MGM INSTITUTE OF HEALTH SCIENCES

(Deemed to be University u/s 3 of UGC Act, 1956)
Grade 'A' Accredited by NAAC
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CHOICE BASED CREDIT SYSTEM

(CBCS)

(with effect from 2025-26 Batches)

Curriculum for

M.Sc. Medical Genetics

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

Amended History

1. Amended as per AC-51/2025, [Resolution No. 3.1 (Annexure-3.2)], [Resolution No. 3.5 (Annexure-7)]; Dated 29/04/2025.

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

Resolution No. 3.1 of Academic Council (AC-51/2025): Resolved to approve the CBCS syllabus, including Program Outcomes (POs), Course Outcomes (COs), and PO-CO Mapping for 15 two-year postgraduate programs under MGMSBS for Semesters I and II. These include: M.Sc. Medical Biotechnology , **M.Sc. Medical Genetics**, M.Sc. Clinical Embryology, M.Sc. Clinical Nutrition, M.Sc. Medical Dialysis Technology, M.Sc. Molecular Biology, M.Sc. Medical Radiology & Imaging Technology , M.Sc. Cardiac Care Technology , M.Sc. Operation Theatre and Anaesthesia Technology, M.Sc. Emergency and Trauma Care, M. Optometry, Master in Hospital Administration, Master of Public Health, M.Sc. Health Informatics & M.Sc. Clinical Research to be effective from batch admitted in Academic Year 2025-26 onwards [ANNEXURE-3.1 to 3.30].

Annexure-3.2 of AC-51/2025

MGM SCHOOL OF BIOMEDICAL SCIENCES

(A constituent unit of MGM INSTITUTE OF HEALTH SCIENCES)
(Deemed to be University u/s 3 of UGC Act 1956)
Grade "A^{++}" Accredited by NAAC
Sector 1, Kamothe, Navi Mumbai-410209,Tel.No.:022-2743763, 27437632, 27432890
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CHOICE BASED CREDIT SYSTEM (CBCS)

(Academic Year 2025 - 26)

Curriculum for

M.Sc. Allied Health Sciences

M.Sc. Medical 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 23 courses each with its own distinct, specialized body of knowledge and skill. This includes 8 UG courses and 15 PG courses. The college at its growing years started with mere 100 students has recorded exponential growth and is now a full-fledged educational and research institution with the student strength reaching approximately **800** at present.

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

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

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

Name of the Degree: M.Sc. Medical 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

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

Course Outcomes
Semester I

MMGEN 101 T	Cell Biology	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Differentiate between prokaryotic and eukaryotic cells based on structural and functional aspects.	**PO1, PO4**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, 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.
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)
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
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
CO7	Gain practical insights into biotechnology-based clinical applications and patient care.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO8	Prepare for professional roles in clinical research, diagnostics, and hospital-based biotechnology settings.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors

Semester II

MMGEN 106 T	Molecular Biology	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Explain the central dogma of molecular biology and its significance in gene expression	**PO1**	Lecture, Practical Demonstration, Assignment, Seminar	Internal Exam, 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.
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.
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 Extract DNA and RNA from biological samples with high purity.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	Analyze nucleic acids and proteins using UV-Visible spectroscopy.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	Conduct Agarose gel electrophoresis for DNA visualization and integrity assessment.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Execute PCR and real-time PCR (qPCR) for molecular diagnostics and gene amplification.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Separate and analyze proteins using SDS-PAGE and Western blotting.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Apply HPLC techniques for the purification and separation of biomolecules.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva

CO7	Document and interpret results using gel documentation systems. Understand and apply analytical techniques in clinical and research settings.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO8	Develop problem-solving skills for biomolecular analysis in medical biotechnology.	**PO1,PO2, PO3,PO4, PO5,PO6, PO7,PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
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, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Demonstrate bacterial conjugation and understand horizontal gene transfer.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Retrieve and analyze nucleotide and protein sequences using NCBI and BLAST and Perform multiple sequence alignment and construct phylogenetic trees for evolutionary studies.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Utilize molecular docking tools to analyze protein-ligand interactions in drug discovery.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO7	Apply homology modeling techniques to predict protein structures using Swiss-Model.	**PO1,PO2, PO3,PO4, PO5,PO6, PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO8	Integrate genetic engineering and bioinformatics approaches for biomedical and biotechnological research applications.	**PO1,PO2, PO3,PO4, PO5,PO6, PO7,PO8**	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
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	Daily log book, Direct observation and feedback by mentors

			Training, Problem-Based Learning.	
CO2	Effectively communicate and collaborate with healthcare professionals and patients.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO3	Apply QA and QC protocols in a regulated laboratory environment.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO4	Analyze and troubleshoot clinical and diagnostic challenges using biotechnological approaches.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO5	Understand and adhere to hospital regulatory standards and accreditation requirements (NABH/NABL).	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO6	Develop decision-making skills for effective healthcare management and administration.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO7	Gain practical insights into biotechnology-based clinical applications and patient care.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
CO8	Prepare for professional roles in clinical research, diagnostics, and hospital-based biotechnology settings.	**PO1,PO3, PO5, PO8**	Pre-Clinical Orientation, Laboratory Hands-on Training, Problem-Based Learning.	Daily log book, Direct observation and feedback by mentors
SEC 001 T	**Innovation and Entrepreneurship**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Students will grasp the concepts of innovation, its ecosystem, and the role of various stakeholders such as government policies, startups, and innovation hubs.	**PO5, PO8**	Lecture, Practical, Quiz, Assignment, Seminar, group discussion	Theory exam, Practical exam, Seminar, Journal club, case study presentation, station exercise
CO2	Cultivating an entrepreneurial mindset and leadership qualities necessary for driving innovation and leading ventures.	**PO5, PO8**	Lecture, Practical, Quiz, Assignment, Seminar, group discussion	Theory exam, Practical exam, Seminar, Journal club, case study presentation, station exercise
CO3	Understanding the intersection of technology and innovation and leveraging emerging technologies for entrepreneurial ventures	**PO1, PO5, PO6, PO8**	Lecture, Practical, Quiz, Assignment, Seminar, group discussion	Theory exam, Practical exam, Seminar, Journal club, case study presentation, station exercise

OUTLINE OF COURSE CURRICULUM

M. Sc. MEDICAL 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**

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

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

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

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

OUTLINE OF COURSE CURRICULUM
M. Sc. MEDICAL 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	Innovation and Entrepreneurship	3	-	-	-	**3**	45	-	-	-	**45**	-	**100**	**100**
SEC 002 T	NPTEL Swayam (Course Selected as per Below List)													
Total		**15**	**0**	**8**	**12**	**23**	**225**	**0**	**120**	**180**	**525**	**100**	**550**	**650**

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

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

FIRST YEAR

M. Sc. MEDICAL GENETICS

SEMESTER-I

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

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

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

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

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

Reference Books:

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

Name of the Program	M. Sc. Medical Genetics
Semester	Semester I
Name of the Subject	Immunology
Subject Code	MMGEN 102 T

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

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

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

Reference Books:

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

Name of the Program	M. Sc. Medical Genetics
Semester	Semester I
Name of the Subject	Biomolecules
Subject Code	MMGEN 103 T

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

Sr. No.	Topics	No. of Hrs.
1	**Fundamentals of Biochemistry:** Structure and function of biomolecules: Carbohydrates, Proteins, Lipids, and Nucleic Acids, pH, buffers, and physiological significance, Water and electrolyte balance, Enzyme classification, kinetics, and inhibition, Mechanism of enzyme action and regulation, Bioenergetics and ATP generation, Mitochondrial electron transport chain and oxidative phosphorylation.	**15**

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

Reference Books:

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

Name of the Program	M. Sc. Medical Genetics
Semester	Semester I
Name of the Subject	Research Methodology & Biostatistics (Core Course)
Subject Code	CC 001 T

Teaching Objective	• The course is intended to give an overview of research and statistical models commonly used in medical and bio-medical sciences. The goal is to impart an intuitive, understanding and working knowledge of research designs and statistical analysis. The strategy would be to simplify, analyze the treatment of statistical inference and to focus primarily on how to specify and interpret the outcome of research.
Learning Outcomes	• Student will be able to understand develop statistical models, research designs with the understating of background theory of various commonly used statistical techniques as well as analysis, interpretation & reporting of results and use of statistical software.

