	Annexure-17 of AC-51/2025
PROGRAM OUTCOME (POs)	
Course Code	**M.Sc. MEDICAL GENETICS**
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.
PO 7	**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 GENETICS**
SEMESTER I	
MMGEN 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.
MMGEN 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.

MMGEN 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.
C07	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).
C07	Apply immunological techniques for disease diagnosis using commercial kits
CO8	Correlate theoretical knowledge with practical applications in immunology and cellular biology.
MMBT 105 CP	**MGEN 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.
C07	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	
MMGEN 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.

MMGEN 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.
MMGEN 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.
MMGEN 109 T	**Bionformatics**
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
MMGEN 110 P	**Practical Lab II (MMGEN 106 & MMGEN 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.

MMGEN 111 P	Practical Lab III (MMGEN 108 & MMGEN 109)
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.
CO 8	Integrate genetic engineering and bioinformatics approaches for biomedical and biotechnological research applications.
MMGEN 112 CP	**MGEN 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 Ehancement 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

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CO PO Mapping

Programe - M.Sc. Medical Genetics

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	
	Cell Biology (MMGEN 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 (MMGEN 102 T)	CO1	Describe the key components and mechanisms of innate and adaptive immunity.	3	1	1	2	1	2	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	1.8
		CO3	Explain antigen-antibody interactions, major histocompatibility complex (MHC) molecules, and antigen presentation mechanisms.	3	2	2	1	1	2	1	1	1.6
		CO4	Analyze immune signaling pathways, the complement system, and cytokine-mediated regulation of immune responses.	3	1	1	3	1	1	1	1	1.5
		CO5	Evaluate immunological disorders such as autoimmunity, hypersensitivity, and immunodeficiency diseases.	3	1	1	3	2	1	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	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	2.0
		CO8	Demonstrate knowledge of immunogenetics and antibody engineering for therapeutic and research applications.	3	1	3	1	1	2	2	1	1.8
			Average	3	1.38	1.75	1.75	1.25	1.625	1.75	1.75	1.78
	Biomolecules (MMGEN 103 T)	**CO1**	Describe the structure and function of carbohydrates, proteins, lipids, and nucleic acids.	3	1	1	1	1	1	1	1	1.3
		CO2	Explain the concepts of pH, buffers, and their physiological relevance in biological systems.	3	2	1	2	1	1	1	2	1.6
		CO3	Analyze enzyme kinetics, inhibition mechanisms, and regulatory pathways in metabolic reactions.	3	1	2	1	1	1	1	1	1.4
		CO4	Illustrate energy production through bioenergetics, the electron transport chain, and oxidative phosphorylation.	3	2	2	2	1	1	1	1	1.6
Semester 1		**CO5**	Compare key metabolic pathways, including glycolysis, gluconeogenesis, lipid metabolism, and amino acid catabolism.	3	1	1	2	1	1	1	1	1.4
		CO6	Evaluate the biochemical basis of metabolic disorders such as diabetes, obesity, and dyslipidemia.	3	1	1	3	1	1	1	2	1.6
		C07	Interpret liver and kidney function tests, their clinical significance, and hormonal regulation disorders.	3	1	3	1	1	1	1	2	1.6
		C08	Apply biochemical principles to understand disease markers in cancer, cardiovascular diseases, and oxidative stress-related disorders.	3	1	1	3	1	2	2	3	2.0
			Average	3	1.25	1.5	1.88	1	1.13	1.13	1.63	1.6
	(MMGEN 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.	3	3	2	2	1	2	1	2	2.0
		CO2	**Conduct** blood group typing using haemagglutination tests.	3	3	2	2	1	2	1	2	2.0
		CO3	**Understand and demonstrate** the principles of immunodiagnostic tests such as VDRL/Widal (demonstration-based).	3	3	2	2	1	2	1	2	2.0
		CO4	**Analyze** the histological organization of lymphoid organs.	3	3	2	2	1	2	1	2	2.0

