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Semester I
MBP101: General Biochemistry

UNIT-I
Some important properties of water, dissociation of water and its ion product, Kw, buffer and buffering capacity pH, Bronsted acids, ionization of weak acids and bases, Henderson Hasselbalch equation, Titration curves and buffering action, Goods buffer, water and intermolecular forces, thermodynamics in biochemistry, law of thermodynamics, Gibb’s free energy and biomolecules in water.

Unit-II
Amino Acids: Structure, properties, classification, function, ionization and characterization, naturally occurring modifications of amino acids in proteins, non-protein amino acids, structure of proteins: primary, Secondary (α-helix, β-Plated and random coils), peptide bond, Ramachandran plots and collagen structure, protein sequencing, protease mapping, characterization of peptides, tertiary and quaternary structures of proteins/enzymes.

Unit-III
Carbohydrates: introduction, classification, types, optical isomerism, muta-rotation, basic structure and functions of monosaccharides, oligosaccharides, polysaccharides, energy storage molecules-starch, glycogen, building blocks-cellulose, hemicellulose, and chitin. lipids: classification, structure, properties and function of fatty acids, triglycerides, phospholipids, glycolipids, sphingolipids, sterols, cerebrosides, steroids, prostaglandins, glycolipids and proteoglycans, carbohydrate metabolism, brief overview of glycolysis and Krebs cycle.

Unit-IV
Nucleic acids: nucleosides and nucleotides, primary structure of nucleic acids, structure, properties and functions of DNA and RNA, secondary and tertiary level organization, different DNA forms, conformation, super coiling, stereochemistry: nucleoside, torsion angles, sugar conformation, NMR study, DNA structure: different types of DNA and their structure, DNA motifs, DNA repeats and their significance, function and stability, spectroscopic study of DNA: dye binding, interaction, denaturation, and renaturation of DNA, thermal denaturation and Tm value, vitamins, coenzymes and other small molecules.

Suggested Books
MBP102: Computational Biology and Bioinformatics

Unit-I [12L]
Characteristics & capabilities; classification; computer system: components of computer system with block diagram, CPU, data representation in computers, computer storage and memory, preliminary concept of software, hardware, operating systems: Unix/Linux oriented programming paradigm, Basics, FORTRAN, C, concepts of object oriented programming (OOP), application of OOP, structure of C++ programs, keywords, constants, variables, data types, declaration of variables, reference variables, dynamic initialization of variables, operators, scope resolution operator, conditional statement, if then, loops etc., main function, function prototyping, call by reference, return by reference, inline functions, default arguments, constant arguments, function overloading, friend functions.

Unit-II [12L]
Various file formats for bio-molecular sequences: GenBank, FASTA, GCG, MSF etc. Basic concepts of sequence similarity, identity and homology, definitions of homlogues, orthologues, paralogues and xenologues, BLAST, FASTA, PSI-BLAST, PASTA, scoring matrices: basic concept of a scoring matrix, matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, principles based on which these matrices are derived. Pairwise sequence alignments, Needleman and Wunsch, Smith and Waterman algorithms for pairwise alignments. Multiple sequence alignments, patterns, motifs and profiles, various types of pattern representations.

Unit-III [12L]
Basic concepts in systematics, taxonomy and phylogeny; molecular evolution; nature of data used in taxonomy and phylogeny, definition and description of phylogenetic trees and various types of trees. Phylogenetic analysis algorithms such as maximum parsimony, UPGMA, transformed distance, neighbors-relation, neighbor-joining, probabilistic models and associated algorithms such as probabilistic models of evolution and maximum likelihood algorithm, bootstrapping methods, use of tools such as Phylip, Mega, PAUP

Unit-IV [12L]
Classification and comparison of protein structures: purpose and concepts, secondary structure prediction; methods and algorithm, brief over view of tertiary structure prediction: fundamentals of the methods for 3D structure prediction (sequence similarity/identity of target proteins of known structure, fundamental principles of protein folding etc.). 3-D structure visualization: Rasmol, PyMol, SPDBV, CHIME, VMD, Cn3D, Structure analysis tools.

