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. Medical Biotechnology

Amended as per AC-52/2025, Dated 28/11/2025

Amended History

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

2. Amended as per AC-52/2025, [Resolution No. 5.1,(Annexure-17A)]; [Resolution No. 5.8, (Annexure-24A)]; Dated 28/11/2025.

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-3.1 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
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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 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, 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, gluconeogenesis, lipid metabolism, and amino acid catabolism.	**PO1, PO4**	Lecture, Assignment, Seminar	Internal Exam, Seminar, 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 Extract DNA and RNA from biological samples with high purity.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (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
MMBT 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, 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
SEC 001 T	**Innovation and Entrepreneurship**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Students will grasp the concepts of innovation, its ecosystem, and the role of various stakeholders such as government policies, startups, and	**PO5, PO8**	Lecture, Practical, Quiz, Assignment, Seminar, group discussion	Theory exam, Practical exam, Seminar, Journal club, case study

	innovation hubs.			presentation, station exercise
CO2	Cultivating an entrepreneurial mindset and leadership qualities necessary for driving innovation and leading ventures.	**PO5, PO8**	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, PO5, PO6, PO8**	Lecture, Practical, Quiz, Assignment, Seminar, group discussion	Theory exam, Practical exam, Seminar, Journal club, case study presentation, station exercise

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**

Resolution No. 5.8 of Academic Council (AC-52/2025):

The Academic Council resolved to approve the continuation of SWAYAM/NPTEL elective courses for postgraduate students, wherever applicable to their respective programmes. Accordingly, students admitted from the Academic Year 2025-26 onwards shall be permitted to choose any one approved elective course. The Council further approved the inclusion of 2 and 3 credit courses in the index. This approach is in alignment with the current NCAHP curriculum guidelines, which recommend flexibility for open electives through recognized national platforms.

Accordingly, the names of individual elective courses shall be removed from the existing syllabi. The links of SWAYAM/ NPTEL courses (https://swayam.gov.in/nc_details/NPTEL) shall be incorporated in the syllabus index under the existing course code SEC-002 T, titled: “NPTEL/SWAYAM (Name of the Course Chosen by the Student)”

In alignment with Resolution No. 3.1 of the Academic Council (AC-51/2025), the detailed syllabi of individual courses shall be removed and replaced with the approved links of SWAYAM/NPTEL or common reference pool courses. The complete course content shall remain accessible on the official SWAYAM/NPTEL portals. Students may select any one course from the provided links, in alignment with the credit requirements mentioned in their respective syllabi, as per Annexures 24A, 24B, 24C, 24D, 24E, 24F, 24G, 24H, 24I, 24J, 24K, 24L, 24M, 24N, and 24O.

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	Innovation and Enterpreneurship	3	-	-	-	**3**	45	-	-	-	**45**	-	**100**	**100**
SEC 002 T	NPTEL Swayam (Course Selected as per Below List)													
Total		**15**	**0**	**8**	**12**	**23**	**225**	**0**	**120**	**180**	**525**	**100**	**550**	**650**

Common Pool of Swayam/NPTEL Coureses offered as elective option (SEC 002)

Course ID	Discipline	Course Name	Institute	Duration	Start date	End date	Exam date	Enrollment End date	Exam Registration End date	UG/PG	Click here to Join the course	NPTEL URL	NPTEL ID
noc25-bt06	Biotechnology and Bioengineering	BioInformatics: Algorithms and Applications	IIT Madras	12 Weeks	20-01-2025	11-04-2025	26-04-2025	27-01-2025	28-02-2025	UG/PG	https://onlinecourses.nptel.ac.in/noc25_bt06/preview	https://nptel.ac.in/courses/102106065	https://nptel.ac.in/courses/102106065
noc25-bt13	Biotechnology and Bioengineering	Computational Genomics	IISER Bhopal	12 Weeks	20-01-2025	11-04-2025	27-04-2025	27-01-2025	28-02-2025	PG	https://onlinecourses.nptel.ac.in/noc25_bt13/preview	https://nptel.ac.in/courses/102106339	https://nptel.ac.in/courses/102106339
noc25-bt29	Biotechnology and Bioengineering	Maternal Infant Young Child Nutrition	IIT Bombay	12 Weeks	20-01-2025	11-04-2025	26-04-2025	27-01-2025	28-02-2025	UG/PG	https://onlinecourses.nptel.ac.in/noc25_bt29/preview	https://nptel.ac.in/courses/102101091	https://nptel.ac.in/courses/102101091
noc25-ge05	Multidisciplinary	Biophotonics	IIT Kharagpur	12 Weeks	20-01-2025	11-04-2025	03-05-2025	27-01-2025	28-02-2025	PG	https://onlinecourses.nptel.ac.in/noc25_ge05/preview	https://nptel.ac.in/courses/127105225	https://nptel.ac.in/courses/127105225
noc25-ge07	Multidisciplinary	Comprehensive Molecular Diagnostics and Advanced Gene Expression Analysis	IIT Kharagpur	12 Weeks	20-01-2025	11-04-2025	03-05-2025	27-01-2025	28-02-2025	UG/PG	https://onlinecourses.nptel.ac.in/noc25_ge07/preview	https://nptel.ac.in/courses/127105391	https://nptel.ac.in/courses/127105391
noc25-ge25	Multidisciplinary	One Health	ICMR - Regional Medical Research Centre, Bhubaneswar	12 Weeks	20-01-2025	11-04-2025	03-05-2025	27-01-2025	28-02-2025	PG	https://onlinecourses.nptel.ac.in/noc25_ge25/preview	https://nptel.ac.in/courses/127106233	https://nptel.ac.in/courses/127106233
noc25-ge27	Multidisciplinary	Qualitative Research Methods and Research Writing	IIT Kharagpur	12 Weeks	20-01-2025	11-04-2025	27-04-2025	27-01-2025	28-02-2025	PG	https://onlinecourses.nptel.ac.in/noc25_ge27/preview	https://nptel.ac.in/courses/109105115	https://nptel.ac.in/courses/109105115
noc25-bt21	Biotechnology and Bioengineering	Host-Pathogen Interaction (Immunology)	IISER Bhopal	12 Weeks	20-01-2025	11-04-2025	04-05-2025	27-01-2025	28-02-2025	PG	https://onlinecourses.nptel.ac.in/noc25_bt21/preview	https://onlinecourses.nptel.ac.in/noc24_bt24/preview	https://onlinecourses.nptel.ac.in/noc24_bt24/preview
noc25-bt22	Biotechnology and Bioengineering	Human Physiology	IISER Pune	12 Weeks	20-01-2025	11-04-2025	26-04-2025	27-01-2025	28-02-2025	PG	https://onlinecourses.nptel.ac.in/noc25_bt22/preview	https://onlinecourses.nptel.ac.in/noc24_bt05/preview	https://onlinecourses.nptel.ac.in/noc24_bt05/preview
noc25-hs61	Humanities and Social Sciences	Patent Law for Engineers and Scientists	IIT Madras	12 Weeks	20-01-2025	11-04-2025	03-05-2025	27-01-2025	28-02-2025	UG/PG	https://onlinecourses.nptel.ac.in/noc25_hs61/preview	https://onlinecourses.nptel.ac.in/noc24_hs155/preview	https://onlinecourses.nptel.ac.in/noc24_hs155/preview
noc25-mg05	Management	AI in Human Resource Management	IIT Guwahati	12 Weeks	20-01-2025	11-04-2025	04-05-2025	27-01-2025	28-02-2025	PG	https://onlinecourses.nptel.ac.in/noc25_mg05/preview	https://nptel.ac.in/courses/110103626	https://nptel.ac.in/courses/110103626
noc25-hs70	Humanities and Social Sciences	Science Communication: Research Productivity and Data Analytics using Open Source Software	IIT Delhi	12 Weeks	20-01-2025	11-04-2025	03-05-2025	27-01-2025	28-02-2025	PG	https://onlinecourses.nptel.ac.in/noc25_hs70/preview	https://nptel.ac.in/courses/109102392	https://nptel.ac.in/courses/109102392
noc25-ag04	Agricultural and Food Engineering	Food Science and Technology	IIT Kharagpur	12 Weeks	20-01-2025	11-04-2025	26-04-2025	27-01-2025	28-02-2025	UG/PG	https://onlinecourses.nptel.ac.in/noc25_ag04/preview		

FIRST YEAR

M. Sc. MEDICAL BIOTECHNOLOGY

SEMESTER-I

Code No.	Core Subjects
Discipline Specific Core Theory	
MMBT 101 T	Cell Biology
MMBT 102 T	Immunology
MMBT 103 T	Biomolecules
CC 001 T	Research Methodology & Biostatistics (Core Course)
Discipline Specific Core Practical	
MMBT 104 P	Practical Lab I (MMBT 101 & MMBT 102)
MMBT 105 CP	MBT Directed Clinical Education-I
CC 001 P	Research Methodology & Biostatistics (Core Course)

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester I
Name of the Subject	Cell Biology
Subject Code	MMBT 101 T

Course Objective	• To provide fundamental knowledge of cell structure, function, and organization in both prokaryotic and eukaryotic systems. • To understand the types of mammalian cells, their interactions, and the role of cellular communication in development and physiology. • To explore mechanisms of cellular transport, protein trafficking, and signal transduction pathways. • To analyze the regulatory aspects of the cell cycle, programmed cell death, and implications in diseases like cancer. • To develop an integrative understanding of cellular functions, differentiation, and their biomedical applications.
Course Outcomes	After completing the course, students will be able to: • Differentiate between prokaryotic and eukaryotic cells based on structural and functional aspects. • Describe the organization and roles of cellular organelles and the cytoskeleton in maintaining cell integrity and function. • Explain mammalian cell types, their differentiation pathways, and their significance in tissue architecture. • Analyze various cell-cell interactions, junctions, and extracellular matrix components in maintaining cellular communication. • Illustrate mechanisms of membrane transport, vesicular trafficking, and the impact of cellular signalling pathways in physiological processes. • Evaluate the regulation of the cell cycle, mechanisms of cell death, and their roles in embryogenesis, development, and disease pathology. • Apply knowledge of cellular biology to understand stem cell biology, regenerative medicine, and cancer biology.

