AC 10/02/12
Item No. 4.26

UNIVERSITY OF MUMBAI

Program: M.Sc.
Course : Biophysics
Syllabus for the Semester I & II

(Credit Based Semester and Grading System with effect from the academic year 2012–2013)

Preamble

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 may be defined: Biophysics is that 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.

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 use a variety of techniques such as UV visible spectroscopy, Gel electrophoresis, X-ray crystallography, microcalorimetry, Atomic Force Microscope, FTIR, Raman, SPR, NMR, fluorescence spectroscopy, Fluorescence Microscopy, Viscometry, G M Counter etc are used to study problem in exciting areas in biophysics ranging from structure aided drug design to cell signalling and transcriptional silencing etc.

Biophysicist works in Universities, R & D industry, Medical Centres/Colleges, Research Institutes, Government Organisation etc.

The two year programme of M.Sc. (Biophysics) is prescribed according to the credit system of University of Mumbai from the academic year 2012-13. The course has been divided in to four semesters. The programm has total 16 theory papers, and four in each semester.

The programme is designed to provide students a broad based training in Biophysics with strong background of basic concepts as well as exposing them to the advanced fields. 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 move into advanced and frontier areas of biological research in the future. Hence, one paper is also introduced on soft skill as per the guideline given by University of Mumbai. This paper focusses on perception, comprehensive, presentation skills etc. This will enable to add new dimension in frontier research skills in students.

Revised syllabus of M.Sc. Biophysics
Semester I & II
(Based on Credit and grading system)

Semester I

Paper code	Paper nomenclature	Lectures	Credit	Practical Paper No & Code	Hrs	Credit	Total Credit
PSBP101	General Physico-chemical Principles	60	04	Paper I (PSBPP 101)	60	02	06
PSBP102	Biomathematics & Biostatistics	60	04	Paper II (PSBPP 102)	60	02	06
PSBP103	Cell Biophysics	60	04	Paper III (PSBPP 103)	60	02	06
PSBP104	Methods in Biophysics	60	04	Paper IV (PSBPP 104)	60	02	06
	Total						**24**
	Semester II						
PSBP 201	Molecular Biophysics	60	04	Paper V (PSBPP 201)	60	02	06
PSBP202	Biochemistry	60	04	Paper VI (PSBPP 202)	60	02	06
PSBP203	Molecular Biology & Protein Engineering	60	04	Paper VII (PSBPP 203)	60	02	06
PSBP204	Membrane Biophysics	60	04	Paper VIII (PSBPP 204)	60	02	06
	Total						**24**
	Grand Total (Sem I & II)						**48**

Total credits for M.Sc. Part I =(Sem I- 24 and sem II-24) =48

Evaluation: The students will be evaluated internally and externally. The internal evaluation is done by concern teacher and external evaluation done by the committee appointed by the University norms. Standard passing and scale as per the university norms.

M.Sc. BioPhysics Syllabus

Semester I & II

Credit Based and Grading System

To be implemented from the Academic year 2012-2013

SEM: I

Paper I: General Physico-chemical Principles: **PSBP101**
Paper II: Biomathematics & Biostastics: **PSBP102**
Paper II: Cell Biophysics: **PSBP103**
Paper III: Methods in Biophysics**:** **PSBP104**

SEM: II

Paper IV: Molecular Biophysics: **PSBP201**
Paper V: Biochemistry: **PSBP202**
Paper VI: Molecular Biology & Protein Engineering: **PSBP203**
Paper VIII: Membrane Biophysics: **PSBP204**

SEMESTER I

General Physico-chemical Principles**: PSBP101**

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
PSBP101	I	Laws of Physics and Chemistry	4	
	II	Energies Forces & Bonds		
	III	Principles of Kinetics of Molecules		
	IV	Proton Transfer equilibria		
	V	Electron Transport & Oxidative phosphorylation		

