10 = 10
Section – D	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		Four Short notes/Explanations (In Sanskrit Language with Devanagari Script)	4x5 = 20

Internal Assessment Full Marks - 25

Section – A	-	Project (In Sanskrit Language with Devanagari Script)	10
		Short Questions (Any three should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

Core Corse – 7

Full Marks – 75

End Semester Full Marks - 50

Section –A	-	One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
		Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – B	-	One long answer type question (In Sanskrit Language with Devanagari Script)	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
Section – C	-	One long answer type question	1x10 = 10
		Two Short notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10

Internal Assessment Full Marks - 25

Section – D	-	Project (In Sanskrit Language with Devanagari Script)	10
		Short Questions (Any three should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

SEC1

(Skill Based)

Full Marks – 25

Only Internal Assessment Full Marks - 25

Translation (From Bengali/English to Sanskrit)	10
Paragraph Writing or Letter Writing in Sanskrit	10
Attendance	5

SEMESTER – IV

Core Corse – 8

Full Marks – 75

End Semester Full Marks - 50

Section –A	-	One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
		Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – B	-	One long answer type question (In Sanskrit Language with Devanagari Script)	1x10 = 10
		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
Section – C	-	One long answer type question	1x10 = 10
		Two Short notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10

Internal Assessment Full Marks - 25

Section – D	-	Project (In Sanskrit Language with Devanagari Script)	10
		Short Questions (Any three should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

Core Corse – 9

Full Marks – 75

End Semester Full Marks - 50

Section –A	-	Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
Section – B		Two long answer type questions (Any one In Sanskrit Language with Devanagari Script)	2x10 = 20
		Four Short notes/Explanations (In Sanskrit Language with Devanagari Script)	4x5 = 20

Internal Assessment Full Marks - 25

Section – A	-	Project (In Sanskrit Language with Devanagari Script)	10
		Short Questions (Any three should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

Core Corse – 10

Full Marks – 75

End Semester Full Marks - 50

Section –A	-	One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
		Short answer type Questions (In Sanskrit Language with Devanagari Script)	5x2 = 10
		One long answer type question (In Sanskrit Language with Devanagari Script)	1x10 = 10
Section – B		One Short note/Explanation (In Sanskrit Language with Devanagari Script)	1x5 = 5
		One long answer type question	1x10 = 10
		Two Short notes/Explanations (In Sanskrit Language with Devanagari Script)	2x5 = 10

Internal Assessment Full Marks - 25

Section – B	-	Project (In Sanskrit Language with Devanagari Script)	10
		Short Questions (Any three should be In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

SEC2

(Skill Based)

Full Marks – 25

Only Internal Assessment Full Marks - 25

Viva	10
Practical on Computer Awareness	10
Attendance -	5

SEMESTER – V

Core Corse – 11

Full Marks – 75

All the questions are to be answered in Sanskrit Language with Devanagari Script

End Semester Full Marks - 50

Section –A	-	Two long answer type questions	2x10 = 20
		Three Short notes/Explanations	3x5 = 15
Section – B	-	One Short note/Explanation	1x5 = 5
		Short answer type Questions	5x2 = 10

Internal Assessment Full Marks - 25

Section – C	-	Project (In Sanskrit Language with Devanagari Script)	10
		Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

Core Corse – 12

Full Marks – 75

All the questions are to be answered in Sanskrit Language with Devanagari Script

End Semester Full Marks - 50

Section –A	-	Short answer type Question	5x2 = 10
Section – B	-	long answer type questions	1x10 = 10
		Two Short notes/Explanations	2x5 = 10
Section – D	-	One long answer type question	1x10 = 10
		Two Short notes/Explanations	2x5 = 10

Internal Assessment Full Marks - 25

Section – C	-	Project (In Sanskrit Language with Devanagari Script)	10
		Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

DSE1

Veda & Vyakarana

Full Marks – 75

All the questions are to be answered in Sanskrit Language with Devanagari Script

End Semester Full Marks - 50

i)	-	Short answer type Questions	5x2 = 10
ii)	-	One long answer type question	1x10 = 10
iii)		One Short note/Explanation	1x5 = 5
iv)	-	One Short note/Explanation	1x5 = 5
v)	-	One long answer type question	1x10 = 10
vi)	-	Two Formations/Explanations of Sutras	2x5 = 10

Internal Assessment Full Marks - 25

On any from i to vi	-Project (In Sanskrit Language with Devanagari Script)	10
	Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
	Attendance	5

DSE2

Darshana

Full Marks – 75

All the questions are to be answered in Sanskrit Language with Devanagari Script

End Semester Full Marks - 50

Saptapadrthi	-	Short answer type Questions	5x2 = 10
		Four Short notes/Explanations	4x5 = 20
Brihadarannyakopanishad		- Two long answer type questions	2x10 = 20

Internal Assessment Full Marks - 25

Saptapadrthi	-	Project (In Sanskrit Language with Devanagari Script)	10
Brihadarannyakopanishad		-Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

DSE3

Kavya

Full Marks – 75

All the questions are to be answered in Sanskrit Language with Devanagari Script

End Semester Full Marks - 50

Sahityadarpanam -	Two long answer type questions	2x10 = 20
Shisupalavadham -	Four Short notes/Explanations	4x5 = 20
Yugajivanam -	Short answer type Questions	5x2 = 10

Internal Assessment Full Marks - 25

Shisupalavadham-	Project (In Sanskrit Language with Devanagari Script)	10
Sahityadarpanam -	Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
	Attendance	5

SEMESTER – VI

Core Corse – 13

Full Marks – 75

All the questions are to be answered in Sanskrit Language with Devanagari Script

End Semester Full Marks - 50

Section –A	-	Short answer type Questions	5x2 = 10
Section – B	-	One long answer type question	1x10 = 10
		Two Short notes/Explanations	2x5 = 10
Section – C	-	One long answer type question	1x10 = 10
		Two Short notes/Explanations	2x5 = 10

Internal Assessment Full Marks - 25

Section – C	-	Project (In Sanskrit Language with Devanagari Script)	10
Section – B	-	Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

Core Corse – 14

Full Marks – 75

All the questions are to be answered in Sanskrit Language with Devanagari Script

End Semester Full Marks - 50

Section –A	-	Short answer type Questions	5x2 = 10
		Change of voice	5x2 = 10
Section – B	-	Translation Bengali/English to Sanskrit	15
Section – C	-	Essay Writing	15

Internal Assessment Full Marks - 25

On any from A, B & C	----- Project (In Sanskrit Language with Devanagari Script)	10
	Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
	Attendance	5

DSE4

Veda & Vyakarana

Full Marks – 75

All the questions are to be answered in Sanskrit Language with Devanagari Script

End Semester Full Marks - 50

I	-	One long answer type question	1x10 = 10
II	-	Short answer type Questions	5x2 = 10
III	-	Two Short notes/Explanations	2x5 = 10
IV	-	One long answer type question Two Short notes/Explanations	1x10 = 10 2x5 = 10

Internal Assessment Full Marks - 25

On any from I to IV	--Project (In Sanskrit Language with Devanagari Script)	10
	Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
	Attendance	5

DSE5

Darshana

Full Marks – 75

All the questions are to be answered in Sanskrit Language with Devanagari Script

End Semester Full Marks - 50

Bangiyadarshanachinta	-	Short answer type Questions	5x2 = 10
		Two long answer type questions	2x10 = 20
Comparative Studies	-	Four Short notes/Explanations	4x5 = 20

Internal Assessment Full Marks - 25

Bangiyadarshanachinta	-	Project (In Sanskrit Language with Devanagari Script)	10
Comparative Studies	-	Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
		Attendance	5

DSE6

Kavya

Full Marks – 75

All the questions are to be answered in Sanskrit Language with Devanagari Script

End Semester Full Marks - 50

Kavyalankarasutravritti –	One long answer type Question	10
	Short answer type questions	5x2 = 10
Bhattikavyam -	One long answer type question	10
	Four Short notes/Explanations	4x5 = 20

Internal Assessment Full Marks - 25

Kavyalankarasutravritti -	Project (In Sanskrit Language with Devanagari Script)	10
Bhattikavyam -	Short Questions (In Sanskrit Language with Devanagari Script)	2x5 = 10
	Attendance	5

N.B.: - The Question Pattern of Generic Elective (H) is similar to the Question Pattern of B.A. Sanskrit Programme (Core Courses).

B.A. (General)

Semester	Core Courses (4 Courses)	Ability Enhancement Courses (AECC) (2 Courses)	Skill Enhancement Courses (SEC) (2 Courses)	Elective: Discipline Specific (DSE) (2 Courses)	Elective: Generic Elective (GE) (2 Courses)
I	Introduction to Sociology **(SOCGCOR01T)**	Environmental Science			
II	Sociology of India **(SOCGCOR02T)**	English/MIL Communication			
III	Sociological Theories **(SOCGCOR03T)**				
IV	Methods of Sociological Inquiry **(SOCGCOR04T)**				
V			Theory and Practice of Development **(SOCSSEC01M)**	(Any one course from the 2 courses given below) Gender and Sexuality **(SOCGDSE01T)** Marriage, Family and Kinship **(SOCGDSE02T)**	Polity and Society in India **(SOCGGEC01T)**
VI			Gender Sensitization **(SOCSSEC02M)**	(Any one course from the 2 courses given below) Social Stratification **(SOCGDSE03T)** Religion and Society **(SOCGDSE04T)**	Economy and Society **(SOCGGEC02T)**

B.A. (General Program) Sociology

Syllabus

Under Choice Based Credit System (CBCS)

West Bengal State University

June 2018

Semester I
CORE COURSE 1
(SOCGCOR01T)
Introduction to Sociology

Outline:

1. **Sociology-The Discipline:** Sociology as a science and as an interpretative discipline; Study of Social Phenomena (8 hrs.)

2. **Basic Concepts**: society, community, association, institution; culture-components, culture change, diffusion, cultural-lag, cultural universals and relativism, ethnocentrism, acculturation; social groups - primary, secondary, formal-informal, in group-out group, and reference groups; social structure, social system, social action; status and role, role conflict, role set; norms and values-conformity and deviance; law and customs; socialization – theories and agencies; nature-nurture debate, social interaction (25 hrs.)

3. **Marriage and Family**: Types and forms of marriage; family-structure and function; personality and socialization; Social control; family, changing structure of family marriage and sex roles in modern society; divorce and its implications; gender issues; role conflicts. (12 hrs.)

4. **Social Stratification**: Concepts-hierarchy, inequality and stratification; forms and functions; class- different conceptions of class: class-in-itself and class-for-itself; caste and class; caste as a class, social mobility
(15 hrs.)

5. **Social Institutions**: Economy, Polity, Education and Religion (5 hrs.)

6. **Social Movements**: Concepts of social movements; genesis of social movements; ideology and social movement (5 hrs.)

7. **Social change**: Continuity and change as fact, and as value; directed social change; social movement and social change; social policy
(5 hrs.)

Reading Reference

1. Alex Inkeles: What Is Sociology, PHI Learning, 1964

2. An Introduction to Sociology: Ken Browne, 3rd edition, Polity, 2005

3. Contemporary Sociology: An Introduction to Concepts and Theory, M. Francis Abraham, OUP India, 2006

4. Samakalin Samajtatwa: Ganguly & Moinuddin, 2nd Edition, Reena Books: Kolkata, 2013

5. Sociology: A Down-to-Earth Approach: James M. Henslin, Pearson; 11th edition 2011

6. Sociology: Essays on Approach and Method: A. Beteille, OUP India 2002

7. The Concise Encyclopedia of Sociology: George Ritzer and J. Michael Ryan (Edits), Blackwell Publishing, 2011

Semester II
Core Course 02
(SOCGCOR02T)
Sociology of India

Outline:

1. India as a Plural Society (10 hrs.)

2. **Social Institutions and Practices**(25 hrs.)
   2.1 Caste
   2.2 Tribe
   2.3 Class
   2.4 Village
   2.5 Family and Kinship
3. **Identities and Change**(20 hrs.)
   3.1 Dalit Movement
   3.2 Women's Movement
4. **Challenges to State and Society**(20 hrs.)
   4.1Communalism
   4.2 Secularism

Reading Reference

1. Contemporary India: Economy, Society, Politics: Neera Chandhoke & Praveen Priyadarshi, Pearson Education India, 2009
3. Dalit identity and Politics. Shah, Ghanshyam. Delhi: Sage 2001
4. Development and Civil Society: Biswajit Ghosh (Ed), Rawat, 2012
5. Family and Social Change in Modern India: Giri Raj Gupta, Vikas Publishing House, 1976
6. Family, Kinship and Marriage in India: Patricia Uberoi, OUP India, 1994
7. Handbook of Indian Sociology: Veena Das, OUP India, 2006
8. Indian Society: Institutions and Change: Rajendra K Sharma, Atlantic Publishers & Dist, 2004

9. India's Agony over Religion: Gerald James Larson, Suny Press, 1995

10. On Civil Society: Issues and Perspectives: N.Jayaram, Sage, 2005

11. Religion in India: T. N. Madan, OUP India, 1992

12. Samakalin Bharatiya Samaj: Ganguly & Moinuddin, PHI Learning 2008 (in Bengali)

13. Social Background of Indian Nationalism (6Th-Edn): A. R. Desai, Popular Prakashan, 2005

14. Social Change in India: B Kuppuswamy, Vikas Publications, 1972

15. Social Stratification: Dipankar Gupta, OUP India 1991

16. Society in India: Change & Continuity: D.G Mandelbaum, University of California Press, 1970

17. The everyday state and society in modern India: C.J. Fuller and Veronique Benei (eds), C. Hurst & Co. Publishers, 2001

18. The Furies of Indian Communalism: Religion, Modernity, and Secularization: Achin Vanaik, Verso, 1997

19. Tradition, Rationality, and Change: Essays in Sociology of Economic Development and Social Change: M.S.A Rao, Popular Prakashan, 1972

20. Tribal India today: Nadeem Hashain, (2nd Ed.), Harnam Publications, New Delhi, 1991

21. Tribe, Caste and Religion: R. Thaper (ed.), New Delhi: Macmillan 1977

22. Understanding Contemporary India: Critical Perspectives: Achin Vanaik & Rajeev Bhargava, Orient BlackSwan, 2010

23 Bharatiya Samaj Prasangey: Aniruddha Choudhury, Chatterjee Publishers, 2016

Semester III
Core Course 03
(SOCGCOR03T)
Sociological Theories

Outline:

1. **Karl Marx**(25 hrs.)

    1.1 Materialist Conception of History
    1.2 Class and Class Struggle

2. **Emile Durkheim**(25 hrs.)

    2.1 Social Fact
    2.2 Forms of Solidarity

3. **Max Weber**(25 hrs.)

    3.1 Ideal Types and Social Action
    3.2 Types of Authority

Reading Reference

1. A Short History of Sociological Thought: Alan Swingewood, PHI Learning, 1991

2. Classical Sociological Theory: George Ritzer, McGraw Hill, 1996

3. How to Read Karl Marx: Ernest Fischer, Aakar: New Delhi 2008

4. Masters of Sociological Thought: Lewis A. Coser,Rawat: Jaipur, 1977

5. Tatwo O Chintadarshe Samokalin Samajtatwa: Ramanuj Ganguly, 2nd Ed, Reena Books: Kolkata 2013 (in Bengali)

6. The Communist Manifesto (21 February 1848), Karl Marx & Friedrich Engels, Echo Library, 2009

Semester IV
Core Course 04
(SOCGCOR04T)
Methods of Sociological Enquiry

Outline:

1. The Logic of Social Research(25 hrs.)
- 1.1 What is Sociological Research?
- 1.2 Objectivity in the Social Sciences
- 1.3 Reflexivity

2. Methodological Perspectives(25 hrs.)
- 2.1 The Comparative Method
- 2.2 The Ethnographic Method

3. Modes of Enquiry(25 hrs.)
- 3.1 Theory and Research
- 3.2 Analysing Data: Quantitative and Qualitative

Reading Reference

1. Doing Social Research: T L Baker, 3rd Edition, Mcgraw-hill Book Company, 1999

2. Fundamentals of Social Statistics: Kirk W. Elifson, Richard P. Runyon, & Audrey Haber, McGraw-Hill Higher Education, 1998

3. Methods in Social Research: William Josiah Goode & Paul K. Hatt, McGraw-Hill, 1952

4. Methods of Social Research: K D Bailey, 4th Edition, Simon and Schuster, 1994

5. Scientific Social Surveys and Research: P.V. Young, PHI-Learning, New Delhi

6. The Practice of Social Research: Earl Babbie, 12th Edition, Wadsworth Publishing Company/ Cengage Learning, 2010

7. The Practice of Social Research: Guided Activities: Earl R. Babbie & Theodore C. Wagenaar, Cengage Learning, 2006

Discipline Specific Elective 01
(SOCGDSE01T)
Semester V
Gender and Sexuality

Outline:

1. **Gender as a Social Construct**(20 hrs.)

1.1Gender, Sex, Sexuality
1.2 Patriarchy, Misogyny, Androcentrism, Gender stereotyping,Male Gaze

2. **Gender: Differences and Inequalities**(20 hrs.)

2.1 Class, Caste
2.2 Family, Work

3.Sexual Identities(20hrs)
3.1 Heterosexual, Bisexual, Lesbian and Homosexual
3.2, Transgender, Transvestite, Hijra, Koti

4. **Politics of Gender**(15 hrs.)

4.1. Resistance and Movements: Women's and LGBTQ Movements in India

Reading References:

1. Abbott, Pamela, Claire Wallace and Melissa Tyler. 2005. An Introduction to Sociology: Feminist Perspectives. London: Routledge.

2. Agarwal,B.1994,A Field of one's Own, Gender and Land Rights in South Asia ,Cambridge, Cambridge University Press

3. Altekar, A.S. 1983,The Position of Women in Hindu Civilization. Delhi, Motilal Banarasidass, Second Edition: P Fifth Reprint.

4. Bhasin, Kamala. 1993. What is Patriarchy? New Delhi: Kali for Women.

5. Chanana, Karuna, 1988, Socialization, Women and Education, Explorations in Gender Identity, New Delhi

6. Fernandes, Leela. (ed). 2014. Routledge Handbook of Gender in South

Asia. London: Routledge

7. Forbes,G.1998,Women in Modern India ,New Delhi, Cambridge University press

8. Furr. L, Allen. 2018. Women, Violence and Social Stigma. Jaipur: Rawat Publications.

9. Gandhi, N. And N. Shah ,1992,The issues at Stake, Theory and Practice in the Contemporary Women's Movement in India, New Delhi, Kali for Women.

10. Ghadially , Rehana (ed) ,1988,Women in India Society, New Delhi, Sage

11. Halberstam, Judith. 1998. Female Masculinity. Durham: Duke University Press (Also New Delhi: Zubaan 2012 Reprint).

12. Jackson, Stevi and Sue Scott (eds.) 2002. Gender: A Sociological Reader. London: Routledge.

13. Jayawardene,Kumari,1991,Feminism and Nationalism in the third World, New Delhi, Kali For Women

14. Kalaramadam, S. 2016. Gender, Governance and Empowerment in India. London: Routledge

15. Kalia, H.L. 2005. Work and the Family. Jaipur: Rawat Publications.

16. Kolaskar, A and Dash, Motilal (ed) .2012. Women and Society: The Road to Change. New Delhi: OUP

17. Lorber, Judith and Susan A. Farrell (eds.). 1991. The Social Construction of Gender. Newbury Park, Calif: Sage Publications.

18. Maccoby, Eleaner and Carol Jacklin,1975, The Psychology of Sex Differences, Stanford, Stanford University Press

19. McCormack ,C. And M. Strathern (ed), 1980, Nature, Culture and Gender, Cambridge: Cambridge University Press

20. Menon, Nivedita (ed.).1999. Gender and Politics in India. New Delhi:

Oxford University Press.

21. Mies Maria ,1980,Indian Women and Patriarchy, Conflicts and Dilemmas of Students and Working Women, New Delhi, Concept

22. Newton, Esther. 2000. Margaret Mead Made Me Gay: Personal Essays, Public Ideas. Durham: Duke University Press.

23. Oakley, Ann,1972,Sex, Gender and Society, New York, Harper and Row

24. Palriwala, Rajni and Carla Risseeuw (eds.). 1996. Shifting Circles of Support: Contextualising Kinship and Gender in South Asia and Sub-Saharan Africa. New Delhi: Sage Publications.

25. Rege, Sharmila. (ed). 2003. Sociology of Gender: The Challenge of Feminist Sociological Knowledge. New Delhi: Sage.

26. Smith, Bonnie, G. 2013. Women's Studies: The Basics. London: Routledge

27. Vaid ,S.& K. Sangari,1989,Recasting Women, Essays in Colonial History, New Delhi, Kali For Women

Discipline Specific Elective 02
(SOCGDSE02T)
Semester V
Marriage, Family and Kinship

Outline:

1. **Introduction: Kinship, Critique and the Reformulation** (10 hrs.)

1.1. Biological and Social Kinship
1.2. Cultural Kinship

2. Descent, Alliance(20 hrs.)
2.1. Descent, Filiation, Complementary Filiation
2.2. Marriage and Alliance

3. Family and Household(20 hrs.)
3.1. Structure and Change
3.2. Reimagining Families

4. Contemporary Issues in Marriage, Family and Kinship(25 hrs.)
4.1. Choice and Regulation in Marriage
4.2. Power and Discrimination in the Family
4.3. New Reproductive Technologies
4.4. Marriage Migration

Reading References:

1. A.M. Shah, 1998 The Family in India: Critical Essays, New Delhi: Orient Blackswan

2. Baldassar, Loretta, and Laura Merla, eds. Transnational families, migration and the circulation of care: Understanding mobility and absence in family life. Vol. 29. Routledge, 2013.

3. Banerjee, Kakoli. "Gender stratification and the contemporary marriage market in India." Journal of Family Issues 20.5 (1999): 648-676.

4. Carsten, J., 2004, After Kinship, Cambridge: Cambridge University Press

5. Donner, Henrike. Domestic goddesses: maternity, globalization and middle-class identity in contemporary India. Routledge, 2016.

6. Dyson, Tim, and Mick Moore. "On kinship structure, female autonomy, and demographic behavior in India." Population and development review (1983): 35-60.

7. Kashyap, Lina. "The impact of modernization on Indian families: The counselling challenge." International Journal for the Advancement of Counselling 26.4 (2004): 341-350.

8. L. Stone (eds.), 2004 Kinship and Family: An Anthropological Reader, U.S.A.: Blackwell

9. McAdoo, Harriette Pipes. Family ethnicity: Strength in diversity. Sage, 1999.

10. Patricia Uberoi (ed.), 1993 Family, Kinship and Marriage in India. Delhi: Oxford University Press

11. R. Chopra, C. Osella and F. Osella 2004 (eds.), South Asian Masculinities: Context of Change, Sites of Continuity, Delhi: Kali for Women

Discipline Specific Elective 03
(SOCGDSE03T)
Semester VI
Social Stratification

Outline:

1. **Social Stratification:** Concepts and Approaches(15 hrs.)
2. **Forms of Social Stratification** (35 hrs.)
   - 2.1 Race and Ethnicity
   - 2.2 Caste and Class
   - 2.3 Gendering Inequality
   - 2.4 Poverty and Social Exclusion
3. **Social Mobility:** meaning, types and factors responsible (25 hrs.)

Reading References:

1. Ahmad, Imtiaz, ed. Caste and social stratification among Muslims in India. South Asia Books, 1978.
2. Arum, Richard, Irenee R. Beattie and Karly Ford (eds.). 2011. The Structure of Schooling: Readings in the Sociology of Education. London: Sage.
3. Barber, Bernard. Social stratification: A comparative analysis of structure and process. Harcourt, Brace, 1957.
4. Bendix, Reinhard and Seymour Martin Lipset (eds.). 1967. Class, Status and Power. London: Routledge & Kegan Paul.
5. Beteille, Andre. 1977. Inequality among Men. London: Blackwell.
6. Bottero, Wendy. 2005. Stratification. London: Routledge.
7. Bottomore, T. B. 1971. Sociology: A Guide to Problems and Literature. London: George Allen & Unwin Ltd.

