BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI – 620 024.

M.Sc. Biochemistry Course Structure under CBCS

(For the candidates admitted from the academic year 2016-2017 onwards)

Semester	Course	Course Title	Ins. Hrs / Week	Credit	Exam Hrs	Marks		Total
						Int.	Extn.	
I	Core Course – I (CC)	Chemistry of Biomolecules	6	4	3	25	75	100
	Core Course – II (CC)	Analytical Techniques	6	4	3	25	75	100
	Core Course – III (CC)	Enzymes and Enzyme Technology	5	4	3	25	75	100
	Core Course – IV (CC)	Cell Biology and Physiology	5	4	3	25	75	100
	Core Practical- I (CP)	Practical – I (Biochemical Techniques and Enzymology)	8	4	3	40	60	100
	Total		**30**	**20**				**500**
II	Core Course – V (CC)	Metabolism and Regulation	6	5	3	25	75	100
	Core Course – VI (CC)	Molecular Biology	6	5	3	25	75	100
	Core Practical - II (CP)	Practical – II (Molecular and Microbial Techniques)	8	4	3	40	60	100
	Elective – I (EC)	Biostatistics	5	5	3	25	75	100
	Elective – II (EC)	Microbiology	5	5	3	25	75	100
	Total		**30**	**24**				**500**
III	Core Course – VII (CC)	Immunology	6	5	3	25	75	100
	Core Course – VIII (CC)	Clinical Biochemistry	6	5	3	25	75	100
	Core Practical - III (CP)	Practical – III (Clinical Biochemistry)	8	4	3	40	60	100
	Elective – III	Genetic Engineering	5	5	3	25	75	100
	Elective – IV	Developmental Biology	5	5	3	25	75	100
	Total		**30**	**24**				**500**
IV	Core Course –IX (CC)	Endocrinology	5	5	3	25	75	100
	Core Course – X (CC)	Bioinformatics	5	5	3	25	75	100
	Core Practical- IV (CP)	Practical – IV (Phytochemistry, Soil Analysis and Immunological Techniques)	8	4	3	40	60	100
	Elective – V	Ecology and Environmental Sciences	5	4	3	25	75	100
	Project Work	Dissertation=80 Marks [2 reviews –20+20=40 marks Report Valuation = 40 marks] Viva = 20 Marks	7	4	-	-	-	100
	Total		**30**	**22**				**500**
Grand Total			**120**	**90**				**2000**

Core Paper	-	10
Core Practical	-	4
Elective	-	5

Note:

1. Theory	Internal	25 marks	External	75 marks
2. Practical	”	40 marks	”	60 marks

3. Separate passing minimum is prescribed for Internal and External

a) The passing minimum for CIA shall be 40% out of 25 marks (i.e. 10 marks)
b) The passing minimum for University Examinations shall be 40% out of 75 marks (i.e. 30 marks)
c) The passing minimum not less than 50% in the aggregate.

*****

CORE COURSE I

CHEMISTRY OF BIOMOLECULES

Objectives:

To understand the basis of macromolecules and their structure.

Unit I

Carbohydrates: Structure and biological functions of Mono, di and Polysaccharides. Types of polysaccharides: Homo polysaccharides -chitin, fructans, mannans, xylans, and galactans. Structure and biological importance of Hetero polysaccharides- sugar derivatives- glycosaminoglycans, proteoglycans. Glycoprotein – Blood group and bacterial cell wall polysaccharides, O- linked and N- linked oligosaccharides, marine polysaccharides and Lectins.

Unit II

Aminoacids and its general properties. Classification of amino acids. The peptide bond– Chemical synthesis of peptides –Merrifield method. Proteins– classification and general properties. Orders of protein structure, Primary- Ramachandran plot, Secondary structure– the α-helix, β- pleated sheet. Collagen triple helix. Protein sequencing methods.

Unit III

Super secondary structure– helix– loop helix, the hairpin β -motif and the β-α-β-motif. Tertiary and quaternary structure- Forces stabilizing tertiary and quaternary structure- Structure of myoglobin, Structure of hemoglobin– oxygen binding and changes in conformation. Methods of isolation, characterization and purification of proteins.

Unit IV

Lipids: Definition and classification of lipids. Biological significance of lipids. Types of Fatty acids-Essential, Non essential. Structure and biological functions of phospholipids, sphingolipids, glycolipids. Steroids – structure and functions of cholesterol, bile acids, sex hormones, ergosterol. Structure and biological role of prostaglandins, thromboxanes and leukotrienes.

Unit V

Nucleic acid: Structure of purines, pyrimidines, nucleosides and nucleotides. DNA double helical structure. A, B and Z forms of DNA. Triple and quadruple structures.DNA super coiling and linking number. Properties of DNA: buoyant density, viscosity, hypochromicity, denaturation and renaturation – the cot curve. DNA sequencing– chemical and enzymatic methods. Chemical synthesis of DNA. RNA– types and biological role- Secondary, tertiary structures of RNA.

Reference Books:

1. Biochemistry Zubay 4th edition William C.Brown Publication, 1998.
2. Harper's Biochemistry 29th edition McGraw Hill, 2012.
3. Biochemistry Stryer 5th edition .W.H Freeman, 2002.
4. Principles of Biochemistry.7th edition Lehninger Nelson Cox Macmillan worth Publishers, 2013.
5. Biochemistry. Davidson and Sittmann, NMS 4th ed. Lippincott William's and Wilkins, 1999
6. Biochemistry – Voet and Voet. J O H N WI VP & *Publisher* Kaye Pace Associate Publisher, 2011.
7. Biochemistry Student Companion, by Berg, 7th Edition Berg, Jeremy M. / Tymoczko, John L. / Stryer, Lubert Published by W. H. Freeman, 2011.
8. 8.Chemistry of natural Products , Sujata V. Bhat, Bhimsen A. Nagasampagi, Meenakshi Sivakumar First Edition – 2005.

*****

CORE COURSE II

ANALYTICAL TECHNIQUES

Objectives:

1. To understand the working principles, construction and applications of the instruments used in the studies related to various disciplines of biological sciences.
2. To apprise the importance of research and to learn the art of publication.

Unit I

Electrochemical techniques – Principles, Electrochemical cells and reaction – pH and buffers. Measurement of pH – glass electrode and titration curves. Ion selective and gas sensing electrodes, oxygen electrode, and their applications. Methods for studying cells and organelles. Methods for lysis of plant, animal and microbial cell Sub-cellular fractionation. General scheme for purification of bio-components.

