M.Sc. Biophysics

PANJAB UNIVERSITY, CHANDIGARH

Outlines of Tests, Syllabi and Courses of reading for Choice Based Credit System (CBCS) M.Sc. in Biophysics under the framework of Honours school system examination, Academic Session 2024-2025

Choice Based Credit System (CBCS) is one of the important measures recommended by the University Grants Commission (UGC) to enhance academic standards and quality in higher education includes innovation and improvements in curriculum, teaching-learning process, and examination and evaluation systems. CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising Core, and Discipline Specific and Generic Elective courses. The performance of students in examinations will be evaluated following the Grading system, which provides uniformity in the evaluation and computation

examinations. The grading system will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students.

OBJECTIVES OF THE COURSE

The objectives of the M.Sc. Biophysics programme are manifold starting with understanding the diverse phenomena observed in nature through fundamental concepts of biology, physics and chemistry using logical reasoning. It imparts students with an in-depth knowledge and understanding through the Core courses, which form the basis of Biophysics, namely, Cell and Membrane Biophysics, Gene and Protein Engineering, Medical Physics, Methods in High throughput Biology, Programming & Statistical Data Analysis and Biomolecular Spectroscopy. The syllabus shall also provide comprehensive knowledge, and improve theoretical and practical skills of the subject by incorporating extensive hands on experiments and practical sessions. The Discipline Specific elective courses are designed for more specialized content to equip students with experimental and theoretical techniques. The Generic elective courses are designed quin1(syst)-3rdiring49(Disc)3(ipl)ulyve nt(studen( ))-41(12c

Creative thinking and problem solving capabilities are also aimed to be encouraged through Dissertation/Thesis work. It also gives a flavor of how research leads to new findings. The laboratory-based Lab Rotation course is designed to develop an appreciation for the fundamental concepts and their applications, Instrumentation, Scientific methods/tools of biophysics. The M.Sc. course lays a solid foundation for a doctorate in biophysics and its Allied subjects later. Major portions of the National Entrance Test (NET for Research Fellowship and Teaching Posts) syllabi are covered in the Comprehensive NET Course in the third semester of the course.

PREAMBLE

The Department of Biophysics at Panjab University was established in the year 1964 with a vision to strengthen the field of Basic Medical Sciences of Panjab University. It originated with Electro Physiology, Radiation Biophysics and Electron Microscopy. Apart from the traditional areas in Biophysics such as Cell and Molecular Biophysics, Radiation Biophysics, Membrane Biophysics and Neuro Biophysics, the Department had put in efforts in recent times to move into new emerging areas such as Molecular Modelling, Bioinformatics, Molecular Imaging, Translational research in Cancer, Molecular Medicine and Nuclear Medicine. Advances in these areas have paved a way for the designing and development of drugs and medical technologies for the welfare of mankind.

It is the only department in India, which offers both undergraduate and postgraduate courses in the discipline of Biophysics (Honours School). The department also offers excellent research opportunities leading to the award of Ph.D. degree. The courses being offered to three years B.Sc. (Honours School) and two years M.Sc. (Honours School) students in biophysics are planned in a way so as to provide a broad base in the subject and can be accepted in the diverse fields of biomedical sciences. The department is also actively involved in collaborations with other departments of various Universities/Institutes for multidisciplinary research.

World over, the alumni from this department have been appropriately employed and most of them have occupied coveted positions in the academia, industry, medical institutions, national laboratories and prestigious research institutions of India as well as abroad. In the last few years, around fifty alumni have been awarded doctoral as well as post doctoral fellowships in USA & Europe and even some have been able to secure professional positions in academia as well as in industry.

The department has been selected by UGC for Special Assistance Program (SAP) as DSA based on its accomplishments in research and education. Moreover, the Department of Science and

M.Sc. Biophysics

Under the Framework of Honours School System

Choice Based Credit System

Session 2024-2025

M.Sc. Biophysics under the framework of Honours School System is a two-year course divided into four semesters with a total of 80 credits.

- A student is required to complete 80 credits for the completion of the course and the award of degree.
- In general, one-hour theory lecture per week equals 1 Credit, 2 hours practical class per Week equals 1 credit.