8. Bourdieu, Pierre, and Jean-Claude Passeron. Reproduction in education, society and culture. Vol. 4. Sage, 1990.

9. Bourdieu, Pierre, and Loïc JD Wacquant. An invitation to reflexive sociology. University of Chicago press, 1992.

10. Bourdieu, Pierre. "Social space and symbolic power." Sociological theory 7.1 (1989): 14-25.

11. Bourdieu, Pierre. The social structures of the economy. Polity, 2005.

12. De Vos, George A. Ethnic pluralism: Conflict and accommodation: The role of ethnicity in social history. Alta Mira Press, 1995.

13. Eriksen, Thomas Hylland. Ethnicity and nationalism: Anthropological perspectives. Pluto Press, 2002.

14. Gupta, Dipankar (ed.). 1992. Social Stratification. New Delhi: Oxford University Press.

15. H. H. and C. Wright Mills. 1946. From Max Weber. New York: Oxford University Press

16. Haralambos, Michael and Martin Holborn. 2008. Sociology: Themes & Perspectives. London: HarperCollins Publishers Ltd.

17. Juliet. 1971. Woman's Estate. Harmondsworth: Penguin

18. Kerbo, Harold R. Social stratification and inequality: Class conflict in historical and comparative perspective. McGraw-Hill College, 1996.
19. Lenski, Gerhard E. Power and privilege: A theory of social stratification. UNC Press Books, 2013.

20. Lin, Nan. Social capital: A theory of social structure and action. Vol.19. Cambridge university press, 2002.

21. McLellan, David. 1980. The Thought of Karl Marx. London: Papermac, MacMillan.

22. Moore, Wilbert Ellis. Social change. Prentice Hall, 1974.

23. Omi, Michael, and Howard Winant. 2015. Racial Formation in the United States. New York: Routledge

24. Parsons, Talcott. "A revised analytical approach to the theory of social stratification." New York (1953).

25. Sharma, Kanhaiya Lal. Social Stratification and Mobility. Rawat Publications, 1994.

26. Sharma, Kanhaiyalal. Social stratification in India: issues and themes. Sage Pubns, 1997.

27. Sharma, Kanhaiya Lal, and Yogendra Singh. Social inequality in India: Profiles of caste, class, power, and social mobility. South Asia Books, 1995.

28. Sharma, Kanhaiyalal. Essays on Social Stratification. Jaipur: Rawat, 1980.

29. T. Bottomore. 1966. Classes in Modern Society. New York: Pantheon Books.

30. Tawney, R. H. 1964. Equality. London: George Allen & Unwin Inc

31. Tumin, Melvin M. 1994. Social Stratification: The Forms and Functions of Inequality. New Delhi: Prentice-Hall of India.

Discipline Specific Elective 04
(SOCGDSE04T)
Semester VI

Religion and Society

Outline:

1. Understanding Religion(30 hrs.)

1.1. Sociology of Religion: Meaning and Scope
1.2. Sacred and Profane
1.3 Religion and Rationalization
1.4 Rites of Passage

2. Religion in India(30 hrs.)

2.1. Hinduism
2.2. Islam
2.3. Christianity
2.4. Sikhism
2.5. Buddhism

3. Secularism vs Communalism(15 hrs.)

Reading References:

1. Asad. T. 1993. Genealogies of Religion: Discipline and Reasons of Power in Christianity and Islam, John Hopkins Press: Baltimore, pp 27-54.

2. Berger, Peter L. "Reflections on the Sociology of Religion Today." Sociology of Religion 62.4 (2001): 443-454.

3. Berger, Peter L. The Sacred Canopy: Elements of a Sociological Theory of Religion. Anchor/Open Road Media, 2011.

4. Berger, Peter, Thomas Luckmann. "Sociology of religion and sociology of Knowledge" Sociology and Social Research 47.4

(1963): 417-427

5. Béteille, A. 2002. Sociology: Essays on Approach and Method. OUP: New Delhi, pp134-150.

6. Casanova, José. Public religions in the modern world. University of Chicago Press, 1994

7. Dawson, Andrew. Sociology of religion. Hymns Ancient and Modern Ltd, 2011.

8. Dillon, Michele, ed. Handbook of the Sociology of Religion. Cambridge University Press, 2003.

9. Durkheim, E. 2001. The Elementary Forms of the Religious Life. Carol Cosman (trans). Oxford: Oxford University Press, pp 25-46; 87-100; 153-182.

10. E. E. Evans-Pritchard. 1963 (1940). The Nuer. Oxford: Clarendon Press

11. Emile Durkheim. 1995. The elementary forms of religious life. Translated by Karen E. Fields. New York: The Free Press

12. Gennep A. V, 1960. Rites of Passage. London: Routledge and Kegan and Paul, pp 1-14; 65-70; 74-77; 85-90; 101-107; 116-128; 130-135 & 141-165.

13. Johnstone, Ronald L. Religion and society in interaction: The sociology of religion. Prentice Hall, 1975.

14. Johnstone, Ronald L. Religion in society: sociology of religion. Routledge, 2015.

15. Madan, T.N. 1991. 'Secularism in its Place' in T. N. Madan, T.N. (ed.) Religion in India. New Delhi: OUP, pp 394 -413.

16. Mair, Lucy. 1972. An Introduction to Social Anthropology, New Delhi: OUP.

17. Majumdar, D. N and Madan, T. N. 1987. An Introduction to Social Anthropology. New Delhi: National

18. Malinowski, Bronislaw. 1948. Magic, science and religion and other essays. Selected, and with an introduction by Robert Redfield. Boston: The Free Press

19. Omvedt, G. 2003. Buddhism in India: Challenging Brahmanism and Caste, New Delhi : Sage, pp 23-53.

20. Pickering, William Stuart Frederick. Durkheim's sociology of religion: Themes and theories. Casemate Publishers, 2009.

21. Ramanuj Ganguli and S. A. H. Moinuddin. 2008. Samakaleen Bharatiya Samaj. PHI. Learning

22. Robbins, Thomas. Cults, converts and charisma: The sociology of new religious movements. Sage Publications, Inc, 1988.

23. Robinson, R. 2003. 'Christianity in the Context of Indian Society and Culture' in Das Veena (ed.), Oxford Indian Companion to Sociology and Social Anthropology, OUP: New Delhi, pp. 884- 907.

24. Saberwal, S. 1991. 'Elements of Communalism' in T. N. Madan, (ed.) Religion in India. OUP: New Delhi, pp 339 -350.

25. Smith, Christian, and Robert D. Woodberry. Sociology of religion. Blackwell Publishing Ltd, 2001.

26. Tambiah, Stanley Jeyaraja. 1990. Magic, science, religion and the scope of rationality. Cambridge: Cambridge University Press

27. Turner, Bryan S., ed. The new Blackwell companion to the sociology of religion. John Wiley & Sons, 2016. Davie, Grace. The sociology of religion: A critical agenda. Sage, 2013.

28. Uberoi, J.P.S. 1991. 'The Five Symbols of Sikhism' in Madan, T.N. (ed.) Religion in India. New Delhi: OUP, pp 320 -333.

29. Weber Max. 1905. The Protestant Ethic and the Spirit of Capitalism, New York: Free Press, pp 39– 50.

30. Weber, Max. The sociology of religion. Beacon Press, 1993.

31. Yinger, J. Milton. "Religion, society and the individual; an introduction to the sociology of religion." (1957).

Generic Elective 01
(SOCGGEC01T)
Semester V
Polity and Society in India

Outline:

1. **On Studying Politics and Society in India** : Culture and Ideology, Political Socialization, Political Participation and Mobilization, Political Consensus. (15 hrs.)

2. **Themes in Politics and Society in India** (30 hrs.)

   2.1 Political Economy– The Role of State in Economic Development

   2.2 Political Machine – Federalism and Local Government; Political Parties and Vote Bank.

   2.3 Political Identities- Caste and Ethnicity

   2.4 Political Processes – Reservation; Uniform Civil Code

3. **Separatism and Seccessionism:** Kashmir, Punjab, Mizoram and Nagaland (30 hrs.)

Reading References:

1. Stepam, A.J. Linz Juan, et al (2011) 'Crafting State Nations'

2. P. Chatterjee, 1997. State and Politics in India. Delhi: OUP

4. James Manor (ed.) 1991 Rethinking Third World Politics, London: Longman

5. Z. Hasan (ed.) 2000, Politics and the State in India, New Delhi: Sage

6. Rudolph, Lloyd I, and Susanne Hoeber Rudolph, 1987. In Pursuit Of Lakshmi. Chicago: University of Chicago Press

7. M. J. Schwartz (ed.), 1968, Local level Politics: Social and Cultural Perspectives, London: University of London

8. A.Kohli (ed.), 2001 The Success of India's Democracy,Cambridge: Cambridge University Press

Generic Elective 02
(SOCGGEC02T)
Semester VI
Economy and Society

Outline:

1. Sociological Aspects of Economic Phenomenon(25 hrs.)

1.1 Approaches: Formalism and Substantivism
1.2 Sociological Aspect of Economic Processes

2. Modes of Production(25 hrs.)

2.1 Domestic Mode of Production
2.2 Peasants
2.3 Capitalism
2.4 Socialism

3. Contemporary Issues(25 hrs.)

3.1 Globalization
3.2 Development

Reading References:

1. Appadurai, Arjun. 1986. The Social Life of Things: Commodities in Cultural Perspective. Cambridge: Cambridge University Press.

2. Dodd, Nigel. 1994 The sociology of money: economics, reason & contemporary society. Continuum Intl Pub Group.

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4. Howes, D. (ed). 1996. Cross-Cultural Consumption: Global Markets and Local Realities. London: Routledge.

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6. Sassen, Saskia. 2007. A Sociology of Globalization. New York: W.W. Norton & Co.

7. Simmel, Georg. (David Frisby-Editor, T.B. Bottomore-Translator) The Philosophy of Money, 2004. Routledge (first published 1900)

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9. Smelser, Neil. J. and Richard Swedberg (eds). 1994. 1994. The Handbook of Economic Sociology. Princeton: Princeton University Press.

10. Tonkiss, Fran. 2006. Contemporary Economic Sociology. London: Routledge.

11. Verdery, Katherine. 1996. What Was Socialism, And What Comes Next? Princeton, N. J.: Princeton University Press.

12. Wallerstein, Immanuel Maurice. 1983. Historical Capitalism. London: Verso.

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Skill Enhancement Course 01
(SOCSSEC01M)
Semester V
Theory and Practice of Development

Outline:

1. What is development? (10 hrs.)

2. Recent trends in Development (20 hrs.)

2.1 Neo-liberalism: Growth as Development
2.1a.Re-emergence of Neo-classical perspective
2.1b. SAP and its Critique

2.2 Post development Theory (20 hrs.)

2.2a.Knowledge as Power
2.2b. Participatory Development
2.2c. GAD

2.3Sustainable Development Theory: UN Earth Charter 1992 (25 hrs.)
2.3a. Hegemonic approach: PPP
2.3b. Environmental discourse

3. Human Development Theory: Growth vs. Development (10 hrs.)

Reading References

1) Colclough, Christopher, and James Manor, eds. States or Markets? Neo-liberalism and the development policy debate. Oxford University Press, 1993.

2) Dreze, Jean, and Amartya Sen. "India: Economic development and social opportunity." OUP (1999).

3) Dreze, Jean, and Amartya Sen. India: Development and participation. Oxford University Press, USA, 2002.

4) Eade, Deborah, and Suzanne Williams. The Oxfam handbook of development and relief. Vol. 2. Oxfam, 1995.

5) Escobar, A. 2011. (paperback ed.) Encountering development: The making and unmaking of the Third World Princeton: Princeton Press

6) Ferguson, Iain. Reclaiming social work: Challenging neo-liberalism and promoting social justice. Sage, 2007.

7) Friere, Paulo. 1972. Pedagogy of the Oppressed. New York: Herder & Herder

8) Kirkpatrick, Colin H., Ron Clarke, and Charles Polidano, eds. Handbook on development policy and management. Edward Elgar Publishing, 2002.

9) MacEwan, Arthur. Neo-liberalism or democracy? economic strategy, markets, and alternatives for the 21st century. Zed Books, 1999.

10) Nussbaum, Martha, and Amartya Sen, eds. The quality of life. Oxford University Press, 1993.

11) Sachs, Wolfgang. 2007. The Development Dictionary: A guide to Knowledge as Power. London: Zed Books

12) Schultz, T. Paul, and John Strauss, eds. Handbook of development economics. Vol. 4. Elsevier, 2008.

13) Sen, Amartya. Resources, values, and development. Harvard University Press, 1997.

Skill Enhancement Course 02
(SOCSSEC02M)
Semester VI
Gender Sensitization

Outline:

1. Sex, Gender and Sexuality (20 hrs.)

1.1 Introduction to debates on the social construction of sex and gender
1.2 Cultural construction of masculinity and femininity
1.3 Understanding sexual preference as a right

2. Gender, Family, Community and the State (10 hrs.)

3. Gender Rights and the Law (20 hrs.)

3.1 Women's Rights in Indian Constitution: Fundamental rights and Directive Principles
3.2 Right to property
3.3 Personal laws
3.4 Violence against women
3.5 Sexual harassment
3.6 Rape
3.7 Domestic violence

4. Women's Rights as Human Rights: U.N. Conventions, Convention on the Elimination of all forms of Discrimination against Women (CEDAW), Millennium Development Goals (MDGs) (25 hrs.)

Reading References

1. Altekar,A.S. 1983,The Position of Women in Hindu Civilization. Delhi,Motilal Banarasidass,Second Edition: P Fifth Reprint.

2. Bhasin, Kamala. 1993. What is Patriarchy? New Delhi: Kali for Women.

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4. Box, Steven. Power, Crime, and Mystification. London: Routledge, 1989

5. Butalia, Urvashi. The Other Side of Silence. Durham, NC: Duke University Press, 2000

6. Buzawa, Eva Schlesinger, and Carl G. Buzawa. Domestic violence: The criminal justice response. Sage, 2003.

7. Chanana, Karuna, 1988, Socialization, Women and Eduction, Explorations in Gender Identity,New Delhi

8. Chappell, Duncan, and Vittorio Di Martino. Violence at work. ILO, 2006.

9. Desai ,Neera and M. Krishnaraj,1987, Women and Society in India,Delhi, Ajanta

10. Fernandes, Leela.(ed). 2014. Routledge Handbook of Gender in South Asia. London:Routledge

11. Forbes,G.1998,Women in Modern India ,New Delhi,Cambridge University press

12. Furr.L, Allen. 2018. Women, Violence and Social Stigma. Jaipur: Rawat Publications.

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16. Ghadially, Rehana, ed. Urban women in contemporary India: a reader. Sage, 2007.

17. Hatty, Suzanne E. Masculinities, violence and culture. Sage Publications, 2000.

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Reader. London: Routledge.

19. Jayawardene,Kumari,1991,Feminism and Nationalism in the third World, New Delhi, Kali For Women

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24. Lorber, Judith and Susan A. Farrell (eds.). 1991. The Social Construction of Gender. Newbury Park, Calif: Sage Publications.

25. MacKinnon, Catharine A. Only Words. Cambridge, Mass.: Harvard University Press, 1993

26. Mangubhai, Jayshree P., and Joel G. Lee. Dalit women speak out: Caste, class and gender violence in India. Zubaan, 2012.

27. Menon, Nivedita (ed.).1999. Gender and Politics in India. New Delhi: Oxford University Press.

28. Mies Maria ,1980,Indian Women and Patriarchy,Conflicts and Dilemmas of Students and Working Women,New Delhi,Concept

29. Oakley, Ann,1972,Sex, Gender and Society, New York, Harper and Row

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36. Agnes, Flavia et al. Women and Law in India. New Delhi: OUP, 2004

37. Sahai, Shailly. Social Legislation and Status of Hindu Women. Jaipur: Rawat, 1986

38. Singh, Alka. Women in Muslim Personal Law. Jaipur: Rawat, 1991

39. Omvedt, Gail. Violence Against Women: New Movements and New Theories in India. New Delhi: 1990.

West Bengal State University
Department of Sociology
B.A. (Honours)

Semester	Core Courses (14 Courses)	Ability Enhancement Courses (AECC) (2 Courses)	Skill Enhancement Courses (SEC) (2 Courses)	Elective: Discipline Specific (DSE) (4 Courses)	Elective: Generic Elective (GE) (4 Courses)
I	Introduction to Sociology I **(SOCACOR01T)** Sociology of India I **(SOCACOR02T)**	Environmental Science			Introduction to Sociology **(SOCHGEC01T)**
II	Introduction to Sociology II **(SOCACOR03T)** Sociology of India II **(SOCACOR04T)**	English/MIL Communication			Sociology of India **(SOCHGEC02T)**
III	Political Sociology **(SOCACOR05T)** Sociology of Religion **(SOCACOR06T)** Sociology of Gender **(SOCACOR07T)**		Theory and Practice of Development **(SOCSSEC01M)**		Sociological Theories **(SOCHGEC03T)**
IV	Economic Sociology **(SOCACOR08T)** Sociology of Kinship **(SOCACOR09T)** Social Stratification **(SOCACOR10T)**		Gender Sensitization **(SOCSSEC02M)**		Methods of Sociological Inquiry **(SOCHGEC04T)**
V	Sociological Thinkers I **(SOCACOR11T)** Sociological Research Methods I **(SOCACOR12T)**			(Any two courses from the 3 courses given below) Urban Sociology **(SOCADSE01T)** Agrarian Sociology **(SOCADSE02T)** Environmental Sociology **(SOCADSE03T)**	
VI	Sociological Thinkers II **(SOCACOR13T)** Sociological Research Methods II **(SOCACOR14T)**			(Any two courses from the 3 courses given below) Sociology of Work **(SOCADSE04T)** Sociology of Health and Medicine **(SOCADSE05T)** Indian Sociological Traditions **(SOCADSE06T)**	

B.A. (Honours) Sociology

Syllabus

Under Choice Based Credit System (CBCS)

West Bengal State University

June 2018

Semester I

CORE COURSE 1
(SOCACOR01T)

INTRODUCTION TO SOCIOLOGY – I

Outline: 1. Sociology: Discipline and Concepts (33 hrs.)

1.1 Thinking Sociologically: Sociology and Common Sense, Sociological Imagination

1.2 Emergence of Sociology

1.3 Some Basic Concepts: Social Institution; Social System; Association; Aggregates, Categories; Groups and its forms; Status and Role; Norms & Values; Social Structure; Social Processes: Associative and Dissociative

1.4 Individual, Culture and Society: Meaning of Culture; Humans in Society, Society in Humans; Culture and Personality; Socialization: Concept, Processes, and Agencies

2. Sociology and Other Social Sciences (12 hrs.)

2.1 Sociology and Social Anthropology

2.2 Sociology & Psychology

2.3 Sociology & History

3. Human Society (30 hrs.)

3.1 Individual and Group

3.2 Social Institutions

3.3 Social Structure and Social Control

3.4 Social Processes

3.5 Social Change and Mobility

Reading Reference:

1. Alex, Inkeles. 1975. Sociology. London: Prentice Hall.
2. Anthony Giddens. 2013. Sociology (Seventh Edition).
3. Bottomore, T.B. 1962. Sociology. London: George Allen and Unwin.
4. Fulcher, James and John Scott. 2007. Sociology. Third Ed. OUP.
5. Haralambos, M. 1998. Sociology: Themes and Perspectives, OUP, New Delhi.
6. Henslin, James M., et al. Sociology: A down to earth approach. Pearson Higher Education AU, 2015.
7. Jayaram, N. 1987. Introductory Sociology. Macmillan Press Limited.
8. Macionis, John. 1996. Sociology. New Jersey: Prentice Hall.
9. McIntyre, Lisa J. The practical skeptic: Core concepts in sociology. McGraw-Hill, 2011.

Semester I
Core Course 02
(SOCACOR02T)

Sociology of India – I

Outline:

1. **India: An Object of Knowledge (25 hrs.)**
   - 1.1 The Colonial Discourse
   - 1.2 The Nationalist Discourse
   - 1.3 The Subaltern Critique
2. **Indian Society: Concepts and Institutions (50 hrs.)**
   - 2.1. Caste: concept and critique
   - 2.2. Agrarian Classes
   - 2.3. Industry and Labour
   - 2.4. Tribe: Profile and Location
   - 2.5. Village: Structure and Change
   - 2.6. Kinship: Principle and Pattern
   - **2.7.** Religion and Society

Reading Reference:

1. A. R. Desai. BharatiyaJatiatabaderSamajikPatabhumi (Social Background of Indian Nationalism).
2. Bernard Cohn, Colonialism and its forms of knowledge, Princeton University Press
3. David Mandelbaum – Society in India
4. K. L. Sharma – Social Stratification and Mobility
5. K. L. Sharma – Social Stratification in India
6. M. N. Srinivas – Caste – Its Twentieth Century Avatar
7. M. N. Srinivas – Social Change in Modern India
8. P. Oberoi (ed) - Family, Kinship and Marriage in India
9. Rajni Kothari (ed.) – Caste in Indian Politics
10. Ram Ahuja – Indian Social System
11. S. C. Dube – Indian Society
12. T. K. Oommen – Social Structure and Politics
13. Yogendra Singh – Culture Change in India
14. Yogendra Singh – Essays on Modernization in India
15. Yogendra Singh – Social Change in India
16. Yogendra Singh – The Modernization of Indian Tradition

Semester II

Core Course 03
(SOCACOR03T)

Introduction to Sociology II

Outline:

1. **Understanding Sociological Theory: (7 hrs.)**
   - 1.1 Building blocks of Sociological Theory
   - 1.2 Functions and types of theories
2. **Functionalism (17 hrs.)**
   - 2.1 Roots of Functionalism (Auguste Comte and Emile Durkheim)
   - 2.2 Contributions of Social Anthropologist (Radcliffe Brown and Bronislaw Malinowski)
   - 2.3 Analytical Functionalism of Talcott Parsons
   - 2.4 Empirical Functionalism of Robert K. Merton
   - 2.5 Critique of Functionalism
3. **Interpretive Sociology (17 hrs.)**
   - 3.1 Critique of Structural Functionalism
   - 3.2 George Herbert Mead
   - 3.3 Herbert Blumer and Thomas Kuhn
   - 3.4 Erving Goffman
4. **Conflict Perspective (17 hrs.)**
   - 4.1 Karl Marx
   - 4.2 Ralf Dahrendorf
   - 4.3 Georg Simmel and Lewis Coser
5. **Feminist Perspective (17 hrs.)**
   - 5.1 Liberal Feminist Thought
   - 5.2 Radical Feminist Thought
   - 5.3 Socialist Feminist Thought
   - 5.4 Eco Feminism

Reading Reference:

1. Baert, Patrick. 1998. Social Theory in the Twentieth Century. New York. NYU Press.
2. Bottomore, Tom and Nisbet, Robert. 2004. A History of Sociological Analysis. Jaipur: Rawat
3. Bottomore, Tom. 2002. The Frankfurt School. London: Routledge
4. Collins, Randall. 1994. Four Sociological Traditions. New York. OUP
5. Ritzer, George. 1996. Modern Sociological Theory. New Delhi: McGraw Hill.
6. Seidman, Steven. 2011. Contested Knowledge: Social Theory Today. Singapore: Wiley-Blackwell
7. Thompson, Kenneth and Jeremy Tunstall, Sociological Perspectives, New York:

Penguin Books Ltd
8. Turner, Jonathan. 1995. The Structure of Sociological Theory. Jaipur: Rawat
9. Wallace, A. Ruth and Wolf, Alison. 1990. Contemporary Sociological Theory. New Delhi: PHI Learning
10. Humm, Maggie. 1995. The Dictionary of Feminist Theory the University of Michigan: Ohio State University Press
11. Tong, Rosemarie. 2009. Feminist Thought: A Comprehensive Introduction Westview Press

Semester II

Core Course 04
(SOCACOR04T)

Sociology of India – II

Outline: **1. Ideas on Indian Society (33 hrs.)**

1.1. Tagore, Gandhi and Ambedkar

1.2. Indological (G. S. Ghurye) and Ethnographic Approaches (M. N Srinivas, A. Béteille)

1.3 Benoy Kumar Sarkar, Radhakamal Mukherjee

1.4 D. P. Mukherji, A. R Desai

2. Resistance, Mobilization, Change (30 hrs.)

2.1. Dalit Movements

2.2 Women's Movement

2.3 Peasant Movements

2.4 Ethnic Movements

2.5 Middle Class Phenomenon

3. Challenges to Civilization, State and Society (12 hrs.)

3.1. Communalism

3.2. Secularism

3.3. Nationalism

Reading References:

1. AmalMukhopadhyay (ed.). Bengali Intellectual Tradition
2. B. K. Nagla. 2008. Indian Sociological Thought. Jaipur: Rawat Publications.
3. Bela Dutta Gupta. 1972. Sociology in India. Calcutta: Centre for sociological Research.
4. Deshpande, S., 2003, Contemporary India: A Sociological View, New Delhi: Penguin Books
5. Dhanagare, D. N. (1993). Themes and Perspectives in Indian Sociology. Rawat Publication, Jaipur.
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11. Menon, N., (ed.) 1999, Gender and Politics in India, Oxford University Press
12. P. Uberoi, NandiniSundar and SatishDeshpande (ed). 2007. Anthropology in the East.
13. P.K. Mishra et al (eds). 2007. M.N. Srinivas: The Man and his Works. Rawat.
14. Radcliffe Brown, A.R., 1976, Structure and Function in Primitive Society, Free Press.
15. Ramkrishna Mukherjee. 1979. Sociology of Indian Sociology. Bombay: Allied Publishers.
16. Ritzer, George, 1996, Modern Sociological Theory, McGraw Hill.
17. Robey, David, 1973, Structuralism: An Introduction, Oxford: Clarendon Press
18. Shah, G., 2001, Dalit Identity and Politics, New Delhi: Sage
19. Swapan Kumar Bhattacharyya. 1990. Indian Sociology – The Role of Benoy Kumar Sarkar. The University of Burdwan.
20. SwapanPramanick. 1994. Sociology of G. S. Ghurye. Jaipur: Rawat Publications.
21. Ganguly, Ramanuj. Ambedkar: EktiSamajtattikPorjalochona. New Delhi: Pearson.
22. Y. Singh. 1986. Indian Sociology, VistarPub.B. K. Nagla. 2008. Indian Sociological Thought. Jaipur: Rawat Publications.

