

FIRST SEMESTER

BTPG 01. BIOCHEMISTRY

4hours/week

Credit: 4

Unit I:

Composition; basic structure and function of carbohydrates, Mono, di ,oligosaccharides, Glycosidic bonds; glycoproteins (O- linked and N- linked), glycolipids; Polysaccharides: Classification: Homopolysaccharides (Cellulose, Starch, Chitin, and Glycogen), Heteropolysaccharides, bacterial peptidoglycans, glycosaminoglycans, hyaluronic acid, and heparin and their Structural characteristics and functions, bacterial polysaccharides Purification and Characterization of polysaccharides 16

Unit II:

Glycerophospholipids: Structure and function of (Phosphatic acid, cardiolipin, Phosphatidyl serine, Phosphatidyl ethanolamine, Phosphatidyl glycerol, Phosphatidyl choline, Phosphatidyl inositol), CDP-diacylglycerol, Lung surfactants, Glycosphingolipids: Structure and function of (Sphingosine, ceramides & sphingomyelins, cerebrosides, globosides, gangliosides, sulfatides), Eicosanoids: Prostaglandins, Leukotrienes and Thromboxanes: Chemistry, formation and physiological function. Steroids: Steroids in animal system: Glucocorticoids, mineralocorticoids ,Sterols in Plant system: Phytohormones: Brassinosteroids (functions); Sterols in microbial system 16

Unit III

Fat soluble and water soluble vitamins: structure and function, cofactors and coenzymes: structure and function Coenzymes and their functions - NAD, NADP⁺, FAD, FMN, lipoic acid, TPP, pyridoxal phosphate, biotin and cyanocobalamin. 12

Unit IV

Hormones: Classification; site of formation, target organs; mechanism of action of peptide and steroid hormones :insulin, glucagon, epinephrine, norepinephrin, thyroid hormones, testosterone, estrogen, progesterone, pheromones, hormonal regulation of metabolism by mineralocorticoids. 16

Unit V

Primary, Secondary, Tertiary and Quarternary structure of Proteins Globular protein Hemoglobin and Myoglobin, Fibrous protein: Collagen, Membrane Protein ,ATP synthetase, Protein sequencing, Evolutionary divergence of organisms and its relationship to protein structure and function, protein folding. Nucleic acids- Forms of DNA, Watson Crick pairing, melting of the DNA molecule; structure of tRNA . 16

Reference

1. Lehninger Principles of Biochemistry, Fourth Edition by David L. Nelson Michael M. Cox Publisher: W. H. Freeman; Fourth Edition edition (April 23, 2004) ISBN-10: 0716743396 ISBN-13: 978-0716743392
2. A Text Book of Biochemistry, E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen Oxford and IBH Publishing Co., New Delhi, 1974
3. Biochemistry (2004) by Donald Voet, Judith G. Voet **Publisher:** John Wiley & Sons Inc **ISBN:** 047119350X **ISBN-13:** 9780471193500, 978-0471193500
4. Principles Of Biochemistry (1995) by Geoffrey L Zubay, William W Parson, Dennis E Vance **Publisher:** Mcgraw-hill Book Company – Koga **ISBN:**0697142752 **ISBN-13:** 9780697142757, 978-0697142757
5. Principles Of Biochemistry, 4/e (2006) by Robert Horton H , Laurence A Moran, Gray Scrimgeour K **Publisher:** Pearsarson **ISBN:** 0131977369, **ISBN-13:**9780131977365, 978-0131977365
6. Biochemistry 6th Edition (2007) by Jeremy M. Berg John L. Tymoczko Lubert Stryer **Publisher:** B.i. publications Pvt. Ltd **ISBN:**071676766X **ISBN-13:** 9780716767664, 978-716767664
7. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain and Nitin Jain (2008) Publishers: S. Chand & Co Ltd ISBN: 81-219-245

BTPG02.CELL BIOLOGY AND GENETICS

4hours/week

Credit:4

Unit 1

Membrane proteins, lipids. Fluid mosaic model, membrane fluidity, asymmetry, lipid raft, functions of membrane proteins & lipids. Functions of the memb: delineation and compartmentalization, localization & organization of function, regulation of transport: porins facilitated diffusion, porter molecules; Facilitated transport: symport, antiport, uniport, anion porter, glucose porter; Active transport: proton pumps; Na⁺ K⁺ pumps, Ca²⁺ pumps; Ionic channels: general characteristics of ionic channels, types of ionic channels . 5