Courses/Papers offered in the M.Sc. are divided into three categories:

100) & R U H & R X U V H ¶ means a course that is Compulsory for a particular programme and offered by the Department, where the student is admitted.

ii) Disc L S O L Q H 6 S H F L I L F (O H F W L Y H ' 6 (& R X U V H ¶ means an optional course to be selected by a student out of such courses offered by the Department, where the student is admitted.

iii) Generic Elective (GE) in the department other than where the student is admitted.

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SEMESTER III (Credits = 20, Marks = 500)

Course	Paper	Credits	Marks	Teaching Hrs/week
Compulsory Core Courses				
MBPH-TW-C9	Thesis Work Part I	4	100	4
MBPH-TH-C8	Comprehension of the NET syllabus for Life Sciences	4	100	4
Discipline Specific Elective Courses (Select any two Courses)				
MBPH-DSE1	Radiation Biophysics*	4	100	4
MBPH-DSE2	Physicochemical Techniques*	4	100	4
MBPH-DSE3	HumanPhysiology and Anatomy*	4	100	4
MBPH-DSE4	Molecular Biology*	4	100	4
MBPH-DSE5	Physics of Human Body*	4	100	4
MBPH-DSE6				

SEMESTER IV (Credits = 20, Marks = 500)

Course	Paper	Credits	Marks	Teaching Hrs/week

** Allotment shall be on merit basis of the result of Semester I and II. Thesis must be submitted by 31st July of every academic year, failing which it shall be counted as appear.

Teaching and Evaluation

1. TEACHING : The number of Lectures (48+12) hours for Theory Component of each M.Sc. Courses under Honours School System shall consist of two components (i) 48 contact hours per semester of teaching to be delivered exclusively by the Teacher as per the Scheduled time table (ii) 12 contact hours are for interaction, discussion, assignments and seminars (attended/delivered) by the students.
2. EVALUATION

1. To qualify a Course, the student has to obtain minimum of 40% marks.
2. There shall be one Mid-Semester Examination of 20% Marks for Theory papers in each semester. End-semester examination will be of 80% of total marks.
3. Pattern of end-semester question paper
   i) Nine questions in all will be set with equal weightage. The candidate will be asked to attempt five questions.
   ii) One Compulsory question (consisting of short answer type questions) covering whole syllabus. There will be no choice in this question.
   iii) The remaining eight questions will have Four Units comprising two

so far. The student needs to give a brief synopsis (40 marks) and a presentation (40 marks) in this regard. Internal assessment (20 marks) will be based on attendance, regularity and daily performance.

(ii) In the fourth semester (MBPH-HW1-9) the evaluation (400 marks) will be done on the basis of the final thesis submission and viva-voice (conducted by the external expert duly approved by the Vice Chancellor)

M.Sc.

UNIT IV 15 Hrs

Development and use of transgenic animals: Transgenic mice, methodology, viral vector method, DNA microinjection method, engineered embryonic stem cell method, transgenic animals applications. Knockout animals.

Immobilized proteins: Absorption and covalent coupling, immobilization by metal

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MBPH -

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Unit IV 15 Hrs

Mass Spectroscopy - Basic principles and brief outline of instrumentation, Methods and types of ionization, Mass analyzers and detectors. Types of MS - LC-MS, GC-MS including recent advances in MS, Fast atom bombardment mass spectroscopy; analysis of drugs in biological samples by combined GC-MS. Chemical ionization mass spectroscopy (CIMS), Field ionization Mass Spectrometry (FIMS), Fast Atom Bombardment MS (FAB MS), Matrix Assisted laser desorption / ionization MS (MALDI-MS), Tandem MS. Molecular ions, meta stable ions, fragmentation processes, fragmentation patterns and fragment characteristics in relation to parent structure and functional groups, relative abundances of isotopes and their contribution to characteristic peaks, mass spectrum; its characteristics, presentation and interpretation, interpretation of spectra and applications in biology and science

Photoacoustic Spectroscopy - Basic principles, Techniques & Instrumentation involved,applications.

