

SRI VENKATESWARA UNIVERSITY::TIRUPATI
S.V.U. COLLEGE OF SCIENCES; DEPARTMENT OF BIO-CHEMISTRY
(Syllabus common for SV University College and affiliated by SVU Area
Academic Years (2021-2022); M.Sc. Biochemistry
SCHEME OF INSTRUCTION AND EXAMINATION

First Semester	Code	Title of the Paper	Hrs / week	No. of Credits	Core/ Elective	IA Mark	Sem End Mark	Total Marks
	BCH101	Biochemical and Biophysical Methods	6	4	Core	20	80	100
	BCH 102	Molecular Physiology and Nutrition	6	4	Core	20	80	100
	BCH 103P	Biochemical Preparations & Analysis Practicals	6	4		--	100	100
	BCH 104P	Biochemical & Biophysical Methods Practicals	6	4		--	100	100
	BCH 105	Enzymology	6	4	Compulsory. Foundation	20	80	100
	BCH 106a/b	Cell Biology and Biomolecules/ Environmental Biochemistry	6	4	Elective foundation	20	80	100
	TOTAL		36	24				600
Second Semester	BCH 201	Energy Metabolism	6	4	Core	20	80	100
	BCH 202	Nitrogen Metabolism	6	4	Core	20	80	100
	BCH 203P	Enzymology Practicals	6	4		--	100	100
	BCH 204P	Microbiology Practicals	6	4		--	100	100
	BCH 205	Molecular Biology	6	4	Compulsory Foundation	20	80	100
	BCH 206a/b	Microbial Biochemistry/Genetics	6	4	Elective foundation	20	80	100
	TOTAL		36	24				600

- MOOCS (UGC) to be approved by DDC.

Third Semester	BCH 301	Immunology	6	4	Core	20	80	100
	BCH 302	Ecology and Evolution	6	4	Core	20	80	100
	BCH 303P	Clinical Biochemistry Practicals	6	4	Core	--	50	50
	BCH 304P	Molecular Biology Practicals					50	50
	BCH 305 (SOC)	Clinical Biochemistry (Skill oriented course)	6	4	Core	20	80	100
	BCH 306 Generic Elective	a) Endocrinology b) Plant Biochemistry	6	4	Elective	20	80	100
	BCH 307 Open Elective	a) Analytical methods b) Environmental Biochemistry * MOOCS (4 extra credits)	6	4	Elective to other dept.	20	80	100
	TOTAL		36	24				600
Fourth Semester	BCH 401	Genetic Engineering	6	4	Core	20	80	100
	BCH 402	Research Methodology & Bioinformatics	6	4	Core	20	80	100
	BCH 403P	Immunology & Haematology Practicals	6	4	Core	--	100	100
	BCH 404	Project work	6	4	Core	--	100	100
	BCH405 Generic Elective	a) Developmental Biology b) Applied Biochemistry	6	4	Elective	20	80	100
	BCH406 Open Elective	a) Research Methodology b) Nutritional Biochemistry * MOOCS (4 extra credits)	6	4	Elective to other dept.	20	80	100
	TOTAL		36	24				600

SEMESTER-I

BCH 101: BIOCHEMICAL AND BIOPHYSICAL METHODS

Unit I

Biological relevance of pH, measurement of pH, pKa of functional groups in biopolymers such as proteins and nucleic acids. Importance of buffers in biological systems, ion selective electrodes, and oxygen electrode. Donnan membrane equilibrium. Significance of osmotic pressure in biological systems, viscosity and determination of molecular weight using viscometers.

Microscopy: Basic principles of light microscopy, phase contrast microscopy, electron microscopy, and fluorescence microscopy. Sedimentation methods: Basic principles of centrifugation, preparative, differential and density gradient centrifugations, analytical, ultra centrifugation, applications in the determination of molecular weight, purity of biomolecules and detection of conformational changes of biomolecules. Flow cytometry.

Unit II

Radioactivity: half-life, decay constant, average life, units of radioactivity, Radioactivity measuring techniques, and correction factors. Statistics of counting operations, Radiation dose units, Roentgen, REP, REM maximum permissible dose, Dosimetry and dosimeters; radiation monitoring hazards, Biological effects of radiation, Isotope dilution technique and its application in biochemical investigations. Radioisotopes in biochemistry and medicine. RIA.

Unit III

Theoretical principles, methodology and biochemical applications of separation methods: Counter current distribution, Paper, Thin layer, Reverse phase, absorption, ion exchange, and gas chromatography, affinity chromatography, Gel filtration, HPLC.

Electrophoresis: Paper, agar, immune-electrophoresis, high voltage electrophoresis, SDS-PAGE and isoelectric focusing, Capillary electrophoresis, iso-tachopheresis, Northern blot, Southern blot, Western blot Analyses and development of blots. 2D electrophoresis, Pulse- field gel electrophoresis.

Unit IV

Spectroscopy: Electromagnetic radiations, Beer-Lamberts law principles and applications of colorimetry, spectrophotometry. Concept and biological application of UV, fluorimetry, flame photometry.

AAS, AES, Infrared, ESR, NMR spectroscopy, Polarimetry, CD & ORD. Principles and applications of X-ray Diffraction. MALDI- LCMS, Biosensors.

Recommended Books

1. Principles and Techniques of practical Biochemistry. Eds. Williams and Wilson.
2. Techniques in Molecular biology Ed. Walker & Gastra, Croom Helm, 1983.
3. Principles of instrumental analysis, 2nd Ed, Holt-Sanders, 1980.
4. An introduction to spectroscopy for Biochemistry. Ed. Brown S.N., Academic press.
5. Analytical Biochemistry, Holmes and Hazel peck, Longman, 1983.
6. An introduction to practical biochemistry. David T. Plummer, Tata MacGrew-Hill.
7. Biophysical chemistry, Edshall & Wyman, Academic press Vol II & I.
8. A textbook of quantitative inorganic analysis including elementary instrumental analysis, Vogel ELBS.
9. Biochemical calculations Seigel, IH, 2nd Edit, John Wiley & sons Inc., 1983.
10. Analytical Biochemistry by Friefelder David.

BCH 102: MOLECULAR PHYSIOLOGY

Unit I

Circulatory system: Formation and composition of blood. Total and differential counts in blood. Development of erythrocytes, and leukocytes. Platelets. Plasma proteins Blood clotting mechanism. Erythrocyte Sedimentation Rate.

Circulation of blood. Cardiac cycle, Capillary and venous blood flow. Blood pressure Electrocardiogram Blood gas transport and gaseous exchange in tissues. Acid-base balance in lungs. The value of blood pH, PO₂, PCO₂, Measurements.

Excretory system structure and function of Nephrons. Urine formation; GFR, reabsorption and secretion. Composition. Normal Inorganic and organic constituents abnormal constituents of urine. Acid-base balance equilibrium maintained by the Kidney.

Unit II

Muscular system: Types of Muscular tissue; structure of striated muscle fiber molecular organization of contractile systems, mechanism of muscle contraction, Regulation and energetics of contraction. Role of calcium.

Nervous system: Outlines of organization of nervous system; blood-brain barrier; Nerve growth factor. Origin of membrane potential. Mechanisms of propagation of nerve impulse of synaptic transmission. Myelin sheath – composition and function; biogenic amines amino acids and Peptides; Neurotransmitters. Transmission at cholinergic adrenergic nerve endings.

Electrophysiological methods: PET, MRI, CAT, Sense organs and thermoregulators.

Unit III

Body weight and the body composition. Determination of body fat and body water. Body composition during growth and energy requirements. Measurement of energy expenditure, direct and indirect calorimetry, Respiratory quotient and BMR. Protein nutrition. Essential and non-essential amino acids. Nitrogen balance, methods of calculation of biological value of proteins protein calorie deficiency. Kwashiorkor and Marasmus. Fats as component of diet, measurement of energy value of fats. Essential fatty acids and phospholipids in nutrition.

Unit IV

Vitamins and Minerals: Sources of the vitamins, Requirement of fat-soluble and water-soluble vitamins and their deficiency symptoms. Macro and trace elements in nutrition. Deficiency symptoms and recommended dietary allowances. Special aspects of Nutrition for the infants, children, pregnant and lactating woman and in old age, Importance of Nutrition under stress conditions.

Community Nutrition and Health: Assessment of Nutritional status of community. Anthropometric measurements, clinical examination, Biophysical and Biochemical techniques.

