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<td><strong>Comprehensive Examination</strong></td>
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<td>IV</td>
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<td>IV</td>
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<td><strong>Additional Core 2: Publication of Review Articles / Presentation of Research Papers</strong></td>
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*- Extra Credits, L- Lecture, P- Practicals
BIOMOLECULAR CHEMISTRY

SEM-I
16PBI1101

Hours/week: 6
Credits: 5

Assurance of Learning:
- The course assure to provide students with a basic understanding of:
  - the molecular makeup of living cells;
  - the chemical nature of biological macromolecules, their three-dimensional construction, and the principles of molecular recognition;
  - the metabolism of dietary and endogenous carbohydrate, lipid, and protein.
- At the end of the course, the students should be able to demonstrate the biomolecular constitution and metabolic processes

Unit - I: The molecular logic of life:

Unit – II: Metabolism of Carbohydrates:
Glycolysis, Citric acid cycle, HMP shunt, Glucuronic acid pathway, Gluconeogenesis, Glycogenesis, Glycogenolysis, Glyoxylate cycle. Regulations of Glycolysis and Gluconeogenesis. Metabolism of Amino sugars - sialic acids, Mucopolysaccharides and glycoproteins.

Unit – III: Metabolism of Proteins and Amino acids:

Unit – IV: Metabolism of lipids:

Unit – V: Metabolism of nucleic acids:

Text books for study

References
Assurance of Learning - The course assure to provide students with a basic understanding of:

- the fundamentals of informational pathways;
- the gene expression and regulations of cellular functions in cells;
- the molecular machinery of informational pathways;
- the errors and correction mechanisms of informational molecules.

Unit – I: Introduction:
Terms and definitions – DNA is the Genetic Material: Griffith’s Experiment, Avery, Hershey & chase Experiment. RNA as the Genetic Material: Conrat & Singer Experiment with TMV – Central Dogma. Viral genome – types of RNA and their role.

Organization of Chromosome:

Unit – II: Transposons:
Discovery, IS elements, Transposons in Bacteria (Tn elements), Maize (Ac/Ds and Sp/Dsp elements), Drosophila (P elements) and Yeast (Ty elements). Transposition, Genetic and evolutionary significance of transposons.

Extra chromosomal DNA:
Maternal Inheritance, Structure, gene contents and functions of Chloroplast and Mitochondrial DNA - Interaction between cpDNA and mDNA, theory of prokaryotic endosymbionts. Plasmids: Definition, Types, Structure, Properties, gene content. Use in rDNA technology.

Unit – III: DNA replication:

Recombination:
Homologous and non-homologous recombination- Site specific recombinations & transposition of DNA.

Unit – IV: Transcription:
RNA types (tRNA, mRNA, rRNA, Ribozyme, snRNA, hnRNA, RNAi, RNA-P and micro RNA), structure and functions. Transcription mechanism in prokaryotes and eukaryotes – initiation, elongation and termination, Post transcriptional modifications. Antibiotic inhibitors of transcription.

Translation:
Unit – V: Chromosomal changes and consequences:

Mutation:

Text books for study

References
BIOENERGETICS AND ENZYMOLOGY

SEM-I
16PBI1103

Hours/Week: 6
Credits: 5

Assurance of Learning - The course assure to provide students with a basic:

- understanding of bioenergetics;
- knowledge concerning biotransformation reactions involving enzymes;
- enzyme reactions and its characteristics along with the production and purification process;
- understanding of enzyme kinetics and applications in various fields.

Unit – I: Thermodynamics:
Terms and basic concepts, types of thermodynamic systems. Enthalpy and biochemical reactions, biological thermodynamic standard state, activation energy. Biological oxidation, oxidation - reduction reactions. High-energy phosphate compounds, role of ATP in biological system; energy transfer; acyl-phosphate group transfer.

Unit – II: Basics of Enzymology:
Historical aspects of enzymology, nomenclature and classification of enzymes according to IUB-EC-1964. Intracellular localization of enzymes, homogenization techniques, isolation and fractionation of enzymes – classical methods of purification and crystallization - separation based on molecular size, electric charge, solubility difference and selective adsorption, criteria of purity, units of enzyme activity. Turn over number, specific activity, specificity. Active site- definition, organization and determination of active site residues.