Sr. No	Topic	No. of Hrs.
A	**Research Methodology:**	**23**
1	**Scientific Methods of Research**: Definition of Research, Assumptions, Operations and Aims of Scientific Research. Research Process, Significance and Criteria of Good Research, Research Methods versus Methodology	4
2	**Research Designs**: Observational Studies: Descriptive, explanatory, and exploratory, Experimental Studies: Pre-test design, post-test design, Follow-up or longitudinal design, Cohort Studies, Case – Control Studies, Cross-sectional studies, Intervention studies.	5
3	**Sampling Designs**: Census and Sample Survey, Need and importance for Sampling, Implications of a Sample Design, Different Types of Sample Designs (Probability sampling and non-probability sampling), Systematic sampling, Stratified sampling, Cluster sampling, Multi-stage sampling, Sampling with probability proportional to size, Sequential sampling.	5
4	**Measurement in research**: Measurement Scales, Sources of Error in Measurement,	3
5	**Methods of Data Collection**: Types of data, Collection of Primary Data, Observation Method, Interview Method	4
6	Research Ethics and plagiarism	2
B	**Biostatistics**	**22**
7	**Data Presentation**: Types of numerical data: Nominal, Ordinal, Ranked, Discrete and continuous. Tables: Frequency distributions, Relative frequency, Graph: Bar charts, Histograms, Frequency polygons, scatter plots, line graphs	3
8	**Measures of Central Tendency and Dispersion**: Mean, Median, Mode, Range, Inter quartile range, variance and Standard Deviation, Coefficient of variation, grouped mean and grouped standard deviation (including merits and demerits).	3
9	**Testing of Hypotheses**: Definition, Basic Concepts, Procedure for Hypothesis Testing, power of test, Normal distribution, Parametric Tests including Z-test, t-test, and ANOVA	4
10	**Chi-square Test**: Chi-square as a Non-parametric Test, Applications.	2

11	**Measures of Relationship**: Correlation and Simple Regression Analysis	3
12	**Non-parametric test**: Sign test, Wilcoxon signed-Rank Test, Wilcoxon Rank Sum Test: Mann-Whitney U test, Kruskal Walli's test, Friedman's test, and Spearman Rank correlation test.	3
13	**Vital Health Statistics**: rate, crude rate, age specific rate, Measurement of fertility, Rate, Measures of mortality.	4
Total		**45 hrs**

CC 001 P–Research Methodology & Biostatistics

Sr. No.	Topics	No. of Hrs.
A	**Research Methodology**	
1	Research Article Presentation (Seminar)	**5**
B	**Biostatistics**	
2	Data Presentation	**4**
3	Measures of Central Tendency and Dispersion	**6**
4	Testing of Hypotheses	**16**
5	Chi-square Test	**4**
6	Measures of Relationship	**6**
7	Analysis of Variance	**5**
8	Non parametric or Distribution-free Tests	**8**
9	Computer Application Using Statistical Software including SPSS	**6**
Total		**60 hrs**

Reference Books:

1. Daniel WW. Biostatistics: A foundation for analysis in the health sciences. 10th ed. Wiley; 2013.
2. Gupta SC, Kapoor VK. Fundamentals of mathematical statistics. Sultan Chand & Sons; 2020 Sep.
3. Kothari CR, Garg G. Research methodology: Methods and techniques.2019.
4. Mahajan BK. Methods in biostatistics for medical students and research workers. 7th ed. Jaypee Brothers Medical Publishers; 2010.
5. Murthy MN. Sampling theory and methods. Statistical Publishing Society; 1967.
6. Singh YK. Fundamental of research methodology and statistics. New Age International; 2006.

Resolution No. 3.5 of Academic Council (AC-51/2025):

Resolved to approve the submitted list of recommended books for M.Sc. Clinical Nutrition and the course on **Biostatistics and Research Methodology** [ANNEXURE-7].

Annexure-7 of AC-51/2025

Biostatistics & Research Methodology Books List

Subject	Book Name	Author
Biostatistics & Research Methodology	Biostatistics: A Foundation for Analysis in the Health Sciences (10th ed.)	Daniel WW.
	Biostatistical Analysis (5th ed.)	Zar JH.
	Research Methodology: Methods and Techniques	Kothari CR, Garg G.
	Methods in Biostatistics for Medical Students and Research Workers (7th ed.)	Mahajan BK.
	Sampling Theory and Methods	Murthy MN.
	Fundamentals of Research Methodology and Statistics	Singh YK.
	Fundamentals of Biostatistics (8th ed.)	Rosner B.
	An Introduction to Medical Statistics (4th ed.)	Bland M.

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

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

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

Name of the Program	M. Sc. Medical Genetics
Semester	Semester I
Name of the Subject	MGEN Directed Clinical Education-I
Subject Code	MMGEN 105 CP

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

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

Medical Genetics students will gain extensive clinical exposure in a hospital setting, allowing them to refine their skills in various diagnostic and therapeutic procedures. Under the supervision of experienced professionals, they will progressively interact with patients and healthcare personnel, enhancing their understanding of medical genetics applications in real-world scenarios. Their training will encompass quality assurance (QA) and quality control (QC) in NABH and NABL-accredited laboratories, ensuring they are well-versed in regulatory standards and best practices. Additionally, students will develop problem-solving skills and learn to address complications in healthcare management. This hands-on experience will also prepare them for administrative roles in hospital settings, equipping them with the knowledge, skills, and aptitude required for effective healthcare delivery. Through this structured clinical education, students will be immersed in a dynamic hospital environment, strengthening their competency in medical genetics. **(Total -135 hrs.)**

FIRST YEAR

M.Sc. Medical Genetics

SEMESTER- II

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

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

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

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

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

Reference Books

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

Name of the Program	M. Sc. Medical Genetics
Semester	Semester II
Name of the Subject	Analytical Biotechnology
Subject Code	MMGEN 107 T

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

Sr. No.	Topics	No. of Hrs.
1	**Introduction to Analytical Biotechnology:** Importance of analytical techniques in biotechnology. Sample preparation and handling for biological analysis. Quality control and validation in biotechnology. UV-Visible spectroscopy and its applications in biomolecule quantification. Fluorescence spectroscopy and its use in protein/DNA analysis. Infrared (IR) and Raman spectroscopy for biomolecular characterization. Nuclear Magnetic Resonance (NMR) spectroscopy in structural biology. Mass spectrometry (MS) and its applications in proteomics and metabolomics. Centrifugation, Preparative and analytical centrifuges; RCF, zonal, equilibrium and density gradients	**15**

2	**Chromatographic and Electrophoresis techniques:** Principles of chromatography: Adsorption, partition, ion exchange, size exclusion. High-Performance Liquid Chromatography (HPLC) and Gas Chromatography (GC). Thin Layer Chromatography (TLC) and Paper Chromatography. Affinity chromatography and its applications in protein purification. Applications of chromatography in clinical and pharmaceutical biotechnology. Gel electrophoresis (Agarose, PAGE, SDS-PAGE), Capillary electrophoresis and its biomedical applications, Western, Southern, and Northern blotting techniques, Microarrays and their applications in genomics and transcriptomics.	**15**
3	**Immunoassays, Biosensors and Advance Analytical techniques:** ELISA: Principles, types, and applications in medical diagnostics. Radioimmunoassay (RIA) and its clinical applications. Biosensors: Types (optical, electrochemical, piezoelectric) and applications in diagnostics. Surface Plasmon Resonance (SPR) for biomolecular interactions. Flow cytometry and its applications in immunophenotyping. PCR and Next-generation sequencing (NGS) for genetic analysis.	**15**
Total		**45 hrs**

Reference Books:

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

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

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

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

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

Reference Books:

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

Name of the Program	M. Sc. Medical Genetics
Semester	Semester II
Name of the Subject	Bioinformatics
Subject Code	MMGEN 109 T

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

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

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

Reference Books:

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

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

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

Sr. No.	Topics	No. of Hrs.
1	Practical based on Centrifugation: Density gradient centrifugation	**6**
2	DNA Extraction from Biological Samples	**6**
3	RNA Extraction from Biological Samples	**6**
4	Quantification and Purity Assessment of Nucleic Acids using UV-Visible Spectroscopy	**6**
5	Quantification of Proteins by using Spectroscopy technique	**6**
6	Agarose Gel Electrophoresis for DNA Analysis	**6**
7	Polymerase Chain Reaction (PCR) and Gel Documentation	**6**
8	Protein Separation using SDS-PAGE and Western Blotting	**6**
9	Chromatographic Separation of Biomolecules using HPLC	**6**
10	Real-time PCR and Its application in Disease diagnosis	**6**
Total		**60 hrs**

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

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

Sr. No.	Topics	No. of Hrs.
1	Isolation of Plasmid DNA from Bacteria	**6**
2	Restriction Digestion and Ligation of DNA	**6**
3	Transformation of Recombinant DNA into Bacteria	**6**
4	RFLP technique	**6**
5	Bacterial Conjugation	**6**
6	Sequence Retrieval and Analysis using NCBI and BLAST	**6**
7	Multiple Sequence Alignment and Phylogenetic Tree Construction	**6**
8	Molecular Docking and Protein-Ligand Interaction Analysis	**6**
9	Nucleic Acid sequence databases: Gen Bank, EMBL, DDBJ	**6**
10	Homology Modeling of Proteins using Swiss-Model	**6**
Total		**60 hrs**