Biomathematics & Biostatistics **PSBP 102**

PSBP102	I	Introduction to Biomathamatics	**4**	
	II	General principals		
	III	Introduction to statistics		
	IV	Hypothesis and Tests		

Cell Biophysics: **PSBP103**

PSBP103	I	General organisation of cell	4	
	II	Cell differentiation		
	III	Cell growth & Division		
	IV	Cell cell communication		

Methods in Biophysics: **PSBP 104**

PSBP104	I	Spectroscopy	**4**	
	II	Microscopy		

	III	Separation Techniques		

PSBPP101	**General Biophysics** 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. Viscosity: Determination of viscosity of biofluids and chemicals 5. Colorimeter: Verification of Beer's-Lambert law, determiantion of absorption maxima of color compounds, determination of molecular extinction coefficient. 6. Estimation of percent purities of dyes and inorganic compound	**2**	
PSBPP102	**Biomathematics & Stat** 1. Calculation of measures of dispersion: a) Mean deviation b) std deviation and coefficient variation c) Quartile deviation 2. Test of significance: a) Chi-square test b) t-test 3. To evaluate standard error and interpretation of results of accuracy and precision	**2**	
PSBPP103	**Cell Biophysics** 1. Microscopy: Familiarizes with bright field , phase contrast, fluorescent, polarization microscopes. 2. Classification of gram –ve & +ve oganganisms 3. Observe cell growth/ survival by colony forming assay 4. Estimation of cell viability by dye exclusion and colony techniques. 5. Observe cell death by physical and chemical agents 6. Observe cell division and determine mitotic index (Demonstration) 7. Determination of cellular carbohydrates by Acid shifts (PAS) reaction.	**2**	

	8. Blood analysis: Total WBC count, PCV, MCV etc 9. Differential Counts, 10. Total RBC count, 11. Blood grouping and coagulation. 12. Hemoglobin estimation.		
PSBPP104	Methods in Biophysics (Practical) 1. Fractionation of proteins using: PAGE, PAPER electrophoresis 2. TLC: Amino acids/ sugars/ fruit juice/oil 3. Column chromatography for protein /pigment 4. To study of conformational changes in biomolecules using Ostwald viscometer 5. Refractoemetry: study of sugars/proteins/amino acids	**2**	

SEMESTER II

Molecular Biophysics: **PSBP201**

PSBP201	I	Principles of protein structure & confirmation	4	
	II	Proteins structure and stability		
	III	Structure of Nucleic Acids		
	IV	Molecular distribution & statistical thermodynamics		

Biochemistry: **PSBP202**

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
PSBP202	**I**	Hormones & its Actions	**4**	
	II	DNA structure, Replication & Repairs		
	III	RNA synthesis & Translation		
	IV	Regulation of gene expression in prokaryotes		
	V	Ligand receptors & Interactions		

Molecular Biology & Protein engineering: **PSBP203**

Course Code	UNIT	TOPIC HEADINGS	Credits	L / Week
PSBP203	I	Preparation and analysis of DNA, Enzymatic manipulation of DNA & RNA	**4**	
	II	Construction of Recombinant DNA libraries & In vitro Mutagenesis		
	III	Introduction of DNA into mammalian cell & system for study of cloned Genes		
	IV	Micro sequencing methods for proteins & Engineering proteins for purification		
	V	Chemical approach to protein engineering & Protein engineering for thermostability		

Membrane Biophysics: PSBP 204

PSBP204	I	Membrane structure & Models	4	
	II	Physical properties of membrane		
	III	Membrane transport		
	IV	Molecular dynamics of Membrane		
	V	Membrane potentials & Lipid membrane technology		

PSBPP201	Molecular Biophysics (Practical) 1. Study of thermal denaturation of DNA and protein 2. Mutarotation of glucose and amino acids 3. Study of DNA-Protein interaction using fluorometry 4. Study of fluorescence sensitivity and quenching 5. Absorption spectra of Hb, DNA,RNA etc 6. Study of interaction of acridene orange with DNA 7. Identification of C-terminal and N-terminal amino acid	**2**	