Semester III

Core Course 05
(SOCACOR05T)

POLITICAL SOCIOLOGY

Outline:

1. **Political Culture and Political Socialization (10 hrs.)**
   - 1.1 Meaning and Dimensions of Political Culture
   - 1.2 Meaning and types of Political Socialization
   - 1.3 Agencies of Political Socialization and their role
2. **Basic Concepts (25 hrs.)**
   - 2.1 Power and Authority
   - 2.2 State, Governance and Citizenship
   - 2.3 Elites and the Ruling Classes
3. **Political Systems:** Segmentary, Totalitarian and Democratic **(20 hrs.)**
4. **Political Parties, Pressure Groups, and Local Structures of Power (20 hrs.)**
   - 4.1 Political Parties: Structure and Functions
   - 4.2 Types of Pressure Groups and their relationship with Political Parties
   - 4.3 Local Governance: Panchayat System

Reading References:

1. Ali Ashraf. and L.N. Sharma, Political Sociology: A New Grammar of Politics, 1983 University Press
2. Anthony M. Orum and John G. Dale Political Sociology. Power and Participation in the Modern World. Fifth Edition 2009 OUP
3. Bottomore, T.B. 1975, Political Sociology, Blackie and Sons, Bombay.
4. Bottomore, T.B. 1993, Elites and Society, 2 Edition, Routledge
5. Burchell, Graham et al (Eds),1991, The Foucault Effect: Studies in Governmentality, The University of Chicago Press
6. DavitaGlasberg and Deric Shannon Political Sociology: Oppression, Resistance, and the State, 2010, Pine Forge
7. Fuller, C.J. and V. Benei (Eds.), 2000. The Everyday State and Society in Modern India. Social Science Press
8. Lukes, Steven. 2005, Power: A Radical View, 2 Ed., Hampshire: Palgrave
9. Mills, C. Wright, 1956. The Power Elite, New Edition, OUP
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11. Robbins, Paul. Political ecology: A critical introduction. Vol. 16. 2011, John Wiley & Sons.
12. S. N. Eisenstadt, Political Sociology: A Reader, 1971, New York: Basic Books

Semester III

Core Course 06
(SOCACOR06T)
Sociology of Religion

Outline:

1. Approaches to the Study of Religion (30 hrs.)

1.1 Formulating Religion
1.2 Emile Durkheim: Society as Sacred
1.3 Karl Marx: Religion as Alienation
1.4 Max Weber: Religion as 'Social Action'

2. Elements of Religiosity (20 hrs.)

2.1 Sacred, Myth, Ritual and Prayer
2.2 Time-Space
2.3 Rationality

3. Contemporary Directions in the Sociology of Religion (25 hrs.)

3.1 Religious Fundamentalism
3.2 The Secularization Debate
3.3 Religious Individualism and the Boundaries of Religion
3.4 Religion and Identity: Class, Gender, Sexuality

Reading References:

1. Berger, Peter L. "Reflections on the sociology of religion today." Sociology of Religion 62.4 (2001): 443-454.
2. Berger, Peter L. The sacred canopy: Elements of a sociological theory of religion. Anchor/Open Road Media, 2011.
3. Berger, Peter, Thomas Luckmann. "Sociology of religion and sociology of Knowledge" Sociology and Social Research 47.4 (1963): 417-427
4. Casanova, José. Public religions in the modern world. University of Chicago Press, 1994
5. Dawson, Andrew. Sociology of religion. Hymns Ancient and Modern Ltd, 2011.
6. Dillon, Michele, ed. Handbook of the Sociology of Religion. Cambridge University Press, 2003.
7. E. E. Evans-Pritchard. 1963 (1940). The Nuer. Oxford: Clarendon Press
8. Emile Durkheim. 1995. The elementary forms of religious life. Translated by Karen E. Fields. New York: The Free Press
9. Johnstone, Ronald L. Religion and society in interaction: The sociology of religion. Prentice Hall, 1975.
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11. Malinowski, Bronislaw. 1948. Magic, science and religion and other essays. Selected, and with an introduction by Robert Redfield. Boston: The Free Press
12. Pickering, William Stuart Frederick. Durkheim's sociology of religion: Themes and theories. Casemate Publishers, 2009.
13. Robbins, Thomas. Cults, converts and charisma: The sociology of new religious movements. Sage Publications, Inc, 1988.
14. Smith, Christian, and Robert D. Woodberry. Sociology of religion. Blackwell Publishing Ltd, 2001.
15. Tambiah, Stanley Jeyaraja. 1990. Magic, science, religion and the scope of rationality. Cambridge: Cambridge University Press
16. Turner, Bryan S., ed. The new Blackwell companion to the sociology of religion. John Wiley & Sons, 2016. Davie, Grace. The sociology of religion: A critical agenda. Sage, 2013.
17. Weber, Max. The sociology of religion. Beacon Press, 1993.
18. Yinger, J. Milton. "Religion, society and the individual; an introduction to the sociology of religion." (1957).

Semester III

Core Course 07
(SOCACORO7T)
Sociology of Gender

Outline:

1. Gender as a Patriarchal / Social Construct (25 hrs.)

1.1 Gender, Sex, Sexuality
1.2 Production of Masculinity and Femininity
1.3 Gender Socialization, Gender Roles and Stereotyping
1.4 Sexual Identities: Heterosexual, Bisexual, Lesbian and Homosexual, Transgender, Transvestite, Hijra, Koti

2. Gender: Discrimination and Inequalities (25 hrs.)

2.1.Class, Caste
2.2.Family, Work
2.3.Religion, Ethnicity

3. Gender, Power and Resistance (25 hrs.)

3.1 Social Subordination
3.2 Violence against Women
3.3 Women's and LGBTQ Movements in India

Reading References:

1. Abbott, Pamela, Claire Wallace and Melissa Tyler. 2005. An Introduction to Sociology: Feminist Perspectives. London: Routledge.
2. AbuLughod, Lila. 2002. 'Do Muslim Women Really Need Saving? Anthropological Reflections on Cultural Relativism and its Others', American Anthropologist, Vol. 104, No. 3.
3. Agarwal,B.1994,A Field of one's Own, Gender and Land Rights in South Asia, Cambridge, Cambridge University Press
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16. Halberstam, Judith. 1998. Female Masculinity. Durham: Duke University Press (Also New Delhi: Zubaan 2012 Reprint).
17. Holmes, Mary. 2009. Gender and Everyday Life. London: Routledge.
18. Jackson, Stevi and Sue Scott (eds.) 2002. Gender: A Sociological Reader. London: Routledge.
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20. Kalaramadam,S. 2016. Gender, Governance and Empowerment in India. London: Routledge
21. Lorber, Judith and Susan A. Farrell (eds.). 1991. The Social Construction of Gender. Newbury Park, Calif: Sage Publications.
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23. Menon, Nivedita (ed.).1999. Gender and Politics in India. New Delhi: Oxford University Press.
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25. Newton, Esther. 2000. Margaret Mead Made Me Gay: Personal Essays, Public Ideas. Durham: Duke University Press.
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27. Palriwala, Rajni and Carla Risseeuw (eds.). 1996. Shifting Circles of Support: Contextualising Kinship and Gender in South Asia and Sub-Saharan Africa. New Delhi: Sage Publications.
28. Rege, Sharmila. (ed). 2003. Sociology of Gender: The Challenge of Feminist Sociological Knowledge. New Delhi: Sage.
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30. Sarkar, Siuli. 2016. Gender Disparity in India: Unheard Whimpers. Delhi: PHI Learning.
31. Smith, Bonnie, G. 2013. Women's Studies: The Basics. London: Routledge
32. Tong, Rosemarie. 2009. Feminist Thought. Westview Press.
33. Tong,Rosemarie,1989,Feminist Thought, A Comprehensive Introduction, Colarodo, Westview Press
34. Uberoi, Patricia. 1990. 'Feminine Identity and National Ethos in Indian Calendar Art', in Economic and Political Weekly, Vol. 25, No. 17 (Apr. 28, 1990).
35. Vaid ,S.& K. Sangari,1989,Recasting Women, Essays in Colonial History, New Delhi, Kali For Women
36. Vance, Carole (ed.). 1984. Pleasure and Danger: Exploring Female Sexuality. London: Routledge &Kegan Paul
37. Whelham,Imelda,1997,Modern Feminist Thought, Edinburgh University Press
38. Young, Kate et al. (eds.). 1984. Of Marriage and the Market: Women's Subordination Internationally and Its Lessons. London: Routledge &Kegan Paul

Semester IV

Core Course 08
(SOCACOR08T)

ECONOMIC SOCIOLOGY

Outline:

1. Perspectives in Economic Sociology (18 hrs.)

1.1 Formalism and Substantivism

1.2 New Economic Sociology

2. Forms of Exchange (14 hrs.)

2.1 Reciprocity and Gift

2.2 Exchange and Money

3. Systems of Production, Circulation and Consumption(25 hrs.)

3.1 Hunting and Gathering

3.2 Domestic Mode of Production

3.3 Peasant

3.4 Capitalism

3.5 Socialism

4. Some Contemporary Issues in Economic Sociology(18 hrs.)

4.1 Development

4.2 Globalization

Reading References:

1. Appadurai, Arjun. 1986. The Social Life of Things: Commodities in Cultural Perspective. Cambridge: Cambridge University Press.
2. Carrier, James G. 1995. Gifts and Commodities: Exchange and Western Capitalism since 1700. London: Routledge.
3. Bourdieu, Pierre. The social structures of the economy. Polity, 2005.
4. Dodd, Nigel. 1994 The sociology of money: economics, reason & contemporary society. Continuum Intl Pub Group.
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10. Pramanick&Ganguly (Ed), 2010, Globalization in India, New Delhi: PHI Learning
11. Sahlins, Marshall David. 1974. Stone Age Economics. London: Tavistock.
12. Sassen, Saskia. 2007. A Sociology of Globalization. New York: W.W. Norton & Co.
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15. Smelser, Neil. J. and Richard Swedberg (eds). 1994. 1994. The Handbook of Economic Sociology. Princeton: Princeton University Press.
16. Tonkiss, Fran. 2006. Contemporary Economic Sociology. London: Routledge.
17. Verdery, Katherine. 1996. What Was Socialism, And What Comes Next? Princeton, N. J.: Princeton University Press.
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20. Zelizer, Viviana A. 1989. 'The Social Meaning of Money: "Special Monies"', The American Journal of Sociology, Vol. 95, No.2.

Semester IV

Core Course 09
(SOCACORO9T)

SOCIOLOGY OF KINSHIP

Outline:

1. Introduction: (30 hrs.)

1.1 **Key Terms:** Descent, Consanguinity, Filiations, Incest Taboo, Affinity, Family, Residence

1.2 **Approaches:**

1.2.1 Descent

1.2.2 Alliance

1.2.3 Indological

2. Family, Household and Marriage (15 hrs.)

2.1 Changing Structure and Functions of Marriage, Family and Household

2.2 Meaning, Characteristics and household dimensions of joint family – Disintegration Debate

3. Re-casting Kinship (30 hrs.)

3.1 Power and Discrimination in Family, Kinship and Marriage

3.2 Marriage Migration

3.3 New Reproductive Technologies

3.4 Re-imagining Families: Debates around lesbian, gay, bisexual, transgender and queer (LGBTQ) and Live-in Relationships.

Reading References:

1. Allan, Graham. A sociology of friendship and kinship. G. Allen &Unwin, 1979.
2. Barnard, Alan and Jonathan Spencer (eds.). 2002. Encyclopedia of Social and Cultural Anthropology. London: Routledge.
3. Beattie, John. 1964. Other Cultures. London: Routledge &Kegan Paul.
4. Dube, Leela. "Sociology of kinship." A Survey of Research in Sociology and Social Anthropology 2 (1974): 233.
5. Dumont, Louis. 1968. 'Marriage Alliance', in D. Shills (ed.), International Encyclopaedia of the Social Sciences, Vol.10. New York: Macmillan and Free Press.
6. Fortes, Meyer. 1970. Time and Social Structure and Other Essays. London: The Athlone Press.
7. Goody, Jack (ed.). 1958. The Developmental Cycle in Domestic Groups. Cambridge: Cambridge University Press.

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9. Leach, E. R. 1961. Rethinking Anthropology. London: The Athlone Press. (Particularly the Essay, 'Polyandry, Inheritance and the Definition of Marriage with Particular Reference to Sinhalese Customary Law').
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19. Uberoi, Patricia. 1995. 'When is a Marriage Not a Marriage? Sex, Sacrament and Contract in Hindu Marriage', Contributions to Indian Sociology (n.s.), Vol. 29, No.1&2.
20. Uberoi, Patricia. 2006. 'The Family in India', in Veena Das (ed.). Oxford Handbook of Indian Sociology. New Delhi: Oxford University Press.
21. Weston, Kath. 1991. Families We Choose: Lesbians, Gays, Kinship. New York: Columbia University Press.

Semester IV

Core Course 10
(SOCACOR10T)
Social Stratification

Outline:

1. **Introducing Social Stratification:** Forms and Consequences **(5 hrs.)**

2. **Theories of Stratification (30 hrs.)**
   - 2.1. Marx: Class
   - 2.2. Functionalism: Talcott Parsons and Robert K. Merton
   - 2.3. Max Weber: Class, Status and Power
   - 2.4. Pierre Bourdieu: Forms of Capital
   - 2.5. Feminist Theory: Patriarchy

3. **Identities and Inequalities (30 hrs.)**
   - 3.1. Caste
   - 3.2. Race and Ethnicity
   - 3.3. Gendered Stratification: LGBTQ Identities

4. **Political Economy of Inequality (10 hrs.)**
   - 4.1 Economic Inequality and Democracy
   - 4.2 Globalization and the Third World

Reading References:

1. Acker, Joan. 1973. 'Women and Social Stratification: A Case of Intellectual Sexism', in The American Journal of Sociology, Vol. 78, No. 4.
2. Ahmad, Imtiaz, ed. Caste and social stratification among Muslims in India. South Asia Books, 1978.
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4. Bailey, F. G. 1963. 'Closed Social Stratification in India', in European Journal of Sociology, Vol. 4, No. 1.
5. Barber, Bernard. Social stratification: A comparative analysis of structure and process. Harcourt, Brace, 1957.
11. Bendix, Reinhard and Seymour Martin Lipset (eds.). 1967. Class, Status and Power. London: Routledge &Kegan Paul.
6. Beteille, Andre. 1977. Inequality among Men. London: Blackwell.
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8. Bottomore, T. B. 1971. Sociology: A Guide to Problems and Literature. London: George Allen &Unwin Ltd.
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13. Bourdieu, Pierre. The social structures of the economy. Polity, 2005.
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24. Lin, Nan. Social capital: A theory of social structure and action. Vol. 19. Cambridge university press, 2002.
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26. Moore, Wilbert Ellis. Social change. Prentice Hall, 1974.
27. Omi, Michael, and Howard Winant. 2015. Racial Formation in the United States. New York: Routledge
28. Parsons, Talcott. "A revised analytical approach to the theory of social stratification." New York (1953).
29. Parsons, Talcott. "An analytical approach to the theory of social stratification." American Journal of Sociology 45.6 (1940): 841-862.
30. Parsons, Talcott. "Equality and inequality in modern society, or social stratification revisited." Sociological Inquiry 40.2 (1970): 13-72.
31. Reinhard. 1974. 'Inequality and Social Structure: A Comparison of Marx and Weber', in American Sociological Review, Vol. 39, No. 2.
32. Sharma, KanhaiyaLal. Social Stratification and Mobility. Rawat Publications, 1994.
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40. Worsley, Peter et al. 1970. Introducing Sociology. Harmondsworth: Penguin Books.

Semester V
Core Course 11
(SOCACOR11T)
Sociological Thinkers I

Outline: 1. Karl Marx (25 hrs.)

1.1. Materialist Conception of History

1.2. Capitalist Mode of Production

2. Emile Durkheim (25 hrs.)

2.1. Social Fact

2.2. Individual and Society

3. Max Weber (25 hrs.)

3.1. Social Action and Ideal Types

3.2. Religion and Economy

Reading References:

1. Allan, Kenneth. 2013. The Social Lens: An Invitation to Social and Sociological Theory (Part I: Modernity and the Sociological Response) Third Edition, Sage.
2. Aron, Raymond. 1986. Main Currents in Sociological Thought, Vol. I & II, Penguin Books, Harmondsworth, Middlesex, 1986.
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4. Barnes , H.E. – (1959) Introduction to the History of Sociology
5. Coser, L.A. – (1979) Masters of Sociological Thought . Oxford University Press
6. Coser, Lewis A. Masters of Sociological Thought: Ideas in Social and Historical Context, Second Edition, New York, Harcourt Brace Jovanovitch, 1977
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8. Durkheim, E. 1958. The Rules of Sociological Method. New York: The Free Press.
9. Frisby, David. 2002. Georg Simmel (Revised Edition) (Key Sociologists Series). Routledge.
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11. Gane, Mike. 1992. The Radical Sociology of Durkheim and Mauss. London: Routledge.
12. Giddens, A. 1971. Capitalism and Modern Social Theory: An Analysis of the Writings of Marx, Durkheim and Max Weber. Cambridge: Cambridge University Press
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Progress Publishers, Moscow, 1989.
15. Marx, K. and F. Engels. 1969. Selected Works Vol. 1. Moscow: Progress Publishers.
16. McLellan, David. 1975. Marx. London: Fontana Press.
17. Nisbet, R. A. 1967. The Sociological Tradition. London: Heinemann.
18. Poggi, Gianfranco. 2006. Weber. Cambridge, UK: Polity.Ransome, Paul. 2010. Social Theory. Rawat Publication.
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22. Turner, Bryan S.1999. Classical Sociology, Sage Publications, New Delhi.
23. Weber, Max. 1947. The Theory of Social and Economic Organization. New York: The Free Press.
24. Wolff, Kurt H. (ed.). 1950. The Sociology of Georg Simmel (Tr. Kurt H. Wolff). The Free Press of Glencoe.
25. Zeitlin , Irving – Ideology and the Development of Sociological Theory

Semester V

Core Course 12
(SOCACOR12T)

Sociological Research Methods – I

Outline:

1. What is Sociological Research? (25 hrs.)

1.1 Objectivity and Reflexivity in Sociology
1.2 Theory and Research
1.3 Concepts and Hypothesis
1.4 Field (Issues and Context)

2. Perspectives towards study of social phenomenon(25 hrs.)

2.1 The Scientific Method: Positivism and Empiricism in sociology; Objectivity and Subjectivity; Deductive and Inductive
2.2 Critique of the Scientific Method: Qualitative, Quantitative and Triangulation
2.3 Types of Research: Basic and Applied, Historical, Empirical, Descriptive, Exploratory, Comparative, Feminist

3. Modes of Enquiry (25 hrs.)

3.1 Field Research and Survey Research
3.2 Case Study
3.3 Content Analysis

Reading References:

1. A. L. Epstein (ed.), The Craft of Social Anthropology, Delhi: Hindustan Publishing Corporation
2. Babbie, Earl. The practice of social research. Wadsworth Cengage, 2009.
3. Bentz, Valerie Malhotra, and Jeremy J. Shapiro. Mindful inquiry in social research. Sage Publications, 1998
4. Beteille Andre- (2002) Sociology : Essays on Approach and Method, OUP, Delhi
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13. Mouton, Johann. Understanding social research. Van Schaik Publishers, 1996.
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16. Sandra Harding (ed.) Feminism & Methodology: Social Science Issues, Bloomington: Indiana University Press.
17. Sarantakos, Sotirios. Social research. Palgrave Macmillan, 2012.
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21. Bailey, K. (1994). The Research Process in Methods of social research. Simon and Schuster, 4th ed. The Free Press, New York NY
22. Baker, Therese L. Doing social research. McGraw-Hill College, 1988.
23. Blalock, H. M. 1979. Social Statistics. McGraw-Hill Book Company.
24. Burns, Robert Bounds. Introduction to research methods. Addison Wesley Longman, 1997.
25. Creswell, John W. Research design: Qualitative & quantitative approaches. Sage Publications, Inc, 1994.
26. Denzin, Norman K., and Yvonna S. Lincoln. Handbook of qualitative research. Sage publications, inc, 1994.
27. Elifson, K.W. 1990. Fundamentals of Social Statistics. McGraw-Hill Book Company
28. Goode, W. E. and P. K. Hatt. 1952. Methods in Social Research. New York: McGraw Hill.
29. Gupta, S. P. (2007). Elementary Statistical Methods. Sultan Chand & Sons.
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31. Reaves, Celia C. Quantitative research for the behavioral sciences. John Wiley & Sons, 1992.
32. Young, P.V. 1964. Scientific Social Surveys and Research. Prentice Hall

Semester VI
Core Course 13
(SOCACOR13T)

Sociological Thinkers II

Outline:

1. Talcott Parsons (11 hrs.)

1.1. Action Systems

2. Claude LeviStrauss (8 hrs.)

2.1. Structuralism

3. G. H. Mead and Erving Goffman (15 hrs.)

3.1. Interactional Self

4. Peter L. Berger and Thomas Luckmann (8 hrs.)

4.1. Social Construction of Reality

5. Max Horkheimar, T.W. Adorno and Herbert Marcuse (25 hrs.)

5.1. Critical Social Theory

6. Pierre Bourdieu (8 hrs.)

6.1. A Theory of Practice

Reading References:

1. Berger, Peter. "Luckmann. T. (1966). The social construction of reality: A treatise in the sociology of knowledge." New York: Double and Company (1967).
2. Berger, Peter. "Thomas Luckmann1966 The Social Construction of Reality." Garden City: Doubleday (1977).
3. Bourdieu, Pierre, and Loïc JD Wacquant. An invitation to reflexive sociology. University of Chicago press, 1992.
4. Bourdieu, Pierre, Craig Calhoun, Edward LiPuma, and MoishePostone, eds. Bourdieu: critical perspectives. University of Chicago Press, 1993.
5. Bourdieu, Pierre. Outline of a Theory of Practice. Vol. 16. Cambridge university press, 1977.
6. Burns, Tom. Erving Goffman. Routledge, 2002.
7. Cahill, Spencer. "Erving Goffman." Symbolic Interactionism: An introduction, An interpretation, An intergration New Jersey, Nancy Roberts, Pearson Education Inc. Pearson Prentice Hall(2004).
8. Calhoun, Craig. Critical social theory: Culture, history, and the challenge of difference.