Unit 2

ER: Rough and smooth ER, functions, Golgi complex: structure, types, modification of proteins, protein sorting and trafficking, secretory pathways, exo and endocytosis, coated pits and vesicles, Lysosomes and peroxisomes: enzymatic components and functions, Cytoskeleton: Microtubule, assembly and organization, microfilaments: actin structure and assembly, Intermediate filaments, types, filament based movement in muscle, sliding filament model. Mitochondrion: structural features and functions, Chloroplast structural features and functions, photosystems, LHC, rubisco, Cell junctions- tight, gap junctions. 15

Unit 3

Signal

transduction: electrical impulses and their transmission: Structure and electrical properties of neurons, resting potential, action potential, propagation of action potential, voltage gated and ligand gated channels, synaptic transmission ,chemical signals and receptors, second messengers: cAMP, Ca ions, Ras pathway, glycogen breakdown by epinephrine.

Nucleus, structure of chromosomes, chromosome banding, mitosis and meiosis, chromosomal organization Cell cycle: G1, S,G2, M phases, model organisms, MPF, cyclins, checkpoints, Role of Rb & p53. Cell cycle inhibitors 25

Cellular differentiation: maternal, segmentation and homeotic genes,hox genes, gene interactions bicoid- nanos system. Differentiation in plants, floral development-apetalous,

pistillate, agamous interactions. Cell death and cancer: Apoptosis and necrosis, apoptotic pathways, theories on apoptosis, types of tumor, induction of cancer, properties of cancer cells, oncogenes and c onco genes, tumor suppressors, Molecular pathways- PIP3 Akt, MAP kinase. Aging.

Unit 4

Mono, di and trihybrid crosses, dominance, epistasis, pleiotropic interactions, multiple alleles-ABO blood groups, pseudoalleles, atavism, linkage, sex linkage, sex influenced genes, sex limited genes, linkage groups, two point and three point test crosses, determination of gene order, chromosome mapping, inherited disorders in metabolism-maple syrup urine disease, Lesch Nyhan syndrome, Cytoplasmic inheritance, cytoplasmic male sterility, Down's syndrome, polyploidy, aneuploidy, structural and functional genomics. 25

Unit 5

Behavioral genetics, Hardy Weinberg principle, natural selection, genetic drift, Genetic variation, Allele frequencies and its changes, mutation, gene flow, random mating, inbreeding, outbreeding, assortive mating, hybrid vigour. 10

Reference

1. Principles of Genetics, Snustad, Simmons and Jenkins, John Wiley And Sons Inc
2. Genetics, Robert Weaver and Philip Hendricks, WH.C. Brown Publishers, Iowa
3. Fundamentals of Genetics, B D Singh, Kalyani Publishers
4. Introduction to Genetic Analysis, Griffiths, Wessler, Lewontin, Gelbart, Suzuki and Miller, Freeman's and Co, New York
5. Principles of Genetics: A.G.Gardner, John Wiley and sons.
6. Cell Biology, Smith and Wood
7. Cell and Molecular Biology by Gerald Karp, Academic Press
8. Cell and Molecular Biology Cooper, Hausman, ASM Press.
9. World of the Cell, Becker, Reece, Poenie, The Benjamin/Cumming's Pub.
10. Cell Biology, Lodish et al, W H Freeman and Co., New York.
11. Cell Biology, Thomas D Pollard and W.C.Earnshaw, Saunder's Publishers

BTPG03 BIOPHYSICS AND BIOINFORMATICS

3hours/week

Credit:3

Unit 1

Laws of thermodynamics, the concept of enthalpy, entropy and free energy, thermodynamic equilibrium, redox potential, high energy molecules, examples of redox potential in biological system. 6

Unit 2

DNA polymorphism, GC content and denaturation kinetics, Cot curve, DNA-Protein interaction-. Lambda repressor and cro binding to DNA. Interactions of transcription factors, Leucine Zipper, Cys-His, Zinc fingers. Histone-DNA interaction, RNA protein interactions DNA-drug Interaction . 12

Unit 3

Structural implication of peptide bond, ramachandran plot, protein families, alpha domains, beta domains, alpha- beta domains ,Protein-drug interaction peptide mass fingerprinting using MALDI-TOF, MASCOT database. Energy minimization in molecular docking

10

Unit 4

Introduction to Bioinformatics, Internet, - data mining Online databases and search tools, data organization, Biological data bases, structural data bases, DNA and RNA sequence data bases, genomic sequences, protein seq data bases, Distance matrix methods and parsimony. Multiple sequence alignments-tree alignments, star alignments, pattern in pair wise alignment, genetic algorithm 10

