

PROGRAM OUTCOME	
Course Code	M.Sc. MEDICAL BIOTECHNOLOGY
PO1	Apply Biotechnological Knowledge in Medical Sciences: Utilize molecular, cellular, and computational techniques in medical biotechnology for disease diagnosis, treatment, and research.
PO2	Conduct Independent and Collaborative Research: Design and execute experiments, analyze data, and contribute to scientific advancements in medical biotechnology.
PO3	Utilize Advanced Molecular and Analytical Techniques: Demonstrate proficiency in PCR, flow cytometry, sequencing technologies, protein analysis, and bioinformatics tools.
PO4	Solve Complex Biological Problems: Address medical challenges through biotechnological approaches such as genome editing, stem cell therapy, and personalized medicine.
PO5	Demonstrate Ethical and Professional Responsibility: Adhere to bioethical principles, regulatory guidelines, and good laboratory practices in research and industry.
PO6	Communicate Effectively in Scientific and Industrial Settings: Present research findings, write scientific papers, and engage in effective interdisciplinary communication.
PO7	Adapt to Emerging Trends in Biotechnology: Stay updated with advancements in precision medicine, nanobiotechnology, synthetic biology, and artificial intelligence in healthcare.
PO8	Contribute to Public Health and Biomedical Innovation: Develop cost-effective, innovative solutions for disease prevention, diagnostics, and therapeutics for societal impact
COURSE OUTCOMES (COs)	
Course Code	M.Sc. MEDICAL BIOTECHNOLOGY
SEMESTER I	
MMBT 101 T	Cell Biology
CO1	Differentiate between prokaryotic and eukaryotic cells based on structural and functional aspects.
CO2	Describe the organization and roles of cellular organelles and the cytoskeleton in maintaining cell integrity and function.
CO3	Explain mammalian cell types, their differentiation pathways, and their significance in tissue architecture.
CO4	Analyze various cell-cell interactions, junctions, and extracellular matrix components in maintaining cellular communication.
CO5	Illustrate mechanisms of membrane transport, vesicular trafficking, and the impact of cellular signaling pathways in physiological processes.
CO6	Evaluate the regulation of the cell cycle, mechanisms of cell death, and their roles in embryogenesis, development, and disease pathology.
CO7	Apply knowledge of cellular biology to understand stem cell biology, regenerative medicine, and cancer biology.
MMBT 102 T	Immunology
CO1	Describe the key components and mechanisms of innate and adaptive immunity.
CO2	Differentiate immune system organs and cell types, explaining their roles in immune responses.
CO3	Explain antigen-antibody interactions, major histocompatibility complex (MHC) molecules, and antigen presentation mechanisms.
CO4	Analyze immune signaling pathways, the complement system, and cytokine-mediated regulation of immune responses.

CO5	Evaluate immunological disorders such as autoimmunity, hypersensitivity, and immunodeficiency diseases.
CO6	Apply immunological principles in clinical diagnostics, transplant immunology, tumor immunology, and infectious disease management.
CO7	Discuss vaccine development strategies, monoclonal antibody production, CAR-T cell therapy, and immunotherapeutic advancements.
CO8	Demonstrate knowledge of immunogenetics and antibody engineering for therapeutic and research applications.
MMBT 103 T	Biomolecules
CO1	Describe the structure and function of carbohydrates, proteins, lipids, and nucleic acids.
CO2	Explain the concepts of pH, buffers, and their physiological relevance in biological systems.
CO3	Analyze enzyme kinetics, inhibition mechanisms, and regulatory pathways in metabolic reactions.
CO4	Illustrate energy production through bioenergetics, the electron transport chain, and oxidative phosphorylation.
CO5	Compare key metabolic pathways, including glycolysis, gluconeogenesis, lipid metabolism, and amino acid catabolism.
CO6	Evaluate the biochemical basis of metabolic disorders such as diabetes, obesity, and dyslipidemia.
CO7	Interpret liver and kidney function tests, their clinical significance, and hormonal regulation disorders.
CO8	Apply biochemical principles to understand disease markers in cancer, cardiovascular diseases, and oxidative stress-related disorders.