Sr. No.	Topics	No. of Hrs.
1	**Introduction to Cell Biology:** Evolution of Cell Theory, Typical Prokaryotic Cell, Typical Eukaryotic Cell (Membrane: structure and composition, Membrane proteins: types, topology, and functions, Mitochondria: structure, function, and genome, Chloroplasts and other plastids, Nucleus: structure and function, Endoplasmic reticulum: structure, Golgi apparatus: structure, Lysosomes and peroxisomes: structure and function, Vacuoles: structure and function, Cytoskeleton), Difference between prokaryotes and eukaryotes.	**15**
2	**Cell Types and Cellular Interactions :** Mammalian cell types and differentiation (Epithelial cells: structure and function, Connective tissue cells: structure and function, Neural cells: types, structure and function, Muscle cells: structure and function, Stem cells and progenitors: Adult, Embryonic and Umbilical Stem Cells), Cell-cell interactions, Cell junctions: Tight Junctions, Gap-Junction, Desmosomes, Hemidesmosomes, Cell adhesion molecules, Extracellular matrix: composition and function.	**15**

3	**Cell Transport and Signaling :** Transport across membranes, Vesicular transport and protein trafficking, Signaling molecules, Signal transduction receptors, Protein kinases and phosphatases, Cell signaling cascades, Crosstalk between signaling pathways, Embryonic Development pathways, Nerve Conduction	**15**
4	**Cell Cycle :** Cell cycle phases and regulation, Cyclins and cyclin-dependent kinases, Checkpoints and control mechanisms, Mitosis and meiosis, Programmed cell death, Apoptosis, Autophagy, Necrosis, Gametogenesis and Fertilization, Cell cycle disorders and cancer	**15**
Total		**60 hrs**

Reference Books:

1. **Molecular Biology of the Cell** – Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter
2. **Cell and Molecular Biology: Concepts and Experiments** – Gerald Karp
3. **The Cell: A Molecular Approach** – Geoffrey M. Cooper, Robert E. Hausman
4. **Essential Cell Biology** – Bruce Alberts, Karen Hopkin, Alexander Johnson
5. **The Biology of Cancer** – Robert A. Weinberg

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester I
Name of the Subject	Immunology
Subject Code	MMBT 102 T

Course Objective	• To provide a comprehensive understanding of the fundamental concepts of immunology, including innate and adaptive immunity. • To study the cellular and molecular components of the immune system, including immune organs, cells, and signaling pathways. • To explore immune mechanisms such as antigen recognition, antigen processing, complement activation, and immune regulation. • To analyze immune system disorders, including hypersensitivity, autoimmunity, immunodeficiency, and immune responses in transplantation and cancer. • To understand the applied aspects of immunology in diagnostics, vaccine development, immunotherapy, and infectious disease management.
Course Outcomes	After completing this course, students will be able to: • Describe the key components and mechanisms of innate and adaptive immunity. • Differentiate immune system organs and cell types, explaining their roles in immune responses. • Explain antigen-antibody interactions, major histocompatibility complex (MHC) molecules, and antigen presentation mechanisms. • Analyze immune signaling pathways, the complement system, and cytokine-mediated regulation of immune responses. • Evaluate immunological disorders such as autoimmunity, hypersensitivity, and immunodeficiency diseases. • Apply immunological principles in clinical diagnostics, transplant immunology, tumor immunology, and infectious disease management. • Discuss vaccine development strategies, monoclonal antibody production, CAR-T cell therapy, and immunotherapeutic advancements. • Demonstrate knowledge of immunogenetics and antibody engineering for therapeutic and research applications.

Sr. No.	Topics	No. of Hrs.
1	**Fundamentals of Immunology:** Innate and Adaptive Immunity: Overview, components, and mechanisms. Immune System Organs and Cells: Primary and secondary lymphoid organs, Immune Cells, antigen-presenting cells and Production and Maturation of T-cells and B-cells. Antigens and Antibodies: Structure, function, and diversity. MHC molecules and Antigen Presentation: MHC types, antigen processing pathways. Immunological Disorders: Autoimmunity, hypersensitivity, and immunodeficiency.	**15**

2	**Molecular and Cellular Immunology:** Immune Cell Signaling: Key pathways in lymphocyte activation and differentiation. Complement System: Activation pathways and biological significance. Vaccinology: Principles, types of vaccines, and vaccine development strategies. Immunogenetics: Genetic basis of immune responses. Cytokines and Chemokines: Types, roles, and signaling pathways.	**15**
3	**Applied Immunology:** Clinical Immunology: Diagnostic assays (e.g., ELISA, Western blot, Flow cytometry). Transplantation Immunology: Types, mechanisms, and challenges. Tumor Immunology: Immune evasion, immunotherapy strategies. Infectious Disease Immunology: Immune responses to bacterial, viral, and parasitic infections. Immunotherapeutics: Monoclonal antibodies, CAR-T cells, cytokine therapy. Antibody Engineering: Monoclonal and polyclonal antibodies, hybridoma technology.	**15**
Total		**45 hrs**

Reference Books:

1. **Janeway's Immunobiology** – Kenneth Murphy, Casey Weaver
2. **Kuby Immunology** – Judy Owen, Jenni Punt, Sharon Stranford
3. **Roitt's Essential Immunology** – Peter J. Delves, Seamus J. Martin, Dennis R. Burton
4. **Cellular and Molecular Immunology** – Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai
5. **Fundamental Immunology** – William E. Paul

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester I
Name of the Subject	Biomolecules
Subject Code	MMBT 103 T

Course Objective	• To provide fundamental knowledge of biomolecules, their structure, function, and physiological significance. • To understand enzyme kinetics, mechanisms, regulation, and bioenergetics in cellular metabolism. • To explore metabolic pathways of carbohydrates, lipids, proteins, and nucleotides, along with their regulation. • To analyze the biochemical basis of metabolic disorders and disease pathophysiology. • To apply biochemical principles in clinical diagnostics and understand the role of biochemical markers in diseases.
Course Outcomes	After completing this course, students will be able to: • Describe the structure and function of carbohydrates, proteins, lipids, and nucleic acids. • Explain the concepts of pH, buffers, and their physiological relevance in biological systems. • Analyze enzyme kinetics, inhibition mechanisms, and regulatory pathways in metabolic reactions. • Illustrate energy production through bioenergetics, the electron transport chain, and oxidative phosphorylation. • Compare key metabolic pathways, including glycolysis, gluconeogenesis, lipid metabolism, and amino acid catabolism. • Evaluate the biochemical basis of metabolic disorders such as diabetes, obesity, and dyslipidemia. • Interpret liver and kidney function tests, their clinical significance, and hormonal regulation disorders. • Apply biochemical principles to understand disease markers in cancer, cardiovascular diseases, and oxidative stress-related disorders.

Sr. No.	Topics	No. of Hrs.
1	**Fundamentals of Biochemistry:** Structure and function of biomolecules: Carbohydrates, Proteins, Lipids, and Nucleic Acids, pH, buffers, and physiological significance, Water and electrolyte balance, Enzyme classification, kinetics, and inhibition, Mechanism of enzyme action and regulation, Bioenergetics and ATP generation, Mitochondrial electron transport chain and oxidative phosphorylation.	**15**
2	**Metabolism and its Regulation:** Carbohydrate metabolism: Glycolysis, Gluconeogenesis, TCA cycle, Glycogen metabolism, Lipid metabolism: Beta-oxidation, Fatty acid	**15**

	biosynthesis, Lipoprotein metabolism, Protein and amino acid metabolism: Transamination, Deamination, Urea cycle, Nucleotide metabolism and disorders.	
3	**Clinical Biochemistry and Disease Pathophysiology:** Biochemical basis of metabolic disorders (Diabetes, Obesity, Dyslipidemia). Liver function tests, Kidney function tests, and their clinical relevance. Hormonal regulation and disorders (Thyroid, Adrenal, Pancreatic hormones). Biochemical markers in cancer and cardiovascular diseases. Oxidative stress and free radicals in disease mechanisms. Inborn errors of metabolism: Carbohydrate metabolism disorders, protein metabolism disorders, Lipid metabolism disorders, Lysosomal storage disorders.	**15**
Total		**45 hrs**

Reference Books:

1. **Lehninger Principles of Biochemistry** – David L. Nelson, Michael M. Cox
2. **Biochemistry** – Jeremy M. Berg, John L. Tymoczko, Lubert Stryer
3. **Harper's Illustrated Biochemistry** – Victor W. Rodwell, David Bender
4. **Biochemistry** – Donald Voet, Judith G. Voet
5. **Enzymes: Biochemistry, Biotechnology, and Clinical Chemistry** – Trevor Palmer

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester I
Name of the Subject	Research Methodology & Biostatistics (Core Course)
Subject 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, Kruskal Walli'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 parametric or 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.

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester I
Name of the Subject	Practical Lab I (MMBT 101 & MMBT 102)
Subject Code	MMBT 104 P

Course Objective	• Provide hands-on training in microscopy techniques for analyzing cell structures and blood components. • Develop proficiency in cell counting, viability assays, and differential staining methods. • Train students in immunological techniques such as antigen-antibody interactions, blood typing, and immunodiagnostic assays. • Enhance skills in the identification of blood cells and the study of lymphoid organ microanatomy. • Introduce students to widely used immunological diagnostic tests such as ELISA, Western blotting, and serological assays.
Course Outcomes	After completing this course, students will be able to: • Operate a microscope efficiently and analyze different cell types and structures along with viability and counting. • Conduct blood group typing using haemagglutination tests. • Understand and demonstrate the principles of immunodiagnostic tests such as VDRL/Widal (demonstration-based). • Analyze the histological organization of lymphoid organs. • Perform antigen-antibody interaction studies using ELISA. • Interpret Western blotting results for protein analysis (demonstration-based). • Apply immunological techniques for disease diagnosis using commercial kits. • Correlate theoretical knowledge with practical applications in immunology and cellular biology.

Sr. No.	Topics	No. of Hrs.
1	Microscopy and Cell Structure Analysis	**12**
2	Cell counting (using Haemocytometer) a) WBC- Differential Staining b) Total Count	**12**
3	Cell Viability Assay- (using Typhan blue Stain)	**12**
4	Identification of Blood Cells by Peripheral Blood Smear	**12**
5	Blood group typing using haemagglutination tests.	**12**
6	VDRL test (Demonstration) /Widal test (Demonstration)	**12**
7	Immunodiagnostics (demonstration using commercial kits)	**12**
8	Lymphoid organs and their microscopic organization	**12**
9	Antigen-Antibody Interaction by ELISA	**12**
10	Western-blotting (Demonstration)	**12**
Total		**120 hrs**

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester I
Name of the Subject	MBT Directed Clinical Education-I
Subject Code	MMBT 105 CP

Course Objective	• To provide hands-on exposure to diagnostic and therapeutic procedures in a hospital setting. • To enhance students' ability to interact with patients and healthcare professionals, fostering practical understanding of medical biotechnology applications. • To Train students in quality assurance (QA) and quality control (QC) practices in NABH- and NABL-accredited laboratories. • To develop problem-solving skills for addressing clinical and healthcare management challenges. • To equip students with knowledge of regulatory standards, hospital administration, and healthcare best practices. • To strengthen their competency for careers in clinical diagnostics, research, and hospital-based biotechnology applications.
Course Outcomes	After completing this course, students will be able to: • Demonstrate proficiency in diagnostic and therapeutic techniques used in hospital laboratories. • Effectively communicate and collaborate with healthcare professionals and patients. • Apply QA and QC protocols in a regulated laboratory environment. • Analyze and troubleshoot clinical and diagnostic challenges using biotechnological approaches. • Understand and adhere to hospital regulatory standards and accreditation requirements (NABH/NABL). • Develop decision-making skills for effective healthcare management and administration. • Gain practical insights into biotechnology-based clinical applications and patient care. • Prepare for professional roles in clinical research, diagnostics, and hospital-based biotechnology settings.

