MANGALORE UNIVERSITY

MSc Medical Physics

MPS 406: Biophysics

Teaching hours: Each Unit – 12 h

Objective:

To familiarise the students with applications of principles and methods of physics in biological sciences and Biophysics required understanding the basic processes, interactions, and interconnectedness of physics with life science disciplines.

Outcomes:

- Students will be familiar with concepts such as absorption, adsorption, and chromatographic methods, electrical and mechanical basis used in measurements.
- They will learn about important analytical equipment used in measuring electrical, mechanical, and various other parameters and their principles of operation.
- They will acquire knowledge on membrane and molecular biophysics.
- Develop acquaintance and understand the basic principles of interaction of radiation and their effects on biological materials.
- Students will be familiar with biosensors working on the principles of physics.

Unit I: Physicochemical Fractionation, Electro-analytical Techniques and Spectroscopic Techniques.

Chromatography-Basic Concepts of Adsorption & Partition Chromatography, Principle, Experimental set-up, Methodology & Applications of Adsorption & Partition Chromatography methods i.e. Paper Chromatography and Thin Layer Chromatography.Electrophoresis- Principle, Electrophoretic mobility (EPM) estimation, factors affecting EPM, Instrument design & set-up, Methodology & Applications – Paper Electrophoresis and Gel Electrophoresis. Spectroscopy - Principle, instrumentation and application of spectroscopic instruments: UV Visible, IR spectroscopy, Raman spectroscopy. ONLY Principles and applications of CD, ORD, Fluorescence, Mass, NMR, ESR and Atomic absorption spectroscopy.

Unit II: Hydrodynamic Techniques and Optical & Diffraction Techniques. Centrifugation & Ultracentrifugation - Basic principles, Forces involved, techniques – principles and applications.Viscometry- General features of fluid flow (streamlined and

turbulent) nature of viscous drag for streamlined motion. Definition of viscosity coefficient, expression for viscosity coefficient of gases (with derivation).Principle, Instrument Design, Methods & Applications of Polarimetry, Light scattering, Refractometry, Atomic Force Microscopy.Dichroic ratio of proteins and nucleic acids.Structure determination using X-ray diffraction.

Unit III: Membrane Biophysics and Molecular Biophysics.

Cell membrane models, Composition of biological membranes. Membrane skeleton, elastic properties of membrane.Molecular motion in membrane and membrane fluidity. Nature & magnitude of cell surface charge, Electric properties of membranes: electricdouble layer, Poisson-Boltzmann theory of electric double layer. Chloroplast membrane & energy transduction, Energy transduction through mitochondrial membrane.

Water as universal solvent in biological system, principles of protein structure and confirmation. Forces involved in bimolecular interactions, Ramchandran plot, dihedral/torsional angles. Structure of nucleic acids: composition of nucleic acids, Chargoff'sRule in DNA, RNA base compositions, supercoiling of DNA (linking, twisting and writhing – brief ideas). Interaction of ligands with biomolecules.

Unit IV: Radiation Biophysics and Radiolabeling Techniques.

Radiation Biophysics: Introduction to radiations, Atomic structure, types of radioactive decay, half-life and units of radioactivity. Effects of ionizing and non-ionizing radiations on living systems.Detection and measurement of radioactivity methods, autoradiography.

Radiolabeling Techniques: Properties of different types of radioisotopes, applications of radioisotopes in biology and medicine, isotope dilution techniques, detection and measurement of radioisotopes, incorporation of radioisotopes in biological tissues and cells, radio dating, molecular imaging of radioactive material, safety measures in handling radioisotopes.

Unit V: Electrophysiological and Biophysical Methods

Basic of membrane potentials, principles of bioelectricity, single neuron recording, patch-clamp recording. Principle, Instrument Design, Methods & Applications of ECG, EEG,

EMG, pharmacological testing,PET, SPECT, MRI, fMRI, CAT. Biosensors – principles, design, working, types and applications.

Reference Books

1. Ackerman E.A. Ellis, L.E.E. & Williams L.E. (1979), Biophysical Science, Prentice-Hall Inc.
2. Bulterl.A.V. And Noble D.Eds. (1976), Progress in Biophysics and Molecular Biology (all volumes) pergamon, Oxford.
3. Casey E.J. (1967), Biophysics, concepts and mechanisms. Affiliated East west press.
4. Chang R. (1971), Basic principles of spectroscopy, McGraw-Hill.
5. Crabbe P. (1972), ORD and CD in chemistry and biochemistry, Academic Press.
6. Haschemyer R.N. and Haschemyer A.E.B.V. (1973), Proteins, John willey and sons.
7. Hughes W. (1979), Aspects of Biophysics, John willey and sons.
8. James T.L. (1975), Nuclear Magnetic Resonance in Biochemistry, Academic press.
9. Quagliokiello E., Palmieri F. and singer, T.P. (1977), Horizons in Biochemistry and Biophysics (all volumes) Addison Wesley Publishing Company.
10. Setlow R.B. and pollard E.L. (1962), Molecular Biophysics, Pergamon Press.
11. Spragg S.E. (1980), Physical Behavior of macromolecules with biological functions, John willey and sons.
12. Stanford J.R. (1975), Foundation of Biophysics Academic press.
13. Henry B. Bull (1971), An Introduction to physical biochemistry, F.A.Devis Co.
14. H. H. Perkampus (1992), UV-VIS Spectroscopy and Its applications, Springer-Verlag.
15. Garry D. Christian, James E.O‘reilvy (1986), Instrumentation analysis, Alien and Bacon, Inc.
16. S.M.Khopkar (1984), Basic Concepts of Analytical chemistry, Willey eastern lit.

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