



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-53/2026, Dated 21/04/2026

Amended History

1. Approved 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.
3. Amended as per AC-53/2026, [Resolution No. 5.4,(Annexure-44B)]; Dated 21/04/2026.

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)

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Grade "A⁺⁺" Accredited by NAAC

Sector 1, Kamothe, Navi Mumbai-410209, Tel.No.022-2743763, 27437632, 27432890

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CHOICE BASED CREDIT SYSTEM (CBCS)

(Academic Year 2025 - 26)

Curriculum for

M.Sc. Allied Health Sciences

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

Postgraduate qualification in Biotechnology can earn 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 fields of biology. There is a great demand for this course abroad as most of the foreign countries are looking for experts 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



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Annexure-44B of AC-53/2026

CHOICE BASED CREDIT SYSTEM (CBCS)

(Academic Year 2025 - 26)

Curriculum for

M.Sc. Allied Health Sciences

M.Sc. Medical Biotechnology

Semester I & II

Resolution No. 5.4 of Academic Council (AC-53/2026):

Resolved to approve the proposal to conduct separate practical examinations for M.Sc. Clinical Embryology, M.Sc. Medical Biotechnology and M.Sc. Medical Genetics for Semesters I and II by revising the programme index and removing the previously approved combined practical structure. Under the revised structure, separate practical subjects corresponding to their respective theory courses will be introduced, while the already approved theory and practical syllabus will remain unchanged. The revised index also incorporates Programme Outcomes (POs) and Course Outcomes (COs). The revised structure will be implemented from the Academic Year 2026-27 onwards.

[ANNEXURE-44A, 44B & 44C - Syllabus for Semesters I and II].

[ANNEXURE-45A, 45B & 45C - Program Outcomes (POs) and Course Outcomes (COs)]

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)

Course Outcomes

Semester I

MMBT 104 (A) P	Cell Biology	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Apply aseptic techniques and sterilization methods in cell biology laboratories.	PO1,PO2, PO3,PO5, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	Use microscopy to identify and differentiate various cell types and structures.	PO1,PO2, PO3,PO6,	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	Perform cell counting, staining, and viability assays with accurate interpretation.	PO1,PO2, PO3,PO4, PO6.	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Analyze osmotic behavior and membrane integrity in biological cells.	PO1,PO2, PO4,PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Demonstrate knowledge of fixation, tissue processing, and microtomy.	PO1,PO2, PO3,PO5	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Identify stages of mitosis and meiosis and relate them to cell cycle regulation.	PO1,PO2,P O4,PO6	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
MMBT 104 (B) P	Immunology	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Identify blood cells and perform haemagglutination-based immunological tests.	PO1, PO2, PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	Analyze the microscopic organization of lymphoid organs.	PO1, PO2, PO6	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	Demonstrate antigen–antibody interactions using immunodiffusion assays.	PO1, PO2, PO4, PO6	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Isolate mononuclear immune cells using density gradient techniques.	PO1, PO2, PO3, PO4	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Perform and interpret ELISA and kit-based immunodiagnostic assays.	PO1, PO2, PO3, PO4, PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Understand serological and protein-based immunodetection methods.	PO1, PO2, PO , PO4, PO5, PO6, 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).