Community orientation & clinical visit (Including related Practical to the Parent course)

Medical Biotechnology 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 of medical biotechnology 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 medical biotechnology. **(Total -135 hrs.)**

FIRST YEAR

M.Sc. MEDICAL BIOTECHNOLOGY

SEMESTER- II

Code No.	Core Subjects
Discipline Specific Core Theory	
MMBT 106 T	Molecular Biology
MMBT 107 T	Analytical Biotechnology
MMBT 108 T	Genetic Engineering
MMBT 109 T	Bioinformatics
Discipline Specific Core Practical	
MMBT 110 P	Practical Lab II (MMBT 106 & MMBT 107)
MMBT 111 P	Practical Lab III (MMBT 108 & MMBT 109)
MMBT 112 CP	MBT Directed Clinical Education-II
Skill Enhancement Course	
SEC 001 T	Innovation and Entrepreneurship
SEC 002 T	NPTEL Swayam

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester II
Name of the Subject	Molecular Biology
Subject Code	MMBT 106 T

Course objective	• To provide a comprehensive understanding of the central dogma and molecular mechanisms governing genetic information flow. • To study the structure and functions of DNA and RNA, along with variations such as SNPs, STRs, and transposons. • To explore the mechanisms of DNA replication, damage, and repair in prokaryotic and eukaryotic systems. • To analyze transcription and translation processes, their regulation, and post-transcriptional and post-translational modifications. • To understand gene expression regulation mechanisms in prokaryotes and eukaryotes, including operon models, epigenetics, and non-coding RNAs.
Course Outcomes	After completing this course, students will be able to: • Explain the central dogma of molecular biology and its significance in gene expression. • Describe the structure and function of DNA and RNA, including their types, modifications, and regulatory elements. • Compare prokaryotic and eukaryotic DNA replication mechanisms, including DNA damage and repair processes. • Illustrate transcription and translation mechanisms, their regulation, and RNA processing events such as splicing and RNA interference. • Analyze operon models (lac, trp, and ara operons) and their regulation mechanisms in prokaryotes. • Discuss epigenetic modifications, chromatin remodelling, and the role of non-coding RNAs in gene expression regulation. • Evaluate the impact of post-translational modifications (phosphorylation, glycosylation, ubiquitination) on protein function. • Apply molecular biology concepts to understand genetic regulation, gene expression control, and its implications in disease and biotechnology.

Sr. No.	Topics	No. of Hrs.
1	**Introduction to molecular biology:** Central Dogma its importance and functions, DNA and RNA: Structure, types, and functions, Repetitive DNA, single nucleotide polymorphisms (SNPs), and short tandem repeats (STRs), Transposons. DNA Replication Prokaryotic vs. eukaryotic replication mechanisms. DNA Damage and Repair. Models of homologous recombination: Holliday junction, double-strand break repair model.	**15**
2	**Transcription and Translation:** Prokaryotic Transcription, Eukaryotic Transcription, General and specific transcription factors. Regulatory elements: Enhancers, silencers, and insulators. Mechanisms of transcription regulation, RNA splicing and processing, Alternate splicing and its regulation, Post-transcriptional gene silencing (RNA interference). Prokaryotic vs. eukaryotic translation mechanisms. Regulation of translation: Translational control in	**15**

	prokaryotes and eukaryotes. Co- and post-translational modifications of proteins, Phosphorylation, glycosylation, ubiquitination, and proteolytic cleavage.	
3	**Regulation of Gene Expression:** Prokaryotic Regulation, Operon theory: lac operon, trp operon, and ara operon. Mechanisms of regulation: Induction, repression, attenuation, positive and negative control. Catabolite repression, cAMP-CRP interaction. Eukaryotic Regulation, Epigenetic regulation: DNA methylation, histone modification. Role of non-coding RNAs (e.g., miRNAs, lncRNAs) in gene expression. Chromatin remodelling complexes (e.g., SWI/SNF).	**15**
Total		**45 hrs**

Reference Books

1. **Molecular Biology of the Gene** – James D. Watson, Tania A. Baker
2. **Molecular Biology** – Robert F. Weaver
3. **Lewin's Genes XII** – Jocelyn E. Krebs, Elliott S. Goldstei
4. **Molecular Biology of the Cell** – Alberts, Johnson, Lewis, Raff, Roberts, Walter
5. **Advanced Molecular Biology**- R. M. Twyman.

Name of the Programme	M.Sc. Medical Biotechnology
Semester	Semester II
Name of the Subject	Analytical Biotechnology
Subject Code	MMBT 107 T

Course Objective	• To introduce fundamental analytical techniques essential for biotechnology research and diagnostics. • To explore spectroscopic methods such as UV-Vis, fluorescence, IR, Raman, NMR, and MS for biomolecular characterization. • To understand chromatographic and electrophoretic separation techniques used in clinical and pharmaceutical biotechnology. • To provide knowledge of immunoassays and biosensors for biomolecule detection and diagnostics. • To familiarize students with advanced analytical techniques such as flow cytometry, PCR, and NGS for biomedical applications.
Course Outcomes	After completing this course, students will be able to: • Explain the significance of analytical techniques in biotechnology and biomedical research. • Describe the principles and applications of various spectroscopic techniques (UV-Vis, fluorescence, IR, Raman, NMR, MS) in biomolecular analysis. • Demonstrate proficiency in chromatography and electrophoresis techniques for separation and purification of biomolecules. • Apply immunoassays (ELISA, RIA) and biosensors for disease diagnostics and biomarker detection. • Utilize advanced analytical tools such as flow cytometry, microarrays, PCR, and NGS for genetic and proteomic analysis. • Analyze data obtained from analytical techniques and interpret results for biomedical and biotechnological applications. • Evaluate the role of analytical methodologies in pharmaceutical biotechnology, clinical diagnostics, and therapeutic development.

Sr. No.	Topics	No. of Hrs.
1	**Introduction to Analytical Biotechnology:** Importance of analytical techniques in biotechnology. Sample preparation and handling for biological analysis. Quality control and validation in biotechnology. UV-Visible spectroscopy and its applications in biomolecule quantification. Fluorescence spectroscopy and its use in protein/DNA analysis. Infrared (IR) and Raman spectroscopy for biomolecular characterization. Nuclear Magnetic Resonance (NMR) spectroscopy in structural biology. Mass spectrometry (MS) and its applications in proteomics and metabolomics. Centrifugation, Preparative and analytical centrifuges; RCF, zonal, equilibrium and density gradients	**15**
2	**Chromatographic and Electrophoresis techniques:** Principles of chromatography: Adsorption, partition, ion exchange, size exclusion. High-Performance Liquid Chromatography (HPLC) and Gas Chromatography (GC). Thin Layer Chromatography (TLC) and Paper Chromatography. Affinity chromatography and its applications in protein purification. Applications of chromatography in clinical and pharmaceutical biotechnology. Gel electrophoresis (Agarose, PAGE, SDS-PAGE), Capillary electrophoresis and its	**15**

	biomedical applications, Western, Southern, and Northern blotting techniques, Microarrays and their applications in genomics and transcriptomics.	
3	**Immunoassays, Biosensors and Advance Analytical techniques:** ELISA: Principles, types, and applications in medical diagnostics. Radioimmunoassay (RIA) and its clinical applications. Biosensors: Types (optical, electrochemical, piezoelectric) and applications in diagnostics. Surface Plasmon Resonance (SPR) for biomolecular interactions. Flow cytometry and its applications in immunophenotyping. PCR and Next-generation sequencing (NGS) for genetic analysis.	**15**
Total		**45 hrs**

Reference Books:

1. Biophysical chemistry-Principles and techniques, Upadhyay; Upadhyay and Nath, H Himalaya Publishing House
2. Physical biochemistry- applications to biochemistry and molecular biology, David
3. Freifelder, Freeman and Co.
4. **Principles of Instrumental Analysis** – Douglas A. Skoog, F. James Holler, Stanley R. Crouch
5. Tools and techniques of biotechnology, Mousumi Debnath, Pointer Publishers

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester II
Name of the Subject	Genetic Engineering
Subject Code	MMBT 108 T

Course objective	• To provide an understanding of the fundamental principles and historical significance of genetic engineering. • To introduce molecular tools, gene cloning strategies, and expression systems used in recombinant DNA technology. • To explore genome editing technologies such as CRISPR-Cas, TALENs, and ZFNs and their applications. • To familiarize students with gene therapy approaches and their role in treating genetic disorders. • To discuss transgenic research, including applications in medicine, agriculture, and biotechnology. • To emphasize ethical, biosafety, and regulatory aspects of genetic modifications.
Course outcomes	After completing this course, students will be able to: • Explain the history, principles, and applications of genetic engineering. • Demonstrate proficiency in DNA and RNA extraction, PCR techniques, and molecular cloning strategies. • Analyze the role of restriction enzymes, ligases, and vectors in gene cloning and expression. • Apply genome editing tools like CRISPR-Cas, RNA interference, and gene silencing for genetic modifications. • Evaluate the applications of gene therapy in the treatment of inherited and acquired diseases. • Assess the role of recombinant DNA technology in vaccine development and regenerative medicine. • Discuss biosafety concerns, ethical issues, and regulatory frameworks in genetic engineering research.

Sr. No.	Topics	No. of Hrs.
1	**Introduction to Genetic Engineering :** History and scope of genetic engineering, Gene cloning strategies and molecular tools, Applications in medicine, agriculture, and industry, Enzymes used in Genetic Engineering, Restriction enzymes and DNA ligases, DNA and RNA extraction technique, PCR and its applications (rRT-PCR, qPCR, digital PCR). Ethical and biosafety considerations in transgenic research.	**15**
2	**Gene Cloning and Expression Systems:** DNA Transfer in Microbes, Transformation, transduction and conjugation. Vectors: Plasmids, bacteriophages, cosmids, BACs, YACs. Expression systems: Bacterial, yeast, insect, and mammalian cells. Reporter genes and their applications.	**15**
3	**Genome Editing and Gene Therapy:** Principles of gene editing: CRISPR-Cas, TALENs, and ZFNs, RNA interference (RNAi) and gene silencing, Applications of gene therapy in genetic and acquired diseases, Generation of knockout and knock-in models, Stem cell and	**15**

	regenerative medicine application, Transgenic animals and plants: Methods and applications. Mechanism and Production of recombinant Vaccines. Implications of human genome editing.	
Total		**45 hrs**

Reference Books:

1. Principles of Gene Manipulation and Genomics – Sandy B. Primrose & Richard Twyman
2. Molecular Cloning: A Laboratory Manual – Michael R. Green & Joseph Sambrook
3. Gene Cloning and DNA Analysis: An Introduction – T. A. Brown
4. Genome Editing: Principles and Applications – Krishnarao Appasani
5. Biotechnology and Biosafety – R. S. Thakur

Name of the Program	M. Sc. Medical Biotechnology
Semester	Semester II
Name of the Subject	Bioinformatics
Subject Code	MMBT 109 T

Course objective	• To introduce the fundamentals of bioinformatics and its applications in medical research. • To familiarize students with major biological, protein, medical, and small molecule databases. • To develop an understanding of sequence alignment techniques and structure prediction methods. • To provide knowledge on computational approaches used in drug discovery and network pharmacology. • To enable students to perform molecular docking, drug-target interaction analysis, and ligand optimization. • To introduce the basics of molecular dynamics simulation and quantitative structure-activity relationship (QSAR) modeling.
Course Outcomes	After completing this course, students will be able to: • Explain the principles and applications of bioinformatics in medical and biological research. • Navigate major biological databases such as GenBank, UniProt, PDB, and KEGG for data retrieval and analysis. • Perform sequence alignment using tools like BLAST and understand primer design strategies. • Analyze protein structures using homology modeling, ab initio methods, and structure visualization tools. • Apply network pharmacology concepts to study multi-target drugs and systems biology approaches. • Demonstrate the fundamentals of molecular docking and drug-target interaction analysis. • Utilize molecular dynamics simulation and QSAR modeling in drug discovery and optimization.

