Department of Genetics

Program Specific Outcomes (PSO)

Program- MSc. Genetics (404)

The course prepares students for pursuing further research and teaching.

Key features:
- Students have high success rate of qualifying the NET examination.
- Most make it to the best institutions across the country for doctoral studies.
- Our alumni are placed in prestigious institutions such as IISc, CCMB, IGIB, NII, IISERs and NCBS among others.
- Some students make a successful transition to foreign universities
- Alumni from the department has also secured faculty positions at prestigious universities in India and abroad.

Program - PhD Genetics

The PhD programs prepares the doctoral students to pursue research, teaching and industry-oriented jobs.
- Find placement as post-doctoral fellows in research institutions in India and foreign institutions
- Alumni have acquired faculty positions at prestigious institutions within and outside the country
- Many have also been absorbed in the industry

Course Outcome (CO)

PROGRAM: MSc Genetics

- **GEN0701: Introduction to Genetics**
  Genetic analysis is studied with reference to reverse and forward genetics and use of phenotypic, biochemical and molecular markers. Emphasis is laid on sources of genetic variation, which forms the basis of understanding diversity in a population.

- **GEN0702: Chromosome, Genes and Genomes**
  Genome organization in model organisms, techniques for studying chromosomes and applications such as comparative genome hybridization and somatic cell hybrids are taught.

- **GEN0703: Cell Biology and Biochemistry**
  Cell structural organization, regulation of biochemical pathways and networks with special attention to physiological conditions such as stress, exercise and starvation as well as diseased conditions such as Diabetes.

- **GEN0704: Bioinformatics and Biostatistics**
  This course is aimed at imparting knowledge of application of computational methods in order to address biological problems. Web-based programs to obtain and manipulate biological data (both sequence and structure) are taught to highlight sequence-structure-function relationship to further understanding of biological systems.

- **GEN0705: Practicals (based on the theory courses taught)**
  Experimental and hands-on knowledge on bacterial culture, mutagenesis, studying chromosomal aberration, protein estimation and enzyme kinetics, SDS-PAGE analysis, usage of gene prediction, and basic tools such as ClustalW, BLAST, PDB etc. Phylogenetic analysis, multiple sequence alignment and homology modeling tools are also taught.

- **GEN0801: Population, evolutionary and quantitative genetics**
  Forces that have an impact on levels of genetic variations in natural and/or experimental populations for both qualitative and quantitative traits, and the tools to study these traits are taught.

- **GEN0802: Molecular Biology**
  The students learn of the transport of biomolecules in eukaryotes, turnover of regulatory molecules, signaling, crosstalk between basic processes and cell cycle, and basics on programmed cell death.

- **GEN0803: Regulation of Gene Expression**
  Gene expression is regulated at various stages of transcription, translation and post- translation and epigenetic regulation is taught by using examples from various model organisms.

- **GEN0804: Recombinant DNA Technology**
  This paper provides the details of the various techniques and tools used as well as their application in the generation of commercial products of myriad usage (Biotechnology).

- **GEN0805: Practicals (Based on theory courses taught)**
  With these set of practicals, students learn the basic Recombinant DNA technology skills required for any molecular biology work. This includes running agarose gel, plasmid preparations, nucleic acid isolation, restriction enzyme digestion, primer design & PCR and Southern hybridization. They also learn to perform recent techniques such as bisulphite conversion of DNA for methylation analysis.

- **GEN0901: Microbial Genetics**
  This paper deals with the strength of microbial genetics: both prokaryotic as well as eukaryotic systems. Current molecular tools involved in microbial genetic analysis such as construction of vectors and artificial chromosome systems are also studied.

- **GEN0902: Human Genetics**
  This introductory course attempts to walk the students through classical genetics and molecular genetics. Application of mapping tools, cloning strategies culminating in the, new/ current knowledge on genetic variations in health and disease across populations and their clinical/diagnostic implications are dealt with

- **GEN0903: Plant Genetics and Breeding**
  This course primarily deals with how to undertake plant genome analysis and gene mapping through the use of DNA markers and how this information could be utilized in bringing the efficiencies in selection methods of plant breeding and gene isolation through forward genetics approach.

- **GEN0904: Plant Biotechnology**
  This course is designed to provide students with specialized knowledge of the theory and practical skills of plant tissue culture, somatic cell genetics and genetic engineering relevant to crop improvement.

