Course Structure for M. Sc. (Biophysics) program

for the batch of the academic year 2018-19.

S. No.	Title of Paper	Paper Code	Credit		
			L	T	P
Semester I (Total 28 Credits)					
1.	Biochemistry	MBP101	4	0	0
2.	Programming and Bioinformatics	MBP102	4	0	0
3.	Cell and Molecular Biology	MBP103	4	0	0
4.	Structural Biology	MBP104	4	0	0
5.	Lab Course-I	MBP105	0	0	4
6.	Lab Course-II	MBP106	0	0	4
7.	*Basics of Mathematics (CBCS)*	MBP107	*4*	*0*	*0*
Semester II (Total 24 Credits)					
1.	Thermodynamics and Kinetics	MBP201	4	0	0
2.	Radiation Biophysics	MBP202	4	0	0
3.	Mathematical and Bio-Statistical Techniques	MBP203	4	0	0
4.	Lab Course III	MBP204	0	0	4
5.	Microbiology and Immunology *(CBCS)*	MBP205	*4*	*0*	*0*
6.	*Numerical Methods and Programming (Skill Development)*	PGSD201	*2*	*0*	*2*
Semester III (Total 28 Credits)					
1.	Membrane Biophysics	MBP301	4	0	0
2.	Quantum Physics and Chemistry	MBP302	4	0	0
3.	Biophysical Techniques	MBP303	4	0	0
4.	Genetics and Recombinant DNA Techniques	MBP304	4	0	0
5.	Lab Course IV	MBP305	0	0	2
6.	*Enzymology (CBCS)*	MBP306	*4*	*0*	*0*
7.	*Measurement and Data Presentation (Ability Enhancement)*	PGAE301	*4*	*0*	*0*
Semester IV (Total 16 Credits)					
1.	Project Work	MBP401	0	0	12
2.	*Pharmacology and Toxicology (CBCS)*	MBP402	*4*	0	0
Total Credit			**96**		

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Biochemistry (MBP101)

Unit-I **[12L]**

Physico-chemical properties of water relevant to the course (structure of water, hydrogen bonding, structure of crystalline water, water as solvent, micelles formation, hydrophobic interaction). Dissociation of water (ion products, Kw, pH-scale). Henderson Hasselbalch equation and its usefulness: pK_a, degree of dissociation and its dependence on pH, determination of pK_a). Bronsted-Lowry acid and base (ionization of weak acids and conjugate bases, titration curve). Buffers (definition, buffering capacity, buffering zone, equivalent point, end-point, molarity of buffers, preparation of buffers, characteristics of buffers). Unusual buffers. Goods buffers. Buffering in living organisms. Measurements of pH. Thermodynamics in biochemistry (fundamental equations of thermodynamics, first and second laws of thermodynamics. Gibbs free energy related to other thermodynamic properties, constant-pressure heat capacity change, Gibbs-Helmholtz equation, equilibrium constant). Biomolecules in water.

Unit-II **[12L]**

Amino acids, buildig blocks of proteins (general structural formula (convention), classification and chemical structure of side chains, configuration versus conformation, L- and D-configurations of amino acids (convention), ionization of amino acids (numbering of ionizable groups: pK_a values), ampholytes, zwiterion and its consequences, isoelectric point (pI) and its relationship with pK_a values, optical properties (absorption, fluorescence, optical (*l*- and *d*) rotation). Rare amino acids. Peptide bond (conventions (peptide group, peptide unit (trans- and cis- conformations, physico-chemical properties of peptide bond), oligopeptide, polypeptides and proteins. Levels of structure of proteins (primary, Secondary (α-helix, 3_{10}-helix, β-sheet, and β-turns). tertiary and quaternary). Unordered structure versus random coils. Ramachandran plot. Collagen structure. Protein sequencing (protease mapping).

Unit-III **[12L]**

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, cerebroids, steroids, prostaglandins, glycolipids and proteoglycans. Carbohydrate metabolism, a brief overview of glycolysis and Krebs cycle.

Unit-IV **[12L]**

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 T_m value. Vitamins, coenzymes and other small molecules.

Suggested Books

1. Textbook of Biochemistry with Clinical Correlations, Thomas M. Devlin, Publisher Wiley, 2010, ISBN0470281731, 9780470281734.
2. Biochemistry: Jeremy M. Berg, John L. Tymoczko, LubertStryer, ISBN:9780716746843
3. Lehninger Principles of Biochemistry, David Lee Nelson, Michael M. Cox. Published by: W.H. Freeman, 2013, ISBN: 1464109621, 9781464109621
4. Principles of Biochemistry, Donald Voet, CharlJudith G. Voet – PublisherWiley, 2013, ISBN 1118092449, 9781118092446
5. Molecular Cell Biology, Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, HiddePloegh, Angelika Amon, Matthew P. Scott, Publisher W.H. Freeman, 2012, ISBN 142923413X, 9781429234139.

Programming and Bioinformatics (MBP102)

Unit-I: Data types, Operators and Expressions [12L]

Basic elements: Identifiers, keywords, Variables and Constants, Variables/Identifiers declaration; Expressions, Statements, Basic data types of C. Operators and Expressions: Arithmetic Operators, Unary Operators, Relational Operator and Logical Operators, Assignment Operators, Conditional Operator, Expression Evaluation (Precedence of Operators); Data Input/output statements.

Unit-II: Control Structures Functions and Array [12L]

Control Structures: Branching- if, if else, switch-case, Looping-for, while, do-while; break, continue. Functions: Library Functions, User defined functions, declaration, definition & scope, accessing a Function, Function Prototypes, Passing Arguments to a Function. Defining an Array, One and two-dimensional arrays, declaration, initialization and processing; Processing an Array, Passing Arrays to Functions.

Unit-III: Bioinformatics Concepts [12L]

Bioinformatics concepts, Scope of Bioinformatics and computational biology; Need for Bioinformatics Technologies, Human Genome Project, Biological databases and various file formats; Sequence retrieval and submission, Overview of available Bioinformatics resources on the web: NCBI/EBI/EXPASY etc, Open access bibliographic resources: PubMed, BioMed Central, Public Library of Sciences. Applications of bioinformatics in drug discovery, pharmacogenomics, systems biology and next generation sequencing etc

Unit-IV: Homology Searching and Sequence Analysis [12L]

Genome informatics: GenBank, FASTA, GCG, MSF etc. Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues and xenologers, BLAST, FASTA, PSI-BLAST, Scoring matrices: basic concept of a scoring matrix, matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, Pairwise sequence alignments, Needleman and Wunsch, Smith and Waterman algorithms for pairwise alignments.

