KANNUR UNIVERSITY

(Abstract)

M Sc Molecular Biology Programme in the Department of Molecular Biology, Dr Janaki Ammal Campus, Palayad - Revised Scheme (Distribution of credits of Four semesters) & Syllabus (1st Semester Only) - Approved- Implemented w.e f 2023 admission- Orders Issued

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ACADEMIC C SECTION

ACAD C/ACAD C3/24546/2023 Dated: 10.01.2024

Read:-1. UO No ACAD C/ ACAD C3/22373/2019 dated 12/09/2023
2. Circular No dated ACAD C/ ACAD C3/22373/2019 dated 12/09/2023
3. Email dated 12/12/2023 from the Head, Dept. of Molecular Biology, Dr Janaki Ammal Campus, Palayad
4. Minutes of the meeting of the Department Council dated 13/11/2023

ORDER

1. The revised Regulations for Post Graduate Programmes under Choice Based Credit and Semester System in the University Teaching Departments/ Schools were implemented w.e.f 2023 admissions vide paper read 1 above

2. As per paper read 2 above, Heads of all Teaching Departments were requested to submit the revised Syllabus in accordance with the approved Regulations along with a copy of the Department Council Minutes.

3. As per paper read 3 above, the Head, Department of Molecular Biology Dr Janaki Ammal Campus, Palayad submitted the scheme (Distribution of credits of Four Semesters) and the Syllabus (1st Semester Only) of M.Sc Molecular Biology Programme, prepared on the basis of department level workshop participating subject experts.

4. Department Council vide the paper read 4 above approved the aforementioned scheme and syllabus of M.Sc Molecular Biology Programme to be implemented in the Dept. of Molecular Biology of the University w.e.f.2023 admission.

5. The Vice Chancellor, after considering the matter in detail and in exercise of the powers of the Academic Council conferred under section 11(1), Chapter III of Kannur University Act 1996, ***approved the Scheme (Distribution of credits of Four Semesters) & Syllabus (1st Semester Only) of M.Sc Molecular Biology Programme and accorded sanction to implement the same in the Department of Molecular Biology, Dr Janaki Ammal Campus, Palayad w.e.f 2023 admissions, subject to reporting to the Academic Council***

6.The Scheme (Credit distribution of Four Semesters) and Syllabus (1st Semester Only) of M.Sc Molecular Biology Programme under CBCSS implemented in the Department of Molecular Biology, Dr Janaki Ammal Campus, Palayad with effect from 2023 admission, is appended and uploaded in the University website (www.kannuruniversity.ac.in)

7. Orders are issued accordingly.

KANNUR UNIVERSITY CIVIL STATION KANNUR Pin-670 002 THANIKARA

Sd/-
Narayanadas K
DEPUTY REGISTRAR (ACAD)
For REGISTRAR

To: 1. Head, Department of Molecular Biology, Dr Janaki Ammal Campus, Palayad
2. Convenor, Curriculum Committee

Copy To: 1.PS to VC/ PA to PVC/ PA to R
2. To Examination Branch (through PA to CE)
3. EP IV/ EXC I
4. Computer Programmer
5. Webmanager (to publish in the website)
6. SF/DF/FC

Forwarded /-By Order

SECTION OFFICER

KANNUR UNIVERSITY

DEPARTMENT OF MOLECULAR BIOLOGY

M.Sc. MOLECULAR BIOLOGY

Scheme and Syllabus

(under Choice Based Credit Semester System -CBCSS, effective from 2023)

SEMESTER I

KANNUR UNIVERSITY

DEPARTMENT OF MOLECULAR BIOLOGY

Regulations, Scheme and Syllabus for
M.Sc. MOLECULAR BIOLOGY
(w.e.f. 2023 Admission)

1. About the Department

The Department of Molecular Biology was established in the year 2008, at Dr. P.K. Rajan Memorial Campus, Puthariyadukkam, Nileshwaram, Kasaragod district, which was moved to Dr Janaki Ammal Campus, Palayad in 2022. The Department offers Postgraduate (M.Sc.) and Doctoral (Ph.D.) programmes in Molecular Biology. The subject Molecular Biology is an emerging area of modern biology with vast potential for application in diverse areas including basic sciences, biomedical sciences and other allied applied areas. The department is well equipped with smart classrooms, MSc practical labs and research lab with the basic instruments needed for the successful conduct of this programme. The department has a bioinformatics lab with computers and internet facility, and a library with more than one thousand books and 13 journals.

