

CORE COURSES

SEMESTER I

BR17101CR: Biodiversity and Bioresources

Unit: I

Biodiversity and Bioresources: Concept and scope; Levels of biodiversity—organisational (genetic, species and ecosystem), spatial (alpha, beta and gamma); Valuing biodiversity— direct- and indirect use values; Concept and conservation of agro-biodiversity; Mega-biodiverse countries; Global biodiversity hotspots (criteria, distribution and conservation implications).

Unit: II

Global, national and local magnitude of biodiversity: Floral, faunal and microbial diversity; Measurement of biodiversity— Methods of survey and inventorization of biodiversity, sampling procedures, biodiversity measures and indices, biodiversity surrogates; Biodiversity informatics— concept and applications; Biodiversity monitoring— global biodiversity targets and indicators.

Unit: III

Biodiversity loss and conservation: Factors of biodiversity loss— ultimate and proximate causes; IUCN threat categories and criteria; Biodiversity and climate change— concerns and challenges; *In situ* conservation strategies— Protected Area Network (National parks, Wildlife sanctuaries and Biosphere reserves); *Ex situ* conservation strategies (Botanical gardens, Zoos, Aquaria, Cryo-banks).

Unit: IV

Role of taxonomy in biodiversity studies; Role of Remote Sensing and Geographical Information System in biodiversity studies; Indian Bioresources Information Network— organisation and role; Biodiversity conservation policy and programmes— International and national efforts; National Biodiversity Action Plan (a brief summary).

Practical Work:

- Collection, description and herbarium preparation of various types of leaves, inflorescences and fruits.
- Types of quadrats and their utility.
- Determination of minimum size and number of quadrats for phytosociological studies.
- Computation of frequency, density, abundance and cover of constituent species of different communities.
- Field demonstration of Global Positioning System (GPS) and its utility in biodiversity studies.
- Role of Herbarium and its significance in biodiversity studies.
- Field study of various threatened endemic plants of Kashmir Himalaya.
- To prepare an inventory of economically important woody plants in KUBG.

SEMESTER I

BR17102CR: Plant Resources

Unit: I

Plant resources: Archeo-ethnobotany; Origin of agriculture; Centres of origin and domestication of cultivated plants as proposed by de Candolle and Vavilov; Green revolution— benefits and adverse consequences.

Cereals and pseudocereals: Cultivation and utility of rice (*Oryza sativa*), wheat (*Triticum aestivum*), maize (*Zea mays*), buckwheat (*Fagopyrum* spp.).

Unit: II

Fodder and oil crops: General account of fodder crops, methods of domestication and utility of alfalfa (*Medicago sativa*); Origin & evolution of *Brassica juncea* and *Brassica campestris*; Extraction and processing of mustard and sunflower oil.

Fibre crops: Plant fibres, types; Origin, evolution and processing of cotton and jute.

Fruits: Cultivation and commercial importance of some fruits grown in Kashmir (apple, pear, walnut, almond, apricot).

Unit: III

Vegetables, spices and condiments: Methods of cultivation of vegetables grown in Kashmir; Wild vegetables of Kashmir (overview); Spices and condiments; Origin, distribution, cultivation and importance of saffron.

Extractives: Gums and resins, classification, important sources and their commercial value; Dyes and tannins, extraction, processing and use.

Unit: IV

Medicinal plants: Morphology, ethnobotanical and medicinal importance of *Arnebia benthamii*, *Aconitum heterophyllum*, *Atropa acuminata*, *Podophyllum hexandrum*, *Saussurea costus*, *Rheum emodi*, *Digitalis purpurea*, *Valeriana jatamansii*, *Viola odorata*, *Picrorhiza kurroa*, *Dioscorea deltoidea* and *Hippophae rhamnoides*.

Bioprospecting: Concept and methods of bioprospecting; Role of traditional knowledge in bioprospecting; Biopiracy, case studies of biopiracy (Basmati, Neem, Turmeric, Periwinkle); Traditional Knowledge Digital Library (TKDL) — concept and importance.

Practical Work:

- Study the diagnostic features of some economically important angiosperm families (Asteraceae, Apiaceae, Brassicaceae, Fabaceae, Caryophyllaceae, Rosaceae, Lamiaceae and Poaceae).
- Study various types of plant fibres.
- Study the presence and structure of starch granules and oil bodies in various food crops.
- Study some commonly used spices and condiments.
- Pseudocereal- Buckwheat: Morphological features and seed structure; Test for presence of starch and proteins.
- Study the diagnostic features and medicinal importance of native medicinal plants of Kashmir Himalaya.

Practical Work:

- Study the diagnostic features of some economically important angiosperm families (Asteraceae, Apiaceae, Brassicaceae, Fabaceae, Caryophyllaceae, Rosaceae, Lamiaceae and Poaceae).
- Study various types of plant fibres.
- Study the presence and structure of starch granules and oil bodies in various food crops.
- Study some commonly used spices and condiments.
- Pseudocereal- Buckwheat: Morphological features and seed structure; Test for presence of starch and proteins.
- Study the diagnostic features and medicinal importance of native medicinal plants of Kashmir Himalaya.

SEMESTER I

BR17103CR: Animal Resources

Unit: I

Insect resources: Importance and scope of insect based industries; Silkworm breeds, synthesis of silk and cocooning, harvesting and grainage; Apiculture products and apitherapy (honey, beeswax, bee pollen, propolis, royal jelly, bee venom); Lac products, properties and their uses (lac dye, lac wax, shellac, bleached shellac, dewaxed bleached shellac, aleuritic acid); Edible insect industry.

Unit: II

Aquaculture: Fish monoculture, polyculture and composite culture; Pearl and shellfish farming; Integration of aquaculture with agriculture and animal husbandry; Natural and artificial breeding in fish; Genetic approach to fisheries; Fish as a food commodity; Fish by-products; Processing and preservation of fish and its products.

Unit: III

Livestock domestication: History of domestication; Important breeds of livestock (cow, sheep, goat, buffalo) and poultry with special reference to economic characters; Important methods of selection and systems of breeding in farm animals and poultry birds; Genetic and phenotypic consequences and applications of inbreeding and outbreeding; Genetic basis of heterosis and its use.

Unit: IV

Animal products and processing: Principles and practices for production of high quality milk; Pasteurization and sterilization; Utilization of various animal and poultry by-products: blood, fat, hides, bones, wool, hair, and feather; Use of biotechnological tools in improving animal productivity; Scope of meat, fish and poultry processing industry in India.

BR17001GE: Microbial Resources

Unit: I

Microbial resources— historical perspective; Types of microbial resources (algal, fungal, bacterial, viral); Approaches for the assessment of microbial diversity (culture dependent and independent); Morphology and ultrastructure of bacteria and viruses (bacteriophages); Microbial growth and growth curve.

Unit: II

Role of microorganisms in food production and beverages (wine, beer, bread, cheese); Single Cell Proteins— production and utility; Microbes as sources of antibiotics and therapeutic agents; Major commercial microbial products (amino acids, enzymes, steroids and biopolymers).

Unit: III

Bioremediation; Role of microbes in bioremediation of soil and water; Role of microbes in waste water treatment (processes based on attached microbial growth, activated sludge process).

Unit: IV

Role of microbes in biogeochemical cycles (carbon, nitrogen, sulphur & phosphorus cycle); Microbes as bioindicators; Phycoviruses and algal blooms; Biodefence and bioterrorism.

SEMESTER II

BR17203CR: Bioenergy and Biofuels

Unit: I

Introduction: Concept of bioenergy; Biomass as energy source; Biomass feedstocks and biomass feedstock characterization; Biomass fuel analysis; Wood pellet technology; Pyrolysis and gasification of biomass; History and classification of biofuels (first, second, third and fourth generation biofuels).

Unit: II

Liquid biofuels: Vegetable oils as fuels; Biodiesel, concept & history; Biodiesel production by transesterification; Properties of biodiesel; Algae as a source of biodiesel; Production of bioethanol; Lignocellulosic biomass as feedstock for ethanol production; Ethanologens.

Bioenergy crops: Jatropha, Sugarcane, Sweet sorghum, Pongamia and Maize.

Unit: III

Gaseous biofuels: Biogas production process; Biogas processing technologies for anaerobic digestion; Biohydrogen; Green algae and cyanobacteria as powerhouses of biohydrogen; Biohydrogen from biorenewable feedstocks; Artificial photosynthesis; Hydrocarbon biofuels.

Unit: IV

Biofuel economy and policy: Estimation of biofuel prices; Biodiesel and bioethanol economy; Current status of biodiesel production in India; Biorenewable energy costs and biohydrogen economy; Bioenergy policy and impact of bioenergy programmes in India (Overview); Global biofuel projections.

Practical Work:

- Determination of saponification value of fat/oil.
- Preparation of biodiesel from various oils.
- Comparison of time of flow and density of biodiesel and vegetable oils.
- Determination of iodine number of oil/fat and biodiesel.
- Study of some important algal sources of biofuel.
- Study the importance of jatropha, maize and sugarcane as major bioenergy crops.
- Demonstrate the fermentation process for ethanol production.

SEMESTER II**BR15203CR: Biofertilizers and Biopesticides****Unit: I**

Biofertilizers: Concept, types and prospects; Bacterial biofertilizers— morphology, life cycle, isolation, cultivation, association, inoculation and methods of application of *Azotobacter*, *Rhizobium* and *Frankia*.

Phosphorous Solubilising Microorganisms (PSMs): Introduction, isolation, culture, mass production and inoculation.

Unit: II

Cyanobacteria and Azolla as Biofertilizers: Morphology, life cycle, association, cultivation and inoculation; Factors affecting biofertilizer efficiency; Mass production and quality control of biofertilizers.

Arbuscular Mycorrhizas (AM): Morphology, association, cultivation, inoculation, role and application.

Unit: III

Biopesticides: Definition, types, merits and demerits; Biofungicides— fungal fungicides, bacterial fungicides, fungal nematicides (role and application).

Bioherbicides: Concept, current status and prospects; Mass production and commercial formulations; Role of biocontrol in Integrated Pest Management.

Unit: IV

Bacterial insecticides: Classification and mode of action with special reference to *Bacillus thuringensis*; Methods of uses and symptoms of infection.

Fungal and viral insecticides: Biology and their use in insect control; Commercial formulations; Entomopathogenic nematodes and protozoans— mode of action and field efficacy; Preventive and safety measures required in using biopesticides.

Practical Work:

- Preparation of Potato Dextrose Agar (PDA), medium for fungal growth.
- Preparation of Yeast Extract Mannitol Agar (YEMA), medium for bacterial growth.
- Isolation and study of the root nodule bacteria.
- Preparation of a water squash mount of a living mosquito fern (*Azolla*) and to study its symbiotic association with cyanobacteria (*Anabaena*).
- Preparation of vermicompost.

BR17005GE: Biomedicine and Bioprospecting

Unit: I

Biomedicine: Introduction, present scenario & future prospectus; Sources of drugs (plants, animals, microorganism, drugs from organic synthesis); Historical development and present status of Chinese/ Amchi, Ayurvedic, Unani Sidha and Homeopathic systems of medicine.

Unit: II

Ethnobotany: Concept; Ethnobotanical and medicinal importance of some important medicinal plants of Kashmir viz. *Arnebia benthamii*, *Aconitum heterophyllum*, *Atropa acuminata*, *Podophyllum hexandrum*, *Saussurea costus*, *Rheum emodi*, *Digitalis purpurea*, *Valeriana jatamansii*, *Viola odorata*, *Picrorhiza kurroa*, *Dioscorea deltoidea* and *Hippophae rhamnoides*.

Unit: III

Herbal crude medicines: Classification, collection and processing; Various separation techniques for extraction of crude medicine, advantages and limitations; Plant drug standardization; Quality control and quality assurance of herbal drugs; Drug acts and rules.

Unit: IV

Bioprospecting: Concept and methods of bioprospecting; Role of traditional knowledge in bioprospecting; Biopiracy, case studies of biopiracy (Basmati, Neem, Turmeric, Periwinkle, Enola bean); Traditional Knowledge Digital Library (TKDL)— concept and importance.

CORE COURSES

SEMESTER IV

BR17401CR: Plant Resources and Biotechnology

Unit: I

Plant tissue culture: Concept and applications of plant tissue culture; Cellular totipotency; Cell culture and cell cloning; Micropropagation— regeneration through callus cultures, adventitious buds and non adventitious systems (apical and axillary buds); Production of somatic embryos; synthetic seeds (concept); Somatic hybrids & cybrids (Brief idea).

Unit: II

Genetic engineering: Introduction, scope and applications; Cloning vectors— Plasmids, cosmids, phages, artificial chromosomes; Expression vectors; Recombinant DNA technology— Restriction enzymes, ligation, transformation and selection; Construction of genomic and cDNA libraries; Gene transfer methods in plants— *Agrobacterium* mediated gene transfer; Physical methods of gene transfer; Reporter genes.

Unit: III

Molecular markers: PCR— principle and applications, RFLP, RAPD, AFLP, SSR, SNPs, SCARs & their applications; Molecular cytogenetic markers— FISH and GISH, their applications; Quantitative trait loci (QTL) mapping— introduction and types of mapping populations.

Unit: IV

Genetically modified crops: Transgenics for biotic and abiotic stress (insect resistance, virus resistance, herbicide resistance); Modification of plant nutritional content (vitamins, aminoacids, lipids, Iron); GMO's— ecological and ethical concerns.

Biotransformation: Plants as Bioreactors; Transgenic plants for biochemical production— edible vaccines, and secondary metabolites.

Practical Work:

- Demonstration of plant tissue culture technique (sterilization, media preparation and inoculation).
- Isolation of plant genomic DNA by CTAB method.
- Visualization of DNA by Agarose Gel Electrophoresis.
- Demonstration of Polymerase Chain Reaction.
- Preparation of mitotic chromosome preparation from root tips.

SEMESTER IV

BR17402CR: Animal Cell and Tissue Technology

Unit: I

Animal cell and tissue culture: History, scope and applications; Culture media, culture procedures and techniques; Transfection, targeted transfection, transient and stable transfections; Large scale culture of cell lines for production of biomolecules (viral vaccines, interferons, recombinant proteins and hybrid antibodies).

Unit: II

Culture products: Somatic cell fusion, hybridoma technology and production of monoclonal antibodies.

Stem cells: Stem cell lines– origin and types, stem cell therapy and its applications.

Immunodiagnosics: Blood grouping; Rh typing; Immuno electrophoresis; Enzyme linked Immuno Sorbent Assay (ELISA); Radio Immuno Assay (RIA).

Unit: III

Tissue engineering: Concept, approaches, prospects and limitations; Biomaterials for tissue engineering; Tissue engineering of skin and haemoglobin-based blood substitutes; Artificial womb technology.

Unit: IV

Animal cloning: *In vitro* fertilization and embryo transfer; Cloning livestock by nuclear transplantation; Production of transgenic animals with special reference to transgenic mice, cow and sheep; Identification and transfer of genes influencing milk quality and disease resistance.

Practical Work:

- Preparation of culture media for animal cells by filter sterilization methods.
- Establishment of primary cell culture - chick embryo.
- Study the antigen-antibody reactions to determine blood groups.
- Study the differential morphology of human leucocytes.
- Study the cell count using a haemocytometer.
- Comparative studies of haemin crystal in mammals: humans, cow and goat.
- Demonstrate phagocytic activity (phagocytosis) in the insect cells.
- Demonstrate the presence of natural biomaterial chitin in the insect integument.

SEMESTER IV

BR17403CR: Microbial Technology

Unit: I

Microbial genome: Bacterial genome structure, replication (DNA and plasmid); Genetic exchange (transformation, transduction and conjugation); Recombination (hosts, vectors and mechanism); Replication of Bacteriophages: Viral multiplication (lytic and lysogenic).

Unit: II

Culturing of microbes: Isolation and screening of microorganisms; Cultivation of microbes- nutritional requirements and factors affecting microbial growth (pH, temperature, water, oxygen, CO₂); Culture types— static cultures, suspension cultures; synchronous cultures, growth curve, generation time, growth kinetics; Storage and transportation of microbes.

Unit: III

Fermentation technology: Introduction; Types of fermentation (aerobic, anaerobic), fermentors and their types, substrates for fermentation; Role of enzymes in various fermentation processes; Microbial chemostat cultures; Scale-up of cultivation of microorganisms; Microbes in beverages and food production (wine, beer, bread, cheese); Advantages of fermented foods.

Unit: IV

Economic importance of microbes: Major commercial microbial products (amino acids, enzymes, steroids, therapeutic agents and biopolymers); Single Cell Proteins; Role of microbes in bioremediation; Microbes as bioindicators; Biodefence and bioterrorism; Role of microbes in waste water treatment.

Practical Work:

- Estimation of CO₂ in water samples obtained at different stages of Sewage Treatment Plant (STP).
- Estimation of dissolved oxygen in given water sample.
- Check the efficacy of antibiotics on a given microbial sample.
- To grow bacteria from cheek sample of mouth on nutrient medium.
- Study the preparation of yogurt.
- Study the procedure to ascertain the milk quality.

BR17004GE: Bioindustries

Unit: I

Industrial revolution: Causes and consequences; Industrial economic sectors: Primary, Secondary, Tertiary and Quaternary Sectors; Small scale industries and their importance; Entrepreneurship— concept, entrepreneurial skills; Self employment.

Unit: II

Bioindustries: Concept and scope; Role of natural resources in economic development.

Bioindustries in India: Status and scope of agriculture, fisheries, sericulture, forest and dairy industry.

Unit: III

Fruit industry in J & K: Status and scope; Fresh and dry fruits—harvest, processing & storage and marketing.

Potential bioindustries in J & K: Apiculture, tannery, pisciculture, ornamental horticulture and herbal drug industry.

Unit: IV

Sustainable development: Concept, indicators of sustainable development; Quality assurance and quality control; Policies responsible for development of bioindustries. Intellectual Property Rights— concept and importance.

SEMESTER III

BR17302CR: Secondary Metabolites

Unit: I

Phenolic compounds and isoprenoids: Phenolic compounds— occurrence and classification; Shikimic acid pathway for synthesis of phenolic compounds; Terpenes— Occurrence; Classification based on isoprene rule; Biosynthesis of terpenes; Importance of rubber as a bioresource;

Steroids: Occurrence, structure and biological functions of major plant and fungal steroids.

Unit: II

Alkaloids: Introduction, occurrence, classification based on nitrogen heterocyclic ring; Use of alkaloids by humans from historical perspective; Nomenclature (true, proto and pseudo-alkaloids); Biological functions of alkaloids; Non protein amino acids; Glycosylated N-containing toxins.

Unit: III

Plant pigments: Classification; Chlorophyll— structure, biosynthesis and properties; Carotenoids— structure, occurrence and biological function of carotenes and xanthophylls; Flavonoids— structure, occurrence and biological function of anthocyanins, flavonols, flavones; Phenolics and Quinoids— structure, occurrence and function (naphthaquinones, anthraquinones, tannins, lignins); Indole derivatives— structure, occurrence and function (betalains, phytomelanins, indigo).

Unit: IV

Importance of secondary metabolites: Perspectives in human health; Effect of biotic and abiotic stresses on secondary metabolites in plants; Allelopathic effects of secondary metabolites; Taxonomic significance of secondary metabolites.

Practical Work:

- Separation of pigments from leaf extract using phase separation method.
- Detection of presence of phenolics, alkaloids and flavonoids in plant material.
- Preparation of calibration graph for the estimation of total phenols.
- Estimation of free radicle scavenging activity of plant extract.
- Study the effect of pH on the anthocyanins from fruit extracts.

DISCIPLINE CENTRIC ELECTIVE COURSES

SEMESTER IV

BR17404DCE: Bioinformatics

Unit: I

Bioinformatics databases: Bioinformatics— concept and application; Types of databases- Genome (NCBI, EBI, TIGR, SANGER), Nucleic acid (EMBL, GeneBank, DDBJ), Protein (SwissProt, TrEMBL, PIR) databases; Structural classification of proteins (SCOP, CATH).

Unit: II

Sequencing: Conventional and next generation sequencing; Basic Concept of sequence similarity, identity and homology; Sequence based database searches (blast, fasta, gcg, msf, nbrf-pir etc.); Homologues, orthologues, paralogues; Sequence alignment (pair-wise and multiple); Gene finding and genome annotation; **Transcriptomics:** DNA Microarray, Serial analysis of gene expression, Qualitative RT PCR.

Unit: III

Emerging areas of bioinformatics: Computational systems biology, semantic web; Bioontologies (types, application, softwares), annotations; Proteomics— separation, identification of proteins, MS-MS, protein microarray, protein expression profiling, protein- protein interaction mapping; Metabolomics, cheminformatics, phenomics.

Unit: IV

Phylogenetics: Morphological & molecular phylogeny; Representation of molecular phylogeny; Methods of phylogeny— maximum parsimony, likelihood and Bayesian method; Distance methods (UPGMA, NJ); Softwares (PHYLIP, Tree base, Mesquite, NTSY SPC).

Practical Work:

- Role of NCBI, EBI, TIGR and SANGER in maintaining sequence data.
- Demonstration of BLAST and FASTA.
- Study Pairwise and Multiple sequence alignments.
- Demonstration of MSA.
- Construction of Phylogenetic trees using morphological and molecular data.
- Tools for obtaining information about primary structure of proteins.

SEMESTER III

BR17303CR: Biostatistics and Biotechniques

Unit: I

Data types and collection: Data on ratio, interval, ordinal and nominal scales; Continuous and discrete data; Methods of primary and secondary data collection and their limitations.

Processing and analysis of data: Measures of Central Tendency— arithmetic mean, mode, median; Measures of dispersion— mean deviation, variance, standard deviation, coefficient of variation.

Unit: II

Testing of hypothesis: Basic concept, procedure for hypothesis testing, test of difference between means— independent and paired samples, test of proportions and test of goodness of fit.

Sampling techniques: Principles and steps in sample survey; Procedures and practices involved in simple random sampling, systematic, stratified and cluster sampling.

Unit: III

Design and analysis of experiments: Principles of experimentation; Experimental designs— layout, analysis of variance and comparison of treatments in completely randomised design, randomised complete block design and factorial experimental designs.

Correlation and regression: Basic idea of correlation; Simple correlation— calculation of correlation coefficient; Simple linear regression— calculation of regression coefficients.

Unit: IV

Microscopy & spectroscopy: Principle, working & application of fluorescence, phase contrast, scanning electron and transmission electron microscopy; Principle and working of a spectrophotometer; Application of spectroscopic techniques (UV-visible, IR, NMR).

Chromatography: Paper, thin layer, Gas-liquid chromatography; Ion exchange, adsorption and molecular exclusion chromatography; High performance liquid chromatography (HPLC); Radioisotopes— applications in biology.

Practical Work:

- Collection of data from field and construction of frequency tables.
- Diagrammatic and graphical representation of data.
- Comparison of populations on the basis of mean value of parameters, standard deviation and standard error.
- Analysis of variance (one way).
- Demonstration of scanning electron microscopy (SEM).
- Use of paper and thin layer chromatography for the separation of plant pigments.
- Study the principal and working of colorimeter and UV- Visible spectrophotometer.

BR17001GE: Microbial Resources

Unit: I

Microbial resources— historical perspective; Types of microbial resources (algal, fungal, bacterial, viral); Approaches for the assessment of microbial diversity (culture dependent and independent); Morphology and ultrastructure of bacteria and viruses (bacteriophages); Microbial growth and growth curve.

Unit: II

Role of microorganisms in food production and beverages (wine, beer, bread, cheese); Single Cell Proteins— production and utility; Microbes as sources of antibiotics and therapeutic agents; Major commercial microbial products (amino acids, enzymes, steroids and biopolymers).

Unit: III

Bioremediation; Role of microbes in bioremediation of soil and water; Role of microbes in waste water treatment (processes based on attached microbial growth, activated sludge process).

Unit: IV

Role of microbes in biogeochemical cycles (carbon, nitrogen, sulphur & phosphorus cycle); Microbes as bioindicators; Phycoviruses and algal blooms; Biodefence and bioterrorism.

CORE COURSES

SEMESTER I

BR17101CR: Biodiversity and Bioresources

Unit: I

Biodiversity and Bioresources: Concept and scope; Levels of biodiversity—organisational (genetic, species and ecosystem), spatial (alpha, beta and gamma); Valuing biodiversity— direct- and indirect use values; Concept and conservation of agro-biodiversity; Mega-biodiverse countries; Global biodiversity hotspots (criteria, distribution and conservation implications).

Unit: II

Global, national and local magnitude of biodiversity: Floral, faunal and microbial diversity; Measurement of biodiversity— Methods of survey and inventorization of biodiversity, sampling procedures, biodiversity measures and indices, biodiversity surrogates; Biodiversity informatics— concept and applications; Biodiversity monitoring— global biodiversity targets and indicators.

Unit: III

Biodiversity loss and conservation: Factors of biodiversity loss— ultimate and proximate causes; IUCN threat categories and criteria; Biodiversity and climate change— concerns and challenges; *In situ* conservation strategies— Protected Area Network (National parks, Wildlife sanctuaries and Biosphere reserves); *Ex situ* conservation strategies (Botanical gardens, Zoos, Aquaria, Cryo-banks).

Unit: IV

Role of taxonomy in biodiversity studies; Role of Remote Sensing and Geographical Information System in biodiversity studies; Indian Bioresources Information Network— organisation and role; Biodiversity conservation policy and programmes— International and national efforts; National Biodiversity Action Plan (a brief summary).

Practical Work:

- Collection, description and herbarium preparation of various types of leaves, inflorescences and fruits.
- Types of quadrats and their utility.
- Determination of minimum size and number of quadrats for phytosociological studies.
- Computation of frequency, density, abundance and cover of constituent species of different communities.
- Field demonstration of Global Positioning System (GPS) and its utility in biodiversity studies.
- Role of Herbarium and its significance in biodiversity studies.
- Field study of various threatened endemic plants of Kashmir Himalaya.
- To prepare an inventory of economically important woody plants in KUBG.

BR17003GE: Industrial Entomology

Unit: I

Apiculture: Importance and scope; Bee species (biology, morphology, behaviour, and habitat); Bee keeping equipment, hives, bee pasturage and seasonal management; Honey extraction; Factors affecting honey yield; Properties and uses of honey; Granulation, fermentation and storage of honey; Uses of other bee products; Bee enemies including diseases and their control.

Unit: II

Sericulture: Silkworm species, systematic position and salient features; Rearing techniques of mulberry, muga, eri and tassar silkworms; Nutritional requirements of silkworms; Sericulture rearing house and appliances; Grainage technology and cocoon marketing; Enemies and diseases of silkworms and their management; By-products of sericulture.

Unit: III

Lac culture: Lac insect, biology and habitat; Host trees— pruning, inoculation, lac cropping techniques and harvesting; Enemies of lac insect and their control; Processing techniques of lac (traditional and modern); Physical and chemical characteristics of lac.

Unit: IV

Beneficial Insects: Insects as pollinators and biocontrol agents; Insects as soil fertility improving agents and scavengers; Use of insects and insect products in medicine; Use of insects in scientific investigations; Use of insects as food source.

BR17005GE: Biomedicine and Bioprospecting

Unit: I

Biomedicine: Introduction, present scenario & future prospectus; Sources of drugs (plants, animals, microorganism, drugs from organic synthesis); Historical development and present status of Chinese/ Amchi, Ayurvedic, Unani Sidha and Homeopathic systems of medicine.

Unit: II

Ethnobotany: Concept; Ethnobotanical and medicinal importance of some important medicinal plants of Kashmir viz. *Arnebia benthamii*, *Aconitum heterophyllum*, *Atropa acuminata*, *Podophyllum hexandrum*, *Saussurea costus*, *Rheum emodi*, *Digitalis purpurea*, *Valeriana jatamansii*, *Viola odorata*, *Picrorhiza kurroa*, *Dioscorea deltoidea* and *Hippophae rhamnoides*.

Unit: III

Herbal crude medicines: Classification, collection and processing; Various separation techniques for extraction of crude medicine, advantages and limitations; Plant drug standardization; Quality control and quality assurance of herbal drugs; Drug acts and rules.