Semester II

MMBT 110 (A) P	Molecular Biology	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Isolate and purify high-quality genomic DNA and total RNA from biological samples and assess their integrity and purity.	PO1, PO2, PO3, PO4, PO5, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	Quantitatively estimate DNA, RNA, and protein concentrations using colorimetric and spectrophotometric methods.	PO1, PO2, PO3, PO4, PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	Perform conventional PCR amplification and analyze amplified products using agarose gel electrophoresis.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Interpret experimental data, evaluate results, and troubleshoot common laboratory issues in molecular biology experiments.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Follow ethical guidelines, biosafety regulations, and good laboratory practices during molecular experimentation.	PO1, PO2, PO3, PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Communicate experimental findings effectively through proper documentation, calculations, and scientific reporting.	PO1, PO2, PO3, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
MMBT 110 (B) P	Analytical Biotechnology	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Perform chromatographic techniques to separate and identify biomolecules from complex mixtures.	PO1, PO2, PO3, PO4, PO5, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	Quantitatively analyze biomolecules using spectrophotometric methods and calibration curves.	PO1, PO2, PO3, PO4, PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	Separate and analyze nucleic acids and proteins using electrophoretic techniques such as AGE and SDS-PAGE.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Detect and analyze specific proteins using immunoblotting (Western blotting) techniques.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Interpret analytical data, troubleshoot experimental errors, and ensure reproducibility of results.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Demonstrate ethical responsibility, GLP compliance, and effective documentation and communication of analytical findings.	PO1, PO2, PO3, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
MMBT 111 (A) P	Genetic Engineering	Mapped POs	Teaching-Learning Methodologies	Assessment Tools

CO1	Isolate and purify plasmid DNA from bacterial cells and evaluate its quality for downstream genetic engineering applications.	PO1, PO2, PO3, PO4, PO5, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	Perform restriction digestion and ligation of DNA fragments to construct recombinant DNA molecules.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	Introduce recombinant DNA into bacterial cells and assess transformation efficiency.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Analyze genetic variation and polymorphism using the RFLP technique.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Quantitatively evaluate gene expression using real-time PCR and interpret amplification data.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Demonstrate ethical conduct, biosafety compliance, effective documentation, and scientific communication in genetic engineering experiments.	PO1, PO2, PO3, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
MMBT 111 (B) P	Bioinformatics	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Retrieve, curate, and perform comparative analysis of biological sequences using public databases and similarity search tools.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	Perform multiple sequence alignment and construct phylogenetic trees to infer evolutionary relationships.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	Generate and evaluate three-dimensional protein structures using homology modeling techniques.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Conduct molecular docking studies and analyze protein–ligand interactions for functional and therapeutic insights.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Visualize, statistically analyze, and interpret biological data using appropriate graphical and computational methods.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Reconstruct and functionally interpret metabolic pathways to understand biological systems and disease mechanisms.	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
Discipline 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
Discipline Specific Core Practical														
MMBT 104 (A) P	Cell Biology	-	-	4	-	2	-	-	60	-	60	10	40	50
MMBT 104 (B) P	Immunology	-	-	4	-	2	-	-	60	-	60	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	80	470	550

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
Discipline 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
Discipline Specific Core Practical														
MMBT 110 (A) P	Molecular Biology	-	-	2	-	1	-	-	30	-	30	10	40	50
MMBT 110 (B) P	Analytical Biotechnology	-	-	2	-	1	-	-	30	-	30	10	40	50
MMBT 111 (A) P	Genetic Engineering	-	-	2	-	1	-	-	30	-	30	10	40	50
MMBT 111 (B) P	Bioinformatics	-	-	2	-	1	-	-	30	-	30	10	40	50
MMBT 112 CP	MBT Directed Clinical Education-II	-	-	-	12	4	-	-	-	180	180	-	50	50
Skill Enhancement Course														
SEC 001 T	Innovation and Entrepreneurship	3	-	-	-	3	45	-	-	-	45	-	100	100
SEC 002 T	NPTEL / SWAYAM (Name of the Course Chosen by the Student)													
Total		15	0	8	12	23	225	0	120	180	525	120	630	750

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.

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 (A) P	Cell Biology
MMBT 104 (B) P	Immunology
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	Cell Biology
Subject Code	MMBT 104 (A) P

Course Objective	After completing this course, students will be able to: • Understand and apply fundamental laboratory sterilization and biosafety practices. • Develop proficiency in microscopy and identification of different cell types. • Perform quantitative cell counting and viability assessment techniques. • Explain membrane transport phenomena and osmotic behavior in cells. • Understand tissue fixation, processing, and sectioning methods. • Interpret stages of cell division and their biological significance in growth and disease.
Course Outcomes	• Apply aseptic techniques and sterilization methods in cell biology laboratories. • Use microscopy to identify and differentiate various cell types and structures. • Perform cell counting, staining, and viability assays with accurate interpretation. • Analyze osmotic behavior and membrane integrity in biological cells. • Demonstrate knowledge of fixation, tissue processing, and microtomy. • Identify stages of mitosis and meiosis and relate them to cell cycle regulation.