Unit II

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 III

Centrifugation: Principles, differential and analytical centrifugation, density gradient centrifugation; Analysis of sub cellular fractions, ultracentrifuge and its application.
Tracer technique: Nature of Radioactivity: Patterns of decay, half life and its application, Geiger Muller Counter- principle and applications. Scintillation counter – Principle, types and applications. Use of isotopes in biological studies**.**

Unit- IV

Electrophoresis: Principles, electrophoretic mobility, factors influencing electrophoretic mobility – paper, disc, slab gel electrophoresis. Isoelectric focusing, 2D PAGE, blotting techniques, capillary electrophoresis. Pulse field Electrophoresis, Isotachophoresis.

Unit - V

Spectroscopy: Laws of absorption and absorption spectrum.CD, ORD, Principle, instrumentation and applications of UV-visible spectrophotometry, ESR, NMR, IR and spectrofluorimetry. Basic principles of turbidimetry and nephelometry. Principle, instrumentation and applications of luminometry.

Atomic spectroscopy – principle and applications of atomic flame and flameless spectrophotometry. Use of lasers for spectroscopy. MALOF TOF.

Reference Books:

1. Principles and Techniques of Practical Biochemistry, Keith Wilson & John Walker, Cambridge University Press, India. 2005.
2. Biophysical Chemistry (Principles and Techniques) 4th Edition, Avinash Upadhyay, Kakoli Upadhyay and Nirmalendu Nath, Himalaya Publishing House, India, 2014.
3. Bioanalytical Techniques, Abhilasha Shourie and Shilpa S Chapadgaonkar, the Energy and Resources Institute, TERI, India, 2015.
4. Methods and Techniques, 2nd ed, C.R. Kothari, Research Methodology, New Age International Publishers. India, 2004.
5. Introduction to Instrumental Analysis, Braun, R.P.,Tata McGraw Hill, India, 1987.
6. Textbook of Biochemistry, West, E.S. and Todd, W.R, MacMillan, Germany, 1985.
7. Research Methodology, Methods and Techniques 2nd Edition, C.R. Kothari, New Age International Publishers. New Delhi, 2004.
8. Fundamentals of Bio Analytical Techniques and Instrumentation, Ghosal Sabari and Srivastava A. K., PHI Learning Pvt. Ltd. India, 2009.
9. Introduction to Spectroscopy. 3rd Edition. Pavia, Brooks/Cole Pub Co., New Delhi, India, 2000.
10. Basic Instrumentation, K. K. Machve, Neha Publishers & Distributors, India 2010.

*****

CORE COURSE III

ENZYMES AND ENZYME TECHNOLOGY

Objectives:

1. To understand the concepts and classes of enzymes
2. To study about enzyme kinetics and applications of enzymes.

Unit I

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. Active site definition, organization and determination of active site residues.

Unit II

Thermodynamic terms and basic concepts - types of thermodynamic systems. Enthalpy and biochemical reactions, biological thermodynamic standard state, activation energy and free energy. Biological oxidation, redox reactions. High-energy phosphate compounds, role of ATP in biological system; energy transfer; acyl-phosphate group transfer. Types of energy transformation in living systems; energy in photosynthesis. Phosphorylation types. Organization of electron carriers and enzymes in mitochondria, chloroplast and microsomes and their inhibitors, cyanide resistant respiration.

Unit III

Kinetics of catalyzed reaction: Single substrate reactions, bisubstrate reactions, Concept and derivation of Michaelis – Menten equation, Line-weaver burk plot, 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 IV

Criteria of chemical reactions - Collision & transition state theories, specificity of enzymes. Mechanism of catalysis: Proximity and orientation effects, general acid-base catalysis, covalent and electrostatic catalysis - nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis.Theories on mechanism of catalysis. Coenzymes - structure and function, Mechanism of enzymes action: mechanism of action of lysozyme and chymotrypsin. Multienzymes system - Mechanism of action and

regulation of pyruvate dehydrogenase, and fatty acid synthase complex. Isoenzymes.

Unit V

Applications of enzymes in Industry. Immobilization and Immobilized enzymes. Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment. Applications of immobilized enzymes. Biosensors – glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors. Abzymes and Ribozymes. Enzymes of clinical importance - diagnostic significance and therapeutic effects. Enzyme Engineering.

Reference Books

1. Modern concepts in Biochemistry (Alllyn and Bascon Inc. Boston) Bohinski, R.C: 1987.
2. Inorganic, Organic and Biological Chemistry – Caret,(W.M.C. Brown Publ. USA 1993.
3. Enzymes (Longman, London) - Dixon, M. and Webb, J.F.: 1979.
4. Principles of Biochemistry (Worth Publ. Inc. USA) - Lehninger, A.H,+ 1993.
5. Biochemistry: A case Orientede Approach (The C.V. Mosby Co., St. Louis) - Montgomery, R, 1990.
6. Biochemistry- Rawn, J.D, (Neil Patterson Publ. North Carolina) - 1989.
7. Biochemistry- Stryer, I, (II Ed) W.H. Freeman & Co., New York) 1988.
8. Biochemistry - Voet, D. and Voet, J.G, (John Wiley & Sons Inc., New York) 1990.
9. Principles of Biochemistry- White, A., (McGraw Hill Book Co., New York) 1959.
10. Fundamentals of Enzymology- Price and Stevens: (Oxford University Press) 1999.
11. Handbook of Proteolytic Enzymes - Alan J. Barrett, J. Fred Woessner, Neil D. Rawlings , 2012.
12. Fundamentals of Enzymology (Oxford Science Publications) 2nd Edition, Nicholas C. 1989.
13. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry Kindle Edition-T Palmer , 2007.

*****

CORE COURSE IV

CELL BIOLOGY AND PHYSIOLOGY

Objectives:

To understand on integrative physiology at several levels of organization from molecules to living organisms, microscopic structures to macroscopic organization, and cellular properties to organ functions.

Unit I

Tissues: Types of tissue. Epithelium – organization and types. The basement membrane. Bone and cartilage. Major classes of cell junctions – anchoring, tight and gap junctions. Major families of cell adhesion molecules (CAMs) – the cadherins (classical and desmosomal). The integrins. The extracellular matrix of epithelial and nonepithelial tissues. ECM components – collagen, elastin, fibrillin, fibronectin, laminin and proteoglycans and tubulins.

Unit II

Biomembranes, cell cycle, cell death: Membrane assembly – importins and exportins. Membrane transport. Diffusion (passive and facilitated) active transport (symport, antiport, Na+ K+ ATPase), ion gradients, ion selective channels, group translocations, porins, endocytosis and exocytosis. The cell cycle : phases, regulation by cyclins and cyclin – dependent kinases. Checkpoints in cell cycle regulation. Programmed cell death – Brief outline of apoptosis. Differences between apoptosis and necrosis.

Unit III

Blood: Composition and functions of blood. Separation of plasma and serum. Plasma proteins in health and disease. Red blood cells – formation and destruction. Important aspects of RBC metabolism. The RBC membrane – principle proteins (spectrin, ankyrin, glycophorins). Anaemias. Composition and functions of WBCs. Blood coagulation – mechanism and regulation. Fibrinolysis. Anticoagulants.