Unit: IV

Bioprospecting: Concept and methods of bioprospecting; Role of traditional knowledge in bioprospecting; Biopiracy, case studies of biopiracy (Basmati, Neem, Turmeric, Periwinkle, Enola bean); Traditional Knowledge Digital Library (TKDL)— concept and importance.

BR17008GE: Organic Farming

Unit: I

Organic agriculture: Principles of organic agriculture; Objectives and requirements of organic standards; Criteria for substances used in organic production and processing; Standard for organic production and processing; Organic certification; Organic farming and food security.

Unit: II

Organic crop production: Split production and parallel production; Crop production and conversion period; Diversity in crop production; Soil fertility and fertilization; Pest, disease and weed management; Breeding of organic varieties.

Unit: III

Organic animal husbandry: Animal management; Animal origin and conversion period; Breeds and breeding; Mutilations; Animal nutrition; Veterinary medicine; Transport and slaughter; Bee keeping.

Unit: IV

Vermiculture and vermicompositing: Species selection, environmental requirements; Vermicompositing—methods, materials and advantages; Role in soil fertility, plant growth promotion and disease management.

SEMESTER II

BR17205DCE: Biofertilizers and Biopesticides

Unit: I

Biofertilizers: Concept, types and prospects; Bacterial biofertilizers— morphology, life cycle, isolation, cultivation, association, inoculation and methods of application of *Azotobacter*, *Rhizobium* and *Frankia*.

Phosphorous Solubilising Microorganisms (PSMs): Introduction, isolation, culture, mass production and inoculation.

Unit: II

Cyanobacteria and Azolla as Biofertilizers: Morphology, life cycle, association, cultivation and inoculation; Factors affecting biofertilizer efficiency; Mass production and quality control of biofertilizers.

Arbuscular Mycorrhizas (AM): Morphology, association, cultivation, inoculation, role and application.

Unit: III

Biopesticides: Definition, types, merits and demerits; Biofungicides— fungal fungicides, bacterial fungicides, fungal nematicides (role and application).

Bioherbicides: Concept, current status and prospects; Mass production and commercial formulations; Role of biocontrol in Integrated Pest Management.

Unit: IV

Bacterial insecticides: Classification and mode of action with special reference to *Bacillus thuringiensis*; Methods of uses and symptoms of infection.

Fungal and viral insecticides: Biology and their use in insect control; Commercial formulations; Entomopathogenic nematodes and protozoans— mode of action and field efficacy; Preventive and safety measures required in using biopesticides.

Practical Work:

- Preparation of Potato Dextrose Agar (PDA), medium for fungal growth.
- Preparation of Yeast Extract Mannitol Agar (YEMA), medium for bacterial growth.
- Isolation and study of the root nodule bacteria.
- Preparation of a water squash mount of a living mosquito fern (*Azolla*) and to study its symbiotic association with cyanobacteria (*Anabaena*).
- Preparation of vermicompost.

CORE COURSES

SEMESTER III

BR17301CR: Biomolecules

Unit: I

Water: Properties of water and its role in the biological systems; pH and its significance in biological systems; Buffer systems and their importance.

Biological membranes: Solute transport across the membranes; Membrane potential; Vesicular transport— coat proteins, cargo selection, vesicle budding and vesicle fusion.

Unit: II

Carbohydrates: Classification, chemical and optical properties of carbohydrates; Role of monosaccharides in important biological reactions; Oligosaccharides and polysaccharides (sucrose, starch, cellulose, hemicelluloses, pectins).

Lipids: Classification; Biological functions of triacylglycerols, phospholipids, glycolipids, sphingolipids and cholesterol.

Unit: III

Amino acids: Occurrence, structure and classification of amino acids; Properties of amino acids, stereoisomerism in amino acids.

Proteins: Protein structure; Protein folding (concept of chaperones); Fibrous and globular proteins (α -keratin, collagen, haemoglobin); Actin, myosin and molecular motors (overview).

Unit: IV

Enzymes: Mechanism of enzyme action; Kinetics of single substrate enzyme catalyzed reactions— Michaelis-Menton equation; Enzyme inhibition and allosteric regulation.

Nucleic acids: Nucleotides, Phosphoryl group transfer and ATP; RNA splicing; DNA damage and repair mechanisms; Transposable elements in prokaryotes and eukaryotes (examples from bacteria and maize).

Practical Work:

- Extraction and estimation of total titrable acidity in plant extract.
- Effect of various physical and chemical treatments on membrane permeability.
- Preparation of calibration graph for the estimation of starch and proteins.
- Determination of the time course of diastase action on starch.
- Determination of polyphenol oxidase activity.
- Extraction of proteins from fresh material.

SEMESTER III

BR17302CR: Secondary Metabolites

Unit: I

Phenolic compounds and isoprenoids: Phenolic compounds— occurrence and classification; Shikimic acid pathway for synthesis of phenolic compounds; Terpenes— Occurrence; Classification based on isoprene rule; Biosynthesis of terpenes; Importance of rubber as a bioresource;

Steroids: Occurrence, structure and biological functions of major plant and fungal steroids.

Unit: II

Alkaloids: Introduction, occurrence, classification based on nitrogen heterocyclic ring; Use of alkaloids by humans from historical perspective; Nomenclature (true, proto and pseudo-alkaloids); Biological functions of alkaloids; Non protein amino acids; Glycosylated N-containing toxins.

Unit: III

Plant pigments: Classification; Chlorophyll— structure, biosynthesis and properties; Carotenoids— structure, occurrence and biological function of carotenes and xanthophylls; Flavonoids— structure, occurrence and biological function of anthocyanins, flavonols, flavones; Phenolics and Quinoids— structure, occurrence and function (naphthaquinones, anthraquinones, tannins, lignins); Indole derivatives— structure, occurrence and function (betalains, phytomelanins, indigo).

Unit: IV

Importance of secondary metabolites: Perspectives in human health; Effect of biotic and abiotic stresses on secondary metabolites in plants; Allelopathic effects of secondary metabolites; Taxonomic significance of secondary metabolites.

Practical Work:

- Separation of pigments from leaf extract using phase separation method.
- Detection of presence of phenolics, alkaloids and flavonoids in plant material.
- Preparation of calibration graph for the estimation of total phenols.
- Estimation of free radicle scavenging activity of plant extract.
- Study the effect of pH on the anthocyanins from fruit extracts.

SEMESTER IV**BR15004DCE: Bioinformatics****Unit: I**

Bioinformatics databases: Bioinformatics— concept and application; Types of databases- Genome (NCBI, EBI, TIGR, SANGER), Nucleic acid (EMBL, GeneBank, DDBJ), Protein (SwissProt, TrEMBL, PIR) databases; Structural classification of proteins (SCOP, CATH).

Unit: II

Sequencing: Conventional and next generation sequencing; Basic Concept of sequence similarity, identity and homology; Sequence based database searches (blast, fasta, gcg, msf, nbrf-pir etc.); Homologues, orthologues, paralogues; Sequence alignment (pair-wise and multiple); Gene finding and genome annotation; **Transcriptomics:** DNA Microarray, Serial analysis of gene expression, Qualitative RT PCR.

Unit: III

Emerging areas of bioinformatics: Computational systems biology, semantic web; Bioontologies (types, application, softwares), annotations; Proteomics— separation, identification of proteins, MS-MS, protein microarray, protein expression profiling, protein- protein interaction mapping; Metabolomics, cheminformatics, phenomics.

Unit: IV

Phylogenetics: Morphological & molecular phylogeny; Representation of molecular phylogeny; Methods of phylogeny— maximum parsimony, likelihood and Bayesian method; Distance methods (UPGMA, NJ); Softwares (PHYLIP, Tree base, Mesquite, NTSY SPC).

Tutorials: 3 hours/week

SEMESTER III

BR17303CR: Biostatistics and Biotechniques

Unit: I

Data types and collection: Data on ratio, interval, ordinal and nominal scales; Continuous and discrete data; Methods of primary and secondary data collection and their limitations.

Processing and analysis of data: Measures of Central Tendency— arithmetic mean, mode, median; Measures of dispersion— mean deviation, variance, standard deviation, coefficient of variation.

Unit: II

Testing of hypothesis: Basic concept, procedure for hypothesis testing, test of difference between means— independent and paired samples, test of proportions and test of goodness of fit.

Sampling techniques: Principles and steps in sample survey; Procedures and practices involved in simple random sampling, systematic, stratified and cluster sampling.

Unit: III

Design and analysis of experiments: Principles of experimentation; Experimental designs— layout, analysis of variance and comparison of treatments in completely randomised design, randomised complete block design and factorial experimental designs.

Correlation and regression: Basic idea of correlation; Simple correlation— calculation of correlation coefficient; Simple linear regression— calculation of regression coefficients.

Unit: IV

Microscopy & spectroscopy: Principle, working & application of fluorescence, phase contrast, scanning electron and transmission electron microscopy; Principle and working of a spectrophotometer; Application of spectroscopic techniques (UV-visible, IR, NMR).

Chromatography: Paper, thin layer, Gas-liquid chromatography; Ion exchange, adsorption and molecular exclusion chromatography; High performance liquid chromatography (HPLC); Radioisotopes— applications in biology.

Practical Work:

- Collection of data from field and construction of frequency tables.
- Diagrammatic and graphical representation of data.
- Comparison of populations on the basis of mean value of parameters, standard deviation and standard error.
- Analysis of variance (one way).
- Demonstration of scanning electron microscopy (SEM).
- Use of paper and thin layer chromatography for the separation of plant pigments.
- Study the principal and working of colorimeter and UV- Visible spectrophotometer.

CORE COURSES

SEMESTER IV

BR17401CR: Plant Resources and Biotechnology

Unit: I

Plant tissue culture: Concept and applications of plant tissue culture; Cellular totipotency; Cell culture and cell cloning; Micropropagation— regeneration through callus cultures, adventitious buds and non adventitious systems (apical and axillary buds); Production of somatic embryos; synthetic seeds (concept); Somatic hybrids & cybrids (Brief idea).

Unit: II

Genetic engineering: Introduction, scope and applications; Cloning vectors— Plasmids, cosmids, phages, artificial chromosomes; Expression vectors; Recombinant DNA technology— Restriction enzymes, ligation, transformation and selection; Construction of genomic and cDNA libraries; Gene transfer methods in plants— *Agrobacterium* mediated gene transfer; Physical methods of gene transfer; Reporter genes.

Unit: III

Molecular markers: PCR— principle and applications, RFLP, RAPD, AFLP, SSR, SNPs, SCARs & their applications; Molecular cytogenetic markers— FISH and GISH, their applications; Quantitative trait loci (QTL) mapping— introduction and types of mapping populations.

Unit: IV

Genetically modified crops: Transgenics for biotic and abiotic stress (insect resistance, virus resistance, herbicide resistance); Modification of plant nutritional content (vitamins, aminoacids, lipids, Iron); GMO's— ecological and ethical concerns.

Biotransformation: Plants as Bioreactors; Transgenic plants for biochemical production— edible vaccines, and secondary metabolites.

Practical Work:

- Demonstration of plant tissue culture technique (sterilization, media preparation and inoculation).
- Isolation of plant genomic DNA by CTAB method.
- Visualization of DNA by Agarose Gel Electrophoresis.
- Demonstration of Polymerase Chain Reaction.
- Preparation of mitotic chromosome preparation from root tips.

SEMESTER IV

BR17402CR: Animal Cell and Tissue Technology

Unit: I

Animal cell and tissue culture: History, scope and applications; Culture media, culture procedures and techniques; Transfection, targeted transfection, transient and stable transfections; Large scale culture of cell lines for production of biomolecules (viral vaccines, interferons, recombinant proteins and hybrid antibodies).

Unit: II

Culture products: Somatic cell fusion, hybridoma technology and production of monoclonal antibodies.

Stem cells: Stem cell lines– origin and types, stem cell therapy and its applications.

Immunodiagnosics: Blood grouping; Rh typing; Immuno electrophoresis; Enzyme linked Immuno Sorbent Assay (ELISA); Radio Immuno Assay (RIA).

Unit: III

Tissue engineering: Concept, approaches, prospects and limitations; Biomaterials for tissue engineering; Tissue engineering of skin and haemoglobin-based blood substitutes; Artificial womb technology.

Unit: IV

Animal cloning: *In vitro* fertilization and embryo transfer; Cloning livestock by nuclear transplantation; Production of transgenic animals with special reference to transgenic mice, cow and sheep; Identification and transfer of genes influencing milk quality and disease resistance.

Practical Work:

- Preparation of culture media for animal cells by filter sterilization methods.
- Establishment of primary cell culture - chick embryo.
- Study the antigen-antibody reactions to determine blood groups.
- Study the differential morphology of human leucocytes.
- Study the cell count using a haemocytometer.
- Comparative studies of haemin crystal in mammals: humans, cow and goat.
- Demonstrate phagocytic activity (phagocytosis) in the insect cells.
- Demonstrate the presence of natural biomaterial chitin in the insect integument.

SEMESTER IV

BR17403CR: Microbial Technology

Unit: I

Microbial genome: Bacterial genome structure, replication (DNA and plasmid); Genetic exchange (transformation, transduction and conjugation); Recombination (hosts, vectors and mechanism); Replication of Bacteriophages: Viral multiplication (lytic and lysogenic).

Unit: II

Culturing of microbes: Isolation and screening of microorganisms; Cultivation of microbes- nutritional requirements and factors affecting microbial growth (pH, temperature, water, oxygen, CO₂); Culture types— static cultures, suspension cultures; synchronous cultures, growth curve, generation time, growth kinetics; Storage and transportation of microbes.

Unit: III

Fermentation technology: Introduction; Types of fermentation (aerobic, anaerobic), fermentors and their types, substrates for fermentation; Role of enzymes in various fermentation processes; Microbial chemostat cultures; Scale-up of cultivation of microorganisms; Microbes in beverages and food production (wine, beer, bread, cheese); Advantages of fermented foods.

Unit: IV

Economic importance of microbes: Major commercial microbial products (amino acids, enzymes, steroids, therapeutic agents and biopolymers); Single Cell Proteins; Role of microbes in bioremediation; Microbes as bioindicators; Biodefence and bioterrorism; Role of microbes in waste water treatment.

Practical Work:

- Estimation of CO₂ in water samples obtained at different stages of Sewage Treatment Plant (STP).
- Estimation of dissolved oxygen in given water sample.
- Check the efficacy of antibiotics on a given microbial sample.
- To grow bacteria from cheek sample of mouth on nutrient medium.
- Study the preparation of yogurt.
- Study the procedure to ascertain the milk quality.

Course No:	BT-17206 -DCE	Maximum marks	75
Course title:	Laboratory Course II		
Credits:	Three		

1. Media Preparation
2. Isolation of Genomic DNA and RNA.
3. Agarose Gel electrophoresis and Quantification of DNA and RNA.
4. Immunoprecipitation (IP).
5. SDS-PAGE and Western Blotting.
6. Assay of Enzyme activity.
7. Effect of temperature and pH on enzyme activity.
8. Determination of Kinetic constants K_m and V_{max} .
9. Preparation of plant tissue culture media.
10. Plant Tissue Culture

Course No: BT-17306 -DCE

Maximum marks

75

Course title: Laboratory Course III

Credits: Three

1. Competent cell preparation
2. Bacterial Transformation
3. Plasmid Isolation
4. PCR gene amplification.
5. Restriction Digestion
6. Gene cloning
7. GST protein expression and purification
8. Animal Cell Culture.

Course No: CH14107EO
Title: Chemistry in Everyday Life-I (04 Credits)

Max. Marks: 100
External Exam: 80 Marks.

Duration: 64 Contact hours
Internal Assessment: 20 Marks

Unit-I: **(16 contact hours)**

(a) Household Chemicals

Soaps, detergents, Optical brightens and bleaching agents.

Haircare products: Shampoos , Conditioners ,Dyes, Hair curlings and Permanents.

Deodorants and Antiperspirants

Perfumes, Tooth Pastes and Sunscreen lotions.

(b) Agro Chemicals:

Composition and properties of soil, Inorganic and Organic components of soil.

Plant nutrients: Secondary and micro nutrients and their functions.

Fertilizers: Inorganic and Organic fertilizers.

Insecticides, Pesticides and herbicides, Environment and health problems with synthetic pesticides.

Alternate method of insect control: Pheromones , Hormones and Biological control.

Neem: The Worlds Pharmacy.

Unit II: **(16 contact hours)**

Polymers and Plastics: Characteristics and Types of Polymers.

The big six of Polymer: Low Density Polyethylene (LDPE) , High Density Polyethylene (HDPE), Polypropylene PP), Polystyrene (PS), Polyvinyl Chloride (PVC) and Polyethylene - Tetra phthalate (PET or PETE) : their chemical characteristics and uses.

Chemical Features and Applications/Uses of other Polymers: Natural rubber, Synthetic rubber, Polyesters, Polyamides, Polyurethanes, Polyacrylonitriles, Polystyrene and Teflon.

Personal Polymers: Teflon ear bone, Fallopian tube, Heart valve, Contact lenses.

Problems with Polymers: Disposal, Recycling and Environmental concerns.

Ceramics: Composition, structure and properties of ceramics. How to make ceramics.

Silicate Ceramics: Potteries and Clay products. Glass (composition of various glasses),

Cements: Composition of Portland cement.

Unit-III:

(16 contact hours)

(a) Carbohydrates: Definition, classifications. Significance of right and left handedness.

Production through photosynthesis

Composition and functions of Monosaccharides : Glucose, Fructose and Galactose.

Disaccharides: Sucrose, lactose and Maltose. Invert Sugar.

Polysaccharides: Starch, glycogen and Cellulose.

Aerobic and Anaerobic metabolism

(b) Lipids: Oils and Fats : Fatty acids and Triglycerides. Saturated and Unsaturated fatty acids (MUFA and PUFA). Rancidity of Oils & Fats. Absorption of toxic substances by fat.

Steroids: Cholesterol, transport of Cholesterol in blood stream. Cholesterol and heart diseases, Recommended values of HDL and LDL , Steroidal hormones and anabolic steroids

Unit-IV:

(16 contact hours)

Proteins: Introduction Amino Acids, Structural features and classification. Primary, Secondary, Tertiary and Quaternary structures of proteins and their significance. Denaturation and Renaturation of proteins. Urea cycle.

Enzymes: Classification. Theories of mechanism of action of Enzymes ; Fisher Lock and Key Theory, Koshland's Induced Fit Theory. Mechanism of action of Chymotrypsin and Carboxypeptidase.

Nucleic acids: Features and functions of DNA and RNA.

Vitamins: Classes of Vitamins and their functions. Vitamin deficiency diseases.

Minerals: Macro and Micro minerals. Their functions and diseases caused by their deficiencies.

Books Recommended :

1. Chemistry in Context, 4th Ed.; Applying Chemistry to Society (McGraw Hill) – 2013.
2. Principles of Modern Chemistry, 2nd Ed. , Oxtoby and Nachtrieb , (Saunders College Publications) – 1987.
3. Chemistry Fundamentals - An Environmental Prospective ; 2nd Ed. , Buell and Girad, (Jones and Barlett) – 2013.
4. www.chemistryincontext (American Chemical Society)

Course No: CH14205EA
Title: Analytical Techniques. (04 Credits)

Max. Marks: 100

External Exam: 80 Marks.

Duration: 64 Contact hours

Internal Assessment: 20 Marks

Unit-I: Chromatographic techniques (16 Contact hours)

Introduction, Types and Classification; principles – differential migration, nature of partition forces, partition, Mobile phases, stationary phases, resolution, separation time, zone migration, column packing materials, development techniques, differential migration, partition coefficient, retention time, retention volume..

Plate theory, HETP, band broadening, efficiency and resolution. Basic principles and applications of–Liquid-Solid and Liquid-Liquid column chromatography. Paper and thin layer chromatography, ion exchange (size exclusion),

Gas-Liquid chromatography. HPLC-theory, column efficiency, extra column and band broadening, temperature effects and diffusion. Chiral chromatography, chiral stationary phases, applications of HPLC, Electrophoresis.

Unit- II: Electroanalytical and Thermal Methods (16 Contact hours)

Electrophoresis: Factors affecting ion migration, electro-osmosis, theory and applications of capillary electrophoresis.

Polarography – diffusion current, half-wave potential, Ilkovic equation, DME. (Applications in organic/inorganic analysis).

Amperometric titrations-Basic principle and applications.

Coulometry and Electrogravimetry: Electrogravimetry, Controlled-Potential Coulometry, Constant-Current Coulometric Titrations.

Thermal Methods; Thermogravimetry (TG/TGA), Differential Thermal analysis (DTA), Differential scanning calorimetry (DSC), Thermometric titrations

Unit-III: Magnetic Resonance Spectroscopy (16 Contact hours)

Basic principles-Nuclear spin, spin angular momentum, quantization of angular momentum, nuclear magnetic moment, precessional (Larmor) frequency, energy levels in a magnetic field, resonance absorption of radio frequency radiation. Population of energy levels, Relaxation processes (T_1 , T_2).

Shielding and deshielding of magnetic nuclei. Chemical shift, its measurement and factors influencing chemical shifts; local paramagnetic and diamagnetic shielding, neighboring group anisotropy.

Spin- Spin coupling, coupling constants. Low and high resolution ^1H NMR spectrum of protons undergoing chemical exchange (ethanol). Chemical equivalence and magnetic equivalence. Double resonance techniques; spin decoupling, nuclear overhauser enhancement.

Instrumentation; FT-NMR and its advantages. NMR studies of nuclei other than proton – ^{13}C , ^{19}F and ^{31}P .

Unit-IV: Electron Spin Resonance spectroscopy (16 Contact hours)

Basic principles- electron spin, magnetic moment of an electron and its interaction with applied magnetic field. Splitting of spin energy states and absorption of microwave radiation.

Hyperfine coupling, Isotropic and anisotropic hyperfine coupling constants, Fermi contact, Spin polarization effects, Dipolar coupling, McConnell equation and calculation of spin densities in inorganic radicals such as CO_2^\bullet , CH_3^\bullet , BH_3^\bullet and F_2^\bullet .

Spin orbit coupling and significance of g tensors.

Zero field splitting and Kramer's degeneracy (fine structure), Applications

Books Recommended:

1. Chromatographic methods A.Braithwaite and F.J.Smith fifth edition-kluwer academic publishers 1999 ISBN 0751401587
2. Essence of Chromatography Colin.F.Poole-Elsevier.Inc
3. Principles and Practice of Analytical Chemistry, 5th Edition, F. W. Fifield, D. Kealey, Balckwell Sciences Ltd. 2000.
4. Modern Analytical Chemistry, David Harvey, McGraw-HillHigher Education, 2000.

Course No: CH14207EO
Title: Chemistry in Everyday Life-II (04 Credits)

Max. Marks: 100
External Exam: 80 Marks.

Duration: 64 Contact hours
Internal Assessment: 20 Marks

Unit I **(16 Contact hours)**

Water- An Amazing Chemical Stuff.

Molecular structure and its unique properties. Distribution of water on earth. Water content of various organisms and food material. Composition of natural water. The Hydrologic cycle: Recycling & purification.

Hard and Soft water. Standards for drinking water. Major causes of water pollution. Contamination of water: Chemical substances affecting potability, color, turbidity, odour, taste, pH and conductivity of water. Methods of treatment of water for domestic and industrial purposes: Sedimentation, Coagulation, Filtration, Sterilization, Break point Chlorination, Flocculation & Fluorination, demineralization and reverse osmosis. Determination of alkalinity of water. Water born diseases.

Unit II **(16 contact hours)**

Fossil Fuels- Coal, Oil & Natural Gas.

Coal: Formation of Coal deposits. Types & composition of coal. Fuel value of various coals. Analysis of coal: Proximate and ultimate analysis. Significance of fuel gas analysis. Carbonization of coal. Manufacture of metallurgical coke by Otto Hoffman's by product oven.

Oil & Natural Gas: Formation of oil fields, composition & chemical structures of petroleum products. Refining of petroleum, cracking & catalytic reforming. Octane & Cetane rating of fuels. Diesel engine fuel, Kerosene and Gasoline. Lead in petrol: its role, disadvantages & alternatives. LPG & CNG as fuel, addition of mercaptanes to natural gases for safety reasons.

Alternative Fuels: Ethanol, Bio-fuels, Bio-gas, Hydrogen & Fuel cells.

Unit III: Nutrition **(16 contact hours)**

Digestive Processes: Breaking down of larger molecules into smaller molecules undergoing metabolism like carbohydrates, Proteins, fats and Vitamins. Aerobic and Anaerobic Metabolism of Carbohydrates. Role of Fat in Animal Metabolism.

Energy value of Nutrients: Fats and oils, sweets, vegetables and fruits. Counting of energy calories. Per day energy requirements.

Food Additives: Flavoring agents, Preservatives (antimicrobial and antioxidant agents). Shelf life of food material. Artificial sweeteners.

Food Adulterants: Adulterants in Milk, Ghee, Oil, Coffee, Tea, Chilli & Turmeric Powders & Pulses

Unit IV: Forensic Chemistry

(16 contact hours)

Introduction. History of forensic science, Theory of forensic analysis. Fingerprint development, Ninhydrin, Silver Nitrate and Phenolphthalein reactions. Cyanoacrylate and Luminol Tests. Alcohol Detection. Drug Analysis. Hair , Urine and Blood Analysis. DNA fingerprinting. Superglue fuming.

Soil Analysis: pH, Microscopic and Chromatographic Analysis. Instrumentation.

Books recommended

1. Industrial Chemistry by B.K.Sharma. (Goel publishing House).
2. Applied Chemistry by K.Bagavathi. (Sundan MJP Publishers)
3. Text book of Engineering Chemistry by S.S. Dara. (S.Chand and Co)
4. Engineering Chemistry by M.M.Uppal. & S. Bhatia. (Khanna Publishers)
5. Engineering Chemistry by J.C.Kuricose & J.Rajaram (Tata McGraw Hill)
6. General Organic and Bio-chemistry by Bettelheim and Brown. (Campbell books/cole) - 2009
7. Forensic Chemistry by Suzana Bell (Pearson Prentice-Hall)- 2006
8. Forensic Chemistry Handbook by Lawrence Kobilinsky (John Wiley & Sons Inc.) - 2012
9. [http:// www.aafs.org](http://www.aafs.org)
10. <http://www.fbi.gov>.

Course No: CH14305EA
Title: Industrial Pollution and Green Chemistry (04 Credits)

Max. Marks: 100

External Exam: 80 Marks.

Duration: 64 Contact hours

Internal Assessment: 20 Marks

Unit-I: Industrial Pollution. (16 Contact hours)

Industrial Pollution: Cement, Sugar, Drug, Paper and pulp. Thermal power plants, Nuclear power plants and Polymers.

Radio nuclide analysis: Disposal of wastes and their management.

Unit-II: Environmental Toxicology (16 Contact hours)

Principles of Toxicology; Dose Response Relationship; Risk assessment and management.

Organochlorine Compounds: Accumulation and fate in biological systems. Toxicology of PCBs, Dioxins and Furans; Health effects in humans.

Environmental Estrogens.

Unit-III: Green Chemistry-Theory (16 Contact hours)

Introduction: Need for Green Chemistry and the role of chemists. Principles of Green Chemistry.

Tools of Green Chemistry:- Selection of starting materials, Catalysts, Alternative Solvents, Appropriate reagents, Percentage atom utilization. Microwaves and Sonication.

Unit-IV: Green Chemistry-Practice (16 Contact hours)

Green Solvents and Reaction conditions: Supercritical fluids, Aqueous reaction conditions, Immobilized Solvents and irradiative reaction conditions.

Examples of Green materials, reagents and some specific reactions.

Books Recommended:

1. Environmental Chemistry; 8th edn.; S. E. Manahan; CRC Press; 2005.
2. Chemistry of the Environment; 2nd edn.; T. G. Spiro and W. M. Stigliani; Prentice Hall; 2002.
3. Environmental Chemistry; 2nd edn.; Colin Baird; Freeman & Co.; 1991.
4. Chemistry of the Environment; 2nd Edn. R. A. Bailey; H. M. Clark; J. P. Ferris; S. Krause & R. L. Strong; Elsevier; 2005.
5. Environmental Chemistry; 2nd edn.; Samir K. Banerji; Prentice- Hall; 2001.
6. Green Chemistry- Environment Friendly Alternatives; Rashmi Sanghi & M. M. Srivastava; Narosa; 2007.
7. Green Chemistry- An Introductory Text; 2nd Edn.; Mike Lancaster; RSC; 2010.
8. Green Chemistry- Theory and Practice; P. T. Anastas and J. C. Warner; oxford; 2000.
9. Green Chemistry; 1st Edn.; Samuel Delvin; IVY Publishing House; 2008.
10. Green Chemistry- Environmentally Benign Reactions; V. K. Ahluwalia; Ane Books; 2006.