Sr. No.	Topics	No. of Hrs.
1	**Introduction to Bioinformatics:** Introduction to bioinformatics in medical research, History and Evolution and Applications. Major biological databases, Types of databases, Primary, Secondary, Specified, Primary databases: Gen Bank, EMBL, DDBJ, Protein databases: UniProt, PDB, String, Medical databases: OMIM, ClinVar, db SNP, Small Molecules databases: Drug Bank, Pub Chem, Pathways Browsers: Kegg, Reactome, Data submission and retrieval methods.	**15**
2	**Sequence Analysis and structure prediction:** FASTA file formats, Alignment Algorithms, Pairwise sequence alignment, Multiple sequence alignment, BLAST and its variants, Primer design basics, Protein structure hierarchy, Primary, Secondary, Tertiary and Quaternary, Structure prediction/modeling methods, Homology, Ab-initio, threading, 3D structure visualization	**15**

3	**Computational Approaches to Drug Discovery:** Basics of Network Pharmacology, Principles: multi-target drugs and systems biology approaches. Introduction to key tools and databases. Protein-protein interaction (PPI) networks. Gene-disease and drug-target networks. Molecular docking basics, Key concepts and principles, Docking Algorithm Types, Scoring Functions. Drug-target interaction analysis, Visualization, Active site prediction, Molecular Dynamics Simulation. Ligand Optimization, Basics of QSAR, ADMET, Tools for making structural modifications.	**15**
Total		**45 hrs**

Reference Books:

1. Bioinformatics: Basics, Algorithms, and Applications – Ruchi Singh
2. Developing Bioinformatics Computer Skills – Cynthia Gibas & Per Jambeck
3. Bioinformatics: Sequence, Structure, and Databanks – Des Higgins & Willie Taylor
4. Computational Drug Discovery and Design – Riccardo Baron

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester II
Name of the Subject	Practical Lab II (MMBT 106 & MMBT 107)
Subject Code	MMBT 110 P

Course objective	• To develop hands-on expertise in centrifugation techniques for biomolecule separation. • To train students in DNA and RNA extraction from biological samples for molecular analysis. • To familiarize students with UV-Visible spectroscopy for nucleic acid and protein quantification. • To provide proficiency in electrophoretic techniques (Agarose gel & SDS-PAGE) for biomolecular analysis. • To introduce polymerase chain reaction (PCR) and real-time PCR (qPCR) for genetic analysis and disease diagnosis. • To equip students with knowledge of chromatographic techniques (HPLC) for biomolecule purification. • To train in Western blotting for protein detection and analysis.
Course Outcomes	After completing this course, students will be able to: • Perform centrifugation for biomolecule separation and Extract DNA and RNA from biological samples with high purity. • Analyze nucleic acids and proteins using UV-Visible spectroscopy. • Conduct Agarose gel electrophoresis for DNA visualization and integrity assessment. • Execute PCR and real-time PCR (qPCR) for molecular diagnostics and gene amplification. • Separate and analyze proteins using SDS-PAGE and Western blotting. • Apply HPLC techniques for the purification and separation of biomolecules. • Document and interpret results using gel documentation systems. Understand and apply analytical techniques in clinical and research settings. • Develop problem-solving skills for biomolecular analysis in medical biotechnology.

Sr. No.	Topics	No. of Hrs.
1	Practical based on Centrifugation: Density gradient centrifugation	**6**
2	DNA Extraction from Biological Samples	**6**
3	RNA Extraction from Biological Samples	**6**
4	Quantification and Purity Assessment of Nucleic Acids using UV-Visible Spectroscopy	**6**
5	Quantification of Proteins by using Spectroscopy technique	**6**

6	Agarose Gel Electrophoresis for DNA Analysis	**6**
7	Polymerase Chain Reaction (PCR) and Gel Documentation	**6**
8	Protein Separation using SDS-PAGE and Western Blotting	**6**
9	Chromatographic Separation of Biomolecules using HPLC	**6**
10	Real-time PCR and Its application in Disease diagnosis	**6**
Total		**60 hrs**

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester II
Name of the Subject	Practical Lab III (MMBT 108 & MMBT 109)
Subject Code	MMBT 111 P

Course Objective	• Provide hands-on training in plasmid DNA isolation, restriction digestion, ligation, and transformation for gene cloning. • Introduce RFLP and bacterial conjugation techniques for genetic analysis. • Train students in bioinformatics tools for sequence retrieval, alignment, and phylogenetic analysis. • Develop skills in molecular docking and protein-ligand interaction studies for drug discovery. • Familiarize students with biological databases (GenBank, EMBL, DDBJ) for nucleic acid sequence analysis. • Teach homology modeling using Swiss-Model for protein structure prediction.
Course Outcomes	After completing this course, students will be able to: • Isolate plasmid DNA from bacteria and perform restriction digestion and ligation for genetic manipulation. • Conduct bacterial transformation and confirm the presence of recombinant DNA. • Perform RFLP analysis for genetic variation studies. • Demonstrate bacterial conjugation and understand horizontal gene transfer. • Retrieve and analyze nucleotide and protein sequences using NCBI and BLAST and perform multiple sequence alignment and construct phylogenetic trees for evolutionary studies. • Utilize molecular docking tools to analyze protein-ligand interactions in drug discovery. • Apply homology modeling techniques to predict protein structures using Swiss-Model. • Integrate genetic engineering and bioinformatics approaches for biomedical and biotechnological research applications.

Sr. No.	Topics	No. of Hrs.
1	Isolation of Plasmid DNA from Bacteria	**6**
2	Restriction Digestion and Ligation of DNA	**6**
3	Transformation of Recombinant DNA into Bacteria	**6**
4	RFLP technique	**6**
5	Bacterial Conjugation	**6**

6	Sequence Retrieval and Analysis using NCBI and BLAST	**6**
7	Multiple Sequence Alignment and Phylogenetic Tree Construction	**6**
8	Molecular Docking and Protein-Ligand Interaction Analysis	**6**
9	Nucleic Acid sequence databases: Gen Bank, EMBL, DDBJ	**6**
10	Homology Modeling of Proteins using Swiss-Model	**6**
Total		**60 hrs**

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester II
Name of the Subject	MBT Directed Clinical Education-II
Subject Code	MMBT 112 CP

Course Objective	• To provide hands-on exposure to diagnostic and therapeutic procedures in a hospital setting. • To enhance students' ability to interact with patients and healthcare professionals, fostering practical understanding of medical biotechnology applications. • To Train students in quality assurance (QA) and quality control (QC) practices in NABH- and NABL-accredited laboratories. • To develop problem-solving skills for addressing clinical and healthcare management challenges. • To equip students with knowledge of regulatory standards, hospital administration, and healthcare best practices. • To strengthen their competency for careers in clinical diagnostics, research, and hospital-based biotechnology applications.
Course Outcomes	After completing this course, students will be able to: • Demonstrate proficiency in diagnostic and therapeutic techniques used in hospital laboratories. • Effectively communicate and collaborate with healthcare professionals and patients. • Apply QA and QC protocols in a regulated laboratory environment. • Analyze and troubleshoot clinical and diagnostic challenges using biotechnological approaches. • Understand and adhere to hospital regulatory standards and accreditation requirements (NABH/NABL). • Develop decision-making skills for effective healthcare management and administration. • Gain practical insights into biotechnology-based clinical applications and patient care. • Prepare for professional roles in clinical research, diagnostics, and hospital-based biotechnology settings.

Community orientation & clinical visit (Including related Practical to the Parent course)

Medical Biotechnology 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 of medical biotechnology 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 medical biotechnology. **(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. Medical Biotechnology**
Semester	**Semester II**
Name of the Course	**NPTEL Swayam**
Course Code	**SEC 002 T**

Note: The links of SWAYAM/NPTEL courses (https://swayam.gov.in/nc_details/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: _____

Resolution No. 5.1 of Academic Council (AC-52/2025):
Resolved to approve the CBCS syllabus, including Program Outcomes (POs) and Course Outcomes (COs), for Postgraduate (PG) 2-year programs under MGMSBS (semester III & IV) for 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, Masters in Hospital Administration, Masters of Public Health, M.Sc. Health Informatics, M.Sc. Medical Laboratory Technology, M.Sc. Clinical Research, to be effective from batch admitted in the Academic Year 2025-26 onwards. Guidelines for selected programmes as per National Commission for Allied & Healthcare Professions will be adopted for the given programmes from academic year 2026-27 onwards [ANNEXURE-17A, 17B, 17C, 17D, 17E, 17F, 17G, 17H, 17I, 17 J, 17K, 17L, 17M, 17N, 17O & 17P and ANNEXURE-18A, 18B, 18C, 18D, 18E, 18F, 18G, 18H, 18I, 18J, 18K, 18L, 18M, 18N, 18O & 18P].

Annexure-17A of AC-52/2025

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

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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 III & IV

Course Outcome
SEMESTER-III

MMBT 113 T	Genetics and Genomics	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	**Interpret** molecular mechanisms underlying inherited and acquired genetic diseases.	**PO1, PO3**	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO2	**Apply** chromosomal, molecular, and cytogenetic techniques for diagnosis.	**PO1, PO3**	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO3	**Critically analyse** the impact of next-generation sequencing (NGS) and genomics on clinical diagnostics.	**PO1, PO2, PO3, PO7, PO8**	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO4	**Demonstrate** the ability to conduct risk assessment and genetic counselling.	**PO1, PO2, PO4, PO5, PO6**	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO5	**Examine** ethical considerations in the use of genetic information and technologies.	**PO1, PO5**	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
MMBT 114 T	**Principles and Applications of Tissue Culture**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	**Describe** the principles and techniques of tissue culture in both plant and animal systems.	**PO1, PO2, PO3, PO4, PO5, PO7, PO8**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO2	**Apply** aseptic techniques for establishing and maintaining tissue cultures.	**PO1, PO2, PO5**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO3	**Demonstrate** the use of plant and animal tissue culture in disease modelling, genetic engineering, drug screening, and regenerative medicine.	**PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO4	**Analyse** real-world case studies on therapeutic, pharmaceutical, and research applications.	**PO1, PO4, PO8**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO5	**Understand** biosafety, contamination control, and quality assurance protocols	**PO4, PO5**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
MMBT 115 T	**Medical Microbiology**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	**Classify** medically important microbes and understand their structural and functional characteristics	**PO1, PO4**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO2	**Explain** mechanisms of microbial pathogenicity and host-pathogen interactions	**PO1, PO2, PO5, PO8**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).

