MGM INSTITUTE OF HEALTH SCIENCES

(Deemed to be University u/s 3 of UGC Act, 1956)
Grade 'A' Accredited by NAAC
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CHOICE BASED CREDIT SYSTEM

(CBCS)

(with effect from 2025-26 Batches)

Curriculum for

M.Sc. Molecular Biology

Amended as per AC-51/2025, Dated 29/04/2025

Amended History

1. Amended as per AC-51/2025, [Resolution No.3.1(Annexure-3.6)], [Resolution No.3.5, (Annexure-7)]; Dated 29/04/2025.

Resolution No. 3.1 of Academic Council (AC-51/2025):

Resolved to approve the CBCS syllabus, including Program Outcomes (POs), Course Outcomes (COs), and PO-CO Mapping for 15 two-year postgraduate programs under MGMSBS for Semesters I and II. These include: M.Sc. Medical Biotechnology, M.Sc. Medical Genetics, M.Sc. Clinical Embryology, M.Sc. Clinical Nutrition, M.Sc. Medical Dialysis Technology , **M.Sc. Molecular Biology**, M.Sc. Medical Radiology & Imaging Technology , M.Sc. Cardiac Care Technology, M.Sc. Operation Theatre and Anaesthesia Technology, M.Sc. Emergency and Trauma Care, M. Optometry , Master in Hospital Administration , Master of Public Health, M.Sc. Health Informatics & M.Sc. Clinical Research to be effective from batch admitted in Academic Year 2025-26 onwards [ANNEXURE-3.1 to 3.30].

Annexure-3.6 of AC-51/2025

MGM SCHOOL OF BIOMEDICAL SCIENCES

(A constituent unit of MGM INSTITUTE OF HEALTH SCIENCES)
(Deemed to be University u/s 3 of UGC Act 1956)
Grade "A^{++}" Accredited by NAAC
Sector 1, Kamothe, Navi Mumbai-410209,Tel.No.:022-2743763,27437632, 27432890
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CHOICE BASED CREDIT SYSTEM (CBCS)

(Academic Year 2025-26)

Curriculum for

M.Sc. Allied Health Sciences

M.Sc. Molecular Biology

DIRECTOR'S MESSAGE

Welcome Message from the Director

Dear Postgraduate Students,

Welcome to **MGM School of Biomedical Sciences (MGMSBS), MGMIHS**, a premier institution dedicated to advancing allied and health sciences education. As you embark on this transformative academic journey, you are joining a community that fosters excellence in research, clinical expertise, and innovation**.**

MGMIHS, accredited with **NAAC 'A^{++}' Grade (CGPA 3.55, 2022)** and recognized as a **Category I Institution by UGC**, offers an ecosystem that nurtures both academic and professional growth. With **NIRF (151-200 rank band) recognition, NABH-accredited hospitals, NABL-accredited diagnostic labs, and JCI accreditation for MGM New Bombay Hospital**, we uphold global benchmarks in education and healthcare.

At MGMSBS, our **15 postgraduate programs** are meticulously designed to align with the National Commission for Allied and Healthcare Professionals **(NCAHP)** standards**,** National Education Policy **(NEP)** 2020**,** and the National Credit Framework **(NCrF).** We have implemented the **Choice-Based Credit System (CBCS)** to provide academic flexibility while ensuring rigorous training in clinical and technical skills**.** Our state-of-the-art research laboratories, digital classrooms, and the Central Research Laboratory (CRL) foster an environment that encourages innovation and evidence-based learning**.**

Postgraduate education at MGMSBS goes beyond theoretical learning—our curriculum integrates **hands-on clinical training, interdisciplinary collaboration, and exposure to real-world healthcare challenges**. We emphasize **research-driven education**, encouraging students to actively participate in **scientific discoveries, publications, and international collaborations**.

Beyond academics, we believe in **holistic development**, with initiatives such as the **AARAMBH Science and Wellness Club**, which promotes **mental well-being, leadership, and professional networking**.

As you step into this **next phase of academic and professional growth**, we encourage you to explore new ideas, engage in impactful research, and contribute meaningfully to the **healthcare ecosystem**. We are confident that your journey at MGMSBS will shape you into **skilled, compassionate, and visionary professionals**, ready to lead in the ever-evolving healthcare landscape.

We look forward to witnessing your achievements and contributions!

Dr.Mansee Thakur
Director, MGM School of Biomedical Sciences
MGM Institute of Health Sciences, Navi Mumbai

ABOUT MGM SCHOOL OF BIOMEDICAL SCIENCES

Mission

To improve the quality of life, both at individual and community levels by imparting quality medical education to tomorrow's doctors and medical scientists and by advancing knowledge in all fields of health sciences though meaningful and ethical research.

Vision

By the year 2020, MGM Institute of Health Sciences aims to be top-ranking Centre of Excellence in Medical Education and Research. Students graduating from the Institute will have the required skills to deliver quality health care to all sections of society with compassion and benevolence, without prejudice or discrimination, at an affordable cost. As a research Centre, it shall focus on finding better, safer and affordable ways of diagnosing, treating and preventing diseases. In doing so, it will maintain the highest ethical standards.

About – School of Biomedical Sciences

MGM School of Biomedical Sciences is formed under the aegis of MGMIHS with the vision of offering basic Allied Science and Medical courses for students who aspire to pursue their career in the Allied Health Sciences, teaching as well as research.

School of Biomedical Sciences is dedicated to the providing the highest quality education in basic medical sciences by offering a dynamic study environment with well-equipped labs. The school encompasses 23 courses each with its own distinct, specialized body of knowledge and skill. This includes 8 UG courses and 15 PG courses. The college at its growing years started with mere 100 students has recorded exponential growth and is now a full-fledged educational and research institution with the student strength reaching approximately **800** at present.

Our consistent theme throughout is to encourage students to become engaged, be active learners and to promote medical research so that ultimately they acquire knowledge, skills, and understanding so as to provide well qualified and trained professionals in Allied Health Sciences to improve the quality of life.
As there is increased need to deliver high quality, timely and easily accessible patient care system the collaborative efforts among physicians, nurses and allied health providers become ever more essential for an effective patient care. Thus the role of allied health professionals in ever-evolving medical system is very important in providing high-quality patient care.

Last but by no means least, the School of Biomedical Sciences envisions continuously grow and reform. Reformations are essential to any growing institution as they fulfill our bold aspirations of providing the best for the students, for us to serve long into the future and to get ourselves updated to changing and evolving trends in the health care systems

INTRODUCTION

To keep pace with the worldwide education and research scenario in the field of biological science, MGM Institute of Health Sciences has started M.Sc. Molecular Biology course which is designed to enrich the students with wide knowledge and understanding of the advance techniques in molecular biology and its applications. The primary objective of this program is to provide job oriented and research driven education.

VISION

- Academic excellence & development of an excellent intellectual system for rich technology talent pool
- Research & development driven education
- Student involvement in research projects
- Advance education and training

MISSION

- Generation of research& technology talent pool in the area of molecular biology

SALIENT FEATURES

- Very strong infrastructure e.g. classroom, conference and seminar room well equipped library, computer and internet facility, hostel, hospital, hygienic canteen etc.
- Excellent teaching staff - highly experienced faculty, expert and professionals from various organizations.
- Support from state-of-the-art MGMIHS OMICS Research Center: A highly equipped laboratory for advanced life sciences - proteomics, genomics computational biology etc. (This centers providing unique and exploratory platform for discovery research).
- Frequent guest lecturers (by externalfaculty)/seminar/symposium/ workshops.
- Opportunity for students for their involvement in major research projects of institute.
- Provision of project work on applied aspects of molecular biology and opportunity to implement their novel ideas in research.

NAME OF THE DEGREE

Master of Science in Molecular Biology: M.Sc. (Molecular Biology)

OBJECTIVES

The students of M.Sc. Molecular Biology course (2 years) should be able to

- Deep knowledge and understanding of molecular biology and its applications
- Understand key implications of proteomics, Genomics and related aspects.
- Research driven education
- Read and analyze the primary research literature, critically assess scientific experiments and evaluate the impact of a scientific discovery.
- Be primed and able to conduct quality research in latest molecular biology based research topics.