Unit 5

Sequence analysis softwares, SS search, BLAST,FASTA,CLUSTAL, Phylogenetic analysis , construction of phylogenetic tree, evolutionary changes in nucleotide and protein sequences , structure prediction, structural alignment tools, homology modeling, drug design

Applications of Bioinformatics: pharmaceutical industry, immunology, agriculture, forestry, basic research, cheminformatics in biology, geoinformatics, legal ethical and commercial considerations 16

Reference:

1. Introduction to protein structure: Branden and Tooze, Garland Science Pub.
2. Introduction to Biophysics-Rodney Cotterill
3. Molecular Biophysics- Volkenstein M.V, Academic Press
4. DNA topology- Andrew D Bates, Maxwell, Oxford University Press
5. Introduction to Biophysics-Sokal R.R & Rohlf. F.J, Freeman & Co.
6. Bioinformatics: Sequence and Genome analysis- David Mount, Cold Spring Harbour Lab Press, New York.
7. Bioinformatics and Molecular evolution: Paul G Higgs, Teresa K Attwood. Blackwell pub.

BTPG04 INSTRUMENTATION AND BIOSTATISTICS

Number of Hours / Week: 4

Credits: 4

Unit 1.

Microscopy: Light, SEM, TEM, phase contrast, polarization, confocal and interference microscopy, CCD camera, Introduction to Atomic force microscopy. Spectroscopy: Beer-Lamberts law, Principle, Instrument Design, methods and Applications of UV-Visible spectra, IR spectra, Raman Spectra, Fluorescence spectra, NMR and ESR spectra. 15

Unit 2

Principle, Instrument Design, methods and Applications of Polarimetry, ORD, CD, Light scattering, Refractometry, Flowcytometry, X-ray diffraction by crystals, Electron diffraction, Application in Biology, autoradiography, GM counter, Liquid scintillation counting biosensor, dialysis, ultrafiltration 20

Unit 3

Principle, Instrument Design, methods and Applications of Chromatography, ion exchange, molecular sieve, affinity chromatography, TLC, GC, HPLC, Centrifugation and Ultra centrifugation, PAGE, SDS PAGE, Capillary Electrophoresis, isoelectric focusing, Potentiometry, pH meter, ion selective electrodes. 20

Unit 4

Introduction to Biostatistics. Scope of Biostatistics, probability and probability distribution analysis. Variables in biology- collection, classification and tabulation of data- graphical and diagrammatic representation- scatter diagrams, histograms- frequency polygon- frequency curve- logarithmic curves. Descriptive statistics- measures of central tendency, Arithmetic mean, median, mode, geometric mean, harmonic mean. Measures of dispersion, standard deviation, standard error, variance, coefficient of variation. Correlation and Regression. 15

Unit 5

Test of significance. Basic idea of significance test- hypothesis testing, levels of significance, Chi-square test and goodness of fit, comparison of means of two samples, three or more samples. Statistical packages. 10

Reference

1. Practical biochemistry Keith Wilson and John Walker Cambridge edn.
2. Modern experimental Biochemistry- Rodney Boyer, Pearson education.
3. Statistical methods in Biology- Briley N.J.T
4. Biostatistics PN Arora and P K Malhan Himalaya Pub.
5. Biophysics- R N Roy, New Central Agency.

BTPG05 LABORATORY COURSE 1

Number of Hours / Week: 4

Credits: 4

(Biochemistry, Cell biology & Genetics)

1. Preparation of solutions:

- Percentage solutions, Molar, Normal solutions, Dilution of Stock solutions

2. Preparation of buffers using the Henderson Hasselbach equation

3. Spectrophotometric experiments:

Verification of Beer Lambert's law, Quantitative estimation of reducing sugars by Dinitrosalicylic acid method, Quantitative estimation of Methionine by Nitroprusside method, estimation of protein- Biuret, Lowry, Bradford Method, Estimation of Cholesterol by Zak's method, Estimation of DNA, RNA.

4. Chromatographic techniques

- Separation of amino acids by Paper chromatography (Descending /Ascending)
- Separation of Plant pigments by Thin layer chromatography

5. Extraction of Polysaccharides (Starch, Glycogen), Proteins, from appropriate source:

- Quantification of isolated polysaccharide (anthrone method), protein and lipids
- Saponification value, iodine value, of fat sample

6. Identification of mitotic cell cycle stages, problems in Genetics.

7. Problems in biostatistics