		CO5	**Perform** antigen-antibody interaction studies using ELISA.	3	3	2	2	1	2	1	2	2.0
		CO6	**Interpret** Western blotting results for protein analysis (demonstration-based).	3	3	2	2	1	2	1	2	2.0
		C07	**Apply** immunological techniques for disease diagnosis using commercial kits	3	3	2	2	1	2	1	2	2.0
		C08	**Correlate** theoretical knowledge with practical applications in immunology and cellular biology.	3	3	3	3	1	3	2	3	2.6
			Average	3	3	2.13	2.13	1	2.13	1.13	2.13	2.1
	MGEN Directed Clinical Education-I (MMGEN 105 CP)	CO1	Demonstrate proficiency in diagnostic and therapeutic techniques used in hospital laboratories.	3	2	2	1	3	2	1	3	2.1
		CO2	Effectively communicate and collaborate with healthcare professionals and patients.	3	2	2	1	3	2	1	3	2.1
		CO3	Apply QA and QC protocols in a regulated laboratory environment.	3	2	2	1	3	2	1	3	2.1
		CO4	Analyze and troubleshoot clinical and diagnostic challenges using biotechnological approaches.	3	2	2	1	3	2	1	3	2.1
		CO5	Understand and adhere to hospital regulatory standards and accreditation requirements (NABH/NABL).	3	2	2	1	3	2	1	3	2.1
		CO6	Develop decision-making skills for effective healthcare management and administration.	3	2	2	1	3	2	1	3	2.1
		C07	Gain practical insights into biotechnology-based clinical applications and patient care.	3	2	2	1	3	2	1	3	2.1
		C08	Prepare for professional roles in clinical research, diagnostics, and hospital-based biotechnology settings.	3	2	2	1	3	2	1	3	2.1
			Average	3	2	2	1	3	2	1	3	2.1
	Research Methodology & Biostatistics [Core Course] (CC 001 T)	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.	3	3	1	1	3	3	1	1	2.0
			Average	3	3	1	1	3	3	1	1	2
Semester 2	**Molecular Biology (MMGEN 106 T)**	CO1	Explain the central dogma of molecular biology and its significance in gene expression.	3	1	1	1	1	2	1	2	1.5
		CO2	Describe the structure and function of DNA and RNA, including their types, modifications, and regulatory elements.	3	1	1	1	1	1	1	1	1.3
		CO3	Compare prokaryotic and eukaryotic DNA replication mechanisms, including DNA damage and repair processes.	3	1	2	1	1	2	1	1	1.5
		CO4	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
		CO5	Analyze operon models (lac, trp, and ara operons) and their regulation mechanisms in prokaryotes.	3	1	1	2	1	1	1	1	1.4
		CO6	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
		CO7	Evaluate the impact of post-translational modifications (phosphorylation, glycosylation, ubiquitination) on protein function.	3	1	2	1	1	1	1	2	1.5

	CO8	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 (MMGEN 107 T)	**CO1**	Explain the significance of analytical techniques in biotechnology and biomedical research.	3	2	3	1	1	2	2	2	2.0
	CO2	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
	CO3	Demonstrate proficiency in chromatography and electrophoresis techniques for separation and purification of biomolecules.	3	1	3	1	1	1	1	1	1.5
	CO4	Apply immunoassays (ELISA, RIA) and biosensors for disease diagnostics and biomarker detection.	3	1	3	1	1	1	2	2	1.8
	CO5	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
	CO6	Analyze data obtained from analytical techniques and interpret results for biomedical and biotechnological applications.	3	3	1	1	1	2	1	1	1.6
	CO7	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 (MMGEN 108 T)	**CO1**	Explain the history, principles, and applications of genetic engineering.	3	1	1	1	1	1	1	2	1.4
	CO2	Demonstrate proficiency in DNA and RNA extraction, PCR techniques, and molecular cloning strategies.	3	1	3	1	1	1	1	1	1.5
	CO3	Analyze the role of restriction enzymes, ligases, and vectors in gene cloning and expression.	3	2	3	1	1	1	1	1	1.6
	CO4	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
	CO5	Evaluate the applications of gene therapy in the treatment of inherited and acquired diseases.	3	1	1	1	1	1	1	3	1.5
	CO6	Assess the role of recombinant DNA technology in vaccine development and regenerative medicine.	3	1	1	1	1	2	1	3	1.6
	CO7	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 (MMGEN 109 T)	**CO1**	Explain the principles and applications of bioinformatics in medical and biological research.	3	1	3	1	1	1	2	1	1.6
	CO2	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
	CO3	Perform sequence alignment using tools like BLAST and understand primer design strategies.	3	1	3	1	1	1	1	1	1.5