Reference books:

1. Deitel and Deitel: How to Program C, Addison Wesley, Pearson Education Asia, Seventh Edition
2. Bryon Gottfried, Programming with C, McGraw Hill International.
3. Basic Bioinformatics, by S. Ignacimuthu. Publisher: Alpha Science International Limited, 2013, ISBN 1842658042, 9781842658048.
4. Structural Bioinformatics, edited by Jenny Gu, Philip E. Bourn. John Wiley & Sons, 2011 -ISBN1118210565, 9781118210567.
5. Discovering Genomics, Proteomics and Bioinformatics by Campbell, PublisherPearson Education India, ISBN8131715590, 9788131715598.
6. Bioinformatics A Beginner's Guide, by Claverie, John Wiley & Sons, 2003, ISBN 8126503807, 9788126503803.

Cell and Molecular Biology (MPB103)

Unit-I **[12L]**

Cell biology: Organization and structure of prokaryotes and eukaryotes, plasma membrane, nucleus, nuclear pore complex, cytoplasm, mitochondria, chloroplast, endoplasmic reticulum, golgi apparatus, ribosomes, peroxisomes, lysozomes, glyoxysomes, cyto-skeleton. Chromatin, chromosomes, human karotype, condensation of chromatin into chromosomes. Cell cycle (G1, G2, S and M phases), cell division: mitosis.

Unit-II **[12L]**

Cell-cell communication: strategies of cell signalling: cell to cell contact, via signalling molecule (endocrine, paracrine and autocrine). Signalling mediated by intracellular receptors: G protein coupled receptors, receptor tyrosine kinases, non-receptor tyrosine kinases, cAMP pathway, and glycogen metabolism, PI3 kinase/Akt pathway. Programmed cell death, caspases, mitochondrial pathway of apoptosis, PI3 kinase/Akt pathway and cell survival. Cancer biology, stages of tumour development, oncogenes and tumour suppressor genes.

Unit-III **[12L]**

Molecular biology: central dogma, genetic code, gene, Structure of nucleoside and nucleotide and nucleic acids-The nature of chemical bonds; Nomenclature system to designate nucleoside and nucleotides. Polymerisation of nucleotides, structure of DNA and RNA, Deviations in DNA structure and their significance, DNA as a genetic material of bacteria (Avery-MacLeod-McCarty experiment), Virus (Hershey-Chase experiment); DNA Polymerases and Replication of DNA in prokaryotic system, RNA transcription and an overview of Protein translation.

Unit-IV **[12L]**

Chromosomal and Plasmid DNA isolation from *E. coli*; Nucleic acid separation techniques: Agarose gel electrophoresis of DNA. Basic principle of cloning, Vectors: Basic requirements for a suitable cloning vector. Recombinant DNA. Competent cell preparation and transformation protocols. Cloning and selection transformants and recombinants. Characterization of recombinant clone. Blotting: Southern and Northern blotting techniques. Nucleic acid amplification protocols; DNA sequencing. Restriction endonucleases and restriction digestion.

Suggested Books

1. Cell and Molecular Biology: Concepts and Experiments by Gerald Karp, Publisher John Wiley & Sons, 2009, ISBN 0470483377, 9780470483374.
2. Molecular Biology of the Cell, Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter, Taylor & Francis, 2014, ISBN 0815344643, 9780815344643.
3. Molecular Cell Biology, Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, Hidde Ploegh, Angelika Amon, Matthew P. Scott, Publisher, W. H. Freeman, 2012, ISBN 142923413X, 9781429234139.

4. Essential Cell Biology, Fourth Edition, Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, Publisher Garland Science, 2013, ISBN 1317806271, 9781317806271.
5. Cell Biology and Genetics, Cecie Starr, Ralph Taggart, Christine Evers, Lisa Starr, Cengage Learning, 2008, ISBN 0495557986, 9780495557982.
6. Molecular Biology: Genes to Proteins, Burton E. Tropp, Publisher Jones & Bartlett Publishers, 2012, ISBN: 0763786632, 9780763786632.

Structural Biology (MBP104)

Unit-I **[12L]**

Introduction to Protein Structure: the chemical nature of polypeptides and forces determining protein structure. Structural properties of proteins: Secondary structure elements, classification of tertiary structure; protein families and databases for structure classification: SCOP & CATH. Sequence and structure relationship, structural implications of the peptide bond; allowed and disallowed conformations; Ramachandran plot; conformationally constrained amino acids and their importance, determinants of secondary structure, experimental evaluation of structural stability, structure of nucleic acids and other biologically important molecules and molecular assemblies like ribosomes, nucleosomes, functional significance of structure.

Unint-II [**12L]**

Expression of protein for crystallization in Escherichia coli, yeast and insect cells. Post-translational modifications, protein purification for structural studies, preparation of high quality protein for crystallization, methods for characterization of protein for crystallization, basic concept of crystallization, factors affecting protein crystallization, crystallization techniques: Hanging drop, suiting drop, microdialysis, seeding, etc. buffer system and precipitating agents used for crystallization.

Unit-III **[12L]**

Elements of crystal symmetry and the basis of crystallographic theory, Bravais lattices, basic ideas of symmetry: symmetry in chiral molecules, X-ray generation, detection and properties of X-rays, synchrotron radiation, X-ray diffraction, Bragg's law of diffraction, diffraction of macromolecules: molecular replacement method and direct method, theory of diffraction by helical structures and application to alpha-helix and DNA, validation of X-ray structure, ASTM index, analysis of structures and its correctness, submission of data to PDB: atomic coordinates and electron density maps.