Unit – III: Criteria of chemical reactions:

Unit – IV: Kinetics of catalysed reaction:
Single substrate reactions, bisubstrate reactions, concept and derivation of Michaelis–Menten equation, Briggs Haldane relationship, Determination and significance of kinetic constants, limitations of Michaelis – Menten kinetics. Inhibition kinetics- competitive, non-competitive and uncompetitive. Allosteric inhibition, cooperative, cumulative, feedback inhibition.

Unit – V: Applications of Enzymes:

Text books for study

References
LABORATORY COURSE - 1

SEM-I

16PBI1104

Hours/Week; 4
Credits: 4

BIOCHEMISTRY

1. Estimation of liver glycogen.
2. Estimation of amino acids by Sorenson’s formal titration.
3. Estimation of Iodine value of oil.
4. Estimation of Acid value of oil.
5. Estimation of Reducing sugars by Benedict’s titration.
7. Estimation of Ash content
8. Estimation of Magnesium
9. Estimation of phosphorus
10. Estimation of Tryptophan
11. Estimation of Total lipids
12. Estimation of Vitamin C (Titration)
13. Extraction of DNA and RNA
14. Estimation of DNA and RNA
15. Biochemical techniques
   i) Column chromatography for plant Pigments
   ii) Separation of phospholipids by TLC.
   iii) Paper chromatography

References

ENZYMOLOGY

1. Assay of acid phosphatase.
3. Factors influencing reaction rates of acid phosphatase
   i) Effect of Temperature
   ii) Effect of Time
   iii) Effect of pH
   iv) Effect of Enzyme concentration
   v) Effect of substrate concentration
   vi) Measurements of $V_{\text{max}}$ & $K_m$

References

ADVANCED NUTRITION
(Self paced Learning)

SEM-I

16PBI1106

Hours/Week: 0
Credits: 2

Assurance of Learning- The course assures the students to:
- study the proximate principles of Nutrition with reference to RDA;
- understand the disorders associated with nutrition intake;
- learn the basic requirement of nutrition at different stages of life.
- At the end of the course the students would be able to assess nutritional status and design diet plans.

Unit – I: Energy Metabolism:
Basal metabolism – Basal metabolic rate – Factors affecting BMR, - determination of BMR, direct and indirect methods, - Benedict’s Roth apparatus, - respiratory quotient – Biological oxygen demand. Anthropometry; Height, Weight, Skin fold thickness and arm circumference -Their importance in nutrition.

Unit – II: Introduction to Nutritional Biochemistry:

Unit – III: Vitamins:
Fat soluble and water soluble – B-complex vitamins – source, daily requirements – deficiency manifestations. Role of Vitamins as co-factors- in Electron transport chain; and enzyme reactions; Vitamins involved in haemopoiesis.; Role as antioxidants.

Unit – IV: Minerals –
Micro, macro and trace elements – daily requirements – functions – deficiency manifestations – Role as electrolytes.- sodium and potassium. Food fads and Facts

Unit – V: Nutrition at different Stages of life:
During infancy, adolescence, pregnancy ;and aging. Therapeutic diet – Formulations for DM, Hypertension and Atherosclerosis. Assessment of nutritional status, - methods – intake, Biochemical and clinical methods.

Text books for study

References
Assurance of Learning – The course assures the students to;
  • study the cellular basis of development.
  • acquire fundamental knowledge of animal embryonic development— that is how an egg develops into an adult
  • learn how genes function to control phenotype of an organism
  • study the role of environment in the developmental process

Unit – I: Basic concepts:
General principles of cell-cell communication in development: cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, paracrine factors. General concept of organisms development: Potency, commitment, specification, induction, competence, determination & differentiation; morphogenetic gradients; cell fate & cell lineages; genomic equivalence and cytoplasmic determinants; imprinting.

Unit – II: Fertilization, development and sex determination in humans:
Gametogenesis - Sperm & Egg formation; ultra structure of sperm and ovum, egg types, egg membrane. Fertilization, cleavage, Morula, Implantation, blastulation, gastrulation, formation of germ layers, axis formation - anterior and posterior. Sex determination - chromosomes and environment.

Unit – III: Organogenesis - I:
Central nervous system and the epidermis - Formation of neural tube, Differentiation of the neural tube, tissue architecture of the central nervous system, origin of cutaneous structures. Neural crest cells and axonal specificity - specification, Trunk neural crest, pattern generation in the nervous system.