	CO4	Analyze protein structures using homology modeling, ab initio methods, and structure visualization tools.	3	1	3	2	1	1	1	1	1.6
	CO5	Apply network pharmacology concepts to study multi-target drugs and systems biology approaches.	3	1	1	3	1	1	2	1	1.6
	CO6	Demonstrate the fundamentals of molecular docking and drug-target interaction analysis.	3	1	3	2	1	1	1	1	1.6
	CO7	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) (MMGEN 110 P)	**CO1**	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
	CO2	Analyze nucleic acids and proteins using UV-Visible spectroscopy.	3	3	2	2	1	2	1	2	2.0
	CO3	Conduct Agarose gel electrophoresis for DNA visualization and integrity assessment.	3	3	2	2	1	2	1	2	2.0
	CO4	Execute PCR and real-time PCR (qPCR) for molecular diagnostics and gene amplification.	3	3	2	2	1	2	1	2	2.0
	CO5	Separate and analyze proteins using SDS-PAGE and Western blotting.	3	3	2	2	1	2	1	2	2.0
	CO6	Apply HPLC techniques for the purification and separation of biomolecules.	3	3	2	2	1	2	1	2	2.0
	CO7	Document and interpret results using gel documentation systems. Understand and apply analytical techniques in clinical and research settings.	3	3	2	2	1	2	1	2	2.0
	CO8	Develop problem-solving skills for biomolecular analysis in medical biotechnology.	3	3	3	3	1	3	2	3	2.6
		Average	3	3	2.13	2.13	1	2.13	1.13	2.13	2.08
Practical Lab III (MMBT 108 & MMBT109) (MMGEN 111 P)	**CO1**	Isolate plasmid DNA from bacteria and perform restriction digestion and ligation for genetic manipulation.	3	3	2	2	1	2	1	2	2.0
	CO2	Conduct bacterial transformation and confirm the presence of recombinant DNA.	3	3	2	2	1	2	1	2	2.0
	CO3	Perform RFLP analysis for genetic variation studies.	3	3	2	2	1	2	1	2	2.0
	CO4	Demonstrate bacterial conjugation and understand horizontal gene transfer.	3	3	2	2	1	2	1	2	2.0
	CO5	Retrieve and analyze nucleotide and protein sequences using NCBI and BLAST and Perform multiple sequence alignment and construct phylogenetic trees for evolutionary studies.	3	3	2	2	1	2	1	2	2.0
	CO6	Utilize molecular docking tools to analyze protein-ligand interactions in drug discovery.	3	3	2	2	1	2	1	2	2.0
	CO7	Apply homology modeling techniques to predict protein structures using Swiss-Model.	3	3	2	2	1	2	1	2	2.0
	CO8	Integrate genetic engineering and bioinformatics approaches for biomedical and biotechnological research applications.	3	3	3	3	1	3	2	3	2.6
		Average	3	3	2.13	2.13	1	2.13	1.13	2.13	2.08
MGEN Directed Clinical Education-II	**CO1**	Demonstrate proficiency in diagnostic and therapeutic techniques used in hospital laboratories.	3	2	2	1	3	2	1	3	2.1