Reference Books:

1. Polypeptides and Protein Structure by A.G. Walton, Elsevier Science Ltd 1981.
2. Biomolecular NMR Spectroscopy by Evans, 1998.
3. Biological Spectroscopy by I. D. Campbell and Raymond A. Dwek, Benzamin/Cummings Publishing Company, 1984.
4. Principles of Fluorescence Spectroscopy by Lakowicz, Plenum, 1999.
5. Crystal Growth by Buckley, H.E., John Wiley & Sons, 1956.
6. X-ray Structure Determination by G.H. Stout & Jensen, Wiley-Interscience; 2 ed. 1989.
7. Biopolymers by A.G. Walton & J. Blackwell, Academic Press Inc., 1974.
8. Molecular Mechanics by Burkert, V. &Allinger, W.L., An American Chemical Society Publication, 1982.
9. Dynamics of Proteins & Nucleic Acids by J. A. McCammon and S.C. Harvey Cambridge University Press, 1988.
10. Physical Biochemistry by David Friefelder, W.H. Freeman; Second Edition 1982.
11. Molecular Modelling for Beginners by Alan Hinchliffe, John Wiley, 2003.
12. Mass Spectrometry for Biotechnology by Gary Siuzdak, Elsevier India, 2005.
13.

15. Zharov, V. P., and V. S. Letokhov. "Optoacoustic Spectroscopy of Condensed Media." Laser Optoacoustic Spectroscopy. Berlin: Springer-Verlag, 1986. 45-58. Print.

MBPH-PR-C3: Bio-molecular Spectroscopy

PRACITICAL

Total Lectures: 60 Credits: 2

1. of methylene blue and Bromophenol blue.
2. To study the spectra of lycopene and carotene
   (a) Extraction of the compounds (lycopene and Carotene)
   (b) Effect of light after exposure of different time intervals
3. To study the fluorescence spectra of given flurophore (ANS)
   (a) Effect of solvent
   (b) Effect of BSA (protein)
   (c) Effect of denaturation of protein by Urea and Temperature
   (d) Effect of fluorescence quencher KI (Potassium iodide)
4. To study the effect of pH on the electronic spectrum of tyrosine.
5. Hyperchromism of DNA using spectrophotometer: Effect of temperature, Urea and other denaturants.
6. Enzyme kinetics using Spectrophotometers
7. To study and analyze FTIR spectra of a given compound
8. NMR sample preparation, dataset acquisition and analysis of a small molecule, peptide or nucleic acid.

MBPH-TH-C5: CELL AND MEMBRANE BIOPHYSICS

THEORY

Total Lectures: 48+12= 60 Hrs Credits: 4

Objectives: This course introduces the concept of cell differentiation, growth, development and cell-cell communication. The plasma membrane endows the mammalian cell with unique mechanical properties which are essential to the functioning and survival of the cell and the physical properties of the membrane that are important in a much wider context, for example in the processes of signaling, transport, cell communications, vesiculation,

and regeneration. Myelin: Signal transduction involved in cell proliferation, differentiation and demyelination/remyelination, targeting proteins to myelin, Voltage clamp methods. Synaptic Transmission: Molecular mechanism of synaptic plasticity and transmission, synaptic receptors and their mechanisms of action, structure of synapses during development and differentiation of brain.

Unit IV 15 Hrs

Molecular order of Membranes: Polymorphism of lipid/water system, Lecithin-Water phase diagram, Thermotropic structural phase transition, Polymorphism of lipid A6 n BT n617.5 Tm (

S-12(m10r)-10(of)-6(Me)3(mbra)-2(n)-3(e)4(s:)] TJ ET Q q 0.000008871 0 595.32 841.92 re W* n BT /F3 1

11. Cell Membranes: Methods and Reviews Vol.3. Edited by Elliot Elson Springer; 1 ed. 1983.

MBPH-PR-C5: CELL AND MEMBRANE BIOPHYSICS PRACTICAL

Total Lectures: 60 Credits: 2

1.

MBPH-TH-C6: Medical Physics

THEORY

Total Lectures: 48+12= 60 Hrs

of single photon emission conjugated tomography imaging (SPECT) and its applications, Principle and image formation in positron emission tomography (PET).

