M.Sc. in Reproductive Genetics 2 Years (4 Semesters)

Overview: The **M.Sc. in Reproductive Genetics** is a specialized postgraduate program focused on the genetic aspects of human reproduction, including the study of genetic disorders, fertility issues, prenatal diagnostics, and assisted reproductive technologies (ART). This program integrates knowledge from genetics, molecular biology, obstetrics, and gynecology to address the genetic factors that impact fertility, pregnancy, and offspring health.

As genetic testing becomes increasingly important in reproductive medicine, this program prepares students to work in the field of genetic counseling, fertility clinics, prenatal genetic testing, and research on genetic disorders related to reproduction. It combines both theoretical knowledge and practical laboratory skills to train students for roles in healthcare, genetic counseling, research, and the biotechnology sector.

Affiliated Institution: School of Medical Sciences and Technology, Malla Reddy Vishwavidyapeeth (Deemed to be University) ****** The minimum eligibility for M.Sc. in Reproductive Genetics is a pass in B.Sc with at least 50% marks in qualifying exam.

Key Highlights:

- **Genetics in Reproduction**: Study the genetic basis of reproduction, including chromosomal abnormalities, genetic disorders, and inheritance patterns in human reproduction.
- **Assisted Reproductive Technology (ART)**: Learn about the genetic considerations involved in ART, such as in vitro fertilization (IVF), genetic screening, and embryo selection.
- **Genetic Counseling**: Gain skills in providing genetic counseling to couples with fertility problems, genetic disorders, or those undergoing assisted reproduction.
- **Prenatal Diagnosis**: Study the techniques for prenatal genetic testing, including amniocentesis, chorionic villus sampling (CVS), and non-invasive prenatal testing (NIPT).
- **Reproductive Health**: Understand the genetic factors affecting reproductive health, including infertility, polycystic ovary syndrome (PCOS), and genetic causes of miscarriage.
- **Molecular Genetics and Biotechnology**: Gain exposure to cutting-edge technologies used to study genes, including DNA sequencing, gene editing, and genome-wide association studies (GWAS).

Course Curriculum:

The M.Sc. in Reproductive Genetics is typically a two-year program that combines theoretical lectures, laboratory training, and research projects. The curriculum covers a variety of subjects related to genetics and reproduction.

Year 1:

Core Modules:

- **Basic Genetics**: Introduction to molecular genetics, gene structure, function, and inheritance patterns, focusing on human genetics.
- **Human Reproductive Biology**: Study of the biology of reproduction, including the male and female reproductive systems, gametogenesis, fertilization, and pregnancy.
- **Genetic Disorders and Inheritance**: Explore various genetic disorders that affect reproduction, including single-gene disorders, chromosomal abnormalities, and multifactorial inheritance.
- **Molecular Techniques in Genetics**: Learn laboratory techniques such as polymerase chain reaction (PCR), DNA sequencing, and genetic profiling used to diagnose and study genetic diseases.
- **Assisted Reproductive Technologies (ART)**: Introduction to ART techniques such as IVF, egg freezing, sperm donation, genetic screening, and embryo transfer, with a focus on genetic implications.
- **Genetic Counseling in Reproductive Health**: Study the role of genetic counselors in reproductive medicine, including the ethical, legal, and psychological aspects of providing counseling to couples.

Practical Training:

- Laboratory sessions involving DNA extraction, genetic testing, and analysis of reproductive samples.
- Hands-on experience with genetic counseling techniques, including risk assessment and communication strategies.