Sr. No.	Topics	No. of Hrs.
1	Sterilization techniques (Wet and Dry Sterilization, Chemical Sterilization and Ultra-filtration).	10
2	Microscopy and Cellular Morphology study.	10
3	Cell counting (using Haemocytometer) a) WBC- Differential Staining b) Total Count c) Viability assay.	10
4	Cell Membrane Transport and Osmotic Fragility Studies (Osmosis, endosmosis, and exosmosis).	10
5	Cell Fixation, Tissue Processing, and Microtomy.	10
6	Cell Cycle and Cell Division Studies (Study of mitosis and meiosis) by using suitable sample.	10
Total		60 hrs
*Note: Any five practical's of above are mandatory for the course.		

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester I
Name of the Subject	Immunology
Subject Code	MMBT 104 (B) P

Course Objective	After completing this course, students will be able to: • Understand the cellular and structural components of the immune system. • Perform basic immunological diagnostic techniques. • Analyze antigen–antibody interactions using classical immunoassays. • Isolate and handle immune cells for downstream applications. • Understand advanced immunodetection methods used in diagnostics and research. • Correlate immunological techniques with clinical and public health applications.
Course Outcomes	• Identify blood cells and perform haemagglutination-based immunological tests • Analyze the microscopic organization of lymphoid organs • Demonstrate antigen–antibody interactions using immunodiffusion assays • Isolate mononuclear immune cells using density gradient techniques • Perform and interpret ELISA and kit-based immunodiagnostic assays • Understand serological and protein-based immunodetection methods

Sr. No.	Topics	No. of Hrs.
1	Blood film preparation and identification of immune cells.	08
2	Observation and study of Lymphoid organs and their microscopic organization.	10
3	Separation of mononuclear cells by Ficoll-Hypaque.	08
4	Western-blotting (Demonstration).	10
5	To detect the antigen/antibody using Enzyme Linked Immuno Sorbent Assay (ELISA). (Demonstration).	10
6	VDRL test (Demonstration).	8
7	Blood group typing using haemagglutination tests.	6
Total		60 hrs

*Note: Any five practical's of above are mandatory for the course.

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 (A) P	Molecular Biology
MMBT 110 (B) P	Analytical Biotechnology
MMBT 111 (A) P	Genetic Engineering
MMBT 111 (B) P	Bioinformatics
MMBT 112 CP	MBT Directed Clinical Education-II
Skill Enhancement Course	
SEC 001 T	Innovation and Entrepreneurship
SEC 002 T	Comprehensive Molecular Diagnostics and Advanced Gene Expression Analysis (NPTEL)

Name of the Program	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. Goldstein
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	Molecular Biology
Subject Code	MMBT 110 (A) P

Course Objective	After completing this course, students will be able to: • Provide hands-on training in the isolation, purification, and quality assessment of nucleic acids from biological samples. • Enable students to quantitatively estimate biomolecules such as DNA, RNA, and proteins using classical and spectrophotometric techniques. • Develop technical competence in DNA amplification using conventional PCR and analysis through agarose gel electrophoresis. • Familiarize students with experimental design, data interpretation, and troubleshooting of molecular biology experiments. • Promote adherence to good laboratory practices (GLP), biosafety norms, and ethical standards in molecular biology research. • Prepare students for advanced molecular biology applications in diagnostics, research, and biotechnology industries.
Course Outcomes	• Isolate and purify high-quality genomic DNA and total RNA from biological samples and assess their integrity and purity. • Quantitatively estimate DNA, RNA, and protein concentrations using colorimetric and spectrophotometric methods. • Perform conventional PCR amplification and analyze amplified products using agarose gel electrophoresis. • Interpret experimental data, evaluate results, and troubleshoot common laboratory issues in molecular biology experiments. • Follow ethical guidelines, biosafety regulations, and good laboratory practices during molecular experimentation. • Communicate experimental findings effectively through proper documentation, calculations, and scientific reporting.