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10. Culler, Jonathan. On deconstruction: Theory and criticism after structuralism. Cornell University Press, 2007.
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12. Goffman, E.1956.The Presentation of Self in Everyday life. Edinburgh: University of Edinburgh
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19. Potter, Jonathan. Representing reality: Discourse, rhetoric and social construction. Sage, 1996.
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21. Sarup, Madan. An introductory guide to post-structuralism and postmodernism. Pearson Education, 1993.
22. Sturrock, John. Structuralism and since: from Lévi-Strauss to Derrida., OUP, 1979
23. Thompson, John B. Ideology and modern culture: Critical social theory in the era of mass communication. John Wiley & Sons, 2013.
24. Willcocks, Leslie P., and John Mingers. Social theory and philosophy for information systems. John Wiley & Sons Ltd, 2004.
25. Zeitlin, Irving M. Rethinking sociology: A critique of contemporary theory. Appleton-Century-Crofts, 1973.

Semester VI
Core Course 14
(SOCACOR14T)

Sociological Research Methods II

Outline:

1. **Sampling : (12 hrs.)**
   1.1 Probability and Non-probability

2. **Data Collection : (12 hrs.)**
   2.1 Interview
   2.2 Questionnaire
   2.3 Observation

3. **Data Analysis: (15 hrs.)**
   3.1 Quantitative
   3.2 Qualitative

4. **Statistical Methods : (36 hrs.)**
   4.1 Graphical and Diagrammatic Representation – Bar Diagrams, Pie Chart, Histogram, Frequency Polygon, Smoothed Frequency Curve and Ogive
   4.2 Measures of Central Tendency: Mean, Median, Mode
   4.3 Measures of Dispersion: Range, Variance, Standard Deviation

Reading References:

1. Bailey, K. (1994). *Methods of social research*. Simon and Schuster, 4th ed. The Free Press, New York NY 10020.
2. Elifson, K.W., Audrey Haber, & Richard Runyon (1982) Fundamentals of Social Statistics, Addison Wesley
3. Frankfort-Nachmias, Chava, and Anna Leon-Guerrero. Social statistics for a diverse society. Sage Publications, 2017.
4. Goode, W. E. and P. K. Hatt. 1952. *Methods in Social Research*. New York: McGraw Hill.
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8. Kothari, C R, 2004, Research Methodology, New Delhi: New Age International
9. Morgan, Gareth, Ed. Beyond Method: Strategies for social research. Sage, 1983

B.A. (Honours) Sociology

Syllabus

Discipline Specific Elective Papers

Under Choice Based Credit System (CBCS)

West Bengal State University

June 2018

Semester V
Urban Sociology
(SOCADSE01T)

Outline:

1.4 Introducing Urban Sociology: What is Urban, Urbanism and the City **(10 hrs.)**

1.5 Perspectives in Urban Sociology (20 hrs).

2.1.Ecological

2.2. Political Economy

2.3. Network

2.4. City as Culture

1.6 Movements and Settlements (20 hrs.)

3.1. Migration

3.2. Community

1.7 Politics of Urban Space (25 hrs.)

4.1.Culture and Leisure

4.2.Caste, Class and Gender

Reading Reference

1. Abraham, M.-(1976) Urban Sociology, Prentice Hall
2. Bose Ashish –(1974) Studies in India's Urbanization 1961-1971, Tata McGraw Hill
3. Bridge and Sophie Watson, (eds.) The Blackwell City Reader. Oxford and Malden, MA: Wiley Blackwell
4. Desai, A.R. &Pillai(ed)-(1970) Slums and Urbanization, Popular Publications
5. Gilbert, S.J.-(1985) Fundamentals of Industrial Sociology, Tata Mac Graw Hill Publishing Co. Ltd., New Delhi
6. Harvey, D a v i d 1 9 8 5 T h e U r b a n E x p e r i e n c e , B a l t i m o r e : Johns H o p k i n s University Press
7. I. Susser (ed.) The Castells Reader on Cities and Social Theory, Blackwell
8. Miller and form-(1964) Industrial Sociology, Harper and Row, New York
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2 Mumford, Lewis 1961. The City in History: its origins and transformations and its prospects, Mariner Books
3 N. Joyaram& D. Raja Shekhar(ed) 2012 Vulnerebility& Globalization , Rawat Publications
4 NandkarniLaxmi –(1998) Sociology of Industrial workers, Jaipur, Rawat Publications
5 Parker, Simon. Urban Theory and Urban Experience: Encountering the City, London: Routledge
6 PrakasaRao VLS-(1983), Urbanization in India, Concept Publishing Co.
7 Ramachandran, R.-(1991) Urbanization and Urban Systems in India, OUP ,Delhi
8 Ramaswamy& Uma Rawaswamy – (1981) Industry and Labour, OUP
9 Ramaswamy, E.A,- (1988) Industry and Labour , New Delhi ,OUP
10 Ramaswamy, E.A.- (1978) Industrial Revolution in India, New Delhi
11 Rao, M.S.A., C.Bhatt&Kadekar, L.N.(Eds)-(1991): A reader in Urban Sociology, Orient Longman ,New Delhi
12 Robin Cohem& Paul Kenedy, Global Sociology, Palgrave, Maclinan
13 RonnanPaddison -(2001), Handbook of Urban Studies ,Sage India
14 Srivastava, A.K. 1989 Urbanization: Concept and Growth , D.K. Publishers & Distributors, New Delhi

Semester V
Agrarian Sociology
(SOCADSE02T)

Outline:

1. Agrarian Societies and Agrarian Studies(10 hrs.)

1.1 Agrarian Societies
1.2 Agrarian Studies

2. Key Issues in Agrarian Sociology(20 hrs.)

2.1 The Agrarian Question
2.2 The Moral Economy
2.3 Agrarian Commodity Systems

3. Themes in Agrarian Sociology of India (30 hrs.)

3.1 Labour and Agrarian Class Structure
3.2 Markets, Land Reforms and Green Revolution
3.3 Agrarian Movements
3.4 Caste, Gender and Agrarian Realities

4. Agrarian Futures (15 hrs.)

4.1 Agrarian Crisis
4.2 The Global Agrarian Order

Reading Reference

1. Abrol, Yash P., SatpalSangwan, and Mithilesh K. Tiwari, eds. Land Use--Historical Perspectives: Focus on Indo-Gangetic Plains. Allied Publishers, 2002.
2. Beteille, Andre. 2007 'The Study of Agrarian Systems: An Anthropological Approach', from Marxism and Class Analysis, New Delhi: Oxford
3. David Mandelbaum, 1983, Sociology in India Bombay: Popular Publication
4. Desai A R 1994, Rural Sociology, Bombay: Popular Prakshan,
5. Doshi S L & P.C Jain, 1999 Rural Sociology, Jaipur: Rawat Publications
6. Ghuye, 1969, Caste & Race in India, Bombay Popular Prakasan
7. Hans Raj 2000 Rural Sociology, Surjeet Publications
8. Harriss, J o h n. Capitalism and Peasant Farming: Agrarian Structure and Ideology in North Tamil Nadu, Delhi: Oxford University Press, 1982
9. JodhkaSurinder(Ed) 2012, Village Society: Essays from the EPW, New Delhi, Orient Blackswan

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6. Madan, G. R., India's Developing Villages, Bombay: Allied Publications
7. Madan, Vandana (ed) 2002, The Village in India, Oxford India Reading in Sociology and Anthropology, Delhi, OUP
8. Nadkarni, MangeshVenktesh. Farmers' movements in India. Vol. 58. Ahmedabad: Allied Publishers, 1987.
9. Scott, James C. 1976 The Moral Economy of the Peasant: Rebellion and Subsistence in South East Asia, New Haven: Yale University Press
10. Singh, Katar. 2009, Rural Development: Principles, Policies and Management, New Delhi: Sage
11. T. V. Satyamurthy (Ed.) Industry and Agriculture in India Since Independence, Delhi: Oxford University Press
12. Varshney, Ashutosh. Democracy, development, and the countryside: Urban-rural struggles in India. Cambridge University Press, 1998.

Semester V
Environmental Sociology
(SOCADSE03T)

Outline:

1. **Envisioning Environmental Sociology(15 hrs.)**
   - 1.1. What is Environmental Sociology?
   - 1.2. RealistConstructionist Debate.

2. **Approaches (30 hrs.)**
   - 2.1 Treadmill of Production
   - 2.2 Ecological Modernization
   - 2.3 Risk
   - 2.4 Ecofeminism and Feminist Environmentalism
   - 2.5 Political Ecology

3. **Environmental Movements in India (30 hrs.)**
   - 3.1 Forest based movement – Chipko
   - 3.2 Water based movement – Narmada
   - 3.3 Land based movements – Anti-mining and Seed (BeejBachaoAndolan)

Reading Reference

1. Barry, Jhon, 2007,Environment and Social Theory, Routledge
2. Becker, E & Thomas J (ed), 1999, Sustainability and the Social Sciences, Zed Books
3. Bell , M.M.,2004,Invitation to Environmental Sociology, Pine & Forge
4. Bell, Michael Mayerfeld. An invitation to environmental sociology. Sage Publications, 2011.
5. Buttel, Frederick H. "Ecological modernization as social theory." Geoforum 31.1 (2000): 57-65.
6. Buttel, Frederick H. "Reflections on the potentials of ecological modernization as a social theory." Natures sciences sociétés8.1 (2000): 5-12.
7. Gadigil, Madhav&RamachandraGuha, Ecology and Equity: The Use and Abuse of Nature in Contemporary India, OUP New Delhi
8. Guha , Ramchandra,1994,Social Ecology, OUP New Delhi
9. Guha, Ramachandra, 2000, Environmentalism, OUP New Delhi
10. Hannigan, J. A. "Environmental sociology: A social constructionist approach. London: Routledge." (1995).
11. Hannigan, John, 1995, Environmental Sociology, Routledge, London
12. Mol, Arthur PJ. "Ecological modernization and the global economy." Global Environmental Politics 2.2 (2002): 92-115.
13. Padel, Felix, and Samarendra Das. "Orissa's highland clearances: The reality gap in R & R." Social Change 38.4 (2008): 576-608.
14. Rangarajan, Mahesh, ed. Environmental Issues in India: A Reader. Pearson Education India, 2007.
15. Shiva, Vandana, 1991,Ecology and Politics of Survival, Sage New Delhi

Semester V
SOCIOLOGY OF WORK
(SOCADSE04T)

Outline: **1. Interlinking Work and Industry(10 hrs.)**

2. Forms of Industrial Culture and Organisation (20 hrs.)

2.1 Industrialism

2.2 Post-industrial Society

2.3 Information Society

3. Dimensions of Work (20 hrs.)

3.1 Alienation

3.2 Gender

3.3 Unpaid Work and Forced Labour

2 Work in the Informal Sector (10 hrs.)

4.1 Nature and Types

4.2 Social, Political and Economic Consequences

3 Risk, Hazard and Disaster (15 hrs.)

5.1 Socio-Environmental Risk – The case of Tehri Dam

5.2 Health Hazards – Silicosis Intervention

5.3 Industrial Disaster – The case of Bhopal Gas Tragedy

Reading Reference

1. Bhowmik, Sharit. 2012. Industry, Labour and Society, Orient Blackswan
2. Edgell, Stephen. The sociology of work: Continuity and change in paid and unpaid work. Sage, 2011.
3. Erikson, Kai, and Steven Peter Vallas, eds. The nature of work: Sociological perspectives. Yale University Press, 1990.
4. Gilbert, S.J.-(1985) Fundamentals of Industrial Sociology, Tata Mac Graw Hill Publishing Co. Ltd., New Delhi
5. Grint, Keith. The sociology of work: introduction. Polity, 2005.
6. Kumar, Krishan. From post-industrial to post-modern society: New theories of the contemporary world. John Wiley & Sons, 2009.
7. Miller and form-(1964) Industrial Sociology, Harper and Row, New York
8. Miller, D.C. &Form,W.H. (1980) Industrial Sociology, Harper and Row
9. NandkarniLaxmi (1998) Sociology of Industrial Workers, Jaipur, Rawat
10. Parker, Stanley Robert. The sociology of industry. Vol. 1. Allen &Unwin Australia, 1977.
11. Ramaswamy, E.A,-(1978)Industrial Revolution in India, New Delhi
12. Ramaswamy, E.A,-(1988)Industry and Labour, New Delhi, OUP
13. Schneider Eugene-(1979) Industrial Sociology, New Delhi, Tata Mac Graw Hills
14. Seth, N.R.(ed)-(1982)Industrial Sociology in India, Kolkata, Allied Publishers
15. Volti, Rudi. An introduction to the sociology of work and occupations. Sage Publications, 2011.
16. Watson, Tony. Sociology, Work and Organisation. Taylor & Francis, 2017.

Semester VI
Sociology of Health and Medicine
(SOCADSE5T)

Outline:

1. **Introduction to the Sociology of Health and Medicine (20 hrs.)**
   - 1.1 Origins and Development
   - 1.2 Conceptualizing Disease, Sickness and Illness
   - 1.3 Social and Cultural Dimensions of Illness and Medicine

2. **Theoretical Orientations in Health and Illness (30 hrs.)**
   - 2.1 Political Economy
   - 2.2 Systems Approach
   - 2.3 Discourse and Power
   - 2.4 Feminist Approach

3. **Negotiating Health and Illness (25 hrs.)**
   - 3.1 Medical Practices
   - 3.2 Health Policies in India

Reading Reference

10. Annandale, Ellen. The sociology of health and medicine: a critical introduction. Polity, 1998.
11. Foucault, Michel. "The Birth of the Clinic: An Archaeology of Medical Perception (1963), trans." AM Sheridan Smith (New York: Vintage, 1994) 19
12. Freund, Peter ES, Meredith B. McGuire, and Linda S. Podhurst. Health, illness, and the social body: A critical sociology. Prentice Hall, 2003.
13. Good, Byron J. Medicine, rationality and experience: an anthropological perspective. Cambridge University Press, 1993.
14. John M c K i n l a y, 1984 Issues i n t h e P o l i t i c a l Economy of Healthcare. New York: Tavistock
15. Kleinman, Arthur. The illness narratives: suffering, healing, and the human condition. Basic books, 1988.
16. Leslie, Charles M., ed. Asian medical systems: A comparative study. Vol. 3. MotilalBanarsidass Publisher, 1998.
17. Nelson, James Lindemann, and Hilde Lindemann Nelson, eds. meaning and medicine: a reader in the philosophy of health care. Psychology Press, 1999.
18. Turner, Bryan S. Medical power and social knowledge. Sage, 1995.

Semester VI
Indian Sociological Traditions
(SOCADSE06T)

Outline:

1. G S Ghurye (15 hrs.)
1.1 Caste and Race
1.2 City and Civilization

2. RadhakamalMukerjee (15 hrs.)
2.1 Personality, Society, Values
2.2 Social Ecology

3. D. P. Mukerji (15 hrs.)
3.1 Tradition and Modernity
3.2 Middle Class

4. Verrier Elwin (5 hrs.)
3. Tribes in India

5. M.N. Srinivas (10 hrs.)
5.1. Social Change

6. IrawatiKarve (10 hrs.)
2 Gender and Kinship

7. LeelaDube (5 hrs.)
7.1 Caste and Gender

Reading Reference

1. Chakraborty, D 2010, D P Mukerji and the Middle Class in India, Sociological Bulletin 59(2), May-August 235-255

2. Dhanagare, D.N (1999), Themes and Perspectives in Indian Sociology, Delhi: Rawat Publications Chp 7

3. Dube, Leela 2001, Anthropological Explorations in Gender: Intersecting Fields, New Delhi: Sage Chp 3,5& 6

4. Dube, Leela 1967, Caste, Class and Power: Eastern Anthropologist Lucknow 20(2)

215-225

5. East: Founders of Indian Sociology and Anthropology, New Delhi: Permanent Black

6. Elwin, Verrier 1952, Bondo Highlander, Bombay: OUP

7. Elwin, Verrier 1955, The Religion of an Indian Tribe, Bombay: OUP Chp 11, 15, 16, 17

8. Ghurye, G.S. 1969, Caste and Race in India, Delhi: Popular PrakashanPp 114-140,404-460 (82 pages)

9. Ghurye, G.S. 1962, Cities and Civilization, Delhi: Popular Prakashan

10. Guha, Ramchandra 2010, „Between Anthropology and Literature: The Ethnographies of Verrier Elwin‟ in Patricia Uberoi, SatishDespande and NandiniSundar (eds) Anthropology in the East: Founders of Indian Sociology and Anthropology, New Delhi: Permanent Black

11. Karve, Irawati 1961, Hindu Society — an interpretation, Pune: DeshmukhPrakashan

12. Karve, Irawati 1965, Kinship Organization in India, Bombay and New York: Asia Publishing House

13. Madan T N 2011, Sociological Traditions: Methods and Perspectives in the Sociology of India, New Delhi: Sage

14. Madan, T.N. 2010, „Search for Synthesis: The Sociology of D.P Mukerji‟ in Patricia Uberoi, SatishDespande and NandiniSundar (ed) Anthropology in the East: Founders of Indian Sociology and Anthropology, New Delhi: Permanent Black

15. Mukerjee, Radhakamal 1932, (reproduced in1994) „An Ecological Approach to Sociology‟ in RamchandraGuha (ed) Social Ecology Delhi: OUP

16. Mukerjee, Radhakamal 1932, The concepts of balance and organization in Social Ecology Sociology and Social Research 16 (July-August 1932) 503-516

17. Mukerjee, Radhakamal 1950, The Social Structure of Values, London: George Allen and UnwinChp 2,3, 5, 6 & 9

18. Mukerjee, Radhakamal 1951, The Dynamics of Morals, London: Macmillan & Co

19. Mukerji D.P. (1942 republished 2002), Modern Indian Culture: A Sociological Study, New

Delhi: Rupa& Co.

20. Mukerji D.P. (1958 second edition 2002), Diversities: Essays in Economics, Sociology and

    Other Social Problems, Delhi: Manak Publications Pg 177-225, 261-276

21. Munshi, Indra 2004, „Verrier Elwin and Tribal Development‟ in T.B. Subba and SujitSom (eds) Between Ethnography and Fiction: Verrier Elwin and the Tribal Question in India, New Delhi: Orient Longman

22. Srinivas, M. N.1992, On Living in a Revolution and Other Essays, Delhi: OUP Chp 1,2,3,5&7

23. Srinivas, M.N. 1971, Social Change in Modern India University of California Press Berkeley Chp 4-5

24. Srinivas, M.N. 1996, Indian Anthropologists and the study of Indian Society EPW 31(11) 656-657

25. Sundar, Nandini 2010 „In the Cause of Anthropology: The Life and Work of IrawatiKarve‟ in Patricia Uberoi, SatishDespande and NandiniSundar (ed) Anthropology in the East: Founders of Indian Sociology and Anthropology Permanent Black New Delhi

26. Uberoi, Patricia DespandeSatish and SundarNandini (ed) 2010, Anthropology in the

27. Upadhya, Carol 2010, „The Idea of an Indian Society: G.S. Ghurye and the Making of Indian Sociology‟ in Patricia Uberoi, SatishDespande and NandiniSundar (ed) Anthropology in the East: Founders of Indian Sociology and Anthropology New Delhi: Permanent Black

28. Venugopal, C.N. 1988, Ideology and Society in India: Sociological Essays, New Delhi: Criterion Publications Chp 7

Generic Elective (GE)

Semester I
Generic Elective01
(SOCHGEC01T)
Introduction to Sociology

Outline:

1. **Sociology-The Discipline:** Sociology as a science and as an interpretative discipline; Study of Social Phenomena (8 hrs.)

2. **Basic Concepts**: Society, Community, Association, Institution; Culture-Components, Culture change, Diffusion, Cultural-lag, Cultural universals and Relativism, Ethnocentrism, Acculturation; Social Groups - primary, secondary, formal-informal, in group-out group, and Reference groups; Social structure, Social system, Social action; Status and Role, Role Conflict, Role Set; Norms and Values-Conformity and Deviance; law and customs; socialization – theories and agencies; nature-nurture debate, social interaction (25 hrs.)

3. **Marriage and Family**: Types and forms of marriage; family-structure and function; personality and socialization; Social control; family, changing structure of family marriage and sex roles in modern society; divorce and its implications; gender issues; role conflicts. (12 hrs.)

4. **Social Stratification**: Concepts-hierarchy, inequality and stratification; forms and functions; class- different conceptions of class: class-in-itself and class-for-itself; caste and class; caste as a class, social mobility
(15 hrs.)

5. **Social Institutions**: Economy, Polity, Education and Religion (5 hrs.)

6. **Social Movements**: Concepts of social movements; genesis of social movements; ideology and social movement (5 hrs.)

a. **Social change**: Continuity and change as fact, and as value; directed social

change; social movement and social change; social policy

(5 hrs.)

Reading Reference

5. Alex Inkeles: What Is Sociology, PHI Learning, 1964

6. An Introduction to Sociology: Ken Browne, 3rd edition, Polity, 2005

7. Contemporary Sociology: An Introduction to Concepts and Theory, M. Francis Abraham, OUP India, 2006

8. SamakalinSamajtatwa: Ganguly&Moinuddin, 2nd Edition, Reena Books: Kolkata, 2013

9. Sociology: A Down-to-Earth Approach: James M. Henslin, Pearson; 11th edition 2011

10. Sociology: Essays on Approach and Method: A. Beteille, OUP India 2002

11. The Concise Encyclopedia of Sociology: George Ritzer and J. Michael Ryan (Edits), Blackwell Publishing, 2011

Semester II
Generic Elective 02
(SOCHGEC02T)
Sociology of India

Outline:

1. **India as a Plural Society** (10 hrs.)

2. **Social Institutions and Practices**(25 hrs.)
   - 2.1 Caste
   - 2.2 Tribe
   - 2.3 Class
   - 2.4 Village
   - 2.5 Family and Kinship

3. **Identities and Change**(20 hrs.)
   - 3.1 Dalit Movement
   - 3.2 Women's Movement

4. **Challenges to State and Society**(20 hrs.)
   - 4.1 Communalism
   - 4.2 Secularism

Reading Reference

1. Contemporary India: Economy, Society, Politics: NeeraChandhoke& Praveen Priyadarshi, Pearson Education India, 2009
2. Dalit identity and Politics. Shah, Ghanshyam. Delhi: Sage 2001
3. Development and Civil Society: BiswajitGhosh (Ed), Rawat, 2012
4. Family and Social Change in Modern India: Giri Raj Gupta, Vikas Publishing House, 1976
5. Family, Kinship and Marriage in India: Patricia Uberoi, OUP India, 1994
6. Handbook of Indian Sociology: Veena Das, OUP India, 2006
7. Indian Society: Institutions and Change: Rajendra K Sharma, Atlantic

Publishers &Dist, 2004

8. India's Agony over Religion: Gerald James Larson, Suny Press, 1995

9. On Civil Society: Issues and Perspectives: N.Jayaram, Sage, 2005

10. Religion in India: T. N. Madan, OUP India, 1992

11. SamakalinBharatiyaSamaj: Ganguly&Moinuddin, PHI Learning 2008 (in Bengali)

12. Social Background of Indian Nationalism (6Th-Edn): A. R. Desai, Popular Prakashan, 2005

13. Social Change in India: B Kuppuswamy, Vikas Publications, 1972

14. Social Stratification: Dipankar Gupta, OUP India 1991

15. Society in India: Change & Continuity: D.G Mandelbaum, University of California Press, 1970

16. The everyday state and society in modern India: C.J. Fuller and Veronique Benei (eds), C. Hurst & Co. Publishers, 2001

17. The Furies of Indian Communalism: Religion, Modernity, and Secularization: AchinVanaik, Verso, 1997

18. Tradition, Rationality, and Change: Essays in Sociology of Economic Development and Social Change: M.S.A Rao, Popular Prakashan, 1972

19. Tribal India today: NadeemHashain, (2nd Ed.), Harnam Publications, New Delhi, 1991

20. Tribe, Caste and Religion: R. Thaper (ed.), New Delhi: Macmillan 1977

21. Understanding Contemporary India: Critical Perspectives: AchinVanaik& Rajeev Bhargava, Orient BlackSwan, 2010

23 BharatiyaSamajPrasangey: AniruddhaChoudhury, Chatterjee Publishers, 2016

Semester III
Generic Elective 03
(SOCHGEC03T)
Sociological Theories

Outline:

1. **Karl Marx**(25 hrs.)