Unit-IV **[12L]**

Basic principle of Nuclear Magnetic Resonance (NMR) Spectroscopy, typical nuclei, NMR observables and parameters for structure determination, selection rules, spectral density functions and relaxation, Nuclear Overhauser Effect (NOE), analysis of high-resolution NMR spectra, two-dimensional NMR, 2D NMR COSY, assignment of peptides and proteins by proton NMR, 3D structure of proteins and nucleic acids, constitution, conformation and dynamics of small molecules, chemical exchange, ligand binding, applications to chemistry, biology and medicine.

References

1. Creighton, T. E. Ed.: Protein Structure: A Practical Approach. 1989.
2. Creighton, T.E.: Proteins: Structure And Molecular Properties. Second Edition. New York. W. H. Freeman And Company, 1993.
3. Creighton,T.: Protein Folding, 1992.
4. Sternberg, M.J.E.: Protein structure prediction: a practical approach, 1996
5. Pain, R.G.: Mechanisms of protein folding, 1994

6. Leach. A.R: Molecular modelling: principles and applications.
7. NMR spectroscopy of large molecules and multimolecular assemblies in solution. Wider, Wüthrich Curr. Op. Struct. Biol. (1999) 9, 594-601.
8. Multidimensional NMR in liquids - Basic principles and experimental methods van de Ven, VCH (1995).
9. Protein NMR spectroscopy – Principles and Practice. Cavanagh, Fairbrother, PalmerIII, Skelton. Academic Press (1996).

Lab Course-I (MBP105)

1. Source Code to Make Simple Calculator in C programming
2. C program to check whether a number is palindrome or not
3. Program to calculate factorials of n numbers using recursion.
4. Program to generate a Fibonacci series between 1 to N.
5. Program to swap the values of two integers using a function.
6. Write a program to find the length of a protein sequence entered by user.
7. Write a program to concatenate two DNA sequences.
8. Write a program to add two 2 x 2 matrix. Program to append DNA sequence in the existing file.
9. Program to store and concatenate two protein sequences.
10. Find Smallest Element in Array in C Programming
11. Sequence similarity search and analysis using BLAST.
12. Multiple sequence alignment of similar sequences.
13. Function prediction of protein sequence using different annotation tools.
14. Phylogenetic analysis of gene sequences.
15. Secondary structure prediction of protein sequences.
16. Homology modeling and structure validation.
17. Tools used for structure analysis and structure-function relationships.

Lab Course-II (MBP106)

1. RNA extraction from virus.
2. Preparation of complimentary DNA (cDNA).
3. To set up a polymerase chain reaction (PCR).
4. Confirmation the amplicons by agarose gel electrophoresis.
5. Plasmid DNA isolation from *E. coli*.
6. Confirmation of plasmid DNA by agarose gel electrophoresis.
7. To determine the concentration of Glucose in the given sample by Anthrone's/ Fehling's solution Method.
8. Estimation of Chlolestrol in the given sample.
9. To determine total Lipid Profile from Human Serum.
10. To determine the saponification value of Mustard Oil
11. To determine the activity of acid phosphatase and alkine phosphatase.
12. To carry out Vitamin C titration.
13. To estimate the concentration of given protein using Bradford's method.
14. To estimate the concentration of given protein using Biuret's method.
15. To estimate the concentration of given protein using Lowry's method
16. To estimate the concentration of given protein using Beer Lambert's law.
17. To measure kinetic parameters of protein.
18. Effect of temperature on the kinetic parameters of protein.
19. Effect of pH on the kinetic parameters of protein.
20. Effect of inhibitors on the kinetic parameters of protein.
21. Effect of activators on the kinetic parameters of protein.
22. Measure the content of α-helix and α-sheet in given protein.
23. Measure stability parameters like DGD, DGD0, DCP, DHm, and DTm, etc. of a protein.
24. Measure structure of protein using CD, Fluorescence, and UV-vis spectroscopy.
25. Practical for Structural Biology.

Basic of Mathematics (MBP107) (CBCS)

Unit-I

Straight Line, Parabola, Ellipse, Hyperbola equations, Graph and their characteristics, System of Linear Equation, Quadratic Equation, Polynomial function, Graphs of trigonometric functions and basic functions, Expansion of various function, Cartesian Coordinates, Polar coordinates.

Unit-II

Spherical and Cylindrical Coordinate System, Vectors and Scalers, Magnitude and Direction of Vectors, Components of Vectors, Dot product of Vectors, Cross product of Vectors, Addition of Vectors, Multiplication of Vectors, Projectiles, Complex Numbers, De-Morgan's Theorem.

Unit-III

Differentiation of Polynomials, Differentiation of Trigonometric functions, Chain Rule, Derivative of Inverse Trigonometric functions, Integration of Polynomials, Integration of Trigonometric functions, Substitution Method, By-Parts, Partial Fractions, definite integration and their characteristics, Partial differentiation.

Unit-IV

Differential equation, order and degree of differential equation, solution of differential equation, autonomous ode, Partial Differential Equations, application of partial and ordinary differential equations.

References:

1. M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
2. H. Anton, I. Bivens and S. Davis, Calculus (7th Edition), John Wiley and sons (Asia), Pt Ltd., Singapore, 2002.
3. G.C Sharma and Madhu Jain, Vector Analysis and Geometry.
4. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications (Eighth Edition), McGraw – Hill International Edition, 2009.
5. B.S Grehwal, Differential and Integration.
6. R.S Aggarwal, Differential and Integration.
7. S. L. Ross, Differential Equations, John Wiley and Sons, India, 2004.
8. C. H. Edwards and D. E. Penny, Differential Equations and Boundary Value Problems: Computing and Modeling, Pearson Education, India, 2005.
9. Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equation for Scientists and Engineers, Springer, Indian reprint, 2006.

Semester II

Thermodynamics and Kinetics (MBP201)

Unit-I **[12L]**

Fundamental principles of the thermodynamics: surroundings, intensive and extensive properties, thermodynamic processes, state and path functions. First law of thermodynamics: internal energy, reversible work of expansion, heat change at constant volume and constant pressure, enthalpy, exothermic and endothermic reactions, energy as a function of T and V, enthalpy as a function of T and P, heat capacities, relation between Cp and Cv, spontaneous process, concept of entropy and second law of thermodynamics.