Course No: CH14307EO
Title: Philosophy of Science (04 Credits)

Max. Marks: 100
External Exam: 80 Marks.

Duration: 64 Contact hours
Internal Assessment: 20 Marks

Unit-1: Representation. (16 contact hours)

Laws of nature; Knowledge, Sources of knowledge, The rationalists, The empiricists, The Mathematical knowledge, Synthetic Knowledge, Science as knowledge source, Religion and science The Method of science, Induction versus deduction, Representation and reason, minimalism about laws, Laws and counter-factuals, Probabilistic laws, Basic and derived laws, Laws, Regularities and Induction, Necessitation,

Explanation; Kinds of explanation

Natural Kinds; Kinds and classification, Natural kinds and explanatory role.

Realism; Realism and its critics, Instrumentalism, Constructive empiricism, Laws and anti-realism, Anti-realism and inference, Anti-realism and structure of science.

Unit-2: Reason (16 contact hours)

Inductive Scepticism; Theory and observation, Dissolving the problem of Induction, Probability and scientific inference, Kinds of Probability, Classical statistical reasoning.

Inductive Knowledge; Reliabilist epistemology, reasoning with induction, Innate epistemic capacities and reasoning about induction, Internalism and justification.

Method and Progress; Methodology of scientific research programmes, Clinical trials and the scientific method, The content of discovery and the context of justification, Science without the scientific method, Method and the development of sciences, Paradigms and Progress.

Unit-3: Classical Determinism and Probabilistic world (16 contact hours)

The Classical Mechanics; Mechanistic determinism, General principles; Equations of motion, Action at a distance, Electric and magnetic forces, The Failures of the classical mechanics; Atomic structure, The problem of radiation, Motion in time and space.

The birth of modern science; The photo-electric effect, The atomicity of radiation, Particle-wave duality, waves of probability, Uncertainty principle, subject versus object, The fundamental laws of radioactivity; The new Quantum theory; wave mechanics, Diracs Quantum mechanics, The new philosophical principles; the probabilistic reasoning.

Unit-4: The Dawn of Modern Thinking (16 contact hours)

The arrow of Time: From Descartes to quantum theory. The relation of quantum theory to other natural sciences. Language and reality in modern science. The role of modern science in the present development of human thinking.

Books Recommended:

1. Philosophy of science, Alexander Bird, McGill-Queen's University Press.
2. Physics and Philosophy, W. Heisenberg, Harper Perennial Modern Classics
3. Physics and Philosophy, Sir James Jeans, Cambridge University Press
4. Reconstruction of religious thought in Islam, Muhammad Iqbal, Adam Publishers & Dodo Press
5. Philosophy of natural science, Carl G. Hempel, Pearson.
6. The philosophy of science, David Papineau, Oxford University Press.
7. Reality and Representation, David Papineau, Blackwell Publication.
8. Belief, truth and knowledge, D.M. Armstrong, Cambridge University Press.
9. Modern epistemology, Nicholas Everitt and Alec Fisher, McGraw-Hill Higher Education.
10. The structure of scientific revolution, Thomas S. Kuhn, The University of Chicago Press.

Course No: CH14415EA
Title: Chemistry of Materials (02 Credits)

Max. Marks: 50

External Exam: 40 Marks.

Duration: 32 Contact hours

Internal Assessment: 10 Marks

Unit-I: Langmuir Blodgett Films and Liquid crystals (8 Contact hours)

Langmuir- Blodgett Films: Introduction and general preparative techniques. LB Films of various compounds (hydrocarbon, liquid crystals compounds and polymers), Applications – nonlinear optical effects, conduction, photoconductivity and sensors.

Liquid Crystals: Mesomorphism, types of liquid crystals, molecular structural requirement of mesomorphism, properties of liquid crystals, Applications – Liquid crystal displays, thermography, optical imaging and ferroelectric liquid crystals.

Unit- II: Organic Solids and Molecular Devices (8 Contact hours)

Organic solids and fullerenes: Organics conductors, magnetism in organic materials. Fullerenes- History, bonding, properties, doped fullerenes, fullerenes as superconductors and fullerene related compounds (carbon nanotubes)

Molecular devices: Molecular rectifiers and transistors, artificial photosynthetic devices, switches and sensors.

Unit-III: Optical materials (8 Contact hours)

Luminescence and phosphors. Lasers – general principle of lasing action, Ruby laser, Neodymium-YAG lasers, semiconducting lasers, quantum cascade and quantum dot lasers.

Nonlinear optical effects, second and third order harmonic generation, nonlinear optical materials.

Unit- IV: Superconductors (8 Contact hours)

Super conductors: Characteristic properties- Zero resistance, Meissner effect, Heat capacity, Thermal conductivity, absorption of em radiations and Josephson effect. BCS theory of superconductivity, High T_c superconductivity in cuprates: Structure, preparation and characterization of 1-2-3 materials, mechanism of high T_c superconductivity.

Unconventional superconductors: Heavy-fermion superconductors, metal-oxide superconductors, organic superconductors, Applications of high T_c materials.

Books Recommended:

1. Introduction to Solids, Azaroff, Tata McGraw, 1993.
2. Solid State Chemistry and its Applications, West, Wiley, 1989.
3. The Physical Chemistry of Solids, Borg, Biens, Academic press, 1992.
4. Solid State Physics, N. W. Ashcroft and N. D. Mermin, Saunders college, 2001
5. Principles of Solid State, H. V. Keer, Wiley Eastern.
6. Thermotropic Liquid Crystals, Ed., G.W. Gray, John Wiley.
7. The Physics and Chemistry of materials, J.I. Gersten, F.W. Smith, John Wiley and sons, Inc. 2001.

Course No: CH14417EO
Title: Chemistry of the Environment (04 Credits)

Max. Marks: 100

External Exam: 80 Marks.

Duration: 62 Contact hours

Internal Assessment: 20 Marks

Unit –I: Environment and Soils. (16 Contact hours)

Introduction, Segments of Environment; factors affecting Environment. Biogeochemical cycles of C, N, P, S and O.

Nature and Composition of Soil: Air, Water, Inorganic Components, Organic matter and Humus. Macro and Micronutrients in Soil. Acid--Base and Ion exchange reactions in Soil.

Pollution: Fertilizers, Pesticides, Plastics and Metals.

Unit-II: Hydrosphere: (16 Contact hours)

Chemical composition of water bodies: - Lakes & rivers ; Factors determining composition (thermal stratification, acid-base, pE concept).

Aquatic pollution: Inorganic, Organic, Pesticide, Agricultural, Industrial and Sewage. Water quality parameters: Dissolved oxygen, Metals, Content of Chloride, Phosphate, Nitrate, and Microorganisms. Water quality standards.

Analytical Methods for determining BOD, DO, COD, and metals (As, Cd, Hg, Pb & Se) Choice of methods for determination.

Purification and treatment of water (Chlorination, Ozonation, UV radiation)

Unit-III: Atmosphere. (16 Contact hours)

Chemical Composition of Atmosphere: particles, ions, radicals and their formation. Vertical profile of atmosphere, Heat budget of earth s atmospheric system. Chemical and Photochemical Reactions in Atmosphere, Photochemical Smog formation; Oxides of N, C, S and their effects, Sun screens ; Ozone chemistry. Pollution by Chemicals (chlorofluorocarbons, hydrocarbons, O₃)

Green House Effect; Acid Rain; their chemistry and control, Atmospheric Window. Analytical Methods for measuring Air Pollutants.

Continuous monitoring instruments.

Unit-IV: Environmental Toxicology and Industrial Pollution. (16 Contact hours)

Principles of Toxicology; Dose Response Relationship; Risk assessment and management.

Organochlorine Compounds: Accumulation and fate in biological systems. Toxicology of PCBs, Dioxins and Furans; Health effects in humans.

Environmental Estrogens.

Industrial Pollution: - Cement, Sugar, Drug, Paper and pulp. Thermal power plants, Nuclear power plants and Polymers

Radio nuclide analysis: Disposal of wastes and their management..

Books Recommended:

1. Environmental Chemistry; Nigel.J.Bunce; Wurez Publishers; 1991.
2. Environmental Chemistry; 2nd edn; Colin Baird; Freeman &Co; 1991.
3. A Textbook of Environmental Chemistry; O.D.Tyagi & M.Mehra; Anmol Publishers; 1990.
4. Environmental Chemistry; A.K.De; Wiley Eastern;1995.
5. Environmental pollution Analysis; S.M.Khopkar; Wiley Eastern.
6. Environmental pollution; B.K.Sharma& H.Kaur; Goel Publishers;1996.
7. Environmental Toxicology; Ed.Rose; Gordon & Breach Science Publishers.
8. Environmental Chemistry; S.E.Manahan; Lewis Publishers;2000

CLB15103CR: Lab course-I

- Biochemical calculations
- Concept of pH and buffers
- Qualitative analysis of carbohydrates
- Qualitative analysis of amino acids
- Qualitative analysis of lipids
- TLC and paper chromatography amino acids and sugars
- Quantitative Estimation of proteins using Lowry's/ Biurett method
- Quantitative Estimation of glucose by Nelson Somogy's method
- Quantitative Estimation of cholesterol by Zlatki's Method
- Titrimetric estimation of ascorbic acid
- Sterilization techniques
- Preparation of culture media, pure culture techniques
- Study of bacterial growth by turbidimetry/ spectrophotometry and serial dilution methods
- Extraction and Assay of Enzymes

CLB15203CR: Lab Course-II

- Isolation of bacterial genomic DNA
- Isolation of Plasmid DNA
- Preparation of genomic DNA from Plant tissue by CTAB method
- Isolation of DNA from blood samples by Phenol-Chloroform method
- Qualitative and quantitative determination of DNA
- Absorption spectra of Nucleic Acids and Determination of melting temperature of calf thymus DNA.
- Denaturation of DNA and UV absorption studies.
- Agarose gel electrophoresis
- Polyacrylamide gel electrophoresis (PAGE) and SDS- PAGE
- Amplification of DNA segment by PCR

CLB15303CR: Lab Course-III

- Estimation of serum albumin and determination of albumin/globulin ratio.
- Estimation of serum triglycerides, total cholesterol, HDL cholesterol, LDL cholesterol.
- Estimation of serum bilirubin
- Estimation of serum acid phosphate, alkaline phosphate, ALT and AST and their clinical use
- Estimation of serum urea and creatinine
- Urine analysis – Routine and microscopic examination
- Sub Cellular fractionation and marker enzymes activity
- Estimation of serum of normal and sickle hemoglobin
- Estimation of T3, T4, and TSH by ELISA/RIA
- Estimation of antinuclear antibodies and C reactive protein
- Separation of mononuclear cells by Ficoll-Hypaque.
- TLC/ DLC
- Estimation of non-protein nitrogen, urea, urate, creatine and creatinine.
- Tests for urinary proteins
- Tests for lipids and lipoproteins
- Estimation of cholesterol
- Estimation of Na^+ , K^+ and Cl^-
- Estimation of Ca^{++} , Mg^{++} and P
- Estimation of Fe^{+2} , Cu^{+2} and Zn^{+2}
- Estimation of porphyrins and hemoglobin
- Tests for gastric function, occult blood
- Tests for liver and billiary tract diseases
- Tests for renal diseases

SEMESTER IV

CLB15401CR: Internship Dissertation

Internship represents a cross-over point between university and career. The experience one gets during an internship will indicate how he/she should structure future studies, particularly when it comes to deciding what aspects one should focus on. Students carry their internship program outside the parent department wherein project work will be carried out, based on research and actual bench work under the guidance of their respective supervisor at the place of internship. The department facilitates the students for placement for their internship. During the program the students are in close touch with their respective teachers in the department. The students are expected to put at least six working hours daily for a maximum period of six months. At the end of the internship, the internship dissertation will be submitted in the parent department and evaluated.

CLB15402CR: Host Institute Grading

During the internship, the students will be critically evaluated by the supervisors and will be graded by them based on their attendance in the lab, daily experimental work, writing and communication skills and other criteria related to routine lab work.

CLB15403CR: Internship Assessment

This will include an openers enation, defending their dissertation work to be evaluated by an external examiner (to be nominated by Head of the Department) and all the faculty members. The presentation will be followed by the viva of the students to be carried out by the external examiner.

Course Outcome: Students will be taken to field and exposed to socio-economic and geo-physical environment of any region, so that they are able to evaluate the different dimensions of vulnerability, exposure, and risk. The students will also get familiar with the important aspects which shall be kept in mind while preparing disaster management plan of any region. Pertinently, in the field studies course each student shall have to prepare a brief field report according to the nature and purpose of the field.

Credit-I

1. **Activities-** Preparation of Field Visit Plan
2. Application of Spatial Tools
3. Validation and Interpretation of Satellite Data in the Field
4. GPS Field Data Collection and Mapping

Credit-II

1. **Activities-** Identification and Interpretation of Geological Structures and Major Geomorphic Features in the Field
2. Interpretation of Landslide Surface Morphology
3. Visit to Flood Prone Areas and Inundation Assessment
4. Field Evaluation of Environmental Factors Responsible for Snow Avalanche Occurrence

Credit-III

1. **Activities-** Questionnaire Designing
2. Collection of Socio-Economic Data in the Field
3. Collection of Data Pertaining to Vulnerability and Hazards.

Credit- IV

1. Preparation of Disaster Management Plan

Suggested Readings

- David Lambert, 2007, The Field Guide to Geology,
- Enrico L. Quarantelli, and Russell Dynes, 2007, Handbook of Disaster Research, Havidan Rodriguez,
- Robert A. Stallings, 2003, Methods of Disaster Research.

15. Karmakar, A. K. 2010. BoP Theory and Policy – The Indian Experience, Deep & Deep Publications, New Delhi
16. Krueger, A.O. (ed). 2002. Economic Policy Reforms and the Indian Economy. New Delhi: OUP.
17. Mohan, R. (ed). 2002. Facets of the India Economy. New Delhi: OUP
18. National Human Development Report various issues. New Delhi : OUP
19. Pushpangadan, K. and N. Shanta. 2009. The Dynamics of Competition: Understanding India's Manufacturing Sector. New Delhi: OUP.
20. Panagariya, A. 2008. India: The Emerging Giant. USA: OUP.
21. Rakshit, M. 2008 a. Macroeconomics of Post-Reforms India. New Delhi: OUP.
22. Rakshit, M. 2008 b. Money and Finance in the Indian Economy. New Delhi: OUP.
23. Radhakrishna, R. and S. Ray (Eds.). 2005. Handbook of Poverty: Perspectives, Policies and Programmes. New Delhi : OUP
24. Reddy, Y.V. 2004. Lectures on Economic and Financial Sector Reforms in India. New Delhi: OUP.
25. Sikdar, S. 2002. Contemporary Issues in Globalization: An Introduction to Theory and Policy in India. New Delhi: OUP.
26. Tendulkar, S. and T. A. Bhavani. 2007. Understanding Reforms. New Delhi: OUP.
27. Vaidyanathan, A. and K. L. Krishna. 2007. Institutions and Markets in India's Development. New Delhi: OUP.
28. Economic and Political Weekly and Other Selected Journals- Selected Issues

SEMESTER- III

Advanced Econometrics

Course code: Eco-14304EA

Unit 1 Dynamic Econometric Models and Panel Data Models

Autoregressive and distributed lag models- Koyak model, Partial adjustment model, adaptive expectations, Almon approach to distributed-lag models, Panel data- Introduction; Balanced and unbalanced panel; Pooled Model, Fixed effects model and Random effect model.

Unit 2 Simultaneous Equations Models

Simultaneous equation models; Introduction and examples; The simultaneous equation bias and inconsistency of OLS estimators; The identification problem; Rules of identification- order and rank conditions; Methods of estimating simultaneous equation system, Indirect least squares (ILS); 2SLS.

Unit 3 Time Series Analysis

Stochastic Difference equations, Stationarity, unit roots, co-integration-spurious regression, Dickey-Fuller test, Engle-Granger test, Random walk model, Error correction mechanism, Casuality test, Granger and Sim's tests. Forecasting with ARIMA modeling; Box-Jenkins methodology; Vector autocoregression; Problems with VAR modelling – Applications

Unit 4 Applications

Introduction of Econometric Softwares (MS- Excel and STATA): Creating a work file, Entering Data into a work file, Graphing, Generating new Variables, Getting Data, Importing Data, Exporting Data.

Applications: Estimation and hypothesis testing of regression models, Growth rate estimation, Empirical estimation of demand, production and cost functions.

Empirical Research Report Writing.

Reading List

1. W. Enders, (2003) 2nded; Applied Econometric Time Series.
2. F.B Christopher; An Introduction to modern Econometrics using STATA, STATA Press.
3. A.S. Goldberger, (1998), Introductive Econometrics, Harvard University Press, Cambridge, Mass.

4. D.N. Gujarati, (1995), Basic Econometrics (4th Edition), Mcgraw Hill, New Delhi.
5. P. Kennedy, (1998) 4th ed; A Guide to Econometrics, MIT Press, New York.
6. K.L Krishna (Ed.); Econometric Applications in India.
7. G.S Maddala (Ed.), (1993), Econometric Methods and Application (2 Volumes)
8. W.H Greene, 5thed; Econometric Analysis, Prentice Hall.
9. A.C Cameron and P.K Trivedi; Microeconometrics using STATA, STATA Press.
10. STATA Manual, STATA Press.
11. A.S Deaton; The Analysis of Household Surveys: a Micro-Econometric Approach to Development Policy.

SEMESTER- III

Mathematical Economics

SEMESTER- I

Mathematics for Economics

Course code: Eco-14103CR

Unit 1 Basic Concepts

Set Theory: Sets and set operations, Cartesian product of sets, Relations, Functions, one-to-one and onto functions, bijective functions, Composite functions, Inverse functions and Binary operations. Logarithm and Exponents.

Unit 2 Differentiation

Limit, Continuity and Differentiability of a function, Rolle's Theorem, Mean Value Theorems, Taylor's Theorem. Indeterminate forms and L'Hôpital's Rule; Differentiation—Rules of Differentiation, Partial and Total differentials, Derivatives of Implicit functions, Higher Order Differentiation, Euler's theorem; Uses of Differentiation in Economics' -Constrained Optimization, Langragian Multiplier; Marginal Concepts - Relationship Between Average, Marginal and Total, Elasticities.

Unit 3 Integration

Integration: Indefinite and Definite Integrals, Definite Integral, Fundamental Theorems of Integral, Economic Application of Integrals: Consumer's Surplus, Producer's Surplus, Investment and Capital formation.

Unit 4 Matrix Algebra

Matrices: Types and Operations, Determinants, Transpose, adjoint and inverse of a matrix, Rank of a matrix, Cramer's rule, Matrix inversion method, Jacobian and Hessain Rule. Characteristic equation, Eigen values and Eigen vectors.

Reading List

1. R. G. D Allen, (2003); Mathematical Analysis for Economists, The Macmillan Press, New Delhi.

2. A.C Chiang, (1984); Fundamental Methods of Mathematical Economics, Tata McGraw Hill,
3. D. T. Edward, (2008); Introduction to Mathematical Economics, Tata McGraw Hill, Delhi.
4. M. J. Henderson, (2006); Microeconomics Theory, Tata McGraw- Hill, New Delhi.
5. T. Yamane, (1995); Mathematics for Economists, Prentice Hall of India, New Delhi.
6. J. W. Boumal, (2000); Economic Theory and Operation Analysis, Prentice Hall of India, Delhi
7. S. C. Gupta and V. K. Kapoor; Fundamentals of Mathematical Statistics, Himalaya publishing House, New Delhi.

SEMESTER- I

Statistical Methods

Course code: Eco -14104EA

Unit 1 Probability and Distribution

Meaning and definition of Probability, Probability Rules; Addition Rule; Multiplication Rule, Bay's theorem Concept of a random variable: Discrete and continuous; Mathematical Expectation , Expected values of a random variable, Variance of a random variable, Discrete random variables- Bernoulli , Binomial, Poisson, Continuous random variables: The normal distribution, Chi-square distribution. Joint and marginal distributions for bivariate random variables; Conditional probability, Conditional mean and variance.

Unit 2 Theory of Sampling and Estimation

Theory of sampling; Types of sampling, Small and large samples, Sampling distribution: distribution of sample mean, Central limit theorem. Estimation: Types of estimators and their properties, Point and Interval estimates of mean, Characteristics of good estimator: small and large sample properties.

Unit 3 Hypothesis Testing

Testing of hypothesis: Level of significance and Level of confidence, Confidence limits and Critical Region; Tests of significance- Type I and II errors, Goodness of fit, One tailed and two tailed tests; Hypothesis testing based on Z test, t tests, Chi-square and F tests; Analysis of variance.

Unit 4 Correlation Regression and Economic Forecasting

Correlation—meaning and scope: Karl Pearson's Coefficient of Correlation; rank Correlation; Partial and Multiple Correlation, Regression-Meaning and Scope; Simple and Multiple Regression. Forecasting-

Paper ENS 102: Environmental Chemistry

Total Marks: Terminal Examination: 80

Internal Assessment: 20

Marks will be distributed equally among the four units. The question paper will be divided into three sections. Section A will contain eight very brief answer (10 – 20 words each) type questions (two from each unit), each carrying 2 marks. Section B will contain four medium answer (200 – 250 words) type questions (one from each unit), each carrying 8 marks. Section C will contain four long answer (400 – 500 words) type questions (one from each unit), each carrying 16 marks. While all the questions from Section A and B are to be attempted by a candidate, from Section C only two questions are to be attempted.

Unit I: Analytical & Environmental Chemistry

(12 hrs. approx.)

- 1.1. Stoichiometry
- 1.2. Acid-base reactions
- 1.3. Titrimetry
- 1.4. Gravimetry
- 1.5. Solubility of gases in water

Unit II: Instrumentation techniques

(12 hrs. approx.)

- 2.1. Principle and working of pH and conductivity meter
- 2.2. Spectrophotometry and flame photometry
- 2.3. Absorption and emission spectrophotometry
- 2.4. Chromatography - paper, TLC, GLC, HPLC
- 2.5. Radioactive tracers
- 2.6. NMR & ESR

Unit III: Chemistry of atmosphere and soil

(12 hrs. approx.)

- 3.1. Thermo-chemical and photochemical reactions in the atmosphere and their effects
- 3.2. Chemistry of oxygen, ozone and other oxidants
- 3.3. Soil profile and Pedogenesis
- 3.4. Inorganic and organic components of soil
- 3.5. Physico- Chemical properties of soils

Unit IV: Water Characteristics

(12 hrs. approx.)

- 4.1. Lake optics
- 4.2. Thermal phenomena in lakes and streams
- 4.3. Dissolved gases in water - CO₂, DO₂, H₂S and NH₃ and Biochemical oxygen demand and chemical oxygen demand
- 4.4. Carbonate system
- 4.5. Redox equilibria
- 4.6. Phosphorus and nitrogen in inland waters

BIBLIOGRAPHY

1. Environmental Chemistry: IAN Williams
2. Physical Chemistry: Puri, Sharma & Pathani
3. Environmental Chemistry: A. K. De
4. Environmental Chemistry: Stanley E. Manahan
5. An Introduction To Analytical Chemistry: S.A. Iqbal & M. Satake
6. Chromatography Of Environmental Hazards: Lawrence Fishbein
7. Principles Of Biochemistry: Wilson Walker
8. Electron Spin Resonance: J.E. Wertz And J.R. Bolton
9. Analytical Chemistry: D. Kealey And P.J. Haines
10. Text Book Of Quantitative Chemical Analysis: G.H. Jeffery, J. Basset, J. Mendham and R.C. Denney
11. The Surface Chemistry Of Soils: Garrison Sposito
12. The Nature & Properties Of Soils: Brady & Weil
13. Soils In Our Environment: Miller And Gardiner
14. Soil Genesis And Classification: Boul, Hole & Mccacken
15. Essentials Of Geology: Chernicoff, Fox, Venkatakrishnan
16. Text Book Of Limnology: Gerald A. Cole
17. Limnology: S.C. Agarwal
18. Limnology: R. G. Wetzel
19. A Treatise On Limnology: G. E. Hutchinson Vol I - III
20. Limnology. Goldman And Horne
21. Limnology. P. S. Welch
22. A text book of environmental chemistry: Tyagi and Mehra.
23. Soil in the environment: Daniel Hillel.
24. Weathering (An introduction to scientific principles): Bland and Rolls.
25. Soil fertility and fertilizers: Havlin et al.
26. Soil erosion and its control: R P C Morgan.
27. Soil properties: Liu and Evett.
28. Soil science and management: Edward J plaster.
29. Soils (An introduction): Singer and Munns.
30. Basic concept of environmental chemistry: Des W Connel.
31. Basic physical chemistry of the atmospheric science: Peter V Hobbs.
32. Environmental chemistry: Fritz Helmet.
33. Introductory chemistry for environmental science: Harrison and De Mora.
34. An introduction to environmental chemistry: Andrews et al.
35. Stream ecology: Barness and Mishall.
36. Aquatic Ecology: Mishra and saksena.
37. Advances in limnology: H R Singh.
38. High speed liquid chromatography: Rajcsanyi and Rajcsanyi.

43. Aquaculture technology and environment: Jadhoo.

Laboratory Course – ENS 111

(First Semester)

Marks: 200 (Internal Assessment 40 + Terminal Exam 160) Time 5hrs.

Course Contents

1. Estimation of volume of a water body – pond, pool, lake
2. Estimation of rate of flow of water.
3. Determination of water renewal time in a water body
4. Determination of the soil texture in different terrestrial habitats – agriculture land, wasteland, forest, desert and alpine pastures
5. Determination of temperature of soil, water and air samples.
6. Estimation of meteorological parameters.
7. Determination of latitude, longitude and altitude of a place
8. Study of major rock types.
9. Determination of light intensity in different habitats
10. Standardization of reagents – titrants (acids, bases).
11. Determination of pH, conductivity, alkalinity and acidity of water samples.
12. Estimation of pH, conductivity, alkalinity and acidity of sediment and soil samples.
13. Estimation of free carbon dioxide content in polluted and unpolluted waters.
14. Estimation of chloride content in different water bodies
15. Estimation of chloride content in different soil samples.
16. Estimation of cations (calcium, magnesium, sodium, potassium) water samples
17. Estimation of cations (calcium, magnesium, sodium, potassium) soil samples
18. Determination of Beer-Lambert's law.
19. Study of working of Spectrophotometer, Flame Photometer, Atomic Absorption Spectrophotometer and Ion Chromatograph.
20. Collection and Identification of herbs occurring naturally in University campus
21. Determination of primary productivity in terrestrial and aquatic habitats.
22. Productivity and biomass estimation of litter fauna.
23. Study of the pharmacognostic characters of important medicinal plants.
24. Collection and Identification of common aquatic macrophytes.
25. Collection and identification of the fish fauna of different aquatic habitats.

Paper ENS 202: Environmental Toxicology

Total Marks: Terminal Examination: 80

Internal Assessment: 20

Marks will be distributed equally among the four units. The question paper will be divided into three sections. Section A will contain eight very brief answer (10 – 20 words each) type questions (two from each unit), each carrying 2 marks. Section B will contain four medium answer (200 – 250 words) type questions (one from each unit), each carrying 8 marks. Section C will contain four long answer (400 – 500 words) type questions (one from each unit), each carrying 16 marks. While all the questions from Section A and B are to be attempted by a candidate, from Section C only two questions are to be attempted.

UNIT I: Principles of Toxicology

(12 hrs. approx.)

- 1.1. Definition, scope, goals and divisions of toxicology
- 1.2. Dose - response relationship
- 1.3. Factors affecting environmental concentration of toxicants
- 1.4. Factors influencing toxicity
- 1.5. Toxicity of chemical mixtures
- 1.6. Statistical concept of toxicity

UNIT II: Xenobiotics & Toxicity Testing Methods

(12 hrs. approx.)