	(MMGEN 112 CP)	**CO2**	Effectively communicate and collaborate with healthcare professionals and patients.	3	2	2	1	3	2	1	3	2.1
		CO3	Apply QA and QC protocols in a regulated laboratory environment.	3	2	2	1	3	2	1	3	2.1
		CO4	Analyze and troubleshoot clinical and diagnostic challenges using biotechnological approaches.	3	2	2	1	3	2	1	3	2.1
		CO5	Understand and adhere to hospital regulatory standards and accreditation requirements (NABH/NABL).	3	2	2	1	3	2	1	3	2.1
		CO6	Develop decision-making skills for effective healthcare management and administration.	3	2	2	1	3	2	1	3	2.1
		CO7	Gain practical insights into biotechnology-based clinical applications and patient care.	3	2	2	1	3	2	1	3	2.1
		CO8	Prepare for professional roles in clinical research, diagnostics, and hospital-based biotechnology settings.	3	2	2	1	3	2	1	3	2.1
			Average	3	2	2	1	3	2	1	3	2.1
	Skill Ehancement Courses											
	Innovation and Entrepreneurship (SEC 001 T)	**CO1**	Students will grasp the concepts of innovation, its ecosystem, and the role of various stakeholders such as government policies, startups, and innovation hubs.	**3**	**1**	**1**	**1**	**2**	**3**	**1**	**3**	**1.9**
		CO2	Cultivating an entrepreneurial mindset and leadership qualities necessary for driving innovation and leading ventures	**3**	**1**	**1**	**1**	**2**	**3**	**1**	**3**	**1.9**
		CO3	Understanding the intersection of technology and innovation and leveraging emerging technologies for entrepreneurial ventures.	**3**	**1**	**1**	**1**	**2**	**3**	**1**	**3**	**1.9**
			Average	3	1	1	1	2	3	1	3	1.9
	Comprehensive Molecular Diagnostics and Advanced Gene Expression Analysis (NPTEL) (SEC 002 T)	**CO1**	Explain the principles of molecular diagnostics and its role in modern healthcare.	3	1	2	1	1	1	1	1	1.4
		CO2	Describe the significance of biomarkers in disease detection and prognosis.	3	1	1	1	1	1	1	3	1.5
		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 GENETICS**
PO1	**Apply Biotechnological Knowledge in Medical Sciences**: Utilize molecular, cellular, and computational techniques in medical Genetics 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 Genetics.
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 Genetics**: 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 GENETICS**
SEMESTER III	
MGEN 113 T	**Clinical Genetics & Genetic Counselling**
CO1	Explain the molecular and chromosomal basis of genetic disorders.
CO2	Apply genetic principles to assess inheritance patterns in patients and families
CO3	Integrate genetic counseling techniques in medical practice, including risk assessment and communication.
CO4	Understand the ethical and social implications of genetic testing and counseling.
CO5	Diagnose and manage genetic disorders through a comprehensive understanding of molecular pathology, genetics, and clinical features.
CO6	Utilize genetic testing and prenatal diagnostics effectively in the clinical setting.
MGEN 114 T	**Canceer Genetics & Pharmacogenomics**
CO1	Analyze the Molecular Mechanisms of Cancer and interpret Genetic Predisposition to Cancer
CO2	Evaluate Cancer Cell Behavior and Tumor Progression
CO3	Understand and Discuss Tumor Markers and examine the Role of Epigenetics in Cancer Development
CO4	Demonstrate an Understanding of Interethnic Differences in Drug Response
CO5	Understand the Mechanisms of Drug Metabolism and Response

CO6	Apply Pharmacogenomics Principles in Clinical PracticeAnalyze the Molecular Mechanisms of Cancer and interpret Genetic Predisposition to Cancer
MGEN 115 T	**Developmental Genetics & Environment Genetics**
CO1	Describe the basic principles of human embryology
CO2	Apply molecular biology techniques to embryology
CO3	Integrate knowledge of stem cells and regenerative medicine
CO4	Identify congenital anomalies from an embryological perspective
CO5	Critically evaluate the role of environmental factors in development

MGEN 116 T	**Principles of Genetics & Population Genetics**
CO1	Predict the outcomes of simple and dihybrid crosses, including genotype and phenotype ratios for Mendelian and non-Mendelian traits
CO2	Accurately perform and interpret Chi-square tests to evaluate genetic hypotheses and use statistical reasoning to assess the significance of genetic data
CO3	Classify allelic variations and gene mutations (dominant, recessive, lethal, sterile) and identify the genetic basis for complex traits, including gene interactions, pleiotropy, and epistasis
CO4	Apply Hardy-Weinberg principles to calculate allele frequencies and determine equilibrium or evolutionary change
CO5	Construct genetic maps based on recombination frequencies, determining the relative position of genes on chromosomes
CO6	Accurately interpret pedigrees to determine inheritance patterns and predict the likelihood of offspring inheriting specific traits
CO7	Understand and explain how environmental factors contribute to the phenotypic variation within populations and assess the impact of penetrance and expressivity in genetic disorders and traits
CO8	Perform and interpret complementation tests, including intragenic complementation, to assess gene function and utilize homozygosity maps and other advanced tools for mapping genetic traits and diseases
MGEN 117	**Research Project / Dissertation**
CO1	Formulate a research problem by reviewing scientific literature and identifying knowledge gaps in medical genetics.
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.
MGEN 118 P	**Clinical Genetics & Genetic Counselling**
CO1	Explain key concepts of clinical genetics relevant to hereditary cancers and pharmacogenomics.
CO2	Analyze pedigrees and identify patterns consistent with inherited cancer syndromes.
CO3	Demonstrate the ability to counsel patients and families about genetic testing, risk, and management.
CO4	Interpret genetic and genomic test results in the context of cancer predisposition.
CO5	Use pharmacogenomic profiles to guide drug selection and dosing in clinical scenarios.
CO6	Critically evaluate current literature and databases to support genetic variant interpretation.
CO7	Apply ethical reasoning when addressing patient concerns around genetic information and testing.
CO8	Collaborate effectively with multidisciplinary teams in managing hereditary cancer risk and treatment.
MGEN 119 P	**Cancer Genetics & Pharmacogenomics**
CO1	Explain key concepts of cancer genetics and pharmacogenomics, focusing on chromosomal alterations.