Year 2:

Advanced Modules:

- **Genetic Basis of Infertility**: Study the genetic causes of male and female infertility, including mutations in reproductive genes, chromosomal abnormalities, and epigenetic factors.
- **Prenatal and Pre-implantation Genetic Diagnosis**: Study the methods used for prenatal diagnosis of genetic disorders, including non-invasive prenatal testing (NIPT), amniocentesis, and pre-implantation genetic screening (PGS).
- **Epigenetics and Reproductive Health**: Explore how epigenetic modifications affect reproduction, including the role of DNA methylation, histone modification, and chromatin remodeling in fertility and pregnancy.
- **Reproductive Endocrinology and Genetics**: Study the hormonal regulation of reproduction and how genetic factors contribute to disorders such as PCOS, endometriosis, and early menopause.
- **Ethical, Legal, and Social Issues in Reproductive Genetics**: Understand the ethical, legal, and social implications of genetic testing in reproduction, including issues surrounding privacy, consent, and reproductive choices.
- **Genetic Research in Reproductive Medicine**: Explore the latest research in reproductive genetics, including genetic screening for inherited diseases, gene therapy, and personalized reproductive medicine.

Research Project/Dissertation:

- In the second year, students conduct original research in reproductive genetics, typically focusing on an aspect of genetic disorders, ART, or prenatal genetic screening.
- The research culminates in a dissertation, where students present their findings and contribute to the advancement of knowledge in reproductive genetics.

Career and Academic Opportunities:

Career Opportunities:

Graduates of the M.Sc. in Reproductive Genetics can work in a variety of sectors, including healthcare, research, biotechnology, and counseling. Potential career opportunities include:

- **Genetic Counselor**: Provide counseling services to couples, individuals, and families regarding reproductive risks, genetic testing options, and fertility concerns.
- **Clinical Geneticist**: Work in hospitals and fertility clinics diagnosing and managing genetic disorders related to reproduction, including chromosomal abnormalities and infertility.
- **Assisted Reproductive Technology (ART) Specialist**: Work in IVF clinics, offering genetic testing, pre-implantation genetic diagnosis, and fertility treatment options.
- **Research Scientist**: Work in academic or research institutions investigating the genetic causes of reproductive disorders, developing new genetic screening techniques, or studying the genetics of fertility and pregnancy.
- **Prenatal Genetic Testing Specialist**: Conduct genetic testing for prenatal screening, including offering expertise in non-invasive prenatal testing (NIPT), amniocentesis, and CVS.
- **Biotechnology Industry Specialist**: Work in companies that specialize in reproductive health products, including genetic testing kits, ART technologies, and fertility-related biotechnology.
- **Academic Faculty/Researcher**: Teach and conduct research in universities or medical schools specializing in genetics, reproductive medicine, and human development.

Academic Opportunities:

Graduates can pursue advanced academic degrees in specialized fields such as:

- **Ph.D. in Reproductive Genetics**: Focus on a specific aspect of reproductive genetics, such as genetic screening techniques, infertility treatments, or gene therapy.
- **Postdoctoral Research**: Engage in cutting-edge research on genetic disorders, ART, or the molecular basis of reproductive health.

Research Prospects:

- **Genetic Screening**: Develop new techniques for early detection of genetic disorders in embryos and fetuses.
- **Gene Therapy**: Explore potential gene therapies for genetic infertility or heritable reproductive conditions.

- **Epigenetics in Reproduction**: Investigate how environmental factors affect genetic expression in reproduction, leading to improved fertility treatments.
- **Pre-implantation Genetic Testing (PGT)**: Research and refine methods of screening embryos for genetic disorders before implantation during IVF procedures.
- **Fertility and Aging**: Study the genetic factors that influence fertility, particularly in relation to age, and explore potential interventions for age-related infertility.

Professional Opportunities:

- **Certified Genetic Counselor**: Obtain certification from professional organizations such as the **American Board of Genetic Counseling (ABGC)** or **European Board of Medical Genetics (EBMG)**.
- **Professional Memberships**: Join associations like the **American Society for Reproductive Medicine (ASRM)**, **European Society of Human Reproduction and Embryology (ESHRE)**, or the **International Society for Prenatal Diagnosis (ISPD)** to network and stay updated on the latest research in reproductive genetics.

Higher Education and Research Prospects:

- **Ph.D. in Genetics or Reproductive Biology**: Pursue a doctoral degree to further specialize in a specific area of reproductive genetics or molecular biology.
- **Postdoctoral Fellowships**: Engage in advanced research in reproductive genetics, genetic screening technologies, or the molecular mechanisms underlying fertility and pregnancy.