Name of the Program	M.Sc. Medical Genetics
Semester	Semester II
Name of the Subject	MMGEN Directed Clinical Education-II
Subject Code	MGEN 112 CP

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

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

Medical Genetics students will gain extensive clinical exposure in a hospital setting, allowing them to refine their skills in various diagnostic and therapeutic procedures. Under the supervision of experienced professionals, they will progressively interact with patients and healthcare personnel, enhancing their understanding of medical genetics applications in real-world scenarios. Their training will encompass quality assurance (QA) and quality control (QC) in NABH and NABL-accredited laboratories, ensuring they are well-versed in regulatory standards and best practices. Additionally, students will develop problem-solving skills and learn to address complications in healthcare management. This hands-on experience will also prepare them for administrative roles in hospital settings, equipping them with the knowledge, skills, and aptitude required for effective healthcare delivery. Through this structured clinical education, students will be immersed in a dynamic hospital environment, strengthening their competency in medical genetics. **(Total -180 hrs.)**

SKILL ENHANCEMENT COURSE

Name of the Program	**M.Sc. Molecular Biology**
Semester	**Semester II**
Name of the Subject	**Innovation and Entrepreneurship**
Subject Code	**SEC 001 T**

Course Outcome	• Students will grasp the concepts of innovation, its ecosystem, and the role of various stakeholders such as government policies, startups, and innovation hubs. • Cultivating an entrepreneurial mindset and leadership qualities necessary for driving innovation and leading ventures. • Understanding the intersection of technology and innovation and leveraging emerging technologies for entrepreneurial ventures.

Sr. No.	Topics	No. of Hrs.
1	Innovation and Innovation Eco-System, The Policy Framework, Startup L and scape and Innovation Hubs, - Digital India and Make in India, - Linking Innovation with Intellectual Property Rights, Raising Finance for Startups in India, Innovation in Indian Context, Writing a business plan	**15**
2	Creativity and Research, Converting Research to Innovation: Innovation Types and Models, Product Development, IPR and its Commercialization, Support System to Develop Culture of Research and Innovation, commercialization of research and innovation, Fund raising – Research and Innovation, Envisioning Innovation and Scenario Building	**15**
3	Introduction to Innovation in Entrepreneurship, Idea Generation and Validation, Design Thinking in Entrepreneurship, Business Model Innovation, Technology and Innovation, Funding Innovation, Entrepreneurial Mindset, Leadership & amp; Intellectual Property, Scaling and Growth Strategies, sustainability & amp; Social Innovation	**15**
Total		**45 hrs**

Name of the Program	**M.Sc. Medical Genetics**
Semester	**Semester II**
Name of the Course	**NPTEL Swayam**
Course Code	**SEC 002 T**

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

Scheme of University Examination Theory for PG Program:

General structure / patterns for setting up question papers for Theory / Practical courses, their evaluation weightages for PG programs of MGMSBS are given in the following tables

Marks scheme for the University exam:

Final theory marks will be 100 marks (80 marks University Theory exam + 20 Marks Internal assessment).

Question		**Marks distribution**	**Marks allotted per section**	**Marks**
Sec: A	MCQ	10 x 1 M = 10	10	10
Sec: B	SAQ	3/4x 5 M = 15	15	35
Sec: B	LAQ	2/3 x 10 M = 10	20	
Sec: C	SAQ	3/4x 5 M = 15	15	35
Sec: C	LAQ	2/3x 10 M = 10	20	
Total				**80 Marks**

Marks Scheme for the University Examination (50 Marks)

Final theory marks will be 50 marks University Theory exam pattern Research Methodology & Biostatistics (Core course)

Question	**Question No.**	**Question Type**	**Marks Distribution**	**Marks**
Sec: A	1.	LAQ (2 out of 3)	2 X 10 Marks = 20	20
Sec: B	2.	SAQ (6 out of 8)	6 X 05 Marks = 30	30
Total				**50 Marks**

Marks Scheme for the University Examination (100 Marks)

Final theory marks will be 100 marks University Theory exam pattern Elective Course

Question	**Question No.**	**Question Type**	**Marks Distribution**	**Marks**
Sec: A	1.	LAQ (10 out of 12)	10 X 10 Marks = 100	100
Total				**100 Marks**

Practical exam pattern: Total 40 marks with following breakup:

Exercise	Description	Marks
Q No 1	Practical exercise - 1	1 x15=15 M
Q No 2	Station exercise	2x5M=10 M
Q No 3	VIVA	10 M
Q No 4	Journal	5M
Total		**40 Marks**

Practical exam pattern Research Methodology & Biostatistics (Core course)
Total 50-mark distribution:

Exercise	Description	Marks
Q No 1	**Practical/Problem-Solving:** These questions can assess statistical analysis, research design, hypothesis testing, or interpretation of data etc	2 × 10 marks each) = **20 marks**
Q No 2	Identification of study designs, Critical appraisal of research papers, Application of biostatistical tools, Sampling techniques etc	(4 × 5 marks each) = **20 marks**
Q No 3	**Viva Voce (Oral Examination)** Assessing conceptual clarity, application of research methodology, and statistical reasoning.	**10 marks**
Total		**50 Marks**

Practical to be conducted at respective departments and marks submitted jointly by the parent department to the university.

Breakup of theory IA calculation for 20 marks

Description	Marks
Internal exam (at department)	15 marks
Seminar	5 marks
Total	**20 Marks**

Breakup of practical IA calculation:

Description	Marks
Internal exam (at department)	10 marks
Viva	5 marks
Journal	5 marks
Total	**20 Marks**

Note –20 marks to be converted to 10 marks weightage for submission to the university.

Model Checklist for Evaluation of the Clinical Directed Posting (PG)

Name of the student: _____Date:_____
Program: _____
Semester: _____ Name of the Internal faculty/Observer: _____
Name of the External Faculty/Observer: _____

Core Competencies	Marks allotted	Marks obtained
Students will begin to develop critical thinking abilities utilizing the allied health personnel roles of communicator and caregiver. Students will learn principles of professional allied health personnel practice and provide direct care to individuals within a medical surgical setting while recognizing the diverse uniqueness of individuals with health alterations.		
Clinical Teaching		
a. Demonstrate beginning competency in technical skills.	10	
Independent Work by Student guided by faculty		
a. Develop effective communication skills (verbally and through charting) with patients, team members, and family	2.5	
b. Identify intra and inter-professional team member roles and scopes of practice. Establish appropriate relationships with team members.	2.5	
Hands on practical work by students		
a. Protect confidentiality of electronic/manual health records data, information, and knowledge of technology in an ethical manner	05	
Independent work by student		
a. Demonstrate expected behaviors and complete tasks in a timely manner. Arrive to clinical experiences at assigned times. Maintain professional behavior and appearance.	05	
Log book	10	
Viva	10	
Attendance	05	
Total	**50 Marks**	

Sign of Internal Examiner: _____
Sign of External Examiner: _____

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

Annexure-17B of AC-52/2025

MGM SCHOOL OF BIOMEDICAL SCIENCES

(A constituent unit of MGM INSTITUTE OF HEALTH SCIENCES)
(Deemed to be University u/s 3 of UGC Act 1956)
Grade "A^{++}" Accredited by NAAC
Sector 1, Kamothe, Navi Mumbai-410209, Tel.No.:022-2743763, 27437632, 27432890
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CHOICE BASED CREDIT SYSTEM (CBCS)

(Academic Year 2025 - 26)

Curriculum for

M.Sc. Allied Health Sciences

M.Sc. Medical Genetics

Semester III & IV

Course Outcomes
Semester III

MGEN 113 T	Clinical Genetics & Genetic Counselling	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Explain the molecular and chromosomal basis of genetic disorders.	PO1, PO2, PO3, PO4, PO5, PO7, PO8	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO2	Apply genetic principles to assess inheritance patterns in patients and families	PO1, PO2, PO3, PO4, PO5, PO7, PO8	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO3	Integrate genetic counseling techniques in medical practice, including risk assessment and communication.	PO1, PO4, PO5, PO6, PO7, PO8	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO4	Understand the ethical and social implications of genetic testing and counseling.	PO5, PO6	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO5	Diagnose and manage genetic disorders through a comprehensive understanding of molecular pathology, genetics, and clinical features.	PO1, PO2, PO3, PO4, PO7, PO8	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
CO6	Utilize genetic testing and prenatal diagnostics effectively in the clinical setting.	PO1, PO2, PO3, PO4, PO5, PO7, PO8	Lecture, Assignment, Seminar	Internal Exam, Seminar, University Exam (Theory).
MGEN 114 T	**Cancer Genetics & Pharmacogenomics**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Analyze the Molecular Mechanisms of Cancer and interpret Genetic Predisposition to Cancer	PO1, PO2, PO3, PO4, PO7, PO8	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO2	Evaluate Cancer Cell Behavior and Tumor Progression	PO1, PO2, PO3, PO4, PO7, PO8	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO3	Understand and Discuss Tumor Markers and examine the Role of Epigenetics in Cancer Development	PO2, PO3, PO4, PO7, PO8	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO4	Demonstrate an Understanding of Interethnic Differences in Drug Response	PO1, PO4	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO5	Understand the Mechanisms of Drug Metabolism and Response	PO1, PO4	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO6	Apply Pharmacogenomics Principles in Clinical Practice Analyze the Molecular	PO1, PO2, PO3, PO4, PO7, PO8	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).