CO2	Perform bone marrow culture, harvesting, and G-banding for cytogenetic analysis.
CO3	Identify and interpret chromosomal abnormalities such as polyploidy and translocations associated with cancer.
CO4	Correlate cytogenetic findings with specific cancer types and their molecular pathogenesis.
CO5	Demonstrate understanding of flow cytometry principles and its role in cancer cell characterization.
CO6	Analyze pharmacogenomic data to understand variability in drug response among cancer patients.
CO7	Apply laboratory results to support clinical decision-making and personalized cancer treatment plans.
CO8	Critically evaluate research and clinical data in cancer genetics for continuous professional development.
MGEN 120 P	**Developmental Genetics and Environmental Genetics**
CO1	Describe and apply the basic principles of Mendelian and molecular genetics.
CO2	Explain the genetic mechanisms underlying organismal development and identify key regulatory genes involved in developmental processes.
CO3	Assess the impact of environmental factors on gene regulation and phenotype expression.
CO4	Interpret genetic data to evaluate population structure, gene flow, and evolutionary dynamics.
CO5	Solve problems related to inheritance patterns, gene interactions, and population genetics using quantitative methods.
CO6	Demonstrate knowledge of real-world applications of genetic principles in fields such as genetic counseling, genetic engineering, and evolutionary studies.
MGEN 121 P	**Principles** of **Genetics & Population Genetics**
CO1	Explain key principles of classical and population genetics.
CO2	Solve problems related to linkage, multiple alleles, epistasis, and sex-linked inheritance.
CO3	Construct and interpret pedigrees to identify inheritance patterns and carrier probabilities.
CO4	Apply Hardy–Weinberg principles to analyze allele and genotype frequencies in populations.
CO5	Evaluate the effects of mutation, selection, migration, and genetic drift on population structure
CO6	Integrate problem-based learning to reinforce conceptual understanding of genetic interactions.
CO7	Relate genetic principles to disease inheritance and population screening in clinical contexts.
CO8	Demonstrate analytical and critical thinking skills in interpreting genetic data.
SEMESTER IV	
MGEN 122 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.

MGEN 123 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 Genetics-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 Genetics in healthcare, diagnostics, pharmaceuticals, and research.
CO7	Identify potential career pathways and entrepreneurial opportunities in the Genetics sector
CO8	Integrate biosafety, regulatory, and quality assurance practices into professional conduct.
MGEN 117	**Research Project / Dissertation**
CO1	Formulate a research problem by reviewing scientific literature and identifying knowledge gaps in medical Genetics.
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.

MGM SCHOOL OF BIOMEDICAL SCIENCES, NAVI MUMBAI
(A constituent unit of MGM INSTITUTE OF HEALTH SCIENCES)
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CO PO Mapping
Programe - M.Sc. Medical Genetics
Semester III and IV