Unit-II **[12L]**

Concept of free energy, Gibbs-Helmholtz equation, ΔA and ΔG of the system and ΔS of universe, Relationship between standard free energy change and equilibrium constant, variation of equilibrium constant with temperature and pressure, standard free energy changes, oxidation-reduction potential, Nernst equation, reduction potential differences types of half-cells and their reactions, calculation of cell e.m.f., thermodynamic quantities of cell reactions (ΔG, ΔH, and ΔS), Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point.

Unit-III **[12L]**

ATP as universal currency of free energy in biological systems, free energy of hydrolysis of ATP and other organophosphates, structural basis of the high group transfer potential of ATP, ATP hydrolysis and equilibrium of coupled reactions, phosphates as the 'energy currency' of the cell, inter-conversion of adenine nucleotides, biological oxidation-reduction reactions: biological aspects of Nernst equation, experimental approaches to study bioenergetics, thermodynamics of transport.

Unit-IV **[12L]**

Methods of determining rate laws, order of reaction, effect of temperature and pH on reaction rate, simple chemical reactions: zero order, first order, second order, pseudo order, and their half-life expressions, Arrhenius equation, transition state theory, elementary and complex reactions, collision theory of reaction rates, treatment of unimolecular reactions, theory of absolute reaction rates, comparison of results with Eyring and Arrhenius equations, homogeneous catalysis, heterogeneous catalysis, kinetics of enzyme catalysed reactions.

References

1. An Introduction to Chemical Thermodynamics, R.P. Rastogi and R. R. Mishra.
2. Principles of Physical Chemistry, S. H. Maron and C. F. Prutton.
3. New Era of Bioenergetics, by Yasuo Mukohata, Publisher Academic Press, 2012, ISBN 0323140297, 9780323140294.
4. Principles of Bioenergetics: Authors, Vladimir P. Skulachev, Alexander V. Bogachev, Felix O. Kasparinsky, Publisher Springer Science & Business Media, 2012, ISBN 364233430X, 9783642334306.
5. Bioenergetics, Authors: David G. Nicholls, Stuart J. Ferguson, Publisher Academic Press, 2014, ISBN 1483214206, 9781483214207.
6. Lehninger AL : Bioenergetics : The Molecular Basis of Biological Energy Transformations. 2nd ed., Benjamin, Menlo Park, California. 1971.

Radiation Biophysics (MBP202)

Unit-I **[12L]**

Electromagnetic spectrum, properties of non-ionizing and ionizing radiation& their biological effects, radiation units, radioactive decay, ionisation power of radiations, binding energy of nucleus, concept of stable and unstable nuclei, different regions of ionising radiations in detectors, hazards of non-ionizing radiation and their control, medical application of radiation sourcesprinciples of detection anddifferent methods of counting and counters, dosimetry of high-energy photons, electrons and ions, mapping of gamma detector output.

Unit-II **[12L]**

Biological effects of UV radiation, UV in treatment of skin disorders, Biological effects of LASER, application of LASER, application of microwave radiation and ultrasonic waves, chromosome aberration and gene mutation, molecular aspects of radiation damage and repair, somatic and genetic effects of radiation,

Unit-III **[12L]**

Application of ionizing radiation in industry, agriculture and research, internally administered isotopes,radio-iodine in thyroid function analysis,principles of isotope dilution analysis,circulation time, renal, liver and lung function analysis,principles of X-ray diagnosis, high kV radiography, special procedures such as topography, fluoroscopy, stereoscopy, image intensifiers and television monitoring,

Unit-IV **[12L]**

Biomedical imaging techniques and principles of analogue and digital imaging, Ultrasound imaging, nuclear magnetic resonance imaging, X-ray imaging and CT scan,Principle of tomographic techniques, computerised tomography, position emission tomography,application and interpretation of images

References:

1. Roy R.R& Nigam B.P. Nuclear Physics, Theory and Experiment, Wiley.
2. Halliday D, Introductory Nuclear Physics, 2nd Edition, John Wiley.
3. Knoll G.F. Radiation detection and measurements, John Wiley.
4. Altman K.I. Gobes G.B. & Okada S. Radiation Biochemistry, Vol. I & II AP
5. Alper T. Cellular Radiology, Cambridge University Press.
6. Coggle J.E. Biological Effects of Radiation. 2nd edition, Taylor & Francis.
7. Orton C.G. Radiation Dosimetry: Physical and Biological Aspects, Plenum Press.
8. Dunn F and O'Brien, W.D. (eds) Ultrasonic Biophysics, Dowden-Hatchinson& Ross Inc.
9. Chadwick K.H. &Leenbouts H.P. Molecular Theory of Radiation Biology, Springer Verlag.
10. McAingh T.F. (eds) Physics in Medicine and biology, encyclopedia, Pergamon Press.
11. Atlik F.H. Introduction to Radiological Physics and Radiation Dosimetry, John Wiley

Mathematical and Bio-Statistical Techniques (MBP203)

Unit-I **[12L]**

Vectors: Cross and Dot products, Vector fields: General expression for gradient, divergence, curl and orthogonal curvilinear coordinates and their explicit forms in cylindrical and spherical polar coordinates, multiple integrals, Gauss theorem, Stokes theorem.

Matrix theory: Different types of matrices, rank and its application to solutions of linear equations, eigenvalues and eigenvectors, Cayley-Hamilton theorem, diagonalization of symmetric matrices by orthogonal matrices and Hermitian matrices by unitary matrices.

Unit-II **[12L]**

First order differential equation, second order linear differential equation with constant coefficients, methods of solutions and applications, series solutions, ordinary and singular points, Fourier series and transform: parseval and convolution theorems, FFT concept.

Unit-III **[12L]**

Classification and diagrammatic representation of statistical data, frequency distribution, measures of central tendency, measures of dispersion including standard error.

Probability theory-events, additions, multiplication and Bayes theorems, Binomial, Poisson and Gaussian and normal distributions. correlation and regression analysis.

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 (Wilcoxen rank sums test, Wilcoxan sign rank test, KruscalWalli's test, Friedman test), chi-square test,p-test, p-values.