ADMISSION REQUIREMENTS

- Citizenship: Indian nationals can apply under the General category. Foreign nationals or NRI or Indian nationals supported by NRI relatives can apply under the Foreign/NRI category.

- Qualification: Candidates with 50% marks in B.Sc. Molecular Biology/ Biotechnology/ Microbiology/ / Biochemistry/Genetics /Botany/Zoology /B.Sc. Nursing/MBBS/BDS) or any equivalent degree in life sciences of any recognized university.

- Total Seats=10

DURATION OF STUDY

The duration of the study for M.Sc. Molecular Biology will be of four semesters spread over two years.

Program pattern

- First Semester: July
- Second Semester: January
- Third Semester: July
- Fourth Semester: January

*(a) **Dissertation / Project Course** commences in III Semester

(b) **Educational Tours / Field Works/Hospital Visit/Industrial Visit** Course may be carried out in any Semester or all Semestersbutevaluated and Grade Points are to be added in 4th Semester.
(Elective): Any one subject is to be chosen from the following (Subjects offered may change from time o time depending on the availability of expertise)
**Elective courses may or may not have practical and/or field work.
Multidisciplinary / Interdisciplinary

EDUCATIONAL/INDUSTRIAL TOUR:

Industrial visit has its own importance in building a career of a student which is pursuing a professional degree. Objectives of industrial visit are to provide students with an insight regarding internal working of reputed hospitals and labs. Industrial visits providestudents with an opportunity to learn practically thought interactions, working methods and employment practices as theoretical knowledge is not enough for making competent and skillful professionals

M.Sc. MOLECULAR BIOLOGY

PROGRAM OUTCOME

Program Code	Program Objective
PO1	Nurture the scientific and/or clinical knowledge and skills for development of industrial application, health care practices and entrepreneurship.
PO2	Develop the ability of critical thinking to analyze, interpret problems and to find out systematic approach for solution.
PO3	Impart decision making capability of handling various circumstances in their respective areas.
PO4	Demonstrate research skills for planning, designing, implementation and effective utilization of research findings for the community.
PO5	Develop an ability to function as an efficient individual and team player in multidisciplinary sectors for effective outcomes.
PO6	Demonstrate effective written and oral communication skills to communicate effectively in the health care sector, industries, academia and research.
PO7	Inculcate code of ethics in professional and social circumstances to execute them in daily practices and research in respective areas of specialization
PO8	Develop lifelong learning attitude and values for enhancement professional and social skills for an overall development

Course Outcomes
Semester I

MMB 101 T & MMB 104 P	Cell Biology	Mapped PO	Teaching-Learning Methodology	Assessment Tools
CO1	Students will gain an understanding of cell origin.	PO1, PO2	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO2	Basic understanding of cell structure and its components.	PO1, PO2	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO3	Students will understand the cell function.	PO1, PO2	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO4	Understanding of cell regulations and physiology.	PO1, PO2	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
MMB 102 T & MMB 105 P	**Molecular Immunology**	**Mapped PO**	**Teaching-Learning Methodology**	**Assessment Tools**
CO1	Students will gain understanding of the immune system and immunity.	PO1, PO2	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO2	It highlights understanding of the molecular structure of immune cells.	PO1, PO2	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO3	Understanding of role and expression of immune system during infection and immunity	PO1, PO2	Lecture, Practical, Quiz, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO4	Understanding of the status of the immune system during disease system	PO1, PO2	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO5	Exploration of immune system concepts into design and development of new therapeutics.	PO1, PO2	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
MMB 103 T & MMB 106 P	**Molecular Enzymology**	**Mapped PO**	**Teaching-Learning Methodology**	**Assessment Tools**
CO1	Post graduate students will understand the basics of enzymes and their function	PO1, PO2	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment

	in biological systems.			
CO2	They will understand the enzyme modulation during specific situations.	**PO1, PO2**	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO3	Basic understanding of the applications of the enzyme in various industries.	**PO1, PO2**	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO4	Students will learn the basics techniques of enzymology.	**PO1, PO2**	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CC 001 T CC 001 P	**Research Methodology & Biostatistics (Core Course)**	**Mapped PO**	**Teaching-Learning Methodology**	**Assessment Tools**
CO1	Student will be able to understand develop statistical models, research designs with the understating of background theory of various commonly used statistical techniques as well as analysis, interpretation & reporting of results and use of statistical software.	**PO1, PO2, PO3**	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
MMB 107 CP	**MMB Directed Clinical Education-I**	**Mapped PO**	**Teaching-Learning Methodology**	**Assessment Tools**
CO1	Demonstrate proficiency in diagnostic and therapeutic techniques used in hospital laboratories.	PO1	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO2	Effectively communicate and collaborate with healthcare professionals and patients.	PO6	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO3	Develop decision-making skills for effective healthcare management and administration.	PO2, PO3	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors

Semester II

MMB 108 T & MMB 112 P	Gene and Protein Science	Mapped PO	Teaching-Learning Methodology	Assessment Tools
CO1	Students will be able to understand the basis of inheritance, gene organization and structure of DNA.	PO1, PO2	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO2	They will be also understanding gene function and linkages with protein. Understanding of genome and proteome will be important learning outcome.	PO1, PO2	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO3	Understanding of basics of protein structure, purification and characterization will be major outcome of the section.	PO1, PO2	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
MMB 109 T& MMB 113 P	**Bioinformatics & Computational Biology**	**Mapped PO**	**Teaching-Learning Methodology**	**Assessment Tools**
CO1	The major outcome in this section will be basic knowledge of various data banks and datasets mainly for protein sequence and nucleic acid sequence.	PO1, PO5	Lecture, Practical, Assignment, Seminar, group discussion, e-learning	Theory exam, Practical exam, Viva-voce, Seminar, Journal club, skill assessment
CO2	Students will understand the basic skill data analysis including cluster analysis and sequence analysis.	PO1, PO5	Lecture, Practical, Assignment, Seminar, group discussion, e-learning	Theory exam, Practical exam, Viva-voce, Seminar, Journal club, skill assessment
MMB 110 T&MMB 114 P	**DNA Recombinant Technology**	**Mapped PO**	**Teaching-Learning Methodology**	**Assessment Tools**
CO1	Student will be able to understand concept and process of DNA recombinant technology. It will also provide strategy and designs of experiment for product development. Course will also generate and teach as skills in molecular biology.	PO1, PO2, PO5	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
MMB 111 T& MMB 115 P	**Metabolic Engineering**	**Mapped PO**	**Teaching-Learning Methodology**	**Assessment Tools**
CO1	Students will understand the basics of metabolic pathways and network in cellular system.	PO1, PO2, PO5	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO2	Understanding different models of cellular reactions.	PO1, PO2, PO5	Lecture, Practical, Assignment,	Theory exam, Practical exam,

			Seminar, group discussion	Viva-voce, Seminar, Internal Assessment
CO3	Students will understand the concept of metabolic flux analysis and metabolic control analysis.	**PO1, PO2, PO5**	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO4	Understanding of the concept of metabolic design in strain development	**PO1, PO2, PO5**	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
CO5	It will provide the understanding of the potential of metabolic engineering in industrial applications.	**PO1, PO2, PO5**	Lecture, Practical, Assignment, Seminar, group discussion	Theory exam, Practical exam, Viva-voce, Seminar, Internal Assessment
MMB 116 CP	**MMB Directed Clinical Education-II**	**Mapped PO**	**Teaching-Learning Methodology**	**Assessment Tools**
CO1	Demonstrate proficiency in diagnostic and therapeutic techniques used in Hospital laboratories.	PO1	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO2	Effectively communicate and collaborate with healthcare Professionals and patients.	PO6	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO3	Develop decision-making skills for effective healthcare management and Administration.	PO2, PO3	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
SEC 001 T	**Innovation and Entrepreneurship**	**Mapped PO**	**Teaching-Learning Methodology**	**Assessment Tools**
CO1	Students will grasp the concepts of innovation, its ecosystem, and the role of various stakeholders such as government policies, startups, and innovation hubs.	**PO1, PO3, PO4**	Lecture, Practical, Quiz, Assignment, Seminar, group discussion	Theory exam, Practical exam, Seminar, Journal club, case study presentation, station exercise
CO2	Cultivating an entrepreneurial mindset and leadership qualities necessary for driving innovation and leading ventures.	**PO1, PO3, PO4**	Lecture, Practical, Quiz, Assignment, Seminar, group discussion	Theory exam, Practical exam, Seminar, Journal club, case study presentation, station exercise
CO3	Understanding the intersection of technology and innovation and leveraging emerging technologies for entrepreneurial ventures	**PO1, PO3, PO4**	Lecture, Practical, Quiz, Assignment, Seminar, group discussion	Theory exam, Practical exam, Seminar, Journal club, case study presentation, station exercise