- 2.1. Membrane permeability & mechanism of chemical transfer
- 2.2. Absorption & translocation of xenobiotics
- 2.3. Membranous barriers, binding of xenobiotics & storage depots
- 2.4. Excretion of xenobiotics
- 2.5. Toxicity testing methods (single & multi - species, acute, sub-acute and chronic toxicity tests)
- 2.6. Bioassay and its applications in toxicology

UNIT III: Toxicants as Public Health Hazard

(12 hrs. approx.)

- 3.1. Pesticides
- 3.2. Automobile emissions
- 3.3. Heavy metals
- 3.4. Fertilizers
- 3.5. Food additives
- 3.6. Radioactive substances

UNIT IV: Bio-magnification of Xenobiotics

(12 hrs. approx.)

- 4.1. Biomagnification of pesticides, heavy metals and radioactive substances
- 4.2. Biomagnification- study methods (microcosm)
- 4.3. Compartment models
- 4.4. Biotransformation: general principles and types of biotransformation
- 4.5. Antidotal procedures in toxicology
- 4.6. Chemical safety evaluation

BIBLIOGRAPHY

1. Physical Chemistry: Puri, Sharma & Pathani
2. Environmental Toxicology: M. Satake, Y. Mido, M.S. Sethi , S. A. Iqbal, H. Yasuhisa & S. Taguchi
3. Toxicology: P.D. Sharma
4. Introduction To Toxicology: J. Timbrell
5. Environmental Chemistry: Stanley E. Manahan
6. Modern Toxicology: Vol. I P.K. Gupta
7. Environmental Chemistry: S.C. Bhatia
8. Environmental Chemical Hazards: Ram Kumar
9. Pollution Management III Pesticide Pollution: S.K. Agarwal
10. Pollution Management IV Heavy Metal Pollution : S.K. Agarwal
11. Pesticides Man & Biosphere: O.P. Shukla, Omkar, A.K. Kulshretha
12. Pesticides & Environment: G.S. Dhaliwal, Balwinder Singh
13. Agricultural Pollution: Vol I S.G. Mishra, Dinesh Mani
14. Metallic Pollution: S.G. Mishra, Dinesh Mani
15. Chemicals In The Environment: Y. Mido & M. Satake
16. Fundamentals Of Environmental Chemistry: Stanley E. Manahan
17. Introductory Chemistry For Environmental Sciences: Harrison And Mora
18. Environmental Chemistry: B.K. Sharma
19. Environmental Chemistry: A. K. De
20. The Handbook Of Environmental Chemistry: O. Hutzinger Vol III Part A Anthropogenic Compounds
21. Environmental Toxicology: Ming- Ho- Yu
22. Toxicology: The Basic Science of Poison. Klaassen, C.D.
23. Principles and Methods of Toxicology. Hayes, A.W.
24. Statistics in Ecotoxicology. Sparks, T. (Editor).
25. Basic Toxicology: Fundamentals, Target organs, and Risk Assessment. Lu.
26. Toxicology of Insecticides. Matsumura, F.
27. Water contamination and health. Wang, R.G.M. (Editor).
28. Metal toxicity and tolerance in plants. Singh, V. P.

Credit IV: Environmental economics**(16 hrs)**

- 1.1. Environmental economics: Definition and scope
- 1.2. Population, poverty and environment
- 1.3. Concept of intangibles and externalities
- 1.4. Environmental evaluation methods: Hedonic pricing, contingent evaluation and household production function
- 1.5. Carbon credits and trading

ENS14108EO: Plant morphogenesis, Cyto-genotoxicity & Herbal Medicine (04 credits)**Credit I: Plant morphogenesis and regeneration****(16 hrs)**

- 1.1. Initiation, nutrition and maintenance of plant cell and tissue culture
- 1.2. Cellular totipotency, initiation of callus cultures and its characteristics
- 1.3. Cell differentiation and organogenesis
- 1.4. Suspension culture
- 1.5. Tissue culture studies of some threatened medicinal plants of Kashmir Himalaya

Credit II: Herbal medicine and health care**(16 hrs)**

- 1.1. Traditional Herbal Medicines for Healthcare and Management of Human diseases
- 1.2. Medicinal and aromatic materials from plants
- 1.3. Benefits of Medicinal and aromatic plant materials
- 1.4. Industrial utilization of medicinal plants
- 1.5. Phytochemical and anti microbial studies of some medicinal plants

Credit III: Cyto-genotoxicity**(16 hrs)**

- 1.1. Necrosis, apoptosis and inflammation
- 1.2. Somatic and genetic risk of environmental pollutants.
- 1.3. Cancer latency, threshold and non-threshold model of cancer
- 1.4. Mechanism of chemical carcinogens (free radicals and alkylating agents)
- 1.5. Classification of carcinogens (physical, chemical and biological agent)

Credit IV: Toxicogenomics (Testing protocols)**(16 hrs)**

- 1.1. Ames test and micronucleus test
- 1.2. Chromatid and chromosome aberration
- 1.3. Screening, tier testing and test batteries for mutagenicity testing
- 1.4. FISH technique
- 1.5. Use of Comet assay in environmental toxicology

Bibliography

- Environmental Science. Botkin, Keller
- Environmental Science. Cunningham, Saigo
- Environmental Science. Jackson & Jackson

- Environmental Science. Tyler Miller
- Essentials of Geology. Chernicoff, Fox, Venkatakrishnan
- Physical Geology. Monroe & Wicander
- Concepts of Ecology. E.J. Kormondy
- Atmosphere, Weather & Climate. R.G. Barry & R.J. Chorley
- Environment: Principles & Applications. Chris Park.
- Earth Systems. W.G. Ernst
- Environmental Science - Physical Principles & Applications. Boeker & Grondelle
- Fundamentals of Physical Environment. Briggs, Smithson, Addison & Atkinson
- Atmosphere, Weather & Climate. R.G. Barry & R.J. Chorley
- Geosystems: An Introduction to Physical Geography. Robert W. Christopherson
- Introducing Physical Geography. Alan Starhler & Arthur Starhler
- Earths Dynamic Systems. W.K. Hamblin & E.H. Christiansen
- Soils in our Environment. Miller and Gardiner
- Fundamentals of Soils. J. Gerrard
- Environmental Science. Enger and Smith
- Basics of Environmental Science. Michael Allaby
- Principles of Environmental Science. Cunningham and Cunningham
- Environmental Sciences (System and Solutions). Mckinney and Schoch
- Principles of atmospheric physics and chemistry. Goody
- Smoke, Dust and Haze. S K Friedlander
- General Climatology. H. J. Critchfield
- Environmental Chemistry. IAN Williams
- Environmental Chemistry. A. K. De
- Environmental Chemistry. Stanley E. Manahan
- An Introduction to Analytical Chemistry. S.A. Iqbal & M. Satake
- Chromatography of Environmental Hazards. Lawrence Fishbein
- Principles of Biochemistry. Wilson Walker
- Electron Spin Resonance. J.E. Wertz And J.R. Bolton
- Analytical Chemistry. D. Kealey And P.J. Haines
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- Basic physical chemistry of the atmospheric science. Peter V Hobbs

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- An introduction to environmental chemistry. Andrews et al.
- Stream ecology. Barness and Mishall
- Analytical mass spectrometry. Budde
- Primary Productivity of the Biosphere. Helmut Lieth & Robert H. Whittaker
- Tropical Ecosystems & Ecological Concepts. Patnick L. Osborne
- Concepts of Ecology. E.J. Kormondy
- Ecology & Environmental Management. C.C. Park
- Ecology of a Changing Planet. Mark B. Bush
- Ecology for Environmental Sciences: Biosphere, Ecosystems & Man. J. M. Anderson
- Fundamentals of Ecology. E.P. Odum
- Instant Notes in Ecology. Mackenzie, Ball & Virder
- Primer of Ecological Theory. Jonathan Roughgarden
- Ecology with special reference to Animals and Man. S. Charles, Kendeigh
- Evolutionary Ecology. Eric R. Pianka
- A Primer of Ecology. Nicholas J. Gotelli
- Ecology Theories and Applications. Peter Stiling
- Applied Ecology and Natural Resource Management. Guy R. Mcpherson and Stephen Destefano
- Population Ecology. Begon & Mortimer
- Geosystems: An Introduction to Physical Geography. Robert W. Christopherson
- Physical Geology. Plummer, Mc. Geary, Carlson
- Physical Geology. Monroe & Wicander
- Essentials of Geology. Chernicoff, Fox, Venkatakrishnan
- Earths Dynamic Systems. W.K. Hamblin & E.H. Christiansen
- Introducing ecology. Cotgreave and Forseth
- Community ecology. Diamond and Case
- Community ecology. R J Putman
- Biodiversity and conservation. Michael J Jeffries
- Environmental Geology: Principles & Practice. Fred G. Bell
- Physical Geology. Monroe & Wicander
- Economic Geography - A Study of Resources. Prithwish Roy
- Environmental Science. Cunningham, Saigo
- Fish & Fisheries of India. V.G. Jhingram
- Concepts of Ecology. E.J. Kormondy
- River Jhelum, Kashmir Valley. L. Nyman
- Natural Resources and Environmental Technology. Jasper S Lee
- Himalayan Glaciers. Naseerudin Ahmed, Sarwar Rais
- Wildlife Wilderness. G.A.Bhat
- Range ecology. Humphrey
- Flowers of the Himalaya. Adam Stainton
- Wildlife resources. Anderson.
- Microclimate - The Biological Environment, 2nd ed. Normal J. Rosenverg, Blaine L. Blad, Shashi B. Verma
- Atmospheric Change. Graedel and Crutzen
- Atmospheric, Weather and Climate. R.G. Barrey and R.J. Chorley
- Geosystems- An Introduction to Physical Geography. Robert W. Christopherson
- Physical Geology. Plummer, Mc. Greary, Carlson
- Essentials of Geology. Wicander & Monroe
- Earths Dynamic Systems. W.K. Hamblin & E.H. Christiansen

- The Global Casino. Nick Middleton
- Natural Hazard Mitigation. Godschalk, Beatley, Berke, Brower & Kaiser
- Active Tectonics. E. Keller & N. Pinter
- Environmental Chemistry. M. Satake & Y. Mido
- Earth's Dynamic Systems. W.K. Hamblin & E.H. Christiansen
- Physical Geology. Wicander & Monroe
- Environmental Chemistry. Stanley E. Manahan
- Environmental Chemistry. M. Satake, Y. Mido, M.S. Sethi & S. A. Iqbal
- Environmental Chemistry. Ian Williams
- Our Geologic Environment. H. Blatt
- Environment. Raven, Berg and Johnson
- Environmental Science. Botkin, D.B. and Keller, E.A.
- Environmental Science. Nebel, B.J. and Wright, R.T.
- Environmental Geography. Marsh, W.M. and Grossa, Jr. J.M.
- Environmental Oceanography. Abel, D.C. and Mc Connell, R.L.
- Resources of the Earth. Craig, J.R., Vaughan, D.J. and Skinner, B.J.
- Natural Hazards and Disasters. Hyndman, D. and Daudley, N. (Editors)
- Environmental Geochemistry. Eby, G.N.
- Environmental Hydrogeology. Soliman, M.M., LaMoreaux, P.E., Memon, B.A.,
- Mineralogy. Perkins, D. Assad, F.A. and LaMoreaux, J.W.
- Environmental Law, the Economy and Sustainable Development. Revesz, Sands and Stewart
- Higher Education in India. Mehraj-ud-Din
- Environmental Economics and Policy. Tietenberg
- Issues in Environmental Economics. Hanley and Roberts
- Importance of Wildlife Conservation from Islamic Perspective. H.S.A. Yahya
- Psychology. Jhon J. Seamon, Douglas and T. Kenrick
- Society in Focus – Introduction to Sociology. William E. Thompson and Joseph V. Hickey
- Clinical Approach to Rural Development. E.D. Setty
- Environmental psychology. Annete Bolger
- Environment and Society. Francis Moore
- Environmental Economics-A Critical Overview. Alan Gilpin
- The economics of the environment and natural resources. R. Quentin Graflon et al.

General Instructions for the Candidates

1. The first semester is of 24 credit weightage.
2. A candidate has compulsorily to opt for 12 credits from the core component.
3. A candidate has a choice to opt for any 12 credits (3 papers) out of minimum of 16 credits (4 papers) offered as Electives (Allied).
4. A candidate can earn more than the minimum required credits (i.e., more than 96 credits for four Semester programme) which shall be counted towards the final result of the candidate.

COURSE DESCRIPTIONS OPEN ELECTIVE

ENS17OE01: Environmental Ethics and Sociology (2 Credits)

Unit I

- 1.1. An introduction to environmental ethics and philosophy
- 1.2. Ethics in society
- 1.3. Responsibility for environmental degradation
- 1.4. Theories of environmental ethics and philosophy
- 1.5. Resource consumption patterns and the need for equitable utilization

Unit II

- 1.1. Role of agriculture in socio-economic development
- 1.2. Land reforms and Bhoodan movement in India
- 1.3. Community development projects
- 1.4. Rural social structure
- 1.5. Ecological theories of urbanization and urban social problem

ENS17OE02: Global Environmental Problems (02 Credits)

Unit I

- 1.1 Acid rain
- 1.2 Ozone depletion
- 1.3 Deforestation
- 1.4 Biodiversity loss
- 1.5 Global warming and climate change

Unit II

- 1.1. Role of an individual in conservation of natural resources
- 1.2. General idea about environmental laws
- 1.3. International conventions (Stockholm declaration)
- 1.4. Kyoto protocol and Montreal protocol
- 1.5. Earth summit

ENS17OE03: Environmental Protection (02 Credits)

Unit I

- 1.6. Role of an individual in conservation of natural resources
- 1.7. General idea about environmental laws
- 1.8. International conventions (Stockholm declaration)
- 1.9. Kyoto protocol and Montreal protocol
- 1.10. Earth summit

Unit II

- 1.1. Environment management
- 1.2. Control of soil, water and air pollution
- 1.3. Solid and hazardous waste management
- 1.4. Biodiversity conservation
- 1.5. Natural resource management

ENS17OE04: Sustainable Development (2 credits)

Unit I

- 1.1. Concept and strategies of sustainable development
- 1.2. Principles of ecological economics – scope and usefulness
- 1.3. Prey-predator and supply-demand cycles

ENS14201CR: Environmental Pollution and its Control - I
(Air, Noise and Radioactive Pollution)

(04 credits)

Credit I: Air pollution

(16 hrs)

- 1.1. Sources, classification and properties of primary and secondary air pollutants
- 1.2. Pollutant behaviour in atmosphere
- 1.3. Smog and acid rain
- 1.4. Ozone layer depletion
- 1.5. Global warming and climate change

Credit II: Control of air pollution

(16 hrs)

- 1.1. Indoor air pollution and its control: smoke, HCs, particulate matter, Radon
- 1.2. Air quality standards and Monitoring of air pollution: SO_x, NO_x, CO, SPM and hydrocarbon
- 1.3. Control of particulate, gaseous air pollution - SO_x, NO_x, CO and green house gases
- 1.4. Plume Rise and Design of Stack height
- 1.5. Bio-filters and control of air pollution

Credit III: Noise pollution and its control

(16 hrs)

- 1.1. Noise pollution: Definition and sources
- 1.2. Measurement of Noise and sound pressure level,
- 1.3. Equivalent sound pressure level (Leq), Noise pollution level (NPL), Sound exposure level (SEL), Traffic noise index (TNI), Day-Night level (DNL), noise criteria curves
- 1.4. Impact of noise on human health and environment
- 1.5. Noise control and abatement measures

Credit IV: Thermal and radioactive pollution and its control

(16 hrs)

- 1.1. Thermal pollution: causes and consequences
- 1.2. Control of thermal pollution
- 1.3. Radioactive pollution: causes and consequences
- 1.4. Types of radioactive pollutants and their sources
- 1.5. Radioactive waste management and control

ENS14202CR: Environmental Pollution and its Control - II
(Soil and Water Pollution)

(04 Credits)

Credit I: Land degradation and soil pollution

(16 hrs)

- 1.1. Causes and kinds of land degradation and Soil Pollution
- 1.2. Desertification: causes, consequences
- 1.3. Soil erosion: causes, assessment and environmental impacts
- 1.4. Fate of pesticides in soil
- 1.5. Industrial waste effluents and heavy metals and their interaction with soil components

Credit II: Control of land degradation and soil pollution

(16 hrs)

- 1.1. Control of soil pollution
- 1.3. Soil conservation and control of soil erosion

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(16 hrs)

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Credit II: Control of land degradation and soil pollution

(16 hrs)

- 1.1. Control of soil pollution
- 1.3. Soil conservation and control of soil erosion

- 1.2. Waste lands and their reclamation
- 1.4. Sustainable agricultural practices
- 1.5. Integrated pest management

Credit III: Water pollution

(16 hrs)

- 1.1. Sources and types of water pollution
- 1.2. Lake eutrophication and stream pollution
- 1.3. Petroleum hydrocarbons and marine pollution
- 1.4. Ground water pollution
- 1.5. Biocides and Heavy metals and their impact on aquatic life

Credit IV: Control of water pollution

(16 hrs)

- 1.1. Water and waste water standards
- 1.2. Control of eutrophication and restoration of lakes
- 1.3. Wetland conservation
- 1.4. Role of aquatic plants in pollution abatement
- 1.5. Control of Stream pollution and Groundwater Management

ENS14203CR: Laboratory Course

(04 credits)

Course Contents

1. Determination of silt load of a stream / river
2. Estimation of total dissolved and suspended solids in water
3. Determination of rate of soil erosion in different ecosystems
4. Estimation of dissolved oxygen, BOD, COD and dissolved organic matter in different waters
5. Estimation of organic carbon and organic matter in different soils samples
6. Estimation of nitrogen (NH_3 , NO_2 and NO_3) and phosphorus (ortho- and total) in different waters
7. Estimation of phosphorus and nitrogen content in different soil samples
8. Estimation of dissolved silica and sulphate in different water bodies
9. Estimation of gaseous pollutants (SO_x , NO_x) and SPM in industrial emissions
10. Determination of SO_x , NO_x and SPM in ambient air
11. Qualitative and quantitative estimation of phytoplankton and periphyton community in different aquatic habitats
12. Qualitative and quantitative analysis of zooplankton in relation to eutrophication
13. Study of leaf pigment by paper chromatography and TLC methods
14. Comparative anatomical study of mesophytes, hydrophytes and xerophytes
15. Chemical characterization of ground water
16. Study of dose – effect relationships in important toxicants/pollutants
17. Estimation of protein and carbohydrate content in biological samples
18. Application of diversity indices in aquatic and terrestrial ecosystems
19. Spring and stream order classification
20. Biochemical tests for different enzymes

- 1.2. Waste lands and their reclamation
- 1.4. Sustainable agricultural practices
- 1.5. Integrated pest management

Credit III: Water pollution

(16 hrs)

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19. Spring and stream order classification
20. Biochemical tests for different enzymes

DISCIPLINE CENTRIC ELECTIVE

ENS17204DCE: Atmospheric Science

(04 credits)

Unit I: The atmosphere

- 1.1.Introduction to atmospheric science
- 1.2.Atmospheric dynamics
- 1.3.Basic structure and mechanism of atmospheric general circulation,
- 1.4. Monsoon systems, cyclones, anticyclones, jet streams, ENSO
- 1.5.Air-sea interactions

Unit II: Climatology

- 1.1.Fundamentals of climatology
- 1.2.Classification of climate: Koppen's and Trewartha
- 1.3.Climatic zones of India
- 1.4.Climate of J&K
- 1.5. Paleo-climatology and climate change

Unit III: Atmospheric aerosols

- 1.1.Introduction and types of aerosols
- 1.2.Sources, transformation, geographical distribution and atmospheric effects
- 1.3.Chemical composition of aerosols
- 1.4.Carbonaceous aerosols: Black carbon
- 1.5.Global cooling versus global warming

Unit IV: Atmospheric data analysis

- 1.1.Dry and wet atmospheric deposition
- 1.2.LIDARS, SODARS, weather RADARS
- 1.3.Remote-sensing techniques (WP-RASS)
- 1.4. Self recording instruments, radiosondes, radiometersondes, ozone sonde
- 1.5. Climate modeling

ENS17205DCE: Environmental Microbiology

(04 credits)

Unit I: Microbial ecology

- 1.1.History and scope of microbiology
- 1.2.General account of micro-organisms
 - a. Bacteria
 - b. Fungi, algae and viruses
 - c. Protozoa
- 1.3.Interactions between microbes and other organisms
- 1.4. Factors affecting growth of microorganisms
- 1.5. Brief introduction to thermophiles, barophiles, acidophiles, alkalophiles and psychrophiles

Unit II: Microbes and environment

- 1.1. Nature and function of micro-organisms in soil, water and air
- 1.2. Microbial spoilage of food and its preservation
- 1.3. Microbial activity in sewage disposal
- 1.4. Application of micro-organisms in the control of

- a. Oil pollution
- b. Chemical pollution - pesticides, synthetic polymers, and metals
- c. Bio-deterioration of materials
- 1.5. Role of microbes in fixation and solubilization / mineralization of nutrients: carbon, nitrogen, phosphorus, sulphur

Unit III: Microorganisms and human health

- 1.1. Human health and environment: MMR, IMR, Life expectancy, morbidity
- 1.2. Status of communicable diseases in India
- 1.3. Epidemiology (reservoir of infection, communicability and control)
 - a. Air borne diseases: tuberculosis, influenza viruses
 - b. Soil borne diseases: tetanus and gas-gangrene
 - c. Water and food borne diseases: cholera, typhoid, giardiasis, hepatitis
- 1.4. Allergic diseases
- 1.5. Insect vectors of human diseases like malaria, dengue, encephalitis, and their control

Unit IV: Industrial microbiology

- 1.1 Major products of industrial microbiology - Antibiotics, amino acids and biopolymers.
- 1.2 Fermentation technology and bioprocessing
- 1.3 Role of microbiology in metallurgy.
- 1.4 Basic techniques in molecular biology - PCR and electrophoresis
- 1.5 Biosafety levels in microbiology labs.

ENS17206DCE: Green Environment

(02 Credits)

Unit II: Ecotourism

- 1.1. Ecotourism: concept and significance
- 1.2. Tourism in National Parks, sanctuaries, wetlands and other landscapes
- 1.3. Concept of tourism carrying capacity
- 1.4. Tourism policy
- 1.5. Ecotourism potential in J&K

Unit IV: Green cities

- 1.1. Concept of green buildings and cities
- 1.2. Green belt
- 1.3. Consumer behavior
- 1.4. Sustainable urban traffic management
- 1.5. Green city: a case study

ENS17207DCE: Ecological Tour

(02 credits)

During 2nd semester, students are required to go for institutional visit to various academic and research institutions outside Jammu & Kashmir carrying 02 credits and will form a component of Elective Allied. One credit will be given for participation and one credit for Tour report and viva voce.

COURSE DESCRIPTIONS GENERIC ELECTIVE

ENS17GE01: Basics of Ecology and Environment (2 credits)

Unit I

- 1.1 Importance of environment
- 1.2 Components of environment-Atmosphere, hydrosphere, lithosphere and biosphere
- 1.3 Human and environment relations
- 1.4 Environment and development
- 1.5 Tools for environmental management

Unit II

- 1.1 Structure and functions,
- 1.2 Natural and managed ecosystem
- 1.3 Ecosystem goods and services
- 1.4 Ecological Succession
- 1.5 Ecological Interactions

ENS17GE02: Biogeography (2 credits)

Unit 1

- 1.1. Biodiversity and its importance
- 1.2. Threats to biodiversity
- 1.3. Hotspots of Biodiversity
- 1.4. Major biomes of the world: Distribution and characteristic features
- 1.5. Biogeography: Processes and patterns

Unit II

- 1.1. Geographical classification and zones
- 1.2. Zoogeographic realms of the world: Palaearctic, Nearctic, Neotropical, Oriental, Australian and African
- 1.3. Dispersal: Means, modes and barrier
- 1.4. Migrations
- 1.5. Conservation Biogeography

ENS17GE03: Analytical Instrumentation (02 credits)

Unit I

- 1.1. Stoichiometry
- 1.2. Titrimetry and gravimetry
- 1.3. Visible and UV spectroscopy
- 1.4. Atomic absorption spectrophotometry
- 1.5. Principle and applications of microscopy

Unit II

- 1.1. Chromatography-Basic Principle and its classification
- 1.2. Ion-exchange Chromatography
- 1.3. Gas liquid Chromatography/GC-MS
- 1.4. HPTLC and HPLC
- 1.5. Spectro-fluorimetry

ENS17GE04: Environmental Issues (03 credits)

Unit I

- 1.1. History and nature of human population growth
- 1.2. Natural resources, current status and types of resources
- 1.3. Resource depletion

Course Descriptions 3rd SEMESTER

CORE COURSES

ENS17301CR: Natural Resources

(4 credits)

Unit I: Mineral resources

- 1.1. Classification of mineral resources
- 1.2. Metals and minerals from land and their global distribution
- 1.3. Metals and minerals from oceans and their global distribution
- 1.4. Metals and mineral deposits in India with special reference in J&K
- 1.5. Environmental consequences of mineral exploitation

Unit II: Water resources

- 1.1. Inventory of earth's water resources: Surface and groundwater
- 1.2. Water resources of India with special reference to Kashmir
- 1.3. Global water budget
- 1.4. Surface and ground water resources: Global consumption pattern
- 1.5. Water resource management

Unit III: Bio-resources

- 1.1. Animal resources: current status with special reference to India
- 1.2. Fishery resources of India with special reference to J&K
- 1.3. Plant resources
- 1.4. Forest resources of India: Timber and non timber
- 1.5. Rangelands

Unit IV: Energy resources

- 1.1. Renewable energy resources
- 1.2. Non-renewable energy Resources
- 1.3. Nuclear energy
- 1.4. Concept of green fuels
- 1.5. Hydrogen as a source of energy

ENS17302CR: Environmental Impact Assessment

(04 credits)

Unit I: Fundamentals of EIA

- 1.1. Environment impact assessment: Concept, objectives and approaches
- 1.2. Strategic environmental assessment
- 1.3. EIA guidelines 2006 and amendments
- 1.4. Protocol for environment impact statements
- 1.5. Public participation in environmental decision making

Unit II: EIA methodologies

- 1.1. EIA methods
- 1.2. Baseline data generation
- 1.3. Air and water quality assessment
- 1.4. Ecological assessment
- 1.5. Social impact assessment

Unit III: EIA Case studies

- 1.1. Hydro power, irrigation and drainage
- 1.2. Industrial estates and Parks
- 1.3. Highways and Railways
- 1.4. Thermal power projects
- 1.5. Cement and Chemical industries

Unit IV: Ecological modeling

- 1.1. Role of models in ecology
- 1.2. Components of a model
- 1.3. Classes of mathematical models
- 1.4. Models of population (growth and interaction) and pollutant dispersal
 - a. Lotka – Volterra model
 - b. Leslie's matrix model
 - c. Gaussian plume model
- 1.5. Modeling of air quality, water quality and noise characteristics

ENS17303CR: Laboratory Course

(04 credits)

Course Contents

1. Case studies based on environmental laws
2. Survey of different residential areas for determining the prevalence of different air, water, soil and food borne diseases
3. EIA – Leopold Matrix method and case studies
4. Socio-economic studies – preparing of questionnaire and case studies
5. Computation of standard deviation, standard error and coefficient of variation
6. Computation of correlation and regression
7. One way and two way classification of ANOVA
8. Land use / land cover classification from satellite data
9. Delineation of drainage of a given area from satellite data
10. Delineation of point, line and polygon themes
11. Waste auditing of any institution/ organization
12. Working and design of treatment plants
13. Spring and stream order classification
14. Study of colonization potential of periphyton on artificial substrates
15. Study of morphogenetic response of explants on media
16. Collection and demonstration of the pharmacognostic characters of important medicinal plants
17. Comparative anatomical study of mesophytes, hydrophytes and xerophytes
18. Collection and identification of common aquatic macrophytes
19. Field trip to National park/wildlife sanctuary/industrial area
20. Study of insect fauna in different environments

Credit II: Drinking water treatment**(16 hrs)**

- 1.1. Methods of water purification: Flocculation, sedimentation, sedimentation with coagulation
- 1.2. Filtration: Sand filters, pressure filters, horizontal filters
- 1.3. Disinfection and desalination of water
- 1.4. Chemical treatment: Adsorption, gas stripping, ion exchange
- 1.5. Reverse osmosis and distillation

Credit III: Sewage treatment**(16 hrs)**

- 1.1. Wastewater Treatment Plants: Concept, methods and design
 - a. Primary
 - b. Secondary
 - c. Tertiary
- 1.2. Sludge and its disposal techniques
- 1.3. Natural methods of sewage disposal
- 1.4. Biology of sewage treatment
- 1.5. Reclamation and reuse of industrial and domestic wastewater

Credit IV: Solid and hazardous waste management**(16 hrs)**

- 1.1. Sources and generation of solid wastes and their characteristics
- 1.2. Methods of disposal of solid wastes.
- 1.3. Hospital waste management
- 1.4. Hazardous waste: Source, transportation, treatment, storage and disposal
- 1.5. Management of solid, industrial and hazardous wastes and Site remediation

ENS14303CR: Laboratory Course**(04 credits)****Course Contents**

1. Preparation of bacterial smears and gram staining
2. Estimation of bacterial population in different water samples by culture technique
3. Estimation of fungal population in different habitats through culture techniques
4. Case studies based on environmental laws
5. Survey of different residential areas for determining the prevalence of different air, water, soil and food borne diseases
6. EIA – Leopold Matrix method and Case studies
7. Socio-economic studies – preparing of questionnaire and Case studies
8. Computation of standard deviation, standard error and coefficient of variation
9. Computation of Correlation and Regression
10. One way and two way classification of ANOVA
11. Computation of Post hoc tests using statistical software
12. Preparation of different pollution themes with the help of MS PowerPoint
13. Estimation of dust accumulated on plant parts and its effect on morphology and anatomy
14. Land use / land cover classification from satellite data
15. Delineation of drainage of a given area from satellite data
16. Delineation of point, line and polygon themes
17. Preparation of thematic maps using R. S. maps.