Unit IV

Body Fluids: Lymph – composition and functions. CSF – composition and clinical significance. Formation of urine – structure of nephron, glomerular filtration, tubular reabsorption of glucose, water and electrolytes. Countercurrent multiplication, tubular secretion. Composition, functions and regulation of saliva, gastric, pancreatic, intestinal and bile secretions. Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids.

Unit V

Neuromuscular System: Structure of neuron. Propagation of action potential: structure of voltage – gated ion channels. Neurotransmitters - examples, release and cycling of neurotransmitters. The neuromuscular junction – activation of gated ion channels. The acetylcholine receptor. Structure of skeletal muscle. Muscle proteins – myosin, actin, troponin and tropomyosin and other proteins. Sequence of events in contraction and relaxation of skeletal muscle. Pathophysiology of Duchenne muscular dystrophy. Cardiac muscle – $Ca2^{+}$ -Na^{+} exchanger, Ca2+ -ATPase. Brief outline of channelopathies. Cardiac myophathy. Smooth muscle – regulation by Ca2+ and nitric oxide. Source of energy for muscle contraction.

Reference Books

1. Molecular Cell Biology 5th ed., Lodish, WH Freeman (for unit 1, 2, 5) 2003.
2. Harper's Biochemistry 26th ed- Murray, McGraw Hill (unit 2 Biomembranes, unit 3, unit 4, unit 5 muscle) 2003.
3. Principles of Biochemistry- Smith et al. Mammalian Biochemistry. McGraw Hill 7^{th} ed. (for unit 3, unit 4) 1983.

References:

1. Cell and Molecular Biology. De Robertis and De Robertis. Lea and Febiger 8^{th} ed (1987).
2. Molecular Biology of the Cell - Alberts , 4th ed. Garland Sci. 2002.

*****

CORE PRACTICAL I

BIOCHEMICAL TECHNIQUES AND ENZYMOLOGY

Objectives:

1. To assay the activity of enzymes from different sources.
2. To stimulate their interest in learning the structure, function and kinetics of enzyme and their role as catalyst and regulator of cell metabolism and to serve as foundation for more advanced enzymology courses

1. Estimation of proteins by Lowry / Brad ford method
2. Estimation of phospholipids by phosphorous assay
3. Estimation of sodium and potassium by Flame photometry
4. Effect of pH, temperature and substrate concentration for amylase and urease and determination of Vmax & Km
5. Effect of inhibitor on activity of any one enzyme
6. Effect of activator on activity of any one enzyme
7. Desalting of proteins by dialysis
8. Separation of polar and non polar lipids by TLC
9. Rf value calculation of various amino acids using TLC and PC
10. Separation of serum proteins by paper electrophoresis

Reference Books:

1. Laboratory manual for Analytical Biochemistry & separation Techniques, P.Palanivelu, MKU University, Madurai.2001.
2. Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh, 2nd ed, 2005.
3. Biochemical methods – S.Sadasivam, New Age International Pub, 2000.
4. Instrumental Methods of Chemical Analysis Bk.Sharma, Goel publications, Meerut, 2000.
5. Enzyme Kinetics – A modern Approach. AG Marangani, John Wiley & Sons, 2003.
6. Laboratory Manual in Bio Chemistry, Jayaraman, New Age International Pub, 2000.

*****

CORE COURSE V

METABOLISM AND REGULATION

Objectives:

To understand the metabolic pathways and regulatory mechanisms.

Unit I

Bioenergetics: Free energy and entropy. Phosphoryl group transfers and ATP. Enzymes involved in redox reactions. The electron transport chain– organization and role in electron capture. Electron transfer reactions in mitochondria. Oxidative phosphorylation- F1/F0 ATPase- structure and mechanism of action. The chemiosmotic theory. Inhibitors of respiratory chain and Oxidative phosphorylation – uncouplers, ionophores. Regulation of oxidative phosphorylation. Mitochondrial transport systems- ATP/ADP exchange, malate /glycerophosphate shuttle.

Unit II

Carbohydrate metabolism: Glycolysis and gluconeogenesis– pathway, key enzymes and co-ordinate regulation. Pyruvate dehydrogenase complex and the regulation of this enzyme through reversible covalent modification. The citricacid cycle and regulation. The pentose phosphate pathway. Metabolism of glycogen and regulation.

Unit III

Lipid metabolism: Lipogenesis-Control of acetyl CoA carboxylase-Role of hormones-Effect of diet on fatty acid biosynthesis. Regulation of biosynthesis of triacylglycerol, phospholipids and cholesterol. Metabolism of triacylglycerol during stress. α, β,γ, Oxidation of fatty acids– Role of carnitine cycle in the regulation of β -oxidation. Ketogenesis and its control. Lipoprotein metabolism exogenous and endogenous pathways.

Unit IV

Metabolism of amino acids, purines and pyrimidines: Overview of biosynthesis of nonessential amino acids. Catabolism of amino acid– transamination, deamination, ammonia formation, the urea cycle and regulation of ureogenesis. Importance of glutamate dehydrogenase. Overview of Catabolism of carbon skeletons of amino acids. Metabolism of purines- de novo and salvage pathways for purine biosynthesis-Purine catabolic pathway. Metabolism of pyrimidines -biosynthesis and catabolism. Regulation of biosynthesis of nucleotides.

Unit V

Metabolic integration and hormonal regulation: Key junctions in metabolism– glucose-6-phosphate, pyruvate and acetyl CoA. Metabolic

profiles of brain, muscle, liver, kidney and adipose tissue. Metabolic interrelationships in various nutritional and hormonal states– obesity, aerobic, anaerobic endurance, exercise, pregnancy, lactation, IDDM, NIDDM and starvation.

Reference Books

1. Biochemistry- Stryer, Freeman. 5th ed, 2002.
2. Harper's Biochemistry- Murray, 29th ed. Mc. GrawHill, 2011.
3. Principles of Biochemistry. 7th ed, Nelson Cox. Lehninger's McMillan Worth, 2013.
4. Biochemistry- Donald Voet, J.G. Voet, John Wiley, J O H N WI VP & Publisher Kaye Pace
5. Biochemistry- 2nd ed- Kuchel and Ralston. Schaum's Outlines McGraw Hill, 1998.
6. Biochemistry NMS.4th ed- Davidson and Sittman. Lippincott.Willams and Wilkins, 1999.
7. Biochemistry 4th ed- Campbell and Farrell, Brooks/Cole Pub Co. 2002.
8. Metabolic Regulation-Keith N. Frayn, 2009.

*****

CORE COURSE VI

MOLECULAR BIOLOGY

Objectives:

1. To understand the basic structure and functioning of the genetic materials - DNA.
2. To emphasize the molecular mechanism of DNA replication, repair, transcription, protein synthesis and gene regulation in various organisms.

