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
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CHOICE BASED CREDIT SYSTEM (CBCS)

(Academic Year 2025 - 26)

Curriculum for

M.Sc. Allied Health Sciences

M.Sc. Medical Biotechnology

Semester I & II

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 the 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 MGM IHS 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 24 courses each with its own distinct, specialized body of knowledge and skill. This includes 8 UG courses and 16 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, School of Biomedical Sciences envisions to continuously grow and reform. Reformations are essential to any growing institution as it fulfills 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.

Name of the Degree: M.Sc. Medical Biotechnology

AIMS OF THE PROGRAM

Innovative biotechnologist are in great demand of India and abroad. This program is designed to train students to deal in technological applications involved biological application systems, living organisms, or derivatives thereof, to make or modify products to processes for specific use to bridge the gap between industry requirements and the growing demand for skilled manpower in Biotechnology sector.

Postgraduate qualification in Biotechnology can earn to placements in research laboratories run by the government and the corporate sector. Private sector placements are in both technical and managerial positions. The biotech business is growing at an accelerated rate, with a number of companies launching innovative biotech applications. The entry of corporate sector in biotechnology makes career prospects in this field bright.

In academics, one can go for higher qualifications like Ph.D. in various field of biology. There is a great demand of this course abroad as most of the foreign countries are looking for expert in this field. After completion of the course, one can work as Marketing manager, Bioinformatician, Business development Manager.

Duration of Study: The duration of the study for M.Sc. Medical Biotechnology will be of four semesters spread over two years.

Program pattern

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

Eligibility Criteria: As a minimum criterion of eligibility, aspiring candidates are needed to have attained a B.Sc. in any discipline of Life Sciences, Biosciences, Bachelor's degree in any of Physics, Biological Sciences, M.B.B.S, BDS, BAMS, BHMS, B.Pharm., B.Tech (Biotechnology), Bachelor's Degree in Agricultural, Veterinary and Fishery Sciences, or equivalent examination with a minimum aggregate score of 50%.

For any query visit the website: www.mgmsbsnm.edu.in

Program Objectives & Outcome

Programme Objectives	The **M.Sc. Medical Biotechnology** program aims to: 1. **Build a Strong Foundation in Medical Biotechnology**: Provide in-depth theoretical and practical knowledge in molecular biology, genetic engineering, immunology, bioinformatics, animal and plant biotechnology, medical biochemistry, and microbiology. 2. **Enhance Research and Analytical Competency**: Train students in advanced research methodologies, experimental design, data analysis, and scientific interpretation for biomedical applications. 3. **Develop Expertise in Diagnostics and Therapeutics**: Equip students with skills in molecular diagnostics, biopharmaceutical development, gene therapy, and regenerative medicine. 4. **Foster Innovation and Entrepreneurship**: Encourage problem-solving, translational research, and the development of cost-effective healthcare solutions. 5. **Promote Bioethics, Regulatory Compliance, and Industry Readiness**: Educate students on biosafety, intellectual property rights, regulatory frameworks, and industrial applications in biotechnology. 6. **Prepare for Diverse Career Opportunities**: Develop expertise for careers in academia, research, pharmaceuticals, hospitals, and the healthcare industry.
Programme Outcome	Upon completing the program, graduates will be able to: 1. **Apply Biotechnological Knowledge in Medical Sciences**: Utilize molecular, cellular, and computational techniques in medical biotechnology for disease diagnosis, treatment, and research. 2. **Conduct Independent and Collaborative Research**: Design and execute experiments, analyze data, and contribute to scientific advancements in medical biotechnology. 3. **Utilize Advanced Molecular and Analytical Techniques**: Demonstrate proficiency in PCR, flow cytometry, sequencing technologies, protein analysis, and bioinformatics tools. 4. **Solve Complex Biological Problems**: Address medical challenges through biotechnological approaches such as genome editing, stem cell therapy, and personalized medicine. 5. **Demonstrate Ethical and Professional Responsibility**: Adhere to bioethical principles, regulatory guidelines, and good laboratory practices in research and industry. 6. **Communicate Effectively in Scientific and Industrial Settings**: Present research findings, write scientific papers, and engage in effective interdisciplinary communication. 7. **Adapt to Emerging Trends in Biotechnology**: Stay updated with advancements in precision medicine, nanobiotechnology, synthetic biology, and artificial intelligence in healthcare. 8. **Contribute to Public Health and Biomedical Innovation**: Develop cost-effective, innovative solutions for disease prevention, diagnostics, and therapeutics for societal impact.

