AC –

Item No. –

As Per NEP 2020

University of Mumbai

Title of the program

A- P.G. Diploma in Biophysics

B- M.Sc.(Biophysics)

Syllabus for

Semester – Sem I& II

Ref: GR dated 16th May, 2023 for Credit Structure of PG

(With effect from the academic year 2023-24)

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	**Titleofprogram** **O: _____A**	A	**Title of the program** **P.G. Diploma in Biophysics**
	O: _____B	B	**M.Sc. (Biophysics)**
2	**O: _____A Eligibility**	A	B.Sc/ B.Sc Hons. majoring in Biophysics/Physics/Chemistry/Biochemistry/ Microbiology/ Biotechnology/ Forensics science/ Bioinformatics/ any branch of biology with chemistry or physics/ B. Tech (Biotechnology /Bioinformatics).
	O: _____B Eligibility	B	B.Sc/ B.Sc Hons. majoring in Biophysics/Physics/Chemistry/Biochemistry/ Microbiology/ Biotechnology/ Forensics science/ Bioinformatics/ any branch of biology with chemistry or physics/ B. Tech (Biotechnology /Bioinformatics).
3	**R: _____Durationofprogram**	Two Year	
4	**R: _____ IntakeCapacity**	20	
5	**R: _____Scheme of Examination**	NEP 50% Internal 50% External, Semester End Examination Individual Passing in Internal and External Examination	

6	R: _____StandardsofPassing	40%	
7	Semesters	A	Sem I & II
		B	Sem I, II, III& IV
8	Program Academic Level	A	6.0
		B	6.0 & 6.5
9	Pattern	Semester	
10	Status	New	
11	To be implemented from Academic Year	From Academic Year: 2023-24	

Vanshu H

Sign of HOD
Name of the Head of the Department
Name of the Department

Sign of Dean,
Name of the Dean
Name of the Faculty

Preamble

1) Introduction

The subject of Biophysics is one of the important interdisciplinary areas in teaching, training and learning, which is considered to be important in terms of human resource development and national development. Biophysics is the physics of life phenomenon studied at all level, from molecules and cell to the biosphere as whole. It is the branch of knowledge that applies the principles of physics and chemistry and the methods of mathematical analysis and computer modeling to understand how biological systems work.

2) Aims and Objectives

The main emphasis of biophysics is on the quantitative analysis of the physical and chemical aspects of the functions of biological molecules, organisms and entities. The techniques and methodologies that biophysics relies on are closer to physics and chemistry, but areas of application are in the biological, medical and related sciences.Biophysicists mainly use analytical tools that includes UV visible spectroscopy, Gel electrophoresis, X-ray crystallography, macrocalorimetry, Atomic Force Microscopy, FTIR, Raman, SPR, NMR, Fluorescence spectroscopy, Fluorescence Microscopy & spectroscopy, hydrodynamics techniques etc., to address problems in exciting areas in biophysics ranging from structure aided drug design to cell signalling and transcriptional silencing etc.

3) Learning Outcomes

The programme endeavours to provide students a broad basedtraining in Biophysics with strong background of basic concepts as well as exposing them to recent advances in the field. The programme is focussed on recent developments in the areas of biophysics. In addition to theoretical knowledge, significant emphasis has been given to provide hands on experience to the students in the frontier areas of Biophysics. A multidisciplinary approach has been employed to provide best leverage to students to enable them to move into advanced and frontier areas of biological research in future. Another important feature of course is that a sufficient number of elective papers have been introduced. This will enable the addition of new dimension in learning and research skill of students.Biophysicist's are employed in Universities, R & D industry, Medical centres/Colleges, Research Institutes and Government Organisation etc.

