

No	Code	Paper	No. of Hrs/week	Credit	Marks		
					Int	Ext	Total
<b>Semester I</b>							
1	BCH 1C01	Analytical Biochemistry & Bio analytical Techniques	5	5	20	80	100
2	BCH 1C02	Structural Biology, Bioinformatics and Biostatistics	5	5	20	80	100
3	BCH 1C03	Microbiology and Immunology	5	4	20	80	100
4	BCH 1L01	Practical I (BCH 1C01 & BCH 1C02)	5	4	20	80	100
5	BCH 1L02	Practical II (BCH 1C03)	5	4	20	80	100
<b>Semester II</b>							
6	BCH 2C01	Enzymology	5	5	20	80	100
7	BCH 2C02	Plant Biochemistry	5	5	20	80	100
8	BCH 2C03	Cell Biology and Molecular Biology	5	5	20	80	100
9	BCH 2L01	Practical III (BCH 2C01)	5	4	20	80	100
10	BCH 2L02	Practical IV (BCH 2C02, BCH 2C03)	5	4	20	80	100
<b>Semester III</b>							
11	BCH 3C01	Metabolic regulation and Bioenergetics	5	5	20	80	100
12	BCH 3C02	Physiology and Endocrinology	5	5	20	80	100
13	BCH 3C03	Genetics, r DNA technology and IPR	5	5	20	80	100
14	BCH 3L01	Practical V (BCH 3C01, BCH 3C02)	5	4	20	80	100
<b><u>(Any two of the following courses)</u></b>							
15	BCH 3E01	Neurobiochemistry	4	3	20	80	100
16	BCH 3E02	Protein Chemistry	4	3	20	80	100
17	BCH 3E03	Clinical and Nutritional Biochemistry	4	3	20	80	100
18	BCH 3E04	Cell culture Techniques	4	3	20	80	100
<b>Semester IV</b>							
<b><u>(Any two of the following courses)</u></b>							
19	BCH 4E01	Biochemical Toxicology	4	3	20	80	100
20	BCH 4E02	Drug Biochemistry	4	3	20	80	100
21	BCH 4E03	Cancer Biology	4	3	20	80	100
22	BCH 4E04	Ecology and Evolution	4	3	20	80	100
23	BCH 4P01	Project work / Dissertation	15	6	20	80	100
24	BCH 4V01	Viva voce		2	0	100	100
<b>Total</b>				<b>72</b>	<b>2000</b>		

# **SYLLABUS**

## **SEMESTER I**

### **BCH 1C01 ANALYTICAL BIOCHEMISTRY & BIO ANALYTICAL TECHNIQUES**

#### **Unit I. Basics of Analytical Biochemistry**

Types of samples, sample preparation for solid and semi solid samples. Extraction and derivatization of samples. Quantitative measurement. Calibration, accuracy, precision, and reliability. Error calculation. Quality control. Laboratory automation- planning, example and validation.

#### **Unit II. Science and Research Methodology**

Definition, Theory and concepts of epistemology. Methods of science: scientific method versus arbitrary method. Testability, Repeatability, Verification, Falsifiability. Hypothesis, Experiments, design of experiments, variables. Types of research: descriptive- analytical, fundamental- applied, qualitative- quantitative, conceptual- empirical. Data collection: types of data (categorical, nominal or ordinal, continuous or mixed, primary data, secondary data). Analysis of data. Validation. Writing report. Presentation of data. Data management system. Plagiarism. Bibliography.

#### **Unit III. Bioanalytical Techniques**

Hydrodynamic techniques: chromatographic techniques- principles- adsorption, partition, ion exchange, affinity and gel filtration. Instrumentation, method and application of different techniques- HPLC, GC, HPTLC. Centrifugation: Principles and applications of centrifugation; Different Centrifugation techniques. Types of centrifuges.

Electroanalytical techniques: Free Flow Electrophoresis and Zone Electrophoresis –Paper, Gel (AGE, SDS-PAGE, 2D Electrophoresis). Capillary Electrophoresis. Blotting Techniques- Northern Blotting, Western Blotting and Southern Blotting.

#### **Unit IV. Spectroscopic techniques**

NMR, X-Ray Diffraction, Polarimetry, Atomic absorption and Emission spectroscopy, Fluorimetry. Flame Photometry. ORD and CD, Electron –spray. Electron Spin Resonance(ESR) Spectroscopy, Flow Cytometry, Refractometry, FISH, Rotary evaporator. Surface Plasmon resonance. Mass spectroscopy, MALDI TOF MS.

#### **Unit V. Analysis of clinical samples**

Methods for collection and preservation of samples. Instruments used in an automated Biochemistry laboratory. Auto-Analyzers, spectrophotometer, colorimeter, hematology counter, Blood gas analyzers, ELISA reader

### **Unit VI. Isotope techniques**

Nature of radioactivity- Ionising and non ionising radiation. Properties of  $\alpha$ ,  $\beta$ ,  $\gamma$  rays. Measurement of radioactivity, Radiation units, Principles and applications of tracer techniques in Biology. Applications of Radioactive isotopes in biological research. Autoradiography and its applications, Radioimmunoassay. Dosimetry.

### **References**

1. Gowenlock Alan H, Varley's, Practical Clinical Biochemistry, C B S publications.
2. Keith Wilson & John Walker, Principles and Techniques of Biochemistry & Molecular biology Cambridge Press
3. Plummer David T, An introduction to practical Biochemistry, Tata Mac Graw Hill
4. SK Sawhney, R. Singh, Introductory Practical Biochemistry, Narosa publishing house.
5. James P. Allen, biophysical chemistry, wiley Blackwell publications
6. VasanthaPattabhi, N. Gautham, Biophysics, Kluwer Academic Publications, ISBN: 0-306-47520-0
7. Rodney F Boyer, Modern Experimental Biochemistry, Benjamin/ Cummings publishing company Inc.Redwoodcity, California.
8. Avinashupadhyay, kakoliupadhyay and nirmalenduNath, biophysical chemistry, Himalaya publishing house.
9. Panneerselvam R (2004) Research Methodology, Prentice Hall of India, New Delhi.
10. C.R. Kothari, Research Methodology: methods and techniques, 2<sup>nd</sup> revised edition, new age international publications, ISBN: 978-81-224-2488-1
11. Geoffrey Marczyk, David De Matteo, David Festinger, Essentials Of Research Design And Methodology, Wiley publications.
12. Day RA (1992) How to write and publish a scientific paper, Cambridge University Press, London
13. Bordens K and Abbott B (2005) Research designs and methods: A process approaches (6thEd). Columbus, OH: McGraw-Hill Higher Education. ISBN: 978-0-0728-8764-8

# **BCH 1C02 STRUCTURAL BIOLOGY, BIOINFORMATICS AND BIOSTATISTICS**

## **Unit I. Structural Biology of Proteins**

Structural organization in proteins – Ramachandran map and protein conformation. Role Of individual amino acids in protein structure; amino acid propensities, structure prediction Methods.protein folding energetics. Protein engineering. Structure, conformation and properties of polysaccharides.

## **Unit II. Structural Biology of Nucleic Acids**

Structure and conformation Of nucleic acids-dna and rna; different forms of DNA-A, B and Z types; physical properties of DNA (conformational variants). Introduction to circular DNA, supercoiling, helix to random coil transition – denaturation of nucleic acids, hyper chromic effect, T<sub>m</sub>-values , cot curves and their significance.structure, properties And functions of different forms of RNAs. 3-d structure of tRNA.Organization of chromatin Structure. Protein DNA interaction-helix turn helix, helix loop helix, zinc fingers, homeo box. Protein RNA interaction-RNA recognition motif Protein-protein interaction-leucine zippers, bHLH, bZip motifs. Crystallization Techniques for biomolecules, crystallography.