2. About the Programme

The MSc Molecular Biology program envisages empowering the blended students to equip to conduct research in any area of interest in modern biology and hence is amenable to a multidisciplinary approach. The M.Sc. programme is a research oriented collaborative course comprising most of important and recent Sciences like genetic Engineering, Industrial Biotechnology, Environmental Science, genetics etc. giving the students job opportunities in various fields like Teaching, research, Industry, Medical laboratories and more. It also provides the students exposure to most important and recent techniques and information in Life science.

This program is intended for young students with high academic caliber from diverse fields and provides greater opportunity to prepare themselves for competitive examinations like UGC-CSIR JRF/NET, ICMR-JRF/NET, DBT- JRF/NET. GATE etc for those who are ambitious of becoming a teacher or a scientist. This program will prepare students to take research in Molecular Biology and allied areas as a possible career option as well as will enable generation of manpower for the emerging Molecular Biology industry. The student strength is 16. The M.Sc. Molecular Biology program is offered under the Choice based Credit and Semester System with duration of 2 years (4 Semesters), which comprises Classroom Teaching, Laboratory Practical’s, Tutorials in the form of Seminars and a Dissertation (research) in the last semester.

3. Introduction to Choice Based Credit Semester System (CBCSS)

The CBCSS provides an opportunity for the students to choose courses of their interest from the prescribed courses comprising core, elective, open elective courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Grading system provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations which enables the student to move across institutions of higher learning. The uniformity in evaluation system also enable the potential employers in assessing the performance of the candidates.

3.1. Definitions

(i) **Academic Programme** means an entire course of study comprising its programme structure, course details, evaluation schemes etc. designed to be taught and evaluated in a teaching Department/Centre or jointly under more than one such Department/Centre.

(ii) **Course** means a segment of a Programme limited to one semester in a subject.

(iii) **Programme Structure** means a list of courses (Core, Elective, Open Elective) that makes up an Academic Programme, specifying the syllabus, Credits, hours of teaching, evaluation and examination schemes, minimum number of credits required for successful completion of the programme etc. prepared in conformity with University Rules,

(iv) **Core Course** means a course that a student admitted to a particular programme must successfully complete to receive the degree and which cannot be substituted by any other course.

(v) **Elective Course** means an optional course to be selected by a student out of such courses offered in the same Department/Centre.

(vi) **Open Elective Course** means an elective course which can be opted in any of the semesters during the entire Programme other than the first semester. ln the third semester all students shall compulsorily register for an Open Elective Course offered by other Departments or MOOC. Students of other Departments may opt these courses subject to fulfilling of eligibility of criteria as laid down by the Department offering the course.

(vii) **Credit** means the value assigned to a course which indicates the level of instruction; Normally, one-hour lecture per week equals 1 Credit, 2/3 hours

practical class per week equals 1 credit. Credit for a practical could be proposed as part of a course or as a separate practical course.

(viii) **SGPA** means Semester Grade Point Average calculated for individual semester.

(ix) **CGPA** is Cumulative Grade Points Average calculated for all courses completed by the students in the last year of the course by clubbing together SGPA of four semesters.

3.2. Program Objectives:

The M.Sc. programme in Molecular Biology will:

(1) provide training and understanding of basic concepts as well as cutting edge advancement in the field of Molecular Biology,

(2) impart practical skills through laboratory courses and understanding of modern scientific techniques,

(3) enhance analytical, statistical and validation skills through hands on training,

(4) expose students to various aspects of research through dissertation, and

(5) introduce applications of Molecular Biology in order to prepare highly trained and skilled workforce for teaching, research and entrepreneurship.

3.3. Program Outcomes:

On successful completion of this programme students will:

(1) have an in-depth understanding of the basic and recent developments in the field of Molecular Biology,

(2) acquire skills of critical, analytical and problem solving in order to enable them to be successful in various national and international examinations,

(3) conduct independent work in a laboratory,

(4) possess skills for independent thinking and in writing scientific proposal and presentations, and

(5) capable of becoming successful academicians/researchers and/or entrepreneurs.