R._____

4) Credit Structure of the Program (Sem I, II, III & IV)

Year (2Yr PG)	Level	Sem. (2Yr)	Major					RM	OJT / FP	RP	Cum. Cr.
			Mandatory*			Electives Any one					
				TH	PR		TH PR				
I	6.0	SemI	PSBP 101: General Physico-chemical principles	4	2	PSBPE I: Biomolecular hydrodynamic methods OR PSBPE II: Recombinant DNA technology and protein engineering OR MOOCs	2 2 2 2 4 -	RM 4	-	-	22
			PSBP 102: Molecular and cellular Biophysics	2	-						
			PSBP 103: Basic analytical tools in Biophysics	4	2						
		SemII	PSBP 201: Membrane Biophysics and Ion channels	4	2	PSBPE III Biocrystallography and magnetic resonance techniques OR PSBPE IV Proteomics OR MOOCs	4 - 2 2 4 -	-	4 FP/ OJT (Emphasis: Instrumentation)	-	22
			PSBP 202:Radiation Biophysics	4	2						
			PSBP 203: Biochemistry	2	-						
Cum. Cr. For PGDiploma			28			8		4	4	-	44

Exitoption:PGDiploma(44Credits)after ThreeYear UGDegree

Year (2Yr PG)	Level	Sem. (2Yr)	Major						RM	OJT / FP	RP	Cum. Cr.
			Mandatory*			Electives Any one						
				TH	PR		TH	PR				
II	6.5	SemIII	PSBP 301:Advanced Biophysical Techniques	4	2	PSBPE V Structural Biophysics	2	2	-	-	4 (Primary data collection, analysisstatistical method)	22
			PSBP 302:Nanobiophysics	4	2	Or PSBPE VI Medical Biophysics	4	-				
			PSBP 303: Environmental Biophysics	2	-	OR MOOCs	4	-				
		SemIV	PSBP 401 Physiological Biophysics	4	-	PSBPE VII Nanomedicine Or	4	-	-	-	6 (Research Execution towards possible publication)	22
			PSBP 402 Biomathematics & Biostatistics	4	-	PSBPE VIII Advanced microscopy and single molecule biophysics	4	-				
			PSBP 403 Elements of Bioinformatics	4	-	Or MOOCs	4	-				
Cum. Cr. For PG Diploma			28			8			4	4	-	44
Cum. Cr. for 2 Yr PGDegree			54			16			4	4	10	88

Varsha H

Sign of HOD
Name of the Head of the Department
Name of the Department

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Sign of Dean,
Name of the Dean
Name of the Faculty

5) Scheme of Examination: (THEORY AND PRACTICALS) :

a. **Summative assessments (THEORY):**

For 2 credit courses	**25M (45min)**
Q1. Answer any three questions out of six (covering unit I and II)	15M
Q2. MCQ/Match the following/Ture Or False (covering unit I and II)	05M
For 4 credit courses	**50M (1.5h)**
Q1. Answer any 2 questions out of 3 (based on unit I)	10M
Q2. Answer any 2 questions out of 3 (based on unit II)	10M
Q3. Answer any 2 questions out of 3 (based on unit III)	10M
Q4. Answer any 2 questions out of 3 (based on unit IV)	10M
Q5. Write one Essay type answer out of 3 (based on units I-IV)	10M

b. **Formative assessments** (informal and formal tests administered during the learning process).

For 2 credit courses	**25M**
Group tasks/ Assignments/ Quizzes at the time of completion of each unit	15 M
Spoken/oral examination after completion of each unit	10M
For 4 credit courses	**50M**

Open book test/assignments/presentation/quiz/role play/MCQ/problem solving to be designed for each unit

c. **Summative assessments (Practical):**

For 4 credit courses **50M (3 h)**

- Major (20M)
- Minor (20M)
- Journal (5M)
- Viva. (5M)

d. **Formative assessments** (informal & formal tests administered during the learning process).