CC 001 T	Research Methodology & Biostatistics (Core Course)
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.
MMBT 104 P	Practical Lab I – (MMBT 101 & MMBT 102)
CO1	Operate a microscope efficiently and analyze different cell types and structures along with viability and counting.
CO2	Conduct blood group typing using haemagglutination tests.
CO3	Understand and demonstrate the principles of immunodiagnostic tests such as VDRL/Widal (demonstration-based).
CO4	Analyze the histological organization of lymphoid organs.
CO5	Perform antigen-antibody interaction studies using ELISA.
CO6	Interpret Western blotting results for protein analysis (demonstration-based).
CO7	Apply immunological techniques for disease diagnosis using commercial kits
CO8	Correlate theoretical knowledge with practical applications in immunology and cellular biology.
MMBT 105 CP	MBT Directed Clinical Education-I
CO1	Demonstrate proficiency in diagnostic and therapeutic techniques used in hospital laboratories.
CO2	Effectively communicate and collaborate with healthcare professionals and patients.
CO3	Apply QA and QC protocols in a regulated laboratory environment.
CO4	Analyze and troubleshoot clinical and diagnostic challenges using biotechnological approaches.
CO5	Understand and adhere to hospital regulatory standards and accreditation requirements (NABH/NABL).
CO6	Develop decision-making skills for effective healthcare management and administration.
CO7	Gain practical insights into biotechnology-based clinical applications and patient care.
CO8	Prepare for professional roles in clinical research, diagnostics, and hospital-based biotechnology settings.
SEMESTER II	
MMBT 106 T	Molecular Biology
CO1	Explain the central dogma of molecular biology and its significance in gene expression.
CO2	Describe the structure and function of DNA and RNA, including their types, modifications, and regulatory elements.
CO3	Compare prokaryotic and eukaryotic DNA replication mechanisms, including DNA damage and repair processes.
CO4	Illustrate transcription and translation mechanisms, their regulation, and RNA processing events such as splicing and RNA interference.
CO5	Analyze operon models (lac, trp, and ara operons) and their regulation mechanisms in prokaryotes.
CO6	Discuss epigenetic modifications, chromatin remodeling, and the role of non-coding RNAs in gene expression regulation.
CO7	Evaluate the impact of post-translational modifications (phosphorylation, glycosylation, ubiquitination) on protein function.

CO8	Apply molecular biology concepts to understand genetic regulation, gene expression control, and its implications in disease and biotechnology.
MMBT 107 T	Analytical Biotechnology
CO1	Explain the significance of analytical techniques in biotechnology and biomedical research.
CO2	Describe the principles and applications of various spectroscopic techniques (UV-Vis, fluorescence, IR, Raman, NMR, MS) in biomolecular analysis.
CO3	Demonstrate proficiency in chromatography and electrophoresis techniques for separation and purification of biomolecules.
CO4	Apply immunoassays (ELISA, RIA) and biosensors for disease diagnostics and biomarker detection.
CO5	Utilize advanced analytical tools such as flow cytometry, microarrays, PCR, and NGS for genetic and proteomic analysis.
CO6	Analyze data obtained from analytical techniques and interpret results for biomedical and biotechnological applications.
CO7	Evaluate the role of analytical methodologies in pharmaceutical biotechnology, clinical diagnostics, and therapeutic development.

MMBT 108 T	Genetic Engineering
CO1	Explain the history, principles, and applications of genetic engineering.
CO2	Demonstrate proficiency in DNA and RNA extraction, PCR techniques, and molecular cloning strategies.
CO3	Analyze the role of restriction enzymes, ligases, and vectors in gene cloning and expression.
CO4	Apply genome editing tools like CRISPR-Cas, RNA interference, and gene silencing for genetic modifications.
CO5	Evaluate the applications of gene therapy in the treatment of inherited and acquired diseases.
CO6	Assess the role of recombinant DNA technology in vaccine development and regenerative medicine.
CO7	Discuss biosafety concerns, ethical issues, and regulatory frameworks in genetic engineering research.
MMBT 109 T	Bioinformatics
CO1	Explain the principles and applications of bioinformatics in medical and biological research.
CO2	Navigate major biological databases such as GenBank, UniProt, PDB, and KEGG for data retrieval and analysis.
CO3	Perform sequence alignment using tools like BLAST and understand primer design strategies.
CO4	Analyze protein structures using homology modeling, ab initio methods, and structure visualization tools.
CO5	Apply network pharmacology concepts to study multi-target drugs and systems biology approaches.
CO6	Demonstrate the fundamentals of molecular docking and drug-target interaction analysis.
CO7	Utilize molecular dynamics simulation and QSAR modeling in drug discovery and optimization
MMBT 110 P	Practical Lab II (MMBT 106 & MMBT 107)
CO1	Perform centrifugation for biomolecule separation and Extract DNA and RNA from biological samples with high purity.
CO2	Analyze nucleic acids and proteins using UV-Visible spectroscopy.
CO3	Conduct Agarose gel electrophoresis for DNA visualization and integrity assessment.
CO4	Execute PCR and real-time PCR (qPCR) for molecular diagnostics and gene amplification.
CO5	Separate and analyze proteins using SDS-PAGE and Western blotting.
CO6	Apply HPLC techniques for the purification and separation of biomolecules.
CO7	Document and interpret results using gel documentation systems. Understand and apply analytical techniques in clinical and research settings.
CO8	Develop problem-solving skills for biomolecular analysis in medical biotechnology.
MMBT 111 P	Practical Lab III (MMBT 108 & MMBT109)
CO1	Isolate plasmid DNA from bacteria and perform restriction digestion and ligation for genetic manipulation.
CO2	Conduct bacterial transformation and confirm the presence of recombinant DNA.
CO3	Perform RFLP analysis for genetic variation studies.

CO4	Demonstrate bacterial conjugation and understand horizontal gene transfer.
CO5	Retrieve and analyze nucleotide and protein sequences using NCBI and BLAST and Perform multiple sequence alignment and construct phylogenetic trees for evolutionary studies.
CO6	Utilize molecular docking tools to analyze protein-ligand interactions in drug discovery.
CO7	Apply homology modeling techniques to predict protein structures using Swiss-Model.
CO8	Integrate genetic engineering and bioinformatics approaches for biomedical and biotechnological research applications.