## **Unit III. Bioinformatics**

Introduction to bioinformatics, data mining, application of data mining in Bioinformatics, Biological databases and search tools, data organization, sequence databases, structural data bases, derived and specialized data bases, DNA and RNA sequence databases, protein sequence databases, genomic databases, mutation and polymorphism databases, data deposition. Three dimensional structure of proteins, prediction of structural classes, motifs, folds and domains, classification of three dimensional structures in Brookhaven protein data bank (HSSP, SCOP, FSSP, CATH); protein structure prediction, structural alignment methods, homology modelling, dynamical programming, molecular simulation, rational drug design and docking, Applications of bioinformatics.

## **Unit IV. Biostatistics**

Principles and practice of statistical methods in biological research. Basic statistics averages, statistics of dispersion, coefficient of variations, standard deviation, standard error, probability, distributions, tests of statistical significance, Students T-test, hypothesis testing, levels of

significance, Chi-square test and goodness of fit, basics of correlation and regression, analysis of variance, use of statistical softwares, Excel, SPSS, Anova.

### **References**

1. Creighton Thomas E, Proteins: Structures and molecular properties, W H Freeman &Co New York
2. Lehninger Albert, Biochemistry, Kalyani publications, N. Delhi
3. Donald T Haynie, Biological thermodynamics, Cambridge university press
4. Keith Wilson & John Walker, Principles and Techniques of Biochemistry & Molecular biology Cambridge Press
5. W W Daniel John, Biostatistics a foundation for analysis in the health, ( 7th ed 1999) Wley and Sons Inc., Newyork
6. Standard Methods of Biochemical Analysis, S.K.Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067-5, P12-18.
7. Experimental Biochemistry, A Student companion, BeeduSasidharRao and Vijay Deshpande(ed), I.K.InternationalPvt.Ltd, NewDelhi, ISBN 81-88237-41-8, PB13-17, P 49-72.
8. Practical Biochemistry, R.C.GuptaS.Bhargava(eds) CBS Publishers and Distribuors, New Delhi ISBN 81-239-0124-0 P9-27
9. Basic bioinformatics, S. Ignachimuthu, SJNarosa Publishing House
10. Introduction to Bioinformatics, Arthur M Lesk, Oxford.
11. Bioinformatics sequence, structure and database; Des Higin, willie Taylor.
12. Introduction to Bioinformatics; V Kothekur DHRUV Publications.

## **BCH1C03 MICROBIOLOGY AND IMMUNOLOGY**

### **Unit I. Microbial classification and Staining**

Prokaryotes and Eukaryotes. Various approaches used in microbial classification. Molecular level approaches used in microbial taxonomy. Structure of virus, bacteriophage, and fungi. Specimen preparation and staining. Simple staining, differential staining and special staining. Microscopy Bright field, dark field, phase contrast and electron microscopy.

### **Unit II. Bacterial Culture**

Cultivation of bacteria; Nutritional types of bacteria; phototrophs, chemotrophs, auxotrophs, and heterotrophs. Chemotaxis, phototaxis and other taxes. Bacterial media, types of media, preparation of media, physical condition required for growth- temperature, pH, gaseous requirement etc. Growth curve. Culture methods- anaerobic culture method, method of isolating

pure cultures. Preservation techniques of bacterial culture. Brief account of viral and fungal cultivation. Sterilization and disinfection: physical and chemical agents. Testing of disinfectants. Rideal Walker coefficient.

### **Unit III . Microbial genetics and techniques**

Microbial genetics; Spontaneous and induced mutation, UV damage and repair, replica plating, site directed mutagenesis. Transposons. Genetic transfer- bacterial transformation, transduction and conjugation. Virus attack on cells; phage attack on bacteria. Microbiology of water and waste water. Bacteriological techniques for detecting water quality- presumptive test, confirmed and complete test

### **Unit IV. Fundamentals of immunology**

Types of immunity- innate, acquired, passive and active. Physiology of immune response, factors influencing immune response. The complement system- classical, and alternative pathway- biological functions. Antigens and antibody interaction- its biochemistry. Antigen: Types of antigens, Structural aspects of biological antigens. Determinants/epitopes- linear, conformational. Haptens. Immunoglobulins: Structural aspects of immunoglobulin molecules. Classes of Immunoglobulins, distribution and function.

### **Unit V. The Immune System**

Ontogeny/ morphogenesis and physiology of immune system- origin, development, activation and differentiation of B & T cell receptors. Cells of immune system- primary and secondary. Organs of the immune system. Effector mechanisms of immune response- Cell mediated and humoral response. Antigen processing and presentation- MHC molecule: classes and MHC restriction.

### **Unit VI. Clinical Immunology**

Immunology of organ and tissue transplantation- Allograft reaction and GVH reaction, Factors influencing allograft survival. Hypersensitivity reaction: immediate and delayed reactions, Clinical types of hypersensitivity. Immunological tolerance, Immunotherapy, Immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections. Congenital and acquired immunodeficiencies. Immunoprophylaxis: Vaccines- types of vaccines, DNA vaccine.

### **Unit VII. Immunological techniques**

Immunological techniques: Hybridoma technology- Production of Monoclonal Antibody. ELISA, RIA, VDRL, RPR. Agglutination reactions: Types- slide, tube, and plate agglutination, haemagglutination and coagglutination. Precipitation reactions: types- ring test, immunodiffusion (ID), RID, IEP, EID and CIEP.

## **Unit VIII. Biosafety and Bioethics**

Introduction to Biosafety, definition, Objectives of safety guidelines, Risk assessment, Assessment of risk during laboratory research, Risk assessment for planned introduction, risk assessment for biotechnology products. Role of Institutional Biosafety Committee, RCGM, GEAC etc. for GM applications in food and agriculture, bio-safety environmental impacts, Introduction to Bioethics, Applications of Bioethics, Ecological ethics, Rights of future generations.

### **References**

1. Pelczar Michael J, Microbiology, McGraw Hill, N.Delhi
2. Reed Gerald, Prescott and Dunn's industrial Microbiology, C B S publications
3. Alcamo Edward, Fundamentals of Microbiology, Jones & Barrett Publications,
4. Anantha Narayanan & Jayaram Panicker, Text Book of Microbiology, Orient Longman
5. Lim Daniel V, Microbiology, West Publishing Co, New York
6. Stainer Roger Y, General Microbiology, Mac Millon, London
7. Tortora Gerard J et al, Microbiology An Introduction, Benjamin Cummings Pub Co
8. Kubly Janis, Immunology, W H Freeman, New York
9. Roitt Ivan et al, Immunology, Mosby, London
10. Abbas Abdul K, Cellular and Molecular Immunology, W B Saunders Co
11. Janeway Charles A and Travers Paul, Immunobiology, Blackwell scientific publications
12. Bioethics: An introduction for the Biosciences by Ben Mepham
13. Bioethics and Biosafety by Satheesh M.K.I.K. International Publishing house, 2008.