    1.1 Materialist Conception of History
    1.2 Class and Class Struggle

2. **Emile Durkheim**(25 hrs.)

    2.1 Social Fact
    2.2 Forms of Solidarity

3 **Max Weber**(25 hrs.)

    3.1 Ideal Types and Social Action
    3.2 Types of Authority

Reading Reference

1. A Short History of Sociological Thought: Alan Swingewood, PHI Learning, 1991

2. Classical Sociological Theory: George Ritzer, McGraw Hill, 1996

3. How to Read Karl Marx: Ernest Fischer, Aakar: New Delhi 2008

4. Masters of Sociological Thought: Lewis A. Coser,Rawat: Jaipur, 1977

5. Tatwo O ChintadarsheSamokalinSamajtatwa: RamanujGanguly, 2nd Ed, Reena Books: Kolkata 2013 (in Bengali)

6. The Communist Manifesto (21 February 1848), Karl Marx & Friedrich Engels, Echo Library, 2009

Semester IV
Generic Elective 04
(SOCHGEC04T)
Methods of Sociological Enquiry

Outline:

1. The Logic of Social Research(25 hrs.)

1.1 What is Sociological Research?
1.2 Objectivity in the Social Sciences
1.3 Reflexivity

2. Methodological Perspectives(25 hrs.)

2.1 The Comparative Method
2.2 The Ethnographic Method

3. Modes of Enquiry(25 hrs.)

3.1 Theory and Research
3.2 Analysing Data: Quantitative and Qualitative

Reading Reference

1. Doing Social Research: T L Baker, 3rd Edition, Mcgraw-hill Book Company, 1999
2. Fundamentals of Social Statistics: Kirk W. Elifson, Richard P. Runyon, & Audrey Haber, McGraw-Hill Higher Education, 1998
3. Methods in Social Research: William Josiah Goode & Paul K. Hatt, McGraw-Hill, 1952
4. Methods of Social Research: K D Bailey, 4th Edition, Simon and Schuster, 1994
5. Scientific Social Surveys and Research: P.V. Young, PHI-Learning, New Delhi
6. The Practice of Social Research: Earl Babbie, 12th Edition, Wadsworth Publishing Company/ Cengage Learning, 2010
7. The Practice of Social Research: Guided Activities: Earl R. Babbie& Theodore C. Wagenaar, Cengage Learning, 2006

SKILL ENHANCEMENT COURSES

Semester III
Skill Enhancement Course 01
(SOCSSEC01M)
Theory and Practice of Development

Outline:

1. What is development? (10 hrs.)

2. Recent trends in Development (20 hrs.)

2.1 Neo-liberalism: Growth as Development
2.1a.Re-emergence of Neo-classical perspective
2.1b. SAP and its Critique

2.2 Post development Theory (20 hrs.)

2.2a.Knowledge as Power
2.2b. Participatory Development
2.2c. GAD

2.3Sustainable Development Theory: UN Earth Charter 1992 (25 hrs.)
2.3a. Hegemonic approach: PPP
2.3b. Environmental discourse

3. Human Development Theory: Growth vs. Development (10 hrs.)

Reading References

1) Colclough, Christopher, and James Manor, eds. States or Markets? Neo-liberalism and the development policy debate. Oxford University Press, 1993.

2) Dreze, Jean, and Amartya Sen. "India: Economic development and social opportunity." OUP (1999).

3) Dreze, Jean, and Amartya Sen. India: Development and participation. Oxford University Press, USA, 2002.

4) Eade, Deborah, and Suzanne Williams. The Oxfam handbook of development and relief. Vol. 2. Oxfam, 1995.

5) Escobar, A. 2011. (paperback ed.) Encountering development: The making and unmaking of the Third World Princeton: Princeton Press

6) Ferguson, Iain. Reclaiming social work: Challenging neo-liberalism and promoting social justice. Sage, 2007.

7) Friere, Paulo. 1972. Pedagogy of the Oppressed. New York: Herder & Herder

8) Kirkpatrick, Colin H., Ron Clarke, and Charles Polidano, eds. Handbook on development policy and management. Edward Elgar Publishing, 2002.

9) MacEwan, Arthur. Neo-liberalism or democracy? economic strategy, markets, and alternatives for the 21st century. Zed Books, 1999.

10) Nussbaum, Martha, and Amartya Sen, eds. The quality of life. Oxford University Press, 1993.

11) Sachs, Wolfgang. 2007. The Development Dictionary: A guide to Knowledge as Power. London: Zed Books

12) Schultz, T. Paul, and John Strauss, eds. Handbook of development economics. Vol. 4. Elsevier, 2008.

13) Sen, Amartya. Resources, values, and development. Harvard University Press, 1997.

Skill Enhancement Course 02
Semester IV
(SOCSSEC02M)
Gender Sensitization

Outline:

1. Sex, Gender and Sexuality (20 hrs.)

1.1 Introduction to debates on the social construction of sex and gender
1.2 Cultural construction of masculinity and femininity
1.3 Understanding sexual preference as a right

2. Gender, Family, Community and the State (10 hrs.)

3. Gender Rights and the Law (20 hrs.)

3.1 Women's Rights in Indian Constitution: Fundamental rights and Directive Principles
3.2 Right to property
3.3 Personal laws
3.4 Violence against women
3.5 Sexual harassment
3.6 Rape
3.7 Domestic violence

4. Women's Rights as Human Rights: U.N. Conventions, Convention on the Elimination of all forms of Discrimination against Women (CEDAW), Millennium Development Goals (MDGs) (25 hrs.)

Reading References

1. Altekar,A.S. 1983,The Position of Women in Hindu Civilization. Delhi,MotilalBanarasidass,Second Edition: P Fifth Reprint.

2. Bhasin, Kamala. 1993. What is Patriarchy? New Delhi: Kali for Women.

3. Bilton, Tony et al. 1996. Introductory Sociology. New York: Palgrave.

4. Box, Steven. Power, Crime, and Mystification. London: Routledge, 1989

5. Butalia, Urvashi. The Other Side of Silence. Durham, NC: Duke University Press, 2000

6. Buzawa, Eva Schlesinger, and Carl G. Buzawa. Domestic violence: The criminal justice response. Sage, 2003.

7. Chanana, Karuna, 1988, Socialization, Women and Eduction, Explorations in Gender Identity,New Delhi

8. Chappell, Duncan, and Vittorio Di Martino. Violence at work. ILO, 2006.

9. Desai ,Neera and M. Krishnaraj,1987, Women and Society in India,Delhi, Ajanta

10. Fernandes, Leela.(ed). 2014. Routledge Handbook of Gender in South Asia. London:Routledge

11. Forbes,G.1998,Women in Modern India ,New Delhi,Cambridge University press

12. Furr.L, Allen. 2018. Women, Violence and Social Stigma. Jaipur: Rawat Publications.

13. Gandhi, N. And N. Shah ,1992,The issues at Stake, Theory and Practice in the Contemporary Women's Movement in India,NewDelhi,Kali for Women.

14. Gangoli, Geetanjali. Indian feminisms: Law, patriarchies and violence in India. Routledge, 2016.

15. Ghadially , Rehana (ed) ,1988,Women in India Society,NewDelhi,Sage

16. Ghadially, Rehana, ed. Urban women in contemporary India: a reader. Sage, 2007.

17. Hatty, Suzanne E. Masculinities, violence and culture. Sage Publications, 2000.

18. Jackson, Stevi and Sue Scott (eds.) 2002. Gender: A Sociological Reader. London: Routledge.

19. Jayawardene,Kumari,1991,Feminism and Nationalism in the third World, New Delhi, Kali For Women

20. Kalaramadam,S. 2016. Gender, Governance and Empowerment in India. London: Routledge

21. Kalia, H.L. 2005. Work and the Family. Jaipur: Rawat Publications.

22. Kimmel, Michael S. The Gendered Society. New York: Oxford University Press, 2011.

23. Kolaskar, A and Dash, Motilal (ed) .2012. Women and Society: The Road to Change. New Delhi: OUP

24. Lorber, Judith and Susan A. Farrell (eds.). 1991. The Social Construction of Gender. Newbury Park, Calif: Sage Publications.

25. MacKinnon, Catharine A. Only Words. Cambridge, Mass.: Harvard University Press, 1993

26. Mangubhai, Jayshree P., and Joel G. Lee. Dalit women speak out: Caste, class and gender violence in India. Zubaan, 2012.

27. Menon, Nivedita (ed.).1999. Gender and Politics in India. New Delhi: Oxford University Press.

28. Mies Maria ,1980,Indian Women and Patriarchy,Conflicts and Dilemmas of Students and Working Women,NewDelhi,Concept

29. Oakley, Ann,1972,Sex, Gender and Society, New York, Harper and Row

30. Rege, Sharmila. (ed). 2003. Sociology of Gender: The Challenge of Feminist Sociological Knowledge. New Delhi: Sage.

31. Rosaldo, M. Z. and L. Lamphere (eds.). 1974. Woman, Culture and Society. Stanford: Stanford University Press.

32. Sarkar, Siuli. 2016. Gender Disparity in India: Unheard Whimpers. Delhi: PHI Learning.

33. Smith, Bonnie, G. 2013. Women's Studies: The Basics. London: Routledge

34. Tong, Rosemarie. 2009. Feminist Thought. Westview Press.

35. UNDP Human Development Report 2000. OUP, New Delhi, 2000

36. Agnes, Flavia et al. Women and Law in India. New Delhi: OUP, 2004

37. Sahai, Shailly. Social Legislation and Status of Hindu Women. Jaipur: Rawat, 1986

38. Singh, Alka. Women in Muslim Personal Law. Jaipur: Rawat, 1991

39. Omvedt, Gail. Violence Against Women: New Movements and New Theories in India. New Delhi: 1990.

West Bengal State University

CBCS curricula and syllabi for UG 2018

Zoology Honours

(Credit values given within brackets)

SEM	COURSES					Total credits
	CORE	DSE	GEC	AEC	SEC	
I	ZOOACOR01T (4) ZOOACOR01P (2) ZOOACOR02T (4) ZOOACOR02P (2)	-	CEMHGEC01T (4) CEMHGEC01P (2) **OR** GE course offered by any other science department	ENVSAECO1T (2)		**20**
II	ZOOACOR03T (4) ZOOACOR03P (2) ZOOACOR04T (4) ZOOACOR04P (2)		CEMHGEC02T (4) CEMHGEC02P (2) **OR** Any other GEC course offered by any other science department	ENGSAEC01T (2)		**20**
III	ZOOACOR05T (4) ZOOACOR05P (2) ZOOACOR06T (4) ZOOACOR06P (2) ZOOACOR07T (4) ZOOACOR07P (2)		BOTHGEC01T (4) BOTHGEC01P (2) **OR** Any other GEC course offered by any other science department		ZOOSSEC001 (2) OR ANY SEC offered by any other dept.	**26**
IV	ZOOACOR08T (4) ZOOACOR08P (2) ZOOACOR09T (4) ZOOACOR09P (2) ZOOACOR10T (4) ZOOACOR10P (2)		BOTHGEC02T (4) BOTHGEC02P (2) **OR** Any other GEC course offered by any other science department		ZOOSSEC003 (2) OR ANY SEC offered by any other dept.	**26**
V	ZOOACOR11T (4) ZOOACOR11P (2) ZOOACOR12T (4) ZOOACOR12P (2)	ZOOADSE01T (4) ZOOADSE01P (2) ZOOADSE02T (4) ZOOADSE02P (2) ZOOADSE03T (4) ZOOADSE03P (2) (ANY TWO TO BE CREDITED)				**24**

VI	ZOOACOR13T (4) ZOOACOR13P (2) ZOOACOR14T (4) ZOOACOR14P (2)	ZOOADSE04T (4) ZOOADSE04P (2) ZOOADSE05T (4) ZOOADSE05P (2) ZOOADSE06T (4) ZOOADSE06P (2) (ANY TWO TO BE CREDITED)				**24**
	14	4	4	2	2	**140**

COURSE DETAILS : **Cores**

Semester I

ZOOACOR01T (Theory, 4 credits= 60 classes): Non-Chordates I

Unit 1: Protista, Parazoa and Metazoa 19 classes
classes

General characteristics and Classification up to classes

Study of *Euglena*, *Amoeba* and *Paramoecium*

Life cycle and pathogenicity of *Giardia intestinalis*, *Leishmania donovani*, *Entamoeba histolytica* and *Plasmodium vivax*

Locomotion and Reproduction in Protista

Evolution of symmetry and segmentation of Metazoa

Unit 2: Porifera 7 classes

General characteristics and Classification up to classes

Canal system and spicules in sponges

Unit 3: Cnidaria 12 classes

General characteristics and Classification up to classes

Metagenesis in *Obelia*

Polymorphism in Cnidaria

Corals and coral reefs: types, formation, distribution, conservation significance

Unit 4: Ctenophora 4 Classes

General characteristics

Unit 5: Platyhelminthes 10 Classes

General characteristics and Classification up to classes

Life cycle and pathogenicity of *Fasciola hepatica* and *Taenia solium*

Unit 6: Nemathelminthes 8 Classes

General characteristics and Classification up to classes

Life cycle, and pathogenicity of *Ascaris lumbricoides, Ancylostoma duodenale and Wuchereria bancrofti*

Parasitic adaptations in helminths

Origin and evolution of parasitic helminths

ZOOACOR01P (Practicals, 2 credits = 60 classes): Non-Chordates I Lab

1. Study of whole mount of *Euglena, Amoeba and Paramoecium,* Binary fission and Conjugation in *Paramoecium*

2. Examination of freshwater pond water collected from different places for diversity of protists in it.

3. Study of Sycon (T.S. and L.S.), *Hyalonema, Euplectella, Spongilla*

4. Study of *Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora*

5. One specimen/slide of any Ctenophore

6. Study of adult *Fasciola hepatica, Taenia solium* and their life cycles (Slides/microphotographs)

7. Study of adult *Ascaris lumbricoides* and its life stages (Slides/micro-photographs)

8. To submit a Project Report on any related topic on pond water protozoan or invertebrate diversity/ life cycles of mosquitoes, butterfly/moth etc /coral and coral reefs.

Note:

1. Only conspicuous characters required to identify the organism to be noted along with the known systematic positions of it (for Protozoans up to Phylum and others up to Class)
2. It is wise to study the coloured photographs of the organisms suggested for the study as available from internet sources along with the preserved specimens, if are there, or otherwise.

Text Book:

- Biology of the Invertebrates by Jan A Pechenik
- Invertebrates by Brusca and Brusca 2nd Ed

Referrences:

- An introduction to Invertebrates by Janet Moore 2nd ed.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
- Bose, Mala. Parasitoses and Zoonoses, New Central Book Agency , 2017.
- Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.

- Students are encouraged to explore authentic websites (for e.g. wikipedia, different university websites, OCWs) at internet for reading / audio-visual materials on a particular topic if they don't find enough in the text books)

ZOOACOR02T (Theory, 4 credits= 60 classes): Ecology

Unit 1: Introduction to Ecology **4 classes**

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of Physical factors, The Biosphere.

Unit 2: Population **20 classes**

Unitary and Modular populations
Unique and group attributes of population: Demographic factors, life tables, fecundity tables, survivorship curves, dispersal and dispersion.
Geometric, exponential and logistic growth, equation and patterns, r and K strategies Population regulation - density-dependent and independent factors
Population Interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition.

Unit 3: Community **11 classes**

Community characteristics: species diversity, abundance, dominance, richness, Vertical stratification, Ecotone and edge effect. Ecological succession and example of it.

Unit 4: Ecosystem **10 classes**

Types of ecosystem with an example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies Nutrient and biogeochemical cycle with an example of Nitrogen cycle Human modified ecosystem

Unit 5: Applied Ecology **5 classes**

Wildlife Conservation (in-situ and ex-situ conservation).

Management strategies for tiger conservation; Wild life protection act (1972)

ZOOACOR02P (Practicals, 2 credits = 60 classes): Ecology Lab

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided

2. Determination of population density of a natural/hypothetical population. Study of species diversity of a community by quadrat or any other suitable sampling method and calculation of Shannon-Weiner diversity index for the same community.

3. Study of an aquatic ecosystem: Sampling of Phytoplankton and zooplankton, Measurements of temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO2.

4. Excursion: Visit to a National Park/Wild life sanctuary/ any other Protected Forests within West Bengal. Report (including the actual field diary) on the study of the landscape and habitat features, Types of Forests, Major Flora and Fauna, Man-animal conflicts and other problems, Management and conservation measures.

Text book:

1. Ecology: Theories and Applications by Peter Stiling; Pearson 4th Ed. 2001.
2. Ecology: The Experimental Analysis of Distribution and Abundance (Indian Paperback edition) by Charles Krebs
3. for Unit 5, also read Conservation Biology: A Primer for South Asia by Kamaljit S. Bawa, Meera Anna Oommen, and Richard B. Primack, University Press, India)

Referrences:

- A Primer of Ecology by Gotelli; 3rd Ed. Sinauer Associates. 2000.
- Students are encouraged to explore authentic websites (for e.g. different university websites and OCWs) at internet, wikipedia for reading / audio-visual materials on a particular topic if they don't find enough in the text books or otherwise)

Semester II

ZOOACOR03T (Theory, 4 credits= 60 classes): Non-Chordates II

Unit 1: Introduction to Coelomates
Evolution of coelom and metamerism

Unit 2: Annelida
General characteristics and Classification up to classes
Excretion in Annelida

Unit 3: Arthropoda
General characteristics and Classification up to classes
Vision and Respiration in Arthropoda
Metamorphosis in Insects
Social life in bees and termites

Unit 4: Onychophora
General characteristics and Evolutionary significance

Unit 5: Mollusca
General characteristics and Classification up to classes
Respiration in Mollusca
Torsion and detorsion in Gastropoda
Pearl formation in bivalves
Evolutionary significance of trochophore larva

Unit 6: Echinodermata
General characteristics and Classification up to classes
Water-vascular system in Asteroidea
Larval forms in Echinodermata
Affinities with Chordates

Unit 7: Hemichordata
General characteristics of phylum Hemichordata. Phylogenetic relationship with non-chordates and chordates (only recent concept)*

ZOOACOR03P (Practicals, 2 credits = 60 classes): Non-Chordates II Lab

1. Study of following specimens:

Annelids - *Aphrodita, Nereis, Heteronereis, Sabella, Serpula, Chaetopterus, Pheretima, Hirudinaria*
Arthropods - *Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta,* termites and honey bees
Onychophora - *Peripatus*
Molluscs - *Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Pinctada, Sepia, Octopus, Nautilus*
Echinodermates - *Pentaceros/Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and Antedon*
Hemichordates- *Saccoglossus*

2. Digestive system, septal nephridia and pharyngeal nephridia of earthworm 3. T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm

4. Mount of mouth parts and dissection of digestive system and nervous system of Periplaneta

5. To submit a Project Report (mostly literature review) on any related topic to larval forms (crustacean, mollusc and echinoderm)

Note:
1. Only conspicuous characters required to identify the organism to be noted. Along with it, the systematic positions of the organism are to be mentioned (up to Class).
2. It is wise to study the coloured photographs of the whole organisms or its parts suggested for the study as available from internet sources along with the preserved specimens, if are there, and otherwise. Dissections of animals other than common pests are discouraged.

Text Book:

- Biology of the Invertebrates by Jan A Pechenik, Mcgrew-Hill, 2014
  Or
- Invertebrates by Brusca and Brusca 2nd Ed, Sinauer Associates

Referrence:

- An introduction to Invertebrates by Janet Moore 2nd ed.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
- Chaudhury,S.(2017). Economic Zoology. New Central Book Agency
- https://www.nature.com/articles/nature16150) for hemichordate phylogenetic relationship*
- Students are encouraged to explore authentic websites (for e.g. wikipedia, different university websites and OCWs) at internet for reading / audio-visual materials on a particular topic if they don't find enough in the text books or otherwise)

ZOOACOR04T (Theory, 4 credits= 60 classes): Cell Biology

Unit 1: Overview of Cells
Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions

Unit 2: Plasma Membrane
Various models of plasma membrane structure
Transport across membranes: Active and Passive transport, Facilitated transport
Cell junctions: Tight junctions, Desmosomes, Gap junctions
Extracellular Matrix-Cell Interactions

Unit 3: Endomembrane System
Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

Unit 4: Mitochondria and Peroxisomes
Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis Peroxisomes

Unit 5: Cytoskeleton
Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

Unit 6: Nucleus
Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome)

Unit 7: Cell Division
Mitosis and Meiosis
Cell cycle and its regulation
Cancer (Concept of oncogenes and tumor suppressor genes)
Mechanisms of cell death: brief overview

Unit 8: Cell Signaling
Cell signalling transduction pathways; Types of signaling molecules and receptors
GPCR and Role of second messenger (cAMP)

ZOOACOR04P (Practicals, 2 credits = 60 classes): Cell Biology Lab

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis (in pre-prepared slides and/or in photographs obtained from websites).
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
4. Preparation of permanent slide to demonstrate:
   a. DNA by Feulgen reaction
   b. Mucopolysaccharides by PAS reaction
   c. Proteins by Mercurobromophenol blue/Fast Green
5. Cell viability study by Trypan Blue staining

Text Book:

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017

2. Cell Biology by Gerald Karp; Wiley, 7th Ed. 2013
   Or
   Essentials of Cell Biology by Bruce Albert et al.; W.W. Norton Co., 4th Ed, 2013
   Or
   Molecular Cell Biology by Hurvey Lodish et al.; W. H. Freeman, 6th Ed.2013

Reference:

- Students are encouraged to explore authentic websites (for e.g. wikipedia, different university websites and OCWs) at internet for reading / audio-visual materials on a particular topic if they don't find enough in the text books or otherwise)

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Semester III

ZOOACOR05T (Theory, 4 credits= 60 classes): Chordates

Unit 1: Introduction to Chordates
General characteristics and outline classification of Phylum Chordata

Unit 2: Protochordata
General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes.
Metamorphosis in Ascidia
Chordate Features and Feeding in Branchiostoma

Unit 3: Origin of Chordata
Dipleurula concept and the Echinoderm theory of origin of chordates
Advanced features of vertebrates over Protochordata

Unit 4: Agnatha
General characteristics and classification of cyclostomes up to order

Unit 5: Pisces
General characteristics and classification of Chondrichthyes and Osteichthyes up to Subclasses Accessory respiratory organ, migration and parental care in fishes Swim bladder in fishes. Classification up to Sub-Classes

Unit 6: Amphibia
General characteristics and classification up to living Orders
Metamorphosis and parental care in Amphibia

Unit 7: Reptilia
General characteristics and classification up to living Orders
Poison apparatus and Biting mechanism in Snake

Unit 8: Aves
General characteristics and classification up to Sub-Classes
Exoskeleton and migration in Birds
Principles and aerodynamics of flight

Unit 9: Mammals
General characters and classification up to living orders
Phylogenetic significance of Prototheria
Exoskeleton derivatives of mammals
Adaptive radiation in mammals with reference to locomotory appendages
Echolocation in Microchiropterans and Cetaceans

Unit 10: Zoogeography
Zoogeographical realms,
Plate tectonic and Continental drift theory,
Distribution of birds and mammals in different realms

Note: Classification schemes are to be followed as given in Kardong, 2004. All groups are to be studied up to order, except for Mammals up to class.

ZOOACOR05P (Practicals, 2 credits= 30 classes): Chordates Lab

Lab/field study of –

1. **Protochordata**
   Herdmania, Branchiostoma,
   Colonial Urochordates; Sections of Balanoglossus through proboscis and branchiogenital regions, Sections of Amphioxus through pharyngeal, intestinal and caudal regions, *Herdmania* spicules
2. **Agnatha**
   Petromyzon, Myxine
3. **Fishes**
   Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetraodon, Anabas, Flat fish
4. **Amphibia**
   Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra
5. **Reptilia**
   Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus Key for Identification of poisonous and non-poisonous snakes
6. **Aves**
   Study of six common birds from different orders (Stork, Owl/Falcon, Sun Bird, Jacanna, Duck)- types of beaks and claws.
7. **Mammalia**
   Sorex, Bat (Insectivorous and Frugivorous), Funambulus, Loris, Herpestes, Erinaceous.