Whole body counters: Principles of whole body counting, Design of whole body counting systems. Stationary and Moving systems. Liquid scintillation and Medical applications of whole body counting.

SUGGESTED READINGS

1. Medical Physics by J R. Cameron and J.G. Skofronick, John Wiley, New York, 1978.
2. Principles of

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UNIT 4: 15 Hrs

Machine Learning: Introduction to Machine Learning, Supervised Learning, Unsupervised Learning, Ordinary Least Squares Regression, Model Assessment and Selection, Support Vector Machines, Artificial Neural Networks, Ensemble Methods and Random Forests, Deep Learning, Association Rule Mining, Clustering Analysis of Data and Big Data, Association Rule Mining, Big Data, Clustering Analysis.

SUGGESTED READINGS

1. October 2001 ISBN: 0-596-00080-4.
2. R Programming for Data Science, by Roger D. Peng,lulu.com, ISBN10: 1365056821
3. https://leanpub.com/rprogramming
4. http://dss.princeton.edu/training
5. Using R for Introductory Statistics, by John Verzani, Chapman & Hall/CRC, Second Edition 2014,ISBN 146590734.
6. B.Rosner, Fundamentals of biostatistics,7thed. Boston: Brooks/Cole, Cengage Le 396.871 0 595.32

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Syllabus-Semester III

MBPH-DSE1: Radiation Biophysics

THEORY

Total Lectures: 48+12= 60 Hrs Credits: 4

Objectives:Students shall learn how the problem of measuring radiation doses is currently handled in terms of physical concepts, such as energy absorption, and empirical constructs, such as quality factors and equivalent dose rates. Futher, the course also introduce concepts of Nuclear medicine i.e. speciailty of medicine and medical imaging that uses radionuclides and relies on the process of radioactive decay in the diagnosis and treatment of

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radiation syndrome, chronic exposures, cosmic radiation, terrestrial radiation, medical and other exposures, Maximum permissible doses(ICRP Recommendations), basics for exposure limits for occupational exposure, accidental exposures, dose constraints for pregnant women, , regulations, cautions signs and labels , receiving and monitoring radioactive packages. Radioactive decontamination and waste disposal: Radioactive decontamination of labs, clothes, hands, glassware, gloves, metals, plastic, paints and bricks. Management of internal contamination/exposure. Radioactive waste disposal of solids, liquids and gaseous effluents, decay by storage, release into sewerage system, transfer to authorized persons, radioactive spills, management of sealed sources, release of patients administered with radiopharmaceutical/radioisotope.

SUGGESTED READINGS

1. Cellular Radiobiology by Alper, T., Cambridge University Press, 1979.
2. Radiation Biology by Cassarett, A.P., Prentice Hall, 1968.
3. Elements of Radiobiology Selman, J. Charles C Thomas 1983.
4. Radiation Biophysics 2nd edition by Andrew, H.L., Prentice Hall, 1961,1974.
5. Radiation Dosimetry by Frank Herbert Attix, Wiley Interscience Publication, John Wiley, 1986.
6. Fundamental Physics of Radiology by Meredit, W.J. and Massay, J.B J. Wright; 3rd ed. 1977.
7. Radiotracer Methodology in the Biological, Environmental and Physical Science by Wang, C.H., Wills, D.L. and Loveland, W.O., 1975.
8. Textbook of Nuclear Medicine by Michael A.Wilson, Lippincott Raver Publishers, 1997.

MBPH-DSE2: Physicochemical Techniques

THEORY

Total Lectures: 48+12= 60 Hrs Credits: 4

Objectives: This course offers an understanding of the core biophysical biochemical processes of macromolecular separation and characterization. This includes the principles and applications of chromatography, viscosity, velocity sedimentation and ultracentrifugation. It also includes the concepts and methodology of electrophoresis and different immunochemical techniques such as ELISA, RIA and immunoelectrophoresis.

