# MGM SCHOOL OF BIOMEDICAL SCIENCES

**(A constituent unit of MGM INSTITUTE OF HEALTH SCIENCES)**
(Deemed to be University u/s 3 of UGC Act 1956)
Grade "A$^{++}$" Accredited by NAAC
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## CHOICE BASED CREDIT SYSTEM (CBCS)

## (Academic Year 2025 - 26)

## Curriculum for

## M.Sc. Allied Health Sciences

# M.Sc. Medical Genetics

## Semester I & II

## DIRECTOR'S MESSAGE

### Welcome Message from the Director

Dear Postgraduate Students,

Welcome to **MGM School of Biomedical Sciences (MGMSBS), MGMIHS**, a premier institution dedicated to advancing allied and health sciences education. As you embark on this transformative academic journey, you are joining a community that fosters excellence in research, clinical expertise, and innovation**.**

MGMIHS, accredited with **NAAC 'A$^{++}$' Grade (CGPA 3.55, 2022)** and recognized as a **Category I Institution by UGC**, offers an ecosystem that nurtures both academic and professional growth. With **NIRF (151-200 rank band) recognition, NABH-accredited hospitals, NABL-accredited diagnostic labs, and JCI accreditation for MGM New Bombay Hospital**, we uphold global benchmarks in education and healthcare.

At MGMSBS, our **15 postgraduate programs** are meticulously designed to align with the National Commission for Allied and Healthcare Professionals **(NCAHP)** standards**,** National Education Policy **(NEP)** 2020**,** and the National Credit Framework **(NCrF).** We have implemented the **Choice-Based Credit System (CBCS)** to provide academic flexibility while ensuring rigorous training in clinical and technical skills**.** Our state-of-the-art research laboratories, digital classrooms, and the Central Research Laboratory (CRL) foster an environment that encourages innovation and evidence-based learning**.**

Postgraduate education at MGMSBS goes beyond theoretical learning—our curriculum integrates **hands-on clinical training, interdisciplinary collaboration, and exposure to real-world healthcare challenges**. We emphasize **research-driven education**, encouraging students to actively participate in **scientific discoveries, publications, and international collaborations**.
Beyond academics, we believe in **holistic development**, with initiatives such as the **AARAMBH Science and Wellness Club**, which promotes **mental well-being, leadership, and professional networking**.

As you step into this **next phase of academic and professional growth**, we encourage you to explore new ideas, engage in impactful research, and contribute meaningfully to the **healthcare ecosystem**. We are confident that your journey at MGMSBS will shape you into **skilled, compassionate, and visionary professionals**, ready to lead in the ever-evolving healthcare landscape.

We look forward to witnessing your achievements and contributions!

**Dr. Mansee Thakur**
Director, MGM School of Biomedical Sciences
MGM Institute of Health Sciences, Navi Mumbai

# ABOUT MGM SCHOOL OF BIOMEDICAL SCIENCES

## Mission

To improve the quality of life, both at individual and community levels by imparting quality medical education to tomorrow's doctors and medical scientists and by advancing knowledge in all fields of health sciences though meaningful and ethical research.

## Vision

By the year 2020, MGM Institute of Health Sciences aims to be top-ranking Centre of Excellence in Medical Education and Research. Students graduating from the Institute will have the required skills to deliver quality health care to all sections of the society with compassion and benevolence, without prejudice or discrimination, at an affordable cost. As a research Centre, it shall focus on finding better, safer and affordable ways of diagnosing, treating and preventing diseases. In doing so, it will maintain the highest ethical standards.

## About – School of Biomedical Sciences

MGM School of Biomedical Sciences is formed under the aegis of MGM IHS with the vision of offering basic Allied Science and Medical courses for students who aspire to pursue their career in the Allied Health Sciences, teaching as well as research.

School of Biomedical Sciences is dedicated to the providing the highest quality education in basic medical sciences by offering a dynamic study environment with well-equipped labs. The school encompasses 24 courses each with its own distinct, specialized body of knowledge and skill. This includes 8 UG courses and 16 PG courses. The college at its growing years started with mere 100 students has recorded exponential growth and is now a full-fledged educational and research institution with the student strength reaching approximately **800** at present.

Our consistent theme throughout is to encourage students to become engaged, be active learners and to promote medical research so that ultimately they acquire knowledge, skills, and understanding so as to provide well qualified and trained professionals in Allied Health Sciences to improve the quality of life.

As there is increased need to deliver high quality, timely and easily accessible patient care system the collaborative efforts among physicians, nurses and allied health providers become ever more essential for an effective patient care. Thus the role of allied health professionals in ever-evolving medical system is very important in providing high-quality patient care.