DEPARTMENT OF MOLECULAR BIOLOGY-Distribution of Courses and Grades for MSc Molecular Biology Program w.e.f. 2023 admission onwards

Sem	DISCIPLINE SPECIFIC COURSES		Interdisciplinary Elective/ Multidisciplinary Elective/Open Elective (4/2 credits)	Ability Enhancement Courses (AEC) 2 credits	Skill Enhancement Courses (SEC) 2 credits	Value Addition Courses/MOOC Courses (VAC) 2 credits	Internship/Filed Visit/Minor Project/ Institutional Industrial Visit 2 credits	Dissertation/ Major Project	Total Credits
	DS CORE	**DS Elective**							
I	Cell Biology (4C)	Biophysics and Bioinstrumentation (3C) **OR** Biostatistics							
	General Microbiology (4C)								
	Biochemistry (4C)								
	Lab in Cell Biology & Microbiology (3C)								
	Lab in Biochemistry & Biophysics (3C)								
	18 Credits	3 credits							**21 credits**
II	Genetics & Molecular Biology (4C)	Immunology **OR** Environmental Biotechnology **OR** Life style disorders (3C)	Drug design & Development (2C)*						
	Cell Physiology (4C)	Ecology & Biodiversity **OR** Ethics, Patency & Intellectual Property Rights **OR** Human Genetics (3C)	Protein purification strategies (2C)*						

	Lab in Genetics & Molecular Biology (3C)								
	Lab in Physiology & Immunology (3C)								
	14 Credits	6 Credits	4 credits						**24 credits**
III	Advanced Molecular Biology (4C)	Genomics & Bioinformatics **OR** Molecular Neurobiology **OR** Forensic Biology & DNA profiling (3C)	Life & Genes (4C)*	Lab in Genomics & Bioinformatics (2C)		VAC-Academic Scientific Writing (2C)/MOOC	IN/FV/MP/Ind Visit (2C)		
	Genetic Engineering & Biotechnology (4C)	Developmental Biology **OR** Industrial Biotechnology **OR** Molecular Evolution (3C)							
	Lab in Molecular Biology, Genetic Engineering & Biotechnology (2C)								
	10 credits	6 credits	4 credits	2 credits			2 credits		**24 credits**
IV								Research Project related to Molecular Biology (16 Credits)	
								16 credits	**16 credits**
TOTAL CREDIT FOR MSc PROGRAMME									**85 credits**

* Courses designed for the students of other departments

SYLLABUS

The M. Sc. Molecular Biology program comprises of the following courses.

SEMESTER-I		
MSMOB01DSC01	Cell Biology	-4 credits
MSMOB01DSC02	General Microbiology	-4 credits
MSMOB01DSC03	Biochemistry	-4 credits
MSMOB01DSE01	Biophysics and Bioinstrumentation	-3 credits
MSMOB01DSE02	Biostatistics	
MSMOB01DSC04	Lab in Cell Biology & Microbiology	-3 credits
MSMOB01DSC05	Lab in Biochemistry & Biophysics	-3 credits

DETAILED SCHEME OF VALUATION

SEMESTER- I

DS Core: 5 (Theory-4; Practical-2);

DS Elective: 1

Credits : Core-18 (Theory-12; Practical-6); Elective-3

Sl. No.	**Course Code**	**Title of the course**	**Contact hours/week**			**Marks**			**Credits**
			L	**T/S**	**P**	**ESE**	**CE**	**Total**	
1.	MSMOB01DSC01	Cell Biology	3	1		60	40	100	4
2.	MSMOB01DSC02	General Microbiology	3	1		60	40	100	4
3.	MSMOB01DSC03	Biochemistry	3	1		60	40	100	4
4.	MSMOB01DSE01	Biophysics and Bioinstrumentation	2	1		60	40	100	3
	MSMOB01DSE02	Biostatistics							
5.	MSMOB01DSC04	Lab in Cell Biology & Microbiology			6	60	40	100*	3
6.	MSMOB01DSC05	Lab in Biochemistry & Biophysics			6	60	40	100*	3
TOTAL			**11**	**4**	**12**	**360**	**240**	**600**	**21**

*There is no external practical examination. CE includes marks for lab record, test/practical viva.

