

UNIVERSITY OF MUMBAI



Syllabus
for
Semester III & IV
Program: M.Sc.
Course: Biophysics

(Credit Based Semester and Grading System with
effect from the academic year 2013–2014)

M.Sc. Biophysics Semester III & IV
(Credit Based Semester & Grading system)

Semester III

Paper code	Paper nomenclature	Lectures	Credit	Practical Paper No & Code	Hrs	Credit	Total Credit
PSBP 301	Physiological Biophysics	60	04	Paper I (PSBPP 301)	60	02	06
PSBP302	Bio crystallography & Magnetic Resonance Techniques	60	04	Paper II (PSBPP 302)	60	02	06
PSBP303	Radiation Biophysics	60	04	Paper III (PSBPP 303)	60	02	06
PSBP304	Advanced in Biophysical Techniques	60	04	Paper IV (PSBPP 304)	60	02	06
	Total						24
	Semester IV						
PSBP 401	Medical Biophysics	60	04	Paper V (PSBPP 401)	60	02	06
PSPBP 402	Nanomaterials in biology and medicine	60	04	Paper VI PSBP 402	60	02	06
PSBP403	Elements of Bioinformatics & Chemoinformatics	60	04	Paper VII (PSBPP 403)	60	02	06
PSBP404	Molecular Modelling & Drug design	60	04	Paper VIII (PSBP 404)	60	02	06
	Total						24
	Grand Total (Sem III & IV)						48

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

Evaluation: The students will be evaluated internally and externally. The internal evaluation is done by teachers 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 III & IV
Credit Based and Grading System

To be implemented from the Academic year 2013-2014

SEM: III

Theory Papers

SEMESTER III

Paper IX : Physiological Biophysics

Course Code	UNIT	TOPIC Heading	Lectures	Credits
PSBP301	I	Biophysics of Nerve & Muscle:	15	04
	II	Biophysics of Circulatory & Excretory system:	15	
	III	Biophysics of respiration	15	
	IV	Biophysics of special senses	15	
		Total	60	

Paper X: Bio Crystallography & Magnetic Resonance Techniques

Course Code	UNIT	TOPIC Heading	Lectures	Credits
PSBP302	I	NMR Spectroscopy	15	04
	II	ESR Spectroscopy	15	
	III	X-ray diffraction of the macromolecules: Concept of crystallization	15	
	IV	Fibre Structure Determination	15	
		Total	60	

Paper XI: Radiation Biophysics

Course Code	UNIT	TOPIC Heading	Lectures	Credits
PSBP303	I	Elements of Nuclear Physics	15	04
	II	Interaction of Radiation with Matter:	15	
	III	Interaction Of Radiation with Living Cells	15	
	IV	Biological Effects of Radiation:	15	

		Total	60	
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Paper XII: Advanced Biophysical Techniques

Course Code	UNIT	TOPIC Heading	Lectures	Credits
PSBP304	I	Advanced Spectroscopy	15	04
	II	Advanced Microscopy I	15	
	III	Advanced Microscopy II	15	
	IV	Immunotechniques	15	
		Total	60	

Practical Papers

Course code	Title	Credits
PSBPP 301	Physiological Biophysics	02
PSBPP 302	Structural Biophysics	02
PSBPP 303	Radiation & Medical Biophysics	02
PSBPP 304	Review of Literature & Viva Voce	02
	Total	08