	Mechanisms of Cancer and interpret Genetic Predisposition to Cancer			
MGEN 115 T	**Developmental Genetics & Environment Genetics**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Describe the basic principles of human embryology	PO5	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO2	Apply molecular biology techniques to embryology	PO1, PO2, PO3	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO3	Integrate knowledge of stem cells and regenerative medicine	PO1, PO5	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO4	Identify congenital anomalies from an embryological perspective	PO1, PO2, PO3, PO4, PO7, PO8	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO5	Critically evaluate the role of environmental factors in development	PO3, PO5	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
MGEN 116 T	**Principles of Genetics & Population Genetics**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Predict the outcomes of simple and dihybrid crosses, including genotype and phenotype ratios for Mendelian and non-Mendelian traits	PO1, PO2, PO4	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO2	Accurately perform and interpret Chi-square tests to evaluate genetic hypotheses and use statistical reasoning to assess the significance of genetic data	PO2	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
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	PO1, PO4, PO7, PO8	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO4	Apply Hardy-Weinberg principles to calculate allele frequencies and determine equilibrium or evolutionary change	PO4	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO5	Construct genetic maps based on recombination frequencies, determining the relative position of genes on chromosomes	PO6, PO8	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO6	Accurately interpret pedigrees to determine inheritance patterns and predict the likelihood of offspring inheriting specific traits	PO2, PO7, PO8	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
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	PO4, PO8	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).

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	PO1, PO2, PO3, PO4, PO7, PO8	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
MGEN 117	**Research Project/ Dissertation**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Formulate a research problem by reviewing scientific literature and identifying knowledge gaps in medical Genetics.	PO1, PO2, PO3, PO4, PO5, PO6, PO8	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment
CO2	Design and execute experiments using appropriate methodologies, tools, and techniques relevant to biomedical research.	PO1, PO2, PO3, PO4, PO5, PO6, PO8	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment
CO3	Demonstrate proficiency in handling advanced molecular biology, biochemistry, microbiology, and bioinformatics methods as required for their research project.	PO1, PO2, PO3, PO4, PO5, PO6, PO8	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment
CO4	Critically analyse and interpret experimental data using appropriate statistical and computational tools.	PO1, PO2, PO3, PO4, PO5, PO6, PO8	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment (University Exam)
CO5	Adhere to ethical standards in biomedical research, including biosafety, data integrity, and responsible reporting.	PO5	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment
CO6	Communicate research findings effectively through well-structured dissertation writing, presentations, and potential publications.	PO6	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment
CO7	Work independently and collaboratively to solve research challenges and manage time efficiently during the project.	PO2	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment

CO8	Develop a research-oriented mind-set that prepares them for higher studies, industrial R&D, or academic research careers.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report (Synopsis), Internal Assessment
MGEN 118 P	**Clinical Genetics & Genetic Counselling**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Explain key concepts of clinical genetics relevant to hereditary cancers and pharmacogenomics.	PO1, PO2, PO4, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	Analyze pedigrees and identify patterns consistent with inherited cancer syndromes.	PO2, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	Demonstrate the ability to counsel patients and families about genetic testing, risk, and management.	PO1, PO4, PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Interpret genetic and genomic test results in the context of cancer predisposition.	PO1, PO2, PO3, PO4, PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Use pharmacogenomic profiles to guide drug selection and dosing in clinical scenarios.	PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Critically evaluate current literature and databases to support genetic variant interpretation.	PO4, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO7	Apply ethical reasoning when addressing patient concerns around genetic information and testing.	PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO8	Collaborate effectively with multidisciplinary teams in managing hereditary cancer risk and treatment.	PO2, PO4, PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
MGEN 119 P	**Cancer Genetics & Pharmacogenomics**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Explain key concepts of cancer genetics and pharmacogenomics, focusing on chromosomal alterations.	PO1, PO4, PO5. PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	Perform bone marrow culture, harvesting, and G-banding for cytogenetic analysis.	PO1, PO2, PO3, PO5, PO6, PO7	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva

CO3	Identify and interpret chromosomal abnormalities such as polyploidy and translocations associated with cancer.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Correlate cytogenetic findings with specific cancer types and their molecular pathogenesis.	PO1, PO2, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Demonstrate understanding of flow cytometry principles and its role in cancer cell characterization.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Analyze pharmacogenomic data to understand variability in drug response among cancer patients.	PO2, PO4, PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO7	Apply laboratory results to support clinical decision-making and personalized cancer treatment plans.	PO1, PO2, PO4, PO5, PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO8	Critically evaluate research and clinical data in cancer genetics for continuous professional development.	PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
MGEN 120 P	**Developmental Genetics and Environmental Genetics**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Describe and apply the basic principles of Mendelian and molecular genetics.	PO4, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	Explain the genetic mechanisms underlying organismal development and identify key regulatory genes involved in developmental processes.	PO2, PO3, PO4, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	Assess the impact of environmental factors on gene regulation and phenotype expression.	PO2, PO3, PO4, PO5, PO6, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Interpret genetic data to evaluate population structure, gene flow, and evolutionary dynamics.	PO1, PO2, PO3, PO4, PO7, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Solve problems related to inheritance patterns, gene interactions, and population genetics using quantitative methods.	PO1, PO2, PO4, PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Demonstrate knowledge of real-world applications of genetic principles in fields such as genetic counseling, genetic engineering, and evolutionary studies.	PO2, PO4, PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva

MGEN 121 P	Principles of Genetics & Population Genetics	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Explain key principles of classical and population genetics.	PO1, PO4, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO2	Solve problems related to linkage, multiple alleles, epistasis, and sex-linked inheritance.	PO1, PO2, PO3, PO4, PO5, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO3	Construct and interpret pedigrees to identify inheritance patterns and carrier probabilities.	PO1, PO2, PO3, PO4, PO5, PO6, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO4	Apply Hardy–Weinberg principles to analyze allele and genotype frequencies in populations.	PO1, PO5, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO5	Evaluate the effects of mutation, selection, migration, and genetic drift on population structure	PO2, PO5, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO6	Integrate problem-based learning to reinforce conceptual understanding of genetic interactions.	PO1, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO7	Relate genetic principles to disease inheritance and population screening in clinical contexts.	PO2, PO4, PO5	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva
CO8	Demonstrate analytical and critical thinking skills in interpreting genetic data.	PO4, PO5, PO8	Practical and Problem Based Learning	Internal Exam, University Exam (Practical Exam), Viva

Semester IV

MGEN 122 T	Bioethics, IPR and Biosafety	Mapped POs	Teaching-Learning Methodologies	Assessment Tools
CO1	Evaluate ethical concerns in biomedical and biotechnological practices.	PO5	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).