CO3	**Apply** diagnostic methods for detection of infectious agents	**PO1, PO2, PO3, PO4, PO5, PO8**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO4	**Understand** antimicrobial resistance mechanisms and control measures	**PO1, PO2, PO4, PO5, PO7, PO8**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO5	**Perform** microbiological techniques with aseptic skills in a laboratory setting	**PO1, PO5**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
MMBT 116 T	**Clinical Trials and Data Management**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	**Explain** the process and regulatory framework of clinical trials.	**PO1, PO5**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO2	**Design** clinical trial protocols and analyse trial phases.	**PO1, PO2, PO5, PO6**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO3	**Apply** principles of data management, CRFs, and electronic data capture systems.	**PO2, PO7**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO4	**Demonstrate** understanding of quality control, audits, and GCP compliance.	**PO5**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO5	**Recognize** ethical issues, adverse events, and safety reporting in human research.	**PO5**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
MMBT 117	**Research Project / Dissertation**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	**Formulate a research problem** by reviewing scientific literature and identifying knowledge gaps in medical biotechnology.	**PO1, PO2, PO3, PO4, PO5, PO6, PO8**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment
CO2	**Design and execute experiments** using appropriate methodologies, tools, and techniques relevant to biomedical research.	**PO1, PO2, PO3, PO4, PO5, PO6, PO8**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment
CO3	**Demonstrate proficiency** in handling advanced molecular biology, biochemistry, microbiology, and bioinformatics methods as required for their research project.	**PO1, PO2, PO3, PO4, PO5, PO6, PO8**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment
CO4	**Critically analyse and interpret experimental data** using appropriate statistical and computational tools.	**PO1, PO2, PO3, PO4, PO5, PO6, PO8**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment (University Exam)
CO5	**Adhere to ethical standards** in biomedical research, including	**PO5**	Faculty Mentorship and Supervision, Hands-on Laboratory Training,	Dissertation Report (Synopsis), Internal Assessment

	biosafety, data integrity, and responsible reporting.		Documentation and Reporting	
CO6	**Communicate research findings effectively** through well-structured dissertation writing, presentations, and potential publications.	**PO6**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment
CO7	**Work independently and collaboratively** to solve research challenges and manage time efficiently during the project.	**PO2**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment
CO8	**Develop a research-oriented mind-set** that prepares them for higher studies, industrial R&D, or academic research careers.	**PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment
MMBT 118 P	**Genetics and Genomics**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	**Perform peripheral blood lymphocyte culture** and prepare high-quality metaphase chromosome spreads for cytogenetic examination.	**PO1, PO2, PO3, PO4, PO5**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	**Construct and analyze human karyotypes**, differentiating between normal and abnormal chromosomal complements.	**PO1, PO2, PO3, PO4, PO5, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	**Identify chromosomal abnormalities** such as Down's and Turner's syndromes using karyogram interpretation and correlate findings with genetic disorders.	**PO1, PO2, PO3, PO4, PO5, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	**Carry out restriction digestion and RFLP analysis**, demonstrating understanding of DNA polymorphism detection and its relevance to genetic mapping and diagnosis.	**PO1, PO2, PO3, PO4, PO5, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	**Prepare and interpret buccal smears for sex chromatin** and construct pedigree charts to determine inheritance patterns of genetic traits.	**PO1, PO3, PO5**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	**Apply Hardy–Weinberg equilibrium principles** to estimate gene and genotype frequencies and assess population-level genetic variations	**PO1, PO2, PO4, PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
MMBT 119 P	**Principles and Applications of Tissue Culture**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**

CO1	**Prepare and sterilize plant and animal tissue culture media** following standard aseptic techniques to ensure successful culture establishment.	**PO1, PO5**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	**Perform surface sterilization of explants** and maintain contamination-free conditions during culture initiation and growth.	**PO1, PO2, PO5**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	**Induce and maintain callus cultures**, perform organ culture, and carry out anther culture to obtain haploid plants using appropriate plant growth regulators.	**PO1, PO2, PO5**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	**Isolate, culture, and maintain lymphocyte cells**, demonstrating proficiency in basic animal cell culture techniques.	**PO1, PO2, PO3, PO5, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	**Perform cell counting and viability assays** to assess culture health and optimize growth conditions.	**PO1, PO2, PO3, PO5**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	**Carry out trypsinization and subculturing of adherent monolayer cells**, maintaining viability and genetic stability across passages for research applications.	**PO1, PO2, PO3**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
MMBT 120 P	**Medical Microbiology**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	**Perform** differential staining techniques such as Gram staining and acid-fast staining for bacterial identification.	**PO1, PO5**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	**Isolate** microorganisms using streak plate, pour plate, and spread plate methods.	**PO1, PO2, PO5**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	**Culture** and maintain bacterial and fungal isolates from clinical and environmental samples.	**PO1, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	**Conduct** antibiotic sensitivity testing by Kirby-Bauer method and interpret resistance/susceptibility profiles.	**PO1, PO2**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	**Identify** bacteria using standard biochemical tests.	**PO1, PO2**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva

CO6	**Demonstrate** the principles of serological tests including the Widal test (demo).	**PO1, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO7	**Perform** haemagglutination test and analyze results for diagnostic relevance.	**PO1, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva

SEMESTER-IV

MMBT 121 T	Bioethics, IPR and Biosafety	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	**Evaluate** ethical concerns in biomedical and biotechnological practices.	**PO5**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO2	**Understand** different types of IPR and their applications.	**PO7, PO8**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO3	**Apply** various national and international guidelines in biomedical and health research.	**PO5**	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
MMBT 117	**Research Project / Dissertation**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	**Formulate a research problem** by reviewing scientific literature and identifying knowledge gaps in medical biotechnology.	**PO1, PO2, PO3, PO4, PO5, PO6, PO8**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO2	**Design and execute experiments** using appropriate methodologies, tools, and techniques relevant to biomedical research.	**PO1, PO2, PO3, PO4, PO5, PO6, PO8**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO3	**Demonstrate proficiency** in handling advanced molecular biology, biochemistry, microbiology, and bioinformatics methods as required for their research project.	**PO1, PO2, PO3, PO4, PO5, PO6, PO8**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO4	**Critically analyse and interpret experimental data** using appropriate statistical and computational tools.	**PO1, PO2, PO3, PO4, PO5, PO6, PO8**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO5	**Adhere to ethical standards** in biomedical research, including biosafety, data integrity, and responsible reporting.	**PO5**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO6	**Communicate research findings effectively** through well-structured dissertation writing, presentations, and potential publications.	**PO6**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO7	**Work independently and collaboratively** to solve research challenges and manage time efficiently during the project.	**PO2**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO8	**Develop a research-oriented mind-set** that prepares them for higher	**PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8**	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)

	studies, industrial R&D, or academic research careers.			
MMBT 122 P	**Internship/Training (Clinical/ Industrial)**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	**Demonstrate** an understanding of industrial processes, laboratory practices, and biotechnological applications in real-life settings.	**PO2, PO7, PO8**	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO2	**Apply** theoretical knowledge gained during coursework to practical situations in industry/clinical/research environments.	**PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8**	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO3	**Operate** and gain familiarity with standard instruments, diagnostic tools, and workflows followed in biotechnology-related organizations.	**PO3, PO5**	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO4	**Analyse** and document technical data, reports, and observations from industrial exposure.	**PO2**	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO5	**Exhibit** improved professional skills including communication, teamwork, adaptability, and workplace ethics.	**PO5, PO7**	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO6	**Critically** evaluate the role of medical biotechnology in healthcare, diagnostics, pharmaceuticals, and research.	**PO1, PO2, PO6, PO7, PO8**	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO7	**Identify** potential career pathways and entrepreneurial opportunities in the biotechnology sector	**PO6, PO8**	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO8	**Integrate** biosafety, regulatory, and quality assurance practices into professional conduct.	**PO5, PO6, PO8**	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar

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

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														
MMBT 113 T	Genetics & Genomics	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MMBT 114 T	Principles and Applications of Tissue Culture	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MMBT 115 T	Medical Microbiology	2	-	-	-	**2**	30	-	-	-	**30**	**20**	**80**	**100**
MMBT 116 T	Clinical Trials and Data Management	2	-	-	-	**2**	30	-	-	-	**30**	**20**	**80**	**100**
MMBT 117	Research Project / Dissertation	-	-	14	-	**7**	-	-	210	-	**210**	**50**	-	**50**
Discipline Specific Core Practical														
MMBT 118 P	Genetics and Genomics	-	-	4	-	**2**	-	-	60	-	**60**	**10**	**40**	**50**
MMBT 119 P	Principles and Applications of Tissue Culture	-	-	4	-	**2**	-	-	60	-	**60**	**10**	**40**	**50**
MMBT 120 P	Medical Microbiology	-	-	4	-	**2**	-	-	60	-	**60**	**10**	**40**	**50**
Total		**10**	**0**	**26**	**0**	**23**	**150**	**0**	**390**	**0**	**540**	**160**	**440**	**600**

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

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														
MMBT 121 T	Bioethics IPR and Biosafety	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
Discipline Specific Core Practical														
MMBT 117	Research Project / Dissertation	-	-	22	-	**11**	-	-	330	-	**330**	-	**200**	**200**
MMBT 122 P	Internship/Training (Clinical/ Industrial)	-	-	-	18	**6**	-	-	-	270	**270**	-	**50**	**50**
Total		**3**	**0**	**22**	**18**	**20**	**45**	**0**	**330**	**270**	**645**	**20**	**330**	**350**

SECOND YEAR

M. Sc. MEDICAL BIOTECHNOLOGY

SEMESTER-III

Code No.	Core Subjects
Discipline Specific Core Theory	
MMBT 113 T	Genetics and Genomics
MMBT 114 T	Principles and Applications of Tissue Culture
MMBT 115 T	Medical Microbiology
MMBT 116 T	Clinical Trials and Data Management
MMBT 117	Research Project / Dissertation
Discipline Specific Core Practical	
MMBT 118 P	Genetics and Genomics
MMBT 119 P	Principles and Applications of Tissue Culture
MMBT 120 P	Medical Microbiology

Name of the Program	M. Sc. Medical Biotechnology
Semester	Semester III
Name of the Subject	Genetics and Genomics
Subject Code	MMBT 113 T

Course Objective	• Understand the advanced principles of medical genetics, including the molecular basis of genetic disorders. • Analyze the patterns of inheritance and genotype-phenotype correlations in human diseases. • Apply knowledge of genetic techniques in the diagnosis and management of genetic diseases. • Explore the role of genomics and epigenetics in personalized medicine. • Develop an understanding of ethical, legal, and social implications (ELSI) of genetic testing and counseling.
Course Outcomes	After completing this course, students will be able to: • Interpret molecular mechanisms underlying inherited and acquired genetic diseases. • Apply chromosomal, molecular, and cytogenetic techniques for diagnosis. • Critically analyze the impact of next-generation sequencing (NGS) and genomics on clinical diagnostics. • Demonstrate the ability to conduct risk assessment and genetic counseling. • Examine ethical considerations in the use of genetic information and technologies.