SEC 002 T	Comprehensive Molecular Diagnostics and Advanced Gene Expression Analysis (NPTEL)	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Explain the principles of molecular diagnostics and its role in modern healthcare.	**PO1, PO3, PO6**	Lecture, Assignment	Online NPTEL MCQ test
CO2	Describe the significance of biomarkers in disease detection and prognosis.	**PO2, PO3, PO8**	Lecture, Assignment	Online NPTEL MCQ test
CO3	Demonstrate proper methods for sample collection, storage, and processing in a diagnostic lab.	**PO4, PO6, PO8**	Lecture, Assignment	Online NPTEL MCQ test
CO4	Perform molecular diagnostic techniques such as PCR, ELISA, and immunohistochemistry.	**PO1, PO7, PO8**	Lecture, Assignment	Online NPTEL MCQ test
CO5	Analyze the applications of molecular diagnostics in infectious diseases and cancer.	**PO2, PO4, PO6**	Lecture, Assignment	Online NPTEL MCQ test
CO6	Evaluate the role of emerging diagnostic technologies like NGS and CRISPR-based methods.	**PO1, PO7, PO8**	Lecture, Assignment	Online NPTEL MCQ test
CO7	Apply biosafety and biomedical waste disposal protocols in a molecular diagnostics lab.	**PO1, PO5, PO8**	Lecture, Assignment	Online NPTEL MCQ test

OUTLINE OF COURSE CURRICULUM

M.Sc. MOLECULAR BIOLOGY

Semester I

Code No.	Core Course	Credits/Week					Hrs/Semester					Marks		
		Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posting/ Rotation (CP)	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posting/ Rotation (CP)	Total (hrs.)	Internal Assement (IA)	Semester End Exam (SEE)	Total
Discipline Specific Core Theory														
MMB 101 T	Cell Biology	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MMB 102 T	Molecular Immunology	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MMB 103 T	Molecular Enzymology	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
CC 001 T	Research Methodology & Biostatistics (Core Course)	3	-	-	-	**3**	45	-	-	-	**45**	-	**50**	**50**
Discipline Specific Core Practical														
MMB 104 P	Cell Biology	-	-	2	-	**1**	-	-	30	-	**30**	**10**	**40**	**50**
MMB 105 P	Molecular Immunology			2		**1**			30		**30**	**10**	**40**	**50**
MMB 106 P	Molecular Enzymology	-	-	2	-	**1**	-	-	30	-	**30**	**10**	**40**	**50**
MMB 107 CP	MMB Directed Clinical Education - I	-	-	-	12	**4**	-	-	-	180	**180**	-	**50**	**50**
CC 001 P	Research Methodology & Biostatistics (Core Course)	-	-	4	-	**2**	-	-	60	-	**60**	-	**50**	**50**
Total		**12**	**0**	**10**	**12**	**21**	**180**	**0**	**150**	**180**	**510**	**90**	**510**	**600**

OUTLINE OF COURSE CURRICULUM

M.Sc. MOLECULAR BIOLOGY

Semester II

Code No.	Core Course	Credits/Week					Hrs/Semester					Marks		
		Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation (CP)	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation (CP)	Total (hrs.)	Internal Assement (IA)	Semester End Exam (SEE)	Total
Discipline Specific Core Theory														
MMB 108 T	Gene and Protien Science	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MMB 109 T	Bioinformatics and Computational Biology	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MMB 110 T	DNA Recombinant Technology	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MMB 111 T	Metabolic Engineering	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
Discipline Specific Core Practical														
MMB 112 P	Gene and Protien Science	-	-	2	-	**1**	-	-	30	-	**30**	**10**	**40**	**50**
MMB 113 P	Bioinformatics and Computational Biology	-	-	2	-	**1**	-	-	30	-	**30**	**10**	**40**	**50**
MMB 114 P	DNA Recombinant Technology	-	-	2	-	**1**	-	-	30	-	**30**	**10**	**40**	**50**
MMB 115 P	Metabolic Engineering	-	-	2	-	**1**	-	-	30	-	**30**	**10**	**40**	**50**
MMB 116 CP	MMB Directed Clinical Education - II	-	-	-	12	**4**	-	-	-	180	**180**	-	**50**	**50**
Skill Ehancement Course														
SEC 001 T	Innovation and Enterpreneurship	3	-	-	-	**3**	45	-	-	-	**45**	-	**100**	**100**
SEC 002 T	Comprehensive Molecular Diagnostics and Advanced Gene Expression Analysis (NPTEL)													
Total		**15**	**0**	**8**	**12**	**23**	**225**	**0**	**120**	**180**	**525**	**120**	**630**	**750**

FIRST YEAR

M.Sc. MOLECULAR BIOLOGY

SEMESTER I

CODE NO	CORE SUBJECT
Discipline Specific Core Theory	
MMB 101 T	Cell Biology
MMB 102 T	Molecular Immunology
MMB 103 T	Molecular Enzymology
CC 001 T	Research Methodology & Biostatistics (Core Course)
Discipline Specific Core Practical	
MMB 104 P	Cell Biology
MMB 105 P	Molecular Immunology
MMB 106 P	Molecular Enzymology
MMB 107 CP	MMB Directed Clinical Education - I
CC 001 P	Research Methodology & Biostatistics (Core Course)

Name of the Programme	**Molecular Biology**
Semester	**Semester I**
Name of the Subject	**Cell Biology**
Subject Code	**MMB 101T**

Teaching Objective	• To get post graduate students understand the basics of cell biology. • To know the basic cell structures and their components with function. • To understand the cell cycle. • Understanding of the core function of cellsignaling and cell regulationduring maintenance of cell physiology.
Course Outcomes	• Students will gain an understanding of cell origin. • Basic understanding of cell structure and its components. • Students will understand thecell function. • Understanding ofcell regulations and physiology.

Sr. No.	Topic	No. of Hrs.
1	Overview of Cell biology ,Universal features of cells, Diversity of genomesVisualization of cell, its fine structure and molecules	**6**
2	The cell membrane and its structure, Transport across membrane, Ion channels, Receptor mediated endocytosis	**6**
3	Cellular components and function, protein sorting, Vesicular traffic inside the cells Mitochondria and chloroplast and its genetic system	**7**
4	Cell signaling, receptor, ligands, signaling pathways, Signal transduction mechanismsCytoskeleton of cells, cytoskeleton filaments, molecular motors	**7**
5	Cell cycle, regulation of cell division, cell cycle checkpoints. Cell division-Mitosis,meiosis and the mechanism of cell division	**7**
6	Germ cells, Stem cells, Cancer cells	**6**
7	Apoptosis: Mechanism, Pathways, Markers	**6**
Total		**45hrs**

MMB 104 P: CELL BIOLOGY

Sr. No.	Topic	No. of Hrs.
1	Microscopy: **i.** Simple, Compound, inverted and fluorescence **ii.** Cell count using haemocytometer **iii.** WBC- Differential counting **iv.** RBC- Osmotic fragility **v.** Preparation of microbial, animal and plant cells for microscopic examination & staining by Giemsa	**8**
2	Genetic apparatus: i. Cell viability assay ii. Mitosis & meiosis	**7**
3	Buccal smear of exfoliated epithelial cells	4
4	Osmosis, exosmosis and endosmosis	4
5	Fixation of cells & different fixatives	4
6	Preparation of mononuclear cells	3
Total		**30 hrs**

Reference Books:

1. Cell and Molecular biology, Gerald Karp, John Wiley and sons Inc.
2. Cell Biology by C.B. Powar.
3. Cell and Molecular Biology; DeRobertis; Lippincott Williams & Wilkins 8tEdition (2001).
4. Molecular Biology of the Cell and the Hypercell with CDROM; Alberts, Bray; Garland Publishing 1st Edition (1999).
5. Molecular Biology of the Cell with CDROM Alberts, Bruce; Johnson, Alexander; Lewis,Julian 4th Edition (2005).
6. Molecular Cell Biology, H. Lodish, A. Berk, S. L. Zipursky, W. H. Preeman andCompany.