CO2	Understand different types of IPR and their applications.	PO7, PO8	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
CO3	Apply various national and international guidelines in biomedical and health research.	PO5	Lecture, Assignment, Seminar.	Internal Exam, Seminar, University Exam (Theory).
MGEN 123 P	**Internship/Training (Clinical/ Industrial)**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**
CO1	Demonstrate an understanding of industrial processes, laboratory practices, and biotechnological applications in real-life settings.	PO2, PO7, PO8	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/ Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO2	Apply theoretical knowledge gained during coursework to practical situations in industry/clinical/research environments.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/ Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO3	Operate and gain familiarity with standard instruments, diagnostic tools, and workflows followed in Genetics-related organizations.	PO3, PO5	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/ Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO4	Analyse and document technical data, reports, and observations from industrial exposure.	PO2	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/ Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO5	Exhibit improved professional skills including communication, teamwork, adaptability, and workplace ethics.	PO5, PO7	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/ Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO6	Critically evaluate the role of medical Genetics in healthcare, diagnostics, pharmaceuticals, and research.	PO1, PO2, PO6, PO7, PO8	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/ Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO7	Identify potential career pathways and entrepreneurial opportunities in the Genetics sector	PO6, PO8	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/ Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
CO8	Integrate biosafety, regulatory, and quality assurance practices into professional conduct.	PO5, PO6, PO8	Experiential Learning at Industry/Research Institute, Observation and Demonstration, Seminar/ Discussion Sessions	Internship / training log book, Weekly Summary report, Industrial visit report, Seminar
MGEN 117	**Research Project/ Dissertation**	**Mapped POs**	**Teaching-Learning Methodologies**	**Assessment Tools**

CO1	Formulate a research problem by reviewing scientific literature and identifying knowledge gaps in Medical Genetics.	PO1, PO2, PO3, PO4, PO5, PO6, PO8	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO2	Design and execute experiments using appropriate methodologies, tools, and techniques relevant to biomedical research.	PO1, PO2, PO3, PO4, PO5, PO6, PO8	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO3	Demonstrate proficiency in handling advanced molecular biology, biochemistry, microbiology, and bioinformatics methods as required for their research project.	PO1, PO2, PO3, PO4, PO5, PO6, PO8	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO4	Critically analyse and interpret experimental data using appropriate statistical and computational tools.	PO1, PO2, PO3, PO4, PO5, PO6, PO8	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO5	Adhere to ethical standards in biomedical research, including biosafety, data integrity, and responsible reporting.	PO5	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO6	Communicate research findings effectively through well-structured dissertation writing, presentations, and potential publications.	PO6	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO7	Work independently and collaboratively to solve research challenges and manage time efficiently during the project.	PO2	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)
CO8	Develop a research-oriented mind-set that prepares them for higher studies, industrial R&D, or academic research careers.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8	Faculty Mentorship and Supervision, Hands-on Laboratory Training, Documentation and Reporting	Dissertation Report, Viva Voce / Oral Defence (University Exam)

OUTLINE OF COURSE CURRICULUM

M. Sc. MEDICAL GENETICS

Semester III

Code No.	Core Course	Credits/Week					Hrs/Semester					Marks		
		Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation (CP)	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation (CP)	Total (hrs.)	Internal Assement (IA)	Semester End Exam (SEE)	Total
Discipline Specific Core Theory														
MGEN 113 T	Clinical Genetics & Genetic Counselling	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MGEN 114 T	Canceer Genetics & Pharmacogenomics	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MGEN 115 T	Developmental Genetics & Environment Genetics	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MGEN 116 T	Principles of Genetics & Population Genetics	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
MGEN 117	Research Project / Dissertation	-	-	14	-	**7**	-	-	210	-	**210**	**50**	-	**50**
Discipline Specific Core Practical														
MGEN 118 P	Clinical Genetics & Genetic Counselling	-	-	2	-	**1**	-	-	30	-	**30**	**10**	**40**	**50**
MGEN 119 P	Canceer Genetics & Pharmacogenomics	-	-	2	-	**1**	-	-	30	-	**30**	**10**	**40**	**50**
MGEN 120 P	Developmental Genetics & Environment Genetics	-	-	2	-	**1**	-	-	30	-	**30**	**10**	**40**	**50**
MGEN 121 P	Principles of Genetics & Population Genetics	-	-	2	-	**1**	-	-	30	-	**30**	**10**	**40**	**50**
Total		**12**	**0**	**22**	**0**	**23**	**180**	**0**	**330**	**0**	**510**	**170**	**480**	**650**

OUTLINE OF COURSE CURRICULUM

M. Sc. MEDICAL GENETICS

Semester IV

Code No.	Core Course	Credits/Week					Hrs/Semester					Marks		
		Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation (CP)	Total Credits (C)	Lecture (L)	Tutorial (T)	Practical (P)	Clinical Posing/ Rotation (CP)	Total (hrs.)	Internal Assement (IA)	Semester End Exam (SEE)	Total
Discipline Specific Core Theory														
MGEN 122 T	Bioethics IPR and Biosafety	3	-	-	-	**3**	45	-	-	-	**45**	**20**	**80**	**100**
Discipline Specific Core Practical														
MGEN 123 P	Internship/Training (Clinical/ Industrial)	-	-	14	-	**7**	-	-	210	-	**210**	-	**50**	**50**
MGEN 117	Research Project / Dessertation	-	-	22	-	**11**	-	-	**330**	-	**330**	-	**200**	**200**
Total		**3**	**0**	**36**	**0**	**21**	**45**	**0**	**540**	**0**	**585**	**20**	**330**	**350**

SECOND YEAR

M. Sc. MEDICAL GENETICS

SEMESTER-III

Code No.	Core Subjects
Discipline Specific Core Theory	
MGEN 113 T	Clinical Genetics & Genetic Counselling
MGEN 114 T	Cancer Genetics & Pharmacogenomics
MGEN 115 T	Developmental Genetics & Environment Genetics
MGEN 116 T	Principles of Genetics & Population Genetics
MGEN 117	Research Project / Dissertation
Discipline Specific Core Practical	
MGEN 118 P	Clinical Genetics & Genetic Counselling
MGEN 119 P	Cancer Genetics & Pharmacogenomics
MGEN 120 P	Developmental Genetics & Environment Genetics
MGEN 121 P	Principles of Genetics & Population Genetics

Name of the Program	**M. Sc. Medical Genetics**
Semester	**Semester III**
Name of the Subject	**Clinical Genetics & Genetic Counselling**
Subject Code	**MGEN 113 T**

Course Objective	• Describe the structure of chromosomes and clinical implications of chromosomal aberrations such as numerical and structural abnormalities with examples • Explain Mendel's Laws of inheritance, including the Law of Segregation and the Law of Independent Assortment and apply Mendelian principles to predict inheritance patterns in common genetic disorders (autosomal dominant, autosomal recessive, and sex-linked) by drawing pedigree to assess genetic risk. Define and explain non-Mendelian inheritance mechanisms, such as mitochondrial inheritance, polygenic inheritance, and genomic imprinting. • Analyze the genetic basis and molecular basis and identify and describe the clinical manifestations and diagnostic criteria of these genetic conditions. • Define the key components of genetic counseling, including information gathering, risk assessment, and counseling strategies. • Understand the legal, ethical, and social implications of genetic counseling and testing. • Understand the impact of genetic mutations on hemoglobin structure, red blood cell function, and coagulation.
Course Outcomes	By the end of the course, students will be able to: • Explain the molecular and chromosomal basis of genetic disorders. • Apply genetic principles to assess inheritance patterns in patients and families. • Integrate genetic counseling techniques in medical practice, including risk assessment and communication. • Understand the ethical and social implications of genetic testing and counseling. • Diagnose and manage genetic disorders through a comprehensive understanding of molecular pathology, genetics, and clinical features. • Utilize genetic testing and prenatal diagnostics effectively in the clinical setting.

Sr. No.	Topics	No. of Hrs.
1	**Chromosomes and its aberrations** Structure of chromosome, Classification, Structural and numerical chromosomal aberrations with clinical aspect, Downs syndrome & its variant, Patau syndrome, Edward syndrome, Turner syndrome and its variant, Klinefelter syndrome, Cri-du-chat syndrome, Fragile X Syndrome, Terminologies used in clinical genetics, Karyotyping, Genetic Test-FISH, PCR, Sanger Sequencing, MLPA and Next Generation Sequencing. **Mendel's Law of inheritance with clinical aspect**, Pedigree, Autosomal and Sex-linked inheritance **Non-Mendelian inheritance**	**10**
2	**Genetics in Medical Practice:** Terminologies, Principles and their application in medical practice; Case studies (Interacting with patients, learning family history and drawing pedigree chart); Syndromes and disorders: Definition and their genetic basis. **Genetic counseling**: Components of genetic counseling: Indications for and purpose; Information gathering and construction of pedigrees; Legal and ethical considerations; Patterns of inheritance, risk assessment and counselling in common Mendelian and multifactor syndromes.	**15**

	Molecular pathology of monogenic diseases: Cystic fibrosis, Tay Sach's Syndrome & Marfan Syndrome **Genetic disorders of Haemopoietic systems**: Overview of hematopoiesis, Blood cell types and hemoglobin, Sickle cell anemia, Thalassemia & Hemophilia. **Genomic Imprinting**: Neurofibromatosis I, Prader-Willi &Angelman syndromes, BeckwithWiedeman syndrome	
3	**Genetics of Neurogenetic disorders:** Charcot-Marie tooth syndrome, Spino-muscular atrophy, Alzheimer's disease **Syndromes due to triplet nucleotide expansion**; **Genetic basis of muscle disorders**: Dystrophies (Duchenne Muscular dystrophy and Becker Muscular Dystrophy), Myotonias& Myopathies **Genetic basis of eye disorders:** Color Blindness, Retinitis pigmentosa, Glaucoma & Cataracts; **Genetics of skeleton & skin disorders**	**10**
4.	**Complex polygenic syndromes:** Hyperlipidemia, Atherosclerosis, Diabetes mellitus; Mitochondrial syndromes; Management of genetic disorders **IEM-** Protein, carbohydrate and lipid metabolism disorders **Prenatal Diagnosis and PIGD-** Indications for prenatal diagnosis, Indications for Prenatal Diagnosis Genetic testing: biochemical & molecular tests in children, Presymptomatic testing for late onset diseases (predictive medicine) Noninvasive methods (Ultrasound, Endoscopy, MRI, Maternal Serum Screening for Down's syndrome & Neural tube defect, Fetal Blood Sampling, etc.) Invasive methods; Amniocentesis, Chorionic Villi Sampling Ethical issues in pre- natal screening & diagnosis.	**10**
Total		**45 hrs.**