### **BCH 1L01 PRACTICAL I**

1. Preparation of Solutions: Percentage solutions, Molar solutions, , Normal solutions , Dilution of Stock solutions
2. Preparation of buffers using pH meter.
3. Quantitative estimation of proteins – Comparative evaluation by Lowry *et al* method, Bradford method, Biuret method and spectrophotometric method.
4. Quantitative estimation of reducing sugar
5. Quantitative estimation of cholesterol.
6. Estimation of muscle and liver glycogen.
7. Extraction and estimation of starch

8. Qualitative analysis of Carbohydrate mixtures (a combination of polysaccharide, disaccharide and monosaccharide) following systematic analysis. General reactions of amino acids, proteins and lipids.
9. Iodine value and saponification value of oils
10. Detection of abnormal constituents in urine sample
11. Assay of serum AST and ALT
12. Estimation of Serum bilirubin, creatinine and calcium
13. Paper Chromatography of sugars
14. TLC of amino acids
15. Column chromatography of plant pigments and analysis of the spectra of different fractions.
16. Polyacrylamide gel electrophoresis of proteins

### **Bioinformatics**

1. Using Swiss-Prot, GenBank and PDB
2. Similarity search - BLAST
3. Multiple Sequence Alignment - CLUSTAL W
4. Secondary Structure Prediction of Protein
5. Protein/Nucleotide Sequence Analysis using EMBOSS
6. Molecular Visualisation of Protein- RASMOL
7. Biostatistics problems

### **BCH 1L02 PRACTICAL II**

1. Staining techniques:
  - a. Gram's staining
  - b. Acid fast staining
  - c. Capsule staining
  - d. Endospore staining
  - e. Negative staining
  - f. Fungal staining
2. IMVIC tests
3. Fermentation of carbohydrates
4. Analysis of water quality- MPN test
5. Antibiotic sensitivity test



6. Production of microbial enzymes- amylase, cellulase, lipase and pectinolytic enzymes
7. Widal test
8. VDRL test
9. RPR test
10. ELISA
11. Immunodiffusion method
12. Immunoelectrophoresis
13. Complement fixation
14. Testing of motility

## **SEMESTER II**

### **BCH 2C01 ENZYMOLOGY**

#### **Unit I. Enzymes: Activity and Kinetics**

General properties of enzymes, Importance of enzymes in biological systems, Intracellular and extra cellular enzymes; soluble and membrane bound enzymes. Classification, naming and E.C numbering of enzymes. Co-enzymes – chemical structures and specific functions. Enzyme specificity, Structure of active site, Transition state and energy of activation, Transition state stabilization-mechanism, Derivation of Michaelis – Menten equation; Different plots for the determination of  $K_m$  &  $V_{max}$  and their physiological significance. Importance of  $K_{cat}/K_m$ . Kinetics of zero & first order reactions. In vitro measurement of enzyme activity- factors affecting enzyme activity. Classification of multi substrate reactions with examples of each class. Random, ordered and Ping-Pong mechanisms. Reversible and irreversible inhibition. Competitive and non-competitive and uncompetitive inhibition. linear, mixed type inhibitions and their kinetics, Inhibitor constant ( $K_I$ ) and its determination.

#### **Unit II. Mechanisms of Enzyme action and Regulation**

Active site mapping, Mechanism of Enzyme action: Acid-base catalysis, covalent catalysis, proximity, orientation effect. Strain & distortion theory. Chemical modification of active site groups. Structure and mechanisms of Trypsin, chymotrypsin, ribonuclease and lysozyme. Experimental approaches to the determination of enzyme mechanisms. Regulation of enzyme activity – reversible and irreversible, covalent modification, cyclic cascades, allosteric regulation, sequential and concerted models of allosteric regulation, Half site reactivity.

#### **Unit III. Multienzyme complexes and Applications of Enzymes**

Multienzyme systems: Pyruvate dehydrogenase complex and fatty acid synthase complex-their occurrence, properties, mechanism and regulation, Isoenzymes - properties and significance. Lactate dehydrogenase, Designer enzymes: Ribozymes and Abzymes – structure, properties

and functions. Microbial enzymes- amylases, lipases and proteases. Enzyme immobilization techniques. Different procedures for immobilization. Applications of immobilized enzymes. Therapeutic enzymes and diagnostic enzymes-examples and applications. Industrial enzymes-examples and applications, Enzyme engineering: modifying enzymes for stabilization. Applications of enzymes in genetic engineering and biotechnology: Taq Polymerase, reverse transcriptases, restriction endonucleases and ligases. – their applications.

#### **Unit IV. Purification of enzymes from natural sources and measurement of enzyme activity**

Extraction and purification of enzymes from different sources – plant, animal and microbial. Composition of extraction media. Cell disruption and homogenization techniques. Steps in purification- salt fractionation, dialysis, chromatography (molecular sieving, ion exchange, adsorption, affinity). Test of purity. Specific activity determination and enrichment. Enzyme localization. Measurement of enzyme activity: direct and indirect methods.

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#### **References**

1. Price Nicholas C, Fundamentals of Enzymology, Oxford city press, New York
2. Voet Donald & Voet Judith, Biochemistry, John Wiley sons, US
3. Dixon & Webb, Enzymes, Academic press
4. Palmer Trevor, Enzymes: Biochemistry, Biotechnology and Clinical chemistry, Horwood Publishing, Chichester
5. Conn E E , Stump P K Bruening G and Doi R H Outlines of Biochemistry, 5 th Ed, John Wiley & Sons, New York
6. Creighton Thomas E, Proteins: Structures and molecular properties, W H Freeman &Co New York
7. Lehninger's Principles of Biochemistry, 4th ed, Nelson Cox, McMillan Worth.
8. Biochemistry by Stryer. 6 edn., W. H. Freeman and company ltd, U.S.A
9. Enzyme Kinetics: Catalysis & Control A Reference of Theory and Best-Practice Methods , Daniel L. Purich , Academic press.
10. The Enzymes kinetics and mechanism volume II Third Edition Edited by Paul D. Boyer academic press, New York and London 1970
11. Methods in Enzymology, Relevant volumes.

## **BCH 2C02 PLANT BIOCHEMISTRY**

### **Unit I**

**Photosynthesis** –structure, organization and composition of chloroplast membrane. Different photo systems; Light and dark reactions. Photosynthesis in C-4 plants. CAM plants, C-2 and C-3 pathways. Photorespiration and compensation point. Biochemistry of Rubisco and its activation.

### **Unit II**

Sensory photobiology: Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks. Stress response in plants- biotic and abiotic stress,-to temperature, draught, salinity and heavy metals. Acclimatization

### **Unit III**

Plant hormones and growth regulators –chemistry and functions. Plant Defense mechanisms; Phytoalexins – chemistry and functions. Plant toxins

Biochemistry of leaf senescence and abscission ; Biochemistry of fruit ripening. Biochemistry of seed germination and dormancy. Biochemistry of nitrogen fixation –Nitrogenase enzyme – structure and functions. Nif genes, Ammonium assimilation enzymes: glutamine synthetase, glutamate synthase and GDH, Water and mineral balance in plants.

### **Unit IV**

Secondary plant products: major chemical classes of secondary metabolites. Role of secondary metabolites in plants. Biosynthesis, chemistry and functions; **Nitrogen containing compounds**: Alkaloids and its major classes with example -caffeine, theophylline , nicotine and caryophyllin, steroid alkaloids. Non protein amino acids, Amines and Cyanogenic glycosides. **Terpenoids** :isoprene rule, mono, di, sesqui, tri, tetraterpenes and poly terpenes with example, important members and their functions. **Phenols**: simple phenols, phenolic acids, phenyl propane, coumarins, phenolic glycosides, flavonoids, lignins and tannins.

### **Unit V**

Importance of secondary metabolites: uses of secondary metabolites To the producer plants; protection of the plants from predators. To man; as biologically active compounds in mammalian metabolism, as drugs, as precursors of drug in pharmaceuticals, as natural pesticides/ insecticides and other uses. Allelopathy.

### **Unit VI**

Bio-geochemical cycles – carbon cycle; nitrogen cycle, sulphur cycle, phosphorus cycle. Bioremediation and phytoremediation. Xenobiotic metabolism: Absorption & distribution. Phase I reactions- Oxidation, Reduction, Hydrolysis and Hydration. Phase II reactions/Conjugation: Methylation, Glutathione, sugar and amino acid conjugations. Phase III reactions/ compartmentation: secondary conjugation, vacuolar sequestration. Detoxification. Biochemical basis of toxicity: Mechanisms of Toxicity.