Course Outcomes

Semester I

MMBT 101 T	Cell Biology	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Differentiate between prokaryotic and eukaryotic cells based on structural and functional aspects.	**PO1, PO4**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO2	Describe the organization and roles of cellular organelles and the cytoskeleton in maintaining cell integrity and function.	**PO1, PO3**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO3	Explain mammalian cell types, their differentiation pathways, and their significance in tissue architecture.	**PO1, PO4, PO6**	Lecture, Practical Demonstration, Assignment, Group Discussion, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO4	Analyse various cell-cell interactions, junctions, and extracellular matrix components in maintaining cellular communication.	**PO1, PO4**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO5	Illustrate mechanisms of membrane transport, vesicular trafficking, and the impact of cellular signalling pathways in physiological processes.	**PO1, PO3**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO6	Evaluate the regulation of the cell cycle, mechanisms of cell death, and their roles in embryogenesis, development, and disease pathology.	**PO1, PO2, PO4**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO7	Apply knowledge of cellular biology to understand stem cell biology, regenerative medicine, and cancer biology.	**PO1, PO2, PO4, PO5, PO7, PO8**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
MMBT 102 T	**Immunology**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Describe the key components and mechanisms of innate and adaptive immunity.	**PO1**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO2	Differentiate immune system organs and cell types, explaining their roles in immune responses.	**PO1, PO3**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).

CO3	Explain antigen-antibody interactions, major histocompatibility complex (MHC) molecules, and antigen presentation mechanisms.	**PO1, PO3**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO4	Analyze immune signaling pathways, the complement system, and cytokine-mediated regulation of immune responses.	**PO1, PO4**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO5	Evaluate immunological disorders such as autoimmunity, hypersensitivity, and immunodeficiency diseases.	**PO1,PO4, PO6, PO8**	Lecture, Practical Demonstration, Group Discussion, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO6	Apply immunological principles in clinical diagnostics, transplant immunology, tumor immunology, and infectious disease management.	**PO1, PO2, PO3, PO8**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO7	Discuss vaccine development strategies, monoclonal antibody production, CAR-T cell therapy, and immunotherapeutic advancements.	**PO1, PO2, PO7, PO8**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO8	Demonstrate knowledge of immunogenetics and antibody engineering for therapeutic and research applications.	**PO1, PO3, PO5, PO7**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
MMBT 103 T	**Biomolecules**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Describe the structure and function of carbohydrates, proteins, lipids, and nucleic acids.	**PO1**	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO2	Explain the concepts of pH, buffers, and their physiological relevance in biological systems.	**PO1, PO3**	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO3	Analyze enzyme kinetics, inhibition mechanisms, and regulatory pathways in metabolic reactions.	**PO1, PO3, PO2**	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO4	Illustrate energy production through bioenergetics, the electron transport chain, and oxidative phosphorylation.	**PO1, PO4**	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO5	Compare key metabolic pathways, including glycolysis,	**PO1, PO4**	Lecture, Assignment, Seminar	Internal Exam, Seminar,

	gluconeogenesis, lipid metabolism, and amino acid catabolism.			University Exam (Theory).
CO6	Evaluate the biochemical basis of metabolic disorders such as diabetes, obesity, and dyslipidemia.	**PO1, PO4, PO5**	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO7	Interpret liver and kidney function tests, their clinical significance, and hormonal regulation disorders.	**PO1, PO3, PO6, PO8**	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO8	Apply biochemical principles to understand disease markers in cancer, cardiovascular diseases, and oxidative stress-related disorders.	**PO1, PO4, PO7, PO8**	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CC 001 T	**Research Methodology & Biostatistics (Core Course)**	**Mapped POs**	**Teaching-Learning Methodologies**	**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, PO4, PO6, PO7, PO8**	Lecture, Practical, Experiential, Assignment, Problem Based Learning, E-learning	Internal Exam, Seminar, University Exam (Theory and Practical)
MMBT 104 P	**Practical Lab I – (MMBT 101 & MMBT 102)**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Operate a microscope efficiently and analyze different cell types and structures along with viability and counting.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	Conduct blood group typing using haemagglutination tests.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	Understand and demonstrate the principles of immunodiagnostic tests such as VDRL/Widal (demonstration-based).	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Analyze the histological organization of lymphoid organs.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Perform antigen-antibody interaction studies using ELISA.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva

CO6	Interpret Western blotting results for protein analysis (demonstration-based).	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO7	Apply immunological techniques for disease diagnosis using commercial kits	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO8	Correlate theoretical knowledge with practical applications in immunology and cellular biology.	**PO1,PO2, PO3,PO4, PO5,PO6, PO7,PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
MMBT 105 CP	**MBT Directed Clinical Education-I**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Demonstrate proficiency in diagnostic and therapeutic techniques used in hospital laboratories.	**PO1,PO3, PO5, PO8**	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.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO3	Apply QA and QC protocols in a regulated laboratory environment.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO4	Analyze and troubleshoot clinical and diagnostic challenges using biotechnological approaches.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO5	Understand and adhere to hospital regulatory standards and accreditation requirements (NABH/NABL).	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO6	Develop decision-making skills for effective healthcare management and administration.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO7	Gain practical insights into biotechnology-based clinical applications and patient care.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO8	Prepare for professional roles in clinical research, diagnostics, and hospital-based biotechnology settings.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors

Semester II

MMBT 106 T	Molecular Biology	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Explain the central dogma of molecular biology and its significance in gene expression	**PO1**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO2	Describe the structure and function of DNA and RNA, including their types, modifications, and regulatory elements.	**PO1, PO2**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO3	Compare prokaryotic and eukaryotic DNA replication mechanisms, including DNA damage and repair processes.	**PO1, PO3**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO4	Illustrate transcription and translation mechanisms, their regulation, and RNA processing events such as splicing and RNA interference.	**PO1, PO3**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO5	Analyze operon models (lac, trp, and ara operons) and their regulation mechanisms in prokaryotes.	**PO1, PO4, PO5**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO6	Discuss epigenetic modifications, chromatin remodelling, and the role of non-coding RNAs in gene expression regulation.	**PO1, PO7, PO6, PO8**	Lecture, Practical Demonstration, Quiz, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO7	Evaluate the impact of post-translational modifications (phosphorylation, glycosylation, ubiquitination) on protein function.	**PO1, PO3**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO8	Apply molecular biology concepts to understand genetic regulation, gene expression control, and its implications in disease and biotechnology.	**PO1, PO4, PO8**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
MMBT 107 T	**Analytical Biotechnology**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Explain the significance of analytical techniques in biotechnology and biomedical research.	**PO1, PO3**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).

CO2	Describe the principles and applications of various spectroscopic techniques (UV-Vis, fluorescence, IR, Raman, NMR, MS) in biomolecular analysis.	**PO1, PO3**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO3	Demonstrate proficiency in chromatography and electrophoresis techniques for separation and purification of biomolecules.	**PO1, PO3, PO4**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO4	Apply immunoassays (ELISA, RIA) and biosensors for disease diagnostics and biomarker detection.	**PO1, PO3, PO8**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO5	Utilize advanced analytical tools such as flow cytometry, microarrays, PCR, and NGS for genetic and proteomic analysis.	**PO1, PO3, PO7**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO6	Analyze data obtained from analytical techniques and interpret results for biomedical and biotechnological applications.	**PO1, PO2, PO6, PO5**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO7	Evaluate the role of analytical methodologies in pharmaceutical biotechnology, clinical diagnostics, and therapeutic development.	**PO1, PO6, PO7, PO8**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
MMBT 108 T	**Genetic Engineering**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Explain the history, principles, and applications of genetic engineering.	**PO1**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO2	Demonstrate proficiency in DNA and RNA extraction, PCR techniques, and molecular cloning strategies.	**PO1, PO3**	Lecture, Practical Demonstration, Assignment, Seminar Lecture	Internal Exam, Seminar, University Exam (Theory).
CO3	Analyze the role of restriction enzymes, ligases, and vectors in gene cloning and expression.	**PO1, PO2, PO3**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO4	Apply genome editing tools like CRISPR-Cas, RNA interference, and gene silencing for genetic modifications.	**PO1, PO3, PO4, PO7**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).