Recommended Books:

1. Harper's Biochemistry.
2. Trace elements by Underwood.
3. Nutrition by M.S. Swaminathan.
4. The book of Human Nutrition (1996) MS. Bamji, N. Prahlad Rao and V. Reddy.
5. Text Book OF Medical physiology by A.C. Guyton (2001).
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PRACTICALS

BCH 103P: BIOCHEMICAL PREPARATIONS AND ANALYSIS-PRACTICALS

1. General reactions of carbohydrates. Specific reactions of different sugars: arabinose, xylose, fructose, galactose, sucrose, maltose and lactose.
2. General reactions of proteins and amino acids. Precipitation reactions of albumins and globulins.
3. General reactions of lipids and cholesterol.
4. Isolation and estimation of cholesterol from brain.
5. Isolation and estimation of glycogen/starch.
6. Preparation of Casein from milk.
7. Crystallization of albumin.
8. Estimation of proteins in biological samples:
 - a. Biuret method.
 - b. Folin-Lowry method.
 - c. UV method.
 - d. Bradford's dye binding method.
9. Titration curve of amino acid and calculation of PK and PI value.
10. Estimation of amino acids by formal titration.
11. Estimation of amino acid by Ninhydrin method.
12. Estimation of tyrosine by Million's –reaction.
13. Identification of N-terminal group of proteins by Sanger's method.
14. Estimation of fructose in Fruit-juice.

Recommended Books

1. Practical Biochemistry by T Plummer
2. Practical Biochemistry by J Jayaraman
3. Klemir and others: practical Biological chemistry.
4. A manual of laboratory techniques by NIN, Hyderabad

BCH 104P: BIOCHEMICAL & BIOPHYSICAL METHODS-PRACTICALS

1. Effect of solvent system on the R_f value of two solutes using TLC.
2. Separation of purines and pyrimidines by Paper Chromatography.
3. Separation of amino acids by Paper Chromatography.
4. Separation of sugars by TLC.
5. Isolation & Characterization of Brain Lipids by Solid phase extraction and TLC.
6. Separation of amino acids by Paper Electrophoresis (Demonstration).
7. Separation of amino acids by Ion-exchange Chromatography (Demonstration).
8. Separation of Serum proteins by Paper Electrophoresis.
9. Measurement of pH of a biological fluid using pH meter.
10. Absorption spectra of phenol red, amino acids and nucleic acid.
11. Verification of Beer's law and determination of molar extinction coefficient using p-nitro phenol.
12. Isolation and spectrophotometric characterization of plant pigments.
13. Isolation of Mitochondria from Rat liver by density gradient centrifugation (Demonstration).
14. Viscosity measurement of Bovine serum albumin.

15. Measurement of inversion of sucrose by Polarimetry.
16. Measurement of refractive index of Biological sample.
17. Dialysis.

Recommended Books:

1. Hawk's Physiological chemistry
2. Practical Biochemistry by T Plummer
3. Practical Biochemistry by J Jayaraman
4. Klemir and others: practical Biological chemistry.
5. Practical Biochemistry – Koch and Hank Dunn and Drell.
6. Practical Biochemistry-Sawhney (2000)
7. Varley's Practical clinical Biochemistry–Ed. Alan W. Gowenlock (Heinemann Medical Books).

BCH105: ENZYMOLOGY

Unit I

Nomenclature and classification of enzymes according to I.U.B. Convention, specificity and active site. Fundamentals of enzyme assay – enzyme units, coupled kinetic assay. Enzyme localization, Isolation, purification and criteria of purity. Profile of enzyme purification by different separation techniques.

Elements of kinetics – Reaction rates transition state theories free energy change. Methods used in the investigation of kinetics of enzyme-catalyzed reactions – Initial velocity studies and rapid reaction techniques (Continuous flow and Stopped flow). Enzyme kinetics of single substrate reactions, steady state assumption, Michaelis-Menten (Briggs-Haldane), Lineweaver Burk, Eadie Hofstee, and Hanes plots. Pre- steady state kinetics. Effect of pH and temperature.

Unit II

Enzyme inhibition: Types of reversible inhibitors – competitive, non-competitive, un-competitive mixed inhibition and partial inhibition. Substrate inhibition, Feedback inhibition and allosteric inhibition.

Irreversible inhibition. Bisubstrate reactions, Sequential mechanism compulsory order and random order mechanism, non-sequential mechanism, Ping-pong mechanism. Chemical nature of enzyme catalysis: General acid – base catalysis, electrostatic catalysis, covalent catalysis, intermolecular-catalysis, metal ion catalysis, and proximity and orientation.

Unit III

Mechanism of reactions catalyzed by the following enzymes – Chymotrypsin, Trypsin, Carboxypeptidase, Ribonuclease and Lysozyme.

Co-enzymes – the mechanistic role of the following co-enzymes in enzyme catalyzed reactions – Nicotinamide nucleotides, Flavin nucleotides, Co-enzymes A, Lipoic acid, Thiamine pyrophosphate, Biotin, Tetrahydrofolate and Co-enzyme B12. Modern concepts of evaluation of catalysis-catalytic RNA (Ribozyme), abzymes (catalytic antibodies), Synzymes (Synthetic enzymes), Site-directed mutagenesis.

Unit IV

Monomeric enzymes – the Serine proteases, Zymogen activation, Oligomeric enzymes – Isoenzymes (LDH) and multienzyme complexes (pyruvate dehydrogenase complex). Covalent modification (Glycogen phosphorylase, Glutamine synthase, Chymotrypsin).

Allosteary of enzyme action; Binding of ligands to proteins Co-operativity, the Hill Plot for Myoglobin and Hemoglobin, Sigmoidal kinetics: The MWC and KNF models. Significance of sigmoidal behavior. Study of ATCase a typical allosteary enzyme.

Recommended Books:

1. Enzyme structure and mechanism. Alan Fersht, Freeman & Co.1997
2. Principles of enzymology for food sciences: Whitaker Marc Dekker1972.
3. Methods in enzymology Ed. Colowick and Kaplan, Academic Pr (Continuing series)
4. Text book of Biochemistry with clinical correlations (4th edition)-Thomas M. Devlin.
5. Biological chemistry; H.R. Mehler& E.H CordesHarper &Rev.
6. Enzyme kinetics Siegel interscience – Wiley1976.
7. Biochemistry chemical reactions of living cells (2001) David E. Matzler. Vol. I.

BCH106a: CELL BIOLOGY AND BIOMOLECULES

Unit I

Prokaryotic and Eukaryotic cells: Cell organelles Structure, Composition and functions of nucleus, mitochondria plastids, endoplasmic reticulum, Golgi, lysosomes, vacuole, micro bodies, ribosomes, cytoskeleton. Biomembranes, structure and mechanisms of transport.

Cell division, cell cycle and its regulation, cell signaling, stress response, cell communication, cell adhesion, Apoptosis, Senescence, extracellular matrix, integrins.

Unit II

Origin of basic Biomolecules. Amino acids & Proteins: Classification of amino acids, acid-base properties of amino acids, chemical reactions of amino acids, non-protein amino acids, Peptide bond – Structure and conformation. Naturally occurring peptides. Classification of proteins – purification and isolation of proteins, criteria of purity of proteins, physico-chemical properties, structural organization of proteins, Elucidation of primary structure, secondary structure, , Tertiary structure Quaternary structure, Denaturation & renaturation of proteins. Outlines of Proteomics.

Unit III

Carbohydrates: Definition and classification of carbohydrates, nomenclature, Reaction of Mono- saccharides, Acid derivatives of Monosaccharides amino-sugars, Oligo saccharides, structure, properties and importance of Homo & Hetero polysaccharides.

Lipids: Classification, Physical and chemical properties of fatty acids. Characterization of natural fats & oils, structure and biological role of triacyl glycerol, phospholipids, sphingolipids, Gangliolipids, Prosta-glandins, Thromboxanes, Leukotrienes and steroids. Killer fat (*Staphylococcus* killer)

Unit IV

Nucleic acids: Purine and pyrimidine bases, nucleosides, nucleotides, polynucleotides, Structure of nucleic acids primary secondary & Tertiary structure of DNA. DNA denaturation and renaturation kinetics

Structure of RNAs – Secondary and Tertiary structure; Analysis of stability to nucleic acid structures, Nucleic acid sequencing –Higher orders of DNA & RNA Structure, chromatin structure; Gene analysis – southern blot technique and its variance. Porphyrins; Types, chemistry and structure of porphyrins. Vitamins, structures and chemistry.