### **References**

1. Anderson J W and Boardall J, Molecular activities of plant cell; an introduction to the plant biochemistry
2. Bonner J and Varner J E, Plant Biochemistry, Academic Press, New York
3. Buchanan B B and Gruissem W and Jones R L , Molecular biology of plants, Society of American Plant physiologists
4. Hopkins W G , Introduction to plant physiology, John Wiley & Sons, New York
5. Jain, V.K. Fundamentals of plant physiology, revised edition, S. Chand publication
6. Noggle G R and Fritz G J , Introductory Plant Physiology, Prantice Hall of India Pvt Ltd, N. Delhi
7. Pandey, S.N. and Sinha, B.K. plant physiology, 3<sup>rd</sup> edition, vikas publishing house Pvt. Ltd
8. Salisbury F B & Ross C W, Plant Physiology, 4 th Ed Wadsworth Publishing Company, California
9. Taiz L and Zeiger E, Plant Physiology, 2 nd Ed., Sinauer Associates, Inc Publishers, Massachusetts
10. Verma ,V. plant physiology 7<sup>th</sup> revised edition. Emkay publication

### **BCH 2C03 CELL BIOLOGY AND MOLECULAR BIOLOGY**

### **BCH 2L01 PRACTICAL III**

1. Assay of Alkaline and acid phosphatases in serum samples
2. Assay of serum amylase
3. Enzyme assays: Determination of optimum pH, optimum temperature, enzyme proportionality and time proportionality.
4. Ammonium sulfate fractionation of enzyme and desalting by dialysis/Sephadex G-25 filtration
5. Determination of total activity and specific activity of an enzyme.
6. Determination of Michaelis-Menten constant (KM) of an enzyme by Lineweaver-Burk method.
7. Determination of inhibitor constant (KI) of an enzyme by Dixon's method.
8. Extraction of enzymes from animal tissues and isoenzyme analysis by PAGE

### **BCH 2L02 PRACTICAL IV**

#### **PLANT BIOCHEMISTRY**

1. Estimation of ascorbic acid from plant tissues.
2. Extraction and estimation of essential oils.
3. Extraction and estimation of oleoresins.
4. Estimation of dissolved oxygen water
5. Preparation of media and sterilization techniques in tissue culture

#### **MOLECULAR BIOLOGY**

6. Estimation of RNA by colorimetric and spectrophotometric methods.
7. Extraction of DNA and estimation of DNA by colorimetric and spectrophotometric methods.
8. Isolation of RNA from yeast.
9. Agarose gel electrophoresis of DNA
10. Hyperchromic shift on DNA melting

### **SEMESTER III**

#### **BC3C01 METABOLIC REGULATIONS AND BIOENERGETICS**

## **Unit I. Bioenergetics**

Thermodynamics-laws of thermodynamics, enthalpy, entropy, gibbs free energy. high energy phosphate compounds, redox potential, biological oxidation reduction reactions.

## **Unit II. Carbohydrates: metabolism, regulation and disorders**

Regulation of glycolytic pathway (hormonal, allosteric and feedback), homeostasis and metabolic control. Metabolic flux, metabolic control analysis, mechanism of flux control, supply demand analysis. metabolism of sugars other than glucose-fructose, galactose and mannose. Regulation of glycolysis in muscles. Allosteric control of glycogen phosphorylase and glycogen synthase (cyclic and bicyclic cascades), coordinated regulation of glycogen synthesis and breakdown, maintenance of blood glucose level, and its response to stress. Disorders associated with carbohydrate metabolism. Regulation of gluconeogenesis, cori cycle. Biosynthesis of oligosaccharides, glycoprotein synthesis. control of HMP SHUNT, deficiency of G-6-P dehydrogenase.

## **Unit III. Lipid, amino acid, protein, nucleic acid metabolism, regulation and disorders**

Regulation of fatty acid metabolism, formation and utilization of ketone bodies, cholesterol metabolism and regulation, synthesis and breakdown of triacylglycerols-regulation, eicosanoid metabolism- prostaglandin, prostacyclins, thromboxanes, leukotrienes and lipoxins. phospholipid and glycolipid metabolism. Disorders of lipid metabolism.

Protein degradation in cells-lysosomal events, role of ubiquitin and proteasome. regulation of urea cycle, catabolism of amino acids and disorders, biosynthesis of non-essential amino acids, one carbon metabolism associated with amino acid and nucleotide metabolism, uric acid formation and regulation. metabolism of heme, physiologically active amines and nitric oxide.

## **Unit IV. Mitochondrial metabolism, energetics and regulation**

Regulation of TCA cycle, anaplerotic and cataplerotic reactions of TCA intermediates, electron transport chain and oxidative phosphorylation-regulation, structural components, complexes, generation of electrochemical proton gradient: chemi osmosis ATP synthesis: P/O ratio, inhibitor agents and decoupling agents of the respiratory chain and ATP synthesis. Transport process across internal mitochondrial membrane. role of inorganic pyrophosphate in energy metabolism.

## **References**

1. Campbell and Farrel, 2002. biochemistry 4<sup>th</sup>ed. Brooks/cole pub co
2. Lehninger, Principles of biochemistry, fourth edition by david L. Nelson Michael M Cox, 2004. publisher: W.H. Freeman

3. E.S West,W.RTodd,H.S Mason and T.J Van Bruggen ,a textbook of Biochemistry,oxford and IBH publishing co.,newdelhi 1974
4. Biochemistry by Donald voet ,Judith G .voet,1995, publisher:johnwiley \$sons
5. Principles of biochemistry by Geoffrey L Zubay(1995),William W parson ,Dennis E Vance publisher
6. Biochemistry 6 th edition by Jeremy M Berg John L Tymoczko Lubert Stryer publisher (2006):B.I publications pvt ltd.
7. Biochemistry by rastogi(2008) publisher:Mcgraw Hill
8. Devlin Thomas M,textbook of biochemistry with clinical correlations,WileyLiss,newyork
9. Garret Reginald H and Grisham Charles M,Biochemistry,Saunders College Publishing ,Philadelphia
10. Murray,et al.2003,Harpers Biochemistry,26 th ed. McGraw Hill.

## **BC3C01 PHYSIOLOGY AND ENDOCRINOLOGY**

### **Unit 1**

Introduction to Physiology, Scope of Human Physiology, Elementary Tissues, Epithelial Tissue, Connective Tissue, Muscle Tissue, Nervous Tissue.Homeostasis, Blood Buffers, Acid-Base Balance, Hormones.

### **Unit II . Muscle and cardiovascular physiology**

Composition, structure and functions of muscle cells; molecular basis of skeletal, smooth and cardiac muscles; muscle contraction; membrane excitation, neuromuscular junction, rigor mortis. Muscular dystrophy.

Heart anatomy, cardiac muscle, action potential in cardiac muscle, cardiac cycle, heart sounds, conducting mechanism, heart beat and regulation, cardiac output, cardiac cycle, regulatory mechanisms. ECG. Blood pressure, cellular content of blood -erythrocytes, leukocytes, thrombocyte. Hematopoiesis, Coagulation of blood- Clotting factors, Disorders of clotting. Hemoglobin, Blood Groups, Blood Transfusion.Lymph.

### **Unit-III. Renal And Respiratory Physiology**

Kidney.Nephron- Structure and function.Renal circulation, GFR, renal regulation of water and electrolyte balance. Functions of tubules, Nerve supply to urinary bladder.

Organization of respiratory system, respiratory membrane, pulmonary ventilation, pulmonary volumes and capacities, alveolar ventilation, surfactants, exchange of gases ,transport of gases, regulation of respiration, hypoxia, cyanosis, hyper capnia, dyspnea, apnea, periodic breathing,

artificial respiration. Thermoregulation: Comfort zone, body temperature- physical, chemical, neural regulation, acclimatization.