18. Working and design of treatment plants
19. Study of effect of wastewater - treatment on seed germination
20. Study of morphogenetic response of explants on media

ENS14304EA: Environmental Laws

(04 credits)

Credit I: Environmental Protection

(16 hrs)

- 1.1. Environment protection: Issues and problems
- 1.2. National efforts on environmental protection, laws and policy in India
- 1.3. International efforts for environment protection (Stockholm, montreal, kyoto protocol & earth summit)
- 1.4. CITES (1973), Biodiversity act (2002) and Espoo convention (1991)
- 1.5. Indus Water Treaty (1960)

Credit II: National Laws-I

(16 hrs)

- 1.1. Provisions of constitution (article 21,48A, 51A, and 253)
- 1.2. Indian forest act (1927), forest conservation act (1980) and rules (1981)
- 1.3. Wildlife protection act (1972) and amended (2002) and J & K wildlife (protection) act (1978) as amended in (2002)
- 1.4. The Water (Prevention and Control of Pollution) act (1974) as amended up to (1988) and rules (1975)
- 1.5. The air (prevention and control of pollution) act as amended by amendment act (1987) and rules (1982)
- 1.6. The environmental (protection) act (1986) and rules (1986)

Credit III: National Laws-II

(16 hrs)

- 1.1. Hazardous waste management and handling rules (1989)
- 1.2. Biomedical waste (management and handling) rules (1998)
- 1.3. Noise pollution (regulations and control) rules (2000)
- 1.4. Municipal solid wastes (management and handling) rules (2000)
- 1.5. Environmental related laws in J&K (brief description)

Credit IV: National Policy

(16 hrs)

- 1.1. National forest policy (1988)
- 1.2. Public liability insurance act (1991)
- 1.3. Intellectual property rights and patent act (2005)
- 1.4. National environment tribunal act (1995)
- 1.5. National green tribunal act (2010)

- 1.3. Landscape: Structure and processes
- 1.4. Tools and approaches in landscape ecology
- 1.5. Design of conservation reserves

ENS14404EA: Project Work

(08 credits)

It is a special paper where a candidate carries out the application of knowledge in solving/ studying/ exploring a real life/ difficult problem in a creative way. The project work shall be of 8 credits. The project work shall be discipline centric and the candidate has to study the project work on his own with an advisory support by the concerned teacher.

The distribution should be as follows:

- **Part I:** Identification of problem area and literature survey
- **Part II:** Study of specific literature in detail pertaining to the statement of the problem
- **Part III:** Developing a solution, methodology or proposing a hypothesis to solve the problem
- **Part IV:** Experimental analysis, results, discussion, conclusion and recommendations

ENS14405EA: Environmental Biotechnology

(04 credits)

Credit I: Introduction to environmental biotechnology

(16 hrs)

- 1.1. Biotechnology
 - a. Concept and environmental relevance
 - b. Environmental risks
- 1.2. Biotechnology in Pollution control
- 1.3. Genetically modified organisms and bio-safety: A general account.
- 1.4. Environmental genomics: A key to understanding biology, pathophysiology and disease
- 1.5. Molecular taxonomy: Documenting biodiversity by DNA barcoding

Credit II: Eco-friendly role of animals

(16 hrs)

- 1.1. Vermiculture technology
 - a. Earth worms and soil productivity
 - b. Earthworm culture and vermi-composting
- 1.2. Aquaculture improvement through biotechnology
- 1.3. Fish farming through biological wastes
- 1.4. Stem cell and animal cloning
- 1.5. Biological control of insects -definition, principles and control mechanisms

Credit III: In-vitro storage of plants

(16 hrs)

- 1.1. Tissue culture: Concept, importance and methodology
- 1.2. Micropropagation techniques and application
- 1.3. Conservation: Short term, medium term and long term
- 1.4. Recent developments in cryopreservation

- 1.5. Biotechnology in biodiversity conservation: gene banks, germplasm conservation and DNA Banks

Credit IV: Crop improvement through plant tissue culture (16 hrs)

- 1.1. Embryo culture
- 1.2. Anther and Pollen Culture
- 1.3. Protoplast culture
- 1.4. Somaclonal variation, their merits and demerits
- 1.5. Synthetic seeds

ENS14406EA: Wildlife Management (04 credits)

Credit I: Extinction and conservation (16 hrs)

- 1.1. Extinction: Introduction, types and causes
- 1.2. Factors affecting risk of extinction
- 1.3. Population viability analysis as part of recovery plans
 - a. Minimum viable population sizes
 - b. Ecological islands
- 1.4. Captive breeding in animals
- 1.5. Reintroduction of species

Credit II: Threatened species (16 hrs)

- 1.1. Nature of the criteria used to determine the threatened status
- 1.2. Cetartiodactyla (Cervidae and Moschidae)
 - a. Kashmir red deer (*Cervus hanglu*)[†]
 - b. Kashmir musk deer (*Moschus cupreus*)[†]
- 1.3. Cetartiodactyla (Bovidae)
 - a. Markhor (*Capra falconeri*)[†]
 - b. Chiru (*Pantholops hodgsonii*)[†]
- 1.4. Carnivora
 - a. Snow leopard (*Panthera uncial*)[†]
 - b. Himalayan brown bear (*Ursus arctos*)[†]
- 1.5. Passeriformes & Gruiformes
 - a. Kashmir flycatcher (*Ficedula subrubra*)[†]
 - b. Black-necked crane (*Grus nigricollis*)[†]

[†] (Brief background on assessment information, geographic range, population, habitat & ecology, threats and conservation actions)

Credit III: Important bird Areas (16 hrs)

- 1.1. Vegetation characteristics within various biogeographic zones of India
- 1.2. Important bird Areas: Concept, aims, global viewpoint
- 1.3. Objectives and methods of the Indian IBA programme
- 1.4. Globally threatened species of the Indian Trans-Himalayas
- 1.5. Important Bird Areas in Jammu & Kashmir: General overview

Credit IV: Monitoring and evaluation (16 hrs)

- 1.1. Sampling designs for population estimation

- 1.4. Factors affecting growth of microorganisms
- 1.5. Brief introduction to thermophiles, barophiles, acidophiles, alkalophiles and psychrophiles

Credit II: Microbes and environment (16 hrs)

- 1.1. Nature and function of micro-organisms in Soil, Water and Air
- 1.2. Microbial spoilage of food and its preservation
- 1.3. Microbial activity in sewage disposal
- 1.4. Application of micro-organisms in the control of
 - a. Oil pollution
 - b. Chemical pollution - pesticides, synthetic polymers, and metals
 - c. Bio-deterioration of materials
- 1.5. Role of microbes in fixation and solubilization / mineralization of nutrients: carbon, nitrogen, phosphorus, sulphur

Credit III: Microorganisms and human health (16 hrs)

- 1.1. Human health and environment: MMR, IMR, Life expectancy, incidence of chronic diseases
- 1.2. Epidemiology (Reservoir of infection, communicability and control)
 - a. Air borne diseases: Tuberculosis, meningitis
 - b. Soil borne diseases: Tetanus and gas-gangrene
 - c. Water and food borne diseases: Cholera, typhoid, giardiasis, hepatitis
- 1.3. Allergic diseases
- 1.4. Insect vectors of human diseases like Malaria, Dengue, Encephalitis, and their control
- 1.5. Status of communicable diseases in India

Credit IV: Environmental and occupational health (16 hrs)

- 1.1. Basic principle of environmental health, Physiological responses of man to relevant stresses in the environment
- 1.2. Occupational Diseases: Principles and methods of occupational health
- 1.3. Industrial Toxicology: The relationship of occupation of hygiene and safety and disease
- 1.4. Evaluation and Control of occupational health hazards
- 1.5. Occupations health surveillance, occupational health control programmes in the context of Indian factories act-case studies

ENS14307EA: Remote Sensing and GIS (04 credits)

Credit I: Remote-sensing (16 hrs)

- 1.1. Definition, scope and its role in environmental science
- 1.2. Basic principles of remote sensing
 - a. Electromagnetic radiation (EMR) and electromagnetic spectrum
 - b. Interaction of EMR with atmosphere
 - c. Spectral reflectance of vegetation, soil and water
- 1.3. Satellite systems: IRS, landsat and IKONOS
- 1.4. IR and microwave remote sensing
- 1.5. Aerial photography
 - a. Definition and specifications for aerial photography

- b. Types of aerial photography
- c. Photogrammetry

Credit II: Image analysis and interpretation (16 hrs)

- 1.1. Fundamentals of image interpretation: Multi concept in image interpretation
- 1.2. Image analysis: Visual and digital, methods of image analysis
- 1.3. Image processing: Image characteristics and formats
- 1.4. Image rectification: Concept and techniques of digital image pre-processing
- 1.5. Image enhancement: Techniques of image enhancement

Credit III: Geographic information system (16 hrs)

- 1.1. Global positioning systems (GPS)
- 1.2. Principles and scope of GIS, use of GIS
- 1.3. Raster and vector GIS analysis
- 1.4. Map projections
- 1.5. Database concepts and types, data quality standards

Credit IV: Applications of remote sensing and GIS (16 hrs)

- 1.1. Environmental Impact assessment
- 1.2. Forest management
- 1.3. Watershed management and marine resources
- 1.4. Monitoring of biodiversity
- 1.5. Natural disaster management and regional planning

ENS14308EA: Ecological tour to Ladakh (02 credits)

During 3rd semester, students will be required to go for the field study tour within Jammu & Kashmir carrying 02 credits which will form a component of the elective allied. One credit will be given for participation and one credit for field collection, tour report and viva-voce.

ENS14309EO: Aquatic Environments & Environmental Biophysics (04Credits)

Credit I: Oceanography (16 hrs)

- 1.1. Formation and classification of water masses and mixing processes in the oceans
- 1.2. General aspects of ocean currents and circulation
- 1.3. Swell and currents induced by wind
- 1.4. Ocean thermal energy conversion (OTEC)
- 1.5. Vorticity

- b. Types of aerial photography
- c. Photogrammetry

Credit II: Image analysis and interpretation (16 hrs)

- 1.1. Fundamentals of image interpretation: Multi concept in image interpretation
- 1.2. Image analysis: Visual and digital, methods of image analysis
- 1.3. Image processing: Image characteristics and formats
- 1.4. Image rectification: Concept and techniques of digital image pre-processing
- 1.5. Image enhancement: Techniques of image enhancement

Credit III: Geographic information system (16 hrs)

- 1.1. Global positioning systems (GPS)
- 1.2. Principles and scope of GIS, use of GIS
- 1.3. Raster and vector GIS analysis
- 1.4. Map projections
- 1.5. Database concepts and types, data quality standards

Credit IV: Applications of remote sensing and GIS (16 hrs)

- 1.1. Environmental Impact assessment
- 1.2. Forest management
- 1.3. Watershed management and marine resources
- 1.4. Monitoring of biodiversity
- 1.5. Natural disaster management and regional planning

ENS14308EA: Ecological tour to Ladakh (02 credits)

During 3rd semester, students will be required to go for the field study tour within Jammu & Kashmir carrying 02 credits which will form a component of the elective allied. One credit will be given for participation and one credit for field collection, tour report and viva-voce.

ENS14309EO: Aquatic Environments & Environmental Biophysics (04Credits)

Credit I: Oceanography (16 hrs)

- 1.1. Formation and classification of water masses and mixing processes in the oceans
- 1.2. General aspects of ocean currents and circulation
- 1.3. Swell and currents induced by wind
- 1.4. Ocean thermal energy conversion (OTEC)
- 1.5. Vorticity

ENS14301CR: Environmental Impact Assessment & Ecological Modeling (04 credits)

Credit I: Fundamentals of EIA (16 hrs)

- 1.1. Environment impact assessment: Concept, objectives and approaches
- 1.2. Baseline data generation and Strategic environmental assessment
- 1.3. EIA guidelines 2006 and amendments
- 1.4. Protocol for environment impact statements
- 1.5. Public participation in environmental decision making

Credit II: EIA methodologies (16 hrs)

- 1.1. EIA methodology
- 1.2. Air and water quality assessment
- 1.3. Ecological assessment
- 1.4. Social impact assessment
- 1.5. EIA case studies:
Hydel, industrial estates, highways, thermal and nuclear power projects, cement and chemical industries

Credit III: Environmental auditing and planning (16 hrs)

- 1.1. Principles and guidelines of environmental auditing; ISO 14000 series
- 1.2. Preparation and submission of audit report
- 1.3. Environmental planning: Importance and objectives
- 1.4. Land use planning
- 1.5. Urban and rural development and environmental planning

Credit IV: Ecological modeling (16 hrs)

- 1.1. Role of models in ecology
- 1.2. Components of a model
- 1.3. Classes of mathematical models
- 1.4. Models of population (growth and interaction) and pollutant dispersal
 - a. Lotka – Volterra model
 - b. Leslie’s matrix model
 - c. Gaussian plume model
- 1.5. Modelling of air quality, water quality and noise characteristics

ENS14302CR: Environmental Engineering (04 credits)

Credit I: Basics of environmental engineering (16 hrs)

- 1.1. Environmental Engineering: Introduction and scope
- 1.2. Sewage and Storm water drainage
- 1.3. Planning of housing drainage and rural sanitation
- 1.4. Environmental sanitation: Ventilation and air conditioning
- 1.5. Ecological sanitation

Credit II: Drinking water treatment**(16 hrs)**

- 1.1. Methods of water purification: Flocculation, sedimentation, sedimentation with coagulation
- 1.2. Filtration: Sand filters, pressure filters, horizontal filters
- 1.3. Disinfection and desalination of water
- 1.4. Chemical treatment: Adsorption, gas stripping, ion exchange
- 1.5. Reverse osmosis and distillation

Credit III: Sewage treatment**(16 hrs)**

- 1.1. Wastewater Treatment Plants: Concept, methods and design
 - a. Primary
 - b. Secondary
 - c. Tertiary
- 1.2. Sludge and its disposal techniques
- 1.3. Natural methods of sewage disposal
- 1.4. Biology of sewage treatment
- 1.5. Reclamation and reuse of industrial and domestic wastewater

Credit IV: Solid and hazardous waste management**(16 hrs)**

- 1.1. Sources and generation of solid wastes and their characteristics
- 1.2. Methods of disposal of solid wastes.
- 1.3. Hospital waste management
- 1.4. Hazardous waste: Source, transportation, treatment, storage and disposal
- 1.5. Management of solid, industrial and hazardous wastes and Site remediation

ENS14303CR: Laboratory Course**(04 credits)****Course Contents**

1. Preparation of bacterial smears and gram staining
2. Estimation of bacterial population in different water samples by culture technique
3. Estimation of fungal population in different habitats through culture techniques
4. Case studies based on environmental laws
5. Survey of different residential areas for determining the prevalence of different air, water, soil and food borne diseases
6. EIA – Leopold Matrix method and Case studies
7. Socio-economic studies – preparing of questionnaire and Case studies
8. Computation of standard deviation, standard error and coefficient of variation
9. Computation of Correlation and Regression
10. One way and two way classification of ANOVA
11. Computation of Post hoc tests using statistical software
12. Preparation of different pollution themes with the help of MS PowerPoint
13. Estimation of dust accumulated on plant parts and its effect on morphology and anatomy
14. Land use / land cover classification from satellite data
15. Delineation of drainage of a given area from satellite data
16. Delineation of point, line and polygon themes
17. Preparation of thematic maps using R. S. maps.

Course Descriptions 4th SEMESTER

CORE COURSES

ENS17401CR: Environmental Engineering

(04 credits)

Unit I: Fundamentals of environmental engineering

- 1.1. Environmental engineering: Introduction and scope
- 1.2. Sewage and storm water drainage
- 1.3. Planning of housing drainage
- 1.4. Environmental sanitation
- 1.5. Ventilation and air conditioning

Unit II: Drinking water treatment

- 1.1. Methods of water purification: flocculation, sedimentation, sedimentation with coagulation
- 1.2. Filtration: sand filters, pressure filters, horizontal filters
- 1.3. Disinfection and desalination of water
- 1.4. Chemical treatment: adsorption, gas stripping, ion exchange
- 1.5. Reverse osmosis and distillation

Unit III: Sewage treatment

- 1.1. Wastewater treatment plants: Concept, methods and design
 - a. Primary
 - b. Secondary
 - c. Tertiary
- 1.2. Sludge and its disposal techniques
- 1.3. Natural methods of sewage disposal
- 1.4. Biology of sewage treatment
- 1.5. Reclamation and reuse of industrial and domestic wastewater

Unit IV: Solid and hazardous waste management

- 1.1. Solid wastes: sources, generation and their characteristics
- 1.1. Hazardous waste: sources and generation and their characteristics
- 1.2. Disposal and management of solid, industrial and hazardous wastes,
- 1.3. Hospital waste management
- 1.4. Site remediation

ENS17402CR: Biodiversity and Resource Management

(04 credits)

Unit I: Biogeography

- 1.1. Geographical classification and zones
- 1.2. Major biomes of the world: Distribution and characteristic features
- 1.3. Zoogeographic realms of the world: Palaearctic, nearctic, neotropical, oriental, australian and african
- 1.4. Dispersal: Means, modes and barriers, island life
- 1.5. Migrations

Unit II: Biodiversity

- 1.1. Biodiversity: Status and importance, India as a mega-diversity nation
- 1.2. Endemism: Factors controlling distribution of flora and fauna
- 1.3. Hot Spots and cold spots, concept of native and exotic species
- 1.4. Biodiversity decline: Drivers of change and pressures
- 1.5. Threatened species categories of IUCN; concept of extinction threshold and extinction debt

Unit III: Biodiversity Management

- 1.1. Forest conservation: social forestry and joint forest management
- 1.2. Management of rangelands
- 1.3. Fishery resource management
- 1.4. Monitoring and management of bio-diversity
- 1.5. Biodiversity Conservation
 - a. In-situ conservation: National parks, sanctuaries, biosphere reserves, Ramsar Sites
 - b. Ex-situ conservation: botanical gardens, zoological parks, zoos, seed banks, in-vitro conservation

Unit IV: Management of natural resources

- 1.1. Concept and strategies of sustainable development
- 1.2. Management of mineral resources
- 1.3. Management of fresh water resources
- 1.4. Energy crisis and conservation of energy resources
- 1.5. Concept of ecological footprint and carbon sequestration

ENS17403CR: Project Work

(04 credits)

The project work shall be of practical nature and the candidate has to carry out the project work related to environment under the supervision of concerned teacher.

The distribution should be as follows:

- **Part I:** Identification of problem area and general description
- **Part II:** Study of specific literature in detail pertaining to the statement of the problem
- **Part III:** Developing a solution, methodology or proposing a hypothesis to solve the problem
- **Part IV:** Experimental analysis, results, discussion, conclusion and recommendations

Each student has to submit the dissertation of the project work for evaluation. The student has to give seminar (internal) and viva voce (external) of the project work.

- 1.3. Landscape: Structure and processes
- 1.4. Tools and approaches in landscape ecology
- 1.5. Design of conservation reserves

ENS14404EA: Project Work

(08 credits)

It is a special paper where a candidate carries out the application of knowledge in solving/ studying/ exploring a real life/ difficult problem in a creative way. The project work shall be of 8 credits. The project work shall be discipline centric and the candidate has to study the project work on his own with an advisory support by the concerned teacher.

The distribution should be as follows:

- **Part I:** Identification of problem area and literature survey
- **Part II:** Study of specific literature in detail pertaining to the statement of the problem
- **Part III:** Developing a solution, methodology or proposing a hypothesis to solve the problem
- **Part IV:** Experimental analysis, results, discussion, conclusion and recommendations

ENS14405EA: Environmental Biotechnology

(04 credits)

Credit I: Introduction to environmental biotechnology

(16 hrs)

- 1.1. Biotechnology
 - a. Concept and environmental relevance
 - b. Environmental risks
- 1.2. Biotechnology in Pollution control
- 1.3. Genetically modified organisms and bio-safety: A general account.
- 1.4. Environmental genomics: A key to understanding biology, pathophysiology and disease
- 1.5. Molecular taxonomy: Documenting biodiversity by DNA barcoding

Credit II: Eco-friendly role of animals

(16 hrs)

- 1.1. Vermiculture technology
 - a. Earth worms and soil productivity
 - b. Earthworm culture and vermi-composting
- 1.2. Aquaculture improvement through biotechnology
- 1.3. Fish farming through biological wastes
- 1.4. Stem cell and animal cloning
- 1.5. Biological control of insects -definition, principles and control mechanisms

Credit III: In-vitro storage of plants

(16 hrs)

- 1.1. Tissue culture: Concept, importance and methodology
- 1.2. Micropropagation techniques and application
- 1.3. Conservation: Short term, medium term and long term
- 1.4. Recent developments in cryopreservation

- 1.2.Theory and practice of managing the establishment, composition, and development of the forest
- 1.3.Urban forest ecology
- 1.4. Agro-ecosystems: Concept, structural and functional components
- 1.5. Role of biodiversity in agro-ecosystems, Food security and agriculture

Unit IV: Desert and grassland ecology

- 1.1. Ecological complexity of the desert commies
- 1.2. fauna and flora of the deserts
- 1.3. Ladakh cold desert
- 1.4. Grasslands ecology: evolution and types
- 1.5. Biodiversity and conservation in grasslands

ENS17406DCE: Environmental Planning and Auditing

(02 credits)

Unit I

- 1.1.Environmental planning – importance and objectives
- 1.2.Land use planning
- 1.3.Urban development and environmental planning
- 1.4.Rural development and environmental planning
- 1.5. Role of ethics, aesthetics and science in environmental planning

Unit II

- 1.1.Principles and guidelines of environmental auditing
- 1.2.Preparation of environmental audit report
- 1.3.Waste audit procedures – sources, types and management of wastes
- 1.4.ISO 9001 and 9002
- 1.5.ISO 14000

ENS17407DCE: Restoration Ecology

(02 credits)

Unit I: Concepts in restoration ecology

- 1.1. The basic principles and concepts of restoration ecology
- 1.2. Characteristics of degraded and restored ecosystems
- 1.3. Ecological indicators in restoration
- 1.4. Theory and practice of restoring animal and plant diversity
- 1.5. Ecological principles of the restoration of native ecosystems

Unit II: Restoration planning

- 1.1. Goals and objectives
- 1.2. Adaptive management and monitoring
- 1.3. Ethics of restoration
- 1.4. Role of public-private partnership in restoration
- 1.5. Measuring progress and success of restoration programs

- 1.2. Methods of sampling an area: Line transect, belt transect, quadrat, pin frame (point quadrat), permanent quadrat
- 1.3. Mark – Recapture method
- 1.4. Radio telemetry in estimation of animal movement
- 1.5. Data transformations, boot-strap and jack-knife procedure

ENS14407EO: Industrial Ecology & Sustainability

(04 credits)

Credit I: Industrial ecology

- 1.1. Introduction to industrial ecology and its relation to the concept of sustainability
- 1.2. Principles and objectives of industrial ecology
- 1.3. Industrial symbiosis, industrial ecosystems and eco industrial parks
- 1.4. Ecology and biomimicry
- 1.5. Future and challenges of industrial ecology

Credit II: Agriculture meteorology

(16 hrs)

- 1.1. Agro-climatic classifications
- 1.2. Important agro-meteorological parameters
- 1.3. Influence of weather and climate on agriculture
- 1.4. Applications of remote sensing techniques in agricultural meteorology
- 1.5. Agricultural droughts and food shortage

Credit III: Sustainable development

(16 hrs)

- 1.1. Concept and strategies
- 1.2. Brundtland commission (Agenda 21)
- 1.3. Changes in institutional and environmental governance framework
- 1.4. Moving towards sustainability: An Indian perspective
- 1.5. Landmark events in sustainability

Credit IV: Environmental ethics

(16 hrs)

- 1.1. Environmental ethics and philosophy: Introduction
- 1.2. Theories of environmental ethics and philosophy
- 1.3. Different schools of thought vis-à-vis nature and environmental management
- 1.4. Ethics in society: Responsibility for environmental degradation
- 1.5. Eco-centric theories of nature: Deep ecology and animal right theories, environmental rights, environmental racism, SD

Bibliography

- Biodiversity and Conservation. Michael J. Jeffries
- Environmental Biotechnology and Cleaner Bioprocesses. Eugenia J. Olguin, Gloria Sanchez, Elizabeth Hernandez
- Freshwater Aquaculture: R.K. Rath
- Pollution – Ecology and Biotreatment. Mc Eldowney and Waile

- Ponds and Fishculture. C.B. Hall
- Plant Tissue Culture. A.S. Islam
- Aquaculture and Fisheries Biotechnology – Genetic Approaches. R.A. Dunham
- Environmental Geology: Principles & Practice. Fred G. Bell
- Physical Geology. Monroe & Wicander
- Environmental Science. Cunningham, Saigo
- Concepts of Ecology. E.J. Kormondy
- River Jhelum, Kashmir Valley. L. Nyman
- Marine Fisheries Resources. Imtiaz Khan
- Natural Resources and Environmental Technology. Jasper S Lee
- Wildlife Wilderness. G.A. Bhat
- Wetland and water resource modeling and assessment- A watershed perspective. Wei Ji
- Wetlands Monitoring Modeling and Management. Tomasz Okruszko, Edward Maltby, Ian Szatytowicz, Dorota Swiatek and Wiktor Kotowski
- Watershed and drainage. Drick Deep
- Range ecology. Humphrey
- Flowers of the Himalaya. Adam Stainton
- Wildlife resources. Anderson
- Applied Fisheries science. S M Shafi
- Concepts of Ecology. E.J. Kormondy
- Geosystems- An Introduction to Physical Geography. Robert W. Christopherson
- Geoenvironmental Sustainability. Yong, R.N., Mulligam, C.N. and Fuke, M.
- Principles of Crop Production. Acquah, G.
- Natural Resources. Holecheck, J.L., Cole, R.A., Fisher, J.T. and Valdez, R.
- Forest restoration in landscapes – Beyond planting trees. Mansourian, S., Vallauri, D. and Daudley, N. (Editors)
- Utilization of Forest Resources. Wadoo, M.S.
- Limnology. Wetzel, R.G.
- Lakes Handbook. O'Sullivan, P.E. and Reynolds, C.S.
- Groundwater Science. Fitts, C.R.
- Environmental Science. Botkin, D.B. and Keller, E.A.
- Environmental Science. Enger and Smith
- Basics of Environmental Science. Michael Allaby
- Environmental Science. Cunningham & Saigo
- Environmental Science. Tyler Miller
- Environmental Sciences (System and Solutions). McKinney and Schoch

General Instructions for the Candidates

1. The semester is of 24 credit weightage.
2. A candidate has compulsorily to opt for 12 credits from the core.
3. A candidate has compulsorily to opt for Paper ENS-AEP4 (8 credits) & has a choice to opt for any 4 credits (1 paper) out of the remaining 8 credits (2 papers) offered as Electives (Allied).
4. A candidate can earn more than the minimum required credits (i.e., more than 96 credits for four Semester programme) which shall be counted towards the final result of the candidate.