Reference/Text Books
MPB103: Cell and Molecular Biology

UNIT-I
Cell biology: Organization and structure of prokaryotes and eukaryotes, nucleus, cytoplasm, plasma membrane, mitochondria-structure, function respiratory chain and ATP synthesis, endoplasmic reticulum, golgi apparatus, membranes, ribosomes, peroxisomes, lysozomes, transport of proteins through ER, cell division and differentiation, kinetics of cell growth, role of protein kinase in cell growth, cell cycle, cell cycle events: GS, G2, cell division, cytokines, control of cell cycle.

UNIT-II
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, role of protein kinase c in cell growth, dividing and non-dividing cell, synchronization of cell growth, cell transformation, malignant tumor growth, apoptosis

UNIT-III

UNIT-IV
Extraction of genomic DNA from mammalian tissue plant tissue and bacteria, 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, in-vitro mutagenesis: mutagenesis with degenerate oligo-nucleotides region specific mutagenesis linker scanning mutagenesis, transformation of DNA, bacterial yeast expression vectors gene transfer into cultured cells. DNA polymorphism: repeats of DNA and their significance, single nucleotide polymorphism.

Suggested Books


MBP104: Mathematical and Statistical Techniques

UNIT-I [12L]
Vector fields: General expression for gradient, divergence, curl and Laplace operators in orthogonal curvilinear coordinates and their explicit forms in cylindrical and spherical polar coordinates, Gauss theorem, Stokes theorem.

UNIT-II [12L]
Differential equations, integrals & applications: pure time differential equations and autonomous differential equations, methods of solutions and applications
Group theory: groups, examples of simple molecular point groups, subgroups, classes, Lagrange’s theorem, invariant subgroups, factor group, isomorphism and homomorphism, representation of finite groups, reducible and irreducible representations, orthogonality theorems, character tables.

UNIT-III [12L]
Fourier series and transform: parseval and convolution theorems, FFT concept, Special functions: frobenius method of solving second order linear differential, ordinary and singular joints, series solutions for Bessel, Legendre, Legueree, Hermite and Chebyshev equations, error, gamma and beta functions, properties of these functions, classification and diagrammatic representation of statistical data, frequency distribution, measures of central tendency, measures of dispersion including standard error, correlation and regression analysis, interpolation and extrapolation, probability theory-events, additions, multiplication and Bayes theorems, Binomial, Poisson and Gaussian and normal distributions.

UNIT-IV [12L]
Sampling theory, sample size and sampling methods, concept of statistical inference- parametric tests (Z-test, unpaired t-test, paired t-test, one way analysis of variance and two way analysis of variance), non-parametric tests (Wilcoxon rank sums test, Wilcoxon sign rank test, Kruscal Walli’s test, Friedman test), chi-square test, p-test, p-values, statistical packages and their applications, introduction to probabilistic models, stochastic models of diffusion, stochastic models of genetics, genomic test, independence and Markovian chains, statistical reasoning: estimating parameters, confidence limits, Monte-Carlo Methods.

References
MBP105: Lab Course: Practicals

[Any ten experiments from the list will be conducted]
1) To determine the concentration of Glucose in the given sample by Anthrone’s/ Fehling’s solution Method.
2) Estimation of Cholestrol in the given sample.
3) To determine total Lipid Profile from Human Serum.
4) To determine the saponification value of Mustard Oil.
5) To determine the activity of acid phosphatase and alkine phosphatase.
6) To carry out Vitamin C titration.
7) Write a program to swap the values of two integers using a function.
8) Write a program to find mean of two integer values using a friend function.
9) To learn sequence search using various tool such BLAST, FASTA and to determine similarity scoring BLOSUM, SYMCOM and etc.
10) Plasmid DNA isolation
11) Restriction digestion of plasmid DNA
12) Agarose gel electrophoresis
13) Representation and determination of statistical parameter of data in excel and other statistical package such as SAS, SPSS.
14) To solve differential equation, integrals, equations using muPad in MATLAB and other mathematical equations solver such as MATHEMATICA etc.
15) Learn direct command in MATLAB to determine Eigen values and Eigen Vectors and other matrices related characteristics.
Semester II