#### **Unit IV**

Salivary gland and Salivary secretion, Composition of saliva, regulation and functions. Gastric and pancreatic secretion. Glomerular filtration. Disease related to digestion and absorption of food. Achlorohydria; ulcers gastritis; H.pylori - induced gastritis.

Structure and function of eye, ear, taste buds and olfactory receptors. Physiology of vision and Mechanism of hearing. Biochemical composition of nerves tissue; mechanism of transmission of nerve impulses. Autonomous nervous system- sympathetic and parasympathetic functions, neurotransmitters.

#### **Unit V. Endocrinology**

Introduction to endocrinology. Hormones and their receptors. Endocrine glands- secretions and functions, pheromones. cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, protein kinases, tyrosine kinases, inositol phosphates, calcium and calmodulin. regulation of signaling pathways, cytoplasmic or nuclear receptors. Bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

#### **Unit VI. Hormones**

Hypothalamus- hormones and its function. Synthesis, Secretion, Mechanism Of Action, And Regulation of Pituitary Gland Hormones, Thyroid Gland and Parathyroid Gland Hormones, Gastric and Pancreatic Hormones, Adrenal Gland Hormones and Gonadal Hormones. Ovarian cycle and pregnancy. Disorders of hormone secretion: Pituitary hormone disorders: gigantism, dwarfism, acromegaly, diabetes insipidus, syndrome of inappropriate ADH secretion. Thyroid H disorders: thyrotoxicosis, goiter, hypothyroidism, Graves' disease, Hashimoto's disease. Adrenal H disorders: Addison's disease, Cushing's syndrome, congenital adrenal hyperplasia, pheochromocytoma.

#### **References**

1. Arthur.C.Guyton&John.E.Hall, Text Book of Medical Physiology, Elsevier, N. Delhi
2. Donald J Voet and Judith Voet, Principles of Biochemistry.
3. Gerard J. Tortora and Bryan Derrickson, Essentials of anatomy and Physiology, 9<sup>th</sup> edition
4. Harold Harper, Review of Physiological chemistry, Marusan Co



5. John.B.West. Physiological basis of Medical Practice.
6. K.Sembulingam&PremaSembulingam, Essentials of Medical Physiology.
7. Murray et al, Harpers Biochemistry
8. Widmaier, Raff, strang, Vander's Human Physiology-The mechanism of Body function.
9. William Ganong, Review of medical physiology, McGraw Hill
10. Larsen et al, Williams Textbook of Endocrinology.
11. Mac Hadley, Endocrinology.
12. Nelson Cox, Principles of Biochemistry.

### **BCH 3C03 GENTICS, RDNA TECHNOLOGY AND IPR**

#### **Unit I**

Genetics: mendels laws of inheritance, extension of mendelian principles-incomplete dominance, co-dominance, gene interactions, sex linkage, pleiotropy, genomic imprinting, phenocopy , penetrance, expressivity, linkage and crossing over. Chromosomal aberrations (ploidy, aneuploidy, duplication, deletion, inversion, translocation).

Inheritance of mitochondrial and chloroplast genes, microbial genetics-gene transfer in bacteria: conjugation , transformation and transduction. gene mapping in haploids and diploids, complementation analysis. Pedigree analysis, QTL mapping.

#### **Unit II**

Recombinant DNA technology: basic principles of rdna technology, restriction endonuclease, cloning vectors; plasmid vector, phage vector cosmids, phasmid vectors, shuttle vectors. high capacity cloning vectors-bacterial artificial chromosome(BAC),phage P, vector PACs(P1 artificial chromosomes),Yeast artificial chromosomes(YAC) and human artificial chromosomes. gene transfer methods-electroporation , lipofection , retroviral infection, embryonic stem cell transfer. cloning methods.

#### **Unit III**

Totipotency.tissue culture techniques and its applications. composition of MS medium.tissue culture techniques in the production of secondary metabolites. antherculture,embryo culture, somatic embryogenesis, somaclonal variations, protoplast fusion, cybrids, cell lines, cell clones.hybridoma technology. transgenic plants and animals. *Agrobacterium tumefaciens* ,Ti

plasmid and its applications, biopesticides and bioinsecticides-*Bacillus thuringiensis* biopharming.

#### **Unit IV**

Transgenic animals, construction of a transgene, knock out animals. Examples of transgenic and knock out animals as model for human diseases.

Production of antibiotics: enzymes, hormones, organic acids, alkaloids, steroids and alcohol, production of biopolymers, single cell protein, importance of spirulina, genetically modified foods.

#### **Unit V**

Environment biotechnology-biodegradation, bioremediation-strategies, limitations, phytoremediation, degradation of pesticides, role of microbes in abatement of pollution-biofilms, biosensors-operation and classification, bioindicators, biofertilizers, biosurfactants.

#### **Unit VI. Intellectual Property Rights (IPR)**

Objectives of the patent system, basic principles and general requirements of patent law, legal development, patentable subjects and protection in biotechnology, international convention for the protection of new varieties Strasbourg convention, UPOV Convention.

The patentability of micro organisms-claims, Characterization and repeatability disposition in the culture collections, legal protection for plants and other higher organisms, new plant varieties by rights, tissue culture protocols, transfer of technology, patentability of inanimate products of nature vectors, FDA, EPA, Patent office practice, trade secrets, copy right infringement problems, harmonization of patent law. IPR and plant genetic resources, GAAT and TRIPS.

#### **References**

1. Lewin Benjamin, Genes, Wiley Eastern Ltd
2. Molecular Biology of gene: Watson Hopkins, Benjamin Cummings
3. Sambrook Joseph & Russell David W, Molecular Cloning- A laboratory Manual, ColdSpringHarbour laboratory press, New York

4. W R Cornish, Intellectual property patents, copy right, trade marks and allied rights, Sweet and Maxwell, London
5. Carlos CM (2000). Intellectual Property Rights, the WTO and Developing countries; The TRIPS agreement and policy options, Zed Books, New York
6. Walter E Hill, Genetic engineering- A primer, Taylor and Francis, London and Newyork
7. Biotechnology: U Sathyanarayana. Books and Allied (p) Ltd.
8. Recombinant DNA: A Short Course. James D. Watson, Gilman Michael, Jan Witkowski, Mark Zoller. Freeman, W. H. & Company.
9. Biotechnology: John E Smith. Cambridge University Press
10. Genetic Engineering: Principles and Practice. Sandhya Mitra. Laxmi Publications.
11. Biotechnology: B D Singh. Kalyani Publishers.
12. Biotechnology: A guide to Genetic Engineering. Pamela Peter. William C Brown Pub.
13. Molecular Biotechnology: S B Primrose. Panima Publishing Corporation.

#### **BCH 3L01 PRACTICAL V**

1. Blood smear preparation,
2. Determination of haemoglobin concentration
3. Enumeration of blood cells:
  - differential WBC count,
  - total WBC count
  - and total RBC count
4. Erythrocyte sedimentation rate (ESR)
5. Analysis of normal and abnormal urine
  
6. Clinical examination of radial pulse
7. Blood pressure measurement
8. Recording of lung volume and lung capacities using students' respirometer
9. Examination of onion root tip cells for different stages of cell division
10. Karyotype preparation

#### **BCH 3E01 NEUROBIOCHEMISTRY**

## **Unit I . Neurons and Nervous System**

A brief study on Neurocellular anatomy, neural membrane, classification of neuron, nerve fibers, axonal transport, neural growth and neuroglia. Nervous system- Role of the Nervous System in Homeostasis: Cellular organization of specific regions such as cerebellum, cerebral cortex, hippocampus and retina. Electrophysiology of Channels: EEG patterns. Chemical Composition of Brain: Formation, structure and biochemistry of myelin. Chemistry, composition, biosynthesis, catabolism and characteristics of major brain lipids, regional variations. BBB –characteristics and morphology. CSF and blood.