Submission of two Assignments poster/presentation (15M each) based on history/discovery/application/ problems based on techniques/experimentsperformed **30M**

Viva and/ field visit report **20**

Syllabus
P.G. Diploma in Biophysics
(Sem. I & II)

SEMESTER I

PSBP 101	GENERAL PHYSICO-CHEMICAL PRINCIPLES	Credits 04

Unit I: General principles of physical chemistry **(15L)**

The electronic structure of atom, Ionic bond, Covalent bonds, Hydrogen bonds Van der Waals forces, Electric dipoles, Polarization and induced Dipoles, Casimir interactions. General understanding of Quantum mechanics, wave-particle duality, atomic and molecular orbital, hybridization. Pauli Exclusion Principle, Ionization energy, Electron affinity and Chemical bonding, Electronegativity and strong bond, Secondary bonds. Interatomic potentials for strong bonds, Interatomic potential for weak bonds, Noncentral forces, Bond energies, Spring constant.

Unit II: Thermodynamics & Principles of chemical kinetics and biomolecular properties (15L)

Thermodynamic equilibrium, laws of thermodynamics and living system, Entropy, Enthalpy and free energy, Internal energy, Carnot cycle, Chemical potential, Oxidation reduction potential. 0^{th}, 1^{st}, 2^{nd}, and 3^{rd} order reaction, Activation energy and Rate constant, Diffusion, Osmosis, Osmotic pressure, Osmoregulation, Surface tension, Adsorption, Dialysis.

Unit III: Solvent, Solute & Solution in Biological System (15L)

Liquids, Solvents, Solubility, Saturated and unsaturated Solutions, Super saturated solutions, Dilute and concentrated solution, types of solutions, Methods of expression of concentration of solution, Molality, Mole fraction.

Hydrogen ion concentration, Dissociation of water, (water as electrolyte), concentration of equilibrium, Mechanisms of Ionization and Characterization, Acid & Basic solutions, pH and its biological importance, pH meter and its working. General concept of acid, bases and their dissociation constant, Bronsted-Lowry theory, Inductive effect of groups on acid strength, (Carboxyl group, Carbonyl group). Salts & their characteristics & importance in biological system.

Biological Importance of Acids & Bases, Biological & buffering system, Buffer solution, mechanism of buffer action, Factors influencing buffer capacity and pH, Henderson and Hasselbach equation, Buffer systems in the body. (Bicarbonate, Phosphate, Protein buffer, Ammonia buffer, etc.)

Unit IV: Radioactivity (15L)

Energy of Radiation, Radioactive emission, α-ray, β-ray, ϒ -ray, and their properties, Radioactive decay, (α, β decay), Half-life, Units of measurement of radioactivity, types of radioactivity, Isotopes, Isobar, Isotones and their characteristics. Detection of nuclear radiation, Geiger-Muller counter, Proportional counter, Solid and liquid scintillation counter. Radioactive equilibrium, Radioactive isotopes, Nuclear reaction and production of artificial radioactivity, Autoradiography.

References
1.Physical Chemistry for Life Sciences,Peter Atkins and Julio de Paula, 2006, Oxford Press
2. Introduction to Biophysics by Cortell
3. Molecular and Cellular Biophysics, Meyer B Jackson (2006), Cambridge
4. Text Book of Biophysics , R N Roy, New Central Agency (P) Ltd, Calcutta
5. Physical Chemistry for the Biosciences, Raymond Chang,(2004), University book Science
6.Biological Thermodyanamics, Donald, T Hayine, (2007), Cambridge

PSBP 102	**MOLECULAR AND CELLULAR BIOPHYSICS**	Credits 02

Unit I: Biomacromolecules and their biophysical properties **(15L)**

Amino acids and their properties. Primary structure of proteins, Secondary structure: alpha and beta conformation, collagen structure, stability of alpha helix, Ramchandran plot, Tertiary structure, structure of myoglobin and hemoglobin, Quaternary structure, symmetry consideration, Analysis of subunits and chain arrangement of subunits, stability of globular quaternary structure. Nucleic acid composition, structure of DNA and RNA. A, B & Z DNA structure. Primary and secondary structure of nucleic acids. Protein-DNA interactions. Carbohydrates: classification and types, biological significance.