Syllabus details

SEMESTER III

Paper IX: Course code: PSBP 301: Title: Physiological Biophysics

Course Code	Title	Credits: 04
PSBP 301	Physiological Biophysics	Lectures: 60
Unit I: <i>Biophysics of Nerve & Muscle:</i>		15 lectures
<p>Structure of nerve, classification of nerves, myelinated and non-myelinated nerve, generation of nerve impulse, propagation of nerve impulse, synapse, synaptic transmission, Inhibitory post synaptic potential (IPSP), excitatory post synaptic potential (EPSP), glial cell, blood brain barrier, Brain Waves (EEG) : origin of alpha, beta, delta & theta, sleep and wakefulness. Regulation of body temperature by physical, chemical & neural mechanisms, acclimatization.</p> <p>Molecular structure of skeletal, cardiac and smooth muscle, motor unit, molecular basis of muscle contractions (isometric, isotonic & lengthening), work done by muscle, excitation contraction coupling, properties of muscle, neuromuscular transmission, Electromyography.</p>		
Unit II: <i>Biophysics of Circulatory & Excretory system:</i>		15 lectures
<p>Initiation and conduction of cardiac impulse, Electrocardiogram (ECG) and its characteristics, Hemodynamic principles, Physics of Blood viscosity, specific gravity, physics of plasma and serum. Different blood vesicles present in the vascular system, arterial blood Pressure, measurement, effect of hydrostatic pressure on arterial and venous blood pressure, blood volume, blood flows (laminar & turbulent), Reynolds number. Peripheral resistance and its role in vascularity. Cardiac output, factors affecting cardiac output (Exercise, Haemorrhage & blood pressure), myocardial infarction.</p> <p>Structure of nephron, glomerulus, tubules. Tubular functions: Reabsorption & Excretion. Osmotic equilibrium: maintenance of osmotic pressure, regulation of body fluid osmolarity. Glomerular filtration rate and factors affecting it, oedema. Function of kidney (autoregulation, acid base balance). Renal blood flow.</p>		
Unit III: <i>Biophysics of respiration:</i>		15 lectures
<p>Introduction to respiratory system, structure of lungs, diffusion, exchange and transport of gases, physics of pulmonary circulation, perfusion and ventilation. Control of respiration (neuronal & chemical), lung capacities and volumes, lung function tests. Effect of altitude changes on body, high altitude- mountain sickness, low altitude- deep sea diving, adaptive changes, effect of changes in gravitational forces on body (space, aviation), adaptive changes</p>		

Unit IV: Biophysics of special senses: 15 lectures

Structure of the eye, Optics of Vision: refraction, refractive errors, visual acuity, monocular & binocular vision, size of image, role of ocular lens, cataract formation, retinal pigments, rods and cones, Photochemistry of vision, visual cycle. Neurophysiology of vision, colour vision, visual pathway, blindness. Structure of ear, physics of audition (amplitude, frequency, pitch), unit of measurement of sound, intensity, conduction of sound through bone ossicles, impedance matching. Role of inner ear (cochlear mechanism), mechanisms of hearing, detection of localization of sound (direction), loudness of sound (amplitude), discrimination of pitch of sound, Audiometry, deafness, hearing aids. Taste & Smells: taste receptors & their role, conduction, pathway of smell. Balance & Rotation: Biophysics of posture movement, organisation of vestibular apparatus, mechanical sensors, fluid dynamics of semicircular canals, role of utricle, saccule & otolith organs, importance of vestibular function.

Paper X : Course Code : PSBP 302: Bio crystallography & Magnetic resonance techniques

Course code	Title	Credit:04
PSBP 302	Bio crystallography & Magnetic resonance techniques	Lectures: 60
Unit I: NMR Spectroscopy: 15 lectures Modern techniques for structure elucidation FT and FFT Nuclear over Hauser effect. Basic 2D Spectroscopy benefits of 2D experiments (COSYNOESY). Assignment problem in biopolymers, Ligand binding to macromolecules, Chemical exchange, ¹ H NMR spectroscopy, monitoring of cellular pH, gradient in tumor cells etc. Fluidity gradient in lipids, chemical shift, anisotropy of P resonance in membranes		
Unit II : ESR Spectroscopy: 15 lectures Spin labeling: a reporter group technique requirement of such a group, Nitro-oxide spin label probes and their molecular structures, anisotropy of order parameters, dynamics information obtained from ESR molecular polarity from biochemical data, orientation and Intra-molecular distances. Applications of these concepts to studying the structure and function of enzyme i.e. lysozyme etc. (ii) conformational changes in trypsin, spin labeled ligands as probe for binding sites, lipid spin label in the biological membranes		
Unit III: X-ray diffraction of macromolecules: 15 lectures Bragg's law, Parameters governing crystallization of proteins 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: 15 lectures 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