Unit – IV: Organogenesis - II:
Paraxial and intermediate mesoderm - Somites formation, Osteogenesis, Urogenital system. Lateral plate mesoderm and endoderm - Heart formation, digestive tube and its derivatives.

Unit – V: Implications of developmental biology:
Medical implications of developmental biology - genetic disorders in human development, environmental assaults on human development, Future therapies and developmental biology, Environmental regulation of animal development - Environment as a part of normal development, Polyphenisms and plasticity, Learning system.

Text books for study

References
**BIOCHEMISTRY OF NATURAL PRODUCTS**

**SEM-I**

**16PBI1201B**

**Hours/Week:** 4

**Credits:** 4

**Assurance of Learning** – The course assures the students to:

- study the occurrence, properties and economic importance of natural products from plants, animals and microbes.
- classify the natural compounds based on chemistry and applications
- learn isolation strategies of natural products
- discover the therapeutic importance of those natural products.

**Unit – I: General aspect of sources of natural medicinal plant products:**

Introduction to primary and secondary metabolites, types of secondary metabolites, production under stress, isolation of active constituent from plant material.

**Unit – II: Alkaloids:**

Definition, general properties, classification based on nitrogen heterocyclic ring, types - phenylalkylamines, pyridine alkaloids, tropane alkaloids, quinolizidine and pyrrolizidine alkaloids, isoquinoline alkaloids, quinoline, monoterpenes, indole alkaloids, purine alkaloids, ruta alkaloids, medicinal importance of each type. Role of alkaloids in plants.

**Unit – III: Saponins and Steroids:**

Definition, general properties, medicinal importance of saponins. Important saponins of plant origin - diosgenin, hecogenin, glycyrrhizin, aescin and ginseng. Steroids: General properties, classification. Introduction and medicinal importance of - cardiac glycosides from *Digitalis, Strophanthus, Urginea*, steroids from *Withania somnifera, Holarrhena* and *Solanum*.

**Unit – IV: Terpenoids:**

Definition, general properties, classification, introduction and medicinal importance of terpenoids. General account and medicinal importance of myrcene, ocimene, citronellol, menthol and camphor. Tannins, lignins and pectins: General properties and classification.

**Unit – V: Plant pigments:**

Occurrence, classification, introduction and applications of carotenoids, xanthophylls, anthocyanins, flavones, flavonols. Acetate pathway and Shikimic acid pathway. Pyrethroids and rotenones of plant origin: Definition, general properties and importance. Natural products of therapeutic importance from animals- Zootherapy -Venom, Body fluids as medicines – Urine, Saliva and Faeces. Isolation, qualitative and quantitative analysis of secondary metabolites (Skill component)

**Text books for Study**


**References**

1. Chemistry and biology of herbal medicine: V. P. Agrawal and V. P. Khamboj, (Eds.) (Society of Biosciences).
MICROBIOLOGY

SEM-II
16PBI2107

Hours/Week: 5
Credits: 4

Assurance of Learning – The course assures the students to:
- understand the basic classification and characteristic features of microbes;
- learn the implications of microbes in the environment;
- be aware of the microbial diseases, their diagnosis and treatment options;
- study the applications of microbiology in various industries.

Unit – I: General microbiology:

Unit – II: Environmental microbiology:

Unit – III: Industrial microbiology:
Selection of industrially useful microbes. Fermentors and fermentation technology. Industrial production of alcohol, vinegar, lactic acid, antibiotics, enzymes and amino acids. Microbiology of food: sources of contamination, food spoilage and food preservation methods.

Unit – IV: Clinical microbiology:

Unit – V: Applied Microbiology:

Text books for study

References
RECOMBINANT DNA TECHNOLOGY

SEM: II  
16PBI2108  

Hours/Week: 5  
Credits: 4

Assurance of Learning -

- Study of the various underlying principles of genetic engineering that forms the basis of rDNA technology.
- Study the methodologies of gene transfer
- Knowledge on the general principles of generating transgenic plants, animals and microbes
- Students in strategizing research methodologies employing genetic engineering techniques.

Unit – I: Introduction to Recombinant DNA technology:
Isolation (Mechanical, cDNA, Shot gun) & purification of nucleic acid, PCR; Enzymes in molecular biology – restriction endonuclease, ligases, reverse transcriptase, nuclease, polymerase, alkaline phosphatase, terminal transferase, T₄ polynucleotide kinase; linker, adaptors & homopolymers.