Unit II: General organization of cells (15L)

Origin and evolution of cell, shape and size of cell; General organization of prokaryotic and eukaryotic organisms basic concepts and their detailed structure and functions, Prokaryotic cell wall, Eukaryotic cell wall, their functions, ribosomes, physical and biological properties of protoplasm. Cytoskeleton – basic components, properties and functions in prokaryotic and eukaryotic cells. Bacterial growth and cell division. Cell cycle in higher organisms. Basics of cell signallingeg. G protein and GPCRs.

References
1. Molecular Biology of the Cell, Bruce Albert, Alexander Johnson et al (2002), Taylor & Francis Group.
2. Principles of Biochemistry, Lehninger, 8th edition, W H Freeman & Co
3. Biochemistry by Stryer, 9th edition, W H Freeman & Co
4. Molecular Cell Biology, Harvey Lodish, 9th edition, W H Freeman & Co
5. Fundamentals of Biochemistry Voet and Voet, 6th Edition Wiley

PSBP 103	BASIC ANALYTICAL TOOLS IN BIOPHYSICS	Credits: 04

Unit I: Spectroscopy I (15L)

Interaction of Light and Matter. Principle, instruments and application of spectroscopic instruments: UV Visible: absorption of light, radiation sources, sample holders, monochromators, radiation detectors, single and double beam instruments, colorimeter.

Fluorescence: Fluorescence and phosphorescence, fluorimeter, fluorophores, quenching, energy transfer, and applications. Luminometry: bioluminescence and chemiluminescence phenomenon, Atomic absorption spectroscopy: Principle and instrumentations.

Unit II: Spectroscopy II (15L)

IR spectroscopy: Rotational and vibration spectra, Instrumental features, applications. Raman effect, stokes and anti-stokes lines, advantages, applications. CD ORD principles and applications. Basics of NMR and ESR spectroscopy.

Unit III: Microscopy (15L)

Principle, instrumentation and application of microscopy, image formation, magnification, resolving power. optimum resolution, image defects, different types of Microscopy: Dark field, Phase contrast, polarization microscopy, Interference microscopy, Fluorescence microscopy, Electron microscopy: Electron guns, Electron lens, electrostatic focusing, magnetic focusing, SEM, STEM, Atomic force microscopy.

Unit IV: Physiochemical techniques in Biochemistry (15L)

Antigen-Antibody interaction, Principle and application of Immunologicaltechniques in Biology and medicine. ELISA, RIA. Chromatography: paper, TLC, adsorption, partition, ion exchange, gel filtration, affinity and FPLC, GLC, HPLC: mobile phase systems, modes of operations, application. Flow cytometry, Surface plasmon resonance for binding interaction studies.

References:

1.Methods in Molecular Biophysics, Igor N S, N Zaccai& J Zaccai, (2007) Cambridge

2. Biophysical Chemistry, Dagmar (2017) 1st edition CRC press

3. Physical Biochemistry, David Sheehan, 2nd edition, Wiley

4. Essentials of Biophysics, Narayanan, 3rd edition, New age international publishers

5. Biophysical Chemistry, Upadhyay & Upadhyay (2016) Himalaya Publishing

PSBPE I	ELECTIVE: BIOMOLECULAR HYDRODYNAMIC METHODS	Credits 02

Unit I: Biomolecular analytical techniques I (15L)

Electrokinetics methods: electrophoresis, electrophoretic mobility (EPM), factors affecting EPM, Paper, PAGE, SDS-PAGE, Disc gel, gradient gel, electrophoresis of nucleic acid and its application, Pulse field electrophoresis, single cell gel electrophoresis, Isolectrophoresis, preparative electrophoresis, 2-D gel electrophoresis, Capillary, Iso-Electric focusing, applications in biology and medicine.

Unit II:Biomolecular analytical techniques II **(15L)**

Centrifugation: principle, preparative centrifuge, analytical, ultracentrifuge, Ultracentrifugation and their applications in molecular weight, size determination.