PSBPP202	Biochemistry (Practical) 1. Enzyme Assays (LKH, beta galacotsidase, acid phophotase, arginase, Succinic De –hydrogenase) : Time , Temp, Protein concentration, cofactors. LKH: Km & Vmax. 2. Estimation of Protein by Lowery/Biuret/ Bradford methods 3. Isolation of casein protein from milk, Hb from RBC 4. Assessment of antioxidants /Lipid peroxidation from given samples.	**2**	
PSBPP203	Molecular Biology & Protein Engineering (Practical) 1. Isolation of DNA (Nuclear & Mitochondrial) 2. Detection of DNA modifications. 3. Restriction endonuclease digestion and separation of fragments by gel electrophoresis. 4. Determination of base composition of Nucleic acids 5. Gel filtrations chromatography 6. To find out capacity & nature of the given ion exchange resin. 7. DEAE cellulose chromatography of DNA 8. PCR (Demonstration)	**2**	
PSBPP204	**Membrane Biophysics (Practical)** 1. Preparation of liposome's / artificial membrane: Lipid mixture/ BSA / Ovalbumin (Demo) 2. Fluorescence anisotropy and polarization measurement 3. Protein tryptophan fluorescent measurement. 4. Study of membrane fluidity. 5. Effect of hypertonic/ hypotonic/isotonic on RBC membrane. 6. Purification of substances by dialysis 7. Study of volume regulation of erythrocyte and osmotic fragility. 8. Ionophore effect on erythrocyte. 9. Osmolarity: Determination of osmotic pressure of salts.	**2**	

	10. Verification of fick's law of diffusion 11. Study of phase transition of membrane phospholipids 12. To study of membrane potential using fluorescence spectroscopy		

Semester I Detail Syllabus

Course Code	Title	Credits
PSBP 101	**General Physico-chemical Principles** Total lectures:60	4
Unit I: Structure & Bonding: Quantum mechanics: Pauli Exclusion Principle, Ionization energy, electron affinity and chemical binding, Electronegativity and strong bonds, secondary bonds. The electronics structure of atoms, Molecular orbital and Covalent bonds. Molecular interaction: strong and weak interactions. Stereochemistry and Chirality, **20L**		
Unit II: Thermodynamics: Basics of Thermodynamics: Laws of thermodynamics and living organisms, Entropy, Enthalpy, Efficiency and free energy of system, Concept o energy in biological system, living body and thermodynamics, Carnot cycle, Chemical potential. (**20** L)		
Unit III: Kinetics of Molecules & Reactions: 0^{th}, 1^{st},2^{nd} & 3^{rd} order reactions, Diffusion, Osmosis, Osmotic pressure, osmoregulation, surface tension, dialysis, adsorption, viscosity, thermal conduction, collides, sedimentation**. (10L)**		
Unit : IV Acid-Base equilibrium: Bronsted lowry theory, protonationa and deprotonation, buffers, amphiprotic system, protolysis of water, hydrogen ion concentration, pH, acid base balance, Henderson and Hasselbalch equation. (**10L)**		
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. Tex Book of Biophysics , R N Roy, New Central Agency (P) Ltd, Culcutta **5.** Physical Chemistry for the Biosciences, Raymond Chang,(2004), University book Science Biological Thermodyanamics, Donald, T Hayine, (2007), Cambridge		

Course Code	Title	Credits
PSBP102	**Biomathematics & Biostatistics** Total lectures: 60	4
Unit I:**Biomathematics** Limits of functions, derivatives of functions. Probability Calculation, Differential and integral calculus, Derivative and its physical significance, basic rules for differentiation (Without derivation) Maximum and Minimum their application in		

chemistry, Geometric meaning of integration, application in biology and chemistry. (**15L**)