MBP201: Structural Biology

UNIT-I [12L]
Fundamentals of macromolecular structure: structure of proteins, nucleic acids; membranes, action of other biologically important molecules and molecular assemblies like ribosomes, nucleosomes; functional significance of structure, principles of protein structure: anatomy of proteins: secondary structures, motifs, domains, tertiary and quaternary structures, structural implications of the peptide bond; rigid planar peptide unit; cis and trans configuration; conformations of a pair of linked peptide units; torsion angles phi and psi -steric hindrance; allowed and disallowed conformations; Ramachandran plot; conformational maps for glycine and other natural amino acids; conformational constrained amino acids and their importance and Protein Data Bank.

UNIT-II [12L]
Principles of protein folding, forces stabilizing protein structure: electrostatic interactions; van der Waals interactions; hydrogen bonds; hydrophobic interactions; distortional energies, protein denaturation: concept of Gibbs energy, heat capacity, enthalpy and entropy changes molar values, thermodynamic linkage between protein structure stability and function, measuring the conformational stability of a protein by hydrogen exchange, kinetic and equilibrium folding intermediates, models of cooperativity in protein folding, principles of protein misfolding, reliable simulations of protein folding misfolding and aggregation, folding and association versus misfolding and aggregation of proteins, protein folding in the cell: structure and function of the small heat shock protein, family of molecular chaperones, stabilization of protein structure, protein stabilization by naturally occurring osmolytes, investigation of protein unfolding and stability by computer simulation

Unit-III [12L]
Fundamentals of macromolecular crystallography, methods of crystallization: hanging drop, sitting drop, microdialysis, seeding etc. crystallization screening, crystallization trials, crystallizing agents, engineering proteins to promote crystallization, high through put crystallography, concept of Bravais lattice system, unit cell, crystal packing, preparation for an X-ray diffraction experiment, from crystal to data, cryo-crystallography of macromolecules practice and optimization, Conventional X-ray sources and detectors, X-ray data collection from macromolecular crystals, characterizing a crystal from an initial native dataset, monochromatic data collection, diffuse X-ray scattering from macromolecular crystals, time resolved crystallography

Unit-IV [12L]
Methods of crystal X-ray diffraction of macromolecules, Introduction to macromolecular refinement, refinement of the model structure, mathematics of refinement, principle of the Fast Fourier Transform FFT method, molecular replacement, phase determination, substructure determination in multi wavelength anomalous diffraction, single anomalous diffraction and single iso-morphous replacement, substructure determination in iso-morphous replacement and anomalous diffraction experiments, automated structure solution with PHENIX, normalized structure factor, non-crystallographic symmetry and molecular averaging, OMIT map with and without sim weighting, remaining error in the best Fourier map, quality control and validation, crystallographic software.
References
MBP202: Thermodynamics and Bioenergetics

Unit-I [12L]
Thermodynamics: fundamental principles of the thermodynamics of solutions, partial molar and partial specific volumes, chemical potential in ideal and real solution, colligative properties and molecular weight the total free energy of a solution excluded volume for dilute solution and flexible polymers, statistics of linear polymers: molecular weight averages and distributions average dimensions, end to end distance, radius of gyration, interaction between polymer segment and solvent molecules and its effect on the end to end distance.

Unit-II [12L]
Osmotic pressure: principles of osmotic pressure, Vant Hoff’s law, concentration dependence of osmotic pressure, effect of electrostatic charge on the thermodynamic behaviour in solution, equilibrium across a semi, permeable membrane, Donnan effect, osmotic pressure of solutions containing macro ions, osmotic pressure of protein solutions membrane potential, phase equilibria solubility and freezing point melting points crystalline polymers, solubility of crystalline proteins, chemi-osmotic proton circuit, Diffusion: macromolecular diffusion, Einstein and Sutherland equation.