Paper XI: Course Code: PSBP 303: Title: Radiation Biophysics: PSBP 303

Course code	Title	Credit:04
PSBP 303	Radiation Biophysics	Lectures: 60
<p>Unit I: <i>Elements of Nuclear Physics:</i> 15 lectures</p> <p>Structure of atom. Nuclear Nomenclature. Atomic Mass and Energy Units, Atomic Energy Levels, Nuclear Forces, Particulate and Electromagnetic Radiation, Wave Model and Quantum Model, Radioactivity. Alpha, Beta and Gamma Radiation. Radioactive series. Decay law, Half-life, Mean-life, Biological half-life, Effective half-life, Modes of Radioactive Decay, Nuclear Reactions, Neutron activation, production of medically important isotopes using cyclotron.</p>		
<p>Unit II: <i>Interaction of Radiation with Matter:</i> : 15 lectures</p> <p>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.</p>		
<p>Unit III: <i>Interaction Of Radiation with Living Cells:</i> 15 lectures</p> <p>Critical Target, Direct and Indirect Effects of Radiation, Nature of the Damage Induced by Radiation, Models of Cell survival, Target Theory and Linear Quadratic Model, Modification of Cell Survival by LET, Oxygen, Chemicals, Cell Stage, Dose Rate, Dose Fractionation and Hyperthermia. Repair and Recovery. Basis of Radio Sensitivity of Cells. DNA Content and Radiosensitivity, Law of Bergonie and Tribondeau, Induction of Mutations and Chromosomal Aberrations, Assessment of DNA damage by single cell gel electrophoresis, Application of CA analysis in Biodosimetry.</p>		
<p>Unit IV: <i>Biological Effects of Radiation:</i> : 15 lectures</p> <p>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</p>		

Radiation Protection Standards, Maximum Permissible Limits For Radiation Exposure

Paper XII: PSBP 304 : Advanced Biophysical Techniques

Course code	Title	Credit:04
PSBP 304	Advanced Biophysical Techniques	Lectures: 60
<p>Unit I: Advanced Spectroscopy: Basics of Fluorescence correlation spectroscopy, fluorescent speckle microscopy, Image correlation spectroscopy, single molecule tracking in cell biophysics. Principle and Methods of ultrafast structural dynamics of biological systems, Mass Spectrometry: Principle of ionization, separation analysis, structural and functional proteomics, chemical labelling approach, structural mass spectroscopy (15Lectures)</p>		
<p>Unit II: Advanced Microscopy I: Principles, methodology and application of confocal microscopy, Atomic Force Microscopy (AFM). Raman & IR Microscopy, CARS microscopy. (15 lectures)</p>		
<p>Unit III: Advanced Microscopy II: Principle and methodology & applications of electron microscopy, structure determination of macromolecular complexes by cryo-electron microscope, analysis of 2D crystal by electron microscopy. Cryo electron microscopy & tomography of virus particles. Fundamentals of LASERS, FRET, Patch Clamp technique, Fast flow kinetics in enzyme catalysis. (15 lectures).</p>		
<p>Unit IV: Immunotechniques: Classifications of antibodies, immune reactions, Polyclonal, monoclonal antibodies, generation of antibodies, application of hybridoma technology. Techniques based on antigen-antibody reaction. Principles, methodology & applications of Ouchterlony immunodiffusion, immunoelectrophoresis, immunoaffinity, chromatography, rocket immunoelectrophoresis, radioimmunoassay (RIA), Enzyme linked immune sorbent assay(ELISA), Dotblot, immunoelectron microscopy. (15 lectures).</p>		

SEMESTER III Practicals

Course Code	Title	Credits
PSBPp301	<p style="text-align: center;">Structural Biophysics</p> <ol style="list-style-type: none"> 1. Study of ligand binding interaction using Surface Plasmon Resonance Analyzer (SPR) (Demonstration). 2. Damage to plasmid pBR 322 DNA and its observation under UV transilluminator 3. Study of DNA damage by comet assays 4. Observe DNA damage under fluorescence microscope. 5. Preparation of samples for fluorescence images and their observation. 6. Determination of partition coefficient of amino acids and hydrophobicity/ association studies. 7. Protein folding using denaturation by urea and refolding/renaturation of RNAase. 8. Preparation and staining of microtome sections of mammalian tissues (Demonstration) 9. Circular Dichroism and determination of alpha helicity (Demonstration) 	2
PSBPp 302	<p style="text-align: center;">Title: Physiological Biophysics</p> <ol style="list-style-type: none"> 1. Study of surface potentials (EEG, ERG, EMG, EOG, ECG etc) of human subjects. 2. Study of pulmonary functions. 3. To study the velocity of nerve impulse 4. Study of evoked potentials in human and animal subjects 5. Study of cardiopulmonary test/ Heart Rate recovery 6. Measurement of BP and Pulse in human subjects 7. Study of reaction time in human subjects 8. Study of Ergography 9. Study of hearing response to different frequency in human subject. 10. PCV, MCV, ESR 	2
PSBPP303	Radiation & Medical Biophysics	2