Unit II: **Biostatistics I**

1. Introduction, scope, application and use of statistics, collection and classification of data, census and sampling, graphs and diagrams, arithmetic mean, median standard deviation.
2. Correlation and regression for ungrouped data, scatter diagram, calculation and interpretation of correlation coefficient, linear regression coefficients and equation of the Lines of regression, nonlinear relationship transformable to liner form ($Y=Ab^x$, Ya^xb)
3. Probability, definition, addition and multiplicative laws (without proof). Random variable and its distribution, binominal probability distribution, examples and condition s means and Variances, continuous variable, normal distribution, use of normal probability table for finding probabilities. (**15L**)

Unit III: Biostatistics' II

1. Population parameter and sample statistics, sampling techniques, simple random sampling stratified random sampling, systematic sampling standard error of mean.
2. Estimation, Point & interval, confidence interval for proportion.
3. Hypothesis attesting, Type I and Type II errors levels of significance, one-tailed and two tailed test, application to single proportion, equality of the population means and two population proportions.
4. Chi-square test for independent attributes in r x c table, special case of 2 x 2 tables.
5. Students test for significance of correlation coefficient y fore p=0 (small sample test (**15L**)

Unit IV: Biostatistics III

1. Fishers z transformation coefficient for getting yp-0 in large samples test of significance For y (p=0)
2. Design of experiment: Principle and concepts of completely randomized design, randomized block design and Latin square design,
3. variance ratio F-test-Analysis of variance in one-way classification .
4. Non-parametric test: Distribution-free method, sign test for method pairs, Wilcoxon test for unpaired data Run test. (**15L**)

References:

1. Biostastistics:A foundation for analysis in the Health Sciences, 7th Ed.(1998) Wayne D, Wiley
2. DNA Microarrays, David Bowtell & J Sambrook (2002), CSHL Press
3. Principles of Statistics, 2nd Ed. M Pagano & K Gauvreau (2007), Thomson Publ

Course Code	Title	Credits
PSBP 103	**Cell Biophysics** Total lectures:60	4
Unit I: **General organization of cells**: Discovery of Cell, Shape & Size of cell, General organization of prokaryotic and eukaryotic organisms' basic concepts and their detailed structure functions, Prokaryotic cell Wall, Eukaryotic cell wall, functions of cell wall, Physical & Biological properties of cytoplasm, (**15L**)		
Unit II: Cell Differentiation: Cellular differentiation; localization of cytoplasm determinants in egg. Nucleocytoplasmic interaction and cell function, Development of extra cellular matrix, mechanism of alpha adrenergic and related response, modulation of extra cellular matrix by tumor cell- Fibroblast interactions, growth factors in cultured cell-early cytoplasm singles and Cytoskeleton responses. (**15L**)		
Unit III :Cell growth and Division: Kinetics of cell growth, Role of protein kinase in cell growth, cell cycle, cell cycle events: G S G2, Cell division, cytokines, control of cell cycle, Role of protein kinase c in cell growth, dividing and non-dividing cell, synchronization of cell growth, cell transformation, malignant tumor growth, Apoptosis. (**15L**)		
Unit IV : Cell-Cell Communication: Strategies of chemical signaling: Endocrine, paracrine and synaptic. Signaling mediated by intracellular receptors: Mechanisms of transduction by cell surface receptor protein, role of calmodulin, Ca and cyclic nucleotides, phosphoinisitol cycle, sodium proton exchanger, molecular events involved in during sperm-egg interaction, implications and the mechanisms of sperm-zone interaction, Role of soluble factors produced by follicle somatic cell on gamete interactions. Factors influencing sperm egg recognition and binding. (**15L**)		
References: 1. Molecular Biology of the Cell, Bruce Albert, Alexander Jhonson et al (2002), Taylor & Francis Group. 2. The Cell Molecular Approach, G Cooper & R Hausman (2007) ASM Press 3. Molecular Biology , D Roberties, 8th Ed. SAE 4. Biochemistry by Strayer 5. Introduction to Biological Membrane, D Chapman 6. Molecular Cell Biology, Lodish 7. Molecular and Cellular Biophysics, Meyer B Jackson (2006), Cambridge)		