SEMESTER -I

MSMOB01DSC01: Cell Biology

60 hours **4 Credits**

Course Objectives:
The objective of this course is to offer detailed knowledge about cell biology, various cellular organelles and the signal transduction pathways associated with the cellular processes of the cells. The course also aims to provide into the insights of how classical cellular pathways were experimentally discovered.

Course Learning Outcomes:
Upon completion of this course, students will

- learn about cell theory, cell cycle mechanisms, various cellular organelles and their structure and function.
- acquire insight into the processes of transport across cell membranes, process of endocytosis and protein sorting/translocation to various organelles.
- gain knowledge about the concepts of various cellular signal transduction pathways.
- acquire insight into the mechanisms of cellular responses under varying conditions.
- learn the association of the defects in the signalling processes to various diseases.

MODULE-1

Introduction to Cell Biology- Cell theory-Basic properties of cells- different classes-Cellular dimension-Size of cells and their composition-Cell origin and Evolution (Endosymbiotic theory)– Molecules of the Cell.

MODULE-2

Cell Membrane-Proteins and Lipids-Organisation-Lipid bilayer: Composition and properties (Hydropathic plot)-Membrane permeability and transport-Principles of membrane transport-Pores and Channels-Pumps-Differentiation of cell membrane– microvilli – tight junction – belt and spot desmosomes - intercellular communications and gap junctions – cell coat and cell recognition.

MODULE-3

Synthesis, sorting and trafficking of proteins: site of synthesis of organelle and membrane proteins – transport of secretory and membrane proteins across ER – post-translational modification in RER – transport to mitochondria, nucleus, chloroplast and peroxisome - protein glycosylation – mechanism and regulation of vesicular transport – golgi and post-golgi sorting and processing – receptor mediated endocytosis; Synthesis of membrane lipids.

Ribosomes: Specific association rRNA and r-proteins –Nucleolus- ribosome biogenesis – in-vitro assembly experiments to understand ribosome formation and also for understanding the functions of various ribosomal components – active centers of ribosomes.

MODULE-4

Nucleus: Nuclear envelope – Nuclear pore complexes-nuclear matrix – organization of chromatin – supercoiling, linking number, twist - nucleosome and high order of folding and organization of chromosome (Solenoid and Zigzag model)-Global structure of chromosome –(Lamp brush and polytene chromosomes). Cytoskeleton. Cell cycle and its regulation (Cyclin and kinases)-Experiments (Fission Yeast, Xenopus, Sea Urchin) -Check points-mitosis and meiosis. Cell Death: Apoptosis versus necrosis-Apoptotic pathways – autophagy – ageing.

References:

1. Lodish *et al*., Molecular Cell Biology. W H Freeman & Co.
2. Becker W M *et al*., The World of the Cell. Pearson.
3. DeRobertis E D F and DeRobertis E MF, Cell and Molecular Biology. Saunders
4. Karp and Gerald, Cell and Molecular Biology. John Wiley.
5. Polland Thomas D, Cell Biology. Saunders.
6. Standzinski George P Editor, Cell growth, differentiation and senescence. Oxford University Press.
7. Alberts B, Molecular Cell Biology.
8. Casimeris *et al*., Lewin's cells. Jones and Bartlett.
9. Plopper, Principles of cell Biology. Jones and Bartlett.
10. Gartner, Cell Biology and Histology. LWW.
11. Pollard et al., Cell Biology. Sounders.
12. Copper, The Cell a Molecular approach. Sinauer.

MSMOB01DSC02: General Microbiology

60 Hours **4 Credits**

Course Objectives:
The objective of this course is to offer detailed knowledge about the history and diversity of microorganisms; benefits of microorganisms and the various mechanisms of disease, cause, transmission, detection, treatment and prevention.

Course Learning Outcomes:
Upon completion of this course, students will

- learn in detail the adaptations of microorganisms that help them to invade the host cell, how they evade the host immune system and colonise the host cell causing diseases.
- gain overall knowledge about the mechanisms of disease cause, transmission, detection, treatment and prevention.
- develop the ability to relate to any existing or emerging infection as well as will learn about drug resistance and its mechanisms.
- have the know-how to research and develop new tools in the field of microbial science.