Sr. No.	Topics	No. of Hrs.
1	Isolation and Purification of Genomic DNA from Biological Samples	05
2	Isolation and Quality Assessment of Total RNA from Biological Samples	05
3	Quantitative Estimation of DNA Using the Diphenylamine Colorimetric Method	05
4	Quantitative Estimation of RNA Using the Orcinol Colorimetric Method	05
5	Spectrophotometric Quantification of Total Proteins	05
6	Amplification of Target DNA by Conventional Polymerase Chain Reaction (PCR) and Analysis by Agarose Gel Electrophoresis	05
Total		30 hrs

*Note: Any five practical's of above are mandatory for the course.

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester II
Name of the Subject	Analytical Biotechnology
Subject Code	MMBT 110 (B) P

Course Objective	After completing this course, students will be able to: • Provide hands-on training in the isolation, purification, and quality assessment of nucleic acids from biological samples. • Enable students to quantitatively estimate biomolecules such as DNA, RNA, and proteins using classical and spectrophotometric techniques. • Develop technical competence in DNA amplification using conventional PCR and analysis through agarose gel electrophoresis. • Familiarize students with experimental design, data interpretation, and troubleshooting of molecular biology experiments. • Promote adherence to good laboratory practices (GLP), biosafety norms, and ethical standards in molecular biology research. • Prepare students for advanced molecular biology applications in diagnostics, research, and biotechnology industries.
Course Outcomes	• Perform chromatographic techniques to separate and identify biomolecules from complex mixtures. • Quantitatively analyze biomolecules using spectrophotometric methods and calibration curves. • Separate and analyze nucleic acids and proteins using electrophoretic techniques such as AGE and SDS-PAGE. • Detect and analyze specific proteins using immunoblotting (Western blotting) techniques. • Interpret analytical data, troubleshoot experimental errors, and ensure reproducibility of results. • Demonstrate ethical responsibility, GLP compliance, and effective documentation and communication of analytical findings.

Sr. No.	Topics	No. of Hrs.
1	Separation and Identification of Biomolecules Using Paper Chromatography.	5
2	Fractionation and Analysis of Biomolecules by Column Chromatography.	5
3	Spectrophotometric Analysis: Preparation of a Calibration Curve Using Gradient Standards and Quantitative Estimation of an Unknown Sample.	5
4	Separation and Analysis of Nucleic Acids by Agarose Gel Electrophoresis (AGE).	5
5	Separation of Proteins by Sodium Dodecyl Sulfate–Polyacrylamide Gel Electrophoresis (SDS-PAGE).	5
6	Practical based on western blotting.	5
Total		30 hrs

*Note: Any five practical's of above are mandatory for the course.

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester II
Name of the Subject	Genetic Engineering
Subject Code	MMBT 111 (A) P

Course Objective	After completing this course, students will be able to: • Provide hands-on training in core genetic engineering techniques including plasmid isolation, restriction digestion, ligation, and bacterial transformation. • Enable students to understand and apply principles of recombinant DNA technology and horizontal gene transfer mechanisms. • Develop proficiency in molecular techniques for genetic polymorphism analysis and quantitative gene expression studies. • Strengthen experimental design, data acquisition, analysis, and interpretation skills relevant to genetic engineering research. • Instill awareness of biosafety, bioethics, regulatory guidelines, and good laboratory practices in genetic manipulation experiments. • Prepare students for advanced applications of genetic engineering in biomedical research, diagnostics, and biotechnology industries.
Course Outcomes	• Isolate and purify plasmid DNA from bacterial cells and evaluate its quality for downstream genetic engineering applications. • Perform restriction digestion and ligation of DNA fragments to construct recombinant DNA molecules. • Introduce recombinant DNA into bacterial cells and assess transformation efficiency. • Analyze genetic variation and polymorphism using the RFLP technique. • Quantitatively evaluate gene expression using real-time PCR and interpret amplification data. • Demonstrate ethical conduct, biosafety compliance, effective documentation, and scientific communication in genetic engineering experiments.