MBT 112 CP	MBT Directed Clinical Education-II
CO1	Demonstrate proficiency in diagnostic and therapeutic techniques used in hospital laboratories.
CO2	Effectively communicate and collaborate with healthcare professionals and patients.
CO3	Apply QA and QC protocols in a regulated laboratory environment.
CO4	Analyze and troubleshoot clinical and diagnostic challenges using biotechnological approaches.
CO5	Understand and adhere to hospital regulatory standards and accreditation requirements (NABH/NABL).
CO6	Develop decision-making skills for effective healthcare management and administration.
CO7	Gain practical insights into biotechnology-based clinical applications and patient care.
CO8	Prepare for professional roles in clinical research, diagnostics, and hospital-based biotechnology settings.
SKILL ENHANCEMENT COURSES	
SEC 001 T	Innovation and Entrepreneurship
CO1	Students will grasp the concepts of innovation, its ecosystem, and the role of various stakeholders such as government policies, startups, and innovation hubs.
CO2	Cultivating an entrepreneurial mindset and leadership qualities necessary for driving innovation and leading ventures
CO3	Understanding the intersection of technology and innovation and leveraging emerging technologies for entrepreneurial ventures.
SEC 002 T	Comprehensive Molecular Diagnostics and Advanced Gene Expression Analysis (NPTEL)
CO1	Explain the principles of molecular diagnostics and its role in modern healthcare.
CO2	Describe the significance of biomarkers in disease detection and prognosis.
CO3	Demonstrate proper methods for sample collection, storage, and processing in a diagnostic lab.
CO4	Perform molecular diagnostic techniques such as PCR, ELISA, and immunohistochemistry.
CO5	Analyze the applications of molecular diagnostics in infectious diseases and cancer.
CO6	Evaluate the role of emerging diagnostic technologies like NGS and CRISPR-based methods.
CO7	Apply biosafety and biomedical waste disposal protocols in a molecular diagnostics lab.



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

(Deemed 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

CO PO Mapping
Programme - M.Sc. Medical Biotechnology
Semester I and II

- PO1 Apply Biotechnological Knowledge in Medical Sciences:** Utilize molecular, cellular, and computational techniques in medical biotechnology for disease diagnosis, treatment, and research.
PO2 Conduct Independent and Collaborative Research: Design and execute experiments, analyze data, and contribute to scientific advancements in medical biotechnology.
PO3 Utilize Advanced Molecular and Analytical Techniques: Demonstrate proficiency in PCR, flow cytometry, sequencing technologies, protein analysis, and bioinformatics tools.
PO4 Solve Complex Biological Problems: Address medical challenges through biotechnological approaches such as genome editing, stem cell therapy, and personalized medicine.
PO5 Demonstrate Ethical and Professional Responsibility: Adhere to bioethical principles, regulatory guidelines, and good laboratory practices in research and industry.
PO6 Communicate Effectively in Scientific and Industrial Settings: Present research findings, write scientific papers, and engage in effective interdisciplinary communication.
PO7 Adapt to Emerging Trends in Biotechnology: Stay updated with advancements in precision medicine, nanobiotechnology, synthetic biology, and artificial intelligence in healthcare.
PO8 Contribute to Public Health and Biomedical Innovation: Develop cost-effective, innovative solutions for disease prevention, diagnostics, and therapeutics for societal impact

PO Mapping same with correlation level 3,2,1 The notation of 1 - low, 2 - moderate, 3 - high

Semester	Course / Course Code	Course Outcome	Course Outcome	Apply Biotechnological Knowledge in Medical Sciences	Conduct Independent and Collaborative Research	Utilize Advanced Molecular and Analytical Techniques	Solve Complex Biological Problems	Demonstrate Ethical and Professional Responsibility	Communicate Effectively in Scientific and Industrial Settings	Adapt to Emerging Trends in Biotechnology	Contribute to Public Health and Biomedical Innovation	Average	
				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8		
Semester 1	Cell Biology (MMBT 101 T)	CO1	Differentiate between prokaryotic and eukaryotic cells based on structural and functional aspects.	3	1	1	2	1	1	1	1	1.4	
		CO2	Describe the organization and roles of cellular organelles and the cytoskeleton in maintaining cell integrity and function.	3	1	1	1	1	1	1	1	1.3	
		CO3	Explain mammalian cell types, their differentiation pathways, and their significance in tissue architecture.	3	2	1	2	1	2	1	1	1.6	
		CO4	Analyze various cell-cell interactions, junctions, and extracellular matrix components in maintaining cellular communication.	3	1	1	3	1	2	1	1	1.6	
		CO5	Illustrate mechanisms of membrane transport, vesicular trafficking, and the impact of cellular signaling pathways in physiological processes.	3	1	1	1	1	1	1	1	1.3	
		CO6	Evaluate the regulation of the cell cycle, mechanisms of cell death, and their roles in embryogenesis, development, and disease pathology.	3	2	1	3	1	1	1	2	1.8	
		CO7	Apply knowledge of cellular biology to understand stem cell biology, regenerative medicine, and cancer biology.	3	2	1	3	1	2	2	2	2.0	
		Average			3	1.43	1	2.14	1	1.43	1.14	1.29	1.6
	Immunology (MMBT 102 T)	CO1	Describe the key components and mechanisms of innate and adaptive immunity.	3	1	1	2	1	2	1	1	1	1.5
		CO2	Differentiate immune system organs and cell types, explaining their roles in immune responses.	3	1	2	1	1	2	2	2	2	1.8
		CO3	Explain antigen-antibody interactions, major histocompatibility complex (MHC) molecules, and antigen presentation mechanisms.	3	2	2	1	1	2	1	1	1	1.6
		CO4	Analyze immune signaling pathways, the complement system, and cytokine-mediated regulation of immune responses.	3	1	1	3	1	1	1	1	1	1.5
		CO5	Evaluate immunological disorders such as autoimmunity, hypersensitivity, and immunodeficiency diseases.	3	1	1	3	2	1	2	2	2	1.9
		CO6	Apply immunological principles in clinical diagnostics, transplant immunology, tumor immunology, and infectious disease management.	3	2	3	1	2	2	2	3	3	2.3
CO7		Discuss vaccine development strategies, monoclonal antibody production, CAR-T cell therapy, and immunotherapeutic advancements.	3	2	1	2	1	1	3	3	3	2.0	