Name of the Programme	**Molecular Biology**
Semester	**Semester I**
Name of the Subject	**Molecular Immunology**
Subject Code	**MMB 102 T**

Teaching Objective	• To get post graduate students understand the basics of immunology and its importance in immunity and infection**.** • To understand the immune response and tolerance during specific situations. • To highlight the basic applications of the subject.
Course Outcomes	• Students will gain understanding of the immune system and immunity. • It highlights understanding of the molecularstructure of immune cells. • Understanding of role and expression of immune system during infection and immunity • Understandingofthe status of the immune system during disease system • Exploration of immune system concepts into design and development of new therapeutics.

Sr. No.	TOPIC	No. of Hrs.
1	The origin of immunology: Innate and acquired immunity; humoral and cell mediated immunity. Primary and secondary lymphoid organ: antigen, B cell, T cell subsets and macrophages.	**7**
2	Molecular basis of Immunology: Structure of antibody, Molecular basis of antibody diversity, polyclonal and monoclonal antibody, complement, antigen-antibody reactions.	**6**
3	Major Histocompatibility complex (MHC): Class I & II antigens their functions	**5**
4	Immune response and tolerance: Regulation of immune response, immune tolerance; hyper sensitivity, autoimmunity;	**6**
5	Immunity to Infection : Bacteria, viral, fungal and parasitic infections (with examples from each group); Hypersensitivity Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity;	**6**
6	Immunological basis of graft rejection; Clinical transplantation and immunosuppressive therapy; Tumor immunology	**5**
7	Primary immunodeficiency, Acquired or secondary immune deficiencies, immune modulators and immune enhancers	**5**
8	Antibody engineering	**5**
Total		**45hrs**

MMB 105 P: MOLECULAR IMMUNOLOGY

Sr. No.	Topic	No. of Hrs.
1	Practical based on antigen – antibody interactions - Widal,VDRL,Blood grouping,CRP,Titre determination.	**10**
2	Radial Immunodiffusion, double diffusion	**10**
3	Immuno electrophoresis.	**10**
Total		**30 hrs**

Reference Books:

1. Immunology, An introduction by Ian R Tzard, Thomson publisher.
2. Immunology, Gordan Reeve and Ian Todd.
3. Essential Immunology: Ivan Roitt.
4. Kuby, Immunology: Gold by, Kindt and Osborne.
5. Immunology: Roitt, Brostoff, Mole.
6. Introductory Immunology : Huw Davies

Name of Programme	**Molecular Biology**
Semester	**Semester I**
Name of the Subject	**Molecular Enzymology**
Subject Code	**MMB 103 T**

Teaching Objective	• To have a thorough understanding of the origin and different class of enzymes. • To have a thorough understanding of the molecular structure and function of enzyme. • To have a thorough understanding of purification and molecular characterization of enzymes including kinetics. • To understand the role of modulator in enzyme function and its effect. • To understand the industrial and clinical applications of enzyme.
Course Outcomes	• Post graduate students will understand the basics of enzymes and their function in biological systems. • They will understand the enzyme modulation during specific situations. • Basic understanding of the applications of the enzyme in various industries. • Students will learn the basics techniques of enzymology.

Sr. No.	Topic	No. of Hrs.
1	Classification and nomenclature of enzyme, Extracellular and intracellular enzyme, Inducible and constitutive enzyme, properties of enzymes as catalytic power, enzyme specificity, cofactors, isoenzymes, multi enzyme complex and multifunctional enzyme.	**6**
2	Enzyme techniques- enzyme assays, analysis of enzyme assays, Expression of the enzyme activity (International Unit), specific activity of enzyme, Coupled reaction, Isolation and purification of enzyme, concept of fold purification and yield, Importance of pure enzymes, chemical modification of enzyme, molecular techniques in enzymes, immobilization of enzymes.	**7**
3	Factors affecting the rate of enzymes catalyzed reactions, Study of enzyme kinetics, Plots for enzyme kinetics: Michaelis-Menten, Lineweaver-Burke plot and Eddie Hofstee plot. Use of initial velocity, Determination of rate constant for enzyme catalyzed reactions, inhibition and exchange studies to differentiate between multi substrate reaction mechanisms. Methods of examining enzyme-complex, Use of substrate analogs, kinetics of various types of inhibitionand kinetics of enzyme inhibition.	**7**
4	Allosteric enzymes, sigmodial kinetics (Cooperativity phenomenon. Hill and Scatchard plots) and their physiological significance. Symmetric and sequential modes for action of allosteric enzymes and their significance. K class and V class allosteric enzymes.	**7**
5	Active site of enzymes: Basic concept, conformation of active site, mapping of active site by different methods. Lysozyme and chyrnotrypsin as models.	**6**
6	Enzyme engineering: Basic concept for designing a new enzyme in reference to therapeutic enzyme, Immobilization of enzymes, designer enzymes, biosensor enzymes, enzyme crystallization and X-ray crystallography,Flexibility& conformational mobility of enzymes.	**6**
7	Clinical Enzymology: End point and kinetic methods for determination of enzyme activity, SI units. Application of K_m to Diagnostic enzymology serum enzymes in health and disease,	**6**

	Isoenzymes.	
Total		**45hrs**

MMB 106 P: MOLECULAR ENZYMOLOGY

Sr. No.	Topic	No. of Hrs.
1	K_m and V_{max}value of Transaminase and Amylase.	**5**
2	Determination of K cat	**5**
3	Determination of specific activity	**5**
4	Enzyme purification by gel chromatography	**5**
5	Enzyme immobilization	**5**
6	Rapid zymogram of enzyme.	**5**
Total		**30 hrs**

Reference Books:

1. Biochemistry- Stryer, Berg, 6thEdition, W.H.Freeman and Co., 2007.
2. Lehninger' Principles of biochemistry-Nelson, Cox, 4thEdn.W. H Freeman and Co., 2005.
3. Harper's Principles of Biochemistry-Murray, Gardener, Mayes, Rodwell, 27th N Edn. McGraw Hill Education, 2006.
4. Biochemistry-Zubay; G, 3rdEdn. Pearson Education Pvt.Ltd, 2003.
5.Fundamentals of Enzymology by Nicholas Price, Oxford University Press.
6.Enzyme Structure and Mechanism by Alan Fersht,W. H. Freeman.
7.Enzymes: Biochemistry, Biotechnology, Clinical Chemistry by Trevor Palmer, Horwood Publishing.
8.Enzyme Assays: A Practical Approach by Michael J. Danson, Oxford University Press

Name of the Program	**M.Sc. Molecular Biology**
Semester	**Semester - I**
Name of the Course	**Research Methodology & Biostatistics (Core Course)**
Course Code	**CC 001 T**

Teaching Objective	• The course is intended to give an overview of research and statistical models commonly used in medical and bio-medical sciences. The goal is to impart an intuitive, understanding and working knowledge of research designs and statistical analysis. The strategy would be to simplify, analyze the treatment of statistical inference and to focus primarily on how to specify and interpret the outcome of research.
Learning Outcomes	• Student will be able to understand develop statistical models, research designs with the understating of background theory of various commonly used statistical techniques as well as analysis, interpretation & reporting of results and use of statistical software.