	<ol style="list-style-type: none"> 1. To study the characteristics of GM tube and determination of its operating voltage. 2. To verify inverse square law of gamma/uv rays 3. To study the nuclear counting statistics 4. To determine linear and mass attenuation co-efficient using gamma source for aluminium, lead and copper. 5. Estimation of efficacy of the GM detector for gamma and beta source 6. To study Beta particle range and maximum energy 7. To measure short half life of radiation source 8. To measurement of UV radiation dose by chemical and physical methods 9. To determine gamma radiation dose using Fricke Dosimeter. 10. Effect of UV radiation on bacterial /mammalian cell survival. 	
PSBPP304	Review of literature & viva voce	2

SEMESTER IV
Theory Papers

SEMESTER IV

Paper XIII : Medical Biophysics

Course Code	UNIT	TOPIC HEADINGS	Lectures	Credits
PSBP401	I	Biophysical Aspects of Radiotherapy	15	04
	II	Physics of Radiotherapy, Nuclear Medicine and Diagnostic Radiology	15	
	III	Introduction to Nuclear Medicine	15	
	IV	Basic Radiation Protection	15	
		Total	60	04

Paper XIV: Nanomaterials in Biology & Medicine

Course Code	UNIT	TOPIC HEADINGS	Lectures	Credits
PSBP402	I	Introduction	15	04
	II	Biosynthesis and characterization of Nanomaterials	15	
	III	Nanotoxicology	15	
	IV	Applications of nanomaterials in biology & Medicine	15	
	Total	60	04	

Paper XV: Elements of Bioinformatics & Chemoinformatics

Course Code	UNIT	TOPIC HEADINGS	Lectures	Credits
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PSBP403	I	Introduction	15	04
	II	Phylogenetics & Structural Bioinformatics	15	
	III	Elements of Genomics & Proteomics	15	
	IV	Elements of Chemoinformatics	15	
		Total	60	04

Paper XVI: Molecular Modelling & Drug design

Course Code	UNIT	TOPIC HEADINGS	Lectures	Credits
PSBP404	I	Molecular mechanics & conformational analysis	15	04
	II	Molecular docking & Energy minimization	15	
	III	de novo ligand design & 3D –QSAR	15	
	IV	Pharmacopore Modeling & Virtual screening	15	
		Total	60	04

Practical Papers

Course code	Paper title	Credits
PSBPP 401	Nanomaterials in Biology & Medicine	02
PSBPP 401	Bioinformatics, Molecular Modeling & Simulation	02
PSBPP 403	Methods in Biophysics	02
PSBPP 404	Research Project & Viva-voce	02
	Total	08

Syllabus details

SEMESTER IV

Paper XIII: MEDICAL BIOPHYSICS : PSBP 401

Course code	Title	Credit:04
PSBP 401	MEDICAL BIOPHYSICS	Lectures: 60
<p>Unit I: Biophysical Aspects of Radiotherapy: 15lectures Tumour Biology, Growth Kinetic Factors, Cell Cycle, Potentially Doubling Time, Volume Doubling Time, Cell Loss Factor, Studies with Transplanted Tumour System, Basis of Fractionated Radiotherapy, Brachytherapy, 4 R's of Fractionated Radiotherapy, Causes of Clinical Radioresistance and Approaches to Overcome Radioresistance. New Modalities of Radiotherapy, Light Ion Particles, Neutrons, Boron Capture Therapy, Radiolabelled Immunotherapy, Recent Developments, Bio- Effect Models for Radiotherapy, Strandquist's Cube Root Rule, NSD, TDF, BED, Application of LQ Model in Developing Bio-effect Models for Radiotherapy</p>		
<p>Unit II: Physics of Radiotherapy and Diagnostic Radiology: 15 lectures Physical Principles of X-Ray Diagnosis - Interactions of X-Rays with Human Body, Differential Transmission of X-Ray Beam, Spatial Image Formation, Visualization of Spatial Image, Image Quality - Density, Contrast, Detail and Definition Of Radiographs, Choice of kV, mA, Filtration, FSD, Screens, Films, Grids, Contrast Media. CT Scanners and Their Applications, Overview of Digital Subtraction Radiography and Mammography. Scope of Radiotherapy - Beam Therapy and Brachytherapy, Construction and Working Principles of Radiotherapy Delivery Devices - Telecobalt Unit, Medical Electron Linear Accelerator, Remote after Loading Brachytherapy Units, Output and Source Strength Measurements, Central Axis Dosimetry Parameters, Overview of Modern Radiotherapy Techniques, Need and Necessity of Quality Assurance Programme in Radiotherapy.</p>		
<p>Unit III: Introduction to Nuclear Medicine: 15 lectures Unsealed Sources, Production of Radionuclides Used in Nuclear Medicine - Reactor and Accelerator Based Radionuclides, Radionuclide Generators and their Operation Principles, assessment of radiochemical purity of radiopharmaceutical, particle sizing, stability & pyrolysis testing. Principle of localization & usages of radiopharmaceuticals, General Concepts of Radionuclide Imaging. Principal of dynamic studies in radiation medicine imagine of their various</p>		