References

1. E. Kreyszig, Advanced engineering mathematics, 10th ed. Hoboken, NJ: John Wiley, 2011.
2. G. B. Arfken, Mathematical methods for physicists: a comprehensive guide, 7th ed. Amsterdam ; Boston: Elsevier, 2013.
3. J. B. Fraleigh, A first course in abstract algebra, 7th ed. Boston: Addison-Wesley, 2003.
4. D. C. Lay, Linear algebra and its applications, 4th ed. Boston: Addison-Wesley, 2012.
5. B. Rosner, Fundamentals of biostatistics,7th ed. Boston: Brooks/Cole, Cengage Learning, 20.

Lab Course III (MBP204)

List will be uploaded before start of the second semester

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Microbiology and Immunology (MBP205) (CBCS)

Unit-I **[12L]**

History of microbiology, Microbial world, origin and evolution of microorganisms, Differentiating characteristics of each group of microorganisms, Functional features of cells of microorganisms, Bacterial staining- Types and significance, Microbial growth, Media for growth, Phases of growth, Control of microbial growth.

Unit-II **[12L]**

Normal microflora of human body. Determinants of infectious diseases: attachment, colonization, entry, growth and multiplication. Toxigenicity: exotoxin, endotoxins, fever, shock, inflammation. Host-parasite interactions: pathogenicity, virulence, transmission. Nonspecific defense mechanisms of host: general barriers, physical barriers, chemical barriers, biological barriers. Human pathogenic microorganisms.

Unit-III **[12L]**

Cells and tissues of immune system, Hematopoiesis and differentiation, Primary and Secondary lymphoid organs, (Thymus, bone marrow, lymph nodes, Spleen), Lymphoid cells, B lymphocytes, T lymphocytes, Mononuclear phagocytes, Granulocytic cells, Mast cells, Dendritic cells, and their functions. Innate and adaptive immunity, concepts of antigen, antigenicity, Immunogen and immunogenicity, Humoral and cell mediated immune response.

Unit-IV **[12L]**

Structure and function of immunoglobulin, Clonal formation, Major Histocompatibility Complex (MHC) molecules, Antigen presentation, Hypersensitivity reactions (Type I-IV), Autoimmunity, Transplantation and basis of graft rejection, Antigen-antibody interactions, Monoclonal antibodies and Hybridoma technology, Radioimmunoassay (RIA), Enzyme linked immunosorbant assay (ELISA).

References

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

2. Basic Immunology: Functions and Disorders of the Immune System, Authors: Abul K. Abbas, Andrew H. H. Lichtman, Shiv Pillai, PublisherElsevier Health Sciences, 2012, ISBN, 145575899X, 9781455758999.

3. Immunology: Understanding the Immune System, by Klaus D. Elgert, PublisherJohn Wiley & Sons, 2009, ISBN 0470081570, 9780470081570.

4. Microbiology: Principles and Explorations, by Jacquelyn G. Black, Publisher John Wiley & Sons, 2008, ISBN0470107480, 9780470107485.

5. Alcamo's Fundamentals of Microbiology: Body Systems, Glendale Community College Jeffrey C Pommerville, Jeffrey Pommerville, PublisherJones & Bartlett Publishers, 2012, ISBN1449605958, 9781449605957.

6. Human genetics, A.Gardner, R.T.Howell and T.Davies, Published by VinodVasishtha for Viva Books private limited, 2008.

7. Fundamentals of Genetics by S.S. Gahalain, Publisher Anmol Publications Pvt. Limited, 2004, ISBN8126120029, 9788126120024.
8. Genetics, Authors Daniel L. Hartl, Maryellen Ruvolo, PublisherJones & Bartlett Publishers, 2011, ISBN 1449626114, 9781449626112

Numerical Methods and Programming (PGSD201) (Skill Development)

Unit 1: Curve plotting and fitting

Functions: polynomials, trigonometric, exponential, logarithmic and their plotting; normal, tangents, Polar coordinates, transformation of coordinates, parametric equations, tracing of polar curves, curve fitting, least-square fitting method, basic concept of interpolation & extrapolation. C programs of above methods.

Unit 2: Error and numerical solution of equations

Errors of observation and measurement, accuracy and preciseness, relative error, approximate error, bisection method, fix point iteration method, method of false position, Netwon-Raphson's method, C programming of above methods.

Unit 3: System of linear equations

Matrix representation of linear system of equations, solution of system of linear equations, Gauss-elimination method, Gauss-Jordan method, Iteration method for finding solutions, Jacobi's iteration method, Gauss-siedal method. C programs of above methods.

Unit 4: Integration and differential equations

Numerical integration, Simpson's rule, trapezoidal rule, numerically calculation of area under the curve, Initial value problem (I.V.P.), Euler's method, Runge-Kutta method- second or fourth order, system of ODEs, C program for solving ordinary differential equations. C programs of above methods.

Recommended Books

[1] C. F. Gerald and P. O. Wheatley, *Applied numerical analysis*, 4th ed. Reading, Mass: Addison-Wesley Pub. Co, 1989.

[2] S. C. Chapra, *Applied numerical methods with MATLAB for engineers and scientists*. New York: McGraw-Hill, 2013.

[3] S. R. K. Iyengar, R. K. Jain, and M. K. Jain, *Numerical Methods for Scientific and Engineering Computation*. New Age International Publishers.

[4] S. S. Sastry, *Introductory methods of numerical analysis.* Place of publication not identified: Prentice-Hall Of India Pv, 2010.

Semester III

Membrane Biophysics (MBP301)

Unit-I **[12L]**

Composition of biological membrane, function of primary components, hydrophobic effect, lipid-water systems, phase transition in lipid mixtures, critical fluctuations, lipid protein interactions, membrane rafts, correlation of physical properties of cell membrane and cell proteins, elastic properties of the membrane, spontaneous curvature, membrane melting, charge induced microstructures & domains.

Unit-II **[12L]**

Membrane transport, diffusion, electro-diffusion, types of transportation, thermodynamic model, chemical potential, osmotic pressure, water permeability, cellular mechanisms of volume regulation, structure, selectivity & permeability of ion channels, Voltage-gated channels, ligand-gated channels, stretch-activated channels,Na^+, $K^+$and Ca^{2+} channels, pumps as channels.