Conclusion:

The **M.Sc. in Reproductive Genetics** provides students with the necessary skills and knowledge to become experts in the genetic aspects of human reproduction. As advances in genetic testing and assisted reproductive technologies continue to shape the field of reproductive health, this program offers exciting career opportunities in genetic counseling, fertility clinics, research, and biotechnology. Graduates are prepared to tackle complex challenges related to genetic disorders, infertility, and pregnancy, contributing to improving reproductive health outcomes globally.

With the growing importance of personalized medicine and genetic counseling in reproductive care, this program offers students a unique opportunity to be at the forefront of innovations in genetics, reproductive medicine, and biotechnology.

Labs

1. Preimplantation Genetic Testing (PGT) & Embryo Screening Lab

- **Preimplantation Genetic Testing (PGT) Techniques:**
  - ✓ **PGT-A (Aneuploidy Screening)** for chromosomal abnormalities
  - ✓ **PGT-M (Monogenic Disease Screening)** for inherited disorders
  - ✓ **PGT-SR (Structural Rearrangements)** for chromosomal translocations
- **Blastomere & Trophectoderm Biopsy**

- **Fluorescence In Situ Hybridization (FISH) for Chromosomal Screening**
- **qPCR & Next-Generation Sequencing (NGS) for Embryo Genetic Testing**

2. Gamete Genetics & Sperm DNA Integrity Lab

- **Sperm DNA Fragmentation Assays:**
  - ✓ TUNEL assay
  - ✓ Sperm Chromatin Structure Assay (SCSA)
  - ✓ COMET assay
- **Y-Chromosome Microdeletion Testing for Male Infertility**
- **X-Linked Genetic Disorder Screening** in Male Gametes
- **Mitochondrial DNA (mtDNA) Analysis in Oocytes & Sperm**

3. Fertility-Related Genomic Disorders Lab

- **Genetic Testing for Recurrent Pregnancy Loss (RPL):**
  - ✓ Chromosomal microarray (CMA)
  - ✓ Parental karyotyping
- **Single-Gene Disorders Affecting Fertility:**
  - ✓ Cystic Fibrosis (CFTR mutation) and its effect on male infertility
  - ✓ Fragile X Syndrome (FMR1 gene) and ovarian insufficiency
- **Polycystic Ovary Syndrome (PCOS) Genomics:**
  - ✓ SNP genotyping for PCOS susceptibility genes
- **Endometriosis Genetic Risk Factors**

4. Non-Invasive Prenatal Testing (NIPT) & Prenatal Genetics Lab

- **Cell-Free Fetal DNA (cffDNA) Analysis in Maternal Blood**
- **NIPT for Chromosomal Abnormalities (Down Syndrome, Turner Syndrome, etc.)**
- **Carrier Screening for Inherited Genetic Disorders:**
  - ✓ Thalassemia, Sickle Cell Disease, Tay-Sachs Disease, etc.

5. Ovarian Reserve & Aging Genomics Lab

- **Genetic Markers for Ovarian Aging & Early Menopause:**
  - ✓ AMH gene variations
  - ✓ FMR1 premutation analysis
- **Mitochondrial Dysfunction & Oocyte Quality Studies**

6. Epigenetics & Environmental Effects on Reproduction Lab

- **DNA Methylation Studies in Embryo Development**
- **Histone Modifications & Gene Regulation in Fertility**
- **Impact of Endocrine Disruptors (e.g., BPA, Phthalates) on Gamete Epigenetics**

7. Reproductive Oncology & Cancer Genetics Lab

- **BRCA1/BRCA2 Mutations & Their Impact on Ovarian Reserve**
- **Genetic Testing for Hereditary Breast & Ovarian Cancer Syndrome (HBOC)**
- **Fertility Preservation in Cancer Patients: Genetic Considerations**