Name of the Program	**M. Sc. Medical Genetics**
Semester	**Semester III**
Name of the Subject	**Clinical Genetics & Genetic Counselling**
Subject Code	**MGEN 118 P**

Course Objective	• Understand the principles of human genetics and their clinical applications. • Identify and interpret hereditary cancer syndromes and their molecular basis. • Apply genetic counselling skills in clinical settings, focusing on cancer and pharmacogenomics. • Understand the role of genetic testing and genomic technologies in cancer diagnosis and treatment. • Evaluate the ethical, legal, and social implications of genetic information in clinical practice. • Integrate pharmacogenomic data into personalized treatment plans to optimize patient outcomes. • Develop practical skills in pedigree analysis, risk assessment, and variant interpretation.
Course Outcomes	• Explain key concepts of clinical genetics relevant to hereditary cancers and pharmacogenomics. • Analyze pedigrees and identify patterns consistent with inherited cancer syndromes.

	• Demonstrate the ability to counsel patients and families about genetic testing, risk, and management. • Interpret genetic and genomic test results in the context of cancer predisposition. • Use pharmacogenomic profiles to guide drug selection and dosing in clinical scenarios. • Critically evaluate current literature and databases to support genetic variant interpretation. • Apply ethical reasoning when addressing patient concerns around genetic information and testing. • Collaborate effectively with multidisciplinary teams in managing hereditary cancer risk and treatment.

Sr. No.	Topics	No. of Hrs.
CLINICAL GENETICS & GENETIC COUNSELLING		**30**
1	Lymphocyte culture and chromosome analysis- • Culture set up • Harvesting • G-banding	
2	Identification of chromosomal abnormalities using banding technique.	
3	Preparation of pedigree on case-based study	
4	Case based genetic counseling	
5	Case based genetic diagnosis (General laboratory organization of prenatal Diagnosis)	
6	Identification of Trisomy 13, 18, 21	
Total		**30 hrs.**

Reference Books:

1. A Handbook of Clinical Genetics, By J. S. Fitzsimmons
2. A Guide to Genetic Counseling, edited by Wendy R. Uhlmann, Jane L. Schuette, Beverly Yashar
3. Genetic Counseling: Ethical Challenges and Consequences By Dianne M. Bartels

Name of the Program	**M. Sc. Medical Genetics**
Semester	**Semester III**
Name of the Subject	**Cancer Genetics & Pharmacogenomics**
Subject Code	**MGEN 114 T**

Course Objective	• Understand the genetic basis of cancer and differentiate between normal and cancer cells • Explore the mechanisms of tumorigenesis and investigate familial cancers and genetic predispositions • Comprehend the Role of Pharmacokinetics and Pharmacodynamics in Cancer Treatment • Explore Tumor Progression, Angiogenesis, and Metastasis • Understand the Impact of Epigenetic Modifications in Cancer • Examine Pharmacogenomics and Its Role in Personalized Medicine
Course Outcomes	By the end of the course, students will be able to: • Analyze the Molecular Mechanisms of Cancer and interpret Genetic Predisposition to Cancer • Evaluate Cancer Cell Behavior and Tumor Progression • Understand and Discuss Tumor Markers and examine the Role of Epigenetics in Cancer Development • Demonstrate an Understanding of Interethnic Differences in Drug Response • Understand the Mechanisms of Drug Metabolism and Response • Apply Pharmacogenomics Principles in Clinical Practice Analyze the Molecular Mechanisms of Cancer and interpret Genetic Predisposition to Cancer

Sr. No.	Topics	No. of Hrs.
1	**Introduction to Cancer:** An overview, Types of cancer, Cytology of cancer cells, Characteristics of cancer cells, Difference between normal and cancer cells, Contact inhibition, Malignancy as a loss of normal cellular affinities, Differential gene expression in normal vs transformed cells, The genetic basis of cancer, Cancer as hereditary change	**10**
2	**Cell transformation and tumourogenesis:** Cell cycle check point and cancer, Oncogenes Tumour suppressor genes, DNA repair genes and genetic instability, Epigenetic modifications, telomerase activity, centrosome malfunction, Genetic heterogeneity and clonal evolution	**10**
3	**Familial cancers:** Retinoblastoma, Wilms' tumour, Li-Fraumeni syndrome, colorectal, cancer, breast cancer, Epstein Barr virus and its relationship to Burkett's lymphoma, Papilloma virus and cervical carcinoma. Genetic predisposition to sporadic cancer	**10**
4	**Tumour progression:** angiogenesis and metastasis Tumour specific markers	**05**
5	**Pharmacokinetics:** Variation of enzymes in drug metabolism, Pharmacodynamics: Definition, drug metabolism, Biochemical modification, Kinetics of drug metabolism, detoxification system, Cytochrome P459, N Acetyltransferase, Scuccinylcholine sensitivity, G6PD, Debrisoquine metabolism, Alcohol metabolism, Hereditary disorders with altered drug response, Historical aspects of pharmacogenomics, Current status: Pharmacokinetics/Drug metabolites, Pharmacokinetics – receptors Pharmacokinetics of drug transpoters Interethnic difference in drug responses, Genomic variation and pharmacogenomics	**10**
Total		**45 hrs**

Name of the Program	**M. Sc. Medical Genetics**
Semester	**Semester III**
Name of the Subject	**Cancer Genetics & Pharmacogenomics**
Subject Code	**MGEN 119 P**

Course Objective	• Understand the genetic and molecular basis of cancer development and progression. • Gain practical skills in bone marrow culture, chromosome analysis, and G-banding techniques. • Identify chromosomal abnormalities, including translocations and polyploidy, associated with malignancies. • Understand the application of flow cytometry in cancer diagnosis, prognosis, and treatment monitoring. • Interpret the relationship between genetic alterations and pharmacogenomic responses in cancer therapy. • Evaluate the clinical significance of chromosomal aberrations in guiding targeted therapies. • Develop competency in laboratory procedures, data interpretation, and reporting of cytogenetic findings relevant to cancer genetics.
Course Outcomes	• Explain key concepts of cancer genetics and pharmacogenomics, focusing on chromosomal alterations. • Perform bone marrow culture, harvesting, and G-banding for cytogenetic analysis. • Identify and interpret chromosomal abnormalities such as polyploidy and translocations associated with cancer. • Correlate cytogenetic findings with specific cancer types and their molecular pathogenesis. • Demonstrate understanding of flow cytometry principles and its role in cancer cell characterization. • Analyze pharmacogenomic data to understand variability in drug response among cancer patients. • Apply laboratory results to support clinical decision-making and personalized cancer treatment plans. • Critically evaluate research and clinical data in cancer genetics for continuous professional development.