Sr. No.	Topic	No. of Hrs.
A	**Research Methodology:**	**23**
1	**Scientific Methods of Research**: Definition of Research, Assumptions, Operations and Aims of Scientific Research. Research Process, Significance and Criteria of Good Research, Research Methods versus Methodology	4
2	**Research Designs**: Observational Studies: Descriptive, explanatory, and exploratory, Experimental Studies: Pre-test design, post-test design, Follow-up or longitudinal design, Cohort Studies, Case – Control Studies, Cross-sectional studies, Intervention studies.	5
3	**Sampling Designs**: Census and Sample Survey, Need and importance for Sampling, Implications of a Sample Design, Different Types of Sample Designs (Probability sampling and non-probability sampling),Systematic sampling, Stratified sampling, Cluster sampling, Multi-stage sampling, Sampling with probability proportional to size, Sequential sampling.	5
4	**Measurement in research**: Measurement Scales, Sources of Error in Measurement,	3
5	**Methods of Data Collection**: Types of data, Collection of Primary Data, Observation Method, Interview Method	4
6	Research Ethics and plagiarism	2
B	**Biostatistics**	**22**
7	**Data Presentation**: Types of numerical data: Nominal, Ordinal, Ranked, Discrete and continuous. Tables: Frequency distributions, Relative frequency, Graph: Bar charts, Histograms, Frequency polygons, scatter plots, line graphs	3
8	**Measures of Central Tendency and Dispersion**: Mean, Median, Mode, Range, Inter quartile range, variance and Standard Deviation, Coefficient of variation, grouped mean and grouped standard deviation (including merits and demerits).	3
9	**Testing of Hypotheses**: Definition, Basic Concepts, Procedure for Hypothesis Testing, power of test, Normal distribution, Parametric Tests including Z-test, t-test, and ANOVA	4

10	**Chi-square Test**: Chi-square as a Non-parametric Test,Applications.	2
11	**Measures of Relationship**: Correlation and Simple Regression Analysis	3
12	**Non-parametric test**: Sign test, Wilcoxon signed-Rank Test, Wilcoxon Rank Sum Test: Mann-Whitney U test, KruskalWalli's test, Friedman's test, and Spearman Rank correlation test.	3
13	**Vital Health Statistics**: rate, crude rate, age specific rate, Measurement of fertility, Rate, Measures of mortality.	4
Total		**45 hrs**

CC 001 P–Research Methodology & Biostatistics

Sr. No.	Topics	No. of Hrs.
A	**Research Methodology**	
1	Research Article Presentation (Seminar)	5
B	**Biostatistics**	
2	Data Presentation	4
3	Measures of Central Tendency and Dispersion	6
4	Testing of Hypotheses	16
5	Chi-square Test	4
6	Measures of Relationship	6
7	Analysis of Variance	5
8	Non parametricor Distribution-free Tests	8
9	Computer Application Using Statistical Software including SPSS	6
Total		**60 hrs**

Reference Books:

1. Daniel WW. Biostatistics: A foundation for analysis in the health sciences. 10th ed. Wiley; 2013.
2. Gupta SC, Kapoor VK. Fundamentals of mathematical statistics. Sultan Chand & Sons; 2020 Sep.
3. Kothari CR, Garg G. Research methodology: Methods and techniques.2019.
4. Mahajan BK. Methods in biostatistics for medical students and research workers. 7th ed. Jaypee Brothers Medical Publishers; 2010.
5. Murthy MN. Sampling theory and methods. Statistical Publishing Society; 1967.
6. Singh YK. Fundamental of research methodology and statistics. New Age International; 2006.

Resolution No. 3.5 of Academic Council (AC-51/2025):

Resolved to approve the submitted list of recommended books for M.Sc. Clinical Nutrition and the course on **Biostatistics and Research Methodology** [ANNEXURE-7].

Annexure-7 of AC-51/2025

Biostatistics & Research Methodology Books List

Subject	Book Name	Author
Biostatistics & Research Methodology	Biostatistics: A Foundation for Analysis in the Health Sciences (10th ed.)	Daniel WW.
	Biostatistical Analysis (5th ed.)	Zar JH.
	Research Methodology: Methods and Techniques	Kothari CR, Garg G.
	Methods in Biostatistics for Medical Students and Research Workers (7th ed.)	Mahajan BK.
	Sampling Theory and Methods	Murthy MN.
	Fundamentals of Research Methodology and Statistics	Singh YK.
	Fundamentals of Biostatistics (8th ed.)	Rosner B.
	An Introduction to Medical Statistics (4th ed.)	Bland M.

Course code- MMB 107 CP: MMB Directed Clinical Education – I

Community orientation and; clinical visit (Including related Practical to the Parent course) Molecular Biology students will gain extensive clinical exposure in a hospital setting, allowing them to refine their skills in various diagnostic and therapeutic procedures. Under the supervision of experienced professionals, they will progressively interact with patients and healthcare personnel, enhancing their understanding in molecular biology applications in real-world scenarios. Their training will encompass quality assurance (QA) and quality control (QC) in NABH and NABL-accredited laboratories, ensuring they are well-versed in regulatory standards and best practices. Additionally, students will develop problem-solving skills and learn to address complications in healthcare management. This hands-on experience will also prepare them for administrative roles in hospital settings, equipping them with the knowledge, skills, and aptitude required for effective healthcare delivery. Through this structured clinical education, students will be immersed in a dynamic hospital environment, strengthening their competency in molecular biology. **(Total - 180 hrs.)**

FIRST YEAR

M.Sc. MOLECULAR BIOLOGY

SEMESTER II

CODE NO	CORE SUBJECT
Discipline Specific Core Theory	
MMB 108T	Gene and Protein Science
MMB 109 T	Bioinformatics and Computational Biology
MMB 110 T	DNA Recombinant Technology
MMB 111 T	Metabolic Engineering
Discipline Specific Core Practical	
MMB 112 P	Gene and Protein Science
MMB 113 P	Bioinformatics and Computational Biology
MMB 114 P	DNA Recombinant Technology
MMB 115 P	Metabolic Engineering
MMB 116 CP	MMB Directed Clinical Education - II
Skill Enhancement Course	
SEC 001 T	Innovation and Entrepreneurship
SEC 002 T	Comprehensive Molecular Diagnostics and Advanced Gene Expression Analysis (NPTEL)

Name of the Program	**Molecular Biology**
Semester	**Semester II**
Name of the Subject	**Gene and Protein Science**
Subject Code	**MMB 108 T**

Teaching Objective	• To understand an overview of the basics of gene and protein science,this is the most common biomolecule in biological science. • To impart an intuitive, understanding and deep knowledge ofgenes and protein and their structure, organization and functions. • To know the basic techniques of estimation nucleic acid and protein
Course Outcomes	• Students will be able to understand the basis of inheritance, gene organization and structure of DNA. • They will be also understanding gene function and linkages with protein. Understanding of genome and proteome will be important learning outcome. • Understanding of basics of protein structure, purification and characterization will be major outcome of the section.

Sr. No.	Topics	No. of Hrs.
1	The biochemical basis of inheritance, DNA as the genetic material,concept of gene organization,diversity of genomes.	**6**
2	Denaturation and renaturation of DNA, T_m, and complexity of DNA& Cot curves.	**5**
3	Centraldogma, Genetic code, Gene expression – concept of operon and related elements in the unit, regulatory and structural gene.	**6**
4	Extra chromosomal DNA and its functions, DNA isolation and estimation.	**5**
5	Protein chemistry, amino acid composition, solubility of proteins, Isoelectric pH and proteomes.	**5**
6	Protein Structure, Overview: Primary,Secondary, Tertiary and Quarternary structure, Primary structure Peptide bond conformation – Ramchandran Plot, Secondary Structure-Importance of alpha helix in protein structure & stability. Beta sheet structures in different proteins,Bonds& forces involved in tertiary and quarternary structure Contribution of tertiary and quarternary structures to protein architecture (Fibrous & Globular proteins, silk fibroin, Myoglobin, lysozyme), Protein motifs and their contribution to Protein architecture	**7**
7	Protein denaturation and folding, Role of molecular chaperones	**5**
8	Basic of protein estimation, isolation, purification special reference to various chromatographic methods and characterization	**6**
Total		**45hrs**