Sedimentation filtration of biological fluid, Precipitation, Biological significance of precipitation, Colloids & their types, Kinetic & electrical properties of colloids, Stability of colloids, Gibbs Donnan Equilibrium in living systems. Liquids and flow in biological systems: Viscosity and its application, blood flow, cytoplasmic streaming in plants, bacterial motion in water. Static and dynamic light scattering, small angle scattering.

References

1.Methods in Molecular Biophysics, Igor N S, N Zaccai& J Zaccai, (2007) Cambridge
2. Biophysical Chemistry, Dagmar (2017) 1st edition CRC press
3. Physical Biochemistry, David Sheehan 2nd edition, Wiley
4. Essentials of Biophysics, Narayanan 3rd edition, New age international publishers
5. Biophysical Chemistry, Upadhyay & Upadhyay (2016) Himalaya Publishing
6. Principles and techniques of Biochemistry and Molecular Biology, Wilson & Walker

PSBPE II	ELECTIVE: RECOMBINANT DNA TECHNOLOGY AND PROTEIN ENGINEERING	Credit 02

Unit I: Isolation, synthesis of nucleic acids & enzymatic manipulation (15L)

Genomic DNA from bacteria, plant and mammalian tissue. Recovery of large and small fragments of DNA. Chemical synthesis of oligonucleotides, genes and their uses. Analysis of DNA sequences by blotting and hybridization. Restriction endonuclease and mapping enzymes for modification. Radioactive labelling of nucleic acids, construction of hybrid DNA molecules. Polymerase chain reaction (PCR). Preparation and analysis of RNA.

Unit II: Protein engineering (15L)

Cloning and expression vectors, gene expression in bacteria, yeast and mammalian cells. Preparation of Genomic and c-DNA libraries. Screening of Recombinant DNA Libraries: Screening by DNA hybridization, Immunological assay and protein activity. Transformation of DNA using calcium Phosphate, DEAE, Dextrin and Electroporation and its optimization and uses. Site-directed mutagenesis, Production of recombinant proteins and purification using protein fusion tags. Hybridoma technology. Development and use of transgenic animals.

References

1. Molecular cloning a laboratory manual, Russell and Sambrook, 2001, Cold Spring Harbor
2. iGenetics, Russell, 3rd edition Pearson
3. Principles of gene manipulation and genomics, Primrose, 7th edition, John Wiley & Sons
4. Gene cloning and DNA analysis, T A Brown, 7th edition, Wiley

	PRACTICAL PSBP 101	Credit 02
	1. pH Meter: Standardization of pH meter, Preparation of Buffers 2. pH titration curve of acid-base 3. Determination values of Iso-electric point: Amino acids, proteins, phosphoric acids. 4. Study of diffusion of biomolecules/ions (Fick's Law) 5. Effect of hypertonic/ hypotonic/isotonic conditions on RBC membrane. 6. Purification of substances by dialysis	
	PRACTICAL PSBP 103	Credit 02
	1.Colorimeter: determination of absorption maxima of coloured compounds, Verification of Beer's-Lambert law, determination of molar extinction coefficient. 2. Absorption spectra of Hb, DNA, RNA 3. Protein tryptophan fluorescence measurement. 4. Microscopy: Familiarization with bright field, phase contrast, fluorescent, polarization microscopes. 5. Study of bacterial cell growth/ survival by spectrophotometry 6. Observe cell division and determine mitotic index 7. RBC, WBC counting and Differential leukocyte count 8. Paper chromatography/TLC: Amino acids/ sugars/ fruit juice/oil	
	ELECTIVE PRACTICAL PSBPE I	Credit 02
	1.Viscosity: Determination of viscosity of biofluids and chemicals 2.To study of conformational changes in biomolecules using Ostwald viscometer 3. Fractionation of proteins using: PAGE 4. Differential centrifugation of cellular components 5. Agarose gel electrophoresis 6. Isolation of casein protein from milk	
	ELECTIVE PRACTICAL PSBPE II	Credit 02
	1. Isolation of genomic DNA from bacteria 2. Isolation of DNA from onion 3. Restriction endonuclease digestion and separation of fragments by gel Electrophoresis 4. Amplification of DNA by PCR 5. Low protein concentration detection by silver staining 6. Gel filtration chromatography 7. Detection of DNA modification 8. DEAE cellulose chromatography of DNA	