Course Code	Title	Credits
PSBP104	**Methods in Biophysics** Total Lectures:60	4
Unit I: **Spectroscopy**: Principle, instruments and application of spectroscopic instruments: UV Visible: absorption of light, radiation sources, sample holders, monochroamtors, radiation detectors, single and double beam instruments, Colorimeter. IR spectroscopy: Rotational and vibration spectra, Instrumental features, applications. Raman: Raman effect, stokes and anti-stokes lines, advantages, applications. CD ORD principles and applications. Fluorescence: Fluoresces and phosphorescence phenomenon, quenching, energy transfer, and applications. Atomic absorption spectroscopy: Principle and instrumentations. (**15L)**		
Unit II: **Microscopy**: Principle, instrumentation and application of Microscopy, image formation, magnification, resolving power. Different types of Micrscopy: Dark field ,Phase contrast, polarization microscopy, Fluorescence, Electron microscopy: Electron guns, Electron lens, (**15L)**		
Unit III:Separation techniques I: Electrokinetics methods: electrophoresis, electrophoretic mobility (EPM), factors affecting EPM, Paper, PAGE, Capillary, Iso-Electric focusing, applications in biology and medicine. (**15L)**		
Unit IV: Separation technique II: HPLC: mobile phase systems, modes of operations, application, Hydrodynamics method: fundamental principles, Centrifugation, Ultracentrifugation and their applications in molecular weight, size determination. Viscosity and its application (**15L**)		
References 1. Methods in Molecular Biophysics, Igor N S, N Zaccai & J Zaccai, (2007) Cambridge 2. Principle of Biochemistry, D Voet, J Voet and CW Pratt, 3rd Ed, 3. DNA Clonning, Grover Vol. I, II, III 4. Advanced Methods in Protein Microsequencing, Witmann 5. Essential Biophysics, Narayanan, New Age Publ 6. Handbook of Molecular Biophysics (Methods & Application), 2009, HG Bohr, Wiley		

Semester II Detail Syllabus

Course Code	Title	Credits
PSBP 201	**Molecular Biophysics** Total lectures:60	4
Unit I: Principles of proteins structure and confirmations: Basics problems of protein structure, Polypeptide chain geometrics, estimates of potential energy, results of potential energy calculations, hydrogen bonding, hydrobhobic interactions and water as universal solvent in biological systems, Disruption of hydrophobic interactions by urea, ionic interactions, hydrophobic versus ionic interactions, Disulfide bond, Ways of pairing N-half cystine, formation of specific disulfide link, prediction of protein structure. (**15L**)		
Unit II: Protein structure & stability: Two state model of protein stability, chemical denaturation and stabilization, surface denaturation. Principles of ionization equilibrium ionization of side chain, equilibria in proteins. Predicting properties from amino acid composition, Usual amino acids. Primary structure sequencing of polypeptide, hemoglobin, homologies in proteins, Secondary structure alpha and beta confirmation, 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. Protein folding rules, pathways and kintetics. (**15L)**		
Unit III: Structure of Nucleic Acids: Ionization equilibria of nuclosideand nucleotides: compositions of nucleic acid, Chargaff's rule in DNA, RNA base compositions, Primary structure, Covalent chain structure, secondary structure inferences from RNA sequence comparisons, sequence information and analysis of structure function. Structure DNA & RNA **(15)L**		
Unit IV: Molecular distribution and statistical thermodynamics: Binding small molecule by polymer, identical and independent site model, nearest interaction and statistical weight, cooperative binding, anticoperative binding and excluded site binding. The random walk, Helix coil transition in protein. (**15**)		
References: 1. Biophysical Chemistry, The Behaviour of biological macromolecules, Vol I,II, III, Cantor and Schimmel, (2008), W H Freeman & Co 2. Applied Biophysics, A Molecualr Approach for Physical Scientist, Tom A Weigh, (2007), Wiley 3. Introduction to Protein Sciences, Arthur M Lesk (2004), Oxford Press 4. Molecular and Cellular Biophysics, Meyer B Jackson (2006), Cambridge) 5. Chemical Biophysics, Daniel A Beard and Hong Q (2008), Cambridge Univ Press 6. Proteins Structure & Function, David Whitford (2005), Wiley 7. Introduction to Protein Structure, Carl Brenden & Jhon Tooze (1999), Garland Publ, NY 8. Essentials of Biophysics, P Narayanan (2005), New Age Publ. 9. Physical Chemistry for Biomedical Sciences, S R Logan, (1998), Taylor & Francis. 10. Handbook of Molecular Biophysics (Methods & Application), 2009, HG Bohr, Wiley **11.** Principal of Protein Structure, GE Schulz, RH Schirmer (2004), Springer		