Credit IV: Environmental economics**(16 hrs)**

- 1.1. Environmental economics: Definition and scope
- 1.2. Population, poverty and environment
- 1.3. Concept of intangibles and externalities
- 1.4. Environmental evaluation methods: Hedonic pricing, contingent evaluation and household production function
- 1.5. Carbon credits and trading

ENS14108EO: Plant morphogenesis, Cyto-genotoxicity & Herbal Medicine (04 credits)**Credit I: Plant morphogenesis and regeneration****(16 hrs)**

- 1.1. Initiation, nutrition and maintenance of plant cell and tissue culture
- 1.2. Cellular totipotency, initiation of callus cultures and its characteristics
- 1.3. Cell differentiation and organogenesis
- 1.4. Suspension culture
- 1.5. Tissue culture studies of some threatened medicinal plants of Kashmir Himalaya

Credit II: Herbal medicine and health care**(16 hrs)**

- 1.1. Traditional Herbal Medicines for Healthcare and Management of Human diseases
- 1.2. Medicinal and aromatic materials from plants
- 1.3. Benefits of Medicinal and aromatic plant materials
- 1.4. Industrial utilization of medicinal plants
- 1.5. Phytochemical and anti microbial studies of some medicinal plants

Credit III: Cyto-genotoxicity**(16 hrs)**

- 1.1. Necrosis, apoptosis and inflammation
- 1.2. Somatic and genetic risk of environmental pollutants.
- 1.3. Cancer latency, threshold and non-threshold model of cancer
- 1.4. Mechanism of chemical carcinogens (free radicals and alkylating agents)
- 1.5. Classification of carcinogens (physical, chemical and biological agent)

Credit IV: Toxicogenomics (Testing protocols)**(16 hrs)**

- 1.1. Ames test and micronucleus test
- 1.2. Chromatid and chromosome aberration
- 1.3. Screening, tier testing and test batteries for mutagenicity testing
- 1.4. FISH technique
- 1.5. Use of Comet assay in environmental toxicology

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- Environmental Science. Botkin, Keller
- Environmental Science. Cunningham, Saigo
- Environmental Science. Jackson & Jackson

- Environmental Science. Tyler Miller
- Essentials of Geology. Chernicoff, Fox, Venkatakrishnan
- Physical Geology. Monroe & Wicander
- Concepts of Ecology. E.J. Kormondy
- Atmosphere, Weather & Climate. R.G. Barry & R.J. Chorley
- Environment: Principles & Applications. Chris Park.
- Earth Systems. W.G. Ernst
- Environmental Science - Physical Principles & Applications. Boeker & Grondelle
- Fundamentals of Physical Environment. Briggs, Smithson, Addison & Atkinson
- Atmosphere, Weather & Climate. R.G. Barry & R.J. Chorley
- Geosystems: An Introduction to Physical Geography. Robert W. Christopherson
- Introducing Physical Geography. Alan Starhler & Arthur Starhler
- Earths Dynamic Systems. W.K. Hamblin & E.H. Christiansen
- Soils in our Environment. Miller and Gardiner
- Fundamentals of Soils. J. Gerrard
- Environmental Science. Enger and Smith
- Basics of Environmental Science. Michael Allaby
- Principles of Environmental Science. Cunningham and Cunningham
- Environmental Sciences (System and Solutions). Mckinney and Schoch
- Principles of atmospheric physics and chemistry. Goody
- Smoke, Dust and Haze. S K Friedlander
- General Climatology. H. J. Critchfield
- Environmental Chemistry. IAN Williams
- Environmental Chemistry. A. K. De
- Environmental Chemistry. Stanley E. Manahan
- An Introduction to Analytical Chemistry. S.A. Iqbal & M. Satake
- Chromatography of Environmental Hazards. Lawrence Fishbein
- Principles of Biochemistry. Wilson Walker
- Electron Spin Resonance. J.E. Wertz And J.R. Bolton
- Analytical Chemistry. D. Kealey And P.J. Haines
- Text Book of Quantitative Chemical Analysis. G.H. Jeffery, J. Basset, J. Mendham and R.C. Denney
- The Surface Chemistry of Soils. Garrison Sposito
- The Nature & Properties of Soils. Brady & Weil
- Soils in our Environment. Miller and Gardiner
- Soil Genesis and Classification. Boul, Hole & Mccacken
- Essentials of Geology. Chernicoff, Fox, Venkatakrishnan
- Text Book Of Limnology. Gerald A. Cole
- Limnology. R. G. Wetzel
- Limnology. Jacobson
- A Treatise on Limnology (Vol I – III). G. E. Hutchinson
- Limnology. Goldman and Horne
- Limnology. P. S. Welch
- Soil in the environment. Daniel Hillel
- Weathering (An introduction to scientific principles). Bland and Rolls
- Soil fertility and fertilizers. Havlin et al.
- Soil erosion and its control. R P C Morgan.
- Soil properties. Liu and Evett
- Soil science and management. Edward J Plaster
- Soils (An introduction). Singer and Munns
- Basic concept of environmental chemistry. Des W Connel
- Basic physical chemistry of the atmospheric science. Peter V Hobbs

- Environmental chemistry. Fritz Helmet
- Introductory chemistry for environmental science. Harrison and De Mora
- An introduction to environmental chemistry. Andrews et al.
- Stream ecology. Barness and Mishall
- Analytical mass spectrometry. Budde
- Primary Productivity of the Biosphere. Helmut Lieth & Robert H. Whittaker
- Tropical Ecosystems & Ecological Concepts. Patnick L. Osborne
- Concepts of Ecology. E.J. Kormondy
- Ecology & Environmental Management. C.C. Park
- Ecology of a Changing Planet. Mark B. Bush
- Ecology for Environmental Sciences: Biosphere, Ecosystems & Man. J. M. Anderson
- Fundamentals of Ecology. E.P. Odum
- Instant Notes in Ecology. Mackenzie, Ball & Virder
- Primer of Ecological Theory. Jonathan Roughgarden
- Ecology with special reference to Animals and Man. S. Charles, Kendeigh
- Evolutionary Ecology. Eric R. Pianka
- A Primer of Ecology. Nicholas J. Gotelli
- Ecology Theories and Applications. Peter Stiling
- Applied Ecology and Natural Resource Management. Guy R. Mcpherson and Stephen Destefano
- Population Ecology. Begon & Mortimer
- Geosystems: An Introduction to Physical Geography. Robert W. Christopherson
- Physical Geology. Plummer, Mc. Geary, Carlson
- Physical Geology. Monroe & Wicander
- Essentials of Geology. Chernicoff, Fox, Venkatakrishnan
- Earths Dynamic Systems. W.K. Hamblin & E.H. Christiansen
- Introducing ecology. Cotgreave and Forseth
- Community ecology. Diamond and Case
- Community ecology. R J Putman
- Biodiversity and conservation. Michael J Jeffries
- Environmental Geology: Principles & Practice. Fred G. Bell
- Physical Geology. Monroe & Wicander
- Economic Geography - A Study of Resources. Prithwish Roy
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- Earths Dynamic Systems. W.K. Hamblin & E.H. Christiansen

- The Global Casino. Nick Middleton
- Natural Hazard Mitigation. Godschalk, Beatley, Berke, Brower & Kaiser
- Active Tectonics. E. Keller & N. Pinter
- Environmental Chemistry. M. Satake & Y. Mido
- Earths Dynamic Systems. W.K. Hamblin & E.H. Christiansen
- Physical Geology. Wicander & Monroe
- Environmental Chemistry. Stanley E. Manahan
- Environmental Chemistry. M. Satake, Y. Mido, M.S. Sethi & S. A. Iqbal
- Environmental Chemistry. Ian Williams
- Our Geologic Environment. H. Blatt
- Environment. Raven, Berg and Johnson
- Environmental Science. Botkin, D.B. and Keller, E.A.
- Environmental Science. Nebel, B.J. and Wright, R.T.
- Environmental Geography. Marsh, W.M. and Grossa, Jr. J.M.
- Environmental Oceanography. Abel, D.C. and Mc Connell, R.L.
- Resources of the Earth. Craig, J.R., Vaughan, D.J. and Skinner, B.J.
- Natural Hazards and Disasters. Hyndman, D. and Daudley, N. (Editors)
- Environmental Geochemistry. Eby, G.N.
- Environmental Hydrogeology. Soliman, M.M., LaMoreaux, P.E., Memon, B.A.,
- Mineralogy. Perkins, D. Assad, F.A. and LaMoreaux, J.W.
- Environmental Law, the Economy and Sustainable Development. Revesz, Sands and Stewart
- Higher Education in India. Mehraj-ud-Din
- Environmental Economics and Policy. Tietenberg
- Issues in Environmental Economics. Hanley and Roberts
- Importance of Wildlife Conservation from Islamic Perspective. H.S.A. Yahya
- Psychology. Jhon J. Seamon, Douglas and T. Kenrick
- Society in Focus – Introduction to Sociology. William E. Thompson and Joseph V. Hickey
- Clinical Approach to Rural Development. E.D. Setty
- Environmental psychology. Annete Bolger
- Environment and Society. Francis Moore
- Environmental Economics-A Critical Overview. Alan Gilpin
- The economics of the environment and natural resources. R. Quentin Graflon et al.

General Instructions for the Candidates

1. The first semester is of 24 credit weightage.
2. A candidate has compulsorily to opt for 12 credits from the core component.
3. A candidate has a choice to opt for any 12 credits (3 papers) out of minimum of 16 credits (4 papers) offered as Electives (Allied).
4. A candidate can earn more than the minimum required credits (i.e., more than 96 credits for four Semester programme) which shall be counted towards the final result of the candidate.

Unit – I

- **Role of analyst**
- **Tri stimulus color system & hunter lab CDM.**
- **Flame photometry**– Concept of ground state, excited state, ionization energy. resonance line, inferences, components of flame emission spectrophotometer.
- **Principles and application of atomic absorption spectroscopy**– Components of atomic absorption spectroscopy, ICP.

Unit - II

- **X-ray analysis of foods**– Properties, production & detection, x- ray tubes, detectors, sources, application in food industry.
- **Mass spectroscopy**– Instrumentation and interpretation
- **Morphological and thermal Analysis**- SEM and DSC- Basic Principles, Instrumentation, and application in foods

Unit - III

- **Chromatography**– Principles of different chromatographic separations. HPLC, GC and coupling systems
- **Rheology measurement**– Farinograph, Amylograph, Rheometer, Texture analysis.
- **Nuclear magnetic resonance (NMR)** – Principle, Components, Interpretation of NMR spectra, application of NMR.
- **Immunoassays and Nucleic acid based techniques** : ELISA & PCR

Unit-IV (Practical)

1. Working of HPLC
2. Farinography of wheat samples
3. RVA of starch and wheat samples
4. Texture analysis of foods products using Texture Analyser
5. Phase transitions, enthalpy changes and oxidative stability of foods using DSC
6. Structural analysis of food samples using ATR-FTIR
7. Analysis of XRD- Data for estimation of % crystallinity in starch samples
8. Analysis of SEM pictures for studying morphology

References:

1. Food Analysis by Pomeranz.
2. Food Analysis by S. Suzanne Nielsen
3. Advances in Food Diagnostics by Leo M. L. Nollet and Y.H Hui
4. Methods of Analysis for Functional Foods and Nutraceuticals by W.Jaffrey
5. Instrumental Mehods in Food Analysis by J.R. J Pare and J.M.R Belanger

PROCESSING OF FOODS OF PLANT ORIGIN (PRACTICAL) (0+0+4)

Part I (Cereals)

1. Physico-chemical testing of wheat and rice.
2. Experimental milling of wheat and rice. Assessment of per cent of head rice, broken, immature kernels and degree of polish in rice.
3. Determination of quality characteristics of flours.
4. Experimental parboiling and evaluation of quality of parboiled rice.
5. Evaluation of cooking quality of rice.
6. Rheological properties of dough using Farinograph/ Extensograph/Mixograph.
7. Pasting properties of starches using Visco-amylograph/RVA.
8. Experimental baking of bread, cake and biscuit and their evaluation,
9. Experimental extrusion cooking and quality evaluation of extrudates.
10. Solvent extraction of oil seeds.
11. Quality evaluation of oils.
12. Visit to wheat and rice processing plants.
13. Determination of yeast activity
14. Preparation of protein isolates from legumes and evaluation of cooking quality of legumes.

Part II (Fruits and Vegetables)

1. Quality Evaluation of Fruits & Vegetables (TSS, Color, Acidity, Texture etc.)
2. Canning of fruits & vegetables.
3. Testing of can, cut out analysis
4. Preparation and analysis of syrups and Brines.
5. Experimental dehydration of fruits and vegetables (Dehydration and rehydration ratio)
6. Preparation and preservation of juices.
7. Preparation and preservation of squashes and RTS.
8. Preparation and preservation of Jam, Jellies and marmalades.
9. Preparation and preservation of pickle and vinegar.
10. Preparation of tomato ketchup and sauce.
11. Visit to a fruit and vegetable processing industry.

References:

1. Handbook of Analysis and Quality Control of Fruit and Vegetable Products S. Ranganna
2. Preservation of fruits & Vegetables by Siddappa et al 1999. ICAR, New Delhi
3. Pomeranz, Y. (1998). *Wheat: Chemistry and Technology*, Vol. I 3rd Ed., American Association of Cereal Chemists, St. Paul, MN, USA.
4. Juliano, B. O. (1985). *Rice Chemistry and Technology*, American Association of Cereal Chemists, St. Paul, MN, USA.
5. Stanley P. Cauvain & Lindsay S. Young. Baked Products. Blackwell Publishing.
6. Stanley P. Cauvain & Lindsay S. Young. The Chorleywood Bread Process. CRC Publications.
7. Bakery Technology & Engineering by Samuel A. Matz.
8. Manual of American Association of Cereal Chemists
9. Manual of AOAC, 1990

Unit-I (Tutorial)

- Processing of market milk- standardization, toning of milk, homogenization.
- Storage, transportation and distribution of milk. Pasteurization and sterilization.
- Milk products- Processing of cream, butter, cheese, ice cream.
- Sources of meat, composition and nutritive value of meat.
- Conversion of muscle to meat. Factors affecting post mortem changes in meat.
- Properties and shelf life of meat.
- Eating quality of meat – colour, flavor, tenderness, juiciness and water holding capacity.
- Meat quality evaluation
- Preservation of meat by freezing, curing, pickling and smoking of meat.

Unit-II (Practical)

- Quantative estimation of milk constituents such as moisture, %TS, fat.
- Determination of acidity and specific gravity of milk.
- Platform tests on given sample of milk.
- Standardization of milk.
- Detection of adulterants in milk- water, starch, urea.
- Preparation of common milk products like flavoured milk, yoghurt, ice cream.
- To study slaughtering and dressing of meat animals.
- Evaluation of meat quality.
- Preparation of various meat products such as: Meat pickle
- Preparation and evaluation of traditional meat products.
- Determination of meat to bone ratio in Chicken
- Visit to local milk processing plant.

References:

1. Outlines of Dairy Technology by S. K. De
2. Chemistry and Testing of Dairy products by H.V. Atherton & J.A. Newlander
3. Milk and dairy Product Technology by Edger Spreer.
4. Dairy Chemistry by H.H. Sommer
5. Lawre. R. A. & Ledward, D. A. (2006). Lawres Meat Science 7th Ed. Woodhead Publishing Company, Cambridge, England.
6. Throntons Meat Hygiene.
7. Principles of Meat Science by Forest.
8. Developments in Meat Science by Lawrie.
9. Processed Meats by Pearsons.

Unit I:

- Structure and morphology of grain; Classification of wheat
- Milling, aims and principle of milling, steps of milling, milling machinery
- Raw materials used in bakery and their role in the product: Flour, yeast, fat, sugar, baking powder, egg, salt etc.
- Dough rheology and its measurement
- Basics of bread making: Basic bread recipe, flour characteristics and improvement, steps in bread making process, Charley-wood bread making process.
- Manufacturing cookies, biscuits and cakes, icings and toppings
- Enzymes used in baking industry
- Bread faults and their remedies

- **Unit II (Practicals):**

1. Determination of physical properties of kernels: Length, breadth, thickness, volume, aspect ratio, 1000-kernal weight.
2. Physico-chemical tests: Estimation of moisture, protein, fat and minerals.
3. Determination of SDS- sedimentation volume.
4. Determination of gluten content.
5. Preparation of bread.
6. Preparation of cake.
7. Preparation of cookies.
8. Evaluation of cookies

References:

1. Wheat chemistry and technology, Volume-I by Y. Pomeranz.
2. Advances in cereal science and Technology by Y. Pomeranz.
3. Cereals and cereal products by D. A. V. Dendy and B. J. Dobraszczyk.
4. Cereal processing technology by G. Owens.
5. Baking science and technology: fundamentals and ingredients by E. J. Pyler and L. A. Gorton.
6. Bread Science: The Chemistry and Craft of Making Bread by Emily Buehler.

Unit – I (Wheat Chemistry and Technology)

- Current status and future scenario of world wheat production and uses.
- Structure and chemical composition of wheat grain and its relation to processing qualities.
- Criteria of wheat quality – physical and chemical. Molecular basis of wheat grain hardness/softness.
- Wheat milling – principle, conditioning and milling systems. Flour streams, extraction rates and their composition.
- Structure and functionality of wheat proteins, carbohydrates and lipids in bread making.
- Enzymes of wheat and their technological significance.
- Vital wheat gluten – manufacturing techniques, uses and functionality.
- Dough rheology and dough testing apparatus such as recording dough mixers, load extension meter.

Unit – II (Minor Cereal Grains and Bakery products)

- Composition and structure of corn.
- Wet and dry milling of corn. Corn products and their uses.
- Composition and structure of barley and oat. Milling of oat and barley. Classification of malt products, nutritive value and food applications of malt.
- Chemical, technological and nutritional aspects of sorghum and millets.
- Bread making processes, development in bread making methods, functions of ingredients/ additives such as fat, emulsifiers, oxidants, reducing agents, conditioners. Bread faults and remedies.
- Technology of biscuit, cake, cookies and cracker manufacture.
- Durum wheat – chemistry, quality and technology of pasta products.

Unit – III (Rice Chemistry and Technology)

- Rice grain structure and chemical composition.
- Milling of rice – types of rice mill: huller mill, sheller-cum-huller mill, sheller-cum-cone polisher mill, small capacity rice mill. Modern rice milling. Factors affecting rice yield during milling. By-products of rice milling and their utilization.
- Cooking quality of rice.

- Parboiling of rice – traditional method and their drawbacks. CFTRI process of parboiling. Properties of parboiled rice. Changes during parboiling. Advantages and disadvantages of parboiling.
- Rice convenience foods – precooked rice, canned rice, expanded rice, rice based infant food formulas, rice puddings and breads, rice cakes, rice noodles and fermented foods.

Unit IV (Oil seed and Legume processing)

- Types of oil seeds and their chemical composition.
- Oil extraction – Mechanical and solvent extraction.
- Refining of crude oils.
- Processing of oil seeds for protein concentrates and isolates.
- Margarine manufacturing processing and its uses.
- Structure and composition of pulses, their importance in Indian diet.
- Dhal milling and processing of pulses.
- Fermented and traditional products.

References:

1. Pomeranz, Y. (1998). *Wheat: Chemistry and Technology*, Vol. I 3rd Ed., American Association of Cereal Chemists, St. Paul, MN, USA.
2. Juliano, B. O. (1985). *Rice Chemistry and Technology*, American Association of Cereal Chemists, St. Paul, MN, USA.
3. Samuel, A.M. (1996). *The Chemistry and Technology of Cereal as Food and Feed*. CBS Publishers & Distribution, New Delhi.
4. Dandy, D. A. V & Dobraszczyk, B. J. (2001) *Cereal and Cereal Products: Chemistry and Technology*, Aspen Publishers.
5. Kent, N. L. & Evers, A. D. (1994) *Kent's Technology of cereals* 4th Ed. Elsevier science Ltd. Oxford, U. K.

TECHNOLOGY OF MILK AND MILK PRODUCTS (4+0+0)

Unit – I

- Dairy industry in India and its scope.
- Sources and composition of milk, nutritive value.
- Chemistry of Milk-Milk fat, proteins, lactose, vitamins, minerals & salts
- Factors affecting composition of milk.
- Processing of market milk- standardization, toning of milk, homogenization.

Unit – II

- Storage, transportation and distribution of milk. Pasteurization and sterilization.
- Milk products - Processing of cream, butter oil, condensed milk, evaporated milk, whole and skimmed milk.
- Cheese and its types,

Unit – III

- Production of Ice creams & its quality control.
- Starter culture production & propagation for fermented milk products.
- Production of fermented milk products.
- Instantization of milk and milk products.

Unit – IV

- Judging and grading of milk and its products.
- In plant cleaning system.
- Quality standards of milk and milk products.
- Packaging of dairy products.
- By product utilization.

References:

1. Technology of Dairy Products by Early. R.
2. Outlines of Dairy Technology by S. K. De.
3. Chemistry and Testing of Dairy Products by Athanasiadis.

TECHNOLOGY OF MEAT, FISH AND POULTRY PRODUCTS (4+0+0)

Unit – I

- Scope of meat industry in India with special reference to J&K.
- Sources of meat, composition and nutritive value of meat.
- Structure of muscle. Microscopic structure of meat.
- Contraction and relaxation of muscle.
- Factors affecting meat production and quality.

Unit – II

- Slaughtering of animals and poultry.
- Inspection and grading of meat.
- Conversion of muscle to meat. Factors affecting post mortem changes in meat.
- Properties and shelf life of meat.
- Eating quality of meat – colour, flavor, tenderness, juiciness and water holding capacity.
- Meat quality evaluation.
- Mechanical deboning.
- Meat tenderization and aging.
- Restructuring of meat products.
- Preservation of meat by freezing, curing, pickling and smoking of meat.

Unit - III

- Meat plant sanitation and safety.
- By product utilization of meat industry.
- Recent trends in meat processing.
- Traditional meat products of J&K.
- Structure, composition, nutritive value and functional properties of eggs.
- Factor affecting egg quality and measures of egg quality.
- Preservation of eggs by different methods. Preparation of egg powders.

Unit – IV

- Types of fish, composition, structure. Post mortem changes in fish.
- Handling of fresh water fish.
- Preservation of fish by freezing, glazing of fish, canning, smoking, freezing, irradiation and dehydration.
- Technology of production of fish sauce, fish sausage, fish meal and fish oil.

References:

1. Lawre. R. A. & Ledward, D. A. (2006). Lawres Meat Science 7th Ed. Woodhead Publishing Company, Cambridge, England.
2. Throntons Meat Hygiene.
3. Principles of Meat Science by Forest.
4. Developments in Meat Science by Lawrie.
5. Processed Meats by Pearsons.
6. Fish Processing Technology by George M. Hall.
7. Fish Processing Technology by Gopalkumar K. (ICAR – publications).

Unit – I

- **Role of analyst**
- **Tri stimulus color system & hunter lab CDM.**
- **Flame photometry**– Concept of ground state, excited state, ionization energy. resonance line, inferences, components of flame emission spectrophotometer.
- **Principles and application of atomic absorption spectroscopy**– Components of atomic absorption spectroscopy, ICP.

Unit - II

- **X-ray analysis of foods**– Properties, production & detection, x- ray tubes, detectors, sources, application in food industry.
- **Mass spectroscopy**– Instrumentation and interpretation
- **Morphological and thermal Analysis**- SEM and DSC- Basic Principles, Instrumentation, and application in foods

Unit - III

- **Chromatography**– Principles of different chromatographic separations. HPLC, GC and coupling systems
- **Rheology measurement**– Farinograph, Amylograph, Rheometer, Texture analysis.
- **Nuclear magnetic resonance (NMR)** – Principle, Components, Interpretation of NMR spectra, application of NMR.
- **Immunoassays and Nucleic acid based techniques** : ELISA & PCR

Unit-IV (Practical)

1. Working of HPLC
2. Farinography of wheat samples
3. RVA of starch and wheat samples
4. Texture analysis of foods products using Texture Analyser
5. Phase transitions, enthalpy changes and oxidative stability of foods using DSC
6. Structural analysis of food samples using ATR-FTIR
7. Analysis of XRD- Data for estimation of % crystallinity in starch samples
8. Analysis of SEM pictures for studying morphology

References:

1. Food Analysis by Pomeranz.
2. Food Analysis by S. Suzanne Nielsen
3. Advances in Food Diagnostics by Leo M. L. Nollet and Y.H Hui
4. Methods of Analysis for Functional Foods and Nutraceuticals by W.Jaffrey
5. Instrumental Mehods in Food Analysis by J.R. J Pare and J.M.R Belanger

PROCESSING OF FOODS OF PLANT ORIGIN (PRACTICAL) (0+0+4)

Part I (Cereals)

1. Physico-chemical testing of wheat and rice.
2. Experimental milling of wheat and rice. Assessment of per cent of head rice, broken, immature kernels and degree of polish in rice.
3. Determination of quality characteristics of flours.
4. Experimental parboiling and evaluation of quality of parboiled rice.
5. Evaluation of cooking quality of rice.
6. Rheological properties of dough using Farinograph/ Extensograph/Mixograph.
7. Pasting properties of starches using Visco-amylograph/RVA.
8. Experimental baking of bread, cake and biscuit and their evaluation,
9. Experimental extrusion cooking and quality evaluation of extrudates.
10. Solvent extraction of oil seeds.
11. Quality evaluation of oils.
12. Visit to wheat and rice processing plants.
13. Determination of yeast activity
14. Preparation of protein isolates from legumes and evaluation of cooking quality of legumes.

Part II (Fruits and Vegetables)

1. Quality Evaluation of Fruits & Vegetables (TSS, Color, Acidity, Texture etc.)
2. Canning of fruits & vegetables.
3. Testing of can, cut out analysis
4. Preparation and analysis of syrups and Brines.
5. Experimental dehydration of fruits and vegetables (Dehydration and rehydration ratio)
6. Preparation and preservation of juices.
7. Preparation and preservation of squashes and RTS.
8. Preparation and preservation of Jam, Jellies and marmalades.
9. Preparation and preservation of pickle and vinegar.
10. Preparation of tomato ketchup and sauce.
11. Visit to a fruit and vegetable processing industry.

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1. Handbook of Analysis and Quality Control of Fruit and Vegetable Products S. Ranganna
2. Preservation of fruits & Vegetables by Siddappa et al 1999. ICAR, New Delhi
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4. Juliano, B. O. (1985). *Rice Chemistry and Technology*, American Association of Cereal Chemists, St. Paul, MN, USA.
5. Stanley P. Cauvain & Lindsay S. Young. Baked Products. Blackwell Publishing.
6. Stanley P. Cauvain & Lindsay S. Young. The Chorleywood Bread Process. CRC Publications.
7. Bakery Technology & Engineering by Samuel A. Matz.
8. Manual of American Association of Cereal Chemists
9. Manual of AOAC, 1990

Unit-I (Tutorial)

- Processing of market milk- standardization, toning of milk, homogenization.
- Storage, transportation and distribution of milk. Pasteurization and sterilization.
- Milk products- Processing of cream, butter, cheese, ice cream.
- Sources of meat, composition and nutritive value of meat.
- Conversion of muscle to meat. Factors affecting post mortem changes in meat.
- Properties and shelf life of meat.
- Eating quality of meat – colour, flavor, tenderness, juiciness and water holding capacity.
- Meat quality evaluation
- Preservation of meat by freezing, curing, pickling and smoking of meat.