8. Ethics, Counseling & Clinical Genetics Lab

- **Genetic Counseling for Infertility & Prenatal Diagnosis**
- **Regulatory Frameworks in Reproductive Genetics (FDA, ESHRE, ASRM)**
- **CRISPR & Gene Editing in Human Embryos: Ethical Considerations**

PROGRAM OUTCOMES (POs)

PO	Program Outcomes
PO-1	Understand the genetic basis of reproductive health and hereditary disorders.
PO-2	Apply genomic techniques to diagnose and prevent genetic infertility.
PO-3	Conduct research on reproductive genetic mutations and their clinical implications.
PO-4	Utilize genetic counseling approaches for individuals with reproductive concerns.
PO-5	Ensure ethical compliance in genetic testing and reproductive medicine.
PO-6	Collaborate with reproductive specialists for precision medicine in fertility treatments.

COURSE STRUCTURE – M.Sc. Reproductive Genetics

SEMESTER – I

Sl. No.	Broad Category	Course Code	Name of the Subject/Practical	Contact hours/week			Credits
				L	T	P	
1.	Major (Core)	MSRG101	Human Reproductive Anatomy and Physiology	2	1	0	3
2.		MSRG102	Principles of Reproductive Biology	2	1	0	3
3.		MSRG103	Fundamentals of Human Genetics	2	1	0	3
4.		MSRG104	Genetic Disorders & Syndromes in Reproduction	2	0	2	3
5.	**Minor** Select any two minor courses, each worth 3 credits, for a maximum of 6 credits per semester	MSRG105	1. Genomics & Precision Medicine in Fertility 2. Genetic Counseling & Ethical Issues in Reproductive Medicine 3. Genetic Analysis & Cytogenetics Laboratory	2	0	2	6
			4. Prenatal Screening & Diagnosis 5. Computational Biology & Bioinformatics in Genetics 6. Research Methodology & Biostatistics	2	0	2	
6.	**Skill Enhancement Courses**	MSRG106	1. Molecular Techniques in Genetic Testing & PCR	0	0	2	2
			2. Interpretation of genetic test results for reproductive health	0	0	2	
Total				12	3	10	**20**
Total Contact Hours				**25**			

Course outcome for M.Sc. Reproductive Genetics MAJOR

Course Name	Course Outcomes
Human Reproductive Anatomy and Physiology	- Understand the anatomical structures of the male and female reproductive systems.- Explain the physiological processes involved in gametogenesis, fertilization, implantation, and pregnancy.- Analyze the hormonal regulation of reproductive functions and their role in fertility.- Evaluate the impact of reproductive health disorders on fertility and pregnancy outcomes.- Apply anatomical and physiological knowledge to clinical assessments and reproductive healthcare.
Principles of Reproductive Biology	- Understand the fundamental concepts of reproductive biology, including gametogenesis, fertilization, and embryonic development.- Explain the mechanisms of reproductive endocrinology and hormonal control of fertility.- Analyze the role of reproductive cycles in males and females and their clinical significance.- Evaluate the impact of reproductive health issues on fertility, pregnancy, and overall well-being.- Apply reproductive biology principles in fertility management, ART, and reproductive research.
Fundamentals of Human Genetics	- Understand the principles of Mendelian and non-Mendelian inheritance.- Explain chromosomal structure, genetic variation, and mutation mechanisms.- Analyze genetic contributions to normal development and hereditary diseases.- Evaluate the role of genetic counseling, screening, and ethical considerations in reproductive medicine.- Apply molecular and cytogenetic techniques for genetic diagnosis and research.
Genetic Disorders & Syndromes in Reproduction	- Understand the genetic basis of reproductive disorders and congenital abnormalities.- Explain chromosomal abnormalities such as Down syndrome, Turner syndrome, and Klinefelter syndrome.- Analyze inherited disorders affecting fertility, pregnancy, and neonatal health.- Evaluate diagnostic techniques for detecting genetic syndromes in prenatal and postnatal care.- Apply genetic screening and counseling approaches for managing reproductive genetic conditions.