Unit – II: Expression cassette:
Promoters (constitutive, inducible, tissue specific), terminators, reporters, markers (antibiotic resistant, herbicide resistant, antimetabolite), Vectors in gene cloning – Plasmds (pBR322, pUC), Bacteriophages (Phage λ, M13), cosmids, phagemids, yeast plasmid vector, viral vectors (adenovirus, adeno associated virus, baculo virus, herpes virus, retrovirus, cauliflower mosaic virus, tobacco mosaic virus, potato virus X), artificial chromosome (BAC, YAC, HAC), shuttle vector, Expression vector.

Unit – III: Gene transfer methods:
Transformation – physical method (electroporation, micro-injection, particle bombardment, liposome mediated transfer), chemical method (PEG mediated, DEAE Dextran mediated, CaPO₄ mediated gene transfer), Biological method (Agrobacterium mediated gene transfer). Expression systems – prokaryotes (Bacteria) and eukaryotes (yeast, mammalian and, insect cell lines).

Unit – IV: Screening and selection methods:

Unit – V: Molecular Techniques:
RFLP, RAPD, AFLP, DNA Finger printing, DNA Foot printing, Microarray (DNA & Non-DNA).Libraries - Genomic library; C-DNA library & its types; BAC library; YAC library; Methyl filtration libraries; COT fractionation based libraries. Bioethics & Biosafety in genetic engineering; IPR & Patenting.

Text books for Study

References
HUMAN PHYSIOLOGY

SEM-II
16PBI2109

Hours/Week: 4
Credits: 4

Assurance of Learning-

- Study the functional mechanism of body organ systems;
- Understand the homeostatic mechanism of each organ system;
- Recognize and explain the interrelationships within and between anatomical and physiological systems of the human body;
- Knowledge on the influence of environment in the physiological processes.

Unit – I:

Unit – II:
Gastro-intestinal System - General principles of GI function - mastication & swallowing, esophageal motility, salivary secretion, gastric mucosal barrier, pancreatic & biliary secretion, gastrointestinal motility, digestion & absorption, functions of colon, pathophysiology of peptic ulcer, gastrointestinal hormones and their actions, absorption of carbohydrates, fats and proteins, vitamins, water and electrolytes.

Unit – III:
Cardio-vascular and Respiratory Physiology - Properties of cardiac muscle, cardiac cycle, heart as a pump, cardiac output, specialized tissues of the heart, coronary circulation, generation & conduction of cardiac impulse, control of excitation & conduction, electrocardiogram-arrhythmias. Cardiac failure, circulatory shock. Respiration - functional anatomy of respiratory system, pulmonary ventilation, alveolar ventilation, mechanics of respiration, pulmonary circulation, principles of gaseous exchange - oxygen & carbon-dioxide transport, regulation of respiration, hypoxia, oxygen therapy & toxicity, artificial respiration.

Unit – IV:
Unit – V:
Renal and Environmental Physiology - Structure and function of kidney – Structure of nephron, glomerular filtration, tubular reabsorption of glucose, water and electrolytes. Tubular secretion. Urine formation, renal mechanisms for the control of blood volume, blood pressure, micturition, diuretics, renal failure. Environmental physiology - physiology of hot and cold environment, high altitude, aviation physiology, space physiology, deep sea diving & hyperbaric conditions.

Text books for study
1. Arthur C. Guyton, 2005, Text Book of Medical Physiology, WB Saunders’s, USA.

References
LABORATORY COURSE – 3

SEM-II
16PBI2110

Hours/Week: 4
Credits: 4

MICROBIOLOGY

1. Media preparation and Culture techniques.
2. Staining techniques (simple, differential and capsular)
   - Amylase activity
   - Methyl Red test
   - TSI Agar test
   - Citrate Utilization test
4. Potability test of water.
5. Qualitative test for Milk.
   - Methylene Blue Reductase Test.
   - Phosphatase test.
6. Antibiotic sensitivity test.