CO5	Evaluate the applications of gene therapy in the treatment of inherited and acquired diseases.	**PO1, PO5, PO6, PO8**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO6	Assess the role of recombinant DNA technology in vaccine development and regenerative medicine.	**PO1, PO8**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO7	Discuss biosafety concerns, ethical issues, and regulatory frameworks in genetic engineering research.	**PO1, PO5**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
MMBT 109 T	**Bioinformatics**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Explain the principles and applications of bioinformatics in medical and biological research.	**PO1, PO3, PO7**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO2	Navigate major biological databases such as GenBank, UniProt, PDB, and KEGG for data retrieval and analysis.	**PO1, PO2, PO3**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO3	Perform sequence alignment using tools like BLAST and understand primer design strategies.	**PO1, PO3**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO4	Analyze protein structures using homology modeling, ab initio methods, and structure visualization tools.	**PO1, PO3, PO4**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO5	Apply network pharmacology concepts to study multi-target drugs and systems biology approaches.	**PO1, PO4, PO7**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO6	Demonstrate the fundamentals of molecular docking and drug-target interaction analysis.	**PO1, PO3, PO4, PO5**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO7	Utilize molecular dynamics simulation and QSAR modeling in drug discovery and optimization	**PO1, PO6, PO8**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
MMBT 110 P	**Practical Lab II (MMBT 106 & MMBT 107)**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Perform centrifugation for biomolecule separation and	**PO1,PO2, PO3,PO4,**	Practical and Problem Based Learning	Internal Exam, University Exam

	Extract DNA and RNA from biological samples with high purity.	**PO5,PO6, PO8**		(Practical Exam), Viva
CO2	Analyze nucleic acids and proteins using UV-Visible spectroscopy.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	Conduct Agarose gel electrophoresis for DNA visualization and integrity assessment.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Execute PCR and real-time PCR (qPCR) for molecular diagnostics and gene amplification.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Separate and analyze proteins using SDS-PAGE and Western blotting.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Apply HPLC techniques for the purification and separation of biomolecules.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO7	Document and interpret results using gel documentation systems. Understand and apply analytical techniques in clinical and research settings.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO8	Develop problem-solving skills for biomolecular analysis in medical biotechnology.	**PO1,PO2, PO3,PO4, PO5,PO6, PO7,PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
MMBT 111 P	**Practical Lab III (MMBT 108 & MMBT 109)**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Isolate plasmid DNA from bacteria and perform restriction digestion and ligation for genetic manipulation.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	Conduct bacterial transformation and confirm the presence of recombinant DNA.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	Perform RFLP analysis for genetic variation studies.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva

CO4	Demonstrate bacterial conjugation and understand horizontal gene transfer.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Retrieve and analyze nucleotide and protein sequences using NCBI and BLAST and Perform multiple sequence alignment and construct phylogenetic trees for evolutionary studies.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Utilize molecular docking tools to analyze protein-ligand interactions in drug discovery.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO7	Apply homology modeling techniques to predict protein structures using Swiss-Model.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO8	Integrate genetic engineering and bioinformatics approaches for biomedical and biotechnological research applications.	**PO1,PO2, PO3,PO4, PO5,PO6, PO7,PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
MBT 112 CP	**MBT Directed Clinical Education-II**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Demonstrate proficiency in diagnostic and therapeutic techniques used in hospital laboratories.	**PO1,PO3, PO5, PO8**	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.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO3	Apply QA and QC protocols in a regulated laboratory environment.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO4	Analyze and troubleshoot clinical and diagnostic challenges using biotechnological approaches.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO5	Understand and adhere to hospital regulatory standards and accreditation requirements (NABH/NABL).	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training,	Daily log book, Direct observation and feedback by mentors