Unit I

Eukaryotic and Prokaryotic chromosomes: Structure of prokaryotic Chromosomes Structure of eukaryotic chromosomal DNA, banding pattern, c-value, complexity heterochromatin, centromere, nuclear organizer, telomeres, Kinetic complexity of DNA, cot curve, and classes of DNA sequences. Histones, Non-histone proteins, and their properties, structure of nucleosome, role of histones in chromatin folding, concept of gene.

Unit II

Replication: Review of replication in bacteria, plasmid and viruses, Models of DNA replication.DNA replication in prokaryotes and eukaryotes. Eukaryotic DNA polymerases and their roles, origin of replication, Autonomously Replicating Segments (ARS) in yeast, elongation, lagging strand synthesis, and termination.

Recombination: DNA recombination: Homologous, site specific and transposition, Homologous recombination: Holliday Model, Messelsson - Radding Model, Rec BCD pathway. Site specific recombination: Lambda phage integration, and excision rearrangement, of immunoglobulin genes. Transposition: Prokaryotic transposition, conservative and replicative transposition. Eukaryotic transposable elements, yeast and Drosophila transposons.

Unit- III

Transcription: Review of prokaryotic transcription, transcription in eukaryotes: Eukaryotic RNA polymerases and their subunit structure, Class I, II and III promoters, upstream elements, enhancers and silencers, General transcription factors, Class I, II, III genes and their functions, elongation factors, TBP structure and its role in transcription, mediators. Structure of transcription activators, zinc fingers, homeodomains, helix loop helix, bZIP, beta barrels, Post transcriptional modification.

Unit - IV

Translation: genetic code and its features. Wobble hypothesis. Translation machinery, initiation, elongation and termination of translation in prokaryotes and eukaryotes. Translational proof reading, translational

inhibitors, post-translational modifications, chaperones and protein targeting- translocation, heat shock proteins, glycosylation; SNAPs and SNAREs. Bacterial signal sequences. Mitochondrial, chloroplast and nuclear protein transport. Endocytosis - viral entry. Ubiquitin TAG protein destruction.

Unit - V

Chromosomal changes and consequences: Changes in the chromosome number and chromosome structure and its related genetic disorders. Mutation: definition, chemical basis and types. Types of mutagens. Mutant types - lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. DNA repair mechanism: thymine dimer, light activation, excision, recombinational, SOS and mismatch repair. Cancer Biology: genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

Reference Books:

1. The Cell- A Molecular Approach Geoffrey Cooper, Robert E Harsman, 3rd ed ASM Press 2004.
2. Molecular Cell Biology, Lodish et.al. 5th ed., WH Freeman & Company 2003.
3. Cell and Molecular Biology De Robertis and De Robertis.. 8th ed Wolters Kluwer India Pvt Ltd 2001
4. Molecular Biology of the Cell Alberts et al 4th ed. Garland Science Inc. 2002.
5. David Freifelder, 2008. Molecular Biology. (Ed: 2). Narosa Publications, New Delhi.
6. Cell and Molecular Biology, Gerald Karp, 4th ed John Wiley & Sons, Inc, New York 2004.
7. Text book of Principles of Molecular Biology- Cram, 2015.

*****

CORE PRACTICAL II

MOLECULAR AND MICROBIAL TECHNIQUES

Objectives:

To introduce students to various practical aspects of Molecular biology.

Practical:

1. Isolation of plasmid & Genomic DNA
2. Estimation of DNA by diphenylamine method
3. Estimation of RNA by orcinol method
4. Separation of DNA by Agarose Gel Electrophoresis
5. Separation of protein by SDS-PAGE
6. Purification of enzyme by ammonium sulphate precipitation Microbial Techniques
7. Staining technique - Grams staining
8. Determination of bacterial growth curve
9. Media preparation and Culture techniques - pour plate, spread plate and streak plate method
10. Antibiotic Resistance
11. Biochemical Characterization of Bacteria

1. Indole test
2. Methyl Red test
3. Triple Sugar Iron Agar test
4. Voges Proskauer test
5. Citrate Utilization test
6. Catalase test
7. Urease test
8. Oxidase test
9. Nitrate test

Reference Books]

1. Manuals in Biochemistry – Dr. J. Jayaraman, New Age International Pub, 2000.
2. Instrumental Methods of Chemical Analysis Bk.Sharma, Goel publications, Meerut, 2000
3. Laboratory Manual in Bio Chemistry, Jayaraman, New Age International Pub, 2000.
4. Laboratory manual in Biochemistry T.N.Pattabiraman. All India publishers, 1998.
5. Lab Manual in General Microbiology - N Kannan, Palaniappa Brothers, 2000.
6. Lab Manual in Microbiology - Dr P Gunasekaran, New Age International Pub, 2000.

*****

ELECTIVE I

BIOSTATISTICS

Objectives:

1. The course emphasizes on various statistical methods and its significance.
2. The students are expected to understand the concepts and solve relevant problems pertaining to each topic.
3. To provide sufficient background to be able to interpret statistical results in research.

Unit I

Statistical survey – Organizing, planning and executing the survey. Source of data - Primary and secondary data, collection, observation, interview, enquiry forms, questionnaire schedule and check list. Classification and tabulation of data. Diagrammatic and graphic presentation of data.

Unit II

Measures of central tendency - arithmetic mean, median, mode, quartiles, deciles and percentiles. Measures of variation - range, quartile deviation, mean deviation, standard deviation, Coefficient of variation. Correlation analysis - Scatter diagram, Karl's Pearson's coefficient of correlation and Spearman's rank method. Regression analysis.

Unit III

Probability - Definition, concepts, theorems (proof of the theorems not necessary) and calculations of probability - Simple problems. Theoretical distributions – Binomial, Poisson and normal distribution - Simple problems (proof of the theorems not necessary).

Unit IV

Sampling distribution and test of significance – Concepts of sampling, Testing of hypothesis, errors in hypothesis testing, standard error and sampling distribution, sampling of variables (large samples and small samples.). Student's "t" distribution and its applications. Chi-square test and goodness of fit. Analysis of variance - one way and two way classification. Duncan's Multiple Range test. Design of experiment- Completely randomized block design, Randomized block design.

Unit V

Scientific 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.IPR and Patenting – Concept and types.

Reference Books:

1. Statistical Methods, 4th Edition- Gupta, S.P, Sultan Chand & Son Publishers. 2012.
2. Biostatistical Analysis, 5th Edition- Zar, J.H, Pearson Education, 2010.
3. Biostatistics - Daniel, W.W. A Foundation for Analysis in Health Sciences, 10th Edition, John Wiley and Sons, Inc.,1999.