PO1 **Apply Biotechnological Knowledge in Medical Sciences:** Utilize molecular, cellular, and computational techniques in medical Genetics 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 Genetics.
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 Genetics:** 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	Clinical Genetics & Genetic Counselling (MGEN 113 T)	CO1	Explain the molecular and chromosomal basis of genetic disorders.	2	1	3	3	1	1	3	3	2.13
		CO2	Apply genetic principles to assess inheritance patterns in patients and families	3	3	3	3	1	1	3	3	2.50
		CO3	Integrate genetic counseling techniques in medical practice, including risk assessment and communication.	3	1	1	2	3	3	2	3	2.25
		CO4	Understand the ethical and social implications of genetic testing and counseling.	1	1	1	1	3	3	1	1	1.50
		CO5	Diagnose and manage genetic disorders through a comprehensive understanding of molecular pathology, genetics, and clinical features.	3	3	3	3	1	1	3	3	2.50
		CO6	Utilize genetic testing and prenatal diagnostics effectively in the clinical setting.	3	3	3	3	2	1	2	3	2.50
			Average	2.50	2.00	2.33	2.50	1.83	1.67	2.33	2.67	2.23
	Canceer Genetics & Pharmacogenomics (MGEN 114 T)	CO1	Analyze the Molecular Mechanisms of Cancer and interpret Genetic Predisposition to Cancer	3	3	3	3	1	1	3	3	2.50
		CO2	Evaluate Cancer Cell Behavior and Tumor Progression	3	3	3	3	1	1	3	3	2.50
		CO3	Understand and Discuss Tumor Markers and examine the Role of Epigenetics in Cancer Development	2	3	3	3	1	1	3	3	2.38
		CO4	Demonstrate an Understanding of Interethnic Differences in Drug Response	1	1	1	2	1	1	1	1	1.13
		CO5	Understand the Mechanisms of Drug Metabolism and Response	1	1	1	2	1	1	1	1	1.13
		CO6	Apply Pharmacogenomics Principles in Clinical PracticeAnalyze the Molecular Mechanisms of Cancer and interpret Genetic Predisposition to Cancer	3	3	3	3	1	1	3	3	2.50
			Average	2.17	2.33	2.33	2.67	1.00	1.00	2.33	2.33	2.02
	Developmental Genetics & Environment Genetics (MGEN 115 T)	CO1	Describe the basic principles of human embryology	1	1	1	1	2	1	1	1	1.13
		CO2	Apply molecular biology techniques to embryology	3	2	2	1	1	1	1	1	1.50
		CO3	Integrate knowledge of stem cells and regenerative medicine	2	1	1	1	2	1	1	1	1.25
		CO4	Identify congenital anomalies from an embryological perspective	2	2	2	2	1	1	2	2	1.75
		CO5	Critically evaluate the role of environmental factors in development	1	1	1	2	2	1	1	1	1.25
			Average	1.80	1.40	1.40	1.40	1.60	1.00	1.20	1.20	1.38