Unit-III **[12L]**

Donnan equilibrium, the resting membrane potential,Nernst equation, Goldman equation, Nernst-Plank equation,Hodgkin-Huxely equation, Hodking-Kartz experiment, Voltage clamp, transport by flux coupling, transport byphosphotransferase system, membrane impedance and capacitance, transmembrane potential, Zeta,Stern and total electrochemical potential, chemical synapse, post synaptic potential, action potential, properties of Action potential

Unit-IV **[12L]**

Conduction of the electrical activity, spread of electrical signals: passive vs. active, the action potential and its propagation through nerves, Saltatory conduction, propagation in a syncytium, membrane excitability, TRP channels as molecular sensors & integrators, channels and cell excitability, chloride channels and muscle excitability, synaptic integration

References

1. Membrane Biophysics, Authors: Mohammad Ashrafuzzaman, Jack A. Tuszynski, Springer Science & Business Media, 2012, ISBN3642161057, 9783642161056.
2. Structure and dynamics of membranous interfaces, Kaushik Nag, Wiley, 2008, ISBN-0470116315, 9780470116319.
3. Mechanics of the Cell by David Boal, PublisherCambridge University Press, 2012, ISBN-1139501771, 9781139501774.
4. Particles at Fluid Interfaces and Membranes: EditorsP. Kralchevsky, K. Nagayama, Elsevier, 2001, ISBN-0080538479, 9780080538471.
5. The Structure of Biological Membranes, Editor Philip L. Yeagle, CRC Press, 2004, ISBN-1420040200, 9781420040203.
6. Methods in Membrane Lipids, EditorAlex DoPico, Humana Press, 2007, ISBN 1588296628, 9781588296627.

Quantum Physics & Chemistry (MBP302)

Unit-I **[12L]**

de Broglie's wavelength, Bohr atom, Physical basis of quantum mechanics, Schrodinger equation (1D), Physical interpretation and conditions on the wave function, Stationary states and energy spectra, Particle in a square well potential, Tunnelling through potential barrier, Bound and unbound state.

Unit-II **[12L]**

Spherically symmetric potentials in 3-dimensions, Hydrogen atom, Helium atom; singlet and triplet states, Observables, Quantum operators; position, momentum, energy and parity, Spectroscopic notations, L-S coupling, J-J coupling, Commutators; linear and angular momentum, Uncertainty principle, Zeeman and Stark effect, Linear harmonic oscillator

Unit-III **[12L]**

Diatomic molecules, Molecular orbitals of the homo and heteronuclear diatomic molecules, Valance bond treatment of heteronuclear diatomic molecules, Molecular orbital and valence bond methods for the hydrogen molecule, charge distribution in molecular hydrogen, Born-Oppenheimer approximation and its breakdown, LCAO approximation, Vibrational and rotational energy levels in diatomic molecules

Unit-IV **[12L]**

Chemical bond, Bonding and anti-bonding regions-formation of bonds, 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.

References

1. Elementary Quantum Chemistry, F. Pilar, McGraw Hill book company, New York, 1968
2. Quantum Chemistry, N.V. Riggs, Macmillan Company London, Oxford and IBH publishing, 1975
3. Molecular Orbital theory, A. Streitwiser, John Willey, New York, 1961
4. Quantum Chemistry, Ira N Levine, Fourth Edition, Prentice Hall of India, New Delhi, 1994
5. Quantum Mechanics Concepts and Applications Second Edition, NouredineZettili Jacksonville State University, Jacksonville, USA
6. Concepts of Modern Physics, Arthur Beiser, McGraw Hill, 2003

Biophysical Techniques (MBP303)

Unit-I **[12L]**

Reflection, absorption, emission, scattering in spectroscopy, UV-Visible absorption, fluorescence and phosphorescence spectroscopy, Circular Dichroism, dynamic light scattering, rotational and vibrational spectroscopy, study of diatomic vibrations and rotational modes, advantages of Raman spectroscopy, applications, advantages and disadvantages of these techniques to biology.

Unit-II **[12L]**

General principles of NMR spectroscopy, resonance condition, relaxation phenomena and measurements, chemical shifts, coupling constants, proton decoupling (broad band), NOE effects,1H, 13C, solid state NMR, Basic principle and application of ESR, spin-labeling.

Basic principle of Mass spectroscopy, analysis and its application, importance and principle of MALDI-TOF spectroscopy and its applications.

Unit-III **[12L]**

General principles of electrophoresis, Factors affecting electrophoresis, Electrophoresis of proteins, SDS-PAGE, Support media for SDS-PAGE, Native gel, Gradient gel, Isoelectric focussing gel, Molecular mass determination by electrophoresis, Two-dimentional electrophoresis, Detection of proteins in gel, Wester Blotting, Electrophoresis of nucleic acid, Agarose gel elctrophoresis, Support media for agarose gel elctrophoresis, Electrophoresis of RNA, Capillary electrophoresis, Microchip electrophoresis, application of electrophoresis.

Unit-IV **[12L]**

Basic principles of chromatography, paper chromatography, TLC, column chromatography, gas, liquid chromatography, ion exchange chromatography, exclusion chromatography, affinity chromatography, high performance liquid chromatography, fast protein liquid chromatogragphy, their applications to macromolecules.

References

1. Fundamentals of Molecular Spectroscopy, 5th Edn, McGraw Hill, ISBN-10 1259062597, ISBN-13 9781259062599, 2013 May

2. Introductory Raman Spectroscopy by John R. Ferraro, Kazuo Nakamoto and Chris W. Brown, Second Edition, ISBN: 978-0-12-254105-63, Elsevier Science Publishing, 2003

3. Infrared and Raman Spectroscopy; Principles and Spectral Interpretation, by Peter Larkin, Elsevier Science Publishing Co Inc (13 July 2011), ISBN-10: 0123869846, ISBN-13: 978-0123869845

4. Introduction to Magnetic Resonance Spectroscopy ESR, NMR, NQRby D.N. Sathyanarayana (Second Edition), I K Int. Publ. House; Second Edition ISBN-10: 9382332529, ISBN-13: 978-93823325278 Nov 2013

5. Physical Biochemistry, D. Freifelder, W.H. Freeman & Co. San Francisco, 1976

6. NMR Spectroscopy: Basic Principles, Concepts and Applications in Chemistry, Wiley India Pvt Ltd; Second edition ISBN-10: 8126528443, ISBN-13: 978-8126528448, 12 October 2010