Recommended Books:

1. The biochemistry of Nucleic acids; Adams et al., Chapman and Hall, 1986.
2. Proteins: A guide to study by physical & chemical methods, Haschemeyer and Haschemeyer,
3. Proteins: Structure, function and evolution. Dickerson & Geis, 2ndEdn, Benjamin/Cummings.
4. Biochemistry - Zubay C, Addison – Wesley, 1986.
5. Biochemistry, A problem Approach, 2ndEdn. Wood, W.B. Addison Wesley 1981.
6. Biochemistry, Lehninger A. H.
7. Textbook of Biochemistry West, E.S., Todd, Mason & Vanbruggen, Macmillian & Co.
8. Principles of Biochemistry White-A, Handler, PandSmith E.L. Mc Grew Hill.
9. Organic chemistry, I.L. Finar, ELBS. (1985).
10. Organic Chemistry by Morrison and Boyd (2000) PrenticeHall.
11. Fundamentals of Biochemistry by Donald Voet (1999).

BCH106b: Environmental Biochemistry

Unit I

Renewable and non-renewable resources Definition, scope and importance, need for public awareness Forest resources: Use and over-exploitation, deforestation, case studies. Water resources, Mineral resources, Food resources, Food resources, Energy resources, Role of an individual in conservation of natural resources.

Unit II

Ecosystems, Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems and Biodiversity and its conservation

Unit III:Environmental Pollution

Definition, Cause, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides.

Unit IV:Human Population and the Environment,

Population growth, variation among nations, Population explosion –Family Welfare Programme. Environment and human health, Human Rights, Value Education HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Reference books:

1. Environmental Biochemistry - Neelima Rajvaidya, Dilip Kumar Markandey (2005).
2. Environmental and Ecological Biochemistry -P.W. Hochachka T.P. Mommsen
3. Environmental Biochemistry Hardcover – 2005 by D. K. Markandey , N. Rajvaida

SEMESTER-II

BCH 201: ENERGY METABOLISM

Unit I

Broad outlines of Intermediary metabolism, methods of investigation, in vivo studies such as analysis of excretion, Respiratory exchange, Removal of organs and perfusion studies, in vitro studies such as tissue slice techniques; Homogenates and purified enzyme systems; isotope tracer studies, use of inhibitors and antimetabolites.

Metabolism of carbohydrates: Glycolysis, Fermentation, Feeder path ways (of fructose, galactose and mannose), TCA cycle, HMP shunt, Regulation of glycolysis, pyruvate dehydrogenase complex, and TCA cycle.

Unit II

Bioenergetics: Thermodynamic principles – Chemical equilibria; free energy, enthalpy (H), entropy (S). Free energy change in biological transformations in living systems; High energy compounds. Energy, change, oxidation-reduction reactions. Organization of electron carriers and enzymes in mitochondria. Classes of electron-transferring enzymes, inhibitors of electron transport.

Oxidative phosphorylation. Uncouplers and inhibitors of oxidative phosphorylation. Mechanism of oxidative phosphorylation. Mitochondrial transport system. Microsomal electron transport; Photorespiration, cyclic and non-cyclic reactions; photochemical events associated with pigment system – II and I. Utilization of oxygen by oxygenases, Superoxide dismutase and catalase.

Unit III

Uronic acid pathway, metabolism of amino sugars, metabolism of glycogen, starch, sucrose, lactose, glycoproteins. Gluconeogenesis, glyoxylate cycle. Regulation of glycogen metabolism and gluconeogenesis.

Futile cycles in carbohydrate metabolism. Disorders of carbohydrate metabolism – Glycogen, lactose, Fructose.

Unit IV

Biosynthesis and degradation of fatty acids (Saturated and unsaturated) regulation, metabolism of TAG, Glycerol and sphingolipids, cholesterol, prostaglandins.

Biosynthesis and degradation of cholesterol and its regulation. Metabolism of lipoproteins and Ketone bodies.

Recommended Books:

1. Principles of Biochemistry, White. A, Handler, P and Smith.
2. Biochemistry, Lehninger A. L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, Lubert Stryer.
5. Review of physiological chemistry, Harold A. Harper.
6. Text of Biochemistry, West and Todd.
7. Outlines of Biochemistry, Conn and Stummf.
8. Metabolic pathways – Greenberg.
9. Mitochondria, Munn.
10. Biochemistry, 2nd Edition, G. Zubay.

BCH 202: NITROGEN METABOLISM

Unit I

Metabolism of proteins and amino acids: Introduction, General metabolic reactions of amino acids. Degradation and biosynthesis of individual amino acids in animal, plant, and microbial systems. End products of amino acid metabolism - Krebs Haslett urea cycle.

Biosynthesis and Regulation of amino acids and disorders related to amino acid metabolism. Nitrogen cycle, Non-biological and biological nitrogen fixation, Nitrogenase system, Nif genes.

Unit II

Amino acids as biosynthetic precursors-Formation of creatine, serotonin, histamine, polyamines, melatonin, GABA, melanin, catecholamines.

Non-ribosomal peptide synthesis-glutathione, cyclic antibiotics (gramicidin).

Unit III

Metabolism of Nucleic Acids: Biosynthesis and degradation of Purines and regulation of pathways. Biosynthesis and degradation of Pyrimidines and regulation of pathways.

Interconversion of nucleotides, Metabolic disorders related to nucleic acid metabolism.

Unit IV

Toxic chemicals in the environment, Mode of entry of toxic substance, Insecticides, MIC effects, Pesticides, biotransformation of xenobiotics, detoxification.

Carcinogens in air, chemical carcinogenicity, mechanism of carcinogenicity, Environmental carcinogenicity testing

Recommended Books:

1. Principles of Biochemistry, White. A, Handler, P and Smith.
2. Biochemistry, Lehninger A. L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, Lubert Stryer.
5. Review of physiological chemistry, Harold A. Harper.
6. Outlines of Biochemistry, Conn and Stumpf.
7. Metabolic pathways –Greenberg.
8. Mitochondria, Munn.
9. Biochemistry, 2nd Edition, G. Zubay.
10. Environmental hazards & human health R.B. Philip
11. Toxicology - Principles & applications - Niesink & Jon devries.

BCH 203P: ENZYMOLOGY PRACTICALS

1. Amylase from Saliva.
2. Urease from Horse-gram.
3. Acid phosphatase from Potato.
4. Alkaline phosphatase from Serum.
5. Cholinesterase from Blood.
6. SDH from Liver.
7. Invertase from yeast.
8. Trypsin
9. LDH from Serum (Isoenzymes).
10. Enzyme purification and enzyme kinetics (Determination of V_{max} , K_m and K_i).
11. Effect of pH, Temperature, Activators, Inhibitors.
12. Immobilization of enzymes (demonstration only).

BCH 204P: MICROBIOLOGY PRACTICALS

- 1) Handling of Microscopes: Calibration of Microscopes.
- 2) Sterilization techniques: Autoclaving (Moistened-heat), Oven sterilization (dry-heat), Filtration, UV irradiation and Chemical.
- 3) Preparation of media: For Bacteria and Fungi.
- 4) Isolation and cultivation of pure cultures: Serial dilution, Pour plate method, Spread plate method and streak plate method.
- 5) Methods for the estimation of Growth (Growth rate and generation time in bacteria).
- 6) Staining techniques for bacteria and yeast: Gram Staining and Spore staining for bacteria; Methylene blue staining for Yeast.
- 7) Antibiotic sensitivity test.
- 8) Starch hydrolysis assay for the identification amylase-producing microorganisms.
- 9) Gelatin hydrolysis assay for the identification protease-producing microorganisms.
- 10) Preparation of wine from Grapes.
- 11) Production of Alcohol from molasses and its estimation by specific gravity method.
- 12) Production of Citric acid and its estimation by Marrier and Boulet method.
- 13) Production of Lactic acid and its estimation by Barker and Summerson method.
- 14) Induction of mutation in bacteria using physical and chemical mutagens.
- 15) Water analysis for bacteria and determination of BOD and COD of water.
- 16) Observation of Rizobium from root nodules of ground nut plant.
- 17) Isolation of phages from sewage and quantification by plaque assay.

Recommended Books

1. Hawk's Physiological chemistry
2. Practical Biochemistry by T Plummer
3. Practical Biochemistry by J Jayaraman
4. Klemir and others: practical Biological chemistry.
5. Practical Biochemistry – Koch and Hank Dunn and Drell
6. Practical Biochemistry-Sawhney (2000)
7. Varley's Practical clinical Biochemistry – Ed. Alan W.Gowenlock (Heinemann Medical Books)

BCH 205: MOLECULAR BIOLOGY

Unit I

Isolation, fractionation, characterization of nucleic acids, properties of nucleic acids in solution. DNA synthesis and repair - Topology of DNA, conservative, semi conservative and discontinuous synthesis of DNA, DNA primer for DNA synthesis. DNA polymerases I, II, III – their role in DNA synthesis. DNA ligase - mechanism of its action and its role in DNA synthesis. Inhibition of DNA synthesis, fidelity of replication. Alternate lengthening of telomere. Nearest neighbor frequency analysis.