Sr. No.	Topics	No. of Hrs.
1	**Fundamentals of Human Genetics and Genomics:** Human karyotype and genome organization**,** Modes of inheritance (Mendelian, non-Mendelian, Mitochondrial)**,** Penetrance, expressivity, anticipation, imprinting**,** Human Genome Project and its clinical implications**,** Introduction to population genetics.	**12**
2	**Molecular Basis of Genetic Disorders:** Mutation types: point mutations, insertions, deletions, CNVs, Inborn errors of metabolism (examples: PKU, galactosemia), Hemoglobinopathies, neurogenetic disorders (e.g., Huntington's, SMA), Cancer genetics: oncogenes, tumour suppressor genes, familial cancer syndromes (Hereditary Breast and Ovarian Cancer, Retinoblastoma)	**12**
3	**Genetic Diagnostics and Techniques:** Cytogenetic techniques: karyotyping, FISH, Comparative Genomic Hybridization, Molecular diagnostics: PCR, RT-PCR, Sanger sequencing, Next-generation sequencing (NGS). Preimplantation, prenatal, and new-born screening.	**12**
4	**Genetic Counselling and Ethical Issues:** Principles and process of genetic counselling, Risk calculation and pedigree analysis, Informed consent, confidentiality, and data privacy, Ethical, legal, and social implications (ELSI), Case studies and real-world applications.	**9**
Total		**45 hrs**

Name of the Program	M. Sc. Medical Biotechnology
Semester	Semester III
Name of the Subject	Genetics and Genomics
Subject Code	MMBT 118 P

Course Objective	• **To impart practical knowledge of cytogenetic techniques** involved in culturing peripheral blood lymphocytes and preparing metaphase chromosome spreads for chromosomal analysis. • **To develop competence in human karyotyping** and interpretation of normal and abnormal chromosomal patterns. • **To familiarize students with genetic disorders and chromosomal abnormalities**, enhancing diagnostic interpretation through karyogram analysis. • **To introduce molecular genetic tools** such as restriction digestion and RFLP analysis for studying DNA polymorphisms and genetic variations. • **To train students in cytological and classical genetic techniques**, including the study of sex chromatin and pedigree analysis for inheritance patterns. • **To enable application of population genetics principles** like Hardy–Weinberg equilibrium for calculating gene frequency and carrier probability in populations.
Course Outcomes	• **Perform peripheral blood lymphocyte culture** and prepare high-quality metaphase chromosome spreads for cytogenetic examination. • **Construct and analyze human karyotypes**, differentiating between normal and abnormal chromosomal complements. • **Identify chromosomal abnormalities** such as Down's and Turner's syndromes using karyogram interpretation and correlate findings with genetic disorders. • **Carry out restriction digestion and RFLP analysis**, demonstrating understanding of DNA polymorphism detection and its relevance to genetic mapping and diagnosis. • **Prepare and interpret buccal smears for sex chromatin** and construct pedigree charts to determine inheritance patterns of genetic traits. • **Apply Hardy–Weinberg equilibrium principles** to estimate gene and genotype frequencies and assess population-level genetic variations.

Sr. No.	Topics	No. of Hrs.
1	Peripheral blood lymphocyte culture for chromosomal analysis.	**12**
2	Preparation of human karyotype from metaphase chromosome spreads.	**8**
3	Identification of chromosomal abnormalities using karyograms (e.g., Down's syndrome, Turner's syndrome)	**8**
4	Restriction digestion and RFLP analysis for detection of polymorphisms	**8**
5	Study of Sex-chromatin from buccal smear	**8**
6	Pedigree chart preparation and interpretation for autosomal dominant, recessive, and X-linked traits.	**8**
7	Calculation of gene frequency and carrier probability using Hardy-Weinberg equilibrium.	**8**
Total		**60 hrs.**

Reference Books:

1. **Thompson & Thompson Genetics in Medicine** – Nussbaum, McInnes, Willard
2. **Medical Genetics** – Jorde, Carey, Bamshad
3. **Human Molecular Genetics** – Tom Strachan & Andrew Read
4. **Principles of Medical Genetics** – Rimoin DL, Connor JM, Pyeritz RE
5. **Genetics: Analysis and Principles** – Robert J. Brooker
6. Research articles from journals like *Nature Genetics, Human Genetics, Clinical Genetics*

Name of the Program	**M. Sc. Medical Biotechnology**
Semester	**Semester III**
Name of the Subject	**Principles and Applications of Tissue Culture**
Subject Code	**MMBT 114 T**

Course Objective	• To impart fundamental knowledge and advanced principles of animal and plant tissue culture. • To develop an understanding of culture media, aseptic techniques, and culture initiation and maintenance. • To explore various applications of tissue culture in medical biotechnology, research, and therapeutics. • To familiarize students with ethical, biosafety, and regulatory concerns associated with tissue culture techniques.
Course Outcomes	After completing this course, students will be able to: • **Describe** the principles and techniques of tissue culture in both plant and animal systems. • **Apply** aseptic techniques for establishing and maintaining tissue cultures. • **Demonstrate** the use of plant and animal tissue culture in disease modeling, genetic engineering, drug screening, and regenerative medicine. • **Analyze** real-world case studies on therapeutic, pharmaceutical, and research applications. • **Understand** biosafety, contamination control, and quality assurance protocols.

Sr. No.	Topics	No. of Hrs.
1	**Basics of Tissue Culture:** Historical background and development, Principles of sterile techniques, Culture environment: pH, temperature, CO_2, media composition, Types of media (MS, B5, DMEM, RPMI, MEM) and their components, Sterilization techniques: autoclaving, filtration, surface sterilization	**09**
2	**Animal Tissue Culture Techniques:** Primary culture, secondary culture, and continuous cell lines, Cell line authentication and cryopreservation, Sub culturing, cell counting, viability assays (Trypan Blue, MTT), Applications in virology, vaccine production, cytotoxicity assays, stem cell research, 3D culture, organoids, co-culture techniques	**12**
3	**Plant Tissue Culture Techniques:** Explant selection and sterilization, Callus and suspension cultures, Organogenesis and somatic embryogenesis, Micro propagation and clonal propagation, Protoplast culture and somatic hybridization.	**12**
4	**Genetic Engineering and Biotechnological Applications:** Agrobacterium-mediated transformation, Gene transfer methods: electroporation, biolistics, PEG, Production of secondary metabolites and edible vaccines, Applications in phytoremediation and crop improvement, Animal transgenesis using cultured cells.	**12**
Total		**45 hrs.**

Name of the Program	**M. Sc. Medical Biotechnology**
Semester	**Semester III**
Name of the Subject	**Principles and Applications of Tissue Culture**
Subject Code	**MMBT 119 P**

Course Objective	• **To provide hands-on training in the preparation and sterilization of culture media** used for both plant and animal tissue culture. • **To develop skills in aseptic handling techniques** required for surface sterilization of explants and maintenance of contamination-free cultures. • **To introduce students to plant tissue culture methodologies** including callus induction, organ culture, and anther culture for haploid plant production. • **To impart knowledge and skills in animal cell culture techniques**, including isolation, maintenance, and subculturing of animal cells such as lymphocytes. • **To familiarize students with quantitative assessment techniques** such as cell counting and cell viability assays for monitoring culture health and growth. • **To build competence in applying tissue culture principles** for plant improvement, biomedical research, and biotechnological applications.
Course Outcomes	• **Prepare and sterilize plant and animal tissue culture media** following standard aseptic techniques to ensure successful culture establishment. • **Perform surface sterilization of explants** and maintain contamination-free conditions during culture initiation and growth. • **Induce and maintain callus cultures**, perform organ culture, and carry out anther culture to obtain haploid plants using appropriate plant growth regulators. • **Isolate, culture, and maintain lymphocyte cells**, demonstrating proficiency in basic animal cell culture techniques. • **Perform cell counting and viability assays** to assess culture health and optimize growth conditions. • **Carry out trypsinization and subculturing of adherent monolayer cells**, maintaining viability and genetic stability across passages for research applications.

Sr. No.	Topics	No. of Hrs.
1	Preparation of plant cell culture media.	**6**
2	Sterilization and preparation of animal cell culture media	**6**
3	Surface sterilization of explants.	**6**
4	Callus induction and maintenance using suitable plant growth regulators	**8**
5	Organ Culture.	**8**
6	Anther culture for production of Haploid plants.	**6**
7	Isolation and culture of lymphocytes	**8**
8	Cell counting and cell viability assays	**6**
9	Trypsinization of monolayer and sub culturing	**6**
Total		**60 hrs.**

Reference Books:

1. Freshney, R. I. – *Culture of Animal Cells*
2. Razdan, M. K. – *Introduction to Plant Tissue Culture*
3. Bhojwani, S. S. and Razdan, M. K. – *Plant Tissue Culture: Theory and Practice*
4. Butler, M. – *Animal Cell Culture and Technology*
5. Kalyan Kumar De – *Plant Tissue Culture*
6. Selected review articles and protocols from journals like *In Vitro Cellular & Developmental Biology*, *Plant Cell Reports*, and *Nature Protocols*

Name of the Program	M. Sc. Medical Biotechnology
Semester	Semester III
Name of the Subject	Medical Microbiology
Subject Code	MMBT 115 T

Course Objective	• To provide in-depth knowledge of pathogenic microorganisms and their role in human diseases • To understand microbial structure, classification, and mechanisms of pathogenicity • To study diagnostic microbiology, antimicrobial resistance, and prevention strategies • To train students in basic and advanced microbiological techniques relevant to medical settings
Course Outcomes	After completing this course, students will be able to: • **Classify** medically important microbes and understand their structural and functional characteristics • **Explain** mechanisms of microbial pathogenicity and host-pathogen interactions • **Apply** diagnostic methods for detection of infectious agents • **Understand** antimicrobial resistance mechanisms and control measures • **Perform** microbiological techniques with aseptic skills in a laboratory setting