	C03	Compare prokaryotic and eukaryotic DNA replication mechanisms, including DNA damage and repair processes.	3	1	2	1	1	2	1	1	1.5
	C04	Illustrate transcription and translation mechanisms, their regulation, and RNA processing events such as splicing and RNA interference.	3	1	2	1	1	1	1	2	1.5
	C05	Analyze operon models (lac, trp, and ara operons) and their regulation mechanisms in prokaryotes.	3	1	1	2	1	1	1	1	1.4
	C06	Discuss epigenetic modifications, chromatin remodeling, and the role of non-coding RNAs in gene expression regulation.	3	1	1	2	1	1	2	2	1.6
	C07	Evaluate the impact of post-translational modifications (phosphorylation, glycosylation, ubiquitination) on protein function.	3	1	2	1	1	1	1	2	1.5
	C08	Apply molecular biology concepts to understand genetic regulation, gene expression control, and its implications in disease and biotechnology.	3	1	1	3	1	1	1	3	1.8
		Average	3	1	1.38	1.5	1	1.25	1.13	1.75	1.5
Analytical Biotechnology (MMBT 107 T)	C01	Explain the significance of analytical techniques in biotechnology and biomedical research.	3	2	3	1	1	2	2	2	2.0
	C02	Describe the principles and applications of various spectroscopic techniques (UV-Vis, fluorescence, IR, Raman, NMR, MS) in biomolecular analysis.	3	2	3	1	2	1	1	2	1.9
	C03	Demonstrate proficiency in chromatography and electrophoresis techniques for separation and purification of biomolecules.	3	1	3	1	1	1	1	1	1.5
	C04	Apply immunoassays (ELISA, RIA) and biosensors for disease diagnostics and biomarker detection.	3	1	3	1	1	1	2	2	1.8
	C05	Utilize advanced analytical tools such as flow cytometry, microarrays, PCR, and NGS for genetic and proteomic analysis.	3	1	3	1	1	1	2	1	1.6
	C06	Analyze data obtained from analytical techniques and interpret results for biomedical and biotechnological applications.	3	3	1	1	1	2	1	1	1.6
	C07	Evaluate the role of analytical methodologies in pharmaceutical biotechnology, clinical diagnostics, and therapeutic development.	3	1	1	1	1	1	1	3	1.5
		Average	3	1.57	2.43	1	1.14	1.29	1.43	1.71	1.7
Genetic Engineering (MMBT 108 T)	C01	Explain the history, principles, and applications of genetic engineering.	3	1	1	1	1	1	1	2	1.4
	C02	Demonstrate proficiency in DNA and RNA extraction, PCR techniques, and molecular cloning strategies.	3	1	3	1	1	1	1	1	1.5
	C03	Analyze the role of restriction enzymes, ligases, and vectors in gene cloning and expression.	3	2	3	1	1	1	1	1	1.6
	C04	Apply genome editing tools like CRISPR-Cas, RNA interference, and gene silencing for genetic modifications.	3	2	3	2	2	2	3	1	2.3
	C05	Evaluate the applications of gene therapy in the treatment of inherited and acquired diseases.	3	1	1	1	1	1	1	3	1.5
	C06	Assess the role of recombinant DNA technology in vaccine development and regenerative medicine.	3	1	1	1	1	2	1	3	1.6
	C07	Discuss biosafety concerns, ethical issues, and regulatory frameworks in genetic engineering research.	3	2	1	2	3	2	1	2	2.0
		Average	3	1.43	1.86	1.29	1.43	1.43	1.29	1.86	1.7
Bioinformatics (MMBT 109 T)	C01	Explain the principles and applications of bioinformatics in medical and biological research.	3	1	3	1	1	1	2	1	1.6
	C02	Navigate major biological databases such as GenBank, UniProt, PDB, and KEGG for data retrieval and analysis.	3	1	3	1	1	1	1	1	1.5
	C03	Perform sequence alignment using tools like BLAST and understand primer design strategies.	3	1	3	1	1	1	1	1	1.5
	C04	Analyze protein structures using homology modeling, ab initio methods, and structure visualization tools.	3	1	3	2	1	1	1	1	1.6
	C05	Apply network pharmacology concepts to study multi-target drugs and systems biology approaches.	3	1	1	3	1	1	2	1	1.6
	C06	Demonstrate the fundamentals of molecular docking and drug-target interaction analysis.	3	1	3	2	1	1	1	1	1.6
	C07	Utilize molecular dynamics simulation and QSAR modeling in drug discovery and optimization.	3	1	1	1	1	1	1	3	1.5
		Average	3	1	2.43	1.57	1	1	1.29	1.29	1.6
Practical Lab II (MMBT 106 & MMBT 107)	C01	Perform centrifugation for biomolecule separation and Extract DNA and RNA from biological samples with high purity.	3	3	2	2	1	2	1	2	2.0