8. Mount of weberian ossicles of Mystus or Grass Carp,
   Pecten from Fowl head, Dissection of Fowl head (Dissections and mounts subject to permission)

   Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission)

Note:

1. Only conspicuous characters required to identify the animal are to be noted. Along with it, the systematic positions of the animal mentioned (up to Class) and a short note on its habits and habitat are to be noted.
2. It is wise to study the coloured photographs of the whole animal and/or its parts mentioned above for the study, as available from internet sources along with the preserved specimens (if, they are already in the museum). New collection/purchase of animals or their body parts, especially for those which are protected by conservation laws are to be avoided. Dissections of animals other than common pests are discouraged.

Text Book:

- Kardong, K. V. (2002). Vertebrates: Comparative anatomy, function evolution. McGraw Hill 4th Ed. 2005.
- Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.

- Pough H. Vertebrate life, VIII Edition, Pearson International.

References:

- Students are encouraged to explore authentic websites (for e.g. wikipedia, different university websites and OCWs) at internet for reading / audio-visual materials on a particular topic if they don't find enough in the text books or otherwise)
- Comparative Anatomy of the Vertebrates 9th Ed (2015) by Kent; McGrew-Hill
- Elements of Chordate Anatomy by Weichert and Presch, 2017, Amazon.in

ZOOACOR06T (Theory, 4 credits= 60 classes): Physiology: Controlling and Coordinating Systems

Unit 1: Tissues **4 classes**

Structure, locations, classification and functions of epithelial tissues, connective tissues, muscular tissues and nerve tissues

Unit 2: Bone and Cartilage **4**

Structure and types of bones and cartilages, Ossification

Unit 3: Nervous System **10**

Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and Neuromuscular junction; Reflex action and its types

Unit 4: Muscular system **10**

Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle fiber

Unit 5: Reproductive System **6**

Histology of testis and ovary; Physiology of Reproduction

Unit 6: Endocrine System **16**

Histology and function of pituitary, thyroid, pancreas and adrenal; Classification of hormones; Mechanism of Hormone action; Signal transduction pathways for Steroidal and Non steroidal hormones; Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system; Placental hormones

ZOOACOR06P (Practicals, 2 credits= 30 classes): Physiology: Controlling and Coordinating Systems) Lab

1. Recording of simple muscle twitch with electrical stimulation (or Virtual)
2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibers and nerve cells
3. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid
4. Microtomy: Preparation of permanent slide of any five (lung, salivary gland, stomach, small intestine, large intestine only) mammalian (white rat) tissues

Text Book:

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Sembulingam K, Sembulingam P. 2012. Essentials of Medical Physiology. 6th Edn. Jaypee.

Or

Ganong's Review of Medical Physiology by Barret; 25th Ed, McGrew-Hill, 2016

Reference Books

1. Cormack DH. 2003. PDQ Histology. B.C. Decker Ins., London.
2. Gunasegaran JP. 2010. A Text book of Histology and a Practical Guide. Elsevier
3. Junqueria LC, Carneiro J. 2005. Basic histology text and atlas.
4. Randall D , Burggren W. 2001. Eckert Animal Physiology by. 4th edition. W. H. Freeman.
5. Ross MH, Pawlina W. 2010. Histology: A Text and Atlas. Sixth Edition. Lippincott Williams & Wilkins.
6. Eroschenko VP. 2008. diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott & Wilkins.

ZOOACOR07T (Theory, 4 credits= 60 classes): Biochemistry

Unit 1: Fundamentals of biochemical reactions and metabolism

Ionization of water, weak acids and bases, buffering and pH changes in living systems

Metabolism: Catabolism and Anabolism, Compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms

Unit 2: Carbohydrates

Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides; Derivatives of Monosachharides

Carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis

Unit 3: Lipids

Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Triacylglycerols, Phospholipids, Sphingolipid, Glycolipids, Steroids, Eicosanoids and terpinoids.

Lipid metabolism: β-oxidation of fatty acids; Fatty acid biosynthesis

Unit 4: Proteins

Amino acids Structure, Classification, General and Electro chemical properties of α-amino acids; Physiological importance of essential and non-essential amino acids

Proteins Bonds stabilizing protein structure; Levels of organization

Protein metabolism: Transamination, Deamination, Urea cycle, Fate of C-skeleton of Glucogenic and Ketogenic amino acids

Unit 5: Nucleic Acids

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids

Types of DNA and RNA, Complementarity of DNA, Hypo- Hyperchromaticity of DNA

Outlines of nucleotide metabolism

Unit 6: Enzymes

Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes;

Mechanism of enzyme action; Enzyme kinetics; Derivation of Michaelis-Menten equation, Lineweaver-Burk plot; Factors affecting rate of enzyme-catalyzed reactions;

Enzyme inhibition; Allosteric enzymes and their kinetics; Strategy of enzyme action- Catalytic and Regulatory (Basic concept with one example each)

Unit 7: Oxidative Phosphorylation

Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System

ZOOACOR07P (Practicals, 2 credits= 30 classes): Biochemistry Lab

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.

2. Paper chromatography of amino acids.

3. Quantitative estimation by Lowry Method

4. Demonstration of proteins separation by SDS-PAGE.

5. Study of the enzymatic activity of Trypsin and Lipase.

6. Performing the Acid and Alkaline phosphatase assay from serum/ tissue.

Text Book

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.

Referrences:

1. Principles of Biochemistry by Voet, Pratt and Voet; Wiley International Student Ed. 2012
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
3. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.
4. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2008). Molecular Biology of the Gene, VI Edition, Cold Spring Harbor Lab. Press, Pearson Pub.

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Semester IV

ZOOACOR08T (Theory, 4 credits= 60 classes): Comparative Anatomy

Unit 1: Integumentary System **6 Classes**

Structure, function and derivatives of integument in amphibian, birds and mammals

Unit 2: Skeletal System **6**

Overview of axial and appendicular skeleton; Jaw suspension; Visceral arches.

Unit 3: Digestive System **8**

Comparative anatomy of stomach; dentition in mammals

Unit 4: Respiratory System **6**
Respiratory organs in fish, amphibian, birds and mammals

Unit 5: Circulatory System **8**
General plan of circulation, Comparative account of heart and aortic arches

Unit 6: Urinogenital System **6**
Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri

Unit 7: Nervous System 6
Comparative account of brain, Cranial nerves in mammals

Unit 8: Sense Organs **4**
Classification of receptors, Brief account of auditory receptors in vertebrate

ZOOACOR08P (Practicals, 2 credits= 30 classes): Comparative Anatomy Lab

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Study of disarticulated skeleton of Toad, Pigeon and Guineapig
3. Demonstration of Carapace and plastron of turtle
4. Identification of mammalian skulls: One herbivorous (Guineapig) and one carnivorous (Dog) animal
5. Dissection of Tilapia: Circulatory system, Brain, pituitary, urinogenital system

Text Book:

1. Comparative Anatomy of the Vertebrates 9th Ed (2015) by Kent; McGrew-Hill
2. Elements of Chordate Anatomy by Weichert and Presch, 2017, Amazon.in

References:

- Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons
- Kardong, K. V. (2002). Vertebrates: Comparative anatomy, function evolution. McGraw Hill 4th Ed. 2005.

ZOOACOR09T (Theory, 4 credits= 60 classes): Physiology: Life Sustaining system

Unit 1: Physiology of Digestion **12**
Structural organisation and functions of Gastrointestinal tract and Associated glands; Mechanical and chemical digestion of food, absorption of Carbohydrates, Lipids, Proteins and Nucleic Acids; Digestive enzymes

Unit 2: Physiology of Respiration **10**
Mechanism of Respiration, Respiratory volumes and capacities, transport of Oxygen and Carbon dioxide in blood, Dissociation curves and the factors influencing it, respiratory pigments; Carbon monoxide poisoning

Unit 3: Physiology of Circulation **12**

Components of Blood and their functions; Structure and functions of haemoglobin; Haemostasis; Blood clotting system, Fibrinolytic system; Haemopoiesis: Basic steps and its regulation; Blood groups; ABO and Rh factor

Unit 4: Physiology of Heart **8**

Structure of mammalian heart, Coronary Circulation, Structure and working of conducting myocardial fibers, Origin and conduction of cardiac impulses; Cardiac Cycle and cardiac output; Blood pressure and its regulation

Unit 5: Thermoregulation & Osmoregulation

Physiological classification based on thermal biology. Thermal biology of endotherms; Osmoregulation in aquatic vertebrates; Extra-renal osmo-regulatory organs in vertebrates

Unit 6: Renal Physiology **8**

Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid-base balance

ZOOACOR09P (Practicals, 2 credits= 30 classes): Animal Physiology: Life Sustaining system Lab

List of Practicals

1. Determination of ABO Blood group
2. Enumeration of red blood cells and white blood cells using haemocytometer
3. Estimation of haemoglobin using Sahli's haemoglobinometer
4. Preparation of haemin and haemochromogen crystals
5. Recording of blood pressure using a sphygmomanometer/digital meter

Text Book:

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Ganong's Review of Medical Physiology by Barret; 25th Ed, McGrew-Hill, 2016

Reference Books

1. Elaine N. Marieb, 2006. Human Anatomy & Physiology, Pearson Education.
2. Eroschenko VP. 2008. diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott & Wilkins.
3. Fox SI. 2011. Human Physiology. 12th Edn. Mc Graw Hill
4. Gunstream SE. 2010. Anatomy and Physiology with integrated study guide. 4th Edn., Mc Graw Hill.
5. Guyton AC, Hall JE. 2006. Textbook of Medical Physiology. XI Edn. Hercourt Asia PTE Ltd. W.B. Saunders Company.
6. Hill RW, Wyse GA, Anderson M. 2012. Animal Physiology. 3rd Edn. Sineuer Associaes.
7. Sembulingam K, Sembulingam P. 2012. Essentials of Medical Physiology. 6th Edn. Jaypee Pub, New Delhi
8. Sherwood L. 2013. Human Physiology from cells to systems. 8th Edn., Brooks & Cole
9. Tortora GJ, Grabowski S. 2006. Principles of Anatomy & Physiology. XI Edition John Wiley & son
10. Vander A, Sherman J, Luciano D. 2014. Vander's Human Physiology: The Mechanism of Body Function. XIII Edn. McGraw Hills

ZOOACOR10T (Theory, 4 credits= 60 classes): Immunology

Unit 1: Overview of Immune System 4

Basic concepts of health and diseases, Historical perspective of Immunology,
Organs (Primary & Secondary lymphoid organs and its importance) and Cells of the Immune system,
Concept of Haematopoiesis and development of progenitor cells of the Immune system (Brief idea)

Unit 2: Innate and Adaptive Immunity 6

Principle of Innate and Adaptive Immunity.

- Components of innate immunity
  - Epithelial barriers (skin and mucosal membranes [concept])
  - Cellular mechanisms (phagocytes, NK cells, mast cells, eosinophils, inflammation [concept])
  - Humoral mechanisms (complement, cytokines, chemokines etc. [concept])

- Components of adaptive immunity
  - Cellular mechanisms (Cell-Mediated Immune System (CMIS) or T-Cell Immunity [concept])
  - Humoral mechanisms (Formation of Plasma B cells and Memory B cells [concept])

6

Unit 3: Antigen, Antigen presentation & MHC

Concept of Antigen, Immunogen, Allergen & Pathogen.
Adjuvants and haptens, Factors influencing immunogenicity, Epitope.
Types of Antigen Presenting Cells (APC),
Structure of Major Histocompatibility Complex (MHC) molecules.
Mechanism of antigen presentation and involvement of MHC molecules (both MHC-I & MHC-II) in details.
Co-stimulatory molecules on APC.

6

Unit 3: T Cell development

Structure of T cell receptors, Co-stimulatory molecules on T cells
Concept of synapse between APC & T cells (between MHC≈TCR & between Co-stimulatory molecules) in details.
Central differentiation of T cells; T cell selection in thymus
Peripheral differentiation of T cells; Th1 & Th2

6

Unit 4: Immunoglobulins

Structure and functions of different classes of immunoglobulins, Antigen- antibody interactions, Immunoassays (ELISA and RIA), Hybridoma technology, Monoclonal antibody production

Unit 6: Cytokines & Chemokines 4

Brief concept on types of Cytokines & Chemokines
Cytokines (source & function of IL-1, IL-2, IL-4, IL-5, IL-6, IL-8, IL-10, IL-12, Interferons, Tumor Necrosis Factors, Tumor Growth Factors, GM-CSF, M-CSF).
Chemokines **(**source & function of CCL2, CCL3, CCL4, CCL5, CxCL8, CxCL10)

Unit 7: Complement System **4**
Components and pathways of complement activation.

Unit 8: Hypersensitivity **4**
Gell and Coombs' classification and brief description of various types of hypersensitivities.

Unit 9: Immunology of diseases 6
Malaria, Visceral Leishmaniasis, Filariasis, Dengue and Tuberculosis

Unit 10: Vaccines 4
Various types of vaccines. Active & passive immunization (Artificial and natural).

ZOOACOR10P (Practicals, 2 credits= 30 classes): Immunology Lab

List of Practical
1. Demonstration of lymphoid organs.
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of blood cells.
4. ABO blood group determination.
5. Demonstration of ELISA using kit.

(The experiments can be performed on white rats).

Text Book

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication

Reference Books

- Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.
- Abbas, K. Abul and Lechtman H. Andrew (2003.) Basic Immunology E-Book: Functions and Disorders of the Immune System; 2012 Saunders Publication

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Semester V

ZOOACOR11T (Practicals, 2 credits= 30 classes): Molecular Biology Lab

Unit 1: Nucleic Acids
Salient features of DNA and RNA Watson and Crick Model of DNA

Unit 2: DNA Replication
Mechanism of DNA Replication in Prokaryotes, Semi-conservative, bidirectional and discontinuous Replication, RNA priming, Replication of telomeres

Unit 3: Transcription
Mechanism of Transcription in prokaryotes and eukaryotes, Transcription factors, Difference between prokaryotic and eukaryotic transcription.

Unit 4: Translation
Mechanism of protein synthesis in prokaryotes, Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation

Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA
Capping and Poly A tail formation in mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA

Unit 6: Gene Regulation
Regulation of Transcription in prokaryotes: lac operon and trp operon; Regulation of Transcription in eukaryotes: Activators, enhancers, silencer, repressors, miRNA mediated gene silencing, Genetic imprinting

Unit 7: DNA Repair Mechanisms
Types of DNA repair mechanisms, RecBCD model in prokaryotes, nucleotide and base excision repair, SOS repair

Unit 8: Molecular Lab Techniques
PCR, Western and Southern blot, Northern Blot, Sanger DNA sequencing , cDNA technology

ZOOACOR11P (Practicals, 2 credits= 30 classes): Molecular Biology Lab

List of Practicals
1. Demonstration of polytene Chromosome from Drosophila /Chironomid larvae
2. Isolation and quantification of genomic DNA using spectrophotometer (A260 measurement)
3. Agarose gel electrophoresis for DNA

Text Book:
1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Molecular Biology of The Gene by Watson. 7th Edition. Pearson.

References:
- Molecular Cell Biology by Harvey Lodish. 7th Edition. W.H. Freeman.
- iGenetics: A Molecular Approach by Peter. J. Russell. 3rd edition. Pearson Benjamin Cummings.
- Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson and John Walker, Cambridge Univ. Press, Paperback

ZOOACOR12T (Theory, 4 credits= 60 classes): Genetics

Unit 1: Mendelian Genetics and its Extension
Background of Mendel's experiments
Principles of Mendelian inheritance,

Incomplete dominance and co-dominance, Epistasis, Multiple alleles, Lethal alleles, Pleiotropy, Sex-linked, sex- influenced and sex-limited inheritance, Polygenic Inheritance.

Unit 2: Linkage, Crossing Over and Chromosomal Mapping
Linkage and Crossing Over, molecular basis of crossing over, Measuring Recombination frequency and linkage intensity using three factor crosses, Interference and coincidence

Unit 3: Mutations
1. Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example of each), Chromosomal aberrations, gene mutations and human diseases (Down's, Klienfelter's, Turner's, Cri du Chat, Sickle cell, Haemophilia, Thallassimia, Albinism – only genetical aspects here, details of physiological consequences not required), Sex chromosomes and sex-linked inheritance
2. Non-disjunction and variation in chromosome number; Molecular basis of mutations in relation to UV light and chemical mutagens

Unit 4: Sex Determination
Mechanisms of sex determination in Drosophila with reference to alternative splicing
Sex determination in mammals
Dosage compensation in Drosophila & Human

Unit 5: Extra-chromosomal Inheritance
Criteria for extra chromosomal inheritance, Antibiotic resistance in Chlamyadomonas, Kappa particle in Paramoecium Shell spiralling in snail

Unit 6: Recombination in Bacteria and Viruses
Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

Unit 7: Transposable Genetic Elements
Transposons in bacteria,
Ac-Ds elements in maize and P elements in Drosophila,
LINE, SINE, Alu elements in humans

ZOOACOR12P (Practicals, 2 credits= 30 classes): Genetics

List of Practical

1. Chi-square analyses
   Statistical tests of data and decision making
   Chi square test for goodness of fit and student t test for comparing means of two small samples from normal populations (paired/unpaired)

2. Pedigree analysis of some inherited traits in human

3. Identification of chromosomal aberration in Drosophila from photographs

Text Book

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Principles of Genetics by Robert Tamarin; McGraw Hill, 7th Ed. 2017
   Or
   Principles of Genetics by Snustad, D.P., Simmons, M.J. (2009). 5th Ed. John Wiley and Sons Inc

Reference Books

- Developmental biology by Scott. F. Gilbert, 9th edition.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings
- Russell, P. J. (2009). Genetics- A Molecular Approach.III Edition. Benjamin Cummings

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Semester VI

ZOOACOR13T (Theory, 4 credits= 60 classes): Developmental Biology

Unit 1: Introduction 2

Basic concepts: Phases of Development, Cell-cell interaction, Differentiation and growth, Differential gene expression

Unit 2: Early Embryonic Development 20

Gametogenesis, Spermatogenesis, Oogenesis;
Types of eggs, Egg membranes;
Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula;
Fate maps (including Techniques);
Early development of frog and chick up to gastrulation; Embryonic induction and organizers

Unit 3: Late Embryonic Development 8

Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)

Unit 4: Post Embryonic Development 12

Development of brain and Eye in Vertebrate Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each)

Unit 5: Implications of Developmental Biology 8

Teratogenesis: Teratogenic agents and their effects on embryonic development;
In vitro fertilization, Stem cell (ESC), Amniocentesis

ZOOACOR13P (Practicals, 2 credits= 30 classes): Developmental Biology Lab

List of Practical

1. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)

2. Study of the developmental stages and life cycle of Drosophila from stock culture

3. Study of different sections of placenta (microphotographs/ slides)

4. Project report on Drosophila culture/chick embryo development

Text Book:

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Developmental Biology by Gilbert, S. F. (2010), IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA

References:

- Principles of Development by Wolpert and Beddington; OUP Oxford, 2nd Ed., 2001
- Essential Developmental Biology by Slack JMW; 3rd Ed., Wiley

ZOOACOR14T (Theory, 4 credits= 60 classes): Evolutionary Biology

Unit 1: Oigin of earliest life 5

Chemogeny, RNA world, Biogeny, Origin of photosynthesis,
Evolution of eukaryotes, three domains of life

Unit 2: Historical review of evolutionary concept 7

Pre-Darwinian Concepts and theories including Lamarckism,
Darwininan Theory
Neo-Darwinian Synthesis
Anti-evolutionary ideas of Creationism and their scientific refusal

Unit 3: Evidences in favour of Evolution 4

Fossil records: types of fossils, geological time scale, transitional forms: examples of fossils depicting the evolutionary stages of the modern horses
Molecular (universality of genetic code and protein synthesis machinery) evidences

Unit 4: Sources of variations 3

Heritable variations present in natural populations (classical study of Lewontin and Hubby, 1966 in Drosphila, as example)

Unit 5: Population genetics: 16

Concept of Populations and calculation of allele frequencies in a population
Hardy-Weinberg Law and equilibrium (derivations, applications of law to find gene and genotype frequencies in human Populations)
Evolutionary forces disrupting H-W equilibrium-
Natural selection: Definition as the non-differential rate of reproductions and survivals of competing alleles, concept of fitness, selection coefficient, Types of natural selection with examples- Disrupting, Stabilizing, Directional.
Genetic Drift- outline of its mechanism, basic concepts and examples of founder's effect, bottleneck phenomenon;
Role of Gene flow and Mutation rates in changing allele frequencies in a population (No mathematical models)

Unit 6: Products of evolution 10

Inter-population variations: clines, races, Species concepts and modes of speciation (just outlines of Allopatric, Sympatric and Parapatric speciation models with examples), Isolating mechanisms
Adaptive radiations/ macroevolution as exemplified by Galapagos finches

Unit 7: Extinctions 2

Major mass extinctions in the history of life and their impacts on biodiversity on earth (brief descriptions)

Unit 8: Origin and evolution of man 6

Unique hominin characteristics contrasted with primate characteristics (including social and cultural ones),

Primate phylogeny: from Dryopithecus leading to Homo sapiens,
Molecular evidences of human origin and migrations (brief outline)

Unit 8: Molecular Phylogeny 7

The basic concept of molecular phylogeny, Neutral theory of molecular evolution, molecular clock (brief introductions)
Example of evolution in vertebrate globin genes

ZOOACOR14P (Practicals, 2 credits= 30 classes): Evolutionary Biology Lab

List of Practicals

1. Study of fossils from models/ photographs- Direct ancestors of horses, Archaeopteryx

2. Study of homology and analogy from suitable specimens (from Photographs/models)

3. Verification of Hardy-Weinberg equilibrium in a population by chi square analysis

5. Collection of a sample of height, weight, age, sex data from at least 100 individuals and applying of different statistical analyses (frequency distribution, mean, mode, standard deviations, correlations, etc) and graphical representations.

Text Book:

1. Campbell's Biology, 11th Edition by Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky, Jane B. Reece , Published by Pearson Copyright © 2017.
2. Evolution by Ridley,M. 3rd Ed.(2004) Blackwell publishing
   Or
   Evolutionary Biology Douglas, J. Futuyma (1997); Sinauer Associates

Reference:

- Evolution by Barton et al, 1st Ed. 2007 Cold Spring Harbor Lab Press
- Why Evolution is True by Jerry Coyne; 2010, Penguin India
- Strickberger's Evolution by Hall and Halgrimmson; 5th Revised Ed., 2013, Jones and Bartlett,

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DSE: DISCIPLINE SPECIFIC ELECTIVE Courses

Semester V

(any two courses to be credited for honours)

ZOOADSE01T (Theory 4 Credits = 60 classes): Animal Behaviour and Chronobiology

Unit 1: Introduction to Animal Behaviour

1. A brief history of animal behaviour studies including the works of Fabre, Darwin, Von Frisch, Lorenz, Tinbergen, Jane Goodal, Biruté Galdikas, Dian Fossey, Salim Ali, Gopal Bhattacharyya, M. K. Chandrashekhar, Raghavendra Gadagkar.
2. The objectives of modern animal behaviour studies: Tinbergen's four questions.

3. Methods of studying behaviours: Observation vs Watching, Ad libitum observations, Focal animal studies, Instantaneous scan, etc.
4. Branches of Animal Behaviour Studies

Unit 2: Behaviours of Individuals

1. Reflexes and Orientations
2. Instinct
3. Learning: Imprinting and other Programmed Learning, Habituation, Innovations and Cultural Transmission / Social Learning

Unit 3: Social and Sexual Behaviour

1. Social Behaviour: Concept of Sociality, Types of animal Society with examples, Altruism
2. Communications in animals- different types (e.g. pheromones, visuals, tactile, acoustics, etc) with common examples
3. Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance.
4. Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

Unit 4: Introduction to Chronobiology

1. Historical developments in chronobiology;
2. Biological oscillation: the concept of Average, amplitude, phase and period
3. Adaptive significance of biological clocks

Unit 5: Biological Rhythm

1. Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms;
2. Concept of synchronization and masking; Photic and non-photic zeitgebers; Circannual rhythms;
3. Photoperiod and regulation of seasonal reproduction of vertebrates;Role of melatonin.