## **Unit II . Synaptic transmission and neuronal signaling**

Structure of the synapse, correlation of structure and function at the synapse, transmission across the synapse, pre and post synaptic events, membrane potential in the steady state action, action potential and propagation of nerve impulse.

## **Unit III. Neurotransmitters**

Neurotransmitter: Chemistry, synthesis, storage, release, receptors and function of nervous neurotransmitters, transmitter action, synaptic modulation and mechanism of neuronal integration. Myoneural junction

## **Unit IV. Disorders**

Neurotoxic agents and diseases related to them. Chemistry of neuroleptics and anxiolytics, antidepressants and hallucinogenic agents. Biochemical aspects of muscle disease, muscular dystrophies, myotonic dystrophy, periodic paralysis, glycogen storage diseases affecting muscle functions. Biochemical theories of mental disorders. Neurodegenerative Disorders: Parkinson's, Alzheimer's disease, amyotrophic lateral sclerosis, senile dementia.

## **References**

1. Arthur.C.Guyton&John.E.Hall, Text Book of Medical Physiology, Elsevier, N. Delhi
2. C. U. M. Smith, Elements of Molecular Neurotoxicology
3. Gary G. Matthews, Neurobiology Molecules, Cells and System.
4. George J.Siegel, Bernard W.Agranoff, R. Wayne Albers, Stephen K. Fisher& MichaelD. Uhler, Basic Neurochemistry. Molecular, Cellular and Medical aspects.
5. Gerard J. Tortora and Bryan Derrickson, Essentials of anatomy and Physiology, 9<sup>th</sup> edition
6. Grossman &Neavy, Neuro anatomy.
7. John G. Nicholls, A. Robert Martin, Bruce G.Wallance& Paul A. Fuchs, From Neuron to Brain.

### **Unit I.**

Chemical structures and classifications of amino acids. Chemical properties of amino acids; Amino acid derivatives; Non-protein amino acids. Biological amines and their functions; small peptides and cyclic peptides and their biological functions. Proteins: Different types; classifications, physicochemical properties of proteins

### **Unit II.**

Structural organization of proteins, primary secondary, tertiary and quaternary structures. Protein structure – 3-D conformation of a protein molecule. Protein function in terms of biological processes, molecular function and cellular components. e.g. structural, storage, transport, hormonal, receptor, contractile, defensive, enzymatic

### **Unit III.**

Enzymes, catalytic mechanism, active site, cofactors, coenzymes, measurement of enzyme activity, specific activity, enzyme kinetics, Km value, Line Weaver Burk plot, Enzyme inhibitors, activators, enzyme regulation, allosteric enzymes, enzyme immobilization, ELISA

### **Unit IV.**

Protein sample preparation, Separation of macromolecules (and organelles) in cells by ultra-centrifugation, Chromatography and electrophoresis, Separation techniques – 2-D gel and polyacrylamide gel electrophoresis (PAGE). Protein identification – mass determination and Edman degradation

### **Unit V.**

Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods. Protein data bases.

### **References**

1. Conn E E and Stump P K, Outlines of Biochemistry, Wiley, N. Delhi
2. Creighton Thomas E, Proteins: Structures and molecular properties, W H Freeman & Co New York

3. Garrett Reginald H and Grisham Charles M, Biochemistry, Saunders College Publishing, Philadelphia
4. Keith Wilson & John Walker, Principles and Techniques of Biochemistry & Molecular biology Cambridge Press
5. Lehninger Albert, Biochemistry, Kalyani publications, N. Delhi
6. Plummer David T, An introduction to practical Biochemistry, Tata Mac Graw Hill
7. SK Sawhney, R. Singh, Introductory Practical Biochemistry, Narosa publishing house
8. Stryer Lubert & Hall John E, Biochemistry, Freemann
9. Voet Donald & Voet Judith, Biochemistry, John Wiley sons, US

### **BCH 3E03 CLINICAL AND NUTRITIONAL BIOCHEMISTRY**

#### **Unit I. Disorders of metabolism**

Carbohydrate metabolism: Diabetes mellitus, insulin receptors and C-peptide, assay of insulin. Hemoglobin A1C, fructosamines, insulin tolerance test, Glycogen storage diseases, galactosemia, fructosuria, pentosuria; Disorders of protein metabolism- PEM; Phenylketonurea and alkaptonurea; Tyrosinaemia; MSUD; Cystinurea; methylmalonyl urea. Urea cycle disorders; albinism. plasma lipids and lipoprotein abnormalities: hypercholesterolemia- lipidosis and hypolipoproteinemias, Tay Sachs and Niemann Picks diseases. Disorders of nucleic acid metabolism- hypo and hyperuricemia, gout. Biochemical monitoring of therapy; prenatal diagnosis of inborn errors of metabolism, amniotic fluid and fetal blood examination; Acetylcholinesterase and other tests on amniotic fluid; chromosomal abnormalities by cytogenetics

#### **Unit II. Kidney, liver and gastric function tests**

Renal function tests, osmolarity and free water clearances, acute and chronic renal failure, Liver function tests : clinical features and test based on excretory functions, metabolic capacity of liver, synthetic functions of liver, serum enzymes. Gastric function tests: collection of gastric contents, examination of gastric residium, FTM, stimulation tests, tubeless gastric analysis.

#### **Unit III.**

Cardiac function tests. Gastric function test. Disorders associated with vitamin deficiency. Disorders of mineral metabolism. Disorders of porphyrin and heme metabolism – Porphyrins – different types, Jaundice. Disorders of erythrocyte metabolism- hemoglobinopathies, thalassemias. Disorders of clotting mechanisms – Agranulocytosis;

different types of anemias. Hypertension, Hematuria, thrombocytosis; Hemophilia; sickle cell anemia. Regulation of physiological pH- Different mechanisms. Buffer systems of the body. Muscular dystrophy; hemophilia. Disease related to digestion and absorption of food. Achlorohydria; ulcers gastritis; H. pylori - induced gastritis.

#### **Unit IV.**

Energy content of foods. Measurement of energy expenditure: Direct & indirect calorimetry. Definition of BMR and SDA and factors affecting these. Thermogenic effects of foods. Dietary requirements and sources of available and unavailable carbohydrates. Physicochemical properties and physiological actions of un-available carbohydrates (dietary fibre). Protein reserves of human body. Nitrogen balance studies and factors influencing nitrogen balance. Essential amino acids for man and concept of protein quality. Cereal proteins and their limiting amino acids. Protein requirement at different stages of development. Major classes of dietary lipids. Properties and composition of plasma lipoproteins. Dietary needs of lipids. Essential fatty acids and their physiological functions.

#### **Unit V.**

Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper. Dietary sources, biochemical functions and specific deficiency diseases associated with fat and water-soluble vitamins. Hypervitaminosis symptoms of fat-soluble vitamins. Nutritional requirements during pregnancy, lactation and of infants and children

#### **Unit VI.**

Food processing and loss of nutrients during processing and cooking. Anti-nutrients: Naturally occurring food born toxicants: Protease inhibitors, Hemagglutinins, Hepatotoxins, Allergens, Oxalates, Toxins from Mushrooms, Animal food stuffs and sea foods. Protein energy malnutrition (PEM): aetiology, clinical features, metabolic disorders and management of Marasmus and Kwashiorkor diseases.