body organs. Physics of Positron Emission Tomography and Cyclotron, Operational Characteristics of Scanners, Magnetic Resonance Imaging. Absorption Studies using labelled Compounds, Quality Control in Radiation Medicine .

Unit IV: Basic Radiation Protection : 15 lecture

Basic Principles of Radiation Protection, Justification, Optimization and Dose Limitation. Practical Aspects of Implementation of Radiation Protection in Medical Applications, Regulatory Aspects of Radiation Protection. Medical radioprotection in children.

Diathermy: shortwave & microwave diathermy, thermal response of tissues, use of diathermy in therapy. Effect of heat and cold on body tissues, application in therapy and contradiction for use.

Paper XIII: PSBP : Nanomaterial in Biology & Medicine

Course code	Title	Credits: 04
PSPB402	Nanomaterials in Biology & Medicine	Total Lectures:60
Unit I: Introduction:		15 lectures.
Origins of nanotechnology, nanoscience, the unit nanometer, Types of nanomaterials, Silver, Gold, Zinc oxide, quantum dots, CdSe, dendrimers, nanotubes, nanocrystals etc. Properties of nanomaterials (optical, magnetic, electric, thermal, mechanical, catalytic etc), Nanomotors in biological system: ATP synthase, flagellar motor in bacteria, etc.		
Unit II: Biosynthesis and characterization of Nanomaterials:		15 lectures
Concepts of bottom- up approach, top-down approach. Principles of gas & liquid phase synthesis of nanoparticles, Introduction of synthesis of nanoparticles using physical, chemical and biological route. Synthesis of various nanomaterials from bacteria, fungi, plants, algae, DNA & protein templates etc.		
Sample preparation, visualization of nanoparticles by Scanning Electron Microscope, Transmission Electron Microscope, Atomic Force Microscope, X-ray diffraction, light scattering techniques. Electron photon interactions in Raman Spectroscopy of Nanostructures- FTIR.		
Unit III: Nanotoxicology:		15 Lectures
Interaction of nanoparticles with biological systems likes Cells, Cell membrane, tissues, proteins, DNA , RNA, Enzymes etc, impact on structural and functional properties of biological molecules. Pharmaceutical developments based on cytotoxicity of nanoparticles: supermolecular strategies and study of biological interactions, Nanoparticles and immune		

system, biocompatibility and health effects of nanoparticles.

Unit IV: Applications of nanomaterials in biology & Medicine: 15 Lectures

Functionalization of nanoparticles, chemical sensor, biosensors, drug delivery, nanoprobe, nanocomposite in tissue engineering. Nanoparticles for gene delivery system and targeted drug delivery, antibacterial, antiviral and antifungal agents, neurodegenerative disorder etc. Nanoparticles for diagnosis, implants & prostheses, biodefence.