Unit-II (Practical)

- Quantative estimation of milk constituents such as moisture, %TS, fat.
- Determination of acidity and specific gravity of milk.
- Platform tests on given sample of milk.
- Standardization of milk.
- Detection of adulterants in milk- water, starch, urea.
- Preparation of common milk products like flavoured milk, yoghurt, ice cream.
- To study slaughtering and dressing of meat animals.
- Evaluation of meat quality.
- Preparation of various meat products such as: Meat pickle
- Preparation and evaluation of traditional meat products.
- Determination of meat to bone ratio in Chicken
- Visit to local milk processing plant.

References:

1. Outlines of Dairy Technology by S. K. De
2. Chemistry and Testing of Dairy products by H.V. Atherton & J.A. Newlander
3. Milk and dairy Product Technology by Edger Spreer.
4. Dairy Chemistry by H.H. Sommer
5. Lawre. R. A. & Ledward, D. A. (2006). Lawres Meat Science 7th Ed. Woodhead Publishing Company, Cambridge, England.
6. Throntons Meat Hygiene.
7. Principles of Meat Science by Forest.
8. Developments in Meat Science by Lawrie.
9. Processed Meats by Pearsons.

Unit I:

- Structure and morphology of grain; Classification of wheat
- Milling, aims and principle of milling, steps of milling, milling machinery
- Raw materials used in bakery and their role in the product: Flour, yeast, fat, sugar, baking powder, egg, salt etc.
- Dough rheology and its measurement
- Basics of bread making: Basic bread recipe, flour characteristics and improvement, steps in bread making process, Charley-wood bread making process.
- Manufacturing cookies, biscuits and cakes, icings and toppings
- Enzymes used in baking industry
- Bread faults and their remedies

- **Unit II (Practicals):**

1. Determination of physical properties of kernels: Length, breadth, thickness, volume, aspect ratio, 1000-kernal weight.
2. Physico-chemical tests: Estimation of moisture, protein, fat and minerals.
3. Determination of SDS- sedimentation volume.
4. Determination of gluten content.
5. Preparation of bread.
6. Preparation of cake.
7. Preparation of cookies.
8. Evaluation of cookies

References:

1. Wheat chemistry and technology, Volume-I by Y. Pomeranz.
2. Advances in cereal science and Technology by Y. Pomeranz.
3. Cereals and cereal products by D. A. V. Dendy and B. J. Dobraszczyk.
4. Cereal processing technology by G. Owens.
5. Baking science and technology: fundamentals and ingredients by E. J. Pyler and L. A. Gorton.
6. Bread Science: The Chemistry and Craft of Making Bread by Emily Buehler.

Unit – I (Wheat Chemistry and Technology)

- Current status and future scenario of world wheat production and uses.
- Structure and chemical composition of wheat grain and its relation to processing qualities.
- Criteria of wheat quality – physical and chemical. Molecular basis of wheat grain hardness/softness.
- Wheat milling – principle, conditioning and milling systems. Flour streams, extraction rates and their composition.
- Structure and functionality of wheat proteins, carbohydrates and lipids in bread making.
- Enzymes of wheat and their technological significance.
- Vital wheat gluten – manufacturing techniques, uses and functionality.
- Dough rheology and dough testing apparatus such as recording dough mixers, load extension meter.

Unit – II (Minor Cereal Grains and Bakery products)

- Composition and structure of corn.
- Wet and dry milling of corn. Corn products and their uses.
- Composition and structure of barley and oat. Milling of oat and barley. Classification of malt products, nutritive value and food applications of malt.
- Chemical, technological and nutritional aspects of sorghum and millets.
- Bread making processes, development in bread making methods, functions of ingredients/ additives such as fat, emulsifiers, oxidants, reducing agents, conditioners. Bread faults and remedies.
- Technology of biscuit, cake, cookies and cracker manufacture.
- Durum wheat – chemistry, quality and technology of pasta products.

Unit – III (Rice Chemistry and Technology)

- Rice grain structure and chemical composition.
- Milling of rice – types of rice mill: huller mill, sheller-cum-huller mill, sheller-cum-cone polisher mill, small capacity rice mill. Modern rice milling. Factors affecting rice yield during milling. By-products of rice milling and their utilization.
- Cooking quality of rice.

- Parboiling of rice – traditional method and their drawbacks. CFTRI process of parboiling. Properties of parboiled rice. Changes during parboiling. Advantages and disadvantages of parboiling.
- Rice convenience foods – precooked rice, canned rice, expanded rice, rice based infant food formulas, rice puddings and breads, rice cakes, rice noodles and fermented foods.

Unit IV (Oil seed and Legume processing)

- Types of oil seeds and their chemical composition.
- Oil extraction – Mechanical and solvent extraction.
- Refining of crude oils.
- Processing of oil seeds for protein concentrates and isolates.
- Margarine manufacturing processing and its uses.
- Structure and composition of pulses, their importance in Indian diet.
- Dhal milling and processing of pulses.
- Fermented and traditional products.

References:

1. Pomeranz, Y. (1998). *Wheat: Chemistry and Technology*, Vol. I 3rd Ed., American Association of Cereal Chemists, St. Paul, MN, USA.
2. Juliano, B. O. (1985). *Rice Chemistry and Technology*, American Association of Cereal Chemists, St. Paul, MN, USA.
3. Samuel, A.M. (1996). *The Chemistry and Technology of Cereal as Food and Feed*. CBS Publishers & Distribution, New Delhi.
4. Dandy, D. A. V & Dobraszczyk, B. J. (2001) *Cereal and Cereal Products: Chemistry and Technology*, Aspen Publishers.
5. Kent, N. L. & Evers, A. D. (1994) *Kent's Technology of cereals* 4th Ed. Elsevier science Ltd. Oxford, U. K.

TECHNOLOGY OF MILK AND MILK PRODUCTS (4+0+0)

Unit – I

- Dairy industry in India and its scope.
- Sources and composition of milk, nutritive value.
- Chemistry of Milk-Milk fat, proteins, lactose, vitamins, minerals & salts
- Factors affecting composition of milk.
- Processing of market milk- standardization, toning of milk, homogenization.

Unit – II

- Storage, transportation and distribution of milk. Pasteurization and sterilization.
- Milk products - Processing of cream, butter oil, condensed milk, evaporated milk, whole and skimmed milk.
- Cheese and its types,

Unit – III

- Production of Ice creams & its quality control.
- Starter culture production & propagation for fermented milk products.
- Production of fermented milk products.
- Instantization of milk and milk products.

Unit – IV

- Judging and grading of milk and its products.
- In plant cleaning system.
- Quality standards of milk and milk products.
- Packaging of dairy products.
- By product utilization.

References:

1. Technology of Dairy Products by Early. R.
2. Outlines of Dairy Technology by S. K. De.
3. Chemistry and Testing of Dairy Products by Atherton.

TECHNOLOGY OF MEAT, FISH AND POULTRY PRODUCTS (4+0+0)

Unit – I

- Scope of meat industry in India with special reference to J&K.
- Sources of meat, composition and nutritive value of meat.
- Structure of muscle. Microscopic structure of meat.
- Contraction and relaxation of muscle.
- Factors affecting meat production and quality.

Unit – II

- Slaughtering of animals and poultry.
- Inspection and grading of meat.
- Conversion of muscle to meat. Factors affecting post mortem changes in meat.
- Properties and shelf life of meat.
- Eating quality of meat – colour, flavor, tenderness, juiciness and water holding capacity.
- Meat quality evaluation.
- Mechanical deboning.
- Meat tenderization and aging.
- Restructuring of meat products.
- Preservation of meat by freezing, curing, pickling and smoking of meat.

Unit - III

- Meat plant sanitation and safety.
- By product utilization of meat industry.
- Recent trends in meat processing.
- Traditional meat products of J&K.
- Structure, composition, nutritive value and functional properties of eggs.
- Factor affecting egg quality and measures of egg quality.
- Preservation of eggs by different methods. Preparation of egg powders.

Unit – IV

- Types of fish, composition, structure. Post mortem changes in fish.
- Handling of fresh water fish.
- Preservation of fish by freezing, glazing of fish, canning, smoking, freezing, irradiation and dehydration.
- Technology of production of fish sauce, fish sausage, fish meal and fish oil.

References:

1. Lawre. R. A. & Ledward, D. A. (2006). Lawres Meat Science 7th Ed. Woodhead Publishing Company, Cambridge, England.
2. Throntons Meat Hygiene.
3. Principles of Meat Science by Forest.
4. Developments in Meat Science by Lawrie.
5. Processed Meats by Pearsons.
6. Fish Processing Technology by George M. Hall.
7. Fish Processing Technology by Gopalkumar K. (ICAR – publications).

FRUIT AND VEGETABLE TECHNOLOGY (4+0+0)

UNIT-I

Fruit maturity and ripening indices.

Postharvest changes in fruits and vegetables.

Ethylene biosynthesis, mode of action, inhibition of ethylene synthesis.

Composition & related quality factors for processing.

Handling of horticultural produce.

Precooling and transport of horticultural commodities.

UNIT-II

Cold chain management.

Storage: Definition & functions

Types of storage: low cost and high cost storage systems

Controlled atmospheric storage: Its construction and control of gases.

Hypobaric storage

Zero energy cool chamber: Its construction and advantages.

UNIT-III

Principles of preservation,

Preservation by heat, chemicals, sugar, salt, fermentation, drying, freezing

Chemistry of pectin, theories of gel formation

Role of enzymes in processing

Quality standards of fruits & vegetable products.

Canning: spoilage of canned products

UNIT-IV

Fruit & vegetable Juices: Preparation & preservation of juices syrups, cordials,

Squash, concentrate pickles, tomato products

Dehydration of fruits & vegetables

Freezing of fruits & vegetables

Jams, Jellies, Marmalades and preserves

Waste utilization

Reference:

1. Postharvest Technology of Fruit & Vegetables by A.K. Thompson.
2. Postharvest Technology of Fruits & Vegetables by verma & joshi 2000. Indus publications, New Delhi
3. An introduction to Postharvest Technology by RBH Wills. 2003
4. Preservation of fruits & Vegetables by Siddappa et al 1999. ICAR, New Delhi
5. Preservation of Fruits & Vegetables by Srivastava & Kumar, 1996. Intl. Book publishing Co. Lucknow
6. Handbook of Vegetables and Vegetable Processing by Y. H. Hui 2011. Wiley Blackwell
7. Handbook of Fruits and Fruit Processing by Y. H. Hui 2006. Wiley Blackwell

This comprehensive course has been devised to provide the students the theoretical understanding of various geospatial technologies like Remote Sensing and GIS. It deals with the fundamental aspects and at the same time discusses the various applications of these technologies in various applied fields. The students are prepared to carve a place for themselves in the ever expanding world of opportunities that these technologies have to offer at the global level.

Credit-I

1. Fundamentals of Remote Sensing –EMR & EMS
2. Interaction of EMR with the Atmosphere & Earth Surface Features
3. Resolution in Remote Sensing - Spatial, Spectral, Temporal and Radiometric
4. Sensors and Platforms: Their Types and Characteristics
5. Mechanism of Remote Sensing data Acquisition

Credit-II

1. Aerial Photographs and Their Types
2. Fundamentals of Aerial Photograph and Image Interpretation and its Elements
3. Image Interpretation keys; Items, Subject, Regional and Analogous Key
4. Search Methods: Fishing Expedition Method and Logical Search method
5. Multi Concept in Remote Sensing

Credit-III

1. High Resolution and Hyper Spectral Remote Sensing
2. Microwave Remote Sensing : RADAR Basics
3. Digital Images Processing
4. Pre Processing: Radiometric & Geometric Errors
5. Image Enhancement Techniques

Credit-IV

1. Definition, Scope and Development of GIS
2. Components of GIS
3. Geographic Data: Types and Characteristics
4. Data Models: Raster and Vector, Processing and Analysis
5. GIS DBMS: Concepts, Components and Quality

Suggested Readings:

1. Campbell, J.B., Introduction to Remote Sensing, (2nd ed.), Taylor and Francis, London, 1996.
2. Curran, P., Principles of Remote Sensing, Longman, London, 1985.
3. Fazal S. and Rahman A., GIS Terminology, New Age International Publishing, New Delhi, 2007.
4. Jenson, J.R., Remote Sensing and Environment. Pearson India, 2013.
5. Joseph George., Fundamentals of Remote Sensing, (2nd ed.) University Press, Hyderabad, 2005.
6. Kumar, S., Basics of Remote Sensing and GIS, Laxmi Pub, 2005.
7. Lo, C.P. and Yeung AKW., Concepts and Techniques of GIS (2nd ed.), Prentice Hall of India, New Delhi, 2006
8. Leick. A., GPS Satellite Surveying (2nd ed.), John Wiley and Sons, New York, 2003.
9. Lillesand T.M and Keifer R.W., Remote Sensing and Image Interpretation (6th ed.) John Wiley and Sons, New York, 2008.
10. N. K. Agarwal., Essentials of GPS, Spatial Network Pvt. Ltd, 2004.
11. Sabins, J.F.F., Remote Sensing: Principles and Interpretation, W.H. Freeman & Co., New York, 1997
12. Sabins, F.F., Remote Sensing: Principles and Interpretation. Freeman, New York, 1986.
13. Siegal, B.S. and A.R Gillespie., Remote Sensing in Geology, Wiley, New York, 1980.

Credit-I:

1. Correlation, types of correlation, Forms of relation and measuring the strength of association and relation. Construction and meaning of scatter Diagram, Karl Person's Coefficient of Correlation, Rank Correlation
2. Linear regression Analysis
3. Multiple correlation
4. Partial correlation coefficient
5. Multiple Regression
6. Coefficient of Determination

Credit-II:

1. Lorenz Curve and Gini's Coefficient
2. Location Quotient
3. Time series: Moving average, least square method and drawing of line of best fit, second degree equation
4. The exponential curve, Logistic curve
5. Interpolation
6. Sampling its types, t test, Z test, Chi Square test, Mann Whitney- U Test

Credit-III:

1. Cartographic methods and techniques for preparation of maps and diagrams, types and applications
2. Calculation of gradient and slope
3. Went worth's Method of average slope

Credit-IV:

1. Digital Mapping: Preparation of thematic maps
2. Analysis of Socio Economic data with the help of SPSS and presentation in Maps with the help of GIS
3. crop combination data (weaver's, Thomson's, and Rafiullah's, method)

Socio-Economic data (Construction of composite index and mapping of Regional disparities). Livestock data , Hydrometeorological data in maps

SEMESTER- III

Women in Ancient India

Course code: HS14311EA

Unit-I

Historiography-- women's issue as analysed in different historiographical discourses, viz. colonial, Nationalist, Marxist and recent trends.

Unit-II

- I.** The Female Principle: Women in different religious traditions, viz. Brahmanical, Buddhist, Jain, Tantric and Bhakti.
- II.** Co-reference to women in Epics and Puranas

Unit-III

- I.** The socio-sexual constructions of womanhood – in different forms of marriage
- II.** Women in Family and households.
- III.** Women and property

Unit-IV

- I.** Contribution of Women: Economy, Society, Polity and Cultural
- II.** Women and the institution of Sati

Select Readings:

- Agarwal, Bina, *A Field of One's Own: Gender and Land Rights in South Asia*, CUP, 1994.
- Altekar, A.S., *The Position of Women in Hindu Civilisation*, second revised edition, chs. 8, 9.
- Aparna Basu and A. Taneja [eds] *Breaking out of Invisibility; Women in Indian History*, 2002
- Atre, Shubhangana, *The Archetypal Mother*, 1987.
- Barai, Kumudini, *Role of women in the History of Orissa; From the earliest times to 1568 A.D.*, 1994
- Bhattacharji, Sukumari, *Women and Society in Ancient India*, 1994
- Chakravarty, Uma, *Everyday Lives, Everyday Histories; Beyond the Kings and Brahmanas of Ancient India*, 2006
- Chakravarty, U. 'Whatever happened to the Vedic Dasi?: Orientalism, Nationalism and Script from the Past' in Sangari and Vaid [eds] *Recasting Women*, 1989
- Chitgopekar Nilima (ed), *Invoking Goddesses: Gender Politics in Indian Religion*, 2002
- Elamkulam P.N. Kunjan Pillai, 'Matriliney in Kerala' in *Studies in Kerala History*, 1969
- *Gender Studies*, 15(1), Jan-Apr 2008.
- Godelier, Maurice, "The Origin of Male Domination", *New Left Review*, 127, May-June 1981.
- *Godesses*, OUP, 2002.
- Hiltebeitel, A. and K. Erndl (eds), *Is the Goddess a Feminist: The Politics of South Asian*
- Hirschon, Renee, *Women and Property: Women as Property*, 1984.
- Jaini, Padmanabh, *Gender and Salvation*, 1992.
- Jaiswal, Suvira, "Women in early India: Problems and Perspectives", *Proceedings of the Indian History Congress*, 1981, pp. 54-60.
- Joan Wallach Scott, *Gender and Politics of History*, 1986, Ch.1.2
- Kapadia, K.M., *Marriage and Family in India*, third revised edition, 1967.
- Karve, Irawati, *Kinship Organization in India*, second revised edition, 1965.
- Kosambi, D.D., *Myth and Reality*, 1962.
- Moore, Henrietta, *Feminism and Anthropology*, 1988.
- Nath, Vijay, *The Puranic World: Environment, Gender, Ritual and Myth*, 2008
- Orr, Leslie, *Donors Devotees and Daughters of the God*, 2000
- Ramaswamy, Vijaya, *Walking Naked: Women, Society, and Spirituality in South India*, 1997.
- Rangachari, Devika, *Invisible Women, Visible Histories.: Society, Gender And Polity in North India*. 2009
- Tradition' *EPW* 17[43]1992
- Roy, K. *The emergence of Monarchy in north India 8-4 centuries B.C.*, 1994
- Sanday, *Female Power and Male Dominance: On the Origins Of Sexual Inequality*, Cup, 1981
- Shah, Kirit K., *Problem of Identity: Women in Early Indian Inscriptions*, OUP, 2001
- Shah, Shalini, *Love, Eroticism and Female Sexuality in the Classical Sanskrit Literature 7-13th*
- Shah, Shalini, *Poetesses in the Classical Sanskrit Literature: 7th-13th Centuries*, *Indian Journal of*
- Shah, Shalini, *The Making of Womanhood: Gender Relations in the Mahabharata*, 1995
- Sharma, R.S., *Light on Early Indian Society and Economy*, 1966.

- Shaw, Miranda, *Passionate Enlightenment*, 1994.
- Tyagi, Jaya, *Engendering the Early Household*, Orient Longman, Delhi, 2008.

Syllabus Choice Based Credit System (CBCS)

for M.A Persian 2017 onwards

SEMESTER I

(3 core courses, each course of 4 credits)

PER17101CR :-Classical Persian Literature Poetry (Ghazal & Rubai)

Critical Study of the poets and Translation and Explanation of the below mentioned text:

Credit - 1st

انتخاب از غزلیات سعدی شیرازی:

- ا- شب فراق که داند که تا سحر چندست -
- ب- مادرین شهر غریبیم و درین ملک فقیر -
- ج- شب است و شاهد شمع و شراب و شیرینی -
- د- من ندانستم از اول که تویی مهر و وفایی -

Credit - 2nd

انتخاب از غزلیات حافظ شیرازی:

- ا- صبحدم مرغ چمن با گل خواسته گفت -
- ب- دوش دیدم که ملائک در میخانه زدند -
- ج- ستاره ای بد زشید و ماه مجلس شد -
- د- بیا تا گل برافشانیم و می در ساغر اندازیم -

Credit - 3rd

انتخاب از غزلیات خواجو کرمانی:

- ا- اگر سرم برود در سرو فانی شام -
- ب- گویا عزم ندارد که شود روزا مشب -
- ج- دیشب درآمد از دم آن ماه چهره ست -
- د- در چمن دوش بوی تو گذر میکردم -

Credit - 4th

انتخاب از رباعیات عمر خیّام:

- ا- افسوس که نامه جوانی طی شد -
- ب- این قافله عمر عجب می گذرد -

- ج۔ درکار گاہ کوزہ رستم دوش۔
د۔ پیش ازمن و تو لیل و نہاری بوده است۔

Books Recommended For Study

- ۱۔ بوستان ادب از دکتر شمس الدین احمد۔
- ۲۔ دیوان حافظ۔ بہ تصحیح پرفیسر نذیر احمد قاسم غنی۔ و مقدمہ
- ۳۔ کلیات سعدی۔ چاپ فروغی۔
- ۴۔ رباعیات عمر خیام۔
- ۵۔ شعر الجم از شبلی نعمانی۔ ۵ جلد۔
- ۶۔ تاریخ تحول شعر فارسی۔ از زین العابدین مومتمن۔
- ۷۔ دی باخیام۔ از علی دشتی۔
- ۸۔ سخن و سخنوران۔ فروزانفر بدیع الزمان۔
- ۹۔ باکاروان حلہ۔ دکتر عبدالحسین زرین کوب۔
- ۱۰۔ گلستان عجم ترجمہ باکاروان حلہ مطبوعہ اسلام آباد۔
- ۱۱۔ جام جہان نما۔ محمد علی اسلامی ندوش۔
- ۱۲۔ در مکتب حافظ از زرین کوب۔
- ۱۳۔ صور خیال در شعر فارسی از دکتر شفیع کدکئی انتشارات نیل۔

PER17102CR:- Classical Persian Prose.

Critical study of the prescribed books, authors and translation of the text given below.

Credit - 1st

انتخاب از سیاست نامہ از نظام الملک طوسی
۱۔ فصل ہفتم: اندر بر رسیدن از حال عامل وقاضی..... و شرط سیاست

Credit - 2nd

انتخاب از چہار مقالہ (مجمع النوادر)۔ از نظامی عروضی سمرقندی

مقالہ دوم: در ماہیت علم شعر و صلاحیت شاعر۔ از ص ۱۶۸ تا ۱۸۰

Credit - 3rd

انتخاب از گلستان سعدی شیرازی
جدال سعدی بامدعی در بیان تو انگری و درویشی
حکایت اول دوم سوم چهارم

Credit - 4th

انتخاب از تاریخ مسعودی معروف به تاریخ بیهقی تألیف ابوالفضل محمد بن حسین بیهقی
آمدن رسول از بغداد به گاهای درگذشتن القادر بالله خلیفه عباسی

In the examination there will be four Credits in this course - with an alternative choice - and the students will be required to attempt all the four. The Credits will be designed to test students critical understanding of the thematic and formal aspects of prescribed text.

Books Recommended For Study

- ۱- ”بهار ادب“ انتخاب از نثر کلاسیک فارسی با هتنام دکتر شمس الدین احمد -
- ۲- گزیده های از نظم و نثر فارسی - نثر کهن - متن های تاریخی از انتشارات فرهنگ و هنر -
- ۳- سبک شناسی - از ملک اشعر ابهار -
- ۴- نور و ظلمت در تاریخ ادبیات ایران از میخائل - ترجمه از اسد پور پیرانفر -
- ۵- چهار مقاله تصحیح دکتر محمد معین (دیباچه) -
- ۶- دیداری با اهل قلم از شادروان دکتر غلام محسین یوسفی - ۲ جلد
- ۷- قلمرو سعدی - علی دشتی -
- ۸- گنجینه سخن - دکتر ذبیح الله صفا -
- ۹- گلستان سعدی به کوشش - نوالله ایزدپرست

PER17103CR:- Communication and Skills

Credit - Ist

Introduction to the Basic Persian Language & Grammar. Question answer word meaning make sentences. Fill in the blanks from the prescribed book.

Persian Language training course, Preliminary Advance Level- vol.2. by Mehdi Zarghamian.

Credit - 2nd

Translation and study from Persian to Urdu or English of the Ist five chapters of the prescribed book.

Persian Language training course, Preliminary Advance Level- vol.2. by Mehdi Zarghamian.

Credit - 3rd

Translation and study from Persian to Urdu or English of the Last five chapters of the prescribed book.

Persian Language training course, Preliminary Advance Level- vol.2. by Mehdi Zarghamian.

Credit - 4th

- (A) Translation of Unseen passages of English or Urdu into Persian.
- (B) Conversation in Persian and Viva Voce Test.

INSTRUCTIONS FOR THE PAPER SETTER:

In the examination there will be four Credits in this course with an alternative choice and students will be required to attempt all the four. The Credits will be designed to test students close knowledge and proper understanding of the Persian Language. In Credit-II four passages and Credit-III four passages should be given and students should be asked to translate two passages (Paper setter will translate any Four passages from the book into Urdu or English and then ask the students to translate Two passages into Persian). Viva- Voce examination will be conducted by the Head of the Department and concerned teacher.

PER17104DCE:- History of Persian Literature. (Farsi-e-Bastan)

Credit - Ist

۱- اطلاعات درباره مضوعاتی برگزیده زیر:
فارسی باستان - پهلوی - فارسی دری - اوستا

PER17203CR:- Communication and Skills

Credit - 1st

To Learn the Persian Grammatic terms and their usage. Question answer, Fill in the blanks, word meaning & sentence from the prescribed book.

مهدی ضرغامیان ج ۳- از آموزش زبان فارسی

Credit - 2nd

Translation and study of 1st five chapters of the prescribed book.

آموزش زبان فارسی از مهدی ضرغامیان ج ۳-

Credit - 3rd

Translation and study last five chapters of the prescribed book.

آموزش زبان فارسی از مهدی ضرغامیان

Credit - 4th

Oral conversation in Persian Language & Viva Voce Test.

(Note):- The Viva Voce examination will be conducted by the external examiner, Head of the Department and concerned teacher.

PER17204DCE:- History of Persian Literature (Ghanavid & Saljok Period)

Credit - 1st:

۱- وضع نثر فارسی در دوره غزنویان

Credit - 2nd:

۲- وضع شعر فارسی در دوره غزنویان

Credit - 3rd:

۳- ترویج نثر فارسی در دوره سلجوقیان

Credit. 4th

۴- ترویج شعر فارسی در دوره سلجوقیان

PHARMACEUTICS III

DRA, INTELLECTUAL PROPERTY RIGHTS & QUALITY ASSURANCE

1.Requirements of GMP, CGMP, GLP, USFD, WHO guidelines and ISO 9000 series, Drugs and cosmetics act and rules,

2.Documentation-

Protocols, forms and maintenance of records in Pharmaceutical industry Preparation of documents for new drug approval and export registration, Patent processing, and its applications.

3.Pharmaceutical Process validation

Concepts in validation. Validation of manufacturing and analytical equipments.Process validation in manufacturing dosage formulations.Applications of process validation.

4.Pilot plant scale up Techniques.

Transfer of Technology from R and D to pilot scale and to plant scale

5. Basic concepts of quality control and Quality Assurance systems,

Source and control of quality variation of Raw materials , containers, closures, personnel, Environment, etc.

6. In process quality control tests, IPQC problems in Pharmaceutical industries. ICH guidelines.

7. Sampling plans, sampling and characteristic curves.

8. Mater formula generation and Maintenance,

Standard operating Procedure (SOP) for different dosage forms.

9. New product launch and trouble shooting in production

10. Clinical trials and toxicological evaluation of drugs

11.Sewage disposal and pollution control

BOOKS RECOMMENDED.