MODULE-1

History and scope of Microbiology. Microbial Diversity: Place of microorganisms in the living world – criteria used in microbial taxonomy; Classification of bacteria – past and present status – classification based on morphology- gram's staining and culture characteristics – classification based on Bergey's manual of systematic bacteriology (details of sections not expected); Classification of viruses – classification based on host, viral morphology and nucleic characteristics.

MODULE-2

Structural organization of bacteria, fungi and viruses: Ultra structure of bacterial cell wall – cell membrane – flagella – pili – capsule and genome; Structure and architecture of bacteriophages. Fungi-Molds and Yeasts. Bacterial culturing: Physical and chemical methods of sterilization – growth media – mixed microbial population – selection of pure culture – physical conditions of growth – growth curve – storage and transport of microbes.

MODULE-3

Microbial toxins: Exotoxins – endotoxin and other virulence factors. Disinfectants and antibiotics: Methods of testing antimicrobial substances – mechanism and action of important classes of disinfectants and antibiotics – drug resistance of antibiotics.

MODULE-4

Benefits of microbes in various fields: Microbes in fermentation – microbial biogas from biological wastes – microbes in value addition of fish and meat – microbial bioremediation. Microbes and diseases: Bacterial diseases – Streptococcal diseases – Tuberculosis –Plague – Anthrax – Syphilis – Cholera – Tetanus – Leprosy; Viral diseases – Chicken pox – Small pox – Influenza – Rabies – AIDS-SARS and Ebola.

References:

1. Prescott, Harley and Klein, Microbiology. McGraw-Hill
2. Jacquelyn G Black, Microbiology: Principles and Exploration. John Wiley & Sons.
3. Nester et al., Microbiology: A human perspective. McGraw Hill.
4. Albert G Moat et al., Microbial Physiology. John Wiley & Sons.
5. Kathleen Park Talaro, Arthur Talaro, Foundations in Microbiology. Mc Graw Hill.
6. Alcamo, Foundations of Microbiology. Jones and Bartlett Publishers.
7. Cappuceino James, Microbiology: A Laboratory Manual. Pearson Education
8. Toratora Gerad, Microbiology: An Introduction. Pearson Education.
9. Edward A I, Microbiology. Tata McGraw Hill.
10. Lim Daniel, Microbiology. Mc Graw Hill.
11. Pelczar M J Jr, Chan E C S Krieg, Microbiology.
12. Wheelis, Principles of Modern Microbiology. Jones and Barttlett.
13. C.J.Alexopoulos. Introducing Mycology. Wiley.
14. Basman. Microbiology with diseases by holy systems. Pearson.
15. Madigan et al. Biology of Microorganisms. Pearson.

MSMOB01DSC03: Biochemistry

60 Hours **4 Credits**

Course Objectives:
The objective of this course is to offer advanced knowledge of the core principles and topics of biochemistry and their experimental basis. This course provides details about the biomolecules and cellular metabolism.

Course Learning Outcomes:
Upon completion of this course, the students will

- be able to explain/describe the synthesis of proteins, lipids, nucleic acids, and carbohydrates and their role in metabolic pathways along with their regulation including protein folding, modification, and degradation.
- learn the use of current biochemical and molecular techniques to plan and carry out experiments.

MODULE-1

Atomic bond and molecular interaction: Covalent bonds – ionic interactions – hydrogen bonds – Vander Waal's interactions – hydrophobic effect – binding of biomolecules. Biomolecules: Carbohydrates – classification, structure and properties – carbohydrate derivatives – sugar alcohols, sugar acids, amino sugars etc. – biological function of carbohydrates; Proteins – classification of amino acids, structure and properties – classification of proteins and biological functions – levels of organization – primary, secondary, tertiary, quaternary and quinary – sequencing of proteins; Lipids – classification, structure and properties – biological application; Nucleic acids – structure of nitrogen bases – nucleosides – structure of DNA and RNA.

MODULE-2

Enzymes: IUB classification, nomenclature and specificity – mechanism of enzyme action – Michaeli's-Menten equation – derivation, double reciprocal plot – Line-Weaver-Burk-method – significance of K_m and V_{max} values – factors effecting enzyme action – regulation of enzymatic activity – enzyme inhibition – allosteric enzymes – positive and negative modulation – vitamin as co-enzymes – and RNA as enzymes.