Unit-III [12L]
Brownian motion as a random function, Brownian motion as a strong Markov process, harmonic functions transience and recurrence, techniques and applications, intersections and self-intersections of Brownian paths, Brownian motion and random walk, Brownian local time, stochastic integrals and applications, potential theory of Brownian motion, Brownian motion in several dimensions, Markov processes and Markov families, ultracentrifugation: basic principles, Lamma’s equation, Svedberg equation, sedimentation velocity, sedimentation equilibrium, determination of molecular weight from sedimentation, data-shape information from sedimentation date, density gradient methods, molecular weight averages, application of the analytical ultracentrifuge.

Unit-IV [12L]
Flow of energy in the biological world, concepts of chemical energy, free energy, oxidation-reduction potential, respiratory chains, mitochondrial respiratory chain, respiratory control and oxidative phosphorylation, photosynthetic generators of proton motive force, ATP synthase, transducing membranes, ion transport across energy conserving membranes, measurement of driving forces, metabolite and ion transport, molecular biological approaches in Na⁺K⁺ ATPase and H⁺K⁺ ATPase, pump studies, structural basis for molecular mechanisms of calcium transporting, ATPase of sarcoplasmic reticulum, use of Na⁺ as an alternative to H⁺ in energy transduction.

References

MBP203: Biophysical techniques and Bio-instrumentation

Unit-I
[12L]
Light scattering: elastic and inelastic scattering, light scattering by macromolecules, Zimm plot, estimation of chain dimensions experimental results on some proteins and nucleic acids.
Viscosity: general principles, frictional coefficient, Newtonian flow, Poiseuille’s law for capillary flow, application of viscosity measurements.
Electrophoresis: principles of electrophoresis, factors affecting electrophoresis, micro electrophoresis and its applications, gel electrophoresis, separation of macromolecules and other applications, isoelectric focusing and iso-tachophoresis, preparative electrophoresis, 2D electrophoresis

Unit-II
[12L]
Chromatography: basic principles, paper chromatography, TLC, column chromatography, gas, liquid chromatography, ion exchange chromatography, exclusion chromatography, affinity chromatography, high performance liquid chromatography, applications to macromolecules.
Infrared spectroscopy: basic principles, origins of rotational and vibrational spectra, anharmonic oscillator, molecular symmetry, optical density, investigation of molecular structure, hydrogen bonding, dichroism and crystallinity measurements, applications to polypeptides, proteins, nucleic acids and polysaccharides.

Unit-III
[12L]
Raman spectroscopy: principles of experimental aspects, advantages of Raman spectroscopy, Raman spectra of amino acids, application to proteins and nucleic acids, resonance Raman spectroscopy including laser Raman spectroscopy.
Absorption spectroscopy: principle, experimental aspects of visible and UV spectroscopy, absorption of chromophores, chemical analysis by visible and UV light, structural studies of proteins and nucleic acids, ORD and CD, Cotton effect, relation between ORD and CD, physical origins, application to proteins and nucleic acids, fluorescence spectroscopy an applications to biology

Unit-IV
[12L]
NMR spectroscopy: General principles, classical picture - resonance condition, Bloch equation, relaxation phenomena and measurements, Fourier transform technique, chemical shifts, coupling constants, Karplus equation, analysis of simple AB spectrum, rate process (chemical exchange), proton decoupling (broad band), NOE effects, proton magnetic resonance (PMR) spectra of amino acids and peptides, basics of 13C and 31P NMR, conformation of amino acids and peptides, application to proteins and nucleic acids, introduction to solid state NMR, elementary ideas of ESR, principles, hyperfine interaction, g-factor, spin-labeling, application to biomolecules, mass spectroscopy and MALDI-TOF

References
15. Slayter E.M. Optical methods in Biology, John Wiley
MBP204: Quantum Physics

Unit-I
Physical basis of quantum mechanics, Schrödinger equation (1D), physical interpretation and conditions on the wave function, stationary states and energy spectra, particle in a square well potential, linear harmonic oscillator, spherically symmetric potentials in 3-dimensions, rigid rotator, the hydrogen atom

Perturbation theories, non-degenerate case: First and second order perturbations, degenerate case – Zeeman and Stark effect, variational methods, tunnelling through potential barriers, WKB method - methods for time dependent problems, time dependent perturbation theory, first order perturbation - harmonic perturbation, transition probability, Fermi’s golden rule, adiabatic approximation, Sudden approximation