(NPTEL) (SEC 002 T)	CO3	Demonstrate proper methods for sample collection, storage, and processing in a diagnostic lab.	3	1	3	1	2	1	1	1	1.6
	CO4	Perform molecular diagnostic techniques such as PCR, ELISA, and immunohistochemistry.	3	1	3	1	1	1	1	1	1.5
	CO5	Analyze the applications of molecular diagnostics in infectious diseases and cancer.	3	1	1	1	1	1	1	3	1.5
	CO6	Evaluate the role of emerging diagnostic technologies like NGS and CRISPR-based methods.	3	1	1	1	1	1	3	1	1.5
	CO7	Apply biosafety and biomedical waste disposal protocols in a molecular diagnostics lab.	3	1	1	1	3	1	1	1	1.5
	Average		3	1	1.71	1	1.43	1	1.29	1.57	1.5

PROGRAM OUTCOME	
Course Code	M.Sc. MEDICAL BIOTECHNOLOGY
PO1	Apply Biotechnological Knowledge in Medical Sciences: Utilize molecular, cellular, and computational techniques in medical biotechnology for disease diagnosis, treatment, and research.
PO2	Conduct Independent and Collaborative Research: Design and execute experiments, analyze data, and contribute to scientific advancements in medical biotechnology.
PO3	Utilize Advanced Molecular and Analytical Techniques: Demonstrate proficiency in PCR, flow cytometry, sequencing technologies, protein analysis, and bioinformatics tools.
PO4	Solve Complex Biological Problems: Address medical challenges through biotechnological approaches such as genome editing, stem cell therapy, and personalized medicine.
PO5	Demonstrate Ethical and Professional Responsibility: Adhere to bioethical principles, regulatory guidelines, and good laboratory practices in research and industry.
PO6	Communicate Effectively in Scientific and Industrial Settings: Present research findings, write scientific papers, and engage in effective interdisciplinary communication.
PO7	Adapt to Emerging Trends in Biotechnology: Stay updated with advancements in precision medicine, nanobiotechnology, synthetic biology, and artificial intelligence in healthcare.
PO8	Contribute to Public Health and Biomedical Innovation: Develop cost-effective, innovative solutions for disease prevention, diagnostics, and therapeutics for societal impact
COURSE OUTCOMES (COs)	
Course Code	M.Sc. MEDICAL BIOTECHNOLOGY
SEMESTER III	
MMBT 113 T	Genetics and Genomics
CO1	Interpret molecular mechanisms underlying inherited and acquired genetic diseases.
CO2	Apply chromosomal, molecular, and cytogenetic techniques for diagnosis.
CO3	Critically analyse the impact of next-generation sequencing (NGS) and genomics on clinical diagnostics.
CO4	Demonstrate the ability to conduct risk assessment and genetic counselling.
CO5	Examine ethical considerations in the use of genetic information and technologies.
MMBT 114 T	Principles and Applications of Tissue Culture
CO1	Describe the principles and techniques of tissue culture in both plant and animal systems.
CO2	Apply aseptic techniques for establishing and maintaining tissue cultures.
CO3	Demonstrate the use of plant and animal tissue culture in disease modelling, genetic engineering, drug screening, and regenerative medicine.
CO4	Analyse real-world case studies on therapeutic, pharmaceutical, and research applications.
CO5	Understand biosafety, contamination control, and quality assurance protocols
MMBT 115 T	Medical Microbiology
CO1	Classify medically important microbes and understand their structural and functional characteristics
CO2	Explain mechanisms of microbial pathogenicity and host-pathogen interactions
CO3	Apply diagnostic methods for detection of infectious agents
CO4	Understand antimicrobial resistance mechanisms and control measures
CO5	Perform microbiological techniques with aseptic skills in a laboratory setting
MMBT 116 T	Clinical Trials and Data Management
CO1	Explain the process and regulatory framework of clinical trials.
CO2	Design clinical trial protocols and analyse trial phases.
CO3	Apply principles of data management, CRFs, and electronic data capture systems.
CO4	Demonstrate understanding of quality control, audits, and GCP compliance.
CO5	Recognize ethical issues, adverse events, and safety reporting in human research.
MMBT 117	Research Project / Dissertation
CO1	Formulate a research problem by reviewing scientific literature and identifying knowledge gaps in medical biotechnology.
CO2	Design and execute experiments using appropriate methodologies, tools, and techniques relevant to biomedical research.
CO3	Demonstrate proficiency in handling advanced molecular biology, biochemistry, microbiology, and bioinformatics methods as required for their research project.
CO4	Critically analyse and interpret experimental data using appropriate statistical and computational tools.
CO5	Adhere to ethical standards in biomedical research, including biosafety, data integrity, and responsible reporting.
CO6	Communicate research findings effectively through well-structured dissertation writing, presentations, and potential publications.
CO7	Work independently and collaboratively to solve research challenges and manage time efficiently during the project.