Bioenergetics: Enthalpy – entropy – free energy concepts – living body as thermodynamic system – energy of activation – standard free energy – energy rich compounds – ATP – creatine phosphate and pyrophosphate.

MODULE-3

Cellular metabolism: Carbohydrate metabolism – Glycolysis – Kreb's cycle – glycogenolysis – glycogenesis – glucogenesis – gluconeogenesis – pentose phosphate pathway – glyoxylic acid cycle; Amino acid metabolism - Biosynthesis and degradation of amino acids – deamination and transamination (metabolism of glutamic acid, phenyl alanine, methionine, tryptophan, isoleucine and histidine to be given emphasis). Fat metabolism – Biosynthesis and oxidation of fatty acids (beta oxidation) – biosynthesis of phospholipids sphingolipids – glycolipid and cholesterol metabolism; Nucleic acid metabolism – Biosynthesis and degradation of purines and pyrimidines

MODULE-4

Biological oxidation – electron transport system in mitochondria – redox potential – mechanism of oxidative phosphorylation – chemiosmotic coupling hypothesis.

Photosynthesis: Chloroplast as photosynthetic unit –Hill reaction–photosynthesis I and II – Calvin cycle.

References:

1. Smith E L et al., Principles of Biochemistry. Vol. I and Vol.II.
2. Lubert Stryer, Biochemistry. W H Freeman & Co.
3. Lehninger A L, Principles of Biochemistry. CBS publishers.
4. Conn and Stumpf, Concepts in Biochemistry.
5. Mahler H R & Cordes E H, Basic Biological Chemistry. Harper & Row.
6. Awapara J, Introduction to Biological Chemistry. Prentice-Hall of India.
7. Cohn E E & Stumpf P K, Outlines of Biochemistry. Wiley Eastern.
8. Wilson J & Walker K Practical Biochemistry: Principles and Techniques, Cambridge.
9. Sadasivan S & Manikam A, Biochemical methods. New Age International.
10. Patabhiraman T N Laboratory Manual in Biochemistry. All India Publishers.
11. Nelson David L, Principles of Biochemistry. McMillan.
12. Chatterji M N & Rana Shindo, Text Book of Medical Biochemistry. J P Brothers.
13. Das Debjyoti , Biochemistry. Academic Publishers.
14. Voet Donald & Voet Judith, Biochemistry.
15. Garrot Reginald H, Biochemistry, Thomson Publishers.
16. Elliot Willim H & Eliot C Daphne, Biochemistry and Molecular Biology.
17. Camphell Peter N, Biochemistry Illustrated. Churchill Living Stone.
18. Kamal Ritu, Biochemistry of Biomolecules. Paragon International.
19. Metzier David E, Biochemistry: the chemical reactions of living cells. Academic Press.
20. McKee Trudy, Biochemistry: the molecular basis of life. McGraw Hill.
21. Sheehan. Physical Biochemistry. Willy Blackwell.
22. Perasena. Enzymology. Oxford.
23. Heldt et al. Plans Biochemistry. Academic press.

MSMOB01DSE01: Biophysics and Bioinstrumentation

45 Hours **3 Credits**

Course Objectives:
The objective of this course is to offer knowledge on Biophysics, an interdisciplinary science that employs and develops theories and methods of the physical sciences for the investigation of biological systems. Currently, protein physics is one of the fastest growing physics research areas that is vital to many other fields, including medicine, bioengineering, and biology.

Course Learning Outcomes:
Upon completion of this course, students will

- be able to describe how various chromatographic methods can be used to separate various macromolecules
- be able to appraise the importance of various biophysical techniques
- be able to understand the biophysical principles of interaction of light with living systems and their significance in biosphere sustenance.
- understand various kinds of radiations in the environment and their sources, the effects of various radiations on living systems etc.