*****

ELECTIVE II

MICROBIOLOGY

Aim: To provide wide knowledge on general microbiology

Objectives:

To understand the metabolic reaction occurs in the microbial cells, it helps the student to gain basic information about microbiology.

Unit I

Morphology and Ultra structure: Ultra structure of bacteria, fungi, algae and protozoa. Classification of microbes, molecular taxonomy. Cell walls of eubacteria (peptidoglycan) and related molecules. Outer membrane of Gram– negative bacteria. Cell wall and cell membrane synthesis, flagella and motility, cell inclusions like endospores, gas vesicles. Purple and green bacteria, cyanobacteria, homoacetogenic bacteria, Acetic acid bacteria, Budding and appendaged bacteria, spirilla, spirochaetes, Gliding and sheathed bacteria, Pseudomonads, Lactic and propionic acid bacteria. Endospore forming rods and cocci, Mycobacteria, Rickettsia and Mycoplasma. Archaebacteria.

Unit II

Microbial growth and metabolism: Microbial growth– definition. Mathematical expression of growth, growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, factors affecting growth. Microbial metabolism– overview. Photosynthesis in microbes.Role of chlorophylls, carotenoids and phycobilins, Calvin cycle. Chemolithotrophy; Hydrogen– iron– nitrite oxidising bacteria; nitrate and sulfate reduction; methanogenesis and acetogenesis, fermentations– diversity, syntrophy-role of anoxic decompositions. Nitrogen metabolism, nitrogen fixation, hydrocarbon transformation.

Unit III

Microbiological Techniques: Methods in microbiology. Current methods in microbial identification. Pure culture techniques. Theory and practice of sterilization. Principles of microbial nutrition, construction of culture media, Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microbes.

Unit IV

Viruses: Bacterial, plant, animal and tumor viruses. Classification and structure of viruses. Lytic cycle and lysogeny. DNA viruses; positive and negative strand, Double stranded RNA viruses. Replication; example of Herpes, pox, adenoviruses, Retroviruses. Viroids and prions.

Unit V

Medical Microbiology: Disease reservoirs; Epidemiological terminologies. Infectious disease transmissions. Respiratory infections caused by bacteria and viruses; Tuberculosis, sexually transmitted diseases including AIDS; Vector borne diseases, water borne diseases. Public health and water quality. Pathogenic fungi. Antimicrobial agents, Antibiotics. Penicillins and cephalosporins, Broad spectrum antibiotics. Antibiotics from Prokaryotes, Antifungal antibiotics– Mode of action, Resistance to antibiotics. Lantibiotics.

Reference Books

1. Brock Biology of microorganisms- Madigan, 10th ed. Prentice Hall, 2002.
2. Microbiology 4th ed- Davis, Lippincott Williams and Wilkins, 1989.
3. Microbiology - Joklik, Zinsser's Mc Graw-Hill Professional, 1995.
4. Microbiology 5th ed- Pelczar, Mc Graw Hill, 2000.
5. General Microbiology 5th ed- Stainer Ry, Prentice Hall 1986.
6. Medical Microbiology- Brooks, Jawetz, Melnick and Adelberg's Lange Med, 1998.
7. Textbook of Microbiology & Immunology: Edition- Subhash Chandra Parija et al. 2014.
8. Medical Microbiology: 7th -Patrick R. Murray 2012.

*****

CORE COURSE VII

IMMUNOLOGY

Objectives:

To understand about immune response and immunological techniques

Unit I

Elements of Immunology. Types of immunity- innate and acquired. Humoral and cell mediated immunity. Central and peripheral lymphoid organs- Thymus, bone marrow, spleen, lymph nodes and other peripheral lymphoid tissues- GALT. Cells of the immune system- lymphocytes, mononuclear phagocytes- dendritic cells, granulocytes, NK cells and mast cells, cytokines.

Antigens vs immunogens – types – determinants – Haptens - Factors influencing immunogenicity. Immunoglobulins structure, classification and functions. Isotypes, allotypes and idiotypes.

Unit II

Complement activation and its biological consequences. Theories of Antibody formation. – Factors influencing antibody production – Genetic basis of antibody diversity.

T-cell, B-cell receptors, Antigen recognition- processing and presentation to T-cells. Interaction of T and B cells. Immunological memory. Effector mechanisms- macrophage activation. Cell mediated cytotoxicity, immunotolerance, immunosuppression.

Unit III

MHC genes and products. Polymorphism of MHC genes, role of MHC antigens in immune response, MHC antigens in transplantation. Transplantation types. Immune responses to infectious diseases- Viral, bacterial and protozoal. Tumor antigens-immune response to tumor antigens-immunotherapy. AIDS and other immunodeficiency disorders. Autoimmunity - Autoimmune diseases – pathogenesis - treatment. Hypersensitivity - types & Mechanism.

Unit IV

Immunization practices- active and passive immunization. Vaccines- killed, attenuated- toxoids. Recombinant vector vaccines- DNA vaccines, synthetic peptide vaccines- anti idiotype vaccines. Hybridomas - production of polyclonal and monoclonal antibodies. Principles, techniques and application. Genetically engineered antibodies.

Fractionation of leucocytes by density gradient centrifugation. Identification of lymphocytes and their subsets in blood. Leukocyte migration inhibition technique. Delayed type hypersensitivity technique.

Unit V

Agglutination and precipitation: Techniques - Immuno-electrophoresis, RIA, immunoblotting assay, Avidin- biotin mediated immuno assay. Immunohistochemistry- immunofluorescence, immunoferritin technique. Cytokines assay: ELISA and ELISPOT, Abzymes.

Experimental animal models: inbred strains, SCID mice, nude mice, knockout mice cell culture system: Primary lymphoid culture cloned lymphoid cell lines.

Reference Books

1. Essential Immunology, 10th ed - Roitt's, Blackwell Sci, 2001.
2. Immunology, 4th ed- Kuby, Richard A, Goldsby et al. WH Freeman & Co. 2003.
3. Cellular and Molecular Immunology- Abbas, W.B. Saunders Company, 2000.
4. Immunobiology- 5th ed Janeway, C. (Ed), Paul Travers. Garland Publ. 2001.
5. Immunology- Eli Benjamini AU, A short course. 4th ed. Wiley-Liss, 2000.
6. NMS Series in Immunology- 3rd ed, Lippincott Williams & Wilkins.
7. Fundamentals of immunology- Bier, Springer Verlag, 1986.
8. Cellular and Molecular Immunology: 7th Edition, Abul K, 2011.

*****

CORE COURSE VIII

CLINICAL BIOCHEMISTRY

Objectives:

1. To impart thorough knowledge about the biochemical basis of various diseases and disorders.
2. To study various diagnostic and therapeutic methodologies available for diseases and disorders.