CO8	Develop a research-oriented mind-set that prepares them for higher studies, industrial R&D, or academic research careers.
MMBT 118 P	Genetics and Genomics
CO1	Perform peripheral blood lymphocyte culture and prepare high-quality metaphase chromosome spreads for cytogenetic examination.
CO2	Construct and analyze human karyotypes, differentiating between normal and abnormal chromosomal complements.
CO3	Identify chromosomal abnormalities such as Down's and Turner's syndromes using karyogram interpretation and correlate findings with genetic disorders.
CO4	Carry out restriction digestion and RFLP analysis, demonstrating understanding of DNA polymorphism detection and its relevance to genetic mapping and diagnosis.
CO5	Prepare and interpret buccal smears for sex chromatin and construct pedigree charts to determine inheritance patterns of genetic traits.
CO6	Apply Hardy-Weinberg equilibrium principles to estimate gene and genotype frequencies and assess population-level genetic variations
MMBT 119 P	Principles and Applications of Tissue Culture
CO1	Prepare and sterilize plant and animal tissue culture media following standard aseptic techniques to ensure successful culture establishment.
CO2	Perform surface sterilization of explants and maintain contamination-free conditions during culture initiation and growth.
CO3	Induce and maintain callus cultures, perform organ culture, and carry out anther culture to obtain haploid plants using appropriate plant growth regulators.
CO4	Isolate, culture, and maintain lymphocyte cells, demonstrating proficiency in basic animal cell culture techniques.
CO5	Perform cell counting and viability assays to assess culture health and optimize growth conditions.
CO6	Carry out trypsinization and subculturing of adherent monolayer cells, maintaining viability and genetic stability across passages for research applications.
MMBT 120 P	Medical Microbiology
CO1	Perform differential staining techniques such as Gram staining and acid-fast staining for bacterial identification.
CO2	Isolate microorganisms using streak plate, pour plate, and spread plate methods.
CO3	Culture and maintain bacterial and fungal isolates from clinical and environmental samples.
CO4	Conduct antibiotic sensitivity testing by Kirby-Bauer method and interpret resistance/susceptibility profiles.
CO5	Identify bacteria using standard biochemical tests.
CO6	Demonstrate the principles of serological tests including the Widal test (demo).
CO7	Perform haemagglutination test and analyze results for diagnostic relevance.
SEMESTER IV	
MMBT 121 T	Bioethics, IPR and Biosafety
CO1	Evaluate ethical concerns in biomedical and biotechnological practices.
CO2	Understand different types of IPR and their applications.
CO3	Apply various national and international guidelines in biomedical and health research.
MMBT 117	Research Project / Dissertation
CO1	Formulate a research problem by reviewing scientific literature and identifying knowledge gaps in medical biotechnology.
CO2	Design and execute experiments using appropriate methodologies, tools, and techniques relevant to biomedical research.
CO3	Demonstrate proficiency in handling advanced molecular biology, biochemistry, microbiology, and bioinformatics methods as required for their research project.
CO4	Critically analyse and interpret experimental data using appropriate statistical and computational tools.
CO5	Adhere to ethical standards in biomedical research, including biosafety, data integrity, and responsible reporting.
CO6	Communicate research findings effectively through well-structured dissertation writing, presentations, and potential publications.
CO7	Work independently and collaboratively to solve research challenges and manage time efficiently during the project.
CO8	Develop a research-oriented mind-set that prepares them for higher studies, industrial R&D, or academic research careers.

MMBT 122 P	Internship/Training (Clinical/ Industrial)
CO1	Demonstrate an understanding of industrial processes, laboratory practices, and biotechnological applications in real-life settings.
CO2	Apply theoretical knowledge gained during coursework to practical situations in industry/clinical/research environments.
CO3	Operate and gain familiarity with standard instruments, diagnostic tools, and workflows followed in biotechnology-related organizations.
CO4	Analyse and document technical data, reports, and observations from industrial exposure.
CO5	Exhibit improved professional skills including communication, teamwork, adaptability, and workplace ethics.
CO6	Critically evaluate the role of medical biotechnology in healthcare, diagnostics, pharmaceuticals, and research.
CO7	Identify potential career pathways and entrepreneurial opportunities in the biotechnology sector
CO8	Integrate biosafety, regulatory, and quality assurance practices into professional conduct.