Sr. No.	Topics	No. of Hrs.
1	**Fundamentals of Microbiology:** History and scope of medical microbiology, Classification of microorganisms (bacteria, viruses, fungi, parasites), Structure and function of prokaryotic and eukaryotic microbes, Normal flora and its clinical significance.	6
2	**Pathogenesis and Host-Pathogen Interaction:** Bacterial and viral pathogenesis, Virulence factors and toxins, Immune evasion strategies, Zoonotic, nosocomial, and opportunistic infections.	6
3	**Diagnostic Microbiology:** Collection, transport, and processing of clinical specimens, Staining techniques (Gram, Ziehl-Neelsen), Culture media and identification techniques, Serological and molecular diagnostic methods (ELISA, PCR)	6
4	**Systemic Infections and Etiological Agents:** Respiratory, gastrointestinal, urinary, CNS, and skin infections, Causative agents: *Streptococcus, Staphylococcus, E. coli, Salmonella, Mycobacterium, Plasmodium, Candida, Herpesvirus*, etc., Viral hepatitis and HIV, Covid 19.	6
5	**Antimicrobials and Infection Control:** Mechanisms of antimicrobial action and resistance, Antibiotic susceptibility testing (AST), MIC, Vaccines and immunoprophylaxis, Biosafety, waste management, and hospital infection control.	6
Total		**30 hrs.**

Name of the Program	M. Sc. Medical Biotechnology
Semester	Semester III
Name of the Subject	Medical Microbiology
Subject Code	MMBT 120 P

Course Objective	• To provide practical training in basic and advanced microbiological techniques relevant to clinical and environmental samples. • To develop skills in microbial staining, isolation, culture, and identification methods. • To train students in antimicrobial sensitivity testing and interpretation of results. • To introduce serological and immunological assays used in diagnostic microbiology. • To enhance analytical and critical thinking skills for application in medical and healthcare research
Course Outcomes	After completing this course, students will be able to: • **Perform** differential staining techniques such as Gram staining and acid-fast staining for bacterial identification. • **Isolate** microorganisms using streak plate, pour plate, and spread plate methods. • **Culture** and maintain bacterial and fungal isolates from clinical and environmental samples. • **Conduct** antibiotic sensitivity testing by Kirby-Bauer method and interpret resistance/susceptibility profiles. • **Identify** bacteria using standard biochemical tests. • **Demonstrate** the principles of serological tests including the Widal test (demo). • **Perform** haemagglutination test and analyze results for diagnostic relevance.

Sr. No.	Topics	No. of Hrs.
1	Gram staining and acid-fast staining	**8**
2	Isolation of microorganism by streak plate, pour plate and spread method	**12**
3	Culture of bacteria and fungi from clinical/environmental samples	**12**
4	Antibiotic sensitivity testing (Kirby-Bauer method)	**8**
5	Identification of bacteria using biochemical tests	**8**
6	Serological test: Widal test (demo)	**6**
7	Haemagglutination test	**6**
Total		**60 hrs.**

Reference books:

1. **Prescott's Microbiology** – Joanne M. Willey, Linda Sherwood, Christopher J. Woolverton
2. **Jawetz, Melnick & Adelberg's Medical Microbiology** – Geo. F. Brooks, Karen C. Carroll, Janet S. Butel, Stephen A. Morse
3. **Medical Microbiology** – Murray, Rosenthal & Pfaller

Name of the Program	M. Sc. Medical Biotechnology
Semester	Semester III
Name of the Subject	Clinical Trials and Data Management
Subject Code	MMBT 116 T

Course Objective	• To understand the principles, phases, and design of clinical trials. • To acquire knowledge of regulatory guidelines and ethical considerations. • To gain expertise in clinical data management, monitoring, and documentation. • To understand quality control and assurance practices in clinical research. • To enable students to apply Good Clinical Practices (GCP) and manage clinical trial workflows.
Course Outcomes	After completing this course, students will be able to: • **Explain** the process and regulatory framework of clinical trials. • **Design** clinical trial protocols and analyze trial phases. • **Apply** principles of data management, CRFs, and electronic data capture systems. • **Demonstrate** understanding of quality control, audits, and GCP compliance. • **Recognize** ethical issues, adverse events, and safety reporting in human research.

Sr. No.	Topics	No. of Hrs.
1	**Fundamentals of Clinical Trials:** Introduction to clinical trials: purpose, types, and phases (I–IV). Trial design: randomized control trials, Non-randomized (Quasi-experimental) Trials, double-blind, crossover. Key stakeholders: sponsor, investigator, ethics committee, CRO. Protocol development, inclusion/exclusion criteria. Trial Design Guidelines, CONSORT, STROBE, PRISMA, SPIRIT, STARD, CARE, AGREE, SRQR, ARRIVE, SQUIRE, CHEERS.	**8**
2	**Regulatory and Ethical Aspects:** ICH-GCP guidelines, Schedule Y (India), US FDA, EMA, DCGI, Role of Institutional Ethics Committees and informed consent process, Clinical trial registration (CTRI, ClinicalTrials.gov), Adverse event (AE) and serious adverse event (SAE) reporting.	**8**
3	**Quality Control and Assurance in Clinical Research:** Principles of quality control and quality assurance, Monitoring visits and audit processes, Risk-based monitoring approaches, SOPs and documentation practices (ALCOA principles).	**8**
4	**Biostatistics and Trial Outcomes:** Basics of biostatistics: randomization, blinding, sample size, Endpoint classification: primary, secondary, surrogate, Interim analysis and data safety monitoring boards (DSMB), Interpreting statistical results in trial publications	**6**
Total		**30 hrs.**

Reference Book:

1. **Clinical Trials: A Practical Guide** – Duolao Wang & Ameet Bakhai
2. **Principles and Practice of Clinical Research** – John I. Gallin, Frederick P. Ognibene
3. **Fundamentals of Clinical Trials** – Lawrence M. Friedman et al.
4. **Textbook of Clinical Trials** – David Machin, Simon Day, Sylvan Green
5. **Practical Guide to Clinical Data Management** – Susanne Prokscha
6. **ICH-GCP Guidelines** – International Conference on Harmonisation
7. **Indian Guidelines: Schedule Y** – CDSCO, Government of India
8. **Clinical Data Management** – R.K. Bhatt

Name of the Program	M. Sc. Medical Biotechnology
Semester	Semester III
Name of the Subject	Research Project / Dissertation
Subject Code	MMBT 117

Course Objective	• The dissertation course is designed to provide postgraduate students with hands-on experience in scientific research, enabling them to apply theoretical knowledge and laboratory skills acquired during the M.Sc. Medical Biotechnology program. The objective is to cultivate independent thinking, critical analysis, problem-solving abilities, and technical expertise in experimental design, data collection, analysis, and interpretation. It also aims to nurture scientific communication skills, ethical research practices, and the capacity to contribute meaningfully to biomedical and translational research.
Course Outcomes	After completing this course, students will be able to: • **Formulate a research problem** by reviewing scientific literature and identifying knowledge gaps in medical biotechnology. • **Design and execute experiments** using appropriate methodologies, tools, and techniques relevant to biomedical research. • **Demonstrate proficiency** in handling advanced molecular biology, biochemistry, microbiology, and bioinformatics methods as required for their research project. • **Critically analyze and interpret experimental data** using appropriate statistical and computational tools. • **Adhere to ethical standards** in biomedical research, including biosafety, data integrity, and responsible reporting. • **Communicate research findings effectively** through well-structured dissertation writing, presentations, and potential publications. • **Work independently and collaboratively** to solve research challenges and manage time efficiently during the project. • **Develop a research-oriented mindset** that prepares them for higher studies, industrial R&D, or academic research careers.

Research Project / Dissertation:

The dissertation is a mandatory component of the M.Sc. Medical Biotechnology program, designed to provide students with hands-on research experience and the opportunity to apply theoretical knowledge to practical problems. It involves independent project work under the guidance of a faculty supervisor, focusing on advanced areas of medical biotechnology such as molecular biology, immunology, genetics, microbiology, plant medical biotechnology, animal tissue culture, diagnostics, or therapeutics. The dissertation aims to develop critical thinking, problem-solving, data analysis, and scientific writing skills, preparing students for careers in research, industry, or higher studies**.** The dissertation process is stringent and span over two year, the student has to design a protocol and submit it to the institutional research advisory committee and get it approved form it, thereafter the student has to submit the proposal for institutional ethical approval for animal and human ethics committees (Recognized by DHR-ICMR)**,** post approval the student has to conduct a thorough research project work to achieve the objectives mentioned in the approved proposal.
(Total - 210 hrs.)

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SECOND YEAR

M. Sc. MEDICAL BIOTECHNOLOGY

SEMESTER-IV

Code No.	Core Subjects
Discipline Specific Core Theory	
MMBT 121 T	Bioethics, IPR and Biosafety
Discipline Specific Core Practical	
MMBT 117	Research Project / Dissertation
MMBT 122 P	Internship/Training (Clinical/ Industrial)

Name of the Program	M. Sc. Medical Biotechnology
Semester	Semester IV
Name of the Subject	Bioethics, IPR and Biosafety
Subject Code	MMBT 121 T

Course Objective	• To familiarize students with ethical issues in biomedical research and healthcare. • To provide knowledge about intellectual property rights and their relevance in biotechnology. • To understand biosafety principles and regulatory frameworks related to research and product development.
Course Outcomes	After completing this course, students will be able to: • **Evaluate** ethical concerns in biomedical and biotechnological practices. • **Understand** different types of IPR and their applications. • **Apply** various national and international guidelines in biomedical and health research**.**

Sr. No.	Topics	No. of Hrs.
1	**Introduction to Bioethics:** Principles of biomedical ethics: autonomy, beneficence, non-maleficence, justice. Ethics in clinical research: Informed consent, confidentiality, human and animal experimentation. Ethical guidelines: ICMR, DHR, ANRF, Helsinki Declaration, Belmont Report. Case studies in biomedical ethics.	**12**
2	**Intellectual Property Rights (IPR):** Types of IPR: Patents, Copyrights, Trademarks, Trade secrets, Plant variety protection. Patent filing process (India and international). Patentability criteria and limitations in biotechnology. Importance of IPR in academia and industry.	**12**
3	**Biosafety and Biosecurity:** Definition and classification of biological hazards, Risk assessment and management in laboratory and field research, Containment facilities: Biosafety levels (BSL I–IV), Guidelines: Cartagena Protocol, NIH Guidelines, DBT & WHO norms, Dual-use research and bioterrorism concerns.	**12**
4	**Regulatory Frameworks and Institutional Oversight:** Institutional Biosafety Committee (IBSC), Review Boards, Ethical Committees. NABH, NABH Digital Health Standards for Hospitals, NABL, JCI, ISO. National and international regulatory bodies: RCGM, GEAC, CDSCO, WHO. Biosafety and ethics in genome editing (e.g., CRISPR), stem cell research, GMOs. Recent advancements and controversies. Cyber Security, HIPAA, GDPR, DPDP Act 2023 India.	**9**
Total		**45 hrs.**

Reference book:

1. **Bioethics & Biosafety** – R. C. Dubey
2. **Intellectual Property Rights in Biotechnology** – P. Narayanan
3. **Bioethics and Biosafety in Biotechnology** – V. Sree Krishna
4. **ICMR Ethical Guidelines for Biomedical Research** (latest version)
5. WIPO, DBT, ICMR, DHR, ANRF, NABH, NABL, HIPPA, GDPR, DPDP Act 2023, India and WHO online resources.