ZOOADSE01P (Practical, 2 Credits=60 Classes): Animal Behaviour and Chronobiology Lab

List of Practical

1. To study nests (non-invasively) and nesting habits of the birds and social insects (e.g. Social Wasps) .
2. To study the behavioural responses of rice weevil /wood lice to dry and humid conditions.
3. To study geotaxis behaviour in earthworms.
4. To study the phototaxis behaviour in insects/defensive behaviour in mosquito larvae.
5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park (within West Bengal) to study behavioural activities of animals and prepare a short report.
6. Study and actogram construction of locomotor activity of suitable animal models.
7. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

Text Book:

1. Animal Behaviour: Mechanisms. Ecology. Evolution by Drickamar, Vessey, 5th Ed. Jakob; McGraw Hill.
2. Survival Strategies by Raghavendra Gadagkar, University Press

Reference:

- An Introduction to Animal Behaviour by Manning and Dawkins; 5th Ed. Cambridge Univ. Press

- Measuring Behaviour: An Introductory Guide by Martin and Bateson; 3rd Ed.Cambridge Univ. Press
- Introduction to Behavioural Ecology by Krebs and Davies; Wiley-Blackwell

ZOOADSE02T (Theory 4 Credits = 60 classes): Entomology (Insects and their Biology)

Unit 1: Introduction 3
General Features of Insects
Distribution and Success of Insects on the Earth

Unit 2: Insect Diversity and Classifications 15
Classifications of Arthropods with special reference to Insects (Insects are to be classified up to order with estimated species richness of the orders globally, in India and in West Bengal. Conspicuous/important families/Genera/species of each order have to be noted with their peculiar habits and habitats)

Unit 3: General Morphology of Insects (brief outlines) 10
External Features; Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits
Thorax: Wings and wing types, Types of Legs adapted to diverse habitats, Peculiar Abdominal appendages and genitalia - only brief introduction.

Unit 4: Physiology of Insects 10
Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system (brief outlines only)
Photoreceptors: Types, Structure and Function (brief introductions)
Metamorphosis: Types and Neuroendocrine control of metamorphosis (introductory)

Unit 5: Insect Society 10
Social insects: different types of social insects with brief outlines of their social systems
Trophallaxis in social insects such as ants, termites and bees

Unit 6: Insect Plant Interaction 8
Outline of the concept of co-evolution, role of allo-chemicals in host plant mediation, Host-plant selection by phytophagous insects; Major insect pests in paddy (brief introductions)

Unit 7: Insects as Vectors 5
Insects as mechanical and biological vectors, Brief discussion on houseflies and mosquitoes as important vectors

ZOOADSE02P (Practical, 2 Credit=60 Classes): Biology of Insects Lab

List of Practical

1. Study of life cycle of Mosquito
2. Study of different kinds of antennae, legs and mouth parts of insects (any three variants of each)
3. Mounting of insect wings, spiracles and genitalia of any insect
4. Methodology of collection, preservation and identification of insects.
5. Morphological studies of various castes of *Apis*, *Camponotus*, any Termite *(e,g, Odontotermes*) 1

6. Study of major insect pests of paddy and their damages
7. Study of Mulberry silk moth as beneficial insect

Text Book:

1. The Insects: Structure and function, Chapman, R. F., Cambridge University Press,
2. A general text book of entomology, Imms , A. D., Chapman & Hall,

References

- Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
- Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA
- The Insect Societies, Wilson, E. O., Harward Univ. Press, UK
- Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA
- Physiological system in Insects, Klowden, M. J., Academic Press, USA
- Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA
- Medical Entomology, Hati A. K., Allied Book Agency, 2010

ZOOADSE03T (Theory, 4 Credit=60 Classes): Endocrinology

Unit 1: Introduction to Endocrinology **4**

General idea of Endocrine systems, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones

Unit 2: Epiphysis, Hypothalamo-hypophysial Axis **16**

Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction; Structure and functions of hypothalamus and Hypothalamic nuclei, Regulation of neuroendocrine glands, Feedback mechanisms; Structure of pituitary gland, Hormones and their functions, Hypothalamo-hypophysial portal system, Disorders of pituitary gland.

Unit 3: Peripheral Endocrine Glands **16**

Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis; Hormones in homeostasis, Disorders of endocrine glands

Unit 4: Regulation of Hormone Action **14**

Mechanism of action of steroidal, non-steroidal hormones with receptors Bioassays of hormones using RIA & ELISA; Estrous cycle in rat and menstrual cycle in human; Multifaceted role of Vasopressin & Oxytocin; Hormonal regulation of parturition

ZOOADSE03T (Practical, 2 Credit=60 Classes): Endocrinology Lab

List of Practical

1. Dissect and display of Endocrine glands in rat.
2. Study of the permanent slides of all the endocrine glands
3. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland
4. Estimation of plasma level of any hormone using ELISA
5. Designing of primers of any hormone

Text Book:

1. Hall JE. 2015. Guyton and Hall Textbook of Medical Physiology. 13th Edition. Saunders publication.
2. Ross MH, Pawlina W. 2010. Histology: A Text and Atlas. Sixth Edition. Lippincott Williams and Wilkins.

3. Norris DO, Carr JA. 2013. Vertebrate Endocrinology. 5 editions Academic Press;

References:

4. Fox T, Brooks A, Baidya B. 2015. Endocrinology. JP Medical, London.
5. Gardner DG, Shoback D. 2011. Greenspan's Basic and Clinical Endocrinology. 9th Edn. McGraw Hill Lange.
6. Goodman HM. 2000. Basic Medical Endocrinology. 4th Edn. Academic Press.
7. Jameson JL. 2010. Harrison's Endocrinology. 2nd Edn. McGraw Hill.
8. Melmed S, Conn PM. 2005. Endocrinology: Basic and Clinical Principles. 2nd Edn. Humana Press.
9. Melmed S, Polonsky K, Larsen PR, Kronenberg H. 2016. William's Text Book of Endocrinology. 13th Edn. Elsevier.
10. Molina PE. 2013. Endocrine Physiology. 4th Edn. McGraw Hill Lange.
11. Neal JM. 2000. Basic Endocrinology; An Interactive Approach. Blackwell Science.
12. Norris DO. 2007. Vertebrate Endocrinology. 4th Edn. Elsevier Academic Press.
13. Strauss JF, Barbieri RL. 2014. Yen & Jaffe's Reproductive Endocrinology. Elsevier Sounders

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Semester VI

(Any two courses to be credited for honours)

ZOOADSE04T (Theory 4 Credits = 60 classes): Fish and Fishery

Unit 1: Introduction and Classification **4**

General description of fish

Feeding habit, habitat and manner of reproduction

Classification of fish (up to Subclasses) with important examples

14

Unit 2: Morphology and Physiology

Types of fins and their modifications; Locomotion in fish; Hydrodynamics; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fish); Electric organ, Bioluminescence

10

Unit 3: Fisheries

Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears; Depletion of fishery resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations

16

Unit 4: Aquaculture

Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products

Unit 5: Fish in research 6

Transgenic fish, Zebra fish as a model organism in research

ZOOADSE04P (Practical, Credits = 60 classes): Fish and Fishery

List of Practical

1. Morphometric and meristic characters of fishes in relation to identifications of species (with locally cultured non-indigenous fishes)
2. Study of external salient features in Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Gambusia, Labeo, *Heteropneustes*, *Anabas* (all from photographs)
3. Study of different types of scales (through permanent slides/ photographs).
4. Study of crafts and gears used in Fisheries
5. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
6. Study of air breathing organs in Channa, Heteropneustes, Anabas and Clarias
7. Project Report on a visit to any fish farm/ pisciculture unit/Zebra fish rearing Lab.

Text Book:

Q. Bone and R. Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.

Reference

- D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press,
- von der Emde, R.J. Mogdans and B.G. Kapoor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands
- C.B.L. Srivastava, Fish Biology, Narendra Publishing House
- J.R. Norman, A history of Fishes, Hill and Wang Publishers
- S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House
- Chaudhuri, S. (2017), Economic Zoology. New Central Book Agency

ZOOADSE05T (Theory, 4 Credits = 60 classes): Parasitology

Unit 1: Introduction to Parasitology 3

Brief introduction of Parasitism and other animal associations, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship and zoonosis

Unit 2: Parasitic Protists 15

15 Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica*, *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani*, *Plasmodium vivax* , *Plasmodum falciparum and Toxoplasma gondii*

Unit 3: Parasitic Platyhelminthes 15

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciola hepatica*, *Paragonimus westermani*, *Schistosoma haematobium*, *Taenia solium* , *Echinococcus granulosus* and *Hymenolepis nana*

Unit 3: Parasitic Nematodes **15**

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti* and *Trichinella spiralis*. Study of structure, life cycle and importance of Meloidogyne (root knot nematode), Pratylencus (lesion nematode)

Unit 4: Parasitic Arthropoda **3**

Mosquitoes and flies as vectors of human pathogen
Biology,importance and control of myiasis causing diptera
Biology, importance and control of ticks, mites, *Pediculus humanus* (head and body louse), *Xenopsylla cheopis* and *Cimex lectularius*

Unit 6: Parasitic Vertebrates **2**

A brief account of parasitic vertebrates; Cookiecutter Shark, Candiru, Hood Mockingbird and Vampire bat

ZOOADSE05P (Practical, 2 Credits = 60 classes): Parasitology

List of Practicals

- Study of life stages of *Entamoeba histolytica, Giardia intestinalis, Trypanosoma gambiense, Leishmania donovani* and *Plasmodium vivax* through permanent slides/micro photographs
- Study of adult and life stages *of Fasciola hepatica, Schistosoma haematobium, Taenia solium* and *Hymenolepis nana* through permanent slides/micro photographs
- Study of adult and life stages of *Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti* and *Trichinella spiralis* through permanent slides/micro photographs .
- Study of plant parasitic root knot nematode, Meloidogyne from the soil sample
- Study of *Pediculus humanus* (Head louse and Body louse), *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/ photographs
- Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]
- Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by product]

Text Book:

Chatterjee K.D. (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd

References:

- Bose, M.(2017). Parasitoses and Zoonoses. New Central Book Agency(P) Ltd
- Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
- Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers
- Noble, E.R. and Noble G.A. (1982) Parasitology: The biology of animal parasites. V Edition, Lea & Febiger
- Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
- Rattan Lal, Ichhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi

ZOOADSE06T (Theory, 4 Credits = 60 classes): Wildlife and Conservation

Unit 1: Introduction to Wild Life **5**
Values of wild life; Importance of conservation;
Causes of depletion of Wildlife in India;

Unit 2: Evaluation and management of wild life **12**
Forest habitats: major forest types of India and West Bengal
Forest covers estimation: remote sensing and GIS

Unit 3: Management of habitats **8**
Management of Successional wild habitats
Forest fire
Restoration of degraded wild habitats
(The above topics should be learnt mostly in reference to the protected areas in West Bengal)

Unit 4: Population estimation **10**
Population and population density estimations: different methods in practice
Sex Ratio computation and Fertility status

Unit 5: Wildlife conservation practices in India **5**
Traditional Conservation ethics and practices in India
Conservation strategies and Practices: Wildlife Acts (IUCN, WPA of India, CITES etc)

Unit 6: Management planning of wild life in protected areas **5**
Estimation of carrying capacity; Eco tourism / wild life tourism in forests;
Concept of climax persistence; Ecology of perturbence.

Unit 7: Man and Wildlife **5**
Causes and consequences of human-wildlife conflicts;
Mitigation of conflict – an overview;
Wildlife/Ecotourism advantages and disadvantages

Unit 8: Protected areas **10**
Major wildlife areas in India (all from West Bengal): Sanctuaries, National Parks, Tiger and other Wildlife Reserves, Biosphere reserves, etc.
Community reserve: concepts and examples
Management challenges in Tiger reserve

ZOOADSE06P (Practical, 2 Credits = 60 classes): Wildlife and Conservation

List of Practicals

1. Identification of common local flora, mammalian fauna, avian fauna, herpeto-fauna
2. Demonstration of basic equipments needed in wildlife studies use, care and maintenance (Compass, Binoculars, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, etc.
4. Demonstration of different field techniques for flora and fauna

5. Quadrat and other methods for ground cover assessment, Height-Girth relationships in trees, Canopy cover assessment in a patch of vegetations.
6. Trail / transect monitoring for abundance and diversity estimation of mammals and birds, butterflies (direct and indirect evidences)

Text Book:

1. Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.
2. Conservation Biology: A Primer for South Asia by Kamaljit S. Bawa, Meera Anna Oommen, and Richard B. Primack, Atree and University Press

References:

1. Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Coexistence? Cambridge University.
2. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5 th edition. The Wildlife Society, Allen Press.
3. Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
4. Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.

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General Electives

[GEC offered by the Dep. of Zoology are for the students studying with other (i.e. not offered by the dept .of Zoology) honours level core courses]

Same as offered as core courses for the BSc general students

ZOOHGEC01T: Animal Diversity	
Theory (Credits 4)	**Class**
Unit-1 Kingdom Protista	
General characters and classification of Subkingdom Protozoa up to Phylum (Levine et al., 1980); Locomotory Organelles and locomotion in Protozoa	**3**
Unit-2 Phylum Porifera	
General characters and classification up to classes; Canal System in *Sycon*	**3**
Unit-3 Phylum Cnidaria	
General characters and classification up to classes; Polymorphism in Hydrozoa	**3**
Unit-4 Phylum Platyhelminthes	
General characters and classification up to classes; Life history of *Taenia solium*	**3**
Unit-5 Phylum Nematoda	
General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations	**3**
Unit-6 Phylum Annelida	
General characters and classification up to classes; Nephridia in Annelida	**3**
Unit 7 Phylum Arthropoda	
General characters and classification up to classes; Vision in insect, Metamorphosis in Insects	**5**
Unit-8 Phylum Mollusca	
General characters and classification up to classes; Respiration in *Pila*	**3**
Unit-9 Phylum Echinodermata	

General characters and classification up to classes; Water-vascular system in *Asterias*	**4**
Unit-10 Protochordates	
General features; Feeding in *Branchiostoma*	**2**
Unit-11 Agnatha	
General features and classification up to classes (Young, 1981)	**2**
Unit-12 Pisces	
General features and Classification up to Subclasses (Romer, 1959); Osmoregulation in Fishes	**3**
Unit-13 Amphibia	
General features and Classification up to living orders (Duellman & Trueb, 1986); Metamorphosis in Toad	**3**
Unit-14 Reptiles	
General features and Classification up to living Subclass (Young, 1981); Poisonous and non-poisonous snakes, Biting mechanism in snakes	**4**
Unit-15 Aves	
General features and Classification up to orders (Young, 1981); Flight adaptations in birds	**3**
Unit-16 Mammals	
Classification up to Subclasses (Young, 1981); Origin & distribution of Cranial nerves in *Cavia*	**3**

Suggested Readings [Consult Latest Editions]

1. Barnes, R. D. & Ruppert, E. E., (1994). Invertebrate Zoology. 6thEd. Brooks Cole.
2. Brusca, R. C. & Brusca, G. J. (2002). Invertebrates. 4th Ed. Sinauer Associates.
3. Kardong, K.V. (2002). Vertebrates: Comparative anatomy, function evolution. Tata McGraw Hill.
4. Kent, G.C. & Carr, R.K. (2001). Comparative anatomy of theVertebrates. 9thEd. McGraw Hill.
5. Romer, A.S. & Parsons,T.S.(1986).The vertebrate body. 6thEd. Saunders College Pub.
6. Ruppert E. E., Fox, R. & Barnes R. D. (2003). Invertebrate Zoology: a Functional Evolutionary Approach. 7th Ed. Brooks Cole.
7. Young,J. Z.(2004).The Life of Vertebrates. III Edition. Oxford university press.

ZOOHGEC01P: Animal Diversity Lab (Credits 2)

1. Spot identification of the following specimens:

Amoeba, *Euglena, Plasmodium, Paramecium, Sycon*, *Euspongia,, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taenia solium,* Male and female *Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer*, *Limulus*, *Palamnaeus, Scolopendra*, *Julus*, *Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria* and *Antedon, Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis, Passer, Psittacula, Alcedo*, *Sorex*, *Pteropus*, *Funambulus, Suncus*

2. Study of the following permanent slides: Transverse section of male and female *Ascaris*
3. Identification of poisonous and non-poisonous snakes
4. An "animal album" containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

Suggested Readings:

1. Chatterjee and Chatterjee: Practical Zoology
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata

ZOOHGEC02T, Physiology and Biochemistry	
Theory (Credits 4)	**Class**
Unit-1 Nerve and muscle	**8**
1. Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres. **2.** Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction.	
Unit-2 Digestion	**5**
Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids	
Unit-3 Respiration	**5**

Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood	
Unit-4 Excretion	**5**
Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism	
Unit-5 Cardiovascular system	**6**
Composition of blood, Homeostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle	
Unit-6 Reproduction and Endocrine Glands	**7**
Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle. Structure and function of pituitary, thyroid, pancreas and adrenal	
Unit 7 Carbohydrate: Structure and Metabolism	**8**
Introduction to Carbohydrates, Structure & Types of Carbohydrates, Isomerism, Introduction to Intermediary metabolism: Glycolysis, Krebs cycle, Pentose phosphate pathway, Gluconeogenesis, Electron transport chain	
Unit-8 Lipid: Structure and Metabolism	**5**
Introduction to Lipids: Definitions; fats and oils; classes of lipids; Lipoproteins; Biosynthesis and β oxidation of palmitic acid	
Unit-9 Protein: Structure and metabolism	**5**
Proteins and their biological functions, functions of amino acids, physicochemical properties of amino acids. Peptides – structure and properties; primary structure of protein, secondary, tertiary and quaternary structures. Transamination, Deamination and Urea Cycle.	
Unit-10 Enzymes	**4**
Introduction, Classification of Enzymes, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation	
Suggested Readings 1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edn. W.H Freeman & Co. 2. Chatterjea, MN and Shinde, R (2012) . A Textbook of Medical Biochemistry. 8th Edn. Jaypee Pub., N.Delhi 3. Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company 4. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). Harper'sIllustrated Biochemistry. XXVIII Edition. Lange Medical Books/Mc Graw3Hill. 5. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co. 6. Sherwood, L. (2013). Human Physiology from cells to systems. 8th Edn., Brooks & Cole 7. Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc. 8. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology, XI Edition., McGraw Hill 9. Elaine N. Marieb, 2006. Human Anatomy & Physiology, Pearson Education.	
ZOOHGEC02P: Physiology and Biochemistry Lab (Credits 2) 1. Preparation of haemin crystals 2. Identification of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland, small intestine, liver, lung, kidney 3. Qualitative tests to identify functional groups of carbohydrates in given solutions: Glucose (Benedict's test),Sucrose (Iodine test) 4. Quantitative estimation of total protein in given solutions by Lowry's method. 5. Study of activity of salivary amylase under optimum conditions.	

ZOOHGEC03T: Insect, Vectors and Diseases	
Theory (Credits 4)	**Class**
Unit-1 Introduction to Insects	**6**
General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts with respect to feeding habit	
Unit-2 Concept of Vectors	**6**
Brief introduction to Vectors (mechanical and biological), Reservoirs, Host-vector relationship, Adaptations	

as vectors, Host specificity	
Unit-3 Insects as Vectors	**8**
Detailed features of insect orders as vectors – Diptera, Siphonoptera, Siphunculata, Hemiptera	
Unit-4 Dipteran as Disease Vectors	**14**
Study of important Dipteran vectors – Mosquitoes, Sand fly, Houseflies Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis Control of mosquitoes	
Unit-5 Siphonaptera as Disease Vectors	**6**
Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas	
Unit-6 Siphunculata as Disease Vectors	**4**
Human louse (Head, Body and Pubic louse) as important insect vectors; Control of human louse	
Ùnit-7 Hempitera as Disease Vectors	**6**
Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures	

ZOOHGEC03P: Insect Vectors and Diseases Lab (Credits 2)

List of Practical

1. Mounting and Study of different kinds of mouth parts of insects
2. Spot identification of following insect vectors through permanent slides/photographs:*Aedes*,*Culex*,*Anopheles*, *Pediculus humanuscapitis*, *Pediculus humanuscorporis*, *Phithiruspubis*, *Xenopsylla cheopis*, *Cimex lectularius*, *Phlebotomus argentipes*, *Musca domestica*
3. Study of different diseases transmitted by above insect vectors
4. Submission of a project report on any one of the insect vectors and disease transmitted

Suggested Readings

1. Anathakrishnan : Bio resources Ecology 3rdEdition
2. Goldman : Limnology, 2ndEdition
3. Odum and Barrett : Fundamentals of Ecology, 5thEdition
4. Pawlowski : Physicochemical Methods for Water and Wastewater Treatment, 1stEdition
5. Trivedi and Goyal : Chemical and biological methods for water pollution studies
6. Welch : Limnology Vols. I-II
7. Wetzel : Limnology, 3rdedition

ZOOHGEC04T , Environment and Public Health	
Theory (Credits 4)	Class
Unit 1: Introduction	
Sources of Environmental hazards, Hazard identification and accounting, Fate of toxic and persistent substances in the environment, Dose response evaluation, Exposure assessment	10
Unit 2: Climate Change	
Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health	10
Unit 3: Pollution	
Air, water, noise pollution sources and effects, Pollution control	5
Unit 4: Waste Management Technologies	
Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants.	15
Unit 5: Diseases	
Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid, filariasis	10

Suggested Readings [Consult Latest Editions]

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
3. Kofi Asante Duah "Risk Assessment in Environmental management", John Wiley and sons, Singapore, 1998.
4. Kasperson, J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V. N. University Press, New York, 2003.
5. Joseph F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey 1997.

ZOOHGEC03P: Environment and Public Health Lab (Credits 2)

1. To determine pH, Cl, SO4, NO3 in soil and water samples from different locations.

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Skill Enhancement Course (SEC)

[Offered by the Department of Zoology]

ZOOSSEC001 **(2 credits = 30 classes/hours): Aquarium Fish Keeping** **Class**

Unit 1: Introduction to Aquarium Fish Keeping **6**

The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes , problems of releasing aquarium fishes into natural habitats.

Unit 2: Biology of Aquarium Fishes 10

Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish

Unit 3: Food and feeding of Aquarium fishes 8

Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquarium fish as larval predator

Unit 4: Fish Transportation 3

Live fish transport - Fish handling, packing and forwarding techniques.