Course outcome for M.Sc. Reproductive Genetics MINOR

Course Name	Course Outcomes
Genomics & Precision Medicine in Fertility	- Understand the role of genomics in fertility and reproductive health.- Explain how genetic variations influence fertility, implantation, and pregnancy outcomes.- Analyze the applications of precision medicine in treating infertility and recurrent pregnancy loss.- Evaluate advancements in genome sequencing,

Course Name	Course Outcomes
	pharmacogenomics, and personalized ART approaches.- Apply genomic data to optimize fertility treatments and reproductive healthcare decisions.
Genetic Counseling & Ethical Issues in Reproductive Medicine	- Understand the principles and process of genetic counseling in reproductive healthcare.- Explain ethical, legal, and social considerations in genetic testing, ART, and reproductive decision-making.- Analyze case studies involving ethical dilemmas such as embryo selection, gene editing, and surrogacy.- Evaluate the psychological and emotional impact of genetic disorders on patients and families.- Apply genetic counseling techniques to guide individuals and couples in informed reproductive choices.
Genetic Analysis & Cytogenetics Laboratory	- Understand the principles and techniques used in genetic and chromosomal analysis.- Explain karyotyping, fluorescence in situ hybridization (FISH), and chromosomal microarray analysis.- Perform laboratory-based cytogenetic techniques for diagnosing genetic and reproductive disorders.- Analyze chromosomal abnormalities and their clinical implications in fertility and prenatal care.- Apply cytogenetic tools for embryo screening, prenatal diagnosis, and reproductive genetics.
Prenatal Screening & Diagnosis	- Understand the principles of prenatal screening and diagnostic techniques.- Explain the role of non-invasive prenatal testing (NIPT), amniocentesis, and chorionic villus sampling (CVS).- Analyze genetic, biochemical, and ultrasound markers for detecting fetal abnormalities.- Evaluate the ethical, legal, and social implications of prenatal genetic testing.- Apply prenatal screening techniques to improve maternal-fetal health outcomes.
Computational Biology & Bioinformatics in Genetics	- Understand the applications of computational tools in genetic research and reproductive medicine.- Explain bioinformatics techniques for analyzing genomic and transcriptomic data.- Analyze large-scale genetic datasets using software tools such as BLAST, FASTA, and phylogenetic analysis.- Evaluate the role of artificial intelligence and machine learning in fertility genomics.- Apply computational methods for variant analysis, functional genomics, and reproductive genetic studies.
Research Methodology & Biostatistics	- Understand the principles of scientific research design and hypothesis testing.- Explain data collection methods, sampling techniques, and statistical study designs.- Analyze statistical methods used in reproductive genetics and biomedical research.- Evaluate data interpretation, statistical significance, and error analysis.- Apply biostatistical software (SPSS, R, Python) for data analysis and visualization in genetic studies.

M.Sc. in Reproductive Genetics – Course Structure & Syllabus

Course Duration: 2 Years (4 Semesters)

Total Credits: 80–100

Total Teaching & Training Hours: ~3,600

Total Teaching Hours Distribution

- **Theory Classes:** ~1,200–1,500 hours
- **Laboratory Training & Practical Sessions:** ~800–1,000 hours
- **Clinical & Research-Based Training:** ~800–1,000 hours
- **Research Project & Dissertation:** ~300–500 hours

Assessment Methods

Assessment Component	Weightage (%)	Details
Continuous Internal Assessment (CIA)	**40%**	Includes internal exams, assignments, presentations, case studies, and practical performance
End-Semester Examination (ESE)	**60%**	Divided into theory (40%) and practical (20%)
Mid-Semester Exams	**20%** (Part of CIA)	Two internal tests per semester
Assignments & Case Studies	**5%** (Part of CIA)	Research-based assignments, literature reviews, clinical case reports
Seminars & Presentations	**5%** (Part of CIA)	Oral/poster presentations on diabetes management
Practical Performance & Clinical Evaluation	**5%** (Part of CIA)	Skill-based assessments in labs/hospitals
Attendance & Participation	**5%** (Part of CIA)	Regularity in theory & practical sessions
Theory Examination (Final)	**40%** (Part of ESE)	Structured written paper covering subject knowledge
Practical Examination (Final)	**20%** (Part of ESE)	Includes viva, skill demonstration, case handling
Dissertation/Research Project	**Mandatory**	Evaluated in the final year by internal & external examiners
Clinical Internship/Training	**Pass/Fail**	Logbook-based evaluation with hospital mentor review