Last **but** by no means least, School of Biomedical Sciences envisions to continuously grow and reform. Reformations are essential to any growing institution as it fulfills our bold aspirations of providing the best for the students, for us to serve long into the future and to get ourselves updated to changing and evolving trends in the health care systems.

# Name of the Degree: M.Sc. Medical Genetics

**AIMS OF THE PROGRAM**

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

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

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

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

**Program pattern**

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

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

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

# Program Objectives & Outcome

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

# Course Outcomes

# Semester I

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

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

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| **CO5** | Compare key metabolic pathways, including glycolysis, gluconeogenesis, lipid metabolism, and amino acid catabolism. | **PO1, PO4** | Lecture, Assignment, Seminar | Internal Exam, University Exam(Theory Exam) |
| **CO6** | Evaluate the biochemical basis of metabolic disorders such as diabetes, obesity, and dyslipidemia. | **PO1, PO4, PO5** | Lecture, Assignment, Seminar | Internal Exam, University Exam(Theory Exam) |
| **CO7** | Interpret liver and kidney function tests, their clinical significance, and hormonal regulation disorders. | **PO1, PO3, PO6, PO8** | Lecture, Assignment, Seminar | Internal Exam, University Exam(Theory Exam) |
| **CO8** | Apply biochemical principles to understand disease markers in cancer, cardiovascular diseases, and oxidative stress-related disorders. | **PO1, PO4, PO7, PO8** | Lecture, Assignment, Seminar | Internal Exam, University Exam(Theory Exam) |
| **CC 001 T** | **Research Methodology & Biostatistics (Core Course)** | **Mapped POs** | **Teaching-Learning Methodologies** | **Assessment Tools** |
| **CO1** | Student will be able to understand develop statistical models, research designs with the understating of background theory of various commonly used statistical techniques as well as analysis, interpretation & reporting of results and use of statistical software. | **PO1, PO2, PO4, PO6, PO7, PO8** | Lecture, Practical, Experiential, Assignment, Problem Based Learning, E-learning | Internal Exam, University Exam (Theory and Practical), Seminar. |
| **MMGEN 104 P** | **Practical Lab I – (MMGEN 101 & MMGEN 102)** | **Mapped POs** | **Teaching-Learning Methodologies** | **Assessment Tools** |
| **CO1** | Operate a microscope efficiently and analyze different cell types and structures along with viability and counting. | **PO1,PO2, PO3,PO4, PO5,PO6, PO8** | Practical and Problem Based Learning | Internal Exam, University Exam (Practical Exam), Viva |
| **CO2** | Conduct blood group typing using haemagglutination tests. | **PO1,PO2, PO3,PO4, PO5,PO6, PO8** | Practical and Problem Based Learning | Internal Exam, University Exam (Practical Exam), Viva |
| **CO3** | Understand and demonstrate the principles of immunodiagnostic tests such as VDRL/Widal (demonstration-based). | **PO1,PO2, PO3,PO4, PO5,PO6, PO8** | Practical and Problem Based Learning | Internal Exam, University Exam (Practical Exam), Viva |
| **CO4** | Analyze the histological organization of lymphoid organs. | **PO1,PO2, PO3,PO4, PO5,PO6, PO8** | Practical and Problem Based Learning | Internal Exam, University Exam (Practical Exam), Viva |

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| **CO5** | Perform antigen-antibody interaction studies using ELISA. | **PO1,PO2, PO3,PO4, PO5,PO6, PO8** | Practical and Problem Based Learning | Internal Exam, University Exam (Practical Exam), Viva |
| **CO6** | Interpret Western blotting results for protein analysis (demonstration-based). | **PO1,PO2, PO3,PO4, PO5,PO6, PO8** | Practical and Problem Based Learning | Internal Exam, University Exam (Practical Exam), Viva |
| **CO7** | Apply immunological techniques for disease diagnosis using commercial kits | **PO1,PO2, PO3,PO4, PO5,PO6, PO8** | Practical and Problem Based Learning | Internal Exam, University Exam (Practical Exam), Viva |
| **CO8** | Correlate theoretical knowledge with practical applications in immunology and cellular biology. | **PO1,PO2, PO3,PO4, PO5,PO6, PO7,PO8** | Practical and Problem Based Learning | Internal Exam, University Exam (Practical Exam), Viva |
| **MMGEN 105 CP** | **MGEN Directed Clinical Education-I** | **Mapped POs** | **Teaching-Learning Methodologies** | **Assessment Tools** |
| **CO1** | Demonstrate proficiency in diagnostic and therapeutic techniques used in hospital laboratories. | **PO1,PO3, PO5, PO8** | Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning. | Daily log book, Direct observation and feedback by mentors |
| **CO2** | Effectively communicate and collaborate with healthcare professionals and patients. | **PO1,PO3, PO5, PO8** | Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning. | Daily log book, Direct observation and feedback by mentors |
| **CO3** | Apply QA and QC protocols in a regulated laboratory environment. | **PO1,PO3, PO5, PO8** | Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning. | Daily log book, Direct observation and feedback by mentors |
| **CO4** | Analyze and troubleshoot clinical and diagnostic challenges using biotechnological approaches. | **PO1,PO3, PO5, PO8** | Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning. | Daily log book, Direct observation and feedback by mentors |
| **CO5** | Understand and adhere to hospital regulatory standards and accreditation requirements (NABH/NABL). | **PO1,PO3, PO5, PO8** | Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning. | Daily log book, Direct observation and feedback by mentors |
| **CO6** | Develop decision-making skills for effective healthcare management and administration. | **PO1,PO3, PO5, PO8** | Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning. | Daily log book, Direct observation and feedback by mentors |