#### **References**

1. Clinical Biochemistry: Metabolic And Clinical Aspects by William J. Marshall, Stephan K. Bangert, Elizabeth S.M. Ed. S.M (ed) Marshall (2008) Publisher: Elsevier Science Health Science Div
2. Biochemistry by John K. Joseph (2006) Publisher: Campus Books International
3. Basic Medical Biochemistry: A Clinical Approach by Dawn B PH.D. Marks, Allam D. Marks colleen M. Smith (1996) Publisher; Lippincott Williams & Wilkins; illustrated edition

4. Devlin Thomas M, Text Book of Biochemistry with clinical correlations, Wiley Liss, New York
5. Zubay Geoffrey, Biochemistry, Wm C Brown publishers  
Jayadeep Brothers, N. Delhi
- 6.. Harold Harper, Review of Physiological chemistry, Marusan Co
- 7... Voet Donald & Voet Judith, Biochemistry, John Wiley sons, US
8. Garrett Reginald H and Grisham Charles M, Biochemistry, Saunders College Publishing, Philadelphia
9. Kaplan Lawrence A et al, Clinical Chemistry, Mosby, Missouri
10. Modern Nutrition in Health and Diseases by Whol and Goodhart.
11. Human Nutrition and Dietics – S Davidson and J R Pasmore; ELBS, Zurich.
12. Tietz Fundamentals of Clinical Chemistry by Carl A Burtis & E R Ashwood (eds.) (5th Edn.) Saunders WB Co..

## **BCH 3E04 CELL CULTURE TECHNIQUES**

### **Unit I. Introduction**

Animal cell culture: history, importance and progress in Animal cell culture technology. laboratory setup and equipments, aseptic technique. Cell culture media and supplements- Importance of Serum and Serum Free Media, preparation and sterilization of cell culture media and supplements.

Plant cell culture: Conventional plant breeding, tissue culture as a technique to produce novel plants and hybrids, tissue culture media (composition and preparation), initiation and maintenance of callus and suspension cultures.

### **Unit II. Types of Culture**

Primary culture- Types of primary culture; Chicken embryo fibroblast culture, Chicken liver and kidney culture. Secondary culture; Trypsinization; Cell separation ; Continuous cell lines; Passaging number; Anchorage and Anchorage independent cells and cultures; Suspension culture; Organ culture and Histotypic cultures: tissue specific stem cells; embryonic hematopoietic and neural stem cells, classification and sources

### **Unit III . Techniques**



Measurement of viability and cytotoxicity; characterization of cultured cell; cell cloning and selection; Cell synchronization. Transfection and transformation of cell. Maintenance of cell lines. Cryopreservation and germplasm storage. Common cell culture contaminants.

Plant transformation technology- Basis of tumor formation. Features of Ti and Ri plasmids. Mechanism of DNA transfer. Methods of nuclear transformation; viral vectors and their applications; multiple gene transfer; vector less or direct DNA transfer. Particle bombardment, electroporation, micro injection.

### **Unit VI . Application**

Commercial scale production of animal cells, stem cells & their application; Overview of embryonic and adult stem cells for therapy- Neuro degenerative disease, Tissue system failures (heart, kidney and liver failure). Application of cell culture technology in production of human and animal vaccines and pharmaceutical proteins, Application of animal cell culture for *in vitro* testing of drugs and testing of toxicity of environmental pollutants; Hybridoma technology and its application.

### **References**

1. Animal cell culture-Practical approach 3rd edition, Ed. John R.W Masters, Oxford university press-2000
2. Plant biotechnology-J Hammond, et.al; Springer Verlag.
3. Animal Biotechnology, R. Sasidhara, MJP publishers-Chennai.
4. Biotechnology in crop improvement –H S chawla.
5. Practical application of plant molecular biology-R J Henry, Chapman&Hall.
6. Elements of biotechnology; P K Gupta
7. Principles of plant biotechnology: An introduction to genetic engineering in plants SH Mantell,etal
8. Advances in biochemical engineering/ Biotechnology-Anderson, et.al.
9. Plant cell and tissue culture-S Narayanswamy, Tata Mc
10. Culture of Animal cell, Freshney, 5th edition
11. In vitro cultivation of Animal cells. Elsevier India PVT LTD-17-A/1 Main Ring Road, New Delhi-110024
12. An introduction to plant tissue culture-M K Razdam.
13. Cell culture and somatic cell genetics of plants (Vols.1to3)-A K Vasil, A Press.

## **SEMESTER IV**

## **BCH 4E01 BIOCHEMICAL TOXICOLOGY**

### **Unit I.**

Fundamentals of toxicology and Dose – Response relationship: Synergism and Antagonism, Determination of ED50 & LD50. Acute and Chronic exposures. Criteria of toxicity. Factors influencing Toxicity. Hormesis, hazard and risk assessments. Pharmacodynamics & Chemodynamics.

### **Unit II.**

Factors affecting toxic response: disposition; Absorption, distribution, excretion and metabolism. Types of Metabolic changes: Phase I reactions- Oxidation, Reduction, Hydrolysis and Hydration. Phase II reactions/Conjugation- Methylation, Glutathione and amino acid conjugations. Detoxification. Mechanisms of Toxicity: Disturbance of Excitable membrane function. Altered calcium Homeostasis. Covalent binding to cellular macromolecules & Genotoxicity. Tissue specificity of Toxicity.

### **Unit III.**

Principles & Procedures of testing for acute toxic effects: Regulatory guidelines, Mammalian systems affected & the clinical signs of Systemic Toxicity. Factors affecting acute Toxicity studies. Toxicity testing: Test Protocol, Genetic toxicity testing & Mutagenesis assays: In vitro Test systems – Bacterial Mutation Tests: Reversion Test, Fluctuation Tests and Eukaryotic Mutation Tests. In vivo Mammalian Mutation tests – Host mediated assay & Dominant Lethal Test. Use of Drosophila in Toxicity testing. DNA repair assays. Chromosome damage test. Toxicological evaluation of Recombinant DNA derived proteins.

### **Unit IV.**

Toxic Responses to Foreign Compounds: Direct Toxic Action: Tissue Lesions. Mechanism and response in cellular toxicity. Pharmacological, physiological and Biochemical effects; Developmental Toxicology- Teratogenesis. Immunotoxicity, Genetic Toxicity. Diagnosis of toxic changes in liver and kidneys: Metabolism of Haloalkanes, Haloalkenes & Paracetamol with their toxic effects on tissues.

### **Unit V.**

Food toxicology: Role of diet in cardio-vascular diseases and cancer. Toxicology of food additives. Metal toxicity: Toxicology of Arsenic, mercury, lead and cadmium. Environmental factors affecting metal toxicity – effect of light, temperature & PH. Chemical Carcinogenesis.

### **Unit VI.**

Biochemical Mechanisms of Toxicity:Tissue Lesions: Liver Necrosis; kidney Damage; Lung Damage, Liver damage, Cardiac damage; Neurotoxicity.Exaggerated and Unwanted pharmacological effects.Physiological effects. Biochemical Effects: Lethal Synthesis and Incorporation, Interaction with specific Protein Receptors. Teratogenesis.Immunotoxicity.Multi-Organ Toxicity.

### **References**

1. Principles of Biochemical Toxicology by John A. Timbrell, 4<sup>th</sup> edition, Informa Healthcare publications, 2009
2. Environmental Toxicology by Sigmund F. Zakrzewski, Oxford University Press, USA, 2002
3. Principles Of Toxicology by: Karen E Stine, Thomas M Brow, Crc press publications, 2006
4. A Textbook of Modern Toxicology, edited by Ernest Hodgson , 4th Edition, Wiley publications
5. General and Applied Toxicology by Marrs and Turner, Macmillan Press Ltd.
6. Basic Environmental Toxicology by Lorris G. Corkerthm and Barbara S S Shane CRP Press Inc.
7. Introduction to Food Technology by TakayurkiShibamoto& Leonard F. Bzeldanes.
8. Molecular Biotechnology by Barnard R Glick & J JPastmak.