	Principles of Genetics & Population Genetics (MGEN 116 T)	**CO1**	Predict the outcomes of simple and dihybrid crosses, including genotype and phenotype ratios for Mendelian and non-Mendelian traits	2	2	1	2	1	1	1	1	1.38
		CO2	Accurately perform and interpret Chi-square tests to evaluate genetic hypotheses and use statistical reasoning to assess the significance of genetic data	1	2	1	1	1	1	1	1	1.13
		CO3	Classify allelic variations and gene mutations (dominant, recessive, lethal, sterile) and identify the genetic basis for complex traits, including gene interactions, pleiotropy, and epistasis	2	1	1	2	1	1	2	2	1.50
		CO4	Apply Hardy-Weinberg principles to calculate allele frequencies and determine equilibrium or evolutionary change	1	1	1	2	1	1	1	1	1.13
		CO5	Construct genetic maps based on recombination frequencies, determining the relative position of genes on chromosomes	1	1	1	1	1	2	1	2	1.25
		CO6	Accurately interpret pedigrees to determine inheritance patterns and predict the likelihood of offspring inheriting specific traits	1	2	1	1	1	1	2	2	1.38
		C07	Understand and explain how environmental factors contribute to the phenotypic variation within populations and assess the impact of penetrance and expressivity in genetic disorders and traits	1	1	1	2	1	1	1	2	1.25
		C08	Perform and interpret complementation tests, including intragenic complementation, to assess gene function and utilize homozygosity maps and other advanced tools for mapping genetic traits and diseases	2	3	2	3	1	1	2	3	2.13
			Average	1.38	1.63	1.13	1.75	1.00	1.13	1.38	1.75	1.39
	Research Project / Dissertation (MGEN 117)	**CO1**	Formulate a research problem by reviewing scientific literature and identifying knowledge gaps in medical Genetics.	3	3	2	3	2	3	2	3	3
		CO2	Design and execute experiments using appropriate methodologies, tools, and techniques relevant to biomedical research.	3	3	3	3	3	3	3	3	3
		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	3
		CO4	Critically analyse and interpret experimental data using appropriate statistical and computational tools.	3	3	2	3	3	3	2	3	3
		CO5	Adhere to ethical standards in biomedical research, including biosafety, data integrity, and responsible reporting.	2	2	1	1	3	1	1	2	2
		CO6	Communicate research findings effectively through well-structured dissertation writing, presentations, and potential publications.	2	2	1	2	2	3	2	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	3
		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
			Average	2.50	2.75	2.25	2.50	2.75	2.63	2.25	2.75	2.55
	MGEN 118 P Clinical Genetics & Genetic Counselling	CO1	Explain key concepts of clinical genetics relevant to hereditary cancers and pharmacogenomics.	3	2	1	3	1	1	2	3	2.00
		CO2	Analyze pedigrees and identify patterns consistent with inherited cancer syndromes.	1	3	1	2	2	2	2	3	2.00
		CO3	Demonstrate the ability to counsel patients and families about genetic testing, risk, and management.	2	1	1	3	3	3	1	2	2.00
		CO4	Interpret genetic and genomic test results in the context of cancer predisposition.	3	3	3	3	3	3	2	3	2.88
		CO5	Use pharmacogenomic profiles to guide drug selection and dosing in clinical scenarios.	2	2	2	2	3	3	1	3	2.25
		CO6	Critically evaluate current literature and databases to support genetic variant interpretation.	1	2	1	3	2	2	1	3	1.88
		CO7	Apply ethical reasoning when addressing patient concerns around genetic information and testing.	1	1	1	2	3	3	1	3	1.88
		CO8	Collaborate effectively with multidisciplinary teams in managing hereditary cancer risk and treatment.	1	3	2	3	3	3	2	3	2.50
			Average	1.75	2.13	1.50	2.63	2.50	2.50	1.50	2.88	2.17
3	**MGEN 119 P Cancer Genetics & Pharmacogenomics**	CO1	Explain key concepts of cancer genetics and pharmacogenomics, focusing on chromosomal alterations.	2	1	2	2	3	2	1	2	1.88
		CO2	Perform bone marrow culture, harvesting, and G-banding for cytogenetic analysis.	3	3	3	2	3	3	3	2	2.75
		CO3	Identify and interpret chromosomal abnormalities such as polyploidy and translocations associated with cancer.	2	3	2	2	2	2	2	3	2.25
		CO4	Correlate cytogenetic findings with specific cancer types and their molecular pathogenesis.	2	3	1	3	3	3	2	3	2.50