UNIT I: Chromatography 15 Hrs

Theory, operations and applications of Partition, Adsorption, Gelpermeation, Ion exchange and Affinity chromatography, Chromatography on paper, thinlayer and column. Gas liquid and high performance liquid chromatography techniques: hydrophobic interaction chromatography, covalent chromatography, Special techniques in the chromatography of Nucleic acids and of proteins that bind nucleic acids: DEAE-cellulosechromatography, Hydroxyapatite chromatography.

UNIT II: Hydrodynamic methods 15 Hrs

Sedimentation: Theory of velocity Sedimentation, preparative and analytical ultracentrifugation, factors affecting sedimentation velocity, sedimentation coefficient. Zonal centrifugation through pre-formed density gradient. Determination of molecular weight by sedimentati

Viscosity: Theory and measurement of viscosity, Viscometers-Ostwald capillary, Ubbelondecapillary, examples of use of viscometry.

UNIT III: Electrophoresis 15 Hrs

Theory and types of electrophoresis, operations and application of Electrophoresis. Zone electrophoresis, paper, cellulose acetate strip and gel electrophoresis. Sodium dodecyl sulphate polyacrylamide gel Electrophoresis (SDS-PAGE). Disc electrophoresis in polyacrylamide gels. Agarose gel electrophoresis. Electrophoretic transfer-Southern, Northern and Western.

UNIT IV: Immunochemical methods 15 Hrs

Definitions in immunochemistry, The immunological system, Preparation of antibody, Antigen-antibody reaction, Immune reactions useful in bioassay, precipitin reaction, Immunodiffusion, compliment fixation assay, Agglutination, Radioimmunoassay (RIA) theory, operation and applications. Preparation of labelled antigen, Immunoradiometric assays (IRMA). Examples of immunological procedures used in bioassays, Enzyme-linked immunosorbent assay (ELISA). Fluorescent immunoassay. Protein A in immunoassay. Immunological technique for localizing substances in cells, tissue and molecules Fluorescent antibody and Ferritin conjugated antibody. Immunoelectrophoresis.

UNIT 3: The Circulation 15 Hrs

Biophysics of Blood flow, blood pressure, Haemodynamics, Capillary dynamics and exchange of fluids between the blood and

between codon and anticodons, tRNA with modified bases effects pairing, nonsense suppressors.

Unit IV 15 Hrs

in the Senses: Statics of the Body: Review of Forces, torques , and Equilibrium ; Statics: Motion in One Plane and Levers , Statics in the Body ;The Lower Arm , Hip Problem, Statics of Other Synovial Joints , Lower Back Problems , Multisegment Modeling , The Sense of Touch , Diversion into the Units of Force and Pressure ; Force, Pressure

Motion : Kinematics and Musculature , Standing ; Stability, Forces on the Feet, Walking ; Kinematics, Muscular Action, Friction , Energetics , Review of Harmonic Motion, Pendulums, Moments Of Inertia, Ballistic (or Pendulum) Model Of Walking , Inverted Pendulum Model , Running ; Kinematics , Muscular Action , Jumping ; Vertical Jump , Pole Vault Throwing a Ball , Collisions of Human Body , Sustained Acceleration , Physics of Sports

Mechanical Properties Of the Body: Material Components of the Body , Bone, Ligaments

acids, amino acids as precursors of other bioactive compounds, zwitterion, isoelectric point, optical properties of amino acids.

Peptide and Protein conformational analysis: Configuration and Conformation, Definition of a peptide, peptide unit, peptide group, bond length, cis and trans conformation, Ramachandran Plot, primary structure, secondary structure

DNA structure: Different types of DNA and their structure, DNA polymorphism, A, B and Z forms, DNA motifs, repeats and their significance, function and stability. DNA

Unit I

Introduction to Neurobiophysics 15 Hrs

Principles of cellularorganization in the nervous system and population of cells. Functional groups of neurons,neuron circuits and neuroglia cells; Concepts of membrane transport: Transport of ions and molecules through cell membrane, diffusion and active transport through cellular sheets, factors that affect rate of diffusion; Basic principles of membrane potential,action potential,resting membrane potential; Ion Channels: Role of Na/K pump and leak channel, role of Voltage gated channels in conductance of ion during action potential; Nerve action potential: initiation and propagation, recording of membrane potential. Signal transmission,synapses, physiology, neurotransmitters, excitatory and inhibitory synaptic potentials, synaptic summation and facilitation. Synaptic plasticity; Neuromuscular junction and transmission