Paper XV: : PSBP403 : Elements of Bioinformatics & Chemoinformatics

Course code	Title	Credits: 04
PSBP403	Elements of Bioinformatics & Chemoinformatics	Total Lectures:60
<p>Unit I Introduction: Introduction to Bioinformatics and Biological databases, Major Bioinformatics Resources, Types of databases, Sequence databases: formats, organisation and query systems, Nucleotide sequence databases and protein sequence databases, Information & retrieval from biological databases : Database Search algorithms – FASTA & BLAST.</p> <p>Gene prediction: Gene prediction programs in prokaryotes and eukaryotes.</p> <p>Promoter & Regulatory Elements Prediction: Program for promoter and regulatory elements prediction in prokaryotes and eukaryotes. (15L)</p>		
<p>Unit II Phylogenetics & Structural Bioinformatics: Terminology, forms of tree representation, gene phylogeny vs species phylogeny. Molecular phylogeny methods – distance based, character based; programs for construction of phylogenetic trees.</p> <p>Structural Bioinformatics: Pair-wise and multiple sequence alignment, Sequence alignment algorithms, Pairwise alignment algorithms (Global & Local), Multiple sequence alignment, Sequence identity, similarity and homology concepts, scoring matrices, scoring functions, algorithms, profiles and HMMs, prediction of protein motifs and protein domains, derived databases : patterns, profiles, motif and domain. Prediction of secondary and tertiary structure of proteins, homology modelling, threading, ab initio prediction. (15L)</p>		
<p>Unit III Elements of Genomics & Proteomics:</p> <p>Genome mapping, assembly and comparison Functional Genomics - sequence based, micro-array based approaches.</p> <p>Proteomics – protein expression analysis, posttranslational modification, protein-protein interaction (15L)</p>		
<p>Unit IV Elements of Chemoinformatics:</p> <p>Representation of molecular structures –Graphs, connection tables, linear notations, canonical representation, Structure and substructure searching algorithms, Reaction databases, representation of patents and patent databases, Relational databases for molecules. (15L)</p>		

Paper XVI: Molecular Modeling and Drug Design: PSBP 404

Course Code	Title	Credits: 04
PSBP 404	Molecular Modelling & Drug Design	Total Lectures :60
<p>Unit I: Molecular mechanics & conformational analysis: Molecular Mechanics and the forcefield. General form of a generic force field, force field parametrization. Comparison between the different forcefields in existence at present time Conformational analysis: Systematic search, Monte Carlo simulations, Molecular dynamics simulations, distance geometry, strengths and limitations of each method</p>		
<p>Unit II Molecular docking & Energy minimization: Docking by energy minimization, superimposition, molecular dynamics, Metropolis Monte Carlo, genetic algorithms, build-up approach. Different types of scoring function, examples of successful application of docking Energy minimization: Steepest descents, conjugate gradients, Newton Raphson method, advantages and limitations of each method.</p>		
<p>Unit III: de novo ligand design & 3D –QSAR: Classes of de novo ligand design – active site analysis methods, whole-molecule methods, connection methods, random connection and disconnection methods, e.gs of successful application of <i>de novo</i> ligand design. Fragment based drug design, Successful applications of de novo drug design. 3D-QSAR: CoMFA and CoMSIA. Mention of other 3D-QSAR techniques and introduction to the 4th, 5th and 6th dimension in QSAR. 3D-QSAR methods other than CoMFA and CoMSIA.</p>		
<p>Unit IV Pharmacophore Modeling & Virtual screening: Techniques of developing a pharmacophore map covering both ligand based and receptor based approaches, incorporating additional geometric features into a 3D pharmacophore, use of a pharmacophore model in drug design,. Virtual Screening based on similarity, docking, pharmacophore maps and filters for drug-likeness and ADME.</p>		

Practical

<p>PSBPP401</p>	<p>Nanomaterials in Biology & Medicine</p> <ol style="list-style-type: none"> 1. Synthesis of metallic nanoparticles using physical methods (Silver, gold, Zinc oxide, TiO₂, Cd etc). 2. Synthesis of nanoparticles using chemical methods 3. Synthesis of nanoparticles using biological methods like Plants, organisms, proteins and DNA templates. 4. Characterization of nanoparticles using UV, Visible spectroscopy, Dynamic Light Scattering. 5. Characterization of nanoparticles using XRD, SEM & AFM etc (Demo) 6. To demonstrate interaction of nanoparticles with biological systems. 7. Biofunctionalization of nanoparticles 	<p>02</p>	
<p>PSBPP402</p>	<p>Bioinformatics, Molecular Modelling & Simulation.</p> <p>Bioinformatics, Molecular Modelling & Simulation.</p> <p>Database searches, exploring Bioinformatics resources – NCBI, EBI, ExPASy, PUBMED & Entrez.</p> <p>Nucleic acid sequence databases ;search & retrieval: Genbank, EMBL, DDBJ.</p> <p>Protein sequence databases: Uniprot KB, Genpept.</p> <p>.</p> <p>Database similarity searches & Pairwise sequence alignment – Global & Local.</p>	<p>02</p>	