References:

LABORATORY COURSE - 4

SEM- 16PBI2111

Hours/Week: 4
Credits: 4

RECOMBINANT DNA TECHNOLOGY

1. Agarose gel electrophoresis of Nucleic acids (DNA & RNA)
2. Polyacrylamide gel electrophoresis (protein)
3. Isolation of chromosomal DNA from blood samples by Phenol-Chloroform method.
4. Preparation of genomic DNA from Plant tissue by CTAB method
5. Preparation of genomic DNA from bacteria
6. Plasmid DNA isolation
7. Enzyme Linked Immuno Sorbent Assay
8. Plant Tissue culture techniques (Callus induction)
9. Synthetic seed preparation
10. Denaturation of DNA and UV absorption studies.
11. Absorption spectra of Nucleic Acids. Determination of melting temperature of calf thymus DNA.
12. Restriction digestion.
13. PCR

References

Course Description:

The elective course is offered to enhance the students to get through in the competitive exams like UGC & CSIR-JRF NET. The course would be taught in lectures both classical and online. The evaluation will be as online MCQ tests.

Assurance of Learning – The course assure the students to;

- gain knowledge on the classification, taxonomy and plant physiology;
- acquaint with the strategies of e-learning
- covers the topics of the CSIR UGC – Net syllabus that are not included in the core courses;
- make them familiar with pattern of testing in competitive examinations

Unit – I:

Unit – II:
System of classifications: Outline classification of plants, animals & microorganisms, structural details: Important criteria used for classification in each taxon. Classification of plants (Bentham and Hooker), animals (Whitaker’s) and microorganisms. Prokaryote and eukaryote cell: Structural and function of cell wall, mitochondria, chloroplast, ribosomes, E.R., Golgi complex and nucleus.

Unit – III:

Unit – IV:
Photosynthesis and plant physiology: Photosynthesis – Light reaction and dark reaction fixation C₃, C₄and CAM pathways, photorespiratory pathway. Translocation of water, ions, solutes and macromolecules from soil-xylem and phloem, transpiration, introduction to sec metabolites. Stress physiology. Response of plants to biotic (pathogens and insects) and abiotic (water, temp and salt) stresses.
Unit – V:
**Environmental hazards and management:** Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Bioremediation; Phytoremediation; Solid waste management: toxic effects and treatments, methods, technologies for management of hospital waste – incineration, autoclaving, mechanical/chemical, microwave, plasma torch, detoxification, advanced wet oxidation and thermal, dry heat.

**Text books for study**

**References**
MOLECULAR DIAGNOSTICS

SEM-II
16PBI2202B

Hours/Week: 4
Credits: 4

Assurance of Learning-
- Explore the molecular mechanisms of diseases.
- Study the various molecular diagnostic tools available for these diseases.
- Enable the students to learn tissue matching procedures
- Outlines the forensic methodologies

Unit – I: Molecular mechanisms of diseases:

Unit – II: Restriction Fragment Length Polymorphism (RFLP):

Unit – III: Hereditary persistence of fetal hemoglobin: M

Unit – IV: Approaches in hybridoma technology:
Hybridoma variants affecting isotype, antigen binding and idiotype: isolation of class and subclass switch variants by selection.MHC locus,HLA polymorphisms,HLA nomenclature, molecular analysis of the MHC, serological analysis DNA-based typing, combining typing results, HLA test discrepancies, coordination of HLA test methods,additional recognition factors,minor histocompatibility antigens, nonconventional MHC antigens,killer cell immunoglobulin-like receptors, MHC& its disease association.

Unit – V: Polymerase Chain Reaction:

Text books for study

References
RESEARCH METHODOLOGY

SEM-III

16PBI3112

Hours/Week: 4

Credits: 4

Assurance of Learning - The course assures the students to:

- understand the working principles, construction and applications of the instruments used in the studies related to various disciplines of biological sciences;
- understand the statistical concepts and their significance;
- appreciate the importance of research and to learn the art of data collection;
- know the nuances of scientific writing and publishing

Unit – I:


Chromatographic techniques – General principle; adsorption and partition chromatography. Techniques and application of paper, column, thin layer, normal phase and reverse phase - ion-exchange chromatography, exclusion chromatography, affinity chromatography, GLC and HPLC, HPTLC.

Unit – II:

Centrifugation: Principles, differential and analytical centrifugation, density gradient centrifugation; Analysis of sub cellular fractions, ultracentrifuge and its application.


Unit – III:

Spectroscopy – Properties of EMR, absorption spectrum, absorption Vs emission spectrophotometry, AAS & flame photometer, UV / VIS spectroscopy, IR, NMR, GC-MS, MALDI-TOF, LC-MS.


Unit – IV:

Research Methodology: Selection of research problems – hypothesis – definition and characteristics. Experimental approaches – biological, physical and chemical methods. Sources of information: Journals, e-journals, books, biological abstracts, Preparation of index cards, Review writing, Article writing – structure of article. Selection of journals for publication- Impact factor – Citation index and H index. Proposal writing for funding.

