

BIO-PHYSICS

(P.G. DEGREE STANDARD)

UNIT – I STRUCTURAL CHARACTERISTICS

Scope and definition of Biophysics. Biophysics at the macroscopic level - at the microscopic level and at the molecular level. Biophysical Chemistry: Atoms - molecules - energy - structure of atoms and molecules - elementary quantum mechanics - covalent bonds - Hydrogen -bonds - stereochemistry - molecular orbitals - chirality.

UNIT – II APPLICATIONS OF PHYSICAL INSTRUMENTS AND METHODS IN BIOLOGY

Diffusion - sedimentation - electrophoresis - separation techniques - Biomolecular structure determination using X-ray diffraction - electron microscopy - IR - Raman and laser spectrometry - UV-visible spectroscopy - CD-ORD - NMR - model building - computer simulation and graphics.

UNIT – III MACROMOLECULAR STRUCTURE

Structure, function and action of viruses and proteins - structure - function and action of nucleic acids - structure and action of membranes- - structure - function and action of other biologically important molecules and molecular assemblies - ribosomes - nucleosomes.

UNIT – IV CONFORMATIONAL ANALYSIS

Van der Waals radii of atoms (equilibrium separation between non covalently bonded atoms) – contact distance criteria - Noncovalent forces determining biopolymer structure – dispersion forces – electrostatic interactions – van der Waals interactions - hydrogen bonds - hydrophobic interactions - distortional energies - description of various interactions by potential functions - principles of minimization of conformational energy.

UNIT – V PRINCIPLES OF PROTEIN STRUCTURE

Structural implications of the peptide bond - rigid planar peptide unit - cis and trans configuration - conformations of a pair of linked peptide units - torsion angles phi and psi - steric hindrance - hardsphere approximation - allowed and disallowed conformations - Ramachandran Diagram - conformational maps for glycine and other natural amino acids - conformationally constrained amino acids and their importance. UNIT – VI ORGANISATION OF THE NERVOUS SYSTEM

Membrane potentials - origins of membrane potential - electrochemical potentials - Donnan equilibrium - Nernst equation - Goldman equation.

Membrane transport - diffusion-facilitated diffusion - membrane transport proteins - carrier mediated transport - channel mediated transport.

UNIT – VII RADIATION PHYSICS

Radiation Quantities, units and definitions - Radiation measurement. Radiation Biology of

Normal tissue system - Biological effects of ionizing radiation - structural changes in chromosomes - Gene mutation - metabolism and biological effects of radionuclide.

Radiation hazards, Evaluation and control - Regulatory aspects of radiological safety - disposal of radioactive waste. Physics of laser - different types of lasers - biomedical applications - C.T.scan - ultra sonography. NMR Imaging – Principles – Applications.

UNIT – VIII COMPUTERS IN BIOLOGY

Use of computers in sequence analysis and structure analysis – sequence projects structure projects – definitions– structural and functional genomics. The digital nature of biological information – elements of molecular biology – the transfer of information in biological systems – representation of biological molecules as strings of symbols – correspondences to other branches of computation, including computational linguistics, pattern recognition, image processing, etc. Elements of computer science – hardware – software – hierarchies in software – operating systems and application software – algorithms and computational complexity – examples – travelling salesman problem – protein folding problem – the internet.

UNIT – IX DATABASES AND ALGORITHMS FOR ANALYSIS OF SEQUENCE

Computer databases – bio molecular databases – sequence databases – structural databases – details of organisation, access and deposition – derived and specialised databases - data mining - homology v/s similarity – dot matrices – sequence comparison using Needleman and Wunsch method – Hash coding – BLAST and FASTA – Structure analysis – distance matrices – examples

UNIT X CRYSTALLOGRAPHY

External features and symmetry – unit cell and Miller indices – seven crystal systems – Bravais lattices – point groups and space groups – X-ray diffraction – Bragg's law – Generation, detection and properties of X-rays-choice of radiation, synchrotron radiation Powder photographs – interpretation of powder photograph – ASTM index Theory of diffraction by helical structures and application to alpha-helix and DNA. BOOKS FOR STUDY

1. Introduction to Biophysics, C. Sybesma. Academic Press, New York (1977)
2. Lehninger Principles of Biochemistry, D.L.Nelson & M.M.Cox, Worth Publishers, USA (2000).
3. Introductory Biophysics , V. Pattabhi & N. Gautham, Narosa Publications (1999)
4. Biochemistry , D.Voet & J.G.Voet, John Wiley & Sons, New York (1995).
5. Molecular Cell Biology (IV edition) H. Lodish, A. Berk, S.L. Zipursky, P. Matsudaira , D. Baltimore & J. Darnel, W.H. Freeman & Company (2000).
6. Genes VII, B.Lewin, Oxford Univ. Press (2000).
7. Radiation Biophysics, E. L. Alpen, Prentice-Hall, New Jersey, USA, (1990).
8. Cell structure and function, A.G. Loewy, P. Siekevitz, J. R. Menninger, & J. A.N. Gallant, Saunders College Publishing (1991).
9. Principles of cell and Molecular Biology L.J. Kleinsmith & V.M. Kish, Heorper-Collins College publishers (1995).
10. Bioinformatics: A practical guide to the analysis of genes and proteins. A.D. Baxevanis and B.F. Francis (eds). John Wiley and Sons (1998).
11. Introduction to Bioinformatics. T.K. Attwood and D.J. Parry-Smith, Addison Wesley Longman Ltd. (1999).
12. Bioinformatics – Data bases and Algorithms N. Gautham, Narosa Publications (2006).
13. X-ray Structure Determination, G.H. Stout and L.H. Jensen, John Wiley and Sons Inc., New York (1989).
14. Conformation in Fibrous proteins, R.D.B. Fraser & T.P. MacRae, Academic press, New York (1973).
15. Biophysical Chemistry Vol.11, C.R. Cantor & P.R. Schimmel, W.H. Freeman & Co., San Francisco (1980).
16. The Basics of Crystallography & Diffraction, C. Hammond, IUCr – Oxford University

Press (1997).