	<p>BLAST suit of programs, FASTA versions.</p> <p>Multiple sequence alignment & Motif Detection</p> <p>Phylogenetic analysis: Constructing & Refining a Multiple Sequence Alignment, Constructing a distance based phylogenetic tree, Constructing a Maximum parsimony tree, Constructing a Quartet Puzzling Tree, Constructing a maximum likelihood tree using genetic algorithm, constructing a phylogenetic tree using Bayesian Inference.</p>		
PSBPP403	<p>Methods in Biophysics</p> <ol style="list-style-type: none"> 1. Isolation of chloroplast and study of evolution of oxygen by DCPIP method. 2. Isolation of chlorophyll from plant and its absorption spectra. 3. Isolation of subcellular particles and assays of markers enzymes using differential centrifugation method. 4. Kinetic study of enzyme inhibitors: Competitive and non-competitive. 5. Separation of biological samples using paper chromatography 6. Study of membrane equilibria and ligand binding studies by dialysis method. 7. Study of Biological samples by Raman Spectra and FTIR spectra. 8. To synthesize polyacrylamide using free radical initiator and to characterize using IR/Raman spectroscopy. <p>To study the rate of DNA polymerase reaction by Raman /IR spectroscopy.</p>	02	
PSBPP 404	Research Project & viva voce	02	

References:

1. Fundamental and Radiobiology (1966) 2nd Edition Bacq Z.H. Alexander P., Pergamon Press, New York.
2. Radiation Biophysics (1990) Alpen E.L. Printice hall, Engel Wood.
3. Radiation Chemistry (1973) Hughes G. Clarendon Press,
4. Polymers as Biomaterials Ed. By Shalaby W., Shalaby W. Plenum press, N, Y.(1984)
5. Introduction physics of nuclear medicine by Chandra, R.
6. Nuclear Medicine by Lelle, R.D.
7. Technology and interpretation of nuclear medicine procedures by Sodee. D.B. and Early, R.J
8. Nuclear Medicine by Wagner, H.N.
9. Medical physics by Cameron J.R.
10. Radiation Biology, Alison P. Casserette
11. Radiation Biophysics by J.Kiefer
12. Radiobiology for Radiation Therapy, by Eric Hall
13. Radiobiological Basis of Radiotherapy G.G.Steel
14. Radiation Protection, Shapiro
15. The Physics of Radiation Therapy, Faiz M. Khan
16. Molecular Modelling – Principles and Applications, Leach A. R., Prentice Hall.
17. Practical Application of Computer-Aided Drug Design, Ed. Charifson P., Marcel Dekker Inc.
18. 3D QSAR in Drug Design: Theory, Methods and Applications, Ed. Kubinyi H., Ledien ESCOM.
19. Molecular Modelling and Simulation -An Interdisciplinary Guide, Schlick T., Springer
20. Biomedical Nanotechnology, Neelina H. Malsch (2005), Taylor & Francis.
21. Nanochemistry, G B Sergeev,(2006), Elsevier.
22. Bioinformatics A Practical Approach, Shui Qing Ye (2008), Chappman & Hall/CRC.
23. Handbook of Biophotonics, Vol II, V. Tuchin, A. Chiou, S.tefan H, (2012) Wiley
24. Raman Spectroscopy, Fullerenes & Nanotechnology, Maher S Amer (2010) RSC Publ.
25. Introductory Biophysics, James C & J Q Tran (2011), John & Bartlet India Pvt Ltd
26. Biophysics A Physiological Approach, Patric F Dillon (2012) Cambridge Univ. Press
27. Comprehensive Biophysics, Volume I-IX, Edward H Egelman (2012) Elsevier.
28. Text Book of Medical Biophysics, Eleventh Edition, Guyton & Hall, Elsevier
29. Physiology, Biophysics and Biomedical Engineering , Andrew W Wood (2012) CRC Press
30. Introduction to experimental Biophysics, Jay Nadeau (2012) CRC Press
31. Methods in Molecular Biophysics, Igor N Serdyuk, N R Zaccari, Joseph Z (2007), Cambridge University Press.

Additional Books for reference

Annexure A

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