Unit I

Disorder of carbohydrate and lipid metabolism Disorders of carbohydrate metabolism– glycogen storage diseases, galactosemia, fructose intolerance and fructosuria. Blood sugar homeostasis: Role of tissues and hormones in the maintenance of blood sugar. Hypoglycemia, hyperglycemia, glycosuria. Diabetes mellitus – classification, metabolic abnormalities, diagnosis and management. Disorders of lipid metabolism – lipoproteinaemias. Lipid storage diseases – Gaucher's, Tay Sach's Niemann Pick disease. Fatty liver. Atherosclerosis.

Unit II

Disorders of amino acid and nucleic acid metabolism Disorders of amino acid metabolism– amino aciduria, Phenylketonuria, Hartnup disease, alkaptonuria, albinism, cystinuria, cystinosis, homocystinuria and maple syrup urine disease. Disorders of purine, pyrimidine metabolism: Hyperuricemia and gout. Hypouricemia. Orotic aciduria. Serology: C reactive protein test, Rheumatoid arthritis (RA) test.

Unit III

Liver function test and gastric function test Jaundice- Causes, consequences, biochemical findings, treatment in jaundice, hepatitis and cirrhosis. Liver function test. Tests related to excretory (bile pigments) synthetic (plasma proteins, prothrombin time) detoxifying (hippuric acid, NH3, aminopyrine) and metabolic (galactose) functions. Gall stones. Gastric function tests- Stimulation tests – insulin and pentagastrin. Peptic ulcer, gastritis and Zollinger Ellison syndrome.

Unit IV

Renal function test and metabolic disorders: Kidney function- Biochemical findings in glomerulonephritis, renal failure and nephritic syndrome. Nephrolithiasis. Kidney function tests - Glomerular function tests – inulin, urea and creatinine clearance tests, renal plasma flow, plasma microglobulin. Tubular function tests – water load, concentration and acid excretion tests. Abnormal constituents of urine. Clinical enzymology - Serum enzymes and isoenzymes in health and disease – Transaminases (AST, ALT) acid. Alkaline phosphatases, amylase, LDH and CK.

Unit V

Oncology: Cancer cell – morphology and growth characteristics. Biochemical changes in tumor cells. Differences between benign and malignant tumors. Tumor markers – AFP, CEA and HcG Agents causing cancer – radiation, viruses, chemicals. Multistep carcinogenesis – initiation, promotion, progression. Oncogenes and proto- oncogenes – mechanisms of proto-oncogene activation. Tumor suppressor genes – p53.

Reference Books:

1. Clinical Chemistry in diagnosis and treatment, Philip. D. Mayne & Edward Arnold, 6th ed ELBS.1994.
2. Textbook of Clinical Chemistry, 3rd ed- Tietz, WB Saunders, Burtis & Ashwood, 1999.
3. Principles of Internal Medicine. Harrison's Vol 1 & 2, 16th edition Mc Graw Hill.2005.
4. Biochemistry and disease.Cohn and Roth, Williams and Wilkins, 1996.
5. The Metabolic & Molecular Basis of inherited Diseases, Vol 1 - 4 8th ed Serives, Vallersty, Tata McGraw Hill Companies, 2001.
6. Clinical Biochemistry – Metabolic & Clinical Aspects, William J.Marshall, Stephen K.Bansert, Churchill Livingstone, 1995.
7. Clinical Chemistry – Principles, procedures, correlations – Bishop, Lippincott.2000.
8. Textbook of Biochemistry with Clinical Correlation Thomas M Devlin 2nd ed Wiley & Sons. 2006
9. Clinical Biochemistry-Allan GAW Michael J, an Illustrated Colour Text, 5th Edition, 2013.
10. Harper's Biochemistry 25th Edition-Peter A. Mayes (Author), Robert K. Murray, 1999.

*****

CORE PRACTICAL III

CLINICAL BIOCHEMISTRY

Objectives:

To study the various diagnostic and therapeutic methodologies available for diseases and disorders.

I. Hematological studies

1. Blood Grouping and Rh typing.
2. Estimation of hemoglobin content.
3. Total RBC count.
4. Total WBC count.
5. Determination of clotting time
6. Total platelet count.
7. Determination of Prothrombin time
8. Determination of ESR.

II. Biochemical analysis of urine & blood

Collection, preservation (blood and urine)

1. Estimation of blood glucose
2. Estimation of serum total proteins and A: G ratio
3. Estimation of serum cholesterol
4. Estimation of blood and urine urea
5. Estimation of serum and urine calcium
6. Estimation of serum and urine uric acid
7. Estimation of serum bilirubin.
8. Estimation of serum creatinine
9. Estimation of serum AST / ALT
10. Estimation of serum acid phosphatase / alkaline phosphatase

III. Urology

Urine - Qualitative tests of urine. Abnormal constituents - Reducing sugar-Benedict test, protein: -Heat and acetic acid test, and sulfosalicylic acid method, Ketone bodies-Rothera's test, Bile pigment (Fouchet method), bile salt (Hay's test), Urobilinogen-Ehrlich aldehyde test and Bence Jones protein test.

Reference Books

1. Practical Clinical Biochemistry- Varley's by Alan H Gowenlock, published by CBS Publishers and distributors, India Sixth Edition ,1988.
2. Laboratory manual in Biochemistry, T.N.Pattabiraman. All India publishers, 1998.
3. Practical Biochemistry for Students, Varunkumar Malhotra, Jaypee Bros, 1986.
4. Laboratory Manual in Bio Chemistry, Jayaraman, New Age International Pub, 2000.
5. Medical Lab Technology Vol I& II, Kanai L Mukerjee New Delhi: Tata Mcgraw Hill Publishing Company, 1996.
6. Practical Biochemistry – Plummer, New Delhi: Tata Mcgraw Hill Publishing Company, 2000.
7. Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh, 2nd ed, 2005.

*****

ELECTIVE III

GENETIC ENGINEERING

Objective:

To understand and learn the emergence and early development and application of technology.

UNIT I

Introduction to genetic engineering and rDNA technology, gene cloning, specialized tools and techniques, benefits of gene cloning. Isolation and purification of DNA: Preparation of total Cellular DNA, plasmid DNA, bacteriophage DNA, plant cell DNA, isolation of mRNA from mammalian cells.

UNIT II

Vectors and enzymes in cloning: Cloning and Expression vectors- Plasmids pBR, pUC, phages (M3, λ), yeast vectors, cosmids, phagemids, agrobacterium, PAC, BAC, YAC, MAC, HAC vectors, Plant and Animal viruses as vector, binary and shuttle vectors, expression vectors for prokaryotes and eukaryotes, expression cassettes. Restriction endonucleases, ligases, S1 nuclease, reverse transcriptase, polymerase, alkaline phosphatase, terminal transferase, methods of ligation.