- 1.Willing , Tuekerman and Hitchings- Good manufacturing practices for pharmaceuticals.
2. Drug and Cosmetic Acts and Rules.
3. Bharati- Drugs and Pharmacy Laws in India.
4. OPPI- Quality Assurance.
5. Patel – Industrial Microbiology.
- 6.Loftus,B.T and Nash,R.A Pharmaceutical process validation
7. Bolton, S., Pharmaceutical statistics
8. Carletiori, Validation of Aseptic pharmaceutical process.
9. Garfield Quality assurance principles for analytical laboratories
10. Indian pharmacopoeia
11. British pharmacopoeia
12. United states pharmacopoeia

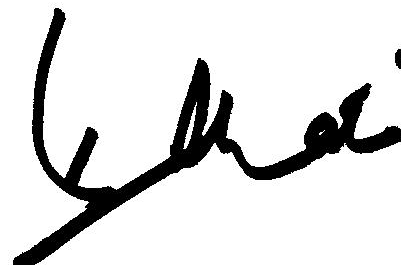
PHARMACOLOGY-III

PHARMACOLOGICAL METHODS AND TOXICOLOGY

1. Principles of Pharmacological and Clinical Evaluation of drugs.
2. Pharmacological Techniques to evaluate drugs belonging to following categories.
 - a) Antipsychotics, antianxiety agents; nootropics; antidepressants, antiparkinsonian agents, antiepileptics, analgesics, anti-inflammatory agents, local anaesthetics.
 - b) Antihypertensives, antiarrhythmics, antiatherosclerotics, drugs for myocardial infarction.
 - c) Antiulcer drugs, antidiabetics, antitussives
 - d) Evaluation of antioxidants
 - e) Transgenic animals, genetically prone animal models
 - f) Anti cancer drugs
 - g) In-vitro techniques
 - h) Antifertility agents
3. Drug Toxicity, Safety Evaluation of new drugs
4. Regulations for Laboratory animal care and ethical requirements

BOOKS RECOMMENDED

1. Modern Pharmacology by C.R. Craig and R.E. Stitzel
2. Goodman and Gilman's : The Pharmacological Basis of Therapeutics edited by Alfred Goodman Gilman, Theodore W. Rall, Alan S. Nies and Palmar Taylor
3. Clinical Pharmacology by D.R. Laurence and P.N. Benett
4. Essentials of Pharmacotherapeutics by F.S.K. Barar
5. Pharmacology by H.P. Rang and M.M. Dale
6. Lewis's Pharmacology revised by James Crosslang
7. Oxford Textbook of Clinical Pharmacology and Drug Therapy by D.G. Grahame Smith and J.K. Aronson
8. S.Singh Essentials of Pharmacology Academia Publishers.



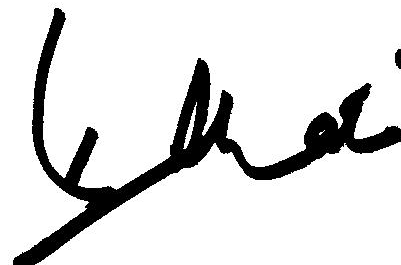
PHARMACEUTICAL CHEMISTRY-III MEDICINAL CHEMISTRY

The following topics will be discussed keeping in view the recent advances:

1. **Cardiovascular Agents** : Anti-hypertensive agents, antiarrhythmic agents, antihyperlipidemic agents, antianginal agents.
2. **Psychopharmacological agents** : Antipsychotic Agents : Introduction, Biochemical basis of mental disorders, Development of antipsychotic agents : Phenothiazines, Butyrophenones: Atypical antipsychotic agents. Antidepressant Drugs : Introduction, Development of tricyclic antidepressants, Monoamine oxidase inhibitors; Selective serotonin-reuptake inhibitors; Atypical antidepressants, Lithium salts. Antianxiety Agents: Introduction, medicinal Chemistry of benzodiazepines; SAR of benzodiazepine derivatives, medicinal chemistry of non-benzodiazepines; serotonin-reuptake inhibitors, development of meprobamate and analogues; atypical anxiolytic agents;
3. **Chemotherapy** : Antiviral agents including the development in chemotherapy of AIDS, Drugs for neoplastic diseases.
4. Drugs affecting immune responses.
5. Radioprotective drugs
6. **Analgesics and anti inflammatory agents**, Prostaglandins, Non steroidal drugs, Steroidal drugs, Endorphins
7. Diuretics

BOOKS RECOMMENDED

1. M.E. Wolf, Bruggers Medicinal Chemistry, John Wiley and Sons, New York, Vol. I, II & III
2. R.F. Doerge, Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Lippincott.
3. W.O. Foye, Principles of Medicinal Chemistry, Lea and Febiger, Philadelphia.
4. Lednicher and Mitschler, Drug synthesis, Vol. I, II & III.
5. Martindale, The Extra Pharmacopoeia, Pharmaceutical Press, London
6. T, Albert, Selective Toxicity, Chapman and Hall, London.
7. Burger's Med. Chem. & Drug Discovery, Vol. I.
8. Monographs and relevant Review articles appearing in various periodicals and Journals.



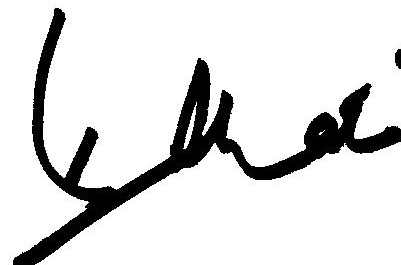
PHARMACOGNOSY AND PHYTOCHEMISTRY-III

CULTIVATION & STANDARDIZATION OF MEDICINAL PLANTS

1. Preparation of herbarium specifications, use of flora and keys of plant identification, Microtomy and advanced histological techniques as applied to pharmacognostical specimen, pharmacognostical drawings and macro and microphotography. Quantitative microscopy as applied to drug evaluation and pollen grain analysis.
2. Agrotechnology of medicinal plants ; Ecotypic, Phenotypic and Genotypic Variability affecting phytopharmaceuticals. Prospects and economics and medicinal and aromatic plants in India. Cultivation methods developed in India for the following plants of commercial significance. Glycyrrhiza, Ipecac, Mentha, Poppy, Psyllium and Senna. Tropane alkaloid and steroid containing plants.
3. Application of chromatographic techniques such as column, paper, TLC, HPTLC, GLC, HPLC and DCCC in the isolation and purification of phytopharmaceuticals.
4. Applications of UV, IR, NMR, ¹HNMR, ¹³CNMR and Mass spectroscopy for structural elucidation of phytopharmaceuticals. Standardization and quality procedures for the assay of plant products.

BOOKS RECOMMENDED

1. Chromatography by Heptman.
2. Techniques in Terpenoid Identification by Dr. Mohd. Ali, Birla Publications, Delhi.
3. Cultivation and Utilization of Medicinal & Aromatic Plants by C.K. Atal and B.M. Kapur, R.R.L. Jammu
4. The Wealth of India (Raw Materials) All Volumes, NISCOM, Delhi.
5. Stahl. E. (1987). Thin Layer Chromatography, Springer-Verlag, Berlin-Hiedelberg- New York.
6. Anonymous (1993) Standardisation of Single Unani Drugs, CCRUM, New Delhi.



(MPP-III) PHARMACY PRACTICE-III

HOSPITAL AND COMMUNITY PHARMACY

A. COMMUNITY PHARMACY

1. Introduction to the concept of community pharmacy, its activities and professional responsibilities.
2. The role of the community pharmacy and its relationship to other local health care providers.
3. Prescribed medication order interpretation and legal requirements.
4. Patient counseling in community pharmacy.
5. Over the counter (OTC) sales.
6. Services to nursing homes/Clinics.
7. Community Pharmacy Management: Financial material and staff management infrastructure requirements, drug information resources computers in community pharmacy.
8. Code of ethics for community pharmacists.
9. Polypharmacy and its implication.

B. HOSPITAL PHARMACY

10. The role of hospital pharmacy department and its relationship to other hospital departments and staff,
- 11. Hospital Drug policy:** Drug committee formulary and guidelines, other hospital committee such as infection control committee and research & ethics committee.
- 12. Hospital Pharmacy Management:** Staff (professional and non professional), materials (drugs, non drugs, consumables), financial (drug budget, cost centers, sources of revenue collection), policy and maintenance and planning, infrastructure requirements (building furniture and fittings, specialized equipment, maintenance and repair), workload statistics, hospital formulary,
13. Organization of hospital pharmacy services.
- 14. Drug Distribution:** Purchasing warehousing (storage conditions, expiry date control, recycling of drugs, stocktaking drug recalled, drug distribution method, ward stock, individual patient dispensing, specific requirements for inpatients, outpatients, casualty emergency, theatre, ICU/ICCU, drugs of dependence.
15. Manufacturing: Sterile and non-sterile production, including total parental nutrition, cytotoxics.
- 16. Radio Pharmaceuticals:** IV additive service, pre packing and labeling, quality control.
- 17. Research:** Practice based research. Research support including clinical trials laboratory based research.
- 18. Pharmacoepidemiology:** Definitions and scope; methods (qualitative, quantitative and meta analysis models); system for monitoring drug effects, advantages and disadvantages of pharmacoepidemiology.
- 19. Pharmacoconomics:** Definitions and scope, types of models and cost effectiveness analysis.
- 20. Public Health Policy and Health Care System.**


21. Rational Prescription and Prescription Writing.

22. Communication Skills: Principle and elements of communications skills, non verbal communication in pharmacy, barriers in communication, listening skills, explaining skills and ethics in communication.

23. Adverse drug reactions: incidence of adverse drug reactions, recognizing of adverse drug reactions, types of adverse drug effects hypersensitivity reactions , selected adverse effects on selected organs, drug addiction and drug abuse, drug interactions: definitions of drug interactions: principles of prevention of adverse drug interactions, clinical importance of drug interactions involving enzyme induction, pharmacoepidemiology documentation of clinical pharmacokinetic and clinical pharmacology data for commonly used drug, management of drug information's services.

BOOKS RECOMMENDED

- 1.Hassan WE, Hospital Pharmacy, Lec and Febiger publication.
2. Allwood MC and Blackwell, Textbook of Hospital pharmacy.
3. Avery's Drug treatment 4th Edn.1997, Adis Internation Limited.
- 4.Roger and Walkar, Clinical Pharmacy and Therapeutics, Churchill Livingstone Publication.
- 5.Joseph T. Dipiro, Pharmacotherapy: A Patho-physiological Approach, Appleton Lange.
- 6.Cotran R.S., Kumar V., Collins T, Robbins Pathologic basis of disease, WB Saunders & Editd.
- 7.Green RJ, Harris ND, Pathology and Therapeutics for Pharmacist: A basis for clinical Pharmacy Practice, Chapman and Hall Publication.
- 8.Eric T Herfindal, Clinical Pharmacy and Therapeutics, William and Wilkins Publication.
- 9.Avery's Drug Treatment 4th Edn 1997, Adis International Ltd.,
- 10.Relevant review articles from recent medical and Pharmaceutical literature.



Semester IV
Physics of Nano-materials

Course No: PHY15402CR	Max. Marks: 100
	External Examination: 80
No. of credits: 04	Internal Assessment: 20

UNIT – I

Introductory aspects: Free electron theory and its features, Idea of band structure of metals, insulators and semiconductors. Density of state in bands and its variation with energy, Effect of crystal size on density of states and band gap. Examples of nanomaterials

UNIT – II

Preparation of Nanomaterials and General Characterization Techniques. Bottom up: Cluster beam evaporation, ion beam deposition, chemical bath deposition with capping techniques and Top down: Ball Milling

Determination of particle size, study of texture and microstructure, Increase in x-ray diffraction peaks of nanoparticles, shift in photo luminescence peaks, variation in Raman spectra of nanomaterials, photoemission microscopy, scanning force microscopy

UNIT – III

Quantum Dots: Electron confinement in infinitely deep square well, confinement in one and two-dimensional wells, idea of quantum well structure, quantum dots – single and interacting quantum dots, self organized quantum dots, spectroscopy of quantum dots

UNIT – IV

Other Nanomaterials: Properties and applications of carbon nanotubes and nanofibres, Nanosized metal particles, Nanostructured polymers, Nanostructured films and Nano structured semiconductors.

Text & Reference Books:

1. Nanotechnology - Molecularly Designed Materials : G.M. Chow & K.E.Gonsalves (American Chemical Society).
2. Nanotechnology Molecular Speculations on Global Abundance : B.C. Crandall (MIT Press).

Reference Books:

1. Quantum Dot Heterostructures: D. Bimerg, M. Grundmann and N.N. Ledentsov (Wiley).
2. Nanoparticles and Nanostructured Films–Preparation, Characterization and Application : J.H. Fendler (Wiley).

Semester I

Antenna and Wave Propagation

Course No: PHY15105DCE	Max. Marks:	100
	External Examination:	80
No. of credits: 04	Internal Assessment:	20

UNIT – I

Antenna Fundamentals and Definitions: Radiation mechanism - over view, Electromagnetic Fundamentals, Solution of Maxwell's Equations for Radiation Problems, Ideal Dipole, Radiation Patterns, Directivity and Gain, Antenna Impedance, Radiation Efficiency. Antenna Polarization Resonant Antennas: Wires and Patches, Dipole antennas, Yagi - Uda Antennas, Micro strip Antenna

UNIT – II

Arrays: Array factor for linear arrays, uniformly excited, equally spaced Linear arrays, pattern multiplication, directivity of linear arrays, non- uniformly excited -equally spaced linear arrays, Mutual coupling, multidimensional arrays, phased arrays, feeding techniques, perspective on arrays. Broad band Antennas: Traveling-wave antennas, Helical antennas, Biconical antennas; Principles of frequency - independent Antennas, spiral antennas, and Log - Periodic Antennas

UNIT – III

Aperture Antennas: Techniques for evaluating Gain, reflector antennas - Parabolic reflector antenna principles, Axi -symmetric parabolic reflector antenna, offset parabolic reflectors, dual reflector antennas, Gain calculations for reflector antennas, feed antennas for reflectors, field representations, matching the feed to the reflector, general feed model, feed antennas used in practice

UNIT – IV

INTELSAT Series, INSAT, VSAT, Remote sensing, Mobile satellite service: GSM. GPS, INMARSAT, Satellite Navigation System, Direct to Home service (DTH), Special services, E-mail, Video conferencing and Internet connectivity

Text Books:

1. Antenna Hand book by J. D. Kraus

Reference Books:

1. Bruce R. Elbert," The Satellite Communication Applications Hand Book, Artech House Boston, 1997
2. Stutzman and Thiele, "Antenna Theory and Design", 2ndEd, John Wiley and Sons nc
3. C. A. Balanis: "Antenna Theory Analysis and Design", John Wiley, 2nd Edition, 1997

Semester II
Advanced Digital Systems

Course No: PHY15206DCE	Max. Marks:	50
	External Examination:	40
No. of credits: 02	Internal Assessment:	10

UNIT – I

Review of Basic Digital Concepts and logical gates, Brief introduction of VLSI Design and Implementation, Traditional vs. Hardware Description Languages, Digital System Design Flow, The Role of Hardware Description, VHDL, Levels of Abstraction, Scope of VHDL, Benefits of using VHDL, VHDL Examples.

UNIT – II

Intro to FPGA, Xilinx ISE , FPGA Prototyping by VHDL Examples: ISE/Spartan 3 FPGA Implementation Walkthrough , Xilinx Spartan-3, Design Examples with Xilinx ISE and Spartan 3E, Programming the FPGA, Project.

References :

Digital Integrated Circuits second edition by John M Rabaey, Anantha Chandrakasan

Text

VHDL Starters Guide Sudhakar Yalamanchili Publisher: Prentice Hall , ISBN: 0-13-145735-7

Forms of examination

The student's knowledge will be tested by a written exam in combination with written and/or oral presentations of the Projects.

Aims: To familiarize students with the basic principles of digital systems design and the use of a hardware description language, VHDL, and xilinx software in the

SEMESTER- III

Women in Ancient India

Course code: HS14311EA

Unit-I

Historiography-- women's issue as analysed in different historiographical discourses, viz. colonial, Nationalist, Marxist and recent trends.

Unit-II

- I.** The Female Principle: Women in different religious traditions, viz. Brahmanical, Buddhist, Jain, Tantric and Bhakti.
- II.** Co-reference to women in Epics and Puranas

Unit-III

- I.** The socio-sexual constructions of womanhood – in different forms of marriage
- II.** Women in Family and households.
- III.** Women and property

Unit-IV

- I.** Contribution of Women: Economy, Society, Polity and Cultural
- II.** Women and the institution of Sati

Select Readings:

- Agarwal, Bina, *A Field of One's Own: Gender and Land Rights in South Asia*, CUP, 1994.
- Altekar, A.S., *The Position of Women in Hindu Civilisation*, second revised edition, chs. 8, 9.
- Aparna Basu and A. Taneja [eds] *Breaking out of Invisibility; Women in Indian History*, 2002
- Atre, Shubhangana, *The Archetypal Mother*, 1987.
- Barai, Kumudini, *Role of women in the History of Orissa; From the earliest times to 1568 A.D.*, 1994
- Bhattacharji, Sukumari, *Women and Society in Ancient India*, 1994
- Chakravarty, Uma, *Everyday Lives, Everyday Histories; Beyond the Kings and Brahmanas of Ancient India*, 2006
- Chakravarty, U. 'Whatever happened to the Vedic Dasi?: Orientalism, Nationalism and Script from the Past' in Sangari and Vaid [eds] *Recasting Women*, 1989
- Chitgopekar Nilima (ed), *Invoking Goddesses: Gender Politics in Indian Religion*, 2002
- Elamkulam P.N. Kunjan Pillai, 'Matriliny in Kerala' in *Studies in Kerala History*, 1969
- *Gender Studies*, 15(1), Jan-Apr 2008.
- Godelier, Maurice, "The Origin of Male Domination", *New Left Review*, 127, May-June 1981.
- *Godesses*, OUP, 2002.
- Hiltebeitel, A. and K. Erndl (eds), *Is the Goddess a Feminist: The Politics of South Asian*
- Hirschon, Renee, *Women and Property: Women as Property*, 1984.
- Jaini, Padmanabh, *Gender and Salvation*, 1992.
- Jaiswal, Suvira, "Women in early India: Problems and Perspectives", *Proceedings of the Indian History Congress*, 1981, pp. 54-60.
- Joan Wallach Scott, *Gender and Politics of History*, 1986, Ch.1.2
- Kapadia, K.M., *Marriage and Family in India*, third revised edition, 1967.
- Karve, Irawati, *Kinship Organization in India*, second revised edition, 1965.
- Kosambi, D.D., *Myth and Reality*, 1962.
- Moore, Henrietta, *Feminism and Anthropology*, 1988.
- Nath, Vijay, *The Puranic World: Environment, Gender, Ritual and Myth*, 2008
- Orr, Leslie, *Donors Devotees and Daughters of the God*, 2000
- Ramaswamy, Vijaya, *Walking Naked: Women, Society, and Spirituality in South India*, 1997.
- Rangachari, Devika, *Invisible Women, Visible Histories.: Society, Gender And Polity in North India*. 2009
- Tradition' *EPW* 17[43]1992
- Roy, K. *The emergence of Monarchy in north India 8-4 centuries B.C.*, 1994
- Sanday, *Female Power and Male Dominance: On the Origins Of Sexual Inequality*, Cup, 1981
- Shah, Kirit K., *Problem of Identity: Women in Early Indian Inscriptions*, OUP, 2001
- Shah, Shalini, *Love, Eroticism and Female Sexuality in the Classical Sanskrit Literature 7-13th*
- Shah, Shalini, *Poetesses in the Classical Sanskrit Literature: 7th-13th Centuries*, *Indian Journal of*
- Shah, Shalini, *The Making of Womanhood: Gender Relations in the Mahabharata*, 1995
- Sharma, R.S., *Light on Early Indian Society and Economy*, 1966.

- Shaw, Miranda, *Passionate Enlightenment*, 1994.
- Tyagi, Jaya, *Engendering the Early Household*, Orient Longman, Delhi, 2008.

Course Name: Personality Development and Soft Skills

Code: SW 173080E

Total Credits: 02

Teaching Hours: 30

Learning Outcomes::

- *Build upon their existing knowledge and understanding on issues related to personality development.*
- *Overcome various obstacles in attaining their goals in life.*

UNIT I: Personality

- Basics of personality
- Techniques : self confidence, goal setting, time management, stress management and self acceptance
- Decision making, Problem solving skills

UNIT II: Interaction

- Communication
- Motivation
- Leadership

Suggested Readings:

- Anastasi, A., 1987: *Psychological testing*, New York: McMillan Revised Edition,
- Davidoff, L. L.,(1976: *Introduction to Psychology*, New York :McGraw Hill Inc.
- Hurlock E.B.,1995: *Developmental Psychology*, New Delhi: Tata McGraw Hill.
- Morgan, C . T. & King , R.A., 1975: *Introduction to Psychology*, New York: McGraw Hill.
- Munn Norman, L.,1967: *Introduction to psychology*, New Delhi: Oxford and IBH.
- Page, J.D.,1967:*Abnormal psychology*, New York :John Wiley & Sons.

Course Name:

**Conflict Mitigation and Peace
Code: SW17306GE**

Total Credits=02

Teaching Hours: 30

Learning Outcomes:

- *Understand, appreciate and subsequently intervene in situations of conflict and violence from early warning to post-conflict reconstruction and restoration.*
- *Understanding of the conflict zones from across the world including inter-state conflict.*

Unit I: Understanding Conflict

- Definitions and Contents of Conflict-Understanding of the concepts such as Violence, Non-Violence, Riot, Feud, Rebellion, Genocide.
- Overview of Social, Economic and Political Conflict.
- Sources and Causes of Conflict

Unit II: Conflict Analysis

- Characteristics of divided Societies and deep-rooted Conflicts-Instances of Communal/Ethnic/Caste/Racial conflict from India and other conflict sites from across the globe
- Relevance of Conflict for Social Work interventions

Suggested Readings:

- Paul Lederach, J.,1997: *Building Peace : Sustainable Reconciliation in Divided Societies*, Washington: USIP
- Weiner, Y. (ed) 1998: *The Handbook of Interethnic Coexistence*, New York: Continuum
- Hurwitz, D. (ed) 1992 : *Walking the Redline: Israelis in the Search of Justice for Palestine*, Philadelphia: New Society Publisher
- Smith, Anthony. 1986: *Ethnic Origins of Nations*, Oxford: Blackwell.

Course Name: Entrepreneurship and Social work
Code: SW17407GE
Total Credits=02

Teaching Hours: 30

Learning Outcomes:

- *Develop an understanding of Entrepreneurship.*
- *Acquire knowledge about the Entrepreneurship Theories and Models with relevance to local conditions.*
- *Gain knowledge about the role of Social work for entrepreneurship development.*

Unit I: Introduction of Entrepreneurship

- Entrepreneurship – Concepts, Classification/Types of Entrepreneurs
- Elements of Entrepreneurship, Social Entrepreneurship: An Overview
- Evolution of Entrepreneurship in India
- Major Functions of Entrepreneur, Entrepreneurship and Manager
- Innovation and Entrepreneurship.

Unit II Social Work and Entrepreneurship

- Steps for Starting a New Venture and Role of Social Work.
- Managing and Running a Successful Enterprise
- Entrepreneurship Development Programmes In India with special reference to J&K.
- NGO and Entrepreneurship development in India

Suggested Readings:

- Alex Nicholls, (2006), *Social Entrepreneurship: New Models of Sustainable Social Change*, New York: Oxford University Press.
- Bornstein, David. (2004). *How to change the world: Social entrepreneurs and the power of new ideas*, New Delhi : Penguin
- David Bornstein, (2007). *How to Change the World: Social Entrepreneurs and the Power of New Ideas*, New York: Oxford University Press.
- Gregory Dees, Jed Emerson, Peter Economy (2002), *Enterprising Non Profits – A Toolkit for Social Entrepreneurs*, New York: John Wiley and Sons.
- Khanka, S.S. (1999). *Entrepreneurial Development*. New Delhi: S.Chand.
- Kumar, K.B.S. (2007). *Social Entrepreneurs: The change makers* IUP: Agartala.
- Mary, NL, (2008). *Social Work in a Sustainable World*. Chicago: Lyceum.
- Nicholls, Alex (2008). *Social entrepreneurship: New models of sustainable social change* New York : Oxford University Press

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SAMPLING TECHNIQUES

COURSE NO: ST17102CR

No. of Credits-4

UNIT I

Simple Random Sampling: Concept of sampling design, expected value and sampling variance of the sample mean, expected value of the sample mean square and estimation of the variance. Determination of sample size. Simple random sampling as applied to qualitative characteristics.

UNIT II

Stratified random Sampling: Estimation of the population mean/total and its variance, choice of sample sizes in different strata, variance under different allocations. Comparison with unstratified sampling. Estimation of the gain in precision due to stratification, construction of strata.

UNIT III

Ratio and Regression methods of Estimation: Variance of the estimates, estimation of variances, optimum property of ratio and regression estimator. Ratio and regression estimator in stratified random sampling. Some modifications of ratio and regression estimators. Comparison among regression, ratio and simple unbiased estimates. Unbiased ratio type estimates.

UNIT-IV

Systematic Sampling: Sample mean and its variances. Comparison of systematic with simple random and stratified sampling in the general case and also in the case of linear trend.

Cluster sampling: Estimation of mean and its variance for equal and unequal clusters. Efficiency in terms of intra-class correlation. Optimum unit of sampling. Sampling with replacement and unequal probabilities. Estimation of mean and its variance.

TEXT BOOKS:

- Cochran, W. G: Sampling Techniques, 3rd edition, Wiley.
- Mukhopadhyay, P. (2000): Theory and Methods of Survey Sampling, Prentice Hall of India, Private limited, New Delhi
- Des Raj & Chandak (1998): Sampling Theory, Narosa.
- Murthy, M. N. (1977): Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
- Skate teal (1984): Sampling Theory of Surveys with Applications, Iowa State University Press, & IARS.
- Singh, D and Chuddar, F. S. (1986): Theory and Analysis of Sample Survey Design, New Age International Publisher.

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07/09/2018

STATISTICAL COMPUTING

COURSE NO: ST17103CR

No. of Credits-4

UNIT-I

Introduction to computers, Classification of computers, advantages, disadvantages and applications of computers, Basic set up of electronic computers, input and output devices. Basic idea about computer packages (Statistical Packages).

UNIT-II

Statistical Software's: MINITAB reading & Manipulation of data, Commands/Statements in MINITAB, Descriptive Statistics. Basic operations on matrices. Working with Software package MINITAB for graphics, EDA: Histogram, Plot, Box plot, Pi-chart, QQ plot, density plot, and Stem and Leaf.

UNIT-III

Using MINITAB: Correlation&Regression analysis: simple and multiple. Tests of significance, Errors in sampling, Critical region and level of significance, Test of significance of large samples, Test of single proportion, Test of significance of difference of proportions.

UNIT-IV

Using MINITAB: Chi-Square test for independence of attributes and Contingency table, t-test, Paired t-test, Test for correlation in sampling from normal population, F-test, testing of two variance of two univariate normal population.

TEXT BOOKS:

- B. Ryan and B.L. Joiner (2001). MINITAB Handbook, Fourth edition, Duxbury.
- R.A. Thisted (1988): Elements of Statistical Computing, Chapman and Hall.
- S.C. Gupta & V.K Kapoor (2012), Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
- Dudewicz, E.J. and Mishra, S.N. (1988): Modern Mathematical Statistics, Wiley, Int'l Students edition.

BAYESIAN ANALYSIS

COURSE NO: ST17405DCE

No. of Credits-2

Unit I

Fundamentals of Bayesian Statistics: Conditional probability and its applications in Bayesian analysis, Bayes theorem for events, Bayes factor, Generalized Bayes theorem for events, Bayes theorem for future events, Bayes theorem for random variables, and Sequential nature of Bayes theorem.

Unit II

Prior distribution and types of prior distributions, proper prior, improper prior, conjugate prior, Jeffrey's prior, informative and non-informative priors.

Bayesian method of estimation: Bayes estimation of Binomial, Poisson, exponential, Weibull and normal distributions by using various types of priors.

References:

- Berger, J.O.: Statistical Decision Theory and Bayesian Analysis, Springer Verlag.
- Robert, C.P. and Casella, G.: Monte Carlo Statistical Methods, Springer Verlag.

BIO - STATISTICS

COURSE NO.: ST17411OE

No. of credits-2

UNIT-I

Epidemiological method: Evolution of Epidemiology, Causal relationship, establishing a causal relationship, Prevalence, Incidence, Prevalence versus incidence. Types of study design:- Cross-sectional study ; Case-Control study measures of association in case control studies, cohort studies; measures of association.

UNIT- II

Importance of sample size in research design: Diagnostic tests:- Accuracy of a diagnostic test, sensitivity and specificity; predictive values, limitation of predictive values. Bayes theorem, Likelihood ratio. LR of positive tests(LR+) & LR of a negative test(LR-). Post test odds when the test outcome is positive (negative). Tree method for obtaining post test probabilities, Receiver operating characteristics curve.

Books Recommended

- Medical statistics, Principles & Methods, K.R. Sundaram, S.N. Dewidi&Sreenivas, BI publications, pvt. Ltd. New Delhi.
- Bio statistics by Daniel. @#