Unit 5: Maintenance of Aquarium 3

General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry

ZOOSSEC002 (2 credits = 30 classes/hours): VERMICOMPOST PRODUCTION

1. Natural role of earthworms in soil fertility
2. Concept of Vermicompost- the need for it
3. Productions:
    a. Suitable worm species and their availabity– for Large scale/small scale, Climate and Temperature
4. Feedstock – for small scale or home farming / large scale or commercial
5. Operations and maintenance
    a. Smells
    b. Moisture
    c. Pest species
    d. Worms escaping
    e. Nutrient levels
6. Harvesting
7. Properties of the vermicompost
8. Benefits of vermicompost
9. Use as soil conditioner
10. Applications

Reference and contacts:

- The Complete Technology Book on Vermiculture and Vermicompost by NPCS Board of Consultants and Engineers; Asia Pacific Business Press, 2004
- Vermicompost production training in 24 Parganas- North: http://www.swanirvar.in/help.php
- Audio-visual training material: https://www.google.co.in/search?rlz=1C1CHZL_enIN766IN766&ei=2Kz2Wr6yDoPIvgTLw6aYDQ&q=vermicompost+preparation&oq=vermicompost&gs_l=psy-ab.1.0.0i71k1l8.0.0.0.8499.0.0.0.0.0.0.0.0..0.0....0...1c..64.psy-ab..0.0.0....0.RNrPR98LJOg#kpvalbx=1
- https://www.youtube.com/watch?v=sQKI0Y7fj24
- https://www.youtube.com/watch?v=oGf7Oe7oP4Y
- http://www.ivri.nic.in/services/vermi.aspx

WEST BENGAL STATE UNIVERSITY

DRAFT

SYLLABUS FOR THREE-YEAR DEGREE COURSE IN ZOOLOGY (GENERAL) UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

(With effect from the session 2018-2019)

BSc General with Zoology
(Credit values given within brackets)

Core Courses for Zoology (CC)

Core Course (CC)			
CC- 1A: Animal Diversity	**CC- 1B: Human Physiology and Biochemistry**	**CC- 1C: Insect Vector and diseases**	**CC- 1D: Environment and Public Health**

Choices for Discipline Specific Electives (DSE)

Discipline Specific Elective (DSE) Any Four (2) Course from 1 to 4			
Applied Zoology	**Food Nutrition and Health**	**Aquatic Biology**	**Immunology**

Choices for Skill Enhancement Courses (SEC)

Skill Enhancement Course-1 & Skill Enhancement Course-2, any two course from 4	
Aquarium Fish Keeping	**Vermicompost**

Sem	Core*	DSE	GE	AECC	SEC	Total credits
I	ZOOGCOR01T (4) ZOOGCOR01P (2) **(Animal Diversity)** CEMGCOR01T (4) CEMGCOR01P (2) BOTGCOR01T (4) BOTGCOR01P (2)			ENVSAEC01T (2)		**20**
II	ZOOGCOR02T (4) ZOOGCOR02P (2) **(Human Physiology & Biochemistry)** CEMGCOR02T (4) CEMGCOR02P (2) BOTGCOR02T (4) BOTGCOR02P (2)			ENGSAEC01T (2)		**20**
III	ZOOGCOR03T (4) ZOOGCOR03P (2) **(Insect Vectors and Diseases)** CEMGCOR03T (4) CEMGCOR03P (2) ZOOGCOR03T (4) ZOOGCOR03P (2)				ZOOSSEC01M (2) **(Aquarium Fish Keeping)** **OR** An SEC offered by any other department	**20**
IV	ZOOGCOR04T (4) ZOOGCOR03P (2) **(Environment and Public Health)** CEMGCOR04T (4) CEMGCOR04P (2)				ZOOSSEC02M (2) **Vermicompost Production** **OR** An SEC offered by any other department	**20**

	BOTGCOR04T (4) BOTGCOR04P (2)					
V		ZOOGDSE01T (4) ZOOGDSE01P (2) **(Applied Zoology)** **OR** ZOOGDSE02T (4) ZOOGDSE02P (2) **(Food Nutrition and Health)** ---------- BOTGDSE01T (4) BOTGDSE01P (2) OR BOTGDSE02T (4) BOTGDSE02P (2) ---------- CEMGDSE01T (4) CEMGDSE01P (2) OR CEMGDSE02T (4) CEMGDSE02P (2)			An SEC offered by any other department	**20**
VI		ZOOGDSE03T (4) ZOOGDSE03P (2) **(Aquatic Biology)** OR ZOOGDSE04T (4) ZOOGDSE04P (2) **(Immunology)** ---------- BOTGDSE03T (4) BOTGDSE03P (2) OR BOTGDSE04T (4) BOTGDSE04P (2) ---------- CEMGDSE03T (4) CEMGDSE03P (2) OR CEMGDSE04T (4) CEMGDSE04P (2)			An SEC offered by any other department	**20**
Total number of	**12**	**6**	**0**	**2**	**4**	**120**

Core Courses for Zoology (CC)

ZOOGCOR01T: Animal Diversity	
Theory (Credits 4)	**Class**
Unit-1 Kingdom Protista	
General characters and classification of Subkingdom Protozoa up to Phylum (Levine et al., 1980); Locomotory Organelles and locomotion in Protozoa	**3**
Unit-2 Phylum Porifera	
General characters and classification up to classes; Canal System in *Sycon*	**3**
Unit-3 Phylum Cnidaria	
General characters and classification up to classes; Polymorphism in Hydrozoa	**3**
Unit-4 Phylum Platyhelminthes	
General characters and classification up to classes; Life history of *Taenia solium*	**3**
Unit-5 Phylum Nematoda	
General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations	**3**
Unit-6 Phylum Annelida	
General characters and classification up to classes; Nephridia in Annelida	**3**
Unit 7 Phylum Arthropoda	
General characters and classification up to classes; Vision in insect, Metamorphosis in Insects	**5**
Unit-8 Phylum Mollusca	
General characters and classification up to classes; Respiration in *Pila*	**3**
Unit-9 Phylum Echinodermata	
General characters and classification up to classes; Water-vascular system in *Asterias*	**4**
Unit-10 Protochordates	
General features; Feeding in *Branchiostoma*	**2**
Unit-11 Agnatha	
General features and classification up to classes (Young, 1981)	**2**
Unit-12 Pisces	
General features and Classification up to Subclasses (Romer, 1959); Osmoregulation in Fishes	**3**
Unit-13 Amphibia	
General features and Classification up to living orders (Duellman & Trueb, 1986); Metamorphosis in Toad	**3**
Unit-14 Reptiles	
General features and Classification up to living Subclass (Young, 1981); Poisonous and non-poisonous snakes, Biting mechanism in snakes	**4**
Unit-15 Aves	
General features and Classification up to orders (Young, 1981); Flight adaptations in birds	**3**
Unit-16 Mammals	
Classification up to Subclasses (Young, 1981); Origin & distribution of Cranial nerves in *Cavia*	**3**

Suggested Readings [Consult Latest Editions]

1. Barnes, R. D. & Ruppert, E. E., (1994). Invertebrate Zoology. 6thEd. Brooks Cole.
2. Brusca, R. C. & Brusca, G. J. (2002). Invertebrates. 4th Ed. Sinauer Associates.
3. Kardong, K.V. (2002). Vertebrates: Comparative anatomy, function evolution. Tata McGraw Hill.
4. Kent, G.C. & Carr, R.K. (2001). Comparative anatomy of theVertebrates. 9thEd. McGraw Hill.
5. Romer, A.S. & Parsons,T.S.(1986).The vertebrate body. 6thEd. Saunders College Pub.
6. Ruppert E. E., Fox, R. & Barnes R. D. (2003). Invertebrate Zoology: a Functional Evolutionary Approach. 7th Ed. Brooks Cole.
7. Young,J. Z.(2004).The Life of Vertebrates. III Edition. Oxford university press.

ZOOGCOR01P: Animal Diversity Lab (Credits 2)

1. Spot identification of the following specimens:

Amoeba, *Euglena, Plasmodium, Paramecium, Sycon*, *Euspongia,, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taenia solium,* Male and female *Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer*, *Limulus*, *Palamnaeus, Scolopendra*, *Julus*, *Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria* and *Antedon, Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis, Passer, Psittacula, Alcedo*,

Sorex, *Pteropus*, *Funambulus, Suncus*

2. Study of the following permanent slides: Transverse section of male and female *Ascaris*

3. Identification of poisonous and non-poisonous snakes

4. An "animal album" containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

Suggested Readings:

1. Chatterjee and Chatterjee: Practical Zoology
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata

ZOOGCOR02T, Physiology and Biochemistry	
Theory (Credits 4)	**Class**
Unit-1 Nerve and muscle	**8**
1. Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres. **2.** Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction.	
Unit-2 Digestion	**5**
Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids	
Unit-3 Respiration	**5**
Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood	
Unit-4 Excretion	**5**
Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism	
Unit-5 Cardiovascular system	**6**
Composition of blood, Homeostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle	
Unit-6 Reproduction and Endocrine Glands	**7**
Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle. Structure and function of pituitary, thyroid, pancreas and adrenal	
Unit 7 Carbohydrate: Structure and Metabolism	**8**
Introduction to Carbohydrates, Structure & Types of Carbohydrates, Isomerism, Introduction to Intermediary metabolism: Glycolysis, Krebs cycle, Pentose phosphate pathway, Gluconeogenesis, Electron transport chain	
Unit-8 Lipid: Structure and Metabolism	**5**
Introduction to Lipids: Definitions; fats and oils; classes of lipids; Lipoproteins; Biosynthesis and β oxidation of palmitic acid	
Unit-9 Protein: Structure and metabolism	**5**
Proteins and their biological functions, functions of amino acids, physicochemical properties of amino acids. Peptides – structure and properties; primary structure of protein, secondary, tertiary and quaternary structures. Transamination, Deamination and Urea Cycle.	
Unit-10 Enzymes	**4**
Introduction, Classification of Enzymes, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation	
Suggested Readings 1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edn. W.H Freeman & Co. 2. Chatterjea, MN and Shinde, R (2012) . A Textbook of Medical Biochemistry. 8th Edn. Jaypee Pub., N.Delhi 3. Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company 4. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). Harper'sIllustrated Biochemistry. XXVIII Edition. Lange Medical Books/Mc Graw3Hill. 5. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co. 6. Sherwood, L. (2013). Human Physiology from cells to systems. 8th Edn., Brooks & Cole 7. Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc. 8. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology, XI Edition., McGraw Hill 9. Elaine N. Marieb, 2006. Human Anatomy & Physiology, Pearson Education.	

ZOOGCOR02P: Physiology and Biochemistry Lab (Credits 2)

1. Preparation of haemin crystals
2. Identification of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland, small intestine, liver, lung, kidney
3. Qualitative tests to identify functional groups of carbohydrates in given solutions: Glucose (Benedict's test),Sucrose (Iodine test)
4. Quantitative estimation of total protein in given solutions by Lowry's method.
5. Study of activity of salivary amylase under optimum conditions.

ZOOGCOR03T: Insect, Vectors and Diseases	
Theory (Credits 4)	**Class**
Unit-1 Introduction to Insects	**6**
General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts with respect to feeding habit	
Unit-2 Concept of Vectors	**6**
Brief introduction to Vectors (mechanical and biological), Reservoirs, Host-vector relationship, Adaptations as vectors, Host specificity	
Unit-3 Insects as Vectors	**8**
Detailed features of insect orders as vectors – Diptera, Siphonoptera, Siphunculata, Hemiptera	
Unit-4 Dipteran as Disease Vectors	**14**
Study of important Dipteran vectors – Mosquitoes, Sand fly, Houseflies Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis Control of mosquitoes	
Unit-5 Siphonaptera as Disease Vectors	**6**
Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas	
Unit-6 Siphunculata as Disease Vectors	**4**
Human louse (Head, Body and Pubic louse) as important insect vectors; Control of human louse	
Ùnit-7 Hempitera as Disease Vectors	**6**
Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures	

ZOOGCOR03P: Insect Vectors and Diseases Lab (Credits 2)

List of Practical

1. Mounting and Study of different kinds of mouth parts of insects
2. Spot identification of following insect vectors through permanent slides/photographs:*Aedes*,*Culex*,*Anopheles*, *Pediculus humanuscapitis*, *Pediculus humanuscorporis*, *Phithiruspubis*, *Xenopsylla cheopis*, *Cimex lectularius*, *Phlebotomus argentipes*, *Musca domestica*
3. Study of different diseases transmitted by above insect vectors
4. Submission of a project report on any one of the insect vectors and disease transmitted

Suggested Readings

1. Anathakrishnan : Bio resources Ecology 3rdEdition
2. Goldman : Limnology, 2ndEdition
3. Odum and Barrett : Fundamentals of Ecology, 5thEdition
4. Pawlowski : Physicochemical Methods for Water and Wastewater Treatment, 1stEdition
5. Trivedi and Goyal : Chemical and biological methods for water pollution studies
6. Welch : Limnology Vols. I-II
7. Wetzel : Limnology, 3rdedition
8. Bose, M. (2017). Parasitoses and Zoonoses, New Central Book Agency

ZOOGCOR04T , Environment and Public Health	
Theory (Credits 4)	Class
Unit 1: Introduction	
Sources of Environmental hazards, Hazard identification and accounting, Fate of toxic and persistent substances in the environment, Dose response evaluation, Exposure assessment	10
Unit 2: Climate Change	
Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health	10
Unit 3: Pollution	
Air, water, noise pollution sources and effects, Pollution control	5
Unit 4: Waste Management Technologies	
Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants.	15
Unit 5: Diseases	
Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid, filariasis	10

Suggested Readings [Consult Latest Editions]

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
3. Kofi Asante Duah "Risk Assessment in Environmental management", John Wiley and sons, Singapore, 1998.
4. Kasperson, J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V. N. University Press, New York, 2003.
5. Joseph F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey 1997.
6. Bose, M. (2017). Parasitoses and Zoonoses, New Central Book Agency

ZOOGCOR03P: Environment and Public Health Lab (Credits 2)

1. To determine pH, Cl, SO4, NO3 in soil and water samples from different locations.

Discipline Specific Electives (DSE)

DSE 1 Credits: 6	
ZOOGDSE01T: Applied Zoology	
Theory (Credits 4)	**Class**
Unit-1 Introduction to Host-parasite Relationship	**3**
Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis	
Unit-2 Epidemiology of Diseases	**7**
Transmission, Prevention and control of diseases: Tuberculosis, Typhoid	
Unit-3 Rickettsia and Spirochetes	**3**
Brief account of *Rickettsia prowazekii, Borrelia recurrentis* and *Treponema pallidum*.	
Unit-4 Parasitic Protozoa	**6**
Life history and pathogenicity of *Entamoeba histolytica, Plasmodium vivax* and *Trypanosoma gambiense*	
Unit-5 Parasitic Helminthes	**4**
Life history and pathogenicity of *Ancylostoma duodenale* and *Wuchereria bancrofti*	
Unit-6 Insects of Economic Importance	**8**
Biology, Control and damage caused by *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio demoleus, Callosobruchus chinensis, Sitophilus oryzae* and *Tribolium castaneum*	
Unit-7 Insects of Medical Importance	**8**
Medical importance and control of *Pediculus humanus corporis*, *Anopheles, Culex, Aedes, Xenopsylla cheopis*	
Unit-8 Animal Husbandry	**3**
Preservation of semen and artificial insemination in cattle	
Unit-9 Poultry Farming	**4**
Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs	

Unit-10 Fish Technology	**4**
Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed	

Suggested Readings

1. Arora, D. R and Arora, B. (2001). *Medical Parasitology*. II Edition. CBS Publications and Distributors.
2. Atwal, A.S. (1986). *Agricultural Pests of India and South East Asia*, Kalyani Publishers.
3. Banerjee, G.C. (). Animal husbandry.
4. Banerjee, G.C. (). Animal husbandry.
5. Chatterjee, K. D. (2009).Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors(P) Ltd
6. Dennis, H. (2009). *Agricultural Entomology.* Timber Press (OR).
7. Dunham R.A. (2004). *Aquaculture and Fisheries Biotechnology Genetic Approache*s. CABI publications, U.K.
8. Hafez, E. S. E. (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
9. Kumar and Corton. *Pathological Basis of Diseases*.
10. Paniker, C.K.J., Ghosh, S. [Ed} (2013). Paniker's Text Book of Medical Parasitology. Jaypee, New Delhi.
11. Parija, S.C. Text book of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
12. Park, K. (2007). *Preventive and Social Medicine*. XVI Edition. B.B Publishers.
13. Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.
14.RatanLalIchhpujaniandRajeshBhatia.MedicalParasitology,IIIEdition,JaypeeBrothersMedicalPublishers(P)Ltd.,NewDelhi
15. Bose, M. (2017). Parasitoses and Zoonoses, New Central Book Agency
16. Chaudhuri, S. (2017). Economic Zoology, New Central Book Agency

ZOOGDSE01P: Applied Zoology, Lab (Credits 2)

1. Study and Identification of *Plasmodium vivax*, *Entamoeba histolytica, Ancylostoma duodenale* and *Wuchereria bancrofti* and their life stages through permanent slides/photomicrographs or specimens.
2. Study and Identification of arthropod vectors associated with human diseases: *Pediculus, Culex,Anopheles, Aedes* and *Xenopsylla.*
3. Study and Identification of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identifying features and economic importance of *Nilaparvata lugens, Apion corchori, Scirpophaga incertulus, Callosobruchus chinensis, Sitophilus oryzae* and *Tribolium castaneum*
5. Visit to poultry farm/ animal breeding centre/ vector biology/ parasitology Centre. Submission of visit report
6. Maintenance of freshwater aquarium.

DSE 2 Credits: 6	
ZOOGDSE02T: Food, Nutrition and Health	
Theory (Credits 4)	**Class**
Unit 1: Basic concept of food and nutrition	6
Food Components and food-nutrients Concept of a balanced diet, nutrient needs and dietary pattern for various groups- adults, pregnant and lactating mothers, infants, school children, adolescents and elderly	
Unit 2: Nutritional Biochemistry	16
Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role Vitamins- Fat-soluble and Water-soluble vitamins- their dietary source and importance Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc: their biological functions	
Unit 3: Health	14
Introduction to health- Definition, concept of health and disease Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin A deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders- their causes, symptoms, treatment, prevention and government programmes, if any. Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary and lifestyle modifications Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS) - their causes, treatment and prevention Common ailments- cold, cough, and fevers, their causes and treatment Concepts of Nutrigenomics and health informatics	

Unit 4: Food hygiene and Community health	14
Potable water- sources and methods of purification at domestic level Food and Water borne infections: Bacterial infection: cholera, typhoid fever, dysentery; Viral infection: hepatitis, poliomyelitis, Protozoan infection: Amoebiasis, Giardiasis; Helminths infection: Taeniasis, Ascariasis, Vector borne diseases: Malaria and Dengue, their transmission, causative agent, sources of infection, symptoms and prevention Brief account of food spoilage: Causes of food spoilage and their preventive measures	
SUGGESTED READINGS 1. Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers 2. Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd. 3. Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd. 4. Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO. 5. Bamji MS, Rao NP, and Reddy V. Text Book of Human Nutrition; 2009; Oxford & IBH Publishing Co. Pvt Ltd. 6. Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill. 7. Lakra P, Singh MD. Textbook of Nutrition and Health; First Ed; 2008; Academic Excellence. 8. Manay MS, Shadaksharaswamy. Food-Facts and Principles; 1998; New Age International (P) Ltd. 9. Gibney et al. Public Health Nutrition; 2004; Blackwell Publishing	

ZOOGDSE02P: Food Nutrition and Health, Lab (Credits 2)

1To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric
2. Lactose and calcium estimation in food by titrimetry
3. Methylene Blue Reductase Test (MBRT) of milk. Gram staining of bacteria.
4. Study of the stored grain pests and mosquito vectors (Anopheles, Culex and Aedes) from slides/ photograph (Sitophilus oryzae, Trogoderma granarium, identification, habitat and food sources, damage caused and control. Preparation of temporary mounts of the above stored grain pests.
5. Project- Undertake computer aided diet analysis and Anthropometric nutritional assessment for different age groups.
OR
Identify nutrient rich sources of foods (fruits and vegetables), their seasonal availability and price
OR
Study of nutrition labelling on selected foods

DSE 3 Credits: 6	
ZOOGDSE03T: Aquatic Biology	
Theory (Credits 4)	**Class**
Unit-1 Aquatic Biomes	**10**
Brief introduction to the aquatic biomes: Fresh water ecosystem(lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs	
Unit-2 Freshwater Biology	**20**
Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico–chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity, dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes (Nitrogen, Sulphur and Phosphorous). **Streams:** Different stages of stream development, Physico-chemical environment, Adaptation of hill- stream fishes.	
Unit-3 Marine Biology	**10**
Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.	
Unit-4 Management of Aquatic Resources	**10**
Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment; Water quality assessment- BOD and COD.	
Suggested Readings 1. Anathakrishnan : Bio resources Ecology 3rdEdition 2. Goldman : Limnology, 2ndEdition 3. Odum and Barrett : Fundamentals of Ecology, 5thEdition 4. Pawlowski : Physicochemical Methods for Water and Wastewater Treatment, 1stEdition 5. Trivedi and Goyal : Chemical and biological methods for water pollution studies	

6. Welch : Limnology Vols. I-II
7. Wetzel : Limnology, 3rdedition
8. Chaudhuri, S. (2017). Economic Zoology, New Central Book Agency

ZOOGDSE03P: Aquatic Biology, Lab (Credits 2)

1. Determine the area of a lake using graphimetric and gravimetric method.
2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
3. Determine the amount of transparency, Dissolved Oxygen, and Free Carbon dioxide, in water collected from a nearby lake / water body.
4. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.
5. A Project Report on a Sewage treatment plant/Marine bio reserve/ Fisheries Institutes.

DSE 4 Credits:6	
ZOOGDSE04T: Theory (Credits 4) Immunology	**Class**
Unit-1 Overview of the Immune System	**5**
Introduction to basic concepts in immunology, components of immune system, principles of innate and adaptive immune system	
Unit-2 Cells and Organs of the Immune System	**8**
Haematopoiesis, Cells of immune system and organs (primary and secondary lymphoid organs) of the immune system	
Unit-3 Antigens	**5**
Basic properties of antigens, B and T cell epitopes, haptens and adjuvants	
Unit-4 Antibodies	**8**
Structure, classes and function of antibodies, monoclonal antibodies, antigen antibody interactions as tools for research and diagnosis	
Unit-5 Working of the immune system	**12**
Structure and functions of MHC, exogenous and endogenous pathways of antigen presentation and processing, Basic properties and functions of cytokines, Complement system: Components and pathways	
Unit-6 Immune system in health and disease	**10**
Gell and Coombs' classification and brief description of various types of hypersensitivities, Introduction to concepts of autoimmunity and immunodeficiency	
Ùnit-7 Vaccines	**2**
General introduction to vaccines, Types of vaccines	
Suggested Readings 1. Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. SaundersP ublication. 2. Abbas, K. Abul and Lechtman H. Andrew (2011.) Basic Immunology: Functions and Disorders of Immune System. Saunders Elsevier Publication. 3. Delves, Martin, Burton and Roitt (2006). Roitt's Essential Immunology. 11th Edn. Blackwell Pub. 4.Kindt,T.J.,Goldsby,R.A.,Osborne,B.A.andKuby,J(2006).Immunology,VIEdition.W.H.FreemanandCompany. 5. Parija, SC (2012). Text book of Microbiology and Immunology. 2nd Edn. Elsevier. 6. Playfair, JHL and Chain, BM (2001) Immunology at a glance. 7th Edn. Blackwell Pub. 7. Virella, G (2007). Medical Immunology 6th Edn. Informa Healthcare.	

ZOOGDSE04P: Immunology, Lab (Credits 2)

1. Demonstration of lymphoid organs in human through model/ photograph.
2. Histological study of spleen, thymus and lymph nodes through slides/photographs
3. Preparation of stained blood film to study various types of blood cells.
4. ABO blood group determination

Skill Enhancement Courses (SEC)

ZOOSSEC01M: Credits:2 Aquarium Fish Keeping	
Aquarium Fish Keeping	**Class**
Unit 1: Introduction to Aquarium Fish Keeping	2
The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes	
Unit 2: Biology of Aquarium Fishes	10
Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish	
Unit 3: Food and feeding of Aquarium fishes	**7**
Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquarium fish as larval predator	
Unit 4: Fish Transportation	**3**
Live fish transport - Fish handling, packing and forwarding techniques.	
Unit 5: Maintenance of Aquarium	**3**
General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry	

ZOOSSEC02M (2 credits): Vermicompost Production	
Vermicompost Production	**Class**
Unit 1: Introduction to Vermicompost Production	4
Natural role of earthworms in soil fertility, Concept of Vermicompost- the need for it	
Unit 2: Productions	8
Suitable worm species and their availabity– for Large scale/small scale, Climate and Temperature, Feedstock – for small scale or home farming / large scale or commercial	
Unit 3: Operations and maintenance	8
Smells, Moisture, Pest species, Worms escaping, Nutrient levels	
Unit 4: Harvesting	2
Unit 5: Properties of the vermicompost	2
Unit 6: Benefits of vermicompost	1
Unit 7: Use as soil conditioner	1
Unit 8: Applications of vermicompost	1
Unit 9: Visit to Vermicompost centre and Submission of Report	
Suggested References 1. https://en.wikipedia.org/wiki/Vermicompost You tube audio-visual training: 2.https://www.google.co.in/search?rlz=1C1CHZL_enIN766IN766&ei=2Kz2Wr6yDoPIvgTLw6aYDQ&q=vermicompost+preparation&oq=vermicompost&gs_l=psy-ab.1.0.0i71k1l8.0.0.0.8499.0.0.0.0.0.0.0.0..0.0....0...1c..64.psy-ab..0.0.0....0.RNrPR98LJOg#kpvalbx=1 3. https://www.youtube.com/watch?v=sQKI0Y7fj24 4. https://www.youtube.com/watch?v=oGf7Oe7oP4Y 5. http://www.ivri.nic.in/services/vermi.aspx 6. Vermicompost production training in 24 Parganas- North: http://www.swanirvar.in/help.php	