Unit-II
Introduction to many electron atoms, wave equation of many electron systems, the helium atom, Hartree–Fock self-consistent field methods, diatomic molecules, the Born-Oppenheimer approximation and its breakdown, LCAO approximation, molecular orbital and valence bond methods for the hydrogen molecule, charge distribution in molecular hydrogen, molecular orbitals of the homo and heteronuclear diatomic molecules, valence bond treatment of heteronuclear diatomic molecules, vibrational and rotational energy levels in diatomic molecules

Unit-III
Chemical bonding: polyatomic molecules, directed valance (Introduction), hybridization and geometry, simple Huckel theory of the linear conjugated systems, examples of simple Huckel calculations, butadiene, simple Huckel theory for the cyclic conjugated systems and aromaticity. advanced MO theories, self-consistent HF equation, Roothan’s equation, elementary ideas of semi empirical methods-semi-empirical and ab-initio SCF theories-extended Huckel theory, ZDO-CNDO theory and applications, INDO and MINDO methods, ab-initio treatments of polyatomic molecules, basis functions, minimal, extended, STO-GTF, CGTF, double Zeta basis set, split valance basis set plus

Unit-IV
Polarization, information derived: barrier to internal rotation and inversion, molecular conformation, Mulliken population analysis, dipole moment, Hellmann-Feynman theorem and its chemical applications: Hellmann Feynman theorem, physical picture of the chemical bond, bonding and anti-bonding regions-formation of bonds-quantum mechanical theory of reaction rates, general principles of molecular dynamics, basic concept of density functional theory-application to biomolecules

References
MBP205: Lab course: Practicals

[If any ten experiments from the list will be conducted]

1) Determination of molar absorption coefficient of the native proteins (RNase-A, α-lactalbumin and lysozyme) from the spectra of model compounds (Try and Trp).
2) Determination of no. of Tryptophan and Tyrosine residues in an unknown protein (Lysozyme) by Edelhoch’s method.
3) Determination of conformational stability from the guanidine hydrochloride-induced denaturation of a protein.
4) Determination of thermal stability from heat-induced transition curves of a protein (RNase-A).
5) Determination of secondary structure elements of proteins (RNase-A, α-lactalbumin and lysozyme) from their CD spectra.
6) Calculation of acceleration due to gravity ‘g’ using simple pendulum.
7) Solar cell & diode characteristics – four different experiments
8) ECG- Experiments.
9) Minimum deviation of prism.
10) EMF of different leaf.
11) Determination of the binding constant for ligand-protein interaction using Stern-Volmer equation
12) Determination of the thermodynamic parameters for ligand-protein interaction using Van-Hoff’s equation
13) Study of the separation of the orbits using Zeeman’s effect.
14) Determination of the surface active parameters of amphiphilic molecules using Gibb’s adsorption equation
15) Determination of root mean square and its deviation for drug-target interaction using GROMACS
Season III

MBP301: Radiation and Medical Biophysics

Unit-I
Electromagnetic spectrum, properties of non-ionizing and ionizing radiation, radiation units, principles of detection and measurement, dosimetry of high-energy photons, electrons and ions, standardization of x-ray and high energy beams, methods of measuring radioactivity, different methods of counting and counters, biological dosimetry, properties and biological effects of UV radiation, UV in treatment of skin disorders, properties and biological effects of LASER, application of LASER in ophthalmology, surgery and dentistry, properties, biological effects and application of microwave radiation and ultrasonic waves

Unit-II
Biological effects of ionizing radiation, cell survival assay, modification of cell survival, chromosome aberration and gene mutation, molecular aspects of radiation damage and repair, somatic and genetic effects of radiation, hazards of non-ionizing radiation and their control, medical application of radiation sources, principles of X-ray diagnosis, high kV radiography, special procedures such as topography, fluoroscopy, stereoscopy, image intensifiers and television monitoring, application of ionizing radiation in industry, agriculture and research

Unit-III
Internally administered isotopes, radio-iodine in thyroid function analysis, principles of isotope dilution analysis, circulation time, renal, liver and lung function analysis, radioisotope scanners and cameras, medical data collection, storage and analysis of hospital data using computers, computers in medical instrumentation and diagnosis.