Marking System & Grading

Marks (%)	Grade	Grade Point (GPA/CGPA Equivalent)	Classification
90 - 100	O (Outstanding)	10	First Class with Distinction
80 - 89	A+ (Excellent)	9	First Class with Distinction
70 - 79	A (Very Good)	8	First Class
60 - 69	B+ (Good)	7	First Class
50 - 59	B (Satisfactory)	6	Second Class
<50 (Fail)	F (Fail)	0	Fail (Re-exam Required)

Pass Criteria:

- **Minimum 50% marks in each subject** (Theory & Practical separately).
- **Aggregate of 55% required for progression** to the next semester.
- **No more than two backlogs** allowed for promotion to the final year.

Exam Pattern for Theory & Practical

A. Theory Examination Pattern

Total Marks: 100 (Converted to 40% for End-Semester Assessment)
Duration: 3 Hours

Section	Question Type	No. of Questions	Marks per Question	Total Marks
Section A	Short Answer Type (SAQ)	10 (Attempt all)	2	20
Section B	Long Answer Type (LAQ)	5 (Attempt any 4)	10	40
Section C	Case-Based/Clinical Scenario	3 (Attempt any 2)	15	30
Section D	MCQs/Objective Type	10 (Compulsory)	1	10
Total				**100**

Weightage:

- Genetic Basis of Reproduction & Hereditary Disorders – 40%
- Molecular & Cytogenetic Techniques in Reproductive Genetics – 30%

- Research & Case Studies in Reproductive Genetics – 20%
- Ethical & Legal Aspects of Genetic Counseling – 10%

Passing Criteria: Minimum **50% (50/100 marks)**

B. Practical Examination Pattern

Total Marks: 100 (Converted to 20% for End-Semester Assessment)
Duration: 4–6 Hours

Component	Marks Distribution
Clinical Case Presentation & Genetic Disorder Assessment	30
OSCE (Objective Structured Clinical Examination) – Skill Demonstration	25
Molecular & Cytogenetic Techniques in Reproductive Genetics	20
Lab-Based Examination (DNA Extraction, PCR, Karyotyping, Preimplantation Genetic Testing)	15
Record Work (Logbook & Assignments)	10
Total	**100**

OSCE (Skill-based Assessment) includes stations on:

- DNA Isolation & PCR for Genetic Testing
- Karyotyping & Chromosomal Abnormality Detection
- Preimplantation Genetic Testing (PGT) Techniques
- Genetic Counseling for Hereditary & Reproductive Disorders

Passing Criteria: Minimum 50% (50/100 marks) in practicals.

Recommended Books & E-Resources

Textbooks

- **"Human Molecular Genetics"** – Tom Strachan & Andrew Read
- **"Medical Genetics"** – Lynn B. Jorde
- **"Principles of Genetics"** – Snustad & Simmons
- **"Preimplantation Genetic Diagnosis"** – Joy D. A. Delhanty

E-Resources & Journals

- **Human Reproduction (Oxford Academic Journal)**
- **American Journal of Medical Genetics**
- **Prenatal Diagnosis (Wiley Journal)**

- **European Society of Human Reproduction and Embryology (ESHRE) Guidelines**

Career Opportunities after M.Sc. in Reproductive Genetics

- **Genetic Counselor** in Fertility & Reproductive Medicine Centers
- **Clinical Geneticist** in Hospitals & Prenatal Screening Units
- **Embryologist & Genetic Specialist** in IVF & ART Clinics
- **Research Scientist** in Genomics & Stem Cell Research
- **Medical Educator** in Universities & Genetic Counseling Programs