MODULE-1
Principles and applications of Biophysical Methods: microscopy- light, phase contrast, fluorescence, Confocal, FRET, Atomic force, Scanning and transmission electron microscopy Spectroscopy- UV- visible, fluorescence, Atomic absorption, Plasma emission spectroscopy Cytophotometry – flow cytometry , FACS
Centrifugation – sedimentation coefficient- Svedberg unit, gradient and differential – ultracentrifugation- analytical centrifugation

MODULE-2
Biomolecular Separation and Structure Determination Methods:
Chromatography: Basic principles- plate and rate theory , resolution of the peak, Types of chromatography- gel filtration- Ion exchange and affinity chromatography – thin layer chromatography – high pressure liquid chromatography (HPLC) , FPLC and Gas Chromatography
Electrophoresis: Principles-Native and reducing PAGE, agarose, IEF- ampholytes, 2D; Gel shift assay, Pulsed field electrophoresis
X-ray Crystallography**:** Crystals; Types of lattices and crystal symmetry, Scattering by atoms and molecules; Scattering in terms of Fourier transforms, Interference from sets of atoms and Bragg's Law, Electron density calculations and phase problem; Model building and Refinement.
ORD/CD spectroscopy, ESR , NMR, Mass spectroscopy- MALDI-TOF, LCMS

MODULE-3
Biomolecular structure, folding and interactions:
Thermodynamics of helix-coil transition, thermodynamics and kinetics of DNA- Cot Curve, Thermodynamics of biomolecular interactions.
Protein tertiary structure; domains, folds and motifs, protein folding and cooperativity, quaternary structure and allosteric interactions. Protein-protein and protein-nucleic acid interaction
Nucleosome and chromatin model; supercoiled DNA; RNA quaternary structure; tRNA structure and folding.

MODULE-4

Applied biophysical methods:

Radiation Biology: Sources of ionizing radiations- radioisotopes- Principles and applications of tracer techniques in biology – radiation dosimetry. Measurement of radioactivity: autoradiography – Gamma counter-G M Counter- liquid scintillation counter

Laser- types of Laser; its application as a tool in surgery and therapy.

physical basis of sound – infra, sub sonic sounds and ultrasonic sounds; Doppler ultrasonography – lithotripsy-echolocation, echocardiography

Bioelectricity and bioluminescence.

References:

1. Chatwal G R, Biophysics, Himalaya Publishing House.
2. Cotterill Rodney M J Biophysics: An Introduction. John Wiley.
3. PattabhiVasantha& Gautham M, Biophysics 2nd edition,Narosa.
4. Subramanyan M A, Biophysics. MJP
5. Roy K N, A Text Book of Biophysics, New Central Book Agency.
6. Ackerman E, Biophysical Science. Prentice-Hall Inc.
7. Kane J W &Steinhein M M , Life Science Physics. John Wiley.
8. Thiravia Raj S, Biophysics. Saras Publications.
9. Glaser. Biophysics. Springer.
10. Pranab Kumar Banerjee,Introduction to biophysics,S Chand
11. Tuszynski et al.,Introduction to molecular Biophysics,CRC Press
12. Nolting,Methods in Modern Biophysics,Springer
13. Keith Wilson and John Walker,Principles And Techniques Of Biochemistry And Molecular Biology

MSMOB01DSE02: Biostatistics

45 Hours **3 Credits**

Course Objectives:
The objective of this elective course is to provide an introduction to selected important topics in biostatistical concepts and reasoning

Course Learning Outcomes:
Upon completion of this course, students will

- be able to recognize the importance of data collection and its role in determining scope of inference.
- be able to interpret statistical results correctly, effectively, and in context.
- be able to appreciate the power of data.

MODULE-I

Nature and scope of Biostatistics and its applications in biology: Discrete and continuous variables – collection and classification and tabulation of data frequency table – diagrammatic and graphic presentation of data – bar diagram - pie diagram – histogram – frequency polygon and frequency curve.

MODULE-II

Measures of central tendency: Arithmetic mean – median – mode. Measures of dispersion: Range – quartile deviation – mean deviation and standard deviation. Analysis of variance: ANOVA – one way and two way classification.

MODULE-III

Probability theory: Basic concepts and definition of probability – relative frequency definition – probability distributions – binomial, Poisson and normal distributions and their applications.

Testing hypothesis; level of significance – critical region , type 1 and type 11 error – tests based on normal distribution – t-test, F-test, Z-transformation and chi-square test.