## **BCH 4E02 DRUG BIOCHEMISTRY**

### **Unit I. Introduction and Receptor Concept**

Introduction to drugs: Classification of drugs, Passage of drugs across biological membrane; Absorption and distribution of drugs; Binding of drugs to plasma proteins. Concept of Pro drug and soft drugs.

Drug receptor interaction: Binding forces in drug receptor interaction, types of receptors, receptor theories, drug receptor interaction, elementary treatment of drug interaction.

### **Unit II. Drug Metabolism and Elimination**

Drugs and Xenobiotics. Drug disposition: absorption, distribution, metabolism and elimination. Drug metabolism, methods - microsomal drug metabolism, phase I & phase II reactions: (hydroxylation, oxidation, azo& nitro reduction, deamination, dehalogenation, hydrolysis, and conjugation). Enzyme induction.Consequences of drug metabolism. Tissue and organs involved in drug metabolism. Elimination of drugs through kidney.

### **Unit III. Drug Delivery and Drug Discovery**

Parameters: Therapeutic window- minimum effective concentrations (MEC) or minimum inhibitory concentration (MIC)), minimum toxic concentration (MTC). Therapeutic index (LD 50, ED 50). Drug delivery systems eg; liposomes, antibody conjugation. Controlling drug toxicity. Drug design. Drug discovery: Target selection and validation, Screening of candidate compounds, Computational screening and Phenotypic screening. Mechanism of drug effects.

### **Unit VI . Chemotherapy**

Chemotherapy of infectious diseases: Pathogenic microbes: Diversity and selective toxicity, Membrane active drugs- sulphonamides, paracetamol. Resistance to antimicrobials, Antibacterial chemotherapy - mode of action and resistance to penicillin, streptomycin, tetracycline and chloramphenicol, Chemotherapy of fungal infections, Chemotherapy of parasite infections, Antiviral chemotherapy. **Tumor chemotherapy**- Some principles of tumor biology, Cell-type-specific antitumor drugs, Drugs that target specific oncoproteins. Cytotoxic antitumor drugs. RNA as drugs. Drugs acting on CNS and Cardio-vascular system- mode of action of barbiturates, salicylates. MAO inhibitors

### **Unit V . Related affairs**

Pharmaceutical products: manufacturing, analytical aspects, product registration. WHO - GMP, European DMF, and US PDA regulations, ICH guidelines. Data Documentation and Patenting. Computer Based Data Mining in Drug Research. Pharmaceutical Product Management Aspects.

### **Reference**

1. Biochemical Pharmacology -Michael Palmer, Alice Chan, Thorsten Dieckmann, John Honek, University of Waterloo.
2. Text book of drug design and discovery- PovlKrogsgaard- Larsen, Tommy Liljefors and Ulf Madsen, 3<sup>rd</sup> Edition, Taylor and Francis Publication, London and New York, ISBN 0-203-30137-4
3. Biopharmaceuticals; Biochemistry and Biotechnology- Gary Walsh, Second Edition, Wiley publications.
4. Text book of pharmaceutical chemistry – Mohammed Ali CBS Publishers and Distributors, New Delhi, 1995
5. Pharmacology , An introduction to Drugs, Prentice Hall Inc, Eaglewood Cliif, New Jersey,1994.
6. Pharmaceutical chemistry- G.R. Chatual, Vol II, 1<sup>st</sup>editin, Himalaya Publishing House, Bombay, 1991.

7. Immunology- Roitt Ivann, Jonathan Brastoff and David Male. 1993.
8. Immunology- Janis Kuby, 3<sup>rd</sup> edition.
9. Text book of microbiology- Ananthanarayanan R and Yayaramman Paniker, 1996.
- 10.

## **BCH 4E03 CANCER BIOLOGY**

### **Unit I.**

Oncogenes, tumour suppressor genes, retroviral oncogenes, proto oncogenes. apoptosis - Historical perspectives , biochemical mechanisms of apoptosis, caspases , bcl-2 family , role of mitochondria in apoptosis, Resistance to apoptosis in cancer and potential targets for therapy .

### **Unit II.**

Tumorigenesis. Chemical and physical carcinogenesis – theories of carcinogenesis – transformation of animal cells by tumor viruses – characteristics of transformed cells – virus host interactions – morphological and biochemical studies – oncogenes. DNA Tumor Viruses, SV40 and Polyoma , Papilloma Viruses E6 and E7 , Adenoviruses E1A and E1B , Hepatitis B Virus , Herpes Viruses

### **Unit III.**

Mechanisms of tumor metastases. Metastatic cascade – survival of tumors in blood and Lymphatics – invasion characteristics of cancer causing agents – role of growth factors in Carcinogenesis – tumor markers – collagen – extracellular matrix molecules – proteoglycans and tumor metastasis.

### **Unit IV.**

Tumor immunology . Historical Perspectives, Mechanisms of the Immune Response to Cancer , Danger Theory , Role of Gene Rearrangement in the Tumor Response , Heat Shock Proteins as Regulators of the Immune Response , Inflammation and Cancer , Immunotherapy , Rationale for Immunotherapy , Identification and Characterization of Tumor-Derived Antigenic Peptides , Cytokines , Interferons, Interleukins , Tumor necrosis factor, Adoptive Immunotherapy , Vaccines , Monoclonal Antibodies , How Tumor Cells Avoid the Immune Response

### **Unit V.**

Cancer prevention :molecular mechanisms of aging and its prevention , somatic mutation , telomere loss , mitochondrial damage formation of oxygen-free radicals , cell senescence , DNA repair and genome stability Caloric restriction. Diet and cancer. Chemo prevention , molecular targets for chemoprevention .chemoprevention of cancer through dietary and nutritional agents, Antimutagens and carcinogen-blocking agents isothiocyanates , oltipraz ,

other organosulfur compounds, Anti proliferative agents. Antitumor agents. Antibiotics, toxin immune conjugates and immune modulators,

### **References**

1. cancer biology, fourth edition, raymond w. Ruddon, University of michigan medical school ann arbor, michigan
2. Introduction to the cellular and molecular biology of cancer *margaret a. Knowlespeter j. Selby*. Oxford University Press.
- 3..Maly B.W.J. Virology a practical approach, IRL Press, Oxford
4. Dunmock N.J. and Primrose S.B. Introduction to modern virology, Blackwell Scientific Publications, Oxford
5. Franks W. and Teich N.M. An introduction to cellular and molecular biology of cancer, Oxford Medical Publications
6. The Molecular Biology of Cancer, Stella Pelengaris and Michael Khan *University of Warwick*.

## **BCH 4E04 ECOLOGY AND EVOLUTION**

### **Unit I. Introduction to Ecological Principles**

The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap, Population Ecology: Characteristics of a population; population growth curves; population regulation. 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 II. Ecosystem Ecology and Applied Ecology**

Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India. Applied Ecology: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation, Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

### **Unit III Introduction to Evolution**

Emergence of evolutionary thoughts: Lamarck; Darwin—concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis. Origin of cells and unicellular evolution: 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. Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multicellular organisms; Major groups of plants and animals; Stages in primate evolution

#### **Unit IV Molecular Evolution and Mechanisms**

Concepts of neutral 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, The Mechanisms: 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.

#### **References**

- 1) Basic Ecology: Fundamentals of Ecology – Eugene P. Odum
- 2) Ecology and Environment – PD Sharma
- 3) Ecology: Principles And Applications – JL Chapman and MJ Reiss
- 4) Organic Evolution (Evolutionary Biology) – Veer Bala Rastogi
- 5) Ecology Environmental Science and Conservation by Sp Singh Js Singh
- 6) Strickberger's Evolution by Monroe W. Strickberger
- 8) Evolution by Douglas Futuyma
- 9) Animal Behavior: An Evolutionary Approach by John Alcock