Unit-IV
Ultrasound, nuclear magnetic resonance imaging and position emission tomography, computerized axial tomography, whole body scanner, dose calibrators, gamma scintillation camera, digital imaging techniques, acquisition, analysis and processing of data from gamma camera, enhancement, tomographic reconstruction, display and recording of the image, Principle and interpretation of electro-encephalogram, electro-cardiogram, and electro-oculogram.

References
11. Atlik F.H. Introduction to Radiological Physics and Radiation Dosimetry, John Wiley
MBP302: Microbiology, Genetics and Immunology

Unit-I [12L]
History of microbiology, discovery of the microbial world, origin and evolution of microorganisms, concepts of species and hierarchical taxa, isolation, pure culture techniques, methods of sterilization and enrichment culture techniques, bacterial identification, nomenclature and classification, new approaches to bacterial taxonomy/classification including ribo-typing and ribosomal RNA sequencing, definition of growth, growth curve, measurement of growth and growth yields, culture collection and maintenance of cultures, different modes of nutrition in bacteria, sulphate reduction, nitrogen metabolism, nitrate reduction, nitrifying and denitrifying bacteria, nitrogen fixation and microbes used as biofertilizer.

Unit-II [12L]

Unit-III [12L]

Unit-IV [12L]
Molecules, cells and tissues of immune system, primary and secondary lymphoid organs (thymus, bursa of fabricius, lymph nodes, spleen), B and T lymphocyte and their functions, concepts of antigen, antigenic determinant, antigenicity, immunogen and immunogenicity, immunoglobulin, structure of immunoglobulin, types and properties of immunoglobulin, theories of antibody formation, clonal selection, Ig genes, and antibody diversity, MHC antigen: - class I, class II, class III, antigen presentation, MHC restriction, humoral and cell mediated immune response.

References
1. Fundamental Immunology, Editor William E. Paul, Publisher Lippincott Williams & Wilkins, 2012, ISBN 1451117833, 9781451117837.


MBP303: Membrane Biophysics

Unit-I [12L]
Cell characteristics, cell visualization, types of cells, cell membrane structure and function, nucleus, endomembrane system, mitochondria, chloroplasts, content of cell membrane, different glycerol phospholipid head groups, cholesterol and cholesterol esters, cholesterol resides in the lipid bilayer, homogeneity of cellular membranes, spontaneous curvature, thermodynamic model, chemical potential

Unit-II [12L]
Structure characteristics of the lipid membrane, compartmentalized hydrophilic and hydrophobic nature of the membrane, forms of barrier for diffusion, forms and functions of membrane proteins (lipid linked and fatty acylated proteins, prenylated proteins, GPI-linked proteins, lipoprotein structure, basis of cellular individuality, permeability barrier-regulate what gets through, Selective pumps & gates-regulate & accelerate molecular passage, generate signals for cell communication, flow of information between cells & between environment & cells, surfaces for ordered array of reactions, LDL model, cytoskeleton

Unit-III [12L]
Review of surface tension, bulk transport, facilitated and secondary transport via uni-porters, exchangers, and co-transporters schilling, generation of trans-membrane ionic gradients: P-type ATPase and NCX, membrane potentials and passive membrane electrical properties, active membrane electrical properties, structure and function of ion channels I: Ca^{2+} channels, structure and function of ion channels II: Na^{+} and K^{+} channels, single channel kinetics, pumps as channels

Unit-IV [12L]
Synaptic transmission, exocytosis/endocytosis I, 11-Apr synaptic transmission, exocytosis/endocytosis II, synaptic transmission- post-synaptic mechanisms, synaptic transmission, trans membrane signalling via GPCRs and enzyme-linked receptors, store-operated channels: STIM and ORAI, water transport, volume and pH regulation, biophysics and physiology of epithelial transport I, biophysics and physiology of epithelial transport II