MMB 112 P: GENE AND PROTEIN SCIENCE

Sr. No.	Topic	No. of Hrs.
1	DNA isolation, Spectrophotometric assessment of purity (260 : 280 ratio)	**5**
2	Tm of DNA,	**5**
3	Electrophoresis of DNA, DNA damage study	**5**
4	Protein isolation, estimation and preservation	**5**
5	Dialysis of protein, Molecular weight determination of proteins by SDS PAGE	**5**
6	Protein characterization	**5**
Total		**30 hrs**

Reference Books:

1. Molecular Biology; David Freifelder, Narosa Publishing House, 2nd edition (2004).
2. Principles of Gene Manipulations; S. B. Primrose, R. M. Twyman, R. W. old, BlackwellScience, 6th Edition (2003).
3. Gene IX; Benjamin Lewin;Oxford Univ. Press, 8th edition (2004).
4. Advanced Molecular Biology; R. M. Twyman, 1st Edition, (2003).
5. Instant Notes on Molecular Biology; P.C. Turner, A. G. Mclennan, A. D. Bates & M. R. H. White, 2nd Edition (2002)
6. Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and ProteinFolding by Alan Fersht.
7. Lehninger' Principles of biochemistry-Nelson,Cox, 4th Edn.,W.H.Freeman and Co., 2005.
8. Harper's Principles of Biochemistry-Murray, Gardener, Mayes, Rodwell, 27th N Edn.McGraw Hill Education, 2006.
9. Biochemistry-Zubay; G, 3rdEdn. Pearson Education P.Ltd, 2003.

Name of the Program	**Molecular Biology**
Semester	**Semester II**
Name of the Subject	**Bioinformatics & Computational Biology**
Subject Code	**MMB 109T**

Teaching Objective	• The course is intended to give an overview of bioinformatics and computational biology in reference to its future applications. • The objective is to impart an intuitive, understanding and knowledge of protein sequenceand nucleic acid data bank. The strategy would be to simplifysequence analysis and prediction. • To understand the basic concept of prediction and probabilistic model in reference to biomolecules.
Course Outcomes	• The major outcome in this section will be basic knowledge of various data banks and datasets mainly for protein sequence and nucleic acid sequence. • Students will understand the basic skill data analysis including cluster analysis and sequence analysis.

Sr. No.	Topic	No. of Hrs.
1	Introduction to Genomic data and Data Organization: Sequence Data Banks – Introduction to sequence date banks –Protein sequence data bank. NBFR-PIR, SWISSPROT, Signal peptide data bank, Nucleic acid sequence data bank –GenBank, EMBL nucleotide sequence data bank, AIDS virus sequence data bank, Structural databanks – protein Data Bank (PDB), The Cambridge Structural Database (CSD): Genome data bank – Metabolic pathway data: Microbial and Cellular Data Banks.	**8**
2	Sequence analysis: Analysis Tools for Sequence Data Banks; Pair wise alignment - NEEDLEMAN and Wunsch algorithm, Smith Waterman, BLAST, FASTA algorithms to analyze sequence data: Sequence patterns motifs and profiles.	**4**
3	Secondary Structure prediction (Proteins)s; prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking. Tertiary Structure predictions; prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking	**4**
4	Cluster analysis; Phylogenetic clustering by simple matching coefficients; Sequence Comparison; Sequencepattern; Regular expressionbased pattern; Theory of profiles and their use in sequence analysis; Markovmodels; Concept of HMMS; Baum-Welch algorithm; Use of profile HMM for protein family classification;Pattern recognition methods, Neighbor Joining	**5**
5	Applications in Biotechnology: Primer Designing, Phylogenetic Tree Analysis with Mammalian and Bacterial 9-10 specific genes, development of specific case studies	**4**
6	Protein classifications, Fold libraries, Protein structure prediction: Fold recognition (threading), Protein structure predictions: Comparative modeling (Homology), Advanced topics: Protein folding, Protein ligand interactions, Molecular Modeling & Dynamics, Drug Designing	**5**

7	Goals of a Microarray experiment; Normalization of Microarray data; Detecting differential gene expression;Principal component analysis; Clustering of microarray data; Structure determination by X-raycrystallography; NMR spectroscopy; PDB (Protein Data Bank) and NDB (Nucleic Acid Data Bank); Fileformats for storage and dissemination of molecular structure	**7**
8	Probabilistic models and machine learning: Gene annotation and evolution	**4**
9	Horizons-The Future: Protein Structure, The Future: Haplotype Mapping	**4**
Total		**45hrs**

MMB 113 P: BIOINFORMATICS &COMPUTATIONAL BIOLOGY

Sr. No.	Topic	No. of Hrs.
1	Study of structure of proteins using PDB, PROSITE, CATH, SCOP	4
2	Multiple alignment and Phylogenetic tree	4
3	Compare DNA/ Protein sequences using BLAST - Orthologs - Paralogs/ Homologs	6
4	Find the motifs in DNA sequences	4
5	Understanding structure function using of KEGG database	4
6	Docking studies using Argus Lab.	4
7	Programmes related to graphics and animation, RASMOL, MOLMOL, MX VRML etc.	4
Total		**30 hrs**

Note: Any 5 Practical from each subject is mandatory.

Reference Books:

1. Introduction to Bioinformatics – Teresa Atwood and David J.Parry, Pearson smith publication (2003).
2. Sequence structure and Database – Des Higgins, Willice Taylor, Oxford press (2003).
3. Bioinformatics: Sequence and Genome analysis by David W. Mount CBS Publishers & Distributors, 2004 reprint.
4. Discovering Genomics, Proteomics and Bioinformatics, Campbell, ISBN: 788131715598, Pearson Education.
5. Bioinformatics: Databases, Tools, and Algorithms, OrpitaBosu, Simminder Kaur, Thukral , ISBN: 9780195676839, Oxford University Press.

Name of the Program	**Molecular Biology**
Semester	**Semester II**
Name of the Subject	**DNA Recombinant Technology**
Subject Code	**MMB 110T**

Teaching Objective	• The course is intended to give an overview of recombinant DNA technology and their wide applications. The goal is to impart an intuitive, understanding and working knowledge of the processinvolved DNA recombinant technology and various strategies and systems.
Course Outcomes	• Student will be able to understand concept and process of DNA recombinant technology. It will also provide strategy and designs of experiment for product development. Course will also generate and teach as skills in molecular biology.

Sr. No.	TOPIC	No. of Hrs.
1	Introduction to recombinant DNA technology: Past, Present and future	**5**
2	Vectors in DNA recombinant technology, Bacteriophage derived vectors in recombinant DNA, Lambda vectors, cosmids, Phagemids/M13 vectors, Yeast vectors.	**5**
3	Enzymes used in DNA recombinant Technology, RE, DNA polymerases, Reverse Transcriptase, Polynucleotide Kinase, Terminal Transferase, Alkaline Phosphatase, S1-Nuclease, Bal-31, DNA Ligase.	**6**
4	Introduction to cloning, Overview of Cloning, Purification and Separation of Nucleic Acids – cutting and joining DNA and vectors Design of Cloning and expression vectors, the construction of cDNA and genomic libraries, The labeling of DNA with radionucleotides, The screening of libraries: Oligonucleotide, cDNA and antibody probes	**8**
5	Transformation and Transfect ion Membrane Fusion, Electroporation Gene-Gun and Micro-injection	**5**
6	Restriction mapping; Chromosome walking and chromosomal localization of genes,RFLP and other uses of cloned sequences, micro cloning; DNA fingerprinting	**5**
7	Restriction modification systems in Bacteria; F factor and conjugation, transformation; Viruses: Generalized and Specialized transduction	**6**
8	Recombinant DNA products applications: Insulin, antigen vaccine, growth hormones	**5**
Total		**45hrs**

MMB114 P: DNA RECOMBINANT TECHNOLOGY

Sr. No.	Topic	No of Hrs.
1	Extraction of genomic DNA	**6**
2	Restriction digestion	**6**
3	DNA Ligation	**6**
4	Bacterial transformation - Plasmid extraction & electrophoresis	**6**
5	Bacterial conjugation	**6**
Total		**30 hrs**

Reference Books:

1. Essential molecular biology by T. A. Brown, Oxford university press.
2. Recombinant DNA: Watson et. al.
3. Molecular Biology Lab fax I & II: T. A. Brown.
4. Gene Cloning and DNA analysis: An introduction, (2006) 5/e. T. A. Brown,Black Well Publishing Company.
5. Principles of Gene Manipulation; S. B. Primrose, R. M. Twyman& R. W. old;Blackwell Science, 6thEdition (2001).
6. Molecular Cloning lab manual; Joseph Sambrook, David W. Russell, cold SpringHarbor Laboratory Press, 3rdEdition (2001).