7. Biomolecular NMR Spectroscopy, by Jeremy N. S. Evans, OUP Oxford (11 May 1995)

ISBN-10: 0198547668, ISBN-13: 978-0198547662
8. Govil G. & Hosur R. V. NMR – Conformation of Biological Molecules, Springer- Verlag.
9. Modern Optical Spectroscopy: With Exercises and Examples from Biophysics and Biochemistry, by William W. Parson, Springer; 2007 edition (12 December 2006), ISBN-10: 354037535X, ISBN-13: 978-3540375357
10. Handbook of Fluorescence Spectroscopy and Imaging: From Single Molecules to Ensembles, Prof. Dr. Markus Sauer, Prof. Dr. Johan Hofkens, Dr. Jörg Enderlein,
2011 Wiley-VCH Verlag GmbH & Co. KGaA, Print ISBN: 9783527316694
11. Principles of Fluorescence Spectroscopy, Lakowicz, Joseph R. 5rd ed. 2006, XXVI, Springer, ISBN-10: 0387312781, ISBN-13: 978-0387312781, June 2010
12. Electrospray and MALDI Mass Spectrometry: Fundamentals, Instrumentation, Practicalities, and Biological Applications, by Richard B. Cole (Editor), Wiley-Blackwell; 2nd Edition edition
ISBN-10: 0471741078, ISBN-13: 978-0471741077, 18 May 2010
13. Friefelder D. Physical biochemistry W.H. Freeman & Co.
14. Stout G.H. & Jensen L.H. X-ray structure determination, Macmillan.
15. Slayter E.M. Optical methods in Biology, John Wiley
16. Blundell T. L. and Johnson L.N. Protein crystallography, Academic Press.
17. Wuthrich K. NMR of proteins and nucleic Acids, Wiley Interscience, Publications.

Genetics and Recombinant DNA Techniques (MBP304)

Unit-I: Genetics I **[12L]**

Mendelian principles: dominance, segregation, independent assortment, Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests, deviation from mendelian inheritance, codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, Linkage & crossing over.

Unit-II: Genetics II **[12L]**

Sex determination, Chromosomal and molecular basis of sex determination, Gene dosage compensation, Gene expression, copy number variation, Mutation, Mutational load assessment, Introduction to human genetic disease, Mitochondrial genome and associated diseases, Monogenic and Polygenic diseases, Conventional and modern approach of diagnosis.

Unit III: Tools and Techniques in Molecular Biology Part I:

Enzymes used in recombinant DNA technology: DNA and RNA polymerases, ligases, methylases, endonucleases and exonucleases. DNAases and RNAases. Sterilization and disinfection. Radioimmunoassay (RIA) and Enzyme Linked Immunosorbant Assay (ELISA). Western blotting techniques.

Unit IV: Tools and Techniques in Molecular Biology Part II:

Nucleic acid isolation methods; Nucleic acid separation techniques: Agarose gel electrophoresis of DNA. Blottings: Southern and Northern blotting techniques. Nucleic acid amplification protocols; DNA sequencing. Vectors: Basic requirements for a suitable cloning vector. Recombinant DNA. Competent cell preparation and transformation protocols. Cloning and selection transformants and recombinants.

References

1. Human genetics, A.Gardner, R.T.Howell and T.Davies, Published by VinodVasishtha for Viva Books private limited, 2008.
2. Fundamentals of Genetics by S.S. Gahalain, Publisher Anmol Publications Pvt. Limited, 2004, ISBN8126120029, 9788126120024.
3. Genetics, Authors Daniel L. Hartl, Maryellen Ruvolo, PublisherJones & Bartlett Publishers, 2011, ISBN 1449626114, 9781449626112.

Lab Course -IV (MBP305)

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. Estimation of hydrodynamic radius of a protein using Dynamic Light Scattering System (DLS).
7. Estimation of molecular weight and purity of a protein using SDS-Gel electrophoresis.

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Enzymology (MBP306)

Unit-I: Introduction to Enzymes [12L]

General concept and background, Nomenclature and Classification of Enzymes. Enzyme activity- chemical nature of enzymes, Mechanism of enzyme catalysis: Acid-base catalysis, covalent catalysis, Metal ion catalysis, Proximity and orientation effects, etc, Lock and key, Induced fit and Transition state Hypotheses, Concept of active site and energetics of enzyme substrate complex formation, Transition-state stabilization, Enzyme catalysis – general principles of catalysis; Quantitation of enzyme activity and efficiency; Enzyme Kinetic Parameters: Km, Vmax and Kcat, Enzyme characterization and Michaelis-Menten kinetics; Kinetics of single and bi-substrate enzyme catalysed reactions. Mechanism of Serine proteases-Chymotryspin, Coenzymes and Cofactors- Prosthetic group, Metalloenzymes and metal activated enzymes, Proenzymes, Isozymes, Abzymes, Synzyme.

Unit-II: Enzyme Inhibition and Regulation [12L]

Enzyme specificity: Types of specificity, Identification of binding site & catalytic site, 3-D structure of active site. Inhibition & its kinetics, Reversible Inhibition- Competitive, Non-Competitive, Uncompetitive, Mixed, Substrate, Allosteric and Product Inhibition. Analysis of enzyme kinetic data. Michaelis-Menten, Lineweaver-Burk and the direct linear plot. Irreversible Inhibition- Suicide inhibition. Examples and Mechanism of various Inhibitions like Penicillin, Iodoacetamide and DIPF. Feedback Regulation, Allosteric enzymes, Allosteric Regulation, Reversible Covalent Modification and Proteolytic Activation. Organisation of enzymes in the cell. Enzymes in the cell, localization, compartmentation of metabolic pathways, enzymes in membranes, Mechanisms of enzyme degradation, lysosomal and nonlysosomal pathways, examples.