References
MBP304: Systems Biology

Unit-I
MATLAB-constants and variables, arithmetic expressions, input-output statements, control statements, subscripted variables, do statements, logical expressions, function and subroutines, simple programs, iteration method, Newton-Raphson method, convergence and rate of convergence, Gauss elimination method, Jordan’s modification, iterative methods, Jacobi methods of iteration methods, Guass-Seidel methods of iteration

Unit-II
Linear interpolation, Lagrange interpolation, Bessel, Laplace Everett formula, interpolation with unequal intervals, Newton forward and backward difference formulas to compute derivatives, numerical integration: trapezoidal rule, Simpson’s rule, truncation error, n\textsuperscript{th} order ordinary differential equations, power series approximations, Mont-Carlo simulation technique and its applications.

Unit-III
Non-linearity and complexities in biological processes, chaotic motion, maps and discrete time series, fixed points, equilibrium and stability: classification and biological significance, bifurcation analysis, phase space and dynamics, linear oscillators, synchronization, synchrony and de-synchrony of two oscillator, coupling of synchrony, stability criteria, Lyapounov exponent, limit cycle, discrete dynamical system, stochastic differential equation

Unit-IV
Deterministic and stochastic description of cellular processes, probabilistic picture of molecular interactions: Gillespie’s picture, master equation formalism of biochemical networks, chemical Langevin equation formalism, dynamical response as switch, genetic switch and oscillator, cell to cell communication and application
Neural network concepts and secondary structure prediction, probabilistic models: Markov chain, random walk, Hidden Markov models, gene identification and other applications.
Evolutionary analysis: distance, clustering methods, rooted and un-rooted tree representation, Boot strapping strategies.

Reference
MBP305: Lab course: Practicals
[any ten practicals from the list will be conducted]

1) Enzyme-Linked Immunosorbent Assay (ELISA)
2) Bacterial culture and Growth curve
3) Polymerase Chain Reaction (PCR) amplification and analysis
4) Write basic programming in MATLAB such as use of loop, conditional statements, plotting curves etc.
5) To write program for determination of roots of polynomials and transcendental equations using various methods such as Newton-Raphson method, Iteration etc.
6) To write program for determine the solution of system of equations using various methods such as Gauss elimination method, Jordan’s modification, Jacobi methods of iteration methods, Gauss – Seidel methods of iteration etc.
7) Gel electrophoresis
8) Enzyme kinetics
9) Bacterial growth curve/kinetics
10) Bacterial staining and identification
11) LASER induced cell damage
12) Detection of glucose/cholesterol/pesticides using biosensors
13) Study of the hydrophobicity/hydrophilicity of the given surface using contact angle measurements.
14) Determination of the critical micelle concentration of amphiphilic molecules by conductivity method
15) Fluorescence based biosensors
Semester IV

MBP401: Nanobiotechnology

Unit-I [12L]
0D, 1D, 2D structures, quantum confinement & size effects, fraction of surface atoms, specific surface energy and surface stress, effect on the lattice parameter, density of states, reactivity of nanomaterials, general methods for nanomaterial synthesis viz. sol-gel, hydrothermal/solvothermal methods, synthesis of metallic, semiconducting and oxide nanoparticles, homo- and hetero-nucleation & growth, template-based synthesis (electrochemical, electrophoretic, melt and solution, CVD, ALD), gas phase Synthesis of nanopowders, vapor (or solution), liquid-solid (VLS or SLS) growth

Unit-II [12L]
Fundamentals of nucleation growth, controlling nucleation & growth, size control at the nanometric scale, aggregation, stability of colloidal dispersions, spontaneous condensation of nanoparticles: homogeneous nucleation, spinodal decomposition, other undesirable post-condensation effects, nanoparticles’ morphology, quantum Wells, doping of a nanoparticle, excitonic binding and recombination energies, capacitance in a nanoparticle, correlation between diffusion and crystallite growth, brief overview of optical properties, mechanical, properties including superplasticity phenomena, reactivity of nanoparticles