MODULE-IV

Correlation and regression analysis: positive correlation – negative correlation coefficient of correlation, regression equation and its application in computing X or Y. Applications of computer in biostatistics.

References:

1. Jasra P K & Raj G, Biostatistics. Krishna Prakasan Media Pvt. Ltd.
2. Dixon W J & Massey F J Jr, Introduction to Statistical Analysis.
3. Khan I A & Khanum a, Fundamentals of Biostatistics. Ukaaz Publications.
4. Sokal R R & Rohif F J, Introduction to Biostatistics. W H Freeman & Co.
5. Lewis A I, Biostatistics. Reinhold Publications.
6. Snedecor G W & Cochran W G, Statistical Methods. Oxford & IBH.
7. Zar, Jerrold H, Biostatistical Analysis. Morgan Kaufman.
8. Hannagan T J, Mastering Statistics. Mac Millan Master Series.
9. Milton Susan J, Statistical Methods in the Biology & Health Sciences. McGraw Hill.
10. Arora P N, Biostatistics. Himalaya Publishing House.

MSMOB01DSC04: Lab in Cell Biology & Microbiology

3 Credits

Course Objectives:
The objective of this practical course is to demonstrate significant cell biological and microbiological principles, quantitative and analytical approaches that enable the students to translate the theoretical foundation in cell biology and microbiology to be translated into practical understanding.

Course Learning Outcomes:
Upon completion of this practical course, students will

- be able to differentiate the cells of various living organisms and get awareness of physiological processes of cell e.g. cell divisions.
- be able to observe and correctly identify different cell types, cellular structures using different microscopic techniques.
- attain skills in microscopy and their handling techniques and staining procedures.
- be able to understand the basic microbial structure and microbial growth

Contents:

1. Study of meiosis in grasshopper testis squash and determination of chiasma frequency.
2. Preparation of chromosome spread from rat bone marrow and analysis of metaphase chromosome by means of G and C banding.
3. Preparation of Human karyotype from photographs of chromosome spreads – normal and abnormal.
4. Staining of buccal epithelial smear to demonstrate Barr body.
5. Preparation of human blood smears to demonstrate drumsticks in neutrophils.
6. Induction of chromosome aberration in onion root tips by a suitable clastogenic agent and its demonstration by means of root tip squashes.
7. Cell fractionation and isolation of nuclei and mitochondria from any suitable material (Rat liver).
8. Preparation and sterilization of culture media.
9. Pure culture technique: Streak plates, spread plate, and pour plate methods.
10. Staining methods: Simple, negative, Acid fast, Gram staining, spore staining, capsule staining, lactophenol cotton blue staining.
11. Measurement of growth – Direct haemocytometer count, viable count, growth curve, determination of growth rate and generation time.
12. Effect of pH, temperature and antibiotics on growth of bacteria.

MSMOB01DSC05: Lab in Biochemistry & Biophysics

3 Credits

Course Objectives:
The objective of this practical course is to provide a basic familiarity with the most common techniques used in biochemistry and biophysics and their applications to challenging problems in biology.

Course Learning Outcomes:
Upon completion of this practical course, students will

- critically evaluate data and design experiments to test hypothesis relevant to the practice of Biochemistry and Biophysics.
- be able to understand the strengths and limitations of various experimental and computational approaches for studying macromolecular structure and function.

Contents:

1. Qualitative analysis of monosaccharide (glucose & fructose), disaccharide (lactose, maltose and sucrose), and polysaccharide (dextrin and starch).
2. Qualitative analysis of protein (albumin, casein, peptone and gelatin).
3. Qualitative analysis of lipids.
4. Estimation of glucose.
5. Estimation of protein.
6. Estimation of amino acid.
7. Estimation of triglycerol / phospholipids / cholesterol.
8. Enzyme kinetics – assay of alkaline phosphatase.
9. Preparation of buffer and measurement of pH (Tris, Phosphate, Acetate buffer).
10. Practical aspects of microscopy, micrometry and camera lucida.
11. Demonstration of diffusion using dialysis tubing.
12. Separation of amino acids by paper, thin layer chromatography and identification of amino acids.
13. Ion exchange chromatography and Molecular sieve chromatography.
14. Separation of proteins by polyacrylamide gel electrophoresis and determination of molecular weight of unknown protein.