SEMESTER II

PSBP 201	MEMBRANE BIOPHYSICS & ION CHANNELS	Credits 04

Unit I: Membrane structure and Models (15L)

Lipids: types of lipids, classification and biological significance. Membrane architecture, Lipid bilayer and early models, Fluids mosaic model, Evidence from model system and biomembranes. Membrane permeability, transmembrane helices, hydropathy plot, Membrane asymmetry, Membrane fluidity, Functional reconstitution of membranes. Models of membrane fusion: bilayer fusion, viral fusion, cellular fusion, SNAREs, cell-cell fusion, fusion in mitochondria,

Unit II: Membrane transport (15L)

Membrane channels and carriers, voltage gated channels, ligand gated channels. Transport system with non-electrolytes and electrolytes. Transport with chemical reaction system: Primary and secondary active transport. Transports of molecules bysimple and facilitated diffusion, Transport by flux coupling. Transport by phosphotransferase system, Transport by vesicle formation, Ionophores, epithelialtransport.

Unit III: Physics of membrane (15L)

Membrane deformations: bending, shearing shape fluctuation etc. Differential geometry of membranes, Elastic properties, Elastic constants, Charge-induced microstructures and domain. Hysteresis of domains formation, Lateral phase separation, selective lipid protein interactions, Membrane melting.Cell surface charge, Resting membrane potential, Action potential, properties of action potential, Nernst equation, Goldman equation, Nernst-Planck equation, Hodgkin-Huxely equation, Hodking-Kartz experiment, Voltage clamp, Na^+, K^+ conductance, channel conductance, membrane impedance and capacitance, Transmembrane potential, Zeta, stern and total electrochemical potential, Chemical synapse, post synaptic potential.

Unit IV: Mitochondrial membrane and membrane mimics (15L)

Electron Transport & oxidative phosphorylation: Reduction potential and free energy changes in redox reaction, organization of electron transport chain in mitochondrial membrane, chemiosmotic coupling, proton gradient drive and synthesis of ATP, P/O ratio for oxidative phosphorylation, Cytosolic NADH electron feeding into electron transfer.

Historical perspective of lipid model systems lipid monolayer. Liposomes: small and large unilamellar and multilamellar vesicles, planar lipid bilayer, synthesis and purification methods. Application of liposomes in biology and medicine

References

1. Cell biology, Karp, Global edition, Wiley
2. Biophysics, Hoppe and Lohman, 2nd edition Springer Verlag
3. Membrane Structural Biology, Mary Luckey, 2014, 2nd edition, Cambridge University Press
4. Biochemistry, Stryer, 9th edition, W H Freeman & Co
5. Molecular Biology of the Cell, Bruce Albert, Alexander Johnson et al (2002), Taylor & Francis Group.
6. Principles of Biochemistry, Lehninger, 8th edition, W H Freeman & Co

PSBP 202	RADIATION BIOPHYSICS	Credits 04

Unit I: Interaction of Radiation with Matter (15L)

Ionization and Excitation of matter by charged particles, Specific ionization, Linear Energy Transfer (LET), Bragg's law, Range Energy Relations, Bremsstrahlung, Interaction, of Gamma rays with Matter, Photoelectric effect, Compton effect, pair production, Attenuation and Absorption Coefficients, Radiation Units-Unit of Exposure, KERMA, Absorbed Dose and Derived Units- Equivalent Dose and Effective Dose.