Unit-III [12L]
Overview of natural bionanomachines, thermal motion of biomolecules, water environment and their importance in bionanomachines modern biomaterials, structure and functional properties of biomaterials, quantum dot structures & their integration with biological structures, nanobiometrics, lipids as nano-bricks & mortar: self-assembled nanolayers, DNA based nanostructures, hybrid conjugates of gold nanoparticles, DNA oligomers, protein-nanoparticles based recognition groups, nanoparticles as carrier for genetic material, nanotechnology in agriculture, fertilizer and pesticides, nanomedicine, drug delivery, DNA computing, molecular design using biological selection, harnessing molecular motors, artificial life, hybrid materials, biosensors

Unit-IV [12L]
Fundamentals of techniques, experimental approaches and data interpretation, applications/limitations of X-ray characterization: X-ray sources, wide angle, extended X-ray absorption technique, SEM/TEM, high resolution imaging, defects in nanomaterials, X-ray photoelectron spectroscopy, UV-Visible, fluorescence, circular diachroism spectroscopy, MALDI-TOF spectroscopy, DLS, electron filtered imaging, atomic force microscopy, prospects of scanning probe microscopes, optical spectroscopy of metal/semiconductor nanoparticles

References
MBP402: Neurophysics

Unit-I
Cellular structure and molecular organization of neurons, cellular neurophysiology of brain, neural signalling, basic systems and their organization, electrophysiological properties, neural cells, specialized communications, neuron firing

Unit-II
Biomolecules in brains, neurochemistry, signalling in nervous system, need, structure, properties and function of ion channels, I-V plots of ion channels, resting membrane potential, action potential, Hodgkin-Huxley model (HH) model, integrate and fire (IF) model, leaky-integrate and fire neuron (LIF) model.

Unit-III
Neurogenetics and immunology, bioenergetics, metabolism of brain development, regeneration of nervous system, learning and remembrance, information processing in brain, coordination system and GPS in brain.

Unit-IV
Clinical neurochemistry, propagation of nerve impulses & transfer of information between nerve cells, effect of drug on transfer of information brain sensory (olfaction, vision, light into neural signal, travel & process of light signal in to the brain and motor system, regulatory system, learning memory and cognition

References
MBP403: Medicinal Chemistry and Drug Design

UNIT-I [12L]
Historical perspectives, current view of pharmacogenetics, pharmacogenetics; biomarkers, promise of personalized medicine, genetic drug response profiles, effect of drug on gene expression, drug metabolism, drug targets, drug solubility, natural resources of lead compounds, pharmacokinetics & drug metabolism, biological testing and bioassays, preclinical testing and clinical trial, synthesis, patenting and manufacture, contour of drugs, development of new drugs, chemical & physiochemical parameters in drug design, design of enzyme inhibitors, computation techniques in drug design process.

Unit-II [12L]
Pharmacological screening of herbal drugs- introduction and evaluation of herbal drugs for antidiabetic, hepatoprotective, diuretic, anti-diarrhocal, antiulcer, wound healing, cardiovascular, anti-inflammatory, analgesic, antipyretic, antifertility, anti-oxidant, anti-viral & cyto-toxic properties, combinatorial chemistry technologies & libraries, solution phase synthesis, gigh-throughput synthesis and screening, development of new drugs, procedures followed in drug design, concept of lead compound and lead modification.

Unit-III [12L]
Basic principles of modelling, modelling software: Sali-modeller, Swiss-modeller, gen-threader, Ab-initio modelling, combined modelling, minimization of a peptide energy using appropriate Force field; Ramachandran plot, torsional space minimization, energy minimization in cartesian space, visualization of macromolecular structures by software such as RasMol, Cn3D, SPDBV etc.

Unit-IV [12L]
Basic concept of drug design, prodrugs, bioprecursor & carrier linked prodrugs, hard and soft drugs, analog based drug design, designing of analogs, structure based drug design, drug design on structure based, molecular docking, drug likeness, introduction to 1D, 2D and 3D QSAR, tools & techniques, physicochemical parameters, quantitative models, drug metabolism- phase-I & phase-II metabolic reactions, introduction to drug designing on the basis of metabolic pathways.

Suggested Books
MBP404: Dissertation

Dissertation work on experimental/theoretical on specific topic will be carried out under the supervision of a faculty member of the Centre.

MBP405: Viva-Voce