Course Code	Title	Credits
PSBP 202	**Biochemistry** Total Lectures: 60	4
Unit I: ***Hormones and its action*****:** Adrenocortical hormones, Thyroid hormones, Insulin, glucagan. Action of cAMP/cGMP, G protein and G protein family receptor, G protein cascades, c-AMP and protein kinase, protein phosporylation, Inositol triphosphate and DAG signals. (**15L**)		
Unit II: ***Replication and Repair*****:** A B & Z DNA structure, major & minor groves in DNA, Protein DNA interactions, supercoiling of DNA, Topoisomerase I and relaxed DNA, DNA gyrase, eukaryotic gene. Replication in vivo, semi-conservative mechanism of replication. Direction of replication. Discovery of DNA polymerase I and its function. DNA synthesis in vitro, other DNA polymerase, role of various proteins/enzymes in DNA synthesis. Model of DNA synthesis, molecular basis of mutations, DNA repair mechanism, reverse transcription. (**15L)**		
Unit III: Transcription & ***Translation***: RNA polymerase and its action, promoter sites of DNA template, sigma factor, elongation and termination of RNA chain, processing of precursors-RNA,sn-RNA and tRNA, mRNA. RNA polymerase I and transcription of mRNA in eukaryotic cells. Transcription factors in eukaryotes. Ribozyme and self splicing, genetic code-discovery and silent features. Recent advances, amino acid activation, fidelity of aminoacyl, tRNA synthesis, tyrosyl AMP complex, tRNA structure and function. Ribosomal RNA structure, Architecture of EM and neutron diffraction. Initiation of protein synthesis, translocation and peptide bond formation, termination and stop codon, protein synthesis in eukaryotes. (**15L**)		
Unit IV :**Regulation of Gene expression in prokaryotes & Eukaryotes**: Operator-operon concept, Negative and positive control of transcription with example of lac operon and Arbinose operon. Control of transcription, control of regulatory protein, transcription termination, repressor, cro protein. Eukaryotic RNA, role of histone, nuclosome, bidirectional replication, repetitive DNA, transcriptiona; factor IIIA. Ligand receptors interaction**:** Kinetics model based on steady state assumptions, allosteric interactions and co-operative behavior regulation and control system in biology. (**15L**)		
Reference: Molecular cloning by Maniatis Vol. I, II, III DNA cloning by Glover vol. I, II, III Genome analysis a practical approach by devis. Protein engineering practical approach by Reas. Advanced method in protein micro sequence by Witmannn. Principles of Biochemistry, Leninger (2008(, Freeman Publ		