			Problem-Based Learning.	
CO6	Develop decision-making skills for effective healthcare management and administration.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO7	Gain practical insights into biotechnology-based clinical applications and patient care.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO8	Prepare for professional roles in clinical research, diagnostics, and hospital-based biotechnology settings.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
SEC 001 T	**Molecular Diagnostics**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Explain the principles of molecular diagnostics and its role in modern healthcare.	**PO1, PO2, PO3, PO5**	Lecture, Assignment, Seminar	Internal Exam, University Exam, (Theory Exam)
CO2	Describe the significance of biomarkers in disease detection and prognosis.	**PO1, PO4, PO8**	Lecture, Assignment, Seminar	Internal Exam, University Exam, (Theory Exam)
CO3	Demonstrate proper methods for sample collection, storage, and processing in a diagnostic lab.	**PO1, PO3, PO5, PO7**	Lecture, Assignment, Seminar	Internal Exam, University Exam, (Theory Exam)
CO4	Perform molecular diagnostic techniques such as PCR, ELISA, and immunohistochemistry.	**PO1, PO6, PO3**	Lecture, Assignment, Seminar	Internal Exam, University Exam, (Theory Exam)
CO5	Analyze the applications of molecular diagnostics in infectious diseases and cancer.	**PO1, PO8**	Lecture, Assignment, Seminar	Internal Exam, University Exam, (Theory Exam)
CO6	Evaluate the role of emerging diagnostic technologies like NGS and CRISPR-based methods.	**PO1, PO7**	Lecture, Assignment, Seminar	Internal Exam, University Exam, (Theory Exam)
CO7	Apply biosafety and biomedical waste disposal protocols in a molecular diagnostics lab.	**PO1, PO5**	Lecture, Assignment, Seminar	Internal Exam, University Exam, (Theory Exam)
SEC 002 T	**Data Analysis for Biologists**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Understand the basic principles of probability and statistical analysis in biological research.	**PO1, PO2**	E-learning, Problem Based Learning, Assignment, Guest Lecture	NPTEL Exam via Online Mode, Assignments

CO2	Use R programming for data manipulation, visualization, and statistical computations.	**PO1, PO2, PO3**	E-learning, Problem Based Learning, Assignment, Guest Lecture	NPTEL Exam via Online Mode, Assignments
CO3	Perform correlation and regression analysis for biological datasets.	**PO1, PO2**	E-learning, Problem Based Learning, Assignment, Guest Lecture	NPTEL Exam via Online Mode, Assignments
CO4	Apply clustering and classification techniques to categorize biological data.	**PO1, PO2**	E-learning, Problem Based Learning, Assignment, Guest Lecture	NPTEL Exam via Online Mode, Assignments
CO5	Analyze high-dimensional biological data using advanced statistical approaches.	**PO1, PO2, PO7**	E-learning, Problem Based Learning, Assignment, Guest Lecture	NPTEL Exam via Online Mode, Assignments

OUTLINE OF COURSE CURRICULUM
M. Sc. MEDICAL BIOTECHNOLOGY
Semester I

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
Discipiline Specific Core Theory														
MMBT 101 T	Cell Biology	4	-	-	-	**4**	60	-	-	-	**60**	**20**	**80**	**100**
MMBT 102 T	Immunology	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MMBT 103 T	Biomolecules	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
CC 001 T	Research Methodology & Biostatistics (Core Course)	3	-	-	-	**3**	45	-	-	-	**45**	-	**50**	**50**
Discipiline Specific Core Practical														
MMBT 104 P	Practical Lab I (MMBT101 & MMBT102)	-	-	8	-	**4**	-	-	120	-	**120**	**10**	**40**	**50**
MMBT 105 CP	MBT Directed Clinical Education-I	-	-	-	9	**3**	-	-	-	135	**135**	-	**50**	**50**
CC 001 P	Research Methodology & Biostatistics (Core Course)	-	-	4	-	**2**	-	-	60	-	**60**	-	**50**	**50**
Total		**13**	**0**	**12**	**9**	**22**	**195**	**0**	**180**	**135**	**510**	**70**	**430**	**500**

OUTLINE OF COURSE CURRICULUM
M. Sc. MEDICAL BIOTECHNOLOGY
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
Discipiline Specific Core Theory														
MMBT 106 T	Molecular Biology	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MMBT 107 T	Analytical Biotechnology	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MMBT 108 T	Genetic Engineering	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MMBT 109 T	Bioinformatics	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
Discipiline Specific Core Practical														
MMBT 110 P	Practical Lab II (MMBT 106 &MMBT 107)	-	-	4	-	**2**	-	-	60	-	**60**	**10**	**40**	**50**
MMBT 111 P	Practical Lab III (MMBT 108 & MMBT 109)	-	-	4	-	**2**	-	-	60	-	**60**	**10**	**40**	**50**
MMBT 112 CP	MBT Directed Clinical Education-II	-	-	-	12	**4**	-	-	-	180	**180**	-	**50**	**50**
Skill Ehancement Course														
SEC 001 T	Molecular Diagnostics	2	-	-	-	**2**	30	-	-	-	**30**	-	**50**	**50**
SEC 002 T	Data Analysis for Biologists													
Total		**14**	**0**	**8**	**12**	**22**	**210**	**0**	**120**	**180**	**510**	**100**	**500**	**600**