Unit-III: Enzyme immobilization [12L]

Enzyme immobilization: Methods of immobilization of enzymes, Physical and chemical techniques for enzyme immobilization, Kinetics of immobilized enzyme, Effect of external mass transfer & intra-particle diffusion, limitation & applications of immobilized enzymes, Bioreactors using immobilized enzyme. Support and medium used for enzyme immobilization: Adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding and suitable examples, Advantages and disadvantages, Enzyme based biosensor: Design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

Unit-IV: Industrial and Clinical uses of Enzymes [12L]

Production and purification of crude enzyme extracts from plant, animal and microbial sources, Methods of characterization of enzymes, Enzyme Engineering and site directed mutagenesis: Introduction, aim, principle & steps of enzyme engineering, design and construction of novel enzymes, Bifunctional and polyfunctional enzyme, Enzyme in organic solvents. Industrial Enzymes- Thermophilic enzymes, enzymes used in various fermentation processes, Metal degrading enzymes. Clinical enzymes, Enzyme Structure activity

Relationship (SAR) and Drug Discovery, Biotransformation Applications of Enzymes and Industrial enzymes

References

1. Buchholz, K., Kasche, V. and Bornscheuer, U., "Biocatalysts and Enzyme Technology", WILEY–VCH, 2005.
2. L. Lehringer, d.L. Nelson, M.M Cox- "Principle of Biochemistry by Werth publishers, 2000.
3. L. Stryer, J.M. Berge, J.L. Tymoezko- "Biochemistry" W.H. freeman & Co. 2002.
4. Introduction to protein structure by B randen and Tooze (1998): Garland publishing group.
5. Enzyme by Palmer (2001); Horwood publishing series.
6. Fundamental of Enzymology by Price and Stevens (2002): Oxford University Press.
7. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd Ed., McGraw Hill, 1986
8. Alan Fersht, Enzyme Structure and Mechanism, 2nd Edition, W H Freeman & Co (Sd); 2nd edition (January 1985), ISBN-13: 978-0716716143, ISBN-10: 0716716143

Measurement and Data presentation (PGAE301) (Ability Enhancement)

Unit 1: Measurement [12L]

Block diagram of Measuring Systems: Performance characteristics, Static characteristics, Accuracy, Precision, Resolution, Types of Errors, Repeatability, Reproducibility, Fidelity, Lag; Specifications of Instruments. Standards and calibration.

Unit 11: Data Acquisition [12L]

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – A/D, D/A converters – Smart sensors.

Unit III: Presentation skills [12L]

Elements of an effective presentation, Structure of a presentation, Presentation tools, Data types, The graph Abstract Data Type, Data Structures for Graphs, Graph Traversals Directed Graphs, Weighted Graphs, Shortest Paths, Minimum spanning Trees. Data Graphing/Plotting using Microsoft Excel, Origin

Unit IV: Advanced technical writing [12L]

Report writing: Definition and importance of reports, qualities of reports, language and style in reports, types of reports, formats (letter, memo, project−reports). Methods of compiling data for preparing report. A computer−aided presentation of a technical project report based on survey−based or reference based topic. Technical paper−writing.

TEXT BOOKS:

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2004.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria& Sons, Delhi, 2003.
3. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.

Semester IV

Project Work (MBP401)

Project/ Dissertation work on experimental/theoretical topics to be carried out under the supervision of a faculty member of the Centre.

Pharmacology and Toxicology (MBP 402) (CBCS)

Unit I: General Pharmacology

Introduction, Drug discovery-a historical outline, general stages in modern-day drug discovery leads, analogues, prodrugs, some desirable properties - bioavailability, solubility, structure, stability, sources of drugs -ethnos pharmaceutical sources, plant sources, marine sources, microorganisms, animal sources, compound collections, data bases and synthesis. Methods and routes of administration: Pathology of the diseased state, the pharmaceutical phase. drug action, pharmacokinetic phase (ADME), pharmacodynamic phase.

Unit II: Drug development

Classification of drugs based on chemical structure: β-lactam antibiotics, benzodiazepine, cardiac glycosides, fibrates, thiazide diuretics. Classification based on mechanism of action: 5-alpha reductase inhibitor, Beta blockers, Nonsteroidal anti-inflammatory drugs – cyclooxygenase inhibitors, proton pump inhibitors. Classification based on mode of action- diuretic, cholinergic, dopaminergic, GABA argic, serotonergic.

Unit III

General Principles of Toxicology

Introduction to toxicology, toxicity tests, acute and chronic toxicity, dose response relationship, disposition of toxicants- absorption, distribution and elimination of toxicants. Target organ toxicity- hepatotoxicity, immunotoxicity, pulmonary toxicity, reproductive toxicity, hepatotoxicity, nephrotoxicity. Toxic effects of Pesticides with special reference to Insecticides, Herbicides, Fungicides, Rodenticides, Fumigants.

Unit IV

Applications of Toxicology

Clinical toxicology- strategy for treatment of the poisoned patient; Food toxicology- safety standards for foods, food ingredients, and contaminants; Forensic toxicology- analytic role, toxicological investigation of a poison death, criminal poisoning of the living; Occupational toxicology- occupational diseases, toxicologic evaluation of occupational agents, exposure monitoring, regulations for laboratory animal care and ethical requirements, clinical trials.

Recommended Books:

1. Casarett and Doull's Toxicology: The Basic Science of Poisons/editor Curtis D. Klaassen.
2. A Textbook of Modern Toxicology by Ernest Hodgson & Patricia E Levi, III Ed. Appleton & Lange 1997.
3. A Textbook of Modern Toxicology IV Edition, edited by Ernest Hodgson Wiley, 2010.
4. Principles of Biochemical Toxicology by John Timbrell, IV Edition.
5. Principles of Toxicology, III Edition 2015 by Karen E Sine & Thomas M Brown, CRC Press Teller & Francis Group.
6. An Introduction to Medicinal Chemistry; Graham L. Patrick (Oxford University Press-2009) 4th Edition.

7. Medicinal Chemistry, Ashutosh Kar. (New Age International-1993) 4th Edition.
8. Medicinal Chemistry- An Introduction, Gareth Thomas (Wiley-2000). 3rd Edition.
9. Foye's Principles of Medicinal Chemistry David A. Williams 2002. Lippincott Williams and Williams. 5th Ed.
10. Medicinal Chemistry- V. K. Ahluwalia 2009, Ane Books Pvt.Ltd
11. The Organic Chemistry of Drug Design and Action Richard B Silverman 2nd Ed 2004,
12. Analogue-based Drug Discovery, J. Fischer & C. R. Ganellin (Wiley-VCH 2006) Ist Edition