Mechanism of replication of *E. coli* DNA. Role of DNA binding proteins – Histones in Eukaryotes, SSB in prokaryotes. Replication of lambda phage DNA, phage T-7 and single stranded DNA, the rolling circle model of replication of DNA. Mitochondrial replication, transcriptional switch.

Unit II

RNA synthesis and processing: RNA polymerases in prokaryotes and eukaryotes. Molecular composition of prokaryote RNA polymerase. Mechanism of transcription. Role of various compounds on RNA polymerases. Inhibitors of RNA synthesis. Biosynthesis of prokaryotic and Eukaryotic m-RNA, r-RNA, and t-RNA.

Processing of RNA- post transcriptional modifications, capping, adenylation and splicing.

Role of the hn RNA, sn RNA and sn RNP in processing of RNA. Functions and information content of DNA methylation, Transcriptional transcript RNA, template DNA, recombination and silencing repair in yeast, sRNA and gene regulation.

Unit III

Genetic code: General features of the code, Deciphering of the genetic code – Nirenberg and Khorana's work. Central dogma in the molecular biology and its verification.

Colinerarity of gene and protein. Wobble hypothesis and deviation from wobble hypothesis. Mitochondrial genetic code and evolution of genetic code. RNA editing and evolution.

Unit IV

Biosynthesis and mechanism of protein synthesis: Different stages and components of protein synthesis, m RNA and t RNA. Amino acid activation, protein chain initiation, elongation, and termination. Ribosomes and types, molecular components of ribosomes. Assembly and dissociation of subunits

Inhibitors of prokaryotic translation. Post – translational modification of proteins. Synthesis of secretory and membrane proteins – signal sequence hypothesis. Mechanism of translation control. Proteins local synthesis and disposal.

Recommended Books:

1. Molecular Biology of the gene by Watson.
2. Genetics by G Zubay.
3. Molecular Biology of the Cell by Albert Bruce.
4. Cell molecular Biology by Baltimore.
5. Molecular Biology by D Friefelder.
6. Molecular Genetics by D Friefelder.
6. Genes VII Benjamin Lewin (2000). Oxford Univ. Press. London.
7. Cell and Molecular Biology 2nd Edit. (2002) By P. K. Gupta, Rastogi Publ.

BCH 206a: MICROBIAL BIOCHEMISTRY

Unit I

Microorganisms and their place in the living World; Historical developments of microbiology (Spontaneous generation, Germ theory of disease and Koch's postulates). Nomenclature and broad classification of bacteria as per Bergey's manual of systematic bacteriology; General characteristics of Actinomycetes, Rickettsiae, Mycoplasmas, Spirochetes. Difference between prokaryotic and eukaryotic cells. Ultra structure of bacterium and endospore. Nucleic acid and 16s RNA based classification.

Nutritional requirements in microorganisms: Modes of nutrition – phototrophy, chemotrophy, methylotrophy, organotrophy, mixotrophy, saprophytic, symbiotic and parasitic modes of nutrition. Isolation of microorganisms – Direct and indirect Methods of maintenance of culture. Growth and kinetics of bacterial cells; Normal and biphasic growth curve, batch and continuous cultures, chemostats. Preservation of cultures (glycerol stocks, freeze drying), Culture collection centers in India.

Unit II

Control of microorganisms: Fundamentals of control, control by physical and chemical agents. Antibiotics and other chemotherapeutic agents. Microbiology of Food, Water, Sewage and Biogas. Water and Sewage treatment. Food and water-borne infections, Bacteriological and Viral standards of water.

Estimation of BOD and COD and their importance. Outlines of the Ames Test.

Introduction to Virology: Classification, Morphology, size, ultra structure and life cycle of some representative viruses (ØX 174, T4, SV40, λ-Phase, M13 and HIV). Methods of culturing of viruses, Isolation, purification and characterization. Biology of subviral agents – Viroids, Prions, Satellite viruses.

Unit III

Genetic material – Direct and Indirect evidences of DNA as genetic material, experimental proof. Evidences of RNA as genetic material – eg. Virus. Chromosome - Chromosome and genes, chromosomal replication, genetic mapping of chromosomes, structure of chromatin - nucleosomes and higher orders of organization, chromosome banding, transposition in human chromosome and chromosomal abnormalities. *Gene – arrangements* in prokaryotes and eukaryotes. Gene structure in eukaryotic organisms, introns, exons, pseudogenes, and gene clusters, spacers, repetitive sequences. Single and multiple copy genes in eukaryotes, eg – Histones, Alu, copia, satellite. Mapping of human genes – techniques used, assignment of important genes. Gene regulatory mechanisms and cell memory. Mechanism of recombination, extra nuclear inheritance. Non-coding explosion, cell fate determination and reprogramming. Genetic technique for Archea. New gene evolution, Tiniest genome of proteobacteria and bacterioidates.

Unit IV

Bacterial genetics – Bacterial chromosomes, plasmids – fertility, resistance, colicinogenic and other, PBR322 and other synthetic plasmids - isolation and uses. Transposable genetic elements, transformation, transduction, and conjugation in bacteria. Linkage map of bacterial chromosome. Recombination in bacteria.

Structure of Bacteriophages and their use in the study of molecular genetics – lytic cycle- replication of T-phages, Lysogeny and its regulation. Transduction – specialized, generalized and abortive. Transfection and cosmids. Fine structure analysis of T- phages, Benzers work and concept of cistrons. Bacterial defence (CRISPR- Gene turning on). Mutation – Types of mutations, mutagens, mechanism of mutation, Mutagenesis, induction and isolation of mutants. Haploid genetic tools. Radiation effects on human heredity. Phylogenetic inheritance. Heritability

and its measurements and mapping .gene duplication and self-incompatibility.

Recommended Books:

- 1) Microbiology by Pelczar, Chan and Krieg 5th edn. 1995 Mc Grew- Hill.
- 2) A Textbook of Microbiology, R.C.Dubey and D. K. Maheswari, S. Chand Co (2001).
- 3) An Introduction to Viruses by S. B. Biswas, Vikas Publishing house.
- 4) Microbial Ecology – Atlas (2001).
- 5) Molecular Genetics by D Friefelder and Cell molecular biology, Albert Bruce.
- 6) Gene VII by Lewin and Genetics by Gardner.

BCH 206b: GENETICS

Unit I

Genetic material – Direct and Indirect evidences of DNA as genetic material, experimental proof. Evidences of RNA as genetic material – eg. Virus.

Chromosome - Chromosome and genes, chromosomal replication, genetic mapping of chromosomes, structure of chromatin - nucleosomes and higher orders of organization, chromosome banding, transposition in human chromosome and chromosomal abnormalities.

Unit II

Gene – arrangements in prokaryotes and eukaryotes. Gene structure in eukaryotic organisms, introns, exons, pseudogenes, and gene clusters, spacers, repetitive sequences. Single and multiple copy genes in eukaryotes, eg – Histones, Alu, copia, satellite. Mapping of human genes – techniques used, assignment of important genes. Gene regulatory mechanisms and cell memory. Mechanism of recombination, extra nuclear inheritance. Non-coding explosion, cell fate determination and reprogramming. Genetic technique for Archea. New gene evolution, Tiniest genome of proteobacteria and bacterioidates.

Unit III

Bacterial genetics – Bacterial chromosomes, plasmids – fertility, resistance, colicinogenic and other, PBR 322 and other synthetic plasmids - isolation and uses. Transposable genetic elements, transformation, transduction, and conjugation in bacteria. Linkage map of bacterial chromosome. Recombination in bacteria.

Structure of Bacteriophages and their use in the study of molecular genetics – lytic cycle- replication of T-phages, Lysogeny and its regulation. Transduction – specialized, generalized and abortive. Transfection and cosmids. Fine structure analysis of T- phages, Benzers work and concept of cistrons. Bacterial defence (CRISPR- Gene turning on)

Unit IV

Mutation – Types of mutations, mutagens, mechanism of mutation, Mutagenesis, induction and isolation of mutants. Haploid genetic tools. Radiation effects on human heredity. Phylogenetic inheritance. Heritability and its measurements and mapping .gene duplication and self incompatibility.