# Semester II

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

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

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

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

| | | | | |
|---|---|---|---|---|
| | | **PO8** | | (Practical Exam), Viva |
| **CO4** | Demonstrate bacterial conjugation and understand horizontal gene transfer. | **PO1,PO2, PO3,PO4, PO5,PO6, PO8** | Practical and Problem Based Learning | Internal Exam, University Exam (Practical Exam), Viva |
| **CO5** | Retrieve and analyze nucleotide and protein sequences using NCBI and BLAST and Perform multiple sequence alignment and construct phylogenetic trees for evolutionary studies. | **PO1,PO2, PO3,PO4, PO5,PO6, PO8** | Practical and Problem Based Learning | Internal Exam, University Exam (Practical Exam), Viva |
| **CO6** | Utilize molecular docking tools to analyze protein-ligand interactions in drug discovery. | **PO1,PO2, PO3,PO4, PO5,PO6, PO8** | Practical and Problem Based Learning | Internal Exam, University Exam (Practical Exam), Viva |
| **CO7** | Apply homology modeling techniques to predict protein structures using Swiss-Model. | **PO1,PO2, PO3,PO4, PO5,PO6, PO8** | Practical and Problem Based Learning | Internal Exam, University Exam (Practical Exam), Viva |
| **CO8** | Integrate genetic engineering and bioinformatics approaches for biomedical and biotechnological research applications. | **PO1,PO2, PO3,PO4, PO5,PO6, PO7,PO8** | Practical and Problem Based Learning | Internal Exam, University Exam (Practical Exam), Viva |
| **MMGEN 112 CP** | **MGEN Directed Clinical Education-II** | **Mapped POs** | **Teaching-Learning Methodologies** | **Assessment Tools** |
| **CO1** | Demonstrate proficiency in diagnostic and therapeutic techniques used in hospital laboratories. | **PO1,PO3, PO5, PO8** | Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning. | Daily log book, Direct observation and feedback by mentors |
| **CO2** | Effectively communicate and collaborate with healthcare professionals and patients. | **PO1,PO3, PO5, PO8** | Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning. | Daily log book, Direct observation and feedback by mentors |
| **CO3** | Apply QA and QC protocols in a regulated laboratory environment. | **PO1,PO3, PO5, PO8** | Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning. | Daily log book, Direct observation and feedback by mentors |
| **CO4** | Analyze and troubleshoot clinical and diagnostic challenges using biotechnological approaches. | **PO1,PO3, PO5, PO8** | Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning. | Daily log book, Direct observation and feedback by mentors |

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

| SEC 002 T | Data Analysis for Biologists | Mapped POs | Teaching-Learning Methodologies | Assessment Tools |
|---|---|---|---|---|
| **CO1** | Understand the basic principles of probability and statistical analysis in biological research. | **PO1, PO2** | E-learning, Problem Based Learning, Assignment, Guest Lecture | NPTEL Exam via Online Mode, Assignments |
| **CO2** | Use R programming for data manipulation, visualization, and statistical computations. | **PO1, PO2, PO3** | E-learning, Problem Based Learning, Assignment, Guest Lecture | NPTEL Exam via Online Mode, Assignments |
| **CO3** | Perform correlation and regression analysis for biological datasets. | **PO1, PO2** | E-learning, Problem Based Learning, Assignment, Guest Lecture | NPTEL Exam via Online Mode, Assignments |
| **CO4** | Apply clustering and classification techniques to categorize biological data. | **PO1, PO2** | E-learning, Problem Based Learning, Assignment, Guest Lecture | NPTEL Exam via Online Mode, Assignments |
| **CO5** | Analyze high-dimensional biological data using advanced statistical approaches. | **PO1, PO2, PO7** | E-learning, Problem Based Learning, Assignment, Guest Lecture | NPTEL Exam via Online Mode, Assignments |