Sr. No.	Topics	No. of Hrs.
1	Isolation and Purification of Plasmid DNA from Bacterial Cells.	5
2	Restriction Endonuclease Digestion and Ligation of DNA Fragments.	5
3	Introduction of Recombinant DNA into Bacterial Cells by Transformation.	5
4	Analysis of Genetic Polymorphism Using Restriction Fragment Length Polymorphism (RFLP) Technique.	5
5	Study of Horizontal Gene Transfer in Bacteria by Conjugation.	5
6	Quantitative Analysis of Gene Expression Using Real-Time Polymerase Chain Reaction (qPCR).	5
Total		30 hrs

*Note: Any five practical's of above are mandatory for the course.

Name of the Program	M.Sc. Medical Biotechnology
Semester	Semester II
Name of the Subject	Bioinformatics
Subject Code	MMBT 111 (B) P

Course Objective	After completing this course, students will be able to: • Provide hands-on training in the use of biological databases and computational tools for sequence retrieval and comparative analysis. • Enable students to perform evolutionary, structural, and functional analyses of biological macromolecules using bioinformatics approaches. • Develop proficiency in in silico techniques such as homology modeling, molecular docking, and pathway analysis relevant to biomedical research. • Strengthen analytical thinking, data interpretation, and statistical visualization skills for large-scale biological datasets. • Promote ethical data usage, reproducibility, and responsible conduct in computational biology research. • Prepare students to apply bioinformatics tools in diagnostics, drug discovery, systems biology, and biomedical innovation.
Course Outcomes	• Retrieve, curate, and perform comparative analysis of biological sequences using public databases and similarity search tools. • Perform multiple sequence alignment and construct phylogenetic trees to infer evolutionary relationships. • Generate and evaluate three-dimensional protein structures using homology modeling techniques. • Conduct molecular docking studies and analyze protein–ligand interactions for functional and therapeutic insights. • Visualize, statistically analyze, and interpret biological data using appropriate graphical and computational methods. • Reconstruct and functionally interpret metabolic pathways to understand biological systems and disease mechanisms

Sr. No.	Topics	No. of Hrs.
1	Retrieval and Comparative Analysis of Biological Sequences Using Public Databases and Similarity Search Tools	5
2	Multiple Sequence Alignment and Phylogenetic Tree Construction for Evolutionary Analysis	5
3	Homology Modeling and Structural Evaluation of Proteins Using Comparative Modeling Approaches	5
4	Molecular Docking and Analysis of Protein–Ligand Interactions Using Computational Tools	5
5	Visualization and Statistical Representation of Biological Data Using Graphical Methods	5
6	Reconstruction and Functional Interpretation of Metabolic Pathways Using Bioinformatics Resources	5
Total		30 hrs

*Note: Any five practical's of above are mandatory for the course.

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.
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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 & Intellectual Property, Scaling and Growth Strategies, sustainability & 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, 17J, 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)	Practic al (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: <i>Streptococcus</i> , <i>Staphylococcus</i> , <i>E. coli</i> , <i>Salmonella</i> , <i>Mycobacterium</i> , <i>Plasmodium</i> , <i>Candida</i> , <i>Herpesvirus</i> , 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.)

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, HIPAA, 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, and communication skills, preparing students for careers in biotechnology research, clinical diagnostics, pharmaceuticals, and allied industries. The students have 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

**MGM SCHOOL OF BIOMEDICAL SCIENCES, NAVI MUMBAI****(A constituent unit of MGM INSTITUTE OF HEALTH SCIENCES)****Department of Medical Biotechnology**

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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

Dept. of Medical Biotechnology

MGMSBS, MGMIHS

Director

MGMSBS

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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27432890

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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