Recommended Books

- 1) Molecular Genetics by D Friefelder and Cell molecular biology, Albert Bruce.
- 2) Gene VII by Lewin and Genetics by Gardner.
- 3) Genetics by Gardinar
- 4) Molecular Biology of the Cell: Brice Alberts

SEMESTER-III

BCH 301: IMMUNOLOGY

Unit I

Introduction: Scope of Immunology, Historical background of Immunology, Biological aspects of Immunology, Self and non-self-recognition, specificity, memory of immune system.

Antigens: Essential features of Ag, haptens, Carrier molecule, Immunological valence, Antigenic determinants. Adjuvants: Freund's complete and incomplete.

Antibodies: Nature, Primary structure of immunoglobulins, light chain, heavy chain, variable region, constant region, Hinge region; Enzymatic fragmentation of Ig. Domain structure of Ig and significance; Classification of Immunoglobulins: Types –IgG (G1, G2, G3 & G4), IgM, IgA, IgD and IgE (Origin, structural functions). Theories of Ab formation-Instructive, selective, clonal selection theories and evidences; Immunological memory. Antibody diversity: Mini gene theory, Mutation theory, Germ line theory, Somatic recombination, V (D) J recombination, Combinatorial diversity, Junctional diversity.

Unit II

Immunity: Types: Active and passive immunity. Cell mediated immunity, humoral immunity, immune response; primary and secondary response. Phagocytosis, mechanism of phagocytosis.

Interferon: Types of Interferons. Null cells: Natural Killer cells.

Complement system: Nature, components of compliment. Pathways: Classical and alternative pathways. Compliment fixation tests.

Unit III

Hypersensitivity (HS): Type I: Allergies and anaphylaxis – IgE, Mast cell degranulation, biologically active agents released in reactions, Clinical manifestations. Type II: Antibody mediated HS reactions; Mechanism, pathogenicity and cases of type II reactions; Hemolytic-disease of new born (HDN). Type III: Immune complex mediated HS reactions: Mechanism & pathogenicity of type III reactions. Soluble immune complexes and insoluble immune complex mediated reactions. Arthus reaction, Serum sickness. Type IV: Delayed type (or) cell-mediated HS reactions; Mechanisms and pathogenicity, Tuberculin reaction. Type V: Stimulatory HS reactions. Mechanism and pathogenicity, Grave's disease.

Blood groups: AB, Rh system, Lewis-Luthern systems, significance, practical application of immuno methodology in blood transfusions, Erythroblastosisfaetalis. Auto immunity: Introduction, Auto recognition, classes of auto immuno diseases. (Hashimoto disease, thyrotoxicosis, Systemic lupus erythomatosis, Autoimmune haemolyticaemia, Rheumatoid arthritis). Transplantation: Terminology, Auto graft, Isograft, Allograft, Xenograft, Immunological basis of transplantation reactions, GVH reaction, Immuno suppression, General mechanisms of Immune suppression, Immune suppression, drugs (azothioprine, methotrexate, cyclophosphamide, cycosporin-A, Steroids).

Unit IV

Immune Deficiencies: Introduction, primary and secondary deficiencies. T-cell, B-cell and combined immune deficiencies, Compliment system deficiency. Acquired immuno deficiency syndrome. SCID. Major Histocompatibility Complex: MHC in mice and HLA in man-fine structure and functions only.

Immunological techniques: Precipitin curve, Immuno diffusion, one and two dimensional, single radial immuno diffusion, Ouchterlony immuno diffusion.

Immuno-electrophoresis: Rocket immuno-electrophoresis; CIE, Graber and William technique.

Agglutination: Direct and Indirect, Widal test, VDRL test. Radioimmunoassay: ELISA – Principle, Methodology and applications. Immuno-fluorescence: Direct, indirect and Sandwich, *in situ* localization by techniques such as FISH and GISH.

Recommended Books:

1. Essential immunology- Ivan M. Roitt.
2. Introduction to Immunology – John W. Kinball.
3. Immunology – D. M. Weir.
4. Immunology – Janis Kuby

BCH 302: Ecology and Evolution

Unit I

The Environment: Physical environment; biotic environment; biotic and abiotic interactions. **Habitat and Niche:** Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemec extinctions, age structured populations.

Unit II

Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. **Community Ecology:** Nature of communities; community 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 III

Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, and P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). **Environmental pollution, Biodiversity management approaches.**

Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Unit IV

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.

Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

Recommended Books

1. Ecology and Environment-P.D.Sharma
2. Organic evolution-Veebala Rastogi
3. Evolution and Ecology-Subroto Biswas and Aman Biswas.

BCH 303P: CLINICAL BIOCHEMISTRY PRACTICALS

1. Estimation of blood glucose.
2. Estimation of blood urea.
3. Estimation of creatine in serum.
4. Estimation of uric acid in serum.
5. Estimation of serum total protein.
6. Estimation of Serum albumin.
7. Estimation of Serum cholesterol.
8. Determination of SGOT.
9. Determination of SGPT.
10. Estimation of serum calcium.
11. Estimation of serum phosphate.
12. Estimation of serum bilirubin.
13. Determination of urine ascorbic acid.
14. Tests for abnormal constituents in urine.
15. Use of diagnostic kits.

Recommended Books:

- 1) Practical Biochemistry by T. Plummer
- 2) Practical Biochemistry by J. Jayaraman
- 3) Klemir and others: practical Biological chemistry.
- 4) Practical Biochemistry – Koch and Hank Dunn and Drell
- 5) Microbiology laboratory Manual (2001) by Aneja, K.M
- 6) Laboratory Manual in Microbiology by P. Gunasekaran (1996), New Age Publ.
- 7) Microbiology laboratory Manual (2001) by Aneja, K.M

304P: MOLECULAR BIOLOGY PRACTICALS

1. Isolation of DNA from bacterial, plant and animal cells.
2. Estimation of DNA by Diphenylamine method.
3. Isolation RNA from yeast cells.
4. Estimation of RNA BY Orcinol method.
5. Estimation of DNA and purity determination by UV absorption method.
6. Determination of melting temperature(T_m).
7. Isolation of plasmid DNA from E. coli.
8. Detection and differentiation of open circular, linear and closed covalent circular plasmid DNA by submarine gel electrophoresis.
9. Transformation of E. coli with ampicillin resistant plasmid.
10. Trasfection of M13 DNA into E. coli JM103.
11. Isolation of phage M13.
12. Isolation of single and double standard M13 DNA.
13. Conjugation: Use of broad host range plasmid RP in demonstrating conjugation transfer of plasmid bacteria.
14. Catabolite repression: Evidence of B-Galactosidase induction in presence of lactose in E .coli lac strains.

Recommended Books:

1. Hawk's Physiological chemistry
2. Practical Biochemistry by T. Plummer
3. Practical Biochemistry by J. Jayaraman

4. Klemir and others: practical Biological chemistry.
5. Practical Biochemistry – Koch and Hank Dunn and Drell
6. Practical Biochemistry-Sawhney (2000)
7. Varley's Practical clinical Biochemistry – Ed. Alan W. Gowenlock (Heinemann Medical Books, London)

BCH305: CLINICAL BIOCHEMISTRY (SKILL ORIENTED COURSE)

Unit I

Introduction to Clinical Biochemistry: Introduction and maintenance of clinical biochemistry laboratory; hazards in clinical biochemistry laboratory; units; 'normal range', reference values. Factors affecting reference values quality control in laboratory – use of external and internal standards; use of WHO standards. Selection of analytical methods. Automation in clinical laboratory. Collection and preservation of specimens.

Disorders of Carbohydrate Metabolism: Importance of extra cellular glucose; blood glucose homeostasis– role of tissues and hormones; hyperglycemia and hypoglycemia. Diabetes mellitus – classification, etiology, clinical and laboratory features. Diagnosis of diabetes mellitus – glucose tolerance test, random fasting and post- prandial glucose levels, glycosuria, ketone bodies, glycosylated hemoglobin, plasma insulin. Metabolic complications – diabetic hyperglycemic coma and nonketotic coma; lactic acidosis; atherosclerosis, neuropathy. Hypoglycemia – fasting and provoked; diagnosis – stimulation tests (I.V. glucagon and leucine test); extended G.T.T; hypoglycemia in children – neonatal and early infancy. Investigation of glycogen storage diseases, galactosemia, hereditary fructosuria, lactose intolerance.

Unit II

Inborn errors of amino acid metabolism – Phenylketonuria, alkaptonuria, Hartnup's maple-syrup urine disease, Plasma proteins in health and changes in diseases; paraproteinaemias; proteinuria. Lipid metabolism: Plasma lipids and lipoproteins and their functions. Hyperlipoproteinemias; Classification – primary and secondary. Investigation of lipoproteinemias and lipidemias. Renal function: Glomerular and tubular functions. Tests for evaluation – concentration, dilution, excretion, clearance tests, nephritic syndrome.