MGM SCHOOL OF BIOMEDICAL SCIENCES, NAVI MUMBAI
(A constituent unit of MGM INSTITUTE OF HEALTH SCIENCES)
 (Deemed 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

CO PO Mapping
Program - M.Sc. Medical Biotechnology
Semester III and IV

- PO1** **Apply Biotechnological Knowledge in Medical Sciences:** Utilize molecular, cellular, and computational techniques in medical biotechnology for disease diagnosis, treatment, and research.
- PO2** **Conduct Independent and Collaborative Research:** Design and execute experiments, analyze data, and contribute to scientific advancements in medical biotechnology.
- PO3** **Utilize Advanced Molecular and Analytical Techniques:** Demonstrate proficiency in PCR, flow cytometry, sequencing technologies, protein analysis, and bioinformatics tools.
- PO4** **Solve Complex Biological Problems:** Address medical challenges through biotechnological approaches such as genome editing, stem cell therapy, and personalized medicine.
- PO5** **Demonstrate Ethical and Professional Responsibility:** Adhere to bioethical principles, regulatory guidelines, and good laboratory practices in research and industry.
- PO6** **Communicate Effectively in Scientific and Industrial Settings:** Present research findings, write scientific papers, and engage in effective interdisciplinary communication.
- PO7** **Adapt to Emerging Trends in Biotechnology:** Stay updated with advancements in precision medicine, nanobiotechnology, synthetic biology, and artificial intelligence in healthcare.
- PO8** **Contribute to Public Health and Biomedical Innovation:** Develop cost-effective, innovative solutions for disease prevention, diagnostics, and therapeutics for societal impact.

PO Mapping same with correlation level 3,2,1 The notation of 1 - low, 2 - moderate , 3 - high

Semester	Course / Course Code	Course Outcome	Course Outcome	Apply Biotechnological Knowledge in Medical Sciences	Conduct Independent and Collaborative Research	Utilize Advanced Molecular and Analytical Techniques	Solve Complex Biological Problems	Demonstrate Ethical and Professional Responsibility	Communicate Effectively in Scientific and Industrial Settings	Adapt to Emerging Trends in Biotechnology	Contribute to Public Health and Biomedical Innovation	Average	
				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8		
Semester III	Genetics and Genomics (MMBT 113 T)	CO1	Interpret molecular mechanisms underlying inherited and acquired genetic diseases.	3	1	3	2	1	2	1	2	1.9	
		CO2	Apply chromosomal, molecular, and cytogenetic techniques for diagnosis.	3	1	3	2	1	2	1	2	1.9	
		CO3	Critically analyse the impact of next-generation sequencing (NGS) and genomics on clinical diagnostics.	3	1	3	2	1	2	3	3	2.3	
		CO4	Demonstrate the ability to conduct risk assessment and genetic counselling.	3	2	1	3	3	3	1	1	2.1	
		CO5	Examine ethical considerations in the use of genetic information and technologies.	3	1	1	1	3	1	1	1	1.5	
		Average		3	1.20	2.2	2.00	1.8	2.00	1.40	1.80	1.9	
	Principles and Applications of Tissue Culture (MMBT 114 T)	CO1	Describe the principles and techniques of tissue culture in both plant and animal systems.	3	3	3	3	3	2	3	3	3	2.9
		CO2	Apply aseptic techniques for establishing and maintaining tissue cultures.	3	3	2	1	3	1	1	1	1	1.9
		CO3	Demonstrate the use of plant and animal tissue culture in disease modelling, genetic engineering, drug screening, and regenerative medicine.	3	3	3	3	3	3	3	3	3	3.0
		CO4	Analyse real-world case studies on therapeutic, pharmaceutical, and research applications.	3	2	1	3	1	1	1	3	1.9	
		CO5	Understand biosafety, contamination control, and quality assurance protocols	2	2	1	3	3	1	1	1	1.8	
	Average		2.8	2.60	2.00	2.6	2.6	1.60	1.8	2.2	2.28		
	Medical Microbiology (MMBT 115 T)	CO1	Classify medically important microbes and understand their structural and functional characteristics	3	2	2	3	1	1	1	1	1	1.8
		CO2	Explain mechanisms of microbial pathogenicity and host-pathogen interactions	3	3	2	3	3	1	1	2	2.3	
		CO3	Apply diagnostic methods for detection of infectious agents	3	3	3	3	3	2	2	3	2.8	
CO4		Understand antimicrobial resistance mechanisms and control measures	3	3	2	2	2	2	3	3	2.5		