## OUTLINE OF COURSE CURRICULUM

## M. Sc. MEDICAL GENETICS

### Semester I

| Code No. | Core Course | Credits/Week | | | | | Hrs/Semester | | | | | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture (L) | Tutorial (T) | Practical (P) | Clinical Posing/ Rotation (CP) | Total Credits (C) | Lecture (L) | Tutorial (T) | Practical (P) | Clinical Posing/ Rotation (CP) | Total (hrs.) | Internal Assement (IA) | Semester End Exam (SEE) | Total |
| **Discipiline Specific Core Theory** | | | | | | | | | | | | | | |
| MMGEN 101 T | Cell Biology | 4 | - | - | - | 4 | 60 | - | - | - | 60 | 20 | 80 | 100 |
| MMGEN 102 T | Immunology | 3 | - | - | - | 3 | 45 | - | - | - | 45 | 20 | 80 | 100 |
| MMGEN 103 T | Biomolecules | 3 | - | - | - | 3 | 45 | - | - | - | 45 | 20 | 80 | 100 |
| CC 001 T | Research Methodology & Biostatistics (Core Course) | 3 | - | - | - | 3 | 45 | - | - | - | 45 | - | 50 | 50 |
| **Discipiline Specific Core Practical** | | | | | | | | | | | | | | |
| MMGEN 104 P | Practical Lab I (MMGEN101 & MMGEN102) | - | - | 8 | - | 4 | - | - | 120 | - | 120 | 10 | 40 | 50 |
| MMGEN 105 CP | MGEN Directed Clinical Education-I | - | - | - | 9 | 3 | - | - | - | 135 | 135 | - | 50 | 50 |
| CC 001 P | Research Methodology & Biostatistics (Core Course) | - | - | 4 | - | 2 | - | - | 60 | - | 60 | - | 50 | 50 |
| **Total** | | 13 | 0 | 12 | 9 | 22 | 195 | 0 | 180 | 135 | 510 | 70 | 430 | 500 |

## OUTLINE OF COURSE CURRICULUM

## M. Sc. MEDICAL GENETICS

### Semester II

| Code No. | Core Course | Credits/Week | | | | | Hrs/Semester | | | | | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture (L) | Tutorial (T) | Practical (P) | Clinical Posing/ Rotation (CP) | Total Credits (C) | Lecture (L) | Tutorial (T) | Practical (P) | Clinical Posing/ Rotation (CP) | Total (hrs.) | Internal Assement (IA) | Semester End Exam (SEE) | Total |
| **Discipiline Specific Core Theory** | | | | | | | | | | | | | | |
| MMGEN 106 T | Molecular Biology | 3 | - | - | - | 3 | 45 | - | - | - | 45 | 20 | 80 | 100 |
| MMGEN 107 T | Analytical Biotechnology | 3 | - | - | - | 3 | 45 | - | - | - | 45 | 20 | 80 | 100 |
| MMGEN 108 T | Genetic Engineering | 3 | - | - | - | 3 | 45 | - | - | - | 45 | 20 | 80 | 100 |
| MMGEN 109 T | Bioinformatics | 3 | - | - | - | 3 | 45 | - | - | - | 45 | 20 | 80 | 100 |
| **Discipiline Specific Core Practical** | | | | | | | | | | | | | | |
| MMGEN 110 P | Practical Lab II (MMGEN 106 & MMGEN107) | - | - | 4 | - | 2 | - | - | 60 | - | 60 | 10 | 40 | 50 |
| MMGEN 111 P | Practical Lab III (MMGEN 108 & MMGEN 109) | - | - | 4 | - | 2 | - | - | 60 | - | 60 | 10 | 40 | 50 |
| MMGEN 112 CP | MGEN Directed Clinical Education-II | - | - | - | 12 | 4 | - | - | - | 180 | 180 | - | 50 | 50 |
| **Skill Ehancement Course** | | | | | | | | | | | | | | |
| SEC 001 T | Molecular Diagnostics | 2 | - | - | - | 2 | 30 | - | - | - | 30 | - | 50 | 50 |
| SEC 002 T | Data Analysis for Biologists | | | | | | | | | | | | | |
| **Total** | | 14 | 0 | 8 | 12 | 22 | 210 | 0 | 120 | 180 | 510 | 100 | 500 | 600 |