Biostatistics – Basics and uses of Measures of Central values, Measures of Dispersion (Standard Deviation and coefficient of variation) in data analysis and presentation. Sample Testing: Large samples (Z), small sample test: t, Chi-square, ANOVA - one way & two way, SPSS.
Unit – V:

**Bioinformatics:** Introduction to Bioinformatics, Bioinformatics and its applications, Information networks - EMB net and NCBI. Databases; Primary Nucleic acid databases - EMBL; Gene Bank and DDBJ. Structure of Gene bank entries. Protein sequences databases; primary databases PIR, MIPS, SWISS - PROT, TrEMBL, NRL-3D. Structure of SWISS - PROT entries. Secondary Databases; PROSITE, PROFILES, PRINTS, Pfam, BLOCKS and IDENTITY. Composite protein Databases.

**Text books for study**

**References**
CLINICAL BIOCHEMISTRY

SEM-III Hours/Week: 4
16PBI3113 Credits: 4

Assurance of Learning – The course assures the students to:
- gain thorough knowledge about the biochemical basis of various diseases and disorders;
- analyze the symptoms of various diseases;
- study various diagnostic and therapeutic methodologies available for diseases and disorders;
- know the available treatment modalities.

Unit – I:


Unit – II:

Unit – III:

Unit – IV:
Unit – V:

Text books for study

References
Assurance of Learning – The course assures the students to:
- study in detail the components of immune system;
- learn the features of immune reactions;
- learn the biochemical basis of immune disorders;
- know the analytical methods involved in immunology.


Unit – II:
Antigens and Antibodies: definition, properties- antigenicity and immunogenicity, antigenic determinants and haptons. Types of antigens - flagellar, somatic, capsular, soluble, heterophile, tumour and autoantigens. Antigen - antibody interactions - molecular mechanism of binding. Affinity, avidity, valency, cross reactivity and multivalent binding. Complement system; components- alternate and classical pathways, initiators and MAC. Inflammation-acute and chronic; mechanism and significance.

Unit – III:

Unit – IV:

Unit – V:
Text books for study


References

2. Frank C. Hay and Olwyn M. R. Westwood, 2006, Practical Immunology, Blackwell Publishing, India.
LABORATORY COURSE – 5  

SEM-III  
16PBI3115  

Hours/Week - 3  
Credits - 2  

CLINICAL BIOCHEMISTRY  

I. Hematological studies  
1. Collection of Blood  
2. Estimation of hemoglobin content.  
3. Total RBC count.  
4. Total WBC count.  
6. Differential WBC count (DC).  
7. Absolute Eosinophil count (AEC).  
8. Total platelet count.  
9. Determination of clotting time  
10. Determination of Prothrombin time  
11. Determination of ESR.  
12. Grouping of blood and Rh typing.  

II. Biochemical analysis of blood  
1. Estimation of blood glucose (2 methods)  
2. Estimation of serum proteins  
3. Estimation of plasma fibrinogen  
4. Estimation of A: G ratio in serum  
5. Estimation of blood urea (2 methods)  
6. Estimation of serum uric acid  
13. Estimation of Vit-A, E & C  

III. Enzyme assays  
1. Determination of serum alkaline phosphatase  
2. Determination of serum acid phosphatase  
3. Determination of serum LDH  
4. Determination of CPK  

IV. Urology  
1. Identification of abnormal constituents  
2. Screening of inborn errors of metabolism  

V. Andrology  
1. Total sperm count.  
2. Motility Test.  
3. Fructose estimation.  

References  
LABORATORY COURSE – 6

SEM-III
16PBI3116

Hours/Week  3
Credits  2

Immunology and Physiological Methods

I. Immunological techniques

1. Widal test – rapid slide test for typhoid
2. VDRL test – test for syphilis
3. Latex agglutination test for rheumatoid factor and Pregnancy
4. Immunoelectrophoresis
5. Skin Prick Test.

II. Miscellaneous

2. ECG recording
3. Histopathology

III. Visit to National Research Centers.

References

Course Description:
The elective course is offered to enhance the students to get through in the competitive exams like UGC & CSIR-JRF NET. The course would be taught in lectures both classical and online. The evaluation will be as online MCQ tests.