		CO5	Demonstrate understanding of flow cytometry principles and its role in cancer cell characterization.	2	2	3	2	2	2	2	3	2.25	
		CO6	Analyze pharmacogenomic data to understand variability in drug response among cancer patients.	1	3	1	3	3	2	1	3	2.13	
		CO7	Apply laboratory results to support clinical decision-making and personalized cancer treatment plans.	2	2	1	2	2	2	1	3	1.88	
		CO8	Critically evaluate research and clinical data in cancer genetics for continuous professional development.	1	1	1	1	3	3	1	3	1.75	
			Average	1.88	2.25	1.75	2.13	2.63	2.38	1.63	2.75	2.17	
	MGEN 120 P Developmental Genetics & Environment Genetics	CO1	Describe and apply the basic principles of Mendelian and molecular genetics.	1	1	1	2	1	1	1	2	1.25	
		CO2	Explain the genetic mechanisms underlying organismal development and identify key regulatory genes involved in developmental processes.	1	2	2	2	1	1	2	3	1.75	
		CO3	Assess the impact of environmental factors on gene regulation and phenotype expression.	2	3	2	3	2	2	2	3	2.38	
		CO4	Interpret genetic data to evaluate population structure, gene flow, and evolutionary dynamics.	2	3	2	2	1	1	2	2	1.88	
		CO5	Solve problems related to inheritance patterns, gene interactions, and population genetics using quantitative methods.	2	2	1	2	2	2	1	2	1.75	
		CO6	Demonstrate knowledge of real-world applications of genetic principles in fields such as genetic counseling, genetic engineering, and evolutionary studies.	1	2	1	2	3	3	1	2	1.88	
			Average	1.50	2.17	1.50	2.17	1.67	1.67	1.50	2.33	1.81	
	MGEN 121 P Principles of Genetics & Population Genetics	CO1	Explain key principles of classical and population genetics.	3	1	1	2	1	1	1	2	1.50	
		CO2	Solve problems related to linkage, multiple alleles, epistasis, and sex-linked inheritance.	3	3	3	3	3	2	2	3	2.75	
		CO3	Construct and interpret pedigrees to identify inheritance patterns and carrier probabilities.	2	2	2	3	3	2	1	2	2.13	
		CO4	Apply Hardy–Weinberg principles to analyze allele and genotype frequencies in populations.	2	1	1	1	2	1	1	2	1.38	
		CO5	Evaluate the effects of mutation, selection, migration, and genetic drift on population structure	1	2	1	1	2	1	1	2	1.38	
		CO6	Integrate problem-based learning to reinforce conceptual understanding of genetic interactions.	2	1	1	1	1	1	1	2	1.25	
		CO7	Relate genetic principles to disease inheritance and population screening in clinical contexts.	1	2	1	2	2	1	1	1	1.38	
		CO8	Demonstrate analytical and critical thinking skills in interpreting genetic data.	1	1	1	2	2	1	1	2	1.38	
			Average	1.88	1.63	1.38	1.88	2.00	1.25	1.13	2.00	1.64	
Semester IV	**Bioethics, IPR and Biosafety (MGEN 122 T)**	**CO1**	Evaluate ethical concerns in biomedical and biotechnological practices.	1	2	1	1	3	1	1	2	1.50	
		CO2	Understand different types of IPR and their applications.	2	2	1	1	2	1	3	3	1.88	
		CO3	Apply various national and international guidelines in biomedical and health research.	3	1	1	1	3	1	1	2	1.63	
			Average	2.00	1.67	1.00	1.00	2.67	1.00	1.67	2.33	1.67	
	Internship/Training (Clinical/ Industrial) (MGEN 123 P)	**CO1**	Demonstrate an understanding of industrial processes, laboratory practices, and biotechnological applications in real-life settings.	3	3	3	3	3	3	3	3	3.00	
		CO2	Apply theoretical knowledge gained during coursework to practical situations in industry/clinical/research environments.	3	3	3	3	3	3	3	3	3.00	
		CO3	Operate and gain familiarity with standard instruments, diagnostic tools, and workflows followed in Genetics-related organizations.	3	2	3	3	3	3	3	3	2.88	
		CO4	Analyse and document technical data, reports, and observations from industrial exposure.	3	2	2	2	3	3	2	3	2.50	
		CO5	Exhibit improved professional skills including communication, teamwork, adaptability, and workplace ethics.	2	2	2	3	2	3	2	3	2.38	
		CO6	Critically evaluate the role of medical Genetics in healthcare, diagnostics, pharmaceuticals, and research.	3	3	3	3	3	3	3	3	3.00	
		CO7	Identify potential career pathways and entrepreneurial opportunities in the Genetics sector	2	2	2	3	3	3	3	3	2.63	
		CO8	Integrate biosafety, regulatory, and quality assurance practices into professional conduct.	2	2	2	2	3	3	2	3	2.38	
			Average	2.63	2.38	2.50	2.75	2.88	3.00	2.63	3.00	2.72	
	Research Project / Dissertation (MGEN 117)	**CO1**	Formulate a research problem by reviewing scientific literature and identifying knowledge gaps in medical Genetics.	2	2	1	3	3	3	1	1	2.00	
		CO2	Design and execute experiments using appropriate methodologies, tools, and techniques relevant to biomedical research.	2	3	2	3	3	3	3	3	2.75	

		CO3	Demonstrate proficiency in handling advanced molecular biology, biochemistry, microbiology, and bioinformatics methods as required for their research project.	3	3	2	3	3	2	3	3	2.75
		CO4	Critically analyse and interpret experimental data using appropriate statistical and computational tools.	1	3	2	1	3	3	2	2	2.13
		CO5	Adhere to ethical standards in biomedical research, including biosafety, data integrity, and responsible reporting.	1	1	1	1	3	3	1	2	1.63
		CO6	Communicate research findings effectively through well-structured dissertation writing, presentations, and potential publications.	1	2	1	2	3	3	1	2	
		CO7	Work independently and collaboratively to solve research challenges and manage time efficiently during the project.	1	3	3	1	3	3	1	1	2.00
		CO8	Develop a research-oriented mind-set that prepares them for higher studies, industrial R&D, or academic research careers.	2	3	2	3	3	3	2	2	2.50
			Average	1.63	2.50	1.75	2.13	3.00	2.88	1.75	2.00	2.20