Course Code	Title	Credits
PSBP203	**Molecular Biology & Protein Engineering** Total Lectures: 60	4
Unit I: ***Preparation, analysis of DNA & Enzymatic Manipulation of DNA & RNA*** : Genomic DNA from mammalian tissue plant tissue and bacteria resolution recovery of large and small fragments of DNAS using various Electromagnetic techniques chemical synthesis of oligonuleotides genes and their uses analysis of DNA'S sequences by blotting and hybridization. Restriction endonuclease and mapping Enzymes for modification and radioactive labeling of nucleic acids, construction of hybrid DNA molecules. Polymerase chain reaction. Preparation and analysis of RNA (**15L**).		
Unit II: ***Construction of Recombinant DNA libraries***: Genomic and c-DNA libraries preparation of inserting DNA from genomic DNA and RNA production of library and amplification. Screening of Recombinant DNA Libraries: Screening by DNA hybridization Immunological assay and protein activity. ***In vitro Mutagensis:*** Mutagenesiss with degenerate oligonuleotides region specific Mutagenesis linker scanning Mutagenesis. ***Introduction of DNA into Mammalian cell and System for study of cloned Genes***: Transformation of DNA using calcium Phosphate DEAE Dextrin and Elecroporation and its optimization and uses. Bacterial Yeast expression vectors gene transfer Into cultured cells. Development and use of transgenic animals. Manipulation and gene Expression in prokaryotes, Heterogeneous protein production in eukaryotic cells (**15L**)		
Unit III*:**Micro sequencing Methods for proteins; Engineering proteins for purification***: Modern advancement such as Tar Sequencing Strategies. DABITC/ PITC methods. Solid phase mirosaequencing; Fast atom Bombardment (FAB) mass spectra in protein sequencing. Choice of purification tag, Enzyme purification Tags. Affinity purification tag, ion exchange, hydrophane IC, covalent and chelae Purification tags; PEG enzyme and PEG enzyme conjugates.(**15L**)		
Unit IV: ***Chemical Approach to protein Engineering***; ***protein engineering for thermo stability***: Functional group modification chimerical Protein, protein engineering of Ab, combing sites, Directed Mutagenesis and protein Engineering. Directed Mutagenesis procedure adding disulfide bonds changing asparaging to other amino acid, reducing number of free sulphydryl residues increasing /modifying Enzyme activity/specificity. Chemeric antibody replacement of FC domains, catalytic Antibodies (enzymes) idiotype vaccines. Hybridoma technology. stability estimates from denaturation curve , Engineering physical and biology properties of protein by chemical modification, Antibody and site Mutagenesis, supercritical fluid in protein extraction (**15L**)		
Reference:		

1. Molecular Clonning,Sambrook and Russell Vol 3, Cold Sprong Harbour lab press 2. Molecular and Cell biology, Lodish et al, (2004) Freeman 3. Electrophoresis in Practice, Reiner Westermeirer, (2005) Wiley 4. Methods in Molecular Biophysics Igor N S et al (2007), Wiley 5. Molecular cloning by Maniatis Vol. I, II, III 6. DNA cloning by Glover vol. I, II, III 7. Genome analysis a practical approach by devis. 8. Protein engineering practical approach by Reas. 9. Advanced method in protein micro sequence by Witmannn. 10. Principles of Biochemistry, Leninger (2008(, Freeman Publ	