Name of the Programme	**M.Sc. Molecular Biology**
Semester	**Semester I**
Name of the Subject	**Metabolic Engineering**
Subject Code	**MMB 111 T**

Teaching Objective	• To get post graduate students understand the basics of metabolic engineering and their function in biological system. • Students understand the cellular reaction and metabolic pathway. • To understand the applications of metabolic engineering.
Course Outcomes	• Students will understand the basics of metabolic pathways and network in cellular system. • Understanding different models of cellular reactions. • Students will understand the concept of metabolic flux analysis and metabolic control analysis. • Understanding of the concept of metabolic design in strain development • It will provide the understanding of the potential of metabolic engineering in industrial applications.

Sr. No.	Topics	No. of Hrs.
1	Introduction to metabolic engineering, Coordination of metabolic reactions: Feedback inhibition, Multigene networks, methods for metabolic characterization: Genome, Transcriptome, Proteome, Metabolome, Fluxome.	**8**
2	Different model of cellular reaction, Stochiometry of cellular reactions, Reaction rates, Dynamic mass balance.	**7**
	Regulation of metabolic pathways: Regulation of Enzymatic Activity, Regulation of Enzyme concentration, metabolic pathway manipulation.	**7**
3	Metabolic flux analysis: Over determined and undetermined systems, Sensitivity analysis, Metabolite Balancing, Tracer Experiments, MS and NMR in labelling measurement, Applications of metabolic flux analysis.	**8**
4	Metabolic control analysis (MCA): Determination of Flux control coefficients, MCA of Linear and Branched pathways.	**8**
5	Metabolic design: Gene amplification, Gene-disruption, Randomized and targeted strain development.	**7**
6	Metabolic Engineering in Practice: Actual examples from research and industrial biotechnology	**7**
Total		**45hrs**

MMB 115 P: METABOLIC ENGINEERING

Sr. No.	Topic	No. of Hrs.
1	Modulation of metabolic enzyme	8
2	Statin inhibition of HMG CoA reductase& its interpretation	7
3	Modification of metabolic network	8
4	Demonstration of cell signaling	7
Total		**30 hrs**

Reference Books:

1.Metabolic Engineering: Principles and Methodologies byGregory N. Stephanopoulos, Aristos Aristidou , Jens C. O. Nielsen.
2.Pathway Analysis and Optimization in Metabolic Engineering byByNéstor V. Torres
By Eberhard O. Voit,Cambridge University Press.

Course code- MMB 116 CP: MMB Directed Clinical Education – II

Community orientation and; clinical visit (Including related Practical to the Parent course) Molecular Biology students will gain extensive clinical exposure in a hospital setting, allowing them to refine their skills in various diagnostic and therapeutic procedures. Under the supervision of experienced professionals, they will progressively interact with patients and healthcare personnel, enhancing their understanding in molecular biology applications in real-world scenarios. Their training will encompass quality assurance (QA) and quality control (QC) in NABH and NABL-accredited laboratories, ensuring they are well-versed in regulatory standards and best practices. Additionally, students will develop problem-solving skills and learn to address complications in healthcare management. This hands-on experience will also prepare them for administrative roles in hospital settings, equipping them with the knowledge, skills, and aptitude required for effective healthcare delivery. Through this structured clinical education, students will be immersed in a dynamic hospital environment, strengthening their competency in molecular biology. **(Total – 180 hrs.)**

SKILL ENHANCEMENT COURSE

Name of the Program	**M.Sc. Molecular Biology**
Semester	**Semester II**
Name of the Subject	**Innovation and Entrepreneurship**
Subject Code	**SEC 001 T**

Course Outcome	• Students will grasp the concepts of innovation, its ecosystem, and the role of various stakeholders such as government policies, startups, and innovation hubs. • Cultivating an entrepreneurial mindset and leadership qualities necessary for driving innovation and leading ventures. • Understanding the intersection of technology and innovation and leveraging emerging technologies for entrepreneurial ventures.

Sr. No.	Topics	No. of Hrs.
1	Innovation and Innovation Eco-System, The Policy Framework, Startup L and scape and Innovation Hubs, - Digital India and Make in India, - Linking Innovation with Intellectual Property Rights, Raising Finance for Startups in India, Innovation in Indian Context, Writing a business plan	**15**
2	Creativity and Research, Converting Research to Innovation: Innovation Types and Models, Product Development, IPR and its Commercialization, Support System to Develop Culture of Research and Innovation, commercialization of research and innovation, Fund raising – Research and Innovation, Envisioning Innovation and Scenario Building	**15**
3	Introduction to Innovation in Entrepreneurship, Idea Generation and Validation, Design Thinking in Entrepreneurship, Business Model Innovation, Technology and Innovation, Funding Innovation, Entrepreneurial Mindset, Leadership & amp; Intellectual Property, Scaling and Growth Strategies, sustainability & amp; Social Innovation	**15**
Total		**45 hrs**

Name of the Program	M.Sc. Molecular Biology
Semester	Semester II
Name of the Subject	Comprehensive Molecular Diagnostics and Advanced Gene Expression Analysis (NPTEL)
Subject Code	SEC 002 T

Course Objectives	• To introduce the principles and significance of molecular diagnostics in healthcare. • To provide knowledge on biomarkers and their role in disease detection. • To familiarize students with sample collection, processing, and quality control in molecular diagnostics. • To impart hands-on knowledge of various molecular diagnostic techniques, including PCR, ELISA, and immunoassays. • To explore the application of molecular diagnostics in infectious diseases and cancer detection. • To introduce emerging technologies like NGS, CRISPR-based diagnostics, and point-of-care devices.
Course Outcomes	After completing this course, students will be able to: • Explain the principles of molecular diagnostics and its role in modern healthcare. • Describe the significance of biomarkers in disease detection and prognosis. • Demonstrate proper methods for sample collection, storage, and processing in a diagnostic lab. • Perform molecular diagnostic techniques such as PCR, ELISA, and immunohistochemistry. • Analyze the applications of molecular diagnostics in infectious diseases and cancer. • Evaluate the role of emerging diagnostic technologies like NGS and CRISPR-based methods. • Apply biosafety and biomedical waste disposal protocols in a molecular diagnostics lab.

Sr. No.	Topics	No. of Hrs.
1	Basic Concepts including Central Dogma in Molecular Biology Definition and Scope of Molecular Diagnostics and Historical Developments Importance and advantages of molecular diagnostics over traditional methods, Nucleic Acid Structure and Function, DNA Replication and Repair, RNA Transcription and Processing, Protein Synthesis from mRNA-Translation	**3**
2	Tools of Molecular diagnostics and Gene expression Analysis (I) PCR (Polymerase Chain Reaction) Fundamentals, RT PCR and qPCR, Modifications of PCR-Hot start, Touch down, nested PCR, Multiplex, Modifications of PCR 2-Long-range PCR, Single-cell PCR, Fast-cycling PCR, Methylation-specific PCR (MSP), Digital Droplet PCR-modern implications, PCR-based mutation analysis	**4**
3	Tools of Molecular diagnostics and Gene expression Analysis (II) Principles (Sanger sequencing, Overview of NGS Technologies and Platform, Application of NGS in Molecular Diagnostics, Clinical Interpretation of NGS Data, Whole genome vs Whole exome sequencing, Targeted gene panels, NGS library preparations)	**4**
4	Tools of Molecular diagnostics and Gene expression Analysis (III) DNA Microarray, FISH (Fluorescence in situ Hybridization), Serial analysis of gene expression, RNA sequencing, Tiling array, DNA protein interaction- chromatin immune precipitation.	**4**
5	Techniques of Gene Manipulation: RNA interference and detection methods, Recombinant DNA Technology, CrispR-CAS9 technology, Epigenetics and diseases, DNA methylation analysis.	**4**