	CO5	Perform microbiological techniques with aseptic skills in a laboratory setting	3	1	2	1	3	1	2	2	1.9	
		Average	3	2.4	2.2	2.40	2.4	1.40	1.80	2.20	2.2	
Clinical Trials and Data Management (MMBT 116 T)	CO1	Explain the process and regulatory framework of clinical trials.	3	2	1	2	3	1	2	2	2.0	
	CO2	Design clinical trial protocols and analyse trial phases.	3	3	1	2	3	3	2	3	2.5	
	CO3	Apply principles of data management, CRFs, and electronic data capture systems.	1	2	1	1	2	3	2	2	1.8	
	CO4	Demonstrate understanding of quality control, audits, and GCP compliance.	1	1	1	1	3	1	2	2	1.5	
	CO5	Recognize ethical issues, adverse events, and safety reporting in human research.	1	1	1	2	3	1	1	2	1.5	
			Average	1.8	1.8	1.00	1.60	2.8	1.80	1.80	2.20	1.9
Research Project / Dissertation (MMBT 117)	CO1	Formulate a research problem by reviewing scientific literature and identifying knowledge gaps in medical biotechnology.	3	3	2	3	2	3	2	3	2.6	
	CO2	Design and execute experiments using appropriate methodologies, tools, and techniques relevant to biomedical research.	3	3	3	3	3	3	3	3	3.0	
	CO3	Demonstrate proficiency in handling advanced molecular biology, biochemistry, microbiology, and bioinformatics methods as required for their research project.	3	3	3	3	3	2	3	3	2.9	
	CO4	Critically analyse and interpret experimental data using appropriate statistical and computational tools.	3	3	2	3	3	3	2	3	2.8	
	CO5	Adhere to ethical standards in biomedical research, including biosafety, data integrity, and responsible reporting.	2	2	1	1	3	1	1	2	1.6	
	CO6	Communicate research findings effectively through well-structured dissertation writing, presentations, and potential publications.	2	2	1	2	2	3	2	2	2.0	
	CO7	Work independently and collaboratively to solve research challenges and manage time efficiently during the project.	1	3	3	2	3	3	2	3	2.5	
	CO8	Develop a research-oriented mind-set that prepares them for higher studies, industrial R&D, or academic research careers.	3	3	3	3	3	3	3	3	3.0	
			Average	2.5	2.75	2.25	2.5	2.75	2.625	2.25	2.75	2.5
	Genetics and Genomics (MMBT 118 P)	CO1	Perform peripheral blood lymphocyte culture and prepare high-quality metaphase chromosome spreads for cytogenetic examination.	3	3	3	2	3	2	1	3	2.5
CO2		Construct and analyze human karyotypes, differentiating between normal and abnormal chromosomal complements.	3	3	3	3	2	2	2	3	2.6	
CO3		Identify chromosomal abnormalities such as Down's and Turner's syndromes using karyogram interpretation and correlate findings with genetic disorders.	3	3	3	3	3	2	2	3	2.8	
CO4		Carry out restriction digestion and RFLP analysis, demonstrating understanding of DNA polymorphism detection and its relevance to genetic mapping and diagnosis.	3	3	3	3	3	2	2	3	2.8	

	C03	Demonstrate proficiency in handling advanced molecular biology, biochemistry, microbiology, and bioinformatics methods as required for their research project.	3	3	3	3	3	2	3	3	2.9
	C04	Critically analyse and interpret experimental data using appropriate statistical and computational tools.	3	3	2	3	3	3	2	3	2.8
	C05	Adhere to ethical standards in biomedical research, including biosafety, data integrity, and responsible reporting.	2	2	1	1	3	1	1	2	1.6
	C06	Communicate research findings effectively through well-structured dissertation writing, presentations, and potential publications.	2	2	1	2	2	3	2	2	
	C07	Work independently and collaboratively to solve research challenges and manage time efficiently during the project.	1	3	3	2	3	3	2	3	2.5
	C08	Develop a research-oriented mind-set that prepares them for higher studies, industrial R&D, or academic research careers.	3	3	3	3	3	3	3	3	3.0
		Average	2.5	2.75	2.25	2.5	2.75	2.63	2.25	2.75	2.5
Internship/Training (Clinical/ Industrial) (MMBT 122 P)	C01	Demonstrate an understanding of industrial processes, laboratory practices, and biotechnological applications in real-life settings.	3	3	3	3	3	3	3	3	3.0
	C02	Apply theoretical knowledge gained during coursework to practical situations in industry/clinical/research environments.	3	3	3	3	3	3	3	3	3.0
	C03	Operate and gain familiarity with standard instruments, diagnostic tools, and workflows followed in biotechnology-related organizations.	3	2	3	3	3	3	3	3	2.9
	C04	Analyse and document technical data, reports, and observations from industrial exposure.	3	2	2	2	3	3	2	3	2.5
	C05	Exhibit improved professional skills including communication, teamwork, adaptability, and workplace ethics.	2	2	2	3	2	3	2	3	2.4
	C06	Critically evaluate the role of medical biotechnology in healthcare, diagnostics, pharmaceuticals, and research.	3	3	3	3	3	3	3	3	3.0
	C07	Identify potential career pathways and entrepreneurial opportunities in the biotechnology sector	2	2	2	3	3	3	3	3	2.6
	C08	Integrate biosafety, regulatory, and quality assurance practices into professional conduct.	2	2	2	2	3	3	2	3	2.4
			Average	2.6	2.4	2.5	2.8	2.9	3.0	2.6	3.0