Unit II: Interaction of radiation with living cells I (15L)

Kinetics of induction of damage in irradiated cells-physical stage, physicochemical stage, chemical stage, biochemical stage, induction of cellular level damage. Mechanism of direct and indirect action of radiation, radiolytic products of water, radical reactions in the biological system. Critical target in the living cells evidences for DNA to be the primary target, Nature of the DNA damage Induced by Radiation. Relationship between DNA content and radiosensitivity. Cell lethality, mitotic death, interphase death and apoptosis, Models of Cell survival, Target Theory, its modifications multi target- single hit and single target- multi hit hypothesis, target size calculation, survival curve parameters-D_q, D_0, n, slope etc and limitations of target theory, Linear Quadratic Model of cell survival and the mechanistic support to LQ model , α/β values for normal and tumour cells.

Unit 3: Interaction of radiation with living cells II (15L)

Factors modifying cellular radiation response: Physical factors modifying cell survival: dose, dose Rate, dose fractionation, LET, hyperthermia. Biological factors: Cell cycle stage, repair and recovery, Elkind and Sutton type (SLD repair), Repair of potentially lethal damage (PLDR). Mammalian cell sensitivity protocol, Law of Bergonie and Tribondeau, classification of cells into different sensitivity groups. Chemical modifiers: Oxygen, Chemical radioprotectors, sensitizers, repair inhibitors, Radiation induced Division delay, biochemical and biophysical changes. Induction of Mutations and Chromosomal Aberrations (CA), factors modifying chromosomal damage, Application of CA analysis in biodosimetry of absorbed radiation.

Unit IV: Biological Effects of Radiation (15L)

Introduction, Historical Data Base, Somatic and Genetic Effects, Immediate and Late Effects. Stochastic and Deterministic Effects. Damage to Individual Organs. Skin, Eye Lens, Reproductive System, Lungs, Endocrine Glands, Threshold Doses, Radiation Sickness, Radiation Syndromes: Haemopoietic Syndrome, G.I. Syndrome, CNS Syndrome LD50 (60) Dose, Late Damage in Skin, Lung and Other Organs. Prenatal Radiation Effects, Radiation Carcinogenesis, Human Data, Risk Evaluation by A-Bomb Survivor Data, Genetic Risk Evaluation, Radiobiological Basis for Radiation Protection Standards, Maximum Permissible Limits For Radiation Exposure

References

1. Fundamental and Radiobiology (1966) 2nd Edition Bacq Z.H.Alexander P., Pergammon Press, New York.
2. Radiation Biophysics (1990) Alpen E.L.Printice hall, Engel Wood.
3. Radiation Chemistry (1973) Hughes G. Clarendon Press
4. Radiation Biology, Alison P. Casserette
5. Radiation Biophysics by J.Kiefer

PSBP 203	**BIOCHEMISTRY**	Credit 02

Unit I: Enzyme structure & mechanisms (15L)

Enzymes, classification & structure, active site and its identification, mechanisms of enzyme action with special reference to chymotrypsin, carboxypeptidase and lysozyme, Enzyme kinetics, Michaelis-Menten equation, Inhibitors, kinetics of competitive, non-competitive and uncompetitive inhibitors, Allosteric cooperative behaviour, ligand protein interaction, Hill equation, Metalloenzymes. Determination of V_{max}, K_m, various graphical plots.

Unit II: Molecular and cellular biology (15L)

Various modes of DNA replication, semi-conservative mechanism of replication, DNA polymerases, role of various proteins/enzymes in DNA synthesis in prokaryotes and eukaryotes. Molecular basis of mutations, DNA repair mechanisms. RNA polymerases, transcription in prokaryotes and eukaryotes.

Messenger RNA, transfer RNA, attachment of amino acids to tRNA, the ribosome - initiation, elongation and termination of translation. Comparison of prokaryotic and eukaryotic protein synthesis. Regulation of Gene expression in prokaryotes Operator-operon concept: Lac and Trp operon

References

1. Principles of Biochemistry, Lehninger, 8th edition, W H Freeman & Co
2. Biochemistry by Stryer, 9th edition, W H Freeman & Co
3. Fundamentals of Biochemistry Voet and Voet, , 6th Edition Wiley
4. iGenetics, Russell, 3rd edition Pearson

PSBPE III	**ELECTIVEBiocrystallography& Magnetic resonance techniques**	Credits 04

Unit I: NMR Spectroscopy (15L)

Modern techniques for structure elucidation FT and FFT. Nuclear over Hauser effect. Basic 2D Spectroscopy benefits of 2D experiments (COSY NOESY). Assignment problem in biopolymers, Ligand binding to macromolecules, Chemical exchange, ^{1}HNMR spectroscopy, monitoring of cellular pH, gradient in tumour cells etc. Fluidity gradient in lipids, chemical shift, anisotropy of P resonance in membranes.