Course Code	Title	Credits
PSBP204	**Membrane Biophysics** Total lecture: 60	4
Unit I*: **Membrane structure and Models***: Membrane architecture, Lipid vesicles and planar Bilayer membrane, Membrane permeability, Membrane Channels, transmembrane helices, hydropath 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, Lipid bilayer and early models, Fluids mosaic model, Evidence from model system and biomembranes. (**15L)**		
Unit II: ***Physical Properties of membrane***: Elastic properties, Elastic constants, Charge-induced microstructures and domain. Hysteresis of domain formation. Lateral phase separation. Critical concentrations fluctuation, selective lipid protein interactions, Membrane melting. **(15L)**		
Unit III: ***Membrane transport***: Transport system with non-electrolytes and electrolytes. Transport with chemical reaction system: Primary and secondary active transport. Transports of molecules by simple and facilitated diffusion Transport by flux coupling. Transport by phosphotransferase system, Transport by vesicle formation **Electron Transport & Oxidative phosphorylation**: Reduction potentials and free energy changes in redox reaction, organization of electron transport chain, chemiosmotic coupling, proton gradient drive and synthesis of ATP, P/O ratio for oxidative phosphorylation, Cytosolic NADH electron feeding into electron transfer (**15L)**		
Unit IV: Membrane potentials & Lipid Membrane Technology: Cell surface charge, Resting membrane potential, Action potential, properties of action potential, Nernst equation, Hodgkin-Huxely equation, Membrane impedance and capacitance, Transmembrane potential, Zeta, stern and total electrochemical potential, Historical perspective of lipid model systems lipid monolayer. Liposomes: small and		

large unilamellar and multilamellar vesicles, planner lipid bilayer, Application of liposomes in biology and medicine. (**15L**)	
References: 1. Molecular & Cellular Biology, D Roberties, 2. Biophysical Aspects of Transmembrane signaling, Sandor D (2005), Springer 3. Biophysics, Vasant Pattabhi, Gautam (2002), Narosa 4. Biomembrane structure and Function, Chapman D. 5. Introduction to Biological Membrane, Jain R K 6. Biophysics, Hopp, Lohman, Mark and Ziegler 7. Advances in Biophysics, Vol 18, 15 8. Molecular and Cellular Biophysics, Meyer B Jackson (2006), Cambridge) 9. Text Book of Physiology, Guyton & Hall, 11^{th} Ed. 2006	

Annexure A

Additional Book for References

Access No.	Title of the Book	The Author's Name
1	Principal of biostatistics 2eld	Pagno
2	DNA Micro arrays : a molecular cloning manual	Browtell
3	Introduction to protein structure 2eld	Branden
4	Guidebook on molecular modeling in drug design	cohen
5	Electrophoresis	Desai
6	Radioactive releases in the environment	copper
7	An Intro. To biomechanics.	Humphrey
8	Biophysics : An Intro	cotterill
9	Principal of fluorescence spectroscopy 3 eld	lokowicz
10	Protein targeting transport and translocation	Dalbey
11	Practical protein crystallography 2eld	MC.Ree
12	Molecular genetics of bacteria 4eld	Dale
13	Biophysics	pattabhi
14	Biophysical aspects pf transmembrane	Damjanovich
15	Drug discovery and development	Rang
16	Textbook of Biophysics	Roy
17	A short intro to biomedical engineering	Sarbadhikari
18	Practical capillary electrophoresis 2 eld.	Weinberger
19	Essential pf genomics and bioinformatics	sensen
20	Biophysics	subramaniam
21	Protein structure & predication	Tramontano
22	Bioinformatics of Genome Regulation and structure	Kolchanov
23	Essential bioinformatics	Xing
24	Introduction to Bioinformatics	Lesk
25	Introduction to Bioinformatics	Attwood
26	Functional Genomics	hunt
27	Bioinformatics Technologies	Chen
28	Micro array Bioinformatics	Stekel
29	Basic Biostatistics and its App.	Datta
30	Quanti Protein by mass Sep.Euro	Sechi
31	Vides Gene.Reg. and Met	Collada
32	Essential of biophysics	Narayanan
33	Micro for an integrative genomics	Kohane
34	Physical chemistry for the Biomedical science	Logan
35	Structural biology	Teng/Springer
36	Water and the cell	Pollack/springer
37	NMR-MPI USR & moss Bauer spectroscopies in molecular magnets	Lascialfari-Springer
38	Modeling in molecular biology	Cio banu-springer
39	Chemical Biophysics, Quantitative Analysis of cellular system	Beard