UNIT III

Construction of genomic and cDNA libraries, selection and screening of recombinants, probes- types, synthesis and uses of probes. Blotting techniques (Southern, Northern and Western), PCR- types and applications, Sequencing: DNA and RNA, site directed mutagenesis. Chromosome walking, jumping, DNA finger printing and foot printing.

UNIT IV

Methods of gene transfer: Microinjection, electroporation, particle bombardment gun (biolistic), ultrasonication, liposome mediated and direct transfer. Restriction analysis of DNA, molecular markers- RFLP, RAPD, VNTR, SSR, AFLP, STS, SCAR, SNP. Microarrays. Genomics (human genomic project) and proteomics – types and applications.

UNIT V

Applications of Genetic Engineering: Recombinant insulin, somatotropin, vaccines, role of genetic engineering in diagnosis and cure of diseases, gene therapy, transgenic plants (herbicide resistant, pesticide resistant, and antisense RNA technology and its application). Transgenic animals. IPR, Patenting, Ethical, legal issues and hazards of genetic engineering.

Reference Books:

1. Principles of Gene Manipulation and Genomics, Seventh edition, S.B. Primrose and R.M. Twyman, 2006 Blackwell Publishing, USA.
2. Molecular Biotechnology- Principles and applications of Recombinant DNA, Bernard R. Glick, Jack J. Pasternak, and Cheryl L. Patten. — 4th ed., ASM Press, Washington, DC , USA
3. Gene cloning and DNA analysis : an introduction / T.A. Brown.—6th ed- Brown, T.A. (Terence A.) , Wiley-Blackwell. 2010.
4. Elements of Biotechnology, P.K. Gupta, Rastogi Publications, 2nd edition 3rd reprint, 2015-2016.
5. A text book of Biotechnology, R.C.Dubey, S.Chand Publications, 2014
6. An Introduction to Genetic Engineering, Third Edition, Desmond S. T. Nicholl, Cambridge University Press, USA
7. Genetic Engineering – Basics, New Applications and Responsibilities, Edited by Hugo A. Barrera-Saldaña, Published by InTech, Croatia, 2011.

*****

ELECTIVE IV

DEVELOPMENTAL BIOLOGY

Objectives:

1. To study the cellular basis of development.
2. To elucidate the early development process of humans.

Unit I

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

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

Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick; organogenesis – vulva formation in Caenorhabditis elegans; eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Unit IV

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum.

Unit V

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

Reference Books

1. Developmental Biology, (Ed: 9) - Gilbert S.F. Sinauer Associates Inc. Massachusetts, USA, 2010.
2. Developmental Biology, TMH Edition, Berrill N.J, 1974.
3. Animal Regeneration- Diwan A.P., Dhakad N.K., Anmol Publications Ltd, India, 1996.
4. Developmental Biology- Browder L.W., Erickson C.A., and Jeffery W.R, Saunder College Publishing House, Philadelphia, USA, 1991.
5. Genetics, 3rd edition- Strickberger, Prentice Hall of India, 2002.
6. Genes VII- Benjamin Lewin, Oxford University Press, 2000.
7. Genetics- Sarin C, Tata McGraw–Hill Publishing Co., Ltd., New Delhi, 1990.
8. Genetics- Gupta PK, Rastogi Publications, Meerut, India, 1996.
9. Molecular Biology of the Cell, (Ed: 3) - Alberts B, Garland Science, USA, 2002.
10. Evolutionary Developmental Biology (2nd edition) - Brian K. Hall, Kluwer Academic Publishers, 1999.

*****

CORE COURSE IX

ENDOCRINOLOGY

Aim:

To obtain sound knowledge in Hormonal Biochemistry.

Objective:

1. Inculcate through understanding of mechanism of action of Hormones.
2. Clinical endocrinology plays a vital role in clinical Biochemistry and Metabolism.
3. This syllabus substantiate understanding other subject

Unit I

Hypothalamic and pituitary hormones: Hormones – classification, biosynthesis, circulation in blood, modification and degradation. Hormone receptors – structure and regulation. Mechanism of hormone action. Hypothalamic and pituitary hormones. Hypothalamic releasing factors. Anterior pituitary hormones: biological actions, regulation and disorders of growth hormones, ACTH, gonadotrophins and prolactin. Leptin. Posterior pituitary hormones – biological actions and regulation of vasopressin. Diabetes insipidus and SIADHsecretion. Oxytocin. Hypopituitarism.

Unit II

Thyroid and parathyroid hormones: Thyroid hormones – synthesis, secretion, regulation, transport, metabolic fate and biological actions. Antithyroid agents. Thyroid functions tests. Hyper and hypothyroidism. Hormonal regulation of calcium and phosphate metabolism. Secretion and biological actions of PTH, calcitonin and calcitriol. Hypercalcemia and hypocalcemia Rickets and osteomalacia.

Unit III

Adrenal hormones: Adrenal cortical hormones.Synthesis, regulation, transport, metabolism and biological effects. Adrenal function tests. Cushing's syndrome, aldosteronism, congenial adrenal hyperplasia, adrenal cortical insufficiency. Adrenal medullary hormones – synthesis, secretion, metabolism, regulation and biological effects of catecholamines. Phaeochromocytoma.

Unit IV

Gonadal, G.I. and pancreatic hormones: Gonadal hormones: Biosynthesis, regulation, transport, metabolism and biological actions of androgens. Hypogonadism and gynecomastia. Biosynthesis, regulation, transport, metabolism and biological effects of oestrogen and progesterone. The menstrual cycle. Pregnancy – diagnostic tests and biochemical changes.

Foetal monitoring. Amenorrhea. Pancreatic hormones – synthesis, regulation, biological effects and mechanism of action of glucagons, somatostatin and insulin. Insulin receptor. Brief account of gastrointestinal hormones.

Unit V

Signal transduction: Fundamental concepts and definitions of signals, ligands and receptors, endocrine, paracrine and autocrine signaling. Receptors and signaling pathways – cell surface receptors, ion channels, G-protein coupled receptors, receptor kinases (tyr, ser/thr).Signal transduction through cytoplasmic and nuclear receptors. The Ras-raf MAP kinase cascade, second messengers – cyclic nucleotides, lipids and calcium ions. Crosstalk in signaling pathways.

Reference Books:

1. Williams Textbook of Endocrinology – Wilson and Foster 13th ed. 2015.
2. Mechanisms of hormone action – Autind and Short, 1980.
3. Harper's Biochemistry – Murray et al. 26th ed. McGraw Hill, 2003.
4. Principles of Biochemistry – Mammalian Biochemistry, Smith et al. McGraw Hill, 1983.
5. Williams et al, Textbook of Endocrinology, 2015.

*****

CORE COURSE X

BIOINFORMATICS

Objective:

1. The purpose of studying this paper is to apply computational facility in different fields of life sciences, physical and chemical sciences.
2. After completion, students could learn drug designing through computer based modification programs using synthetic or natural source.
3. Most important application of Bioinformatics is in the field of drug discovery where it reduces more than 60% of the time, money and labor.