Assurance of Learning – The course assure the students to:
- gain knowledge on evolution and ecology;
- acquaint with the strategies of e-learning
- covers the topics of the CSIR UGC – Net syllabus that are not included in the core courses;
- make them familiar with pattern of testing in competitive examinations

Unit – I: Emergence of evolutionary thoughts:
Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations. Origin of cells and unicellular evolution: Origin of basic biological molecules; abiogenic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller; The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; anaerobic metabolism, and aerobic metabolism.

Unit – II: Paleontology and evolutionary history:
The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multi cellular organisms; major groups of plants and animals; Stages in primate evolution including Homo. Molecular evolution: concepts of neutral evolution, molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification.

Unit – III: Mechanisms of speciation and behavior:
Speciation; allopatriotic and sympatricity; convergent evolution; Sexual selection; co-evolution. Approaches and methods in study of behavior; Proximate and ultimate causation; altruism and evolution; neural basis of learning, memory, cognition, sleep and arousal; biological clocks; social communication; social dominance; use of space and territoriality; mating systems, parental investment and reproductive success; parental care; aggressive behavior; habitat selection and optimality in foraging; migration, orientation and navigation; domestication and behavioral changes.

Unit – IV:
The Environment; biotic and abiotic interactions. Concept of habitat and niche; population ecology; concept of metapopulation. Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community ecology: nature, structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological succession: Types, mechanisms, changes involved in succession & concept of climax.

Unit – V: Ecosystem ecology:
Ecosystem structure, function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: major terrestrial biomes; theory of island biogeography; biogeographical zones of India. Conservation biology: principles and management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves)

Text books for study

References
Assurance of Learning — The course assures the students to:
• make a detailed study of drugs, particularly their actions on living systems;
• learn the pharmacokinetics and pharmacodynamics of drugs;
• know their chemotherapeutic value;
• familiarize with the adverse effects of drug action.

Unit – I:
Drugs — definition, source and nature, types of classification and nomenclature, dose response curve and LD$_{50}$. Role of drugs, Drug — protein interactions, routes of drug administration.

Unit – II:

Unit – III:

Unit – IV:
Drugs acting on various systems: CNS- Sedatives- Hypnotics, GI tract- drugs for peptic ulcer, diarrhoea and constipation. Miscellaneous drugs - antiseptics, disinfectants, chelating agents. Adverse drug reactions and drug induced side effects, biological effects of drug abuse and drug dependence, drug tolerance and intolerance.

Unit – V:
Drug development: Target – oriented drug design, computer aided drug design, Quantitative structure, activity relationship – binding interaction, functional groups and pharmacophore. High throughput screening and Molecular docking.

Text books for study

References
BIOPROCESS TECHNOLOGY
IDC (WS)

SEM III
16PBI3402

Hours/Week 4
Credits 4

Assurance of Learning – The course assures the students to:
- study the avenues of exploiting microbes in bioconversion technology;
- study the downstream processing for product recovery in fermentation;
- know the instrumentation of industrial bioconversion;
- learn the influence of various parameters in the industrial productions.

Unit – I:

Unit – II:
Bioreactor: design, parts and functions, sterilization, impellers, baffles and sparger. Types of reactor – submerged reactor, mechanically stirred draught-tube reactor, continuous flow stir type reactor, airlift reactor, jet loop reactor, surface reactor and packed bed reactor.

Unit – III:

Unit – IV:

Unit – V:

Text books for study

References
Assurance of Learning – The course assures the students to:
- perform a basic assessment of an emergency situation;
- undertake immediate relief and rescue during emergency;
- learn the instrumentations available for emergency relief and rescue;
- demonstrate an awareness of signs, symptoms and treatment for common medical emergencies.

Unit – I:

Unit – II:

Unit – III:

Unit – IV:
Emergency Care: Accident reporting, first aid to victims of road accidents. Patient assessment and management, breathing emergencies, defibrillation. Sudden illness - heart attack, stroke, fainting, convulsion epilepsy, prevention of heart attack and apoplexy.

Unit – V:

Text books for study
2. Standard First Aid and Personal Safety 8th edition – American Red Cross
ASSURANCE OF LEARNING – The course assures the students to:

- study the components of endocrine systems;
- learn the molecular features of hormones and their synthesis;
- study the hormonal regulations of various physiological functions and signaling mechanisms;
- familiarize with the endocrine diseases.