UNIT II 15 Hrs

Neuroanatomy: Brain and its grossanatomy: cerebral hemispheres, basal ganglia, brain stem, Pons, Thalamus,hypothalamus, cerebellum, medulla, corpus striatum and related nuclei, hippocampalformation, amygdala and olfactory pathways, cerebral, cerebellar and cerebrospinaltracts, meninges. Spinal cord, internal structures, spinal nerves,cytoarchitectural lamination, dorsal root afferents, spinal tracts

Autonomic nervous system: Basi69.05 Tm 0 g 0 G -0.036 Tc[(:)] TJ ET Q q 0.000008871 0 5

Unit IV 15 Hrs

Motor mechanisms Cortical and Brain Stem Control of Motor function, Vestibular Apparatus; Cerebellum, Basal Ganglia and overall motor control

Cerebral Cortex and Intellectual functions of Brain: Functional organization of the cerebral cortex, functions of specific cortical areas, learning conditioned reflexes, thoughts, consciousness and memory, consolidation of memory, intercortical transfer of learning drugs that facilitate learning functions of neocortex, aphasia and allied disorders, cerebral dominance, frontal and temporal lobe in higher functions.

Neurophysiologic basis of behavior, motivation and cerebral blood flow. Limbic system and hypothalamus, regulation of biologic rhythms, sexual behavior, fear and range, motivation, mechanism of sleep, wakefulness and self stimulation. Medulla oblongata in control of respiration, heart rate and blood pressure

SUGGESTED READING

1. Core Textbook of Neuroanatomy by Carpenter, MB, Williams & Wilkins; 4 Sub ed. 1991.
2. Textbook of Medical Physiology by AC Guyton, Saunders, 11th ed. 2005
3. The Human Nervous System: Basic Principles of Neurobiology by Charles R. Noback and Robert J. Demarest Mcgraw-Hill (Tx); 3 Sub ed 1980.
4. Physiology by Ganong McGraw-Hill/Appleton & Lange; 21 edition, 2003

MBPH-DSE8: Advanced Microscopic Techniques

THEORY

Total Lectures: 48+12= 60 Hrs Credits: 4

Unit- I 15 Hrs

Compound light microscope: Mechanism of fixation process, Electromagnetic radiation and its interaction with the matter (reflection, refraction, diffraction, interference and polarization), image formation in light microscope, lens aberrations, types of objective lenses, design of compound light microscope, phase, interference and polarization methods for optical contrast.

Unit-II 15 Hrs

Confocal fluorescence microscopy: basic concept, instrumentation, sample preparation, confocal laser scanning microscopy, uses in biology and medicine

Two photon excitation microscopy: basic concept, instrumentation, sample preparation, application

Unit-III 15 Hrs

Electron microscopy: Transmission electron microscopy (TEM) and scanning electron microscopy (SEM)

Specimen preparation for electron microscopy: Fixation, Embedding, buffers and fixatives used in specimen preparation, cryofixation, negative staining, specimen drying techniques, fracturing procedure, replication procedure, mounting and specimen coating for conductivity, immunogold labeling

Instrumentation(pe)4(c)4(im)-3(e)4(n)-3( )-89(pre)3(parat)-2(ion)-5( )-89(for)-87(e)4(lec)6(ti(c)4(.86

2) Biomedical electron microscopy (Illustrated methods and interpretations) by Arvid B. Maunsbarch and Bjorn A. Afzelius

3) Electron Microscopy (Principles and techniques for Biologists) by John J. Bozzola and Lonnie D. Russell.

MBPH-DSE9: Nanobiophysics/Nanoscience and Technology

THEORY

Total Lectures: 48+12= 60 Hrs Credits: 4

Objectives: This course will introduce synthesis of nanoparticles and nanostructures, their characterization and their possible applications. Nanotoxicology will introduce various methods to estimate andcharacterize toxicity induced by nanoparticles. Further various applications of nanoparticles will inculcate students to take up more challenging advance level research problems.