Unit III

Clinical Enzymology: Plasma enzyme in diagnosis and prognosis – aminotransferases, creatine kinase, LDH, alpha amylase, phosphatases, choline esterase, glucose 6-phosphate dehydrogenase, Gamma glutamyl transferase. Isozymes of LDH alkaline phosphatase. Clinical application of plasma enzyme assays in myocardial infarction, liver disease, and muscle disease.

Disorders of Gastrointestinal Tract: Gastric function. Stimulation of gastric secretion. Composition of gastric secretion. Test for gastric function – fractional test meal. Pentagastrin test, insulin stimulation tests; hyperchlorohydrria, achlorohydrria, achylia gastrica. Pancreatic exocrine secretion – composition. Duodenal contents – collection, examination following stimulation of pancreas; analysis; malabsorption syndrome due to intestinal disease and pancreatic dysfunction, differential diagnosis. Disaccharides deficiency.

Unit IV

Biochemical aspects of Liver disease: Bile acid metabolism and bile formation. Bilirubin metabolism: biosynthesis, transport, hepatic uptake and transport, conjugation and excretion, enterohepatic circulation. Liver function tests related to protein, carbohydrate, lipid, pigment metabolism, detoxification and excretion. Serum enzymes in liver disease. Jaundice – classification and differential diagnosis. Kermicterus. Hydrogen ion homeostasis: Blood buffers, bicarbonate-buffering system. Role of Kidney. Red cells, lungs, acidosis and alkalosis.

Recommended Books:

1. Essentials of Food and Nutrition, Vol. I & II, M. S. Swaminathan.
2. Text Book of Biochemistry with clinical correlations. Thomas M. Devlin (JohnWily).
3. Harper's Review of Biochemistry, Murray et al. (Longman).

4. Biochemical aspects of human disease – R.S. Elkeles and A.S. Tavit. (Blackwell Scientific Publications).
5. Clinical chemistry in diagnosis and treatment–Joan F. Zilva and P.R. Pannall (Lloyd-Luke Medical Books).
6. Varley's Practical clinical Biochemistry – Ed. Alan W. Gowenlock (Heinemann Medical Books, London, 1988).
7. Clinical diagnosis and management by Lab methods (John Bernard Henry, W.B. Saunders Company, 1984).
8. Clinical Biochemistry – S. Ramakrishnan and Rajiswami.
9. Chemical Biochemistry (Metabolic and clinical aspects) by W. J. Marshall & S. K. Bangert.
10. Text book of clinical Biochemistry by Tietz et al.

BCH 306a: GENERIC ELECTIVE: ENDOCRINOLOGY

Unit I

History and Introduction to Endocrinology, Classification, chemistry, biosynthesis, secretion, regulation, transport and general mechanisms of actions of Hormones, bio-assay, chemical, RIA, ELISA.

Hormones of the pituitary, hypothalamus and pineal body: Growth hormone. Adrenocorticotrophic hormone, Thyroid stimulating hormone, leutinizing hormone, Follicular stimulating hormone, prolactin, oxytocin, antidiuretic hormone. Their structure, storage, regulation of secretion, mechanism of action and their actions. Structure secretion and actions of hypothalamic releasing hormones and inhibitory hormones. Pineal hormones: Melatonin and serotonin.

Unit II

Hormones of the Thyroid and parathyroid gland: Iodine metabolism, Biosynthesis of thyroid hormones, regulation of secretion. Possible mechanism of action and general functions. Metabolism at target cells and excretion.

Calcitonin and parathyroid hormone. Role of calcitonin in calcium and phosphate homeostasis in blood. Disorders of thyroid and parathyroid.

Unit III

Hormones of Pancreas and Gastro intestinal hormones: Chemistry, biosynthesis and secretion of insulin and glucagon. Actions of insulin and glucagon on Carbohydrate, lipid and protein metabolism. Gastrin, secretin, pancreaticozym, Cholecystokinin etc Adrenal hormones, Structure, biosynthesis metabolism, excretion and actions of adrenaline and noradrenaline.

Corticosteroids: Biosynthesis, secretion, actions, metabolism and excretion of cortisone Cortisol, corticosterone, deoxycorticosterone and aldosterone. Disorders of pancreas and adrenal glands.

Unit IV

Sex hormones (Hormones of Reproduction): Testosterone and inhibin. Estrogens, Progesterone and relaxin Human chorionic gonadotropin; Human placental lactogen, Hormonal regulation of menstrual cycle, contraceptions. Disorders associated with Gonadal hormones.

Miscellaneous hormones: Thymosin – synthesis and actions. Insect molting hormones – (ecdysone) Plant hormones – Auxins, gibberellins, ethylene, and abscissic acid, Pheromones.

Recommended Books:

1. Text book of biochemistry and human biology. Talwar G. P. Prentice Hall India.
2. Human physiology and mechanism of distance–Guyton 3rdedn. Iggkushoen /Seunders.
3. Clinical Biochemistry Vols. 1 and 2: Williams et al Heinemann Medical 1978.
4. Lynchs Medical Laboratory Technology Raphael, S.S., 4thedn. Iggkushoe /Saunders.
5. Text book of Endocrinology – William.
6. General endocrinology –Turner.
7. Biochemical endocrinology of the vertebrates by E. Fruden and H.Lines.
8. Foundation of modern Biochemical series, prentice Hall Inc.1971.
9. Metabolic and endocrine physiology: By Jay Teppermann.
10. Metabolic pathways –Greenberg.
11. Intermediary metabolism and its regulation –Larner.
12. Principles of Biochemistry, White, A, Handler, P and Smith.
13. Receptors and hormone action 1977.
14. Receptors and recognition series.

BCH 306b: GENERIC ELECTIVE: PLANT BIOCHEMISTRY

Unit I

Biosynthesis, Storage, breakdown and transport; physiological effects and mechanisms of action. Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. Structure and biochemical aspects of specialized plant cell organelles, cell plates, primary and secondary cell walls, plasmodesmata importance of vacuolar, characteristic of meristematic cells.

Unit: II

Role of water absorption, adsorption, conduction, transpiration, guttation water balance and stress. Role of different minerals absorption and translocation of inorganic and organic substances.

Special features of secondary plant metabolism, formation and functions of phenolic acids, tannins, lignin, flavonoid pigments, surface walls, cutin and suberin plant protective walls, Terpenes, Embryogenics growth and development, Defence system in plants, Photosynthesis in microbes, bacteria, fungi, algae and yeast.

Unit III

Lamarck; Darwin—concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

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.

Unit IV

Concepts of natural evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.

Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution;

Sexual selection; Co-evolution.

Reference books:

1. Plant Biochemistry (Fourth Edition): Hans-Walter Heldt and Birgit Piechulla
2. Plant Biochemistry - by Dr. V.Arunkumar, Dr.K.Siva Kumar, Dr. N. Senthil Kumar (2010).
3. Origin of Species – Charles Darwin
4. Evolution: The Triumph of an Idea by Carl Zimmer

BCH 307a: OPEN ELECTIVE: ANALYTICAL METHODS

Unit I

Biological relevance of pH, measurement of pH, pKa of functional groups in biopolymers such as proteins and nucleic acids. Importance of buffers in biological systems, ion selective electrodes, and oxygen electrode. Donnan membrane equilibrium. Significance of osmotic pressure in biological systems, viscosity and determination of molecular weight using viscometers.

Microscopy: Basic principles of light microscopy, phase contrast microscopy, electron microscopy, and fluorescence microscopy. Sedimentation methods: Basic principles of centrifugation, preparative, differential and density gradient centrifugations, analytical, ultra centrifugation, applications in the determination of molecular weight, purity of biomolecules and detection of conformational changes of biomolecules. Flow cytometry.

Unit II

Radioactivity: half-life, decay constant, average life, units of radioactivity, Radioactivity measuring techniques, and correction factors. Statistics of counting operations, Radiation dose units, Roentgen, REP, REM maximum permissible dose.

Dosimetry and dosimeters; radiation monitoring hazards, Biological effects of radiation, Isotope dilution technique and its application in biochemical investigations. Radioisotopes in biochemistry and medicine. RIA.

Unit III

Theoretical principles, methodology and biochemical applications of separation methods: Counter current distribution, Paper, Thin layer, Reverse phase, absorption, ion exchange, and gas chromatography, affinity chromatography, Gel filtration, HPLC.