Name of the Program	M. Sc. Medical Biotechnology
Semester	Semester IV
Name of the Subject	Research Project / Dissertation
Subject Code	MMBT 117

Course Objective	• The dissertation course is designed to provide postgraduate students with hands-on experience in scientific research, enabling them to apply theoretical knowledge and laboratory skills acquired during the M.Sc. Medical Biotechnology program. The objective is to cultivate independent thinking, critical analysis, problem-solving abilities, and technical expertise in experimental design, data collection, analysis, and interpretation. It also aims to nurture scientific communication skills, ethical research practices, and the capacity to contribute meaningfully to biomedical and translational research.
Course Outcomes	After completing this course, students will be able to: • **Formulate a research problem** by reviewing scientific literature and identifying knowledge gaps in medical biotechnology. • **Design and execute experiments** using appropriate methodologies, tools, and techniques relevant to biomedical research. • **Demonstrate proficiency** in handling advanced molecular biology, biochemistry, microbiology, and bioinformatics methods as required for their research project. • **Critically analyze and interpret experimental data** using appropriate statistical and computational tools. • **Adhere to ethical standards** in biomedical research, including biosafety, data integrity, and responsible reporting. • **Communicate research findings effectively** through well-structured dissertation writing, presentations, and potential publications. • **Work independently and collaboratively** to solve research challenges and manage time efficiently during the project. • **Develop a research-oriented mindset** that prepares them for higher studies, industrial R&D, or academic research careers.

Research Project / Dissertation:

The dissertation is a mandatory component of the M.Sc. Medical Biotechnology program, designed to provide students with hands-on research experience and the opportunity to apply theoretical knowledge to practical problems. It involves independent project work under the guidance of a faculty supervisor, focusing on advanced areas of medical biotechnology such as molecular biology, immunology, genetics, microbiology, plant medical biotechnology, animal tissue culture, diagnostics, or therapeutics. The dissertation aims to develop critical thinking, problem-solving, data analysis, and scientific writing skills, preparing students for careers in research, industry, or higher studies**.** The dissertation process is stringent and span over two year, the student has to design a protocol and submit it to the institutional research advisory committee and get it approved form it, thereafter the student has to submit the proposal for ethical approval for animal and human ethics committees**,** post approval the student has to conduct a thorough project work to achieve the objectives mentioned in the approved proposal **(Total - 330 hrs.)**

Name of the Program	M. Sc. Medical Biotechnology
Semester	Semester IV
Name of the Subject	Internship/Training (Clinical/ Industrial)
Subject Code	MMBT 122 P

Course Objective	• To expose students to real-world applications of medical biotechnology in industries, hospitals, research laboratories, and healthcare facilities. • To bridge the gap between academic knowledge and industrial/clinical practices. • To provide hands-on experience with advanced instruments, techniques, and workflows used in medical biotechnology. • To develop professional skills including teamwork, communication, problem-solving, and ethical practices. • To enhance students' understanding of regulatory requirements, quality control, biosafety, and industry standards. • To prepare students for careers in biotechnology industries, research organizations, hospitals, and entrepreneurial ventures.
Course Outcomes	After completing this course, students will be able to: • **Demonstrate** an understanding of industrial processes, laboratory practices, and biotechnological applications in real-life settings. • **Apply** theoretical knowledge gained during coursework to practical situations in industry/clinical/research environments. • **Operate** and gain familiarity with standard instruments, diagnostic tools, and workflows followed in biotechnology-related organizations. • **Analyze** and document technical data, reports, and observations from industrial exposure. • **Exhibit** improved professional skills including communication, teamwork, adaptability, and workplace ethics. • **Critically** evaluate the role of medical biotechnology in healthcare, diagnostics, pharmaceuticals, and research. • **Identify** potential career pathways and entrepreneurial opportunities in the biotechnology sector. • **Integrate** biosafety, regulatory, and quality assurance practices into professional conduct.

Internship/Training (Clinical/ Industrial):

The Industrial Visit / Internship is an integral part of the M.Sc. Medical Biotechnology program, designed to provide students with exposure to real-world applications of biotechnology in industry, research laboratories, hospitals, and healthcare settings. It enables students to bridge classroom learning with practical experience, understand professional work environments, and gain insights into industrial processes, regulatory practices, and advanced technologies. This component also enhances problem-solving, teamwork, a-nd communication skills, preparing students for careers in biotechnology research, clinical diagnostics, pharmaceuticals, and allied industries. The students has to search the Internship/Training (Clinical/ Industrial) opportunities on their own at least 2 to 3 months prior before starting of the actual course. The student has to prepare the detailed log book along with weekly summary report **(Total - 270 hrs.)**

MGM SCHOOL OF BIOMEDICAL SCIENCES, NAVI MUMBAI
(A constituent unit of MGM INSTITUTE OF HEALTH SCIENCES)
Department of Medical Biotechnology
(Deemed to be University u/s 3 of UGC Act 1956)
Grade "A++" Accredited by NAAC
Sector 1, Kamothe Navi Mumbai-410209, Tel.No.:022-27437631,27432890
Email. sbsnm@mgmuhs.com / Website : www.mgmsbsnm.edu.in

Internship / Training Logbook

MASTER
IN
MEDICAL BIOTECHNOLOGY

STUDENT NAME: _____

PRN NUMBER: _____

BATCH: _____

SEMESTER: _____

PERIOD FROM:_____**TO**_____

COORDINATOR **HOD** **DIRECTOR**

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AIM:

To provide a structured learning experience that enhances students' technical, analytical, and professional skills while addressing the evolving needs of healthcare organizations. By integrating academic knowledge with hands-on practice, these internships prepare medical biotechnology students to become competent professionals capable of driving biotechnological applications in healthcare.

Guidelines:

1. The internship shall commence after the student has completed and passed all subjects up to Semester III
2. The internship is compulsory
3. The duration of the internship shall be 210 Hours.
4. Activities carried out by the student during the internship must be clearly mentioned.

Evaluation of Internees:

Formative Evaluation: The continuous assessment of interns during their internship should be conducted by the Head of the Department, assigned faculty, or a designated individual from the organization (in the case of industry-based internships). The primary objective of this evaluation is to ensure that interns develop the necessary competencies to function effectively in real-world scenarios. This can be facilitated through the maintenance of records or a logbook by all interns. Such documentation serves as tangible evidence of the training process and, more importantly, reflects the intern's progression in acquiring the required competencies for professional performance.

Summative Evaluation: It will be based on the observations of the assigned person from the Department/Organization and record/logbook maintained by the intern.

Based on this two evaluations, the Head of the Department shall issue certificate of satisfactory completion of the training.

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Email. sbsnm@mgmuhs.com/ Website: www.mgmsbsnm.edu.in

DEPARTMENT OF MEDICAL BIOTECHNOLOGY

Internship/ Training Completion Certificate

Class: _____ **Year:** _____

This is to certify that_____, bearing PRN_____, has successfully completed the internship at _____ **from** _____to_____. During this period, the student has completed a total of **210 hours** of internship, as per the university guidelines.

The student demonstrated a high level of professionalism, technical competence, and problem-solving skills. We wish him/her success in his/her future endeavours.

Head of the Department	Director
Dept. of Medical Biotechnology	MGMSBS
MGMSBS, MGMIHS	Kamothe, Navi Mumbai

Weekly Summary Report

Week: _____

Total Hours Completed This Week: _____

Key Activities Performed:

Challenges Faced & How They Were Addressed:

New Skills Acquired:

Comments by Internship Supervisor:

STUDENT'S DAILY LOG RECORD

Date/Day	Task & Activities	Skill gained	Hours Completed	Supervisor Signature

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Email. sbsnm@mgmuhs.com/ Website: www.mgmsbsnm.edu.in

Final Evaluation (50 Marks)

1. Technical Knowledge & Application (10 marks): _____
2. Problem-Solving & Critical Thinking (5 marks): _____
3. Communication & Teamwork (5 marks): _____
4. Professionalism & Punctuality (5 marks): _____
5. Quality of Log Book Maintenance (5 marks): _____
6. Learning Outcome & Skill Development (5 marks): _____
7. Final Internship Report Quality (5 marks): _____
8. Student's Initiative & Engagement (5 marks): _____
9. Overall Performance (5 marks): _____
10. Total: _____
11. **Final Remark:**

_____

_____

Sign of Internal Examiner: _____

Sign of External Examiner: _____

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**

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 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:_____

Evaluation for Semester III – Dissertation (PG) (Internal Assessment)

Dissertation/Project Proposal : overall performance of the student	**Marks allotted**	**Marks Obtained**
Open mindedness/ Receptivity to feedback Integrates feedback	5 Marks	
Meets deadlines / Regularity in meeting / Consistency in communication	10 Marks	
Continuous Internal evaluation (CIE)		
Interest shown in selecting topic	5 marks	
Appropriate review	10 marks	
Discussion with guide and other faculty	10 marks	
Quality of protocol	5marks	
Preparation of proforma / log book / daily reports	5marks	
TOTAL	**Out of 50**	

Evaluation for Semester IV - Evaluation parameter (Research Project / Dissertation)

Evaluation parameter (Semester IV)	Continuous Internal Evaluation (CIE)	Semester End Evaluation (SEE)	
	Guide	Internal examiner	External examiner
Thesis preparation, Novelty, Overall Lab Work Culture	25	-	-
Dissertation/Project work book	25	25	25
Evaluation of thesis including Viva Voce	-	50	50
Total	50	75	75
Overall Total = 200			

Evaluation for Semester IV - Evaluation of the Internship/Training (Clinical/ Industrial) (PG)

Name of the student: _____Date:_____

Program: _____

Semester: _____ Name of the internal faculty/Observer: _____

Name of the External Faculty/Observer: _____

Final Evaluation (50 Marks)

1. Technical Knowledge & Application (10 marks): _____
2. Problem-Solving & Critical Thinking (5 marks): _____
3. Communication & Teamwork (5 marks): _____
4. Professionalism & Punctuality (5 marks): _____
5. Quality of Log Book Maintenance (5 marks): _____
6. Learning Outcome & Skill Development (5 marks): _____
7. Final Internship Report Quality (5 marks): _____
8. Student's Initiative & Engagement (5 marks): _____
9. Overall Performance (5 marks): _____
10. Total: _____
11. **Final Remark:**

    _____

    _____

Sign of Internal Examiner: _____

Sign of External Examiner: _____

MGM INSTITUTE OF HEALTH SCIENCES

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Grade 'A' Accredited by NAAC

Sector-01, Kamothe, Navi Mumbai - 410209

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