- **GEN0905: Practicals (Based on the theory taught)**
  Study of gene expression is performed to achieve phenotypic and biochemical characterization of wild type and mutant E.coli and yeast strains. Students are taught to work with phages and yeast. Cytogenetics and chromosome preparation for studying banding is also taught. Additionally, genotyping using PCR based fingerprinting methods is also a feature of the hands-on curriculum. A field trip to a plant breeding station is a popular practical among the students. Plant tissue culture is extensively taught and individually performed by the students.

- **GEN1001: Developmental Biology**
  The course envisages giving an insight into how developmental patterns arise using examples from different model systems and highlighting regulatory networks involved in these processes.

- **GEN1002: Immunology**
  The course provides a comprehensive overview of basic immunology beginning with the innate immune responses, followed by a study of the main aspects of acquired immunity and genetics of antibody development.

- **GEN1003(i): ELECTIVE COURSE - Drosophila Genetics**
  Life cycle, stem cell maintenance, mutagenesis and transgenics approaches of Drosophila are taught in detail. The use of **Drosophila** as a model for human

genetic disorders and drug screening in Parkinson's, Huntington's, Alzheimer's diseases, Fragile-X syndrome, Cancer etc. is studied.

- **GEN1003(ii): ELECTIVE COURSE - Biology of Dictyostelium**
  The course is designed to provide some fundamental principles on which to form an intergrated view of various genetic and molecular processes using Dictyostelium discoideum as a model system. The possibility of using Dictyostelium in biology and medicine is also discussed.

- **GEN1003(iii): ELECTIVE COURSE - Cancer Biology and Genetics**
  In this course students are taught the basics of tumor genesis and progression, the genetics basis of its onset and the signaling networks responsible for disease prognosis. The therapeutic relevance of genetic and epigenetic mutations is also discussed.

- **GEN1003(iv): ELECTIVE COURSE - Medical Genomics**
  An effective weaving together of previously separate strands of cytogenetics / biochemical genetics/ immunogenetics/ molecular genetics/ statistical, functional and population genetics in this course allows the students to envision translation of this exciting new knowledge to medical practice by diagnostic and therapeutic innovations.

- **GEN1003(v): ELECTIVE COURSE - Plant-Microbe Interactions**
  The course is designed to provide the genetic and molecular principles underlying plant- microbe interactions. Plant disease susceptibility and resistance is discussed in much detail.

- **GEN1003(vi): ELECTIVE COURSE - RNAi: Biology and Application**
  RNAi is an elegant and revolutionary reverse genetics approach has tremendous commercial promise. This course covers the basic aspects of RNAi biology, use of siRNAs and microRNAs for gene silencing, RNAi vectors and generation of transgenic animals and plants expressing dsRNA and the current and potential applications of RNAi in healthcare and agriculture.

- **GEN1003(vii): ELECTIVE COURSE - Yeast molecular genetics**
  The course is designed to provide some fundamental principles on which to form an integrated view of various genetic and molecular processes using yeast as a model system. Tutorials are in the form of discussion based on primary literature available related to each topic, highlighting the advances in each field.

- **GEN1004: Project Work**
  The objective of this project work is to provide hands-on experience to the students about handling a research problem independently. The students are encouraged to design a small research project around a topic being investigated in the allotted lab. The students are expected to present their objectives and

experimental design before initiation of the experimental work. After completion, the students are expected to present their findings as a presentation and report.

- **GEN1005: Practical (Based on theory)**
  The practical exposed the students to handling Drosophila embryos, experiment with Dictyostelium and introduction to other model organisms such as C.elegans and Zebra fish,

PROGRAM - PhD Genetics

- **PGEN01: Advances in Genetic Analysis-I**
  The course teaches basic genetics and advances in genetic analysis based on yeast, Dictyostellium, Drosophila as model systems as well as microbial pathogenesis

- **PGEN02: Advances in Genetic Analysis-II**
  The course emphasizes on applications of plant biotechnology and breeding for crop improvement as well as advances in medical and cancer genetic analysis.

- **PGEN03: Research methodology**
  The course teaches students to hypothesize, think, analyze, and present their research work using best scientific practices, writing skills and tools while practicing good laboratory practices and research ethics.