Unit – I:

Unit – II:

Unit – III:
Molecular endocrinology of insulin resistance - Endocrinology of adipose tissues - leptin, gherlin, adiponectin, resistin. Fetal endocrine programming of adult disorders (FEPAD): Adverse effects of glucocorticoids in programming events. Endocrinology of insulin like growth factors (IGF’s) and its binding proteins (IGFBP). Modulation of placental hormones and growth factors in FEPAD.

Unit – IV:

Unit – V:
Nuclear receptors (NR) - General features, Ligands that act via nuclear receptor and its sub classes (Orphan receptor and variant receptors). Domain structure of NR - hormone binding domain, antigenic domain and DNA binding domain. Hormone response elements. Detailed study of thyroxine, estrogen, androgen, vitamin D, glucocorticoids, Peroxisome proliferator activated receptor and Liver X Receptor. PPAR in insulin resistance. Receptor activation – upregulation and down regulation. Selective estrogen receptor modulator. Endocrine responsive cancer - breast, endometrial and prostate cancers.

Text books for study
2. Wilson and Foster, 1992, Textbook of Endocrinology, (8th edn), W. B. Saunders, USA.

References
PHARMACEUTICS AND NANOTECHNOLOGY

SEM-IV
16PBI4118

<table>
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<th>Hours/Week</th>
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Assurance of Learning – The course assures the students to:
- study the preparation and packaging methodologies of pharmaceuticals;
- demonstrate various drug delivery system;
- know the basics of nanotechnology and its potential as medicines;
- cognize with the prospective of placement in the pharmaceutical industries.

Unit – I:

Unit – II:

Unit – III:

Unit – IV:
Controlled drug delivery systems: Advantages of controlled drug delivery systems.

Unit – V:
Introduction to Nanotechnology: Properties and Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes), Green synthesis, characterization of Nano material; Absorption, Fluorescence, and Resonance; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging. Applications of nanotechnology in medicine & health, food, agriculture, livestock, aquaculture, forestry and sustainable environment.

Text books for study

References
1. Pharmaceutical dosage forms: Tablets, Volume 1, 2, 3; Herbert. A. Lieberman, Leon lachman & Joseph. B .Schwartz; Marcel Dekker INC.
ADVANCES IN CLINICAL RESEARCH

SEM-IV  
16PBI4119

Hours/Week 6  
Credits 5

Assurance of Learning – The course assures the students to:
- be aware of the protocols and regulations in clinical research;
- familiarize with the ethics and SOPs of clinical research;
- acquire requisite knowledge that will enable them to pursue a career in the clinical research industry;
- not lag behind in maintaining the internationally prescribed standards of clinical ethics.

Unit – I:
Introduction to Clinical Research: terminologies and definition in clinical research, origin and history of clinical research, difference between clinical research and clinical practice, types of clinical research, phases of clinical research, clinical trials in India – the national perspective, post marketing surveillance, pharmaceutical industry – global and Indian perspective, clinical trial market, career in clinical research.

Unit – II:

Unit – III:
Ethical Considerations and Guideline in Clinical Research – Historical guidelines in clinical research, Nuremberg code, declaration of Helsinki, Belmont report, international conference on harmonization (ICH) – Brief history of ICH, Structure of ICH, ICH harmonization process, guidelines for good clinical practice, glossary, the principles of ICHGCP, institutional review board / independent ethics committee, investigator, sponsor, clinical trial protocol and protocol amendment(s), investigator’s brochure, essential documents for the conduct of a clinical trial.

Unit – IV:

Clinical Trial Management - project management, protocol in clinical research, informed consent, case report form, investigator’s brochure (IB), selection of an investigator and site, clinical trial stakeholders, ethical and regulatory submissions, documentation in clinical trials, pharmacovigilance, training in clinical research, roles and responsibilities of clinical research professionals.

Text books for study

References
LAB COURSE – 7

SEM-IV  
16PBI4120

Hours/Week 4  
Credits 4

1. Handling of laboratory animals
2. Extraction of phytochemicals using soxhlet apparatus.
3. Identification of active principles by spectral studies (FTIR, UV-Vis)
4. Estimation of clinical parameters (sugar, Hb, Cholesterol, Proteins and creatinine) using automated analyzer.
5. Routes of administration of drugs/xenobiotics
6. Dissection of animals and aseptic removal of individual organs
7. Histological studies on animals
8. Recording and management of research data.

References