6	Proteomics: Clinical Applications Overview of proteomics techniques and workflows, Protein separation techniques-brief discussion of gel electrophoresis and chromatography, mass spectrometry, label-free and isotope labelling methods, role of metabolomics in laboratory diagnosis.	**4**
7	Proteomics: Advanced topics in Clinical Proteomics High throughput proteomics like-Shotgun and data independent acquisition (DIA), Single cell proteomics and spatial profiling, methods to detect post translational modification and protein-protein interaction, proteomic data analysis and bioinformatic tools, Luminex multiplex assays and its application in biomarker analysis.	**4**
8	Molecular Diagnostics in Infectious Diseases Syndromic Panels and Multiplex Assay, Molecular identification of Microorganism- covering bacterial, viral, fungal and parasitic diseases, antimicrobial resistance testing, POC Molecular diagnostics for infectious diseases, Molecular diagnostics in Hospital acquired infections.	**4**
9	Molecular Diagnostics in Cancer Management Cancer markers, Liquid biopsies in cancer detection, circulating Tumour DNA (ctDNA) analysis, Monitoring treatment response with molecular diagnostics, Molecular diagnostics in targeted therapy, Digital PCR, Molecular diagnostics quality control	**4**
10	Molecular Diagnostics in Genetic and Inherited Disorders Genetic testing and inherited diseases, Non-Invasive Prenatal testing (NIPT) and reproductive genetics, Molecular diagnostics in rare genetic disorders, Pharmacogenomics and Personalized Medicine, genetic counselling and patient education.	**3**
11	Molecular Diagnostics in Medicine Molecular diagnostics in Metabolic disease, Molecular diagnostics in Neurodegenerative disease, Molecular diagnostics in Respiratory, Molecular diagnostics in Gastrointestinal disorders, Molecular diagnostics in Endocrine disorders, Molecular diagnostics in Autoimmune disorders, Molecular diagnostics in Cardiovascular diseases, Molecular diagnostics in Transplantation diseases	**4**
12	Molecular Diagnostics: Quality control and Ethical Concerns in and Futuristic Trends Quality control in molecular diagnostics, Ethical Concerns in Molecular Diagnostics, Microfluidics and Lab-on-chip in molecular diagnostics, AI and ML in molecular diagnostics, Nanotechnology based molecular diagnostics, Single cell Analysis, Integration of Multi-omics Data.	**3**
Total		**45 hrs**

Reference Books:

1. **Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications** – Lela Buckingham & Maribeth L. Flaws
2. **Principles of Molecular Diagnostics and Personalized Cancer Medicine** – Dongfeng Tan & Henry T. Lynch
3. **Handbook of Molecular and Cellular Methods in Biology and Medicine** – Leland J. Cseke, Peter B. Kaufman, Gopi K. Podila
4. Molecular Cloning: A Laboratory Manual by David W. Russell and Joseph Sambrook
5. "Molecular Diagnostics: Fundamentals, Methods, & Clinical Applications" by Lela Buckingham and Maribeth L. Flaws
6. "Cancer Genomics: From Bench to Personalized Medicine" by Graham Dellaire and Jason N. Berman
7. Pharmacogenomics: Challenges and Opportunities in Therapeutic Implementation" by Urs A. Meyer and FolefacAminkeng

***Note:** Attaint the NPTEL Course with title and course code as "**Comprehensive Molecular Diagnostics and Advanced Gene Expression Analysis (Course Code: noc25-ge07) (NPTEL)".**

Scheme of University Examination Theory for PG Program:

General structure / patterns for setting up question papers for Theory / Practical courses, their evaluation weightages for PG programs of MGMSBS are given in the following tables

Marks scheme for the University exam:

Final theory marks will be 100 marks (80 marks University Theory exam + 20 Marks Internal assessment).

Question		Marks distribution	Marks allotted per section	Marks
Sec: A	MCQ	10 x 1 M = 10	10	10
Sec: B	SAQ	3/4x 5 M = 15	15	35
Sec: B	LAQ	2/3 x 10 M = 10	20	
Sec: C	SAQ	3/4x 5 M = 15	15	35
Sec: C	LAQ	2/3x 10 M = 10	20	
Total				**80 Marks**

Marks Scheme for the University Examination (50 Marks)

Final theory marks will be 50 marks University Theory exam pattern Research Methodology & Biostatistics (Core course)

Question	Question No.	Question Type	Marks Distribution	Marks
Sec: A	1.	LAQ (2 out of 3)	2 X 10 Marks = 20	20
Sec: B	2.	SAQ (6 out of 8)	6 X 05 Marks = 30	30
Total				**50 Marks**

Marks Scheme for the University Examination (100 Marks)

Final theory marks will be 100 marks University Theory exam pattern Elective Course

Question	Question No.	Question Type	Marks Distribution	Marks
Sec: A	1.	LAQ (10 out of 12)	10 X 10 Marks = 100	100
Total				**100 Marks**

Practical exam pattern: Total 40 marks with following breakup:

Exercise	Description	Marks
Q No 1	Practical exercise - 1	1 x15=15 M
Q No 2	Station exercise	2x5M=10 M
Q No 3	VIVA	10 M
Q No 4	Journal	5M
Total		**40 Marks**

Practical exam pattern Research Methodology & Biostatistics (Core course)

Total 50-mark distribution:

Exercise	Description	Marks
Q No 1	**Practical/Problem-Solving:** These questions can assess statistical analysis, research design, hypothesis testing, or interpretation of data etc.	2 × 10 marks each) = **20 marks**
Q No 2	Identification of study designs, Critical appraisal of research papers, Application of biostatistical tools, Sampling techniques etc.	(4 × 5 marks each) = **20 marks**
Q No 3	**Viva Voce (Oral Examination)** Assessing conceptual clarity, application of research methodology, and statistical reasoning.	**10 marks**
Total		**50 Marks**

Practical to be conducted at respective departments and marks submitted jointly by the parent department to the university.

Breakup of theory IA calculation for 20 marks

Description	Marks
Internal exam (at department)	15 marks
Seminar	5 marks
Total	**20 Marks**

Breakup of practical IA calculation:

Description	Marks
Internal exam (at department)	10 marks
Viva	5 marks
Journal	5 marks
Total	**20 Marks**

Note –20 marks to be converted to 10 marks weightage for submission to the university.

Model Checklist for Evaluation of the Clinical Directed Posting (PG)

Name of the student: _____Date:_____
Program: _____
Semester: _____ Name of the internal faculty/Observer: _____
Name of the External Faculty/Observer: _____

Core Competencies	Marks allotted	Marks obtained
Students will begin to develop critical thinking abilities utilizing the allied health personnel roles of communicator and caregiver. Students will learn principles of professional allied health personnel practice and provide direct care to individuals within a medical surgical setting while recognizing the diverse uniqueness of individuals with health alterations.		
Clinical Teaching		
a. Demonstrate beginning competency in technical skills.	10	
Independent Work by Student guided by faculty		
a. Develop effective communication skills (verbally and through charting) with patients, team members, and family	2.5	
b. Identify intra and inter-professional team member roles and scopes of practice. Establish appropriate relationships with team members.	2.5	
Hands on practical work by students		
a. Protect confidentiality of electronic/manual health records data, information, and knowledge of technology in an ethical manner	05	
Independent work by student		
a. Demonstrate expected behaviors and complete tasks in a timely manner. Arrive to clinical experiences at assigned times. Maintain professional behavior and appearance.	05	
Log book	10	
Viva	10	
Attendance	05	
Total	**50 Marks**	

Sign of Internal Examiner: _____
Sign of External Examiner: _____

MGM INSTITUTE OF HEALTH SCIENCES

(Deemed to be University u/s 3 of UGC Act, 1956)

Grade 'A' Accredited by NAAC

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