Electrophoresis: Paper, agar, immune-electrophoresis, high voltage electrophoresis, SDS-PAGE and isoelectric focusing, Capillary electrophoresis, isotachopheresis, Northern blot, Southern blot, Western blot Analyses and development of blots. 2D electrophoresis, Pulse- field gel electrophoresis.

Unit IV

Spectroscopy: Electromagnetic radiations, Beer-Lamberts law principles and applications of colorimetry, spectrophotometry. Concept and biological application of UV, fluorimetry, flame photometry.

AAS, AES, Infrared, ESR, NMR spectroscopy, Polarimetry, CD & ORD. Principles and applications of X-ray Diffraction. MALDI- LCMS, Biosensors.

Recommended Books:

1. Principles and Techniques of practical Biochemistry. Eds. Williams and Wilson.
2. Techniques in Molecular biology Ed. Walker & Gastra, Croom Helm, 1983.
3. Principles of instrumental analysis, 2nd Ed, Holt-Sanders, 1980.
4. An introduction to spectroscopy for Biochemistry. Ed. Brown S.N., Academic press
5. Analytical Biochemistry, Holmes and Hazel peck, Longman, 1983.
6. An introduction to practical biochemistry. David T. Plummer, Tata Mac Grew-Hill.
7. Biophysical chemistry, Edshall & Wyman, Academic press Vol II & I.
8. A textbook of quantitative inorganic analysis including elementary instrumental analysis, Vogel ELBS.
9. Biochemical calculations Seigel, IH, 2nd Edit, John Wiley & sons Inc., 1983.
10. Analytical Biochemistry by Friefelder David

BCH 307b: OPEN ELECTIVE: ENVIRONMENTAL BIOCHEMISTRY

Unit I

Renewable and non-renewable resources. Definition, scope and importance, need for public awareness Forest resources: Use and over-exploitation, deforestation, case studies.

Water resources, Mineral resources, Food resources, Food resources, Energy resources, Role of an individual in conservation of natural resources.

Unit II

Ecosystems, Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems and Biodiversity and its conservation

Unit III

Environmental Pollution Definition, Cause, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards.

Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides.

Unit IV

Human Population and the Environment, Population growth, variation among nations, Population explosion –Family Welfare Programme.

Environment and human health, Human Rights, Value Education HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Reference books:

- 1.Environmental Biochemistry - Neelima Rajvaidya, Dilip Kumar Markandey(2005).
- 2.Environmental and Ecological Biochemistry -P.W. Hochachka T.P. Mommsen
- 3.Environmental Biochemistry Hardcover – 2005 by D. K. Markandey , N.Rajvaida

SEMESTER-IV

BCH 401: GENETIC ENGINEERING

Unit I

Cloning and amplification of DNA: Introduction, choice of the organism, use of restriction endonucleases for the production of DNA fragments. Vehicles for cloning - plasmids, phage vectors and cosmids.

RNA isolation, preparation and use of cDNAs. Screening and determination of nucleotide sequences. Application of recombinant DNA technology. Oncogenes and their mode of action.

Unit II

Isolation, sequencing and synthesis of genes: Isolation of genes, sequencing of genes, synthesis of genes, Cloning of specific eukaryotic genes and their expression in bacteria. Operon model: Isolation and chemical nature of repressor. Catabolite repression and role of cAMP and cAMP receptor protein (CRP) in the expression of glucose – sensitive operons. Lac operon, His operon, Trp operon of *E. coli*. Stringent and relaxed control.

Regulation of gene expression in prokaryotes and eukaryotes: Transcriptional control, enzyme induction and repression. Constitutive synthesis of enzymes. Genes involved in regulation, regulatory gene, promoter gene, operator gene and structural genes. Genome imprint.

Unit III

Gene transfer methods and transgenic organisms: Gene transfer methods for animals and plants, Agro bacterium mediated gene transfer, electroporation and particle gun. Transgenic animals, and transgenic plants.

Restriction maps and molecular genetic maps: Restriction mapping, restriction fragment length polymorphisms (RFLP) Linkage and recombination between molecular and phenotypic markers, Random amplified polymorphic DNA (RAPDs) using PCR, Chromosome walking. Organic genome engineering and cell molecular memory/ Biosensors

Unit IV

Applications of genetic engineering in biotechnology: Genome imprint, Dynamic genome engineering and cell molecular memory. Plant, animal cell and Tissue culture methods.

Biosensors: Genetically Modified Organism - Market potential, Diet, Leash, Potato, Rice BT.

Recommended Books

1. Genes and Probes, A Practical Approach Series (1995) by Hames and SJ Higgins; Oxford Univ. Press.
2. Gel Electrophoresis of Nucleic Acids, A practical Approach (1990) by D Rickwood and BD Hames. Oxford Univ. Press.

BCH402: RESEARCH METHODOLOGY AND BIOINFORMATICS

Unit I

Research Methodology: Meaning and scope, steps of Research, Article and thesis writing. Funding agencies, Project proposal preparation, Preparation of proposal, Experimental design and implementation of project, submission of progress report (year wise), statement of expenditure (SE), Utilization certificate (UC). Research ethics, Plagiarism.

Introduction of computation: Computers components, storage devices, graphic devices, concepts of hardware and software, methods and types of networks. Basics of operating systems and types python, cython, Information and Communication Technology (ICT), online methods of teaching (MOOCS).

Unit II

Bio-Statistics: Data - Data types, collection of data, classification, tabulation and interpretation. Measures of central tendencies. Mean, median and mode. Measures of variation - Range, quartile deviation, mean deviation and standard deviation. Coefficient of variation.

Probability. Addition and multiplication theories, conditional probability and probability distributors. Binomial, poisson and normal distribution. Correlation and linear regression. Regression: Regression coefficients and properties. Small sample tests- t, F and chi square tests. ANOVA - one way and two way classifications.

Unit III

Bio-Informatics-I: Origin of bioinformatics biological data (genome projects), Disciplines of bioinformatics, transcriptomics, functional genomics, structural genomics, metabolomics, pharmaco- genomics, structure prediction, drug design and Microarrays.

Genome projects - General introduction to genome projects (rice and Mycobacterium tuberculosis genome project). Special emphasis on Human Genome Project (HGP). Science behind HGP, benefits of HGP, ELSI of HGP in use of genetic information, genetic testing standard, quality and commercialization.

Biological database - Introduction of database (DB), need, organization, search of DB. An over view of biological databases - NCBI, EMBL, DDBJ, SWISS-PROT, PDB, KEGG. Decoding of the genome (Nathan blow study), Ribosomal bar codes, Molecular signatures.

Unit IV

Bio-Informatics-II Sequence alignment - Introduction, significance of sequence alignments and use of dot matrices. Pair wise and multiple sequence alignment (MSA) using Clustal programs.

Sequence analysis - concepts of sequence analysis and their importance. BLAST and FASTA. Proteomics- Introduction, principle, technique, 2-D data base. Gel analysis, post gel analysis, MALDI- TOF. Significance and applications of proteomics in modern biology.

Recommended Books:

1. Statistical methods. S.P.Gupta
2. Fundamentals of mathematical statistics. S.C Gupta & Kapoor
3. Statistical methods in biological and Health Science. J. S. Milton & J.O.Tsokan.
4. Primrose SB. Principles of Genome Analysis: a guide to mapping and sequencing DNA from different organisms. 2nd Ed. 1998. Blackwell Science: Oxford. ISBN0-632-04983-9.
5. Genome Mapping: A practical approach. Dear P (Editor). 1st Ed. 2000. Oxford University Press.
6. Developing Bioinformatics Skills. Alfonso Valencia and Blaschke. L (2005) Oreilles Publication.
7. Bioinformatics sequence, structure and data banks ed. By Des Higgins Willie Taylor (2006).
8. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins" (Andreas D. Baxevanis, B. F. Ouellette), Paperback, 2nd ed., 470 pp., ISBN: 0471383910, Publisher: Wiley, John & Sons, Inc.,Pub.

9. David W. Mount, *Bioinformatics: Sequence and Genome Analysis*, 2nd edition, Cold Spring Harbor Laboratory, 2004, ISBN 0-87969-687-7.
10. *Introduction to Bioinformatics* by T.K. Altwood and D.J. Parry-Smith (Pearson Education Asia 1999).