Sr. No.	**Topics**	**No. of Hrs.**
CANCER GENETICS AND PHARMACOGENOMICS		**30**
1	Bone Marrow culture and chromosome analysis- • Culture set up • Harvesting • G-banding	

2	Identification of chromosomal abnormalities in relation to cancers using banding technique.	
3	Visit to a flow cytometry laboratory.	
4	Identification of Polyploidy'	
5	Identification of Translocations	
Total		**30 hrs.**

Reference Books:

1. Concepts in Pharmacogenomics, By Martin M. Zdanowicz
2. Pharmacogenetics: Making cancer treatment safer and more effective, edited by William G. Newman
3. Cancer Genetics and Genomics for Personalized Medicine, edited by Il-Jin Kim

Name of the Program	**M. Sc. Medical Genetics**
Semester	**Semester III**
Name of the Subject	**Developmental Genetics & Environmental Genetics**
Subject Code	**MGEN 115 T**

Course Objective	• Describe the processes of spermatogenesis and oogenesis, and their role in fertilization and early development and explain the stages of early development, including blastulation, gastrulation, and neurulation and formation of embryonic germ layers and their derivatives. • Describe detail development of cardiovascular system (CVS), respiratory system (RS), central nervous system (CNS), gastrointestinal system (GIT), and genital urinary system (GUS) and face with embryological basis of congenital anomalies • Define stem cells, their classification, sources, understand stem cell differentiation, cryopreservation, and their clinical applications, including in the treatment of diseases such as neurodegenerative disorders, diabetes, and cancer. Investigate the role of stem cells in regenerative medicine. • Understand the ethics and societal implications of stem cell research and address societal concerns, including religious views and regulatory frameworks for stem cell research and patient advocacy. • Explore the effects of environmental factors on development and understand how teratogens and environmental modifications of gene expression contribute to congenital anomalies and discuss the impact of radiation exposure on embryonic and fetal development.
Course Outcomes	By the end of the course, students will be able to: • Describe the basic principles of human embryology: • Apply molecular biology techniques to embryology: • Integrate knowledge of stem cells and regenerative medicine: • Identify congenital anomalies from an embryological perspective: • Critically evaluate the role of environmental factors in development:

Sr. No.	Topics	No. of Hrs.
1	**General embryology- Spermatogenesis, Oogenesis** Fertilization Blastulation, Gastrulation, Formation of embryonic germ layers and their derivatives; Placenta (development, structure and function); Fetal membrane in twins. Neurulation and NTD, Limb bud formation.	**15**
2	**Molecular basis of systemic embryology and its clinical aspect** CVS, RS, CNS, GIT, GUS, EYE Development, Face development Congenital anomaly and its embryological aspect.	**10**
3	**Stem cells and its applications** Introduction to Stem Cells Definition, Classification and Sources of stem cells. Stem cell self-renewal and pluripotency. Embryonic Stem Cells Blastocyst and inner cell mass cells; Organogenesis; Mammalian Nuclear Transfer Technology; Stem cell differentiation; stem cells cryopreservation. Epigenetic controls of stem cells, Induced pluripotent stem (iPS) cells, Cancer stem cells **Application of stem Cells** Overview of embryonic and adult stem cells for therapy, neurodegenerative diseases; Parkinson's, Alzheimer, Spinal Code Injuries and other brain Syndromes; Tissue system; Failures; Diabetes; Cardiomyopathy; Kidney failure; Liver failure; Cancer; Hemophilia etc. **Human Embryonic Stem Cells and Society** Human stem cells research: Ethical consideration; Stem cell religion consideration; Stem	**15**

	cell-based theories: Pre clinical regulatory consideration and Patient advocacy.	
4	Regeneration and Senescence: Ageing: causes and regulation;, A**ging and genetics; Progeria syndrome** **Environmental genetics:** Teratogens, Environmental modifications of Gene expression, radiation Biology: Basics Effects of radiation on cells, Human beings Uses of radiation in Medical Technology	**5**
Total		**45 hrs.**

Name of the Program	**M. Sc. Medical Genetics**
Semester	**Semester III**
Name of the Subject	**Developmental Genetics & Environmental Genetics**
Subject Code	**MGEN 120 P**

Course Objective	• Understand Fundamental Genetic Concepts • Explore Developmental Genetics: To study the genetic control of development, including gene regulation during embryogenesis and the role of developmental genes. • Analyze Environmental Influence on Genetics: To understand how environmental factors affect gene expression, mutation rates, and phenotypic variation. • Introduce Population Genetics, to examine the genetic composition of populations, mechanisms of evolution, and the role of genetic variation in populations. • Develop Practical Skills: To equip students with laboratory skills relevant to genetic analysis, including techniques in molecular biology, developmental biology, and population genetics studies.
Course Outcomes	• Describe and apply the basic principles of Mendelian and molecular genetics. • Explain the genetic mechanisms underlying organismal development and identify key regulatory genes involved in developmental processes. • Assess the impact of environmental factors on gene regulation and phenotype expression. • Interpret genetic data to evaluate population structure, gene flow, and evolutionary dynamics. • Solve problems related to inheritance patterns, gene interactions, and population genetics using quantitative methods. • Demonstrate knowledge of real-world applications of genetic principles in fields such as genetic counseling, genetic engineering, and evolutionary studies.

Sr. No.	**Topics**	**No. of Hrs.**
DEVELOPMENTAL GENETICS &ENVIRONMENTAL GENETICS		**30**
1	Spermatogenesis,	
2	Semen Analysis	
3	Oogenesis	
4	Fertilization	
5	Implantation	
6	Neurulation and neural tube formation	

7	Neural tube defects on specimens	
8	Development of germ layers	
9	Placenta	
10	Development of CVS 1	
11	Development of CVS 2	
12	Development of CNS	
13	Development of GUS 1	
14	Development of GUS 2	
15	Development of FACE	
16	Development of GIT	
17	Development of Eye	
18	Specimens of congenital anomalies	
Total		**30 hrs.**

Reference Books:

1. Moore KL, Torchia MG, Persaud TV. The Developing Human: Clinically Oriented Embryology With STUDENT CONSULT Online Access, 9/e. Elsevier India; 2007.
2. England MA. The Developing Human: Clinically Oriented Embryology. Journal of anatomy. 1989 Oct; 166:270.
3. Singh I. Human embryology. JP Medical Ltd; 2014 Sep 30.
4. Singh I. The prenatal development of enterochromaffin cells in the human gastro-intestinal tract. Journal of anatomy. 1963 Jul;97(Pt 3):377.
5. Singh I, Pal GP. Human Embryology in The Placenta.
6. Stem Cells: A Very Short Introduction, By Jonathan Slack
7. Essentials of Stem Cell Biology,edited by Robert Lanza, Anthony Atala
8. Stem Cells, By Cherian Eapen, Nandhini G, Kurian Anil

Name of the Program	**M. Sc. Medical Genetics**
Semester	**Semester III**
Name of the Subject	**Principles of Genetics & Population Genetics**
Subject Code	**MGEN 116 T**

Course Objective	• Understand Mendelian Genetics • Apply Statistical Analysis to Genetic Data • Analyze Microevolution in Populations and apply the Hardy-Weinberg equilibrium model to calculate allele frequencies and assess whether a population is evolving. • Understand Gene Linkage & Genetic Mapping • Perform Pedigree Analysis • Investigate the Role of the Environment in Gene Expression
Course Outcomes	By the end of this course, students will be able to: • Predict the outcomes of simple and dihybrid crosses, including genotype and phenotype ratios for Mendelian and non-Mendelian traits. • Accurately perform and interpret Chi-square tests to evaluate genetic hypotheses and use statistical reasoning to assess the significance of genetic data. • Classify allelic variations and gene mutations (dominant, recessive, lethal, sterile) and identify the genetic basis for complex traits, including gene interactions, pleiotropy, and epistasis. • Apply Hardy-Weinberg principles to calculate allele frequencies and determine equilibrium or evolutionary change. • Construct genetic maps based on recombination frequencies, determining the relative position of genes on chromosomes. • Accurately interpret pedigrees to determine inheritance patterns and predict the likelihood of offspring inheriting specific traits. • 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. • 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.

Sr. No.	Topic	No. of Hrs.
1	**Introduction to Mendelian Genetics:** Mendel and his experiments, Law of segregate, Law of independent assortment, Applications of laws of probability (product rule, sum rule), Chromosomal basis of segrartion and independent assortment. Chi-square test and its application in analysis of genetic data	**5**
2	**Extensions of Mendelism:** Allelic variation and gene function-Dominance relationships, basis of dominant and recessive mutations, Multiple alleles, allelic series Testing gene mutations for alleles: complementation test, intragenic complementation Genotypes & phenotypes: Effect of the environment on phenotype development Penetrance and expressivity, Visible, sterile and lethal mutations, Gene interactions and modifying genes, Pleiotropy, Pedigree analysis – Symbols of Pedigree, Pedigrees of Sex-linked & Autosomal (dominant & recessive)	**15**
3	**Microevolution in Mendelian population:** Hardy-Weinberg method & its applications – calculating allelic frequencies, assumptions of Hardy-Weinberg equilibrium, proof of	**10**

	Hardy-Weinberg equilibrium, Generation time, testing for fit to Hardy-Weinberg equilibrium Elemental forces of evolution; Mutation, Selection (Types of selection, selection coefficient, selection in natural populations), Genetic drift , Migration	
4	**Linkage & Crossing over** - Chromosome theory of Linkage, kinds of linkage, linkage groups, types of Crossing over, mechanism of Meiotic Crossing over, kinds of Crossing over, theories about the mechanism of Crossing over, cytological detection of Crossing over, significance of Crossing over.	**7**
5	**Genetic mapping of Mendelian traits:** Identifying recombinants and non recombinants in pedigrees. Genetic and physical map distances, Genetic markers, Two-point mapping- LOD score analysis, Multipoint mapping, Homozygosity map	**8**
Total		**45 hrs**