Unit II: ESR Spectroscopy (15L)

Spin labeling: a reporter group technique requirement of such a group, Nitro-oxide spin label probes and their molecular structures, anisotropy of the order parameters, dynamics information obtained from ESR, molecular polarity from biochemical data, orientation Intra-molecular distances. Applications of these concepts to study the structure and function of enzyme i.e. lysozyme etc. conformational change in trypsin, spin labelled ligands as probe for binding sites, lipid spin label in the biological membranes

Unit III: X-ray diffraction of the macromolecules (15L)

Brags law, Parameters governing crystallization of protein and nucleic acids; Analysis of diffraction data, evaluation of unit cell dimension and space group, phase determinations; Calculation and interpretation of electron density map crystal structure; Analysis of structures of proteins, nucleic acids, DNA-RNA and triple helical complexes.

Unit IV: Fiber Structure Determination (15L)

Diffraction by poly crystalline system; Diffraction by a helical chain and a discontinuous helix; X-ray scattering of helix; Analysis of the structure of fibrous proteins; Effect of intermolecular packing; X-ray scattering from nucleic acid fibers

References

1. Principles of Physical Biochemistry, van Holde, 2008 Prentice Hall
2. Physical Biochemistry, David Sheehan, 2nd edition, Wiley
3. NMR in biological systems, KVR Chary, GirjeshGovil, 2008 Springer
4. Understanding NMR spectroscopy, James Keeler, 2nd edition, Wiley
5. Protein NMR spectroscopy, John Cavanagh, 2nd edition, Elsevier

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eam for Creation of Syllabus

Name	College Name	Sign
Prof Varsha Kelkar Mane	I/c Head, University Department of Biophysics, University of Mumbai	
Prof (Dr.) P M Dongre	Principal, PRES ACS Senior College, Satral, Ta. RahuriDistAhmadnagar Director, Research, Pravara Rural Education Society, Pravaranagar	
Dr Jesse John	Adhoc Faculty, Department of Biophysics	
Dr A V Chitre	Visiting Faculty	
Prof S Sivakami	Adjunct	
Prof B S Rao	Adjunct	

Sign of HOD _____
Name of the Head _____
Name of the Department _____

Head,
Department of Biophysics
University of Mumbai

DEPARTMENT OF BIOPHYSICS * UNIVERSITY OF MUMBAI * SANTACRUZ (E) MUMBAI-400098

Sign of Dean _____
Name of the Dean _____
Name of the Faculty _____

Appendix B

Justification for (M.Sc Biophysics)

1.	Necessity for starting the course:	**Highly interdisciplinary field involving research in basic and applied sciences, with emerging applications in the field of diagnostics and therapeutics.**
2.	Whether the UGC has recommended the course:	**No**
3.	Whether all the courses have commenced from the academic year 2023-24	**Yes**
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available?:	**Self-financed** **Permanent faculty unavailable**
5.	To give details regarding the duration of the Course and is it possible to compress the course?:	**Course duration: 02 years** **Course can be compressed to one year as diploma course**
6.	The intake capacity of each course and no. of admissions given in the current academic year:	**20**
7.	Opportunities of Employability / Employment available after undertaking these courses:	**Research scientist in Institutes and industry/ Faculty/Scientific writer/Scientific assistant/officer/Medical representatives/Enterprenuers**

Sign of HOD Varsha M
Name of the Head of the Department
Name of the Department

Sign of Dean,
Name of the Dean
Name of the Faculty