BCH 403P: IMMUNOLOGY AND HAEMATOLOGY PRACTICALS

1. RBCcount.
2. Total WBC count.
3. WBC Differential count.
4. Erythrocyte Sedimentation Rate (ESR).
5. Packed Cell Volume (PCV).
6. Estimation of Haemoglobin(Hb).
7. Mean Cell Haemoglobin and Mean Cell RBC volume.
8. Colour Index and Volume Index of RBC.
9. Osmotic fragility of RBC.
10. Raising of antibodies to soluble antigen in rabbits.
11. Immunodiffusion.
12. Single Radial Immunodiffusion.
13. Rocket immune electrophoresis.
14. Cross overImmuno electrophoresis.
15. Graber and WilliamsImmuno electrophoresis.
16. Detection of HCG by latex agglutination inhibition test.
17. Haemeagglutination tests for identification of human blood groups.
18. Detection by viral fever by slide agglutination tests.

Recommended Books:

- 1) Hawk's Physiological chemistry.
- 2) Practical Biochemistry by TPlummer.
- 3) Practical Biochemistry by JJayaraman.
- 4) Klemir and others: practical Biological chemistry.
- 5) Practical Biochemistry – Koch and Hank Dunn and Drell.
- 6) Practical Biochemistry-Sawhney(2000)
- 7) Varley's Practical clinical Biochemistry – Ed. Alan W. Gowenlock (Heinemann, London, 1988).

BCH 404P: PROJECT WORK (100 MARKS)

Marks allotted to thesis preparation-80 (40 marks for the progress performed by the student in laboratory will be awarded by project research supervisor and another 40 marks for content of the thesis). Marks allotted to viva presentation-20

BCH 405a: GENERIC ELECTIVE: DEVELOPMENTAL BIOLOGY

Unit I

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients.

Cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

Unit II

Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants.

Zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Unit III

Morphogenesis and organogenesis in animals: Cell aggregation and differentiation *Drosophila*, amphibian and chick.

Organogenesis 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: Plant tissue culture, Micro propagation, Somatic cell culture, Soma clonal variations.

Somatic cell hybridization, Protoplast fusion, shoot and root development. Production of transgenic plants. *Arabidopsis* and *Antirrhinum*

Recommended Books:

- 1) Molecular Biology of the cells by Alberts *et al* (1994).
- 2) Cell and Molecular Biology (2001) by EDP de Robertis and EMF de Robertis.
- 3) Text Book OF medical physiology by A.C.Guyton (2001).
- 4) Cell and Molecular Biology 2nd Edit. (2002) By P.K.Gupta, Rastogi Publ

BCH 405b: GENERIC ELECTIVE: APPLIED BIOCHEMISTRY

Unit I

Fermentation Technology: Batch, continuous culture techniques, principle types of fermentors. Industrial production of chemicals- alcohol, acids (citric, lactic and acetic acids), solvents (acetone and butanol). *Antibiotics* (penicillin and streptomycin), Vitamins (Riboflavin and Vitamin B12), amino acids (lysine and glutamic acid), Single Cell Protein (SCP) and Biopesticides (Toxins of *Bacillus thuringensis* and its mode of action).

Unit II

Enzyme Technology: Immobilization of enzymes and cells, different methods. Industrial applications (Production of glucose from starch, Use of glucose isomerase in confectionary industry, Use of lactase in Dairy Industry, Production of invert sugar from sucrose, Use of protease in food, detergent and leather Industries, Medical applications of enzymes). Low calorie sweeteners.

Unit III

Immunotechnology: Hybridoma technique, monoclonal antibodies production, myeloma cell lines, fusion of myeloma cells, selection of hybridomas, protoplast fusion and HAT medium. Screening, purification and application (biochemical research, clinical diagnosis and treatment) of monoclonal antibodies.

Subunit vaccines-against Herpes Simplex virus. Foot and Mouth disease, Live recombinant vaccines- attenuated (Cholera, Salmonella), Vector vaccines directed against viruses and bacteria.

Unit IV

Applications of genetic engineering in biotechnology: Genome imprint, Dynamic genome engineering and cell molecular memory. Biosensors:

Genetically Modified Organisms - Market potential, Diet, Leash, Potato, Rice BT. Intellectual property rights (IPRs).

Recommended Books:

1. Fermentation Technology (2nded.) Standury (Pergmanpress)
2. Biotechnology: Textbook of Industrial microbiology 2nd Edit. By Crueger and Crueger (2000).
3. Principles of Gene manipulation: An Introduction to genetic Engineering (5th). R.V.Old and S. B. Primrose (Blackwell Scientific Publications).
4. Principles of Biotechnology (1985) Alen Weisman (Surrey UniversityPress).
5. Concepts in Biotechnology (1996) Ed., D.Balasubramaian, K.Dharmalingam, J.Green and K.Jayaraman.
6. Industrial Microbiology, Miller and Litsky, McGraw- Hill, 1976.
7. Industrial Microbiology, L.E.Casida, JR. New Age International (1995).
8. Industrial Microbiology (Prescott & Dunn), Ed by G.Reed, CBS Publishers.
9. Immobilized enzymes (1978) by Ichiro Chibata, Halsted PressBook.

BCH 406a: OPEN ELECTIVE: RESEARCH METHODOLOGY

Unit I

Technical writing: Sentence writing, paragraph writing, story writing, review writing, various types of letters writing, critical comments writing. Project proposal preparation: Preparation of informal proposal, modified proposal and formal proposal.

Experimental design and Collection of results, submission of progress report (year wise) and submission of technical report (Format: Title page, Introduction, Aims of the proposal/research, methodology, results, references, acknowledgments, budgetary preparation). Submission of final technical Report. Patenting and intellectual property rights.

Unit II

Introduction of computation: Computers components, storage devices, graphic devises, concepts of hardware and software, methods and types of networks.

Basics of operating systems and types python, cython, Information and communication technology (ICT).

Unit III

Bio-Statistics: Data - Data types, collection of data, classification and tabulation. Measures of central tendencies. Mean, median and mode. Measures of variation - Range, quartile deviation, mean deviation and standard deviation. Coefficient of variation.

Probability. Addition and multiplication theories, conditional probability and probability distributors. Binomial, poisson and normal distribution. Correlation and linear regression.

Regression: Regression coefficients and properties. Small sample tests- t, F and chi square tests. ANOVA - one way and two way classifications.

Unit IV

Research Aptitude: Meaning and scope of research, steps of Research, Article and thesis writing. Funding agencies.

Project proposal preparation, Preparation of proposal, Experimental design and implementation of project, submission of progress report (year wise), statement of expenditure (SE), Utilization certificate (UC).Research ethics, Plagiarism.

Recommended Books:

1. Statistical methods. S.P.Gupta
2. Fundamentals of mathematical statistics. S.C Gupta & Kapoor
3. Statistical methods in biological and Health Science. J. S. Milton & J.O.Tsokan.

BCH 406b: OPEN ELECTIVE: NUTRITIONAL BIOCHEMISTRY

Unit-I

Body weight and the body composition. Determination of body fat and body water. Body composition during growth and energy requirements.

Measurement of energy expenditure, direct and indirect calorimetry, Respiratory quotient and BMR. Protein nutrition.

Unit-II

Essential and non-essential amino acids. Nitrogen balance, methods of calculation of biological value of proteins protein calorie deficiency. Kwashiorkor and Marasmus.

Fats as component of diet, Energy value of fats. Essential fatty acids and phospholipids in nutrition.

Unit-III

Requirement of fat-soluble and water-soluble vitamins and their deficiency symptoms, sources of the vitamins.

Macro and trace elements in nutrition as regards to dietary sources. Deficiency symptoms and recommended dietary allowances.

Unit-IV

Special aspects of Nutrition for the infants, children, pregnant and lactating woman and in old age, Importance of Nutrition under stress conditions.

Community Nutrition and Health: Assessment of Nutritional status of community. Anthropometric measurements, clinical examination. Radiological, Biophysical and Biochemical techniques.

MOOCS (UGC) to be approved by DDC.

Note:

- 1) Open elective will be selected by our students from other department course syllabus depending on their interest.
- 2) Open electives offered by Biochemistry Department will be for students of life sciences other than Biochemistry.

MSc Biochemistry :: Model Question paper

Semester I/II/III/IV Title of the Paper

Time3Hrs
marks: 80

Max

Attempt any **FOUR** from part A (5 x 4=20 marks) and all from part B (4 x 15=60 marks)

SECTION A (5 x 4=20 marks)

1. Unit 1
2. Unit 1
3. Unit 2
4. Unit 2
5. Unit 3
6. Unit 3
7. Unit 4
8. Unit 4

SECTION-B (4X 15= 60 MARKS)

9. Unit 1 a or b
10. Unit 2 a or b
11. Unit 3 a or b
12. Unit 4 a or b