Name of the Program	**M. Sc. Medical Genetics**
Semester	**Semester III**
Name of the Subject	**Principles of Genetics & Population Genetics**
Subject Code	**MGEN 121 P**

Course Objective	1. Understand the fundamental principles of Mendelian and non-Mendelian inheritance. 2. Analyze genetic interactions such as linkage, multiple allelism, epistasis, and sex-linked inheritance. 3. Apply problem-solving approaches to understand patterns of inheritance in individuals and populations. 4. Interpret pedigrees to determine modes of inheritance and assess genetic risk. 5. Understand population genetic principles such as gene frequency, Hardy–Weinberg equilibrium, and evolutionary forces. 6. Develop quantitative reasoning skills for analyzing genetic variation and inheritance patterns. 7. Correlate classical genetics with molecular and clinical genetics applications in human populations.
Course Outcomes	1. Explain key principles of classical and population genetics. 2. Solve problems related to linkage, multiple alleles, epistasis, and sex-linked inheritance. 3. Construct and interpret pedigrees to identify inheritance patterns and carrier probabilities. 4. Apply Hardy–Weinberg principles to analyze allele and genotype frequencies in populations. 5. Evaluate the effects of mutation, selection, migration, and genetic drift on population structure. 6. Integrate problem-based learning to reinforce conceptual understanding of genetic interactions. 7. Relate genetic principles to disease inheritance and population screening in clinical contexts. 8. Demonstrate analytical and critical thinking skills in interpreting genetic data.

Sr. No.	Topics	No. of Hrs.
PRINCIPLES OF GENETICS &POPULATION GENETICS		**30**
1	Problems based on linkage	
2	Problems based on multiple alleles	
3	Problems based on epitasis	
4	Problems based on sex-linked inheritance	
5	Pedigree case studies	
Total		**30 hrs.**

Reference Books:

1. Principles of Population Genetics, Daniel L. Hartl, Andrew G. Clark
2. Principles of Genetics, Binder Ready Version, By D. Peter Snustad, Michael J. Simmons
3. Principles of Behavioral Genetics, By Robert RH Anholt, Trudy F. C. Mackay

Name of the Program	**M. Sc. Medical Genetics**
Semester	**Semester III**
Name of the Subject	**RESEARCH PROJECT / DISSERTATION**
Subject Code	**MGEN 117**

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

Research Project / Dissertation:

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

SECOND YEAR

M.Sc. MEDICAL GENETICS

SEMESTER-IV

Code No.	Core Subjects
Discipline Specific Core Theory	
MGEN 122 T	Bioethics, IPR and Biosafety
Discipline Specific Core Practical	
MGEN 123 P	Internship/Training (Clinical/Industrial)
MGEN 117	Research Project / Dissertation

Name of the Program	**M. Sc. Medical Genetics**
Semester	**Semester IV**
Name of the Subject	**BIOETHICS, IPR AND BIOSAFETY**
Subject Code	**MGEN 122 T**

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

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

Reference book:

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

Name of the Program	**M. Sc. Medical Genetics**
Semester	**Semester IV**
Name of the Subject	**INTERNSHIP/TRAINING (CLINICAL/ INDUSTRIAL)**
Subject Code	**MGEN 123 P**

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

Internship/Training (Clinical/ Industrial):

The Industrial Visit / Internship is an integral part of the M.Sc. Medical Genetics program, designed to provide students with exposure to real-world applications of genetic laboratories, research laboratories, hospitals, and healthcare settings. It enables students to bridge classroom learning with practical experience, understand professional work environments, and gain insights into industrial processes, regulatory practices, and advanced technologies. This component also enhances problem-solving, teamwork, and communication skills, preparing students for careers in Genetics research, clinical diagnostics, pharmaceuticals, and allied industries. The students have to search the Internship/Training (Clinical/ Industrial) opportunities on their own at least 2 to 3 months prior before starting of the actual course. The student has to prepare the detailed log book along with weekly summary report (**210 hrs.)**

Name of the Program	**M. Sc. Medical Genetics**
Semester	**Semester IV**
Name of the Subject	**RESEARCH PROJECT / DESSERTATION**
Subject Code	**MGEN 117**

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

Research Project / Dissertation:

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

Internship / Training Logbook

MASTER
IN
MEDICAL GENETICS

STUDENT NAME: _____

PRN NUMBER: _____

BATCH: _____

SEMESTER:_____

PERIOD FROM:_____**TO**_____

COORDINATOR **HOD** **DIRECTOR**

MGM SCHOOL OF BIOMEDICAL SCIENCES, NAVI MUMBAI
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AIM:

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

Guidelines:

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

Evaluation of Internees:

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

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

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

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(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

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

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

DEPARTMENT OF MEDICAL GENETICS

Internship/ Training Completion Certificate

Class: _____ **Year:** _____

This is to certify that_____, bearing PRN_____,

has successfully completed the internship at _____ **from**

_____to_____. During this period, the student has completed a total of **210 hours** of internship, as per the university guidelines.

The student demonstrated a high level of professionalism, technical competence, and problem-solving skills.

We wish him/her success in his/her future endeavours.

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

Weekly Summary Report

Week: _____

Total Hours Completed This Week: _____

Key Activities Performed:

Challenges Faced & How They Were Addressed:

New Skills Acquired:

Comments by Internship Supervisor:

STUDENT'S DAILY LOG RECORD

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

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

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

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

Final Evaluation (50 Marks)

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

    _____

    _____

Sign of Internal Examiner: _____

Sign of External Examiner: _____

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Scheme of University Examination Theory for PG Program:

General structure / patterns for setting up question papers for Theory / Practical courses, their evaluation weightages for PG programs of MGMSBS are given in the following tables

Marks scheme for the University exam:

Final theory marks will be 100 marks (80 marks University Theory exam + 20 Marks Internal assessment).

Question		**Marks distribution**	**Marks allotted per section**	**Marks**
Sec: A	MCQ	10 x 1 M = 10	10	10
Sec: B	SAQ	3/4x 5 M = 15	15	35
Sec: B	LAQ	2/3 x 10 M = 10	20	
Sec: C	SAQ	3/4x 5 M = 15	15	35
Sec: C	LAQ	2/3x 10 M = 10	20	
Total				**80 Marks**

Practical exam pattern: Total 40 marks with following breakup:

Exercise	**Description**	**Marks**
Q No 1	Practical exercise – 1	1 x15=15 M
Q No 2	Station exercise	2x5M=10 M
Q No 3	VIVA	10 M
Q No 4	Journal	5M
Total		**40 Marks**

Practical to be conducted at respective departments and marks submitted jointly by the parent department to the university.

Breakup of theory IA calculation for 20 marks

Description	**Marks**
Internal exam (at department)	15 marks
Seminar	5 marks
Total	**20 Marks**

Breakup of practical IA calculation:

Description	**Marks**
Internal exam (at department)	10 marks
Viva	5 marks
Journal	5 marks
Total	**20 Marks**

Note –20 marks to be converted to 10 marks weightage for submission to the university.

Model Checklist for Evaluation of the Clinical Directed Posting (PG)

Name of the student: _____Date:_____
Program: _____
Semester: _____ Name of the internal faculty/Observer: _____
Name of the External Faculty/Observer:_____

Core Competencies	Marks allotted	Marks obtained
Students will begin to develop critical thinking abilities utilizing the allied health personnel roles of communicator and caregiver. Students will learn principles of professional allied health personnel practice and provide direct care to individuals within a medical surgical setting while recognizing the diverse uniqueness of individuals with health alterations.		
Clinical Teaching		
a. Demonstrate beginning competency in technical skills.	10	
Independent Work by Student guided by faculty		
a. Develop effective communication skills (verbally and through charting) with patients, team members, and family	2.5	
b. Identify intra and inter-professional team member roles and scopes of practice. Establish appropriate relationships with team members.	2.5	
Hands on practical work by students		
a. Protect confidentiality of electronic/manual health records data, information, and knowledge of technology in an ethical manner	05	
Independent work by student		
a. Demonstrate expected behaviors and complete tasks in a timely manner. Arrive to clinical experiences at assigned times. Maintain professional behavior and appearance.	05	
Log book	10	
Viva	10	
Attendance	05	
Total	**50 Marks**	

Sign of Internal Examiner:_____
Sign of External Examiner:_____

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

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

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

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

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

Name of the student: _____Date:_____

Program: _____

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

Name of the External Faculty/Observer: _____

Final Evaluation (50 Marks)

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

    _____

    _____

Sign of Internal Examiner: _____

Sign of External Examiner: _____

MGM INSTITUTE OF HEALTH SCIENCES

(Deemed to be University u/s 3 of UGC Act, 1956)

Grade 'A' Accredited by NAAC

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