UNITI 15 Hrs

Synthesis of nanoparticles: Chemical precipitation and co-precipitation, polyol, and borohydrate reduction methods, Sol-Gel synthesis; Microemulsions synthesis, Hydrothermal, Solvothermal synthesis methods, Microwave assisted synthesis; Sonochemical assisted synthesis; Shell-Core nanostructure, Organic-

Radioactive decontamination and waste disposal: Radiation decontamination of labs, clothes, hands, glassware, gloves, metals, plastics, paints and bricks. Radioisotopic waste disposal of solid, liquid and gaseous effluents/ waste, decaying storage transfer to authorized personal, management of sealed sources, quality management program, misadministration of radiopharmaceuticals, release of patients administered with radiopharmaceuticals.

Radioactive waste source of radioactive wastes Classification of waste Treatment techniques for solid , liquid and gaseous effluents Permissible limits for disposal of waste Sampling techniques for air, water and solids Geological, hydrological and meteorological parameters Ecological considerations.

Disposal of radioactive wastes General methods of disposal Management of radioactive waste in medical, industrial, agriculture and research establishments.

UNIT II I 15 Hrs

Regulatory Aspects & Licensing The Atomic Energy Act, Rules issued under the Act, Surveillance procedures issued under the Rules, Notifications issued under RPR, 1971 and 2004 AERB Safety Directive, Safety code for Radiotherapy, Radiodiagnosis and NM facility, Duties of Medical physicist/ Technologists/ Radiopharmacists SOP, Regulatory clearance Approval of Radiotherapy, Radiodiagnosis and NM Lab, Physician & RSO, Regulatory consent, authorization disposal of radioactive waste and safe transport of Radioactive materials. Ethics, Registration of radiopharmaceuticals and their use. Historical background of legislation in the atomic energy field, need for control of radiation exposure at national and international levels, national control through acts with supporting regulation at central and state levels international control through specialized agencies, third party liability and insurance in the atomic energy field; ICRU and ICRP Recommendations on Dose Limits, Protection Regulations, Basic Framework of Radiation Protection, Radiation Safety Program, Radiation Safety Officer and duties of Radiation Safs calb Safs calb Safs calb Safs s c

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Lead discovery and Analog Based Drug Design: Rational approaches to lead discovery based on traditional medicine, Random screening, non-random screening, serendipity in drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.

Analog Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement.

Unit II 15 Hrs

Quantitative Structure Activity Relationship (QSAR): SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as partition coefficient, substitution constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

Unit III 15 Hrs

Molecular Modeling and virtual screening techniques

Virtual Screening techniques Drug likeness screening, concept of pharmacophore mapping and pharmacophore based screening.

Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening De novo drug design.

Cheminformatics & Methods in drug design: Introduction to chemiinformatics, ADME databases, Toxicity

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Molecular and immunological Aspects of cell proliferation: The immune system and cancer, Identifying infectious agents as carcinogens, Inflammation and cancer, Cancer vaccines, Inhibition of inflammation

UNIT III 15 Hrs

Oncogenes and Carcinogenesis: Unified theory of carcinogenesis; Cancer by gene activation. Chemical Carcinogenesis: polycyclic aromatic hydrocarbon; mechanism of chemical carcinogenesis, stages of chemical carcinogenesis; metabolic activation, Host factors and chemical carcinogenesis

UNIT IV 15 Hrs

Metastasis: The process of metastasis, Tools of cell invasion: cell adhesion molecules, integrins, and proteases, Intravasation, Transport, Extravasation, Metastatic colonization, Angiogenesis, Other means of tumor neovascularization

SUGGESTED READINGS

1. Cancer: A Problem of Developmental biology by G. Bassy Pierce, Robert Smikis, Louis M. Flink.
2. Dimensions of cancer by Charles E. Kupchel
3. Molecular Biology in Histopathology by John Crocker.

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(related to Biophysics) and their applications till date. Discuss the importance of these discoveries for global population.

SUGGESTED READING