Unit I

Bioinformatics – An overview, Definition & History; Bioinformatics databases & tools on the Internet- NCBI, EBI, PIR, Swiss-Prot, GenBank; pattern and motif searches- BLOCKS, PRINTS, PFAM

Unit II

Proteins – Amino acids — Levels of protein structure – Ramachandran Map. Protein Secondary structure prediction - Chou-Fasmann rules, Gamier-Osguthorpe-Robson (GOR) methods; Predicting 3D structure – homology modeling, threading - fold recognition and ab initio methods - Rosetta – CASP.

Unit III

Biological Sequence analysis – Pairwise sequence comparison – Sequence queries against biological databases – BLAST and FASTA - Multiple sequence alignments – Phylogenetic alignment.

Algorithms and Matrices: Scoring matrices- PAM and BLOSUM; dynamic programming Algorithms, Needleman and Wunsch, Smith-Waterman;

Unit IV

Protein structure visualization tools – RasMol, HEX, Argus Lab Swiss PDB Viewer - Structure –Classification, alignment and analysis – SCOP, CATH, FSSP, UNIX.

Unit V

Functional Genomics (Metabolism and Regulation) in Biochemistry – Sequencing genomes– Genome databases on the web, Prokaryotic Genome Database with comparison with Human genome, HGP, GENECLUSTER, DNA Microarray, SWISS-2DPAGE Database, TIGR,WIT, CYTOSCAPE and DRUG DISCOVERY.

Reference Books

1. Bioinformatics-Sequence and Genome Analysis- David W.Mount, Cold Spring Harbor Laboratory Press (2004).
2. Introduction to Bioinformatics, Attwood, T.K. and D.J. Parry-Smith, Pearson Education Ltd., New Delhi (2004).
3. Bioinformatics – Westhead, D.R., Paris J.H. And R.M. Twyman, Instant Notes: Viva Books Private Ltd, New Delhi (2003).
4. Introduction to Bioinformatics, Arthur M. Lesk, Oxford University Press, New Delhi (2003).
5. Bioinformatics- Sequence, structure and databanks, Higgins D. and W. Taylor (Eds), Oxford University Press, New Delhi (2000).
6. Bioinformatics; A practical Guide to the Analysis of Genes and Proteins, Wiley-Interscience, Baxevanis, A. and B.F. Ouellette , Hoboken, NJ (1998).
7. Introduction to computational Biology, Michael, S. Waterman, Chapman & Hall, (1995).

*****

CORE PRACTICAL IV

PHYTOCHEMISTRY, SOIL ANALYSIS AND IMMUNOLOGICAL

Objectives:

1. To learn the strategies of biochemical research.
2. To provide ample opportunity for the students to specialize in basic and advanced methods used in investigation focusing on biology applications.

Practical:

1. Qualitative and quantitative phytochemical analysis - alkaloids, flavanoids, steroids, tannins, Saponins
2. Antibacterial activity by disc diffusion method
3. *In vitro* antioxidant activity – any two methods
4. Estimation of soil mineral contents-pH, nitrate, nitrite, sulphate, phosphate, calcium, magnesium, chloride, fluoride, silica and ammonia

Immunology

1. Laboratory safety precautions and good laboratory practices
2. Haemagglutination titration
3. Widal test - rapid slide test for typhoid
4. VDRL test - test for syphilis
5. Latex agglutination test for rheumatoid factor and Pregnancy
6. Immunoelectrophoresis
7. Skin Prick Test.

Reference Books:

1. Laboratory manual for Analytical Biochemistry & separation Techniques, P.Palanivelu, MKU University, Madurai.2001.
2. Manuals in Biochemistry – Dr. J. Jayaraman, New Age International Pub, 2000.
3. Practical Biochemistry – Plummer, New Delhi: Tata Mcgraw Hill Publishing Company, 2000.
4. Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh, 2nd ed, 2005.
5. Biochemical methods – S.Sadasivam, New Age International Pub, 2000.
6. Microbiology Lab Manual - John P. Harley 7th edition McGraw Hill Medical Publication division.2007.
7. Diagnostic Enzymology – D.Hawcroft, John Wiley & sons, 1987.
8. Lab Manual in General Microbiology - N Kannan, Palaniappa Brothers, 2000.
9. Lab Manual in Microbiology - Dr P Gunasekaran, New Age International Pub, 2000.

*****

ELECTIVE COURSE V

ECOLOGY AND ENVIRONMENTAL SCIENCES

Objectives:

To study the physical and biological characters of the environment and the inter-relationship between biotic and abiotic components of nature as well as relationship among the individuals of the biotic components

Unit I

Environment – Physical environment: atmosphere (air), hydrosphere, lithosphere properties, interelationship with living organisms. Abiotic and biotic environment and their interactions. Species interactions; types, interspecific competition, herbivory, carnivory, pollination, symbiosis. Population ecology – Population characteristics, population growth curve, population regulation, life history strategies (r and K selection); concept of meta population demes and dispersal, interdemic extinctions, age structured populations.

Unit II

Community ecology: Nature of communities, community structure and attributes, levels of species diversity and its measurement, edges and ecotones. Concept of habitat and niche, types of niche, niche width and overlap, fundamental and realized niche, resource partitioning, character displacement.

Unit III

Ecological succession and Ecosystem Ecology: Ecological succession types, mechanisms, changes involved in succession, concept of climax. Ecosystem structure, function, energy flow and mineral cycling (C, N, P, S), primary production and decomposition, structure and function of terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine) ecosystem.

Unit IV

Pollution: Environmental pollution, global environmental change, biodiversity; status, monitoring and documentation, major drivers of biodiversity change, biodiversity management approaches.

Unit V

Biogeography and Conservation Biology ; Major terrestrial biomes, theory of island biogeography, biogeographically zones of India. Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Reference books

1. Cell Biology, Genetics, Molecular Biology, Evolution And Ecology, P.S. Verma and V.K.Agarwal, S. Chand Company Ltd 2005.
2. Ecology and Environmental Biology, T.K.Saha, Books and Allied (P) Ltd, Kolkata 2011.
3. Modern concepts of Ecology, H.D.Kumar, 8th ed, Vikas Publishing House Pvt Ltd, 2008.
4. Fundamentals of Environment Biology, Dr. Biswarup Mukherjee, Silverline publications, 2008.
5. A Hand Book of Environmental Science, S S Negi, 2008.
6. A Text Book of Environmental Pollution, P.Panday, 2010.
7. A Text Book of Environmental Science, V. Thakur, 2012.
8. A Textbook of Environmental Science, Prabhat Patnaik, 2011.
9. A Textbook of Ecology, S.K. Dubey, 2012.

*****