Semester – III

Theory Papers:
Paper – Gen 301: Immunology 100
Paper - Gen 302: Mutagenesis and cancer Genetics 100
Paper - Gen 303: Analytical Techniques in Genetics 100
Paper-Gen 304: Human Biomedical Genetics and Research Methodology 100

Practical Papers:
Paper- Pr Gen 301: Immunology, Mutagenesis and cancer Genetics 100
Paper- Pr Gen 302: Analytical Techniques in Genetics &Research methodology 100

Semester – IV

Theory Papers:
Paper- Gen 401: Genetic Engineering 100
Paper- Gen 402: Molecular Medicine 100
Paper- Gen 403: Animal and Environmental Biotechnology 100
Paper- Gen 404: Bioinformatics and Intellectual property rights. 100

Practical Papers:
Paper- Pr Gen 401: Genetic Engineering, Molecular Medicine, Biotechnology and Bioinformatics 100
Paper- Pr Gen 402: Project work 100
Syllabus for M.Sc. – II (Genetics)  
Semester - III  

Paper - Gen 301 : Immunology  
Total lectures: 45

Section I

I. Immunity: Types of infection and nature of infective agents. Nonspecific host defense mechanisms. Anatomical barriers; lysozyme, and other antimicrobial agents. Phagocytosis, and phagocytic cells, neutrophils, monocytes and macrophages, innate and acquired immunity, naturally and artificial acquired (passive and active), humoral and cell mediated immunity. [8]

II. Antigen: Recognition of self and non self, the major histocompatibility antigens, H-2 and HLA antigens. Antigenecity: antigen processing and presentation. Cytokines, monokines, lymphokines and their functions. [4]


IV. Complement system: Introduction, alternate and classical pathway, regulation [3]

Section II

I. Immuno-assay methods: Antigen-antibody interaction – affinity and avidity, determination of affinity and avidity constants. Principle, procedure and applications of Immunoprecipitation, neutralization, agglutination, complement fixation, immunodiffusion, immunoelectrophoresis, immunofluorescence, RIA, ELISA, micro ELISA Techniques. [7]

II. Molecular Immunology: theories of antibody formation; clonal selection and network, Genetics of antibody diversity, germ line and somatic mutation theories, immunoglobulin gene, MHC gene and TCR gene organization and their recombination, class switch off Ig genes. [7]

III. Immunization - Immunization practices, use of toxoids, killed and attenuated organisms. Surface components, and newer vaccines, production of vaccines. [5]

IV. Clinical Immunology: Immune disorders; hyper sensitivity, autoimmune and immunodeficiency diseases. Tissue transplantation; auto- iso-, allo-, and xenografts, tissue matching, transplantation rejection, mechanism and control, tumor immunology. [6]

References

Basic and Clinical Immunology; Stites et al., [Ed.] (1982) Lange.
Roitt’s Essential Immunology; Ivan, M. Roitt & Peter J Delves (2001) Blackwell Science
Immunology; Roitt et al., (2001), Mosby.
Immunology; Jan Klein [Ed.] (1990), Blackwell Science.
Kuby-Immunology; Goldsby et al., (2000), WH Freeman &Co.
Basic Immunology: Carpenter
Medical Immunology; Nagoba and Vedpathak.
Paper - Gen 302 : Mutagenesis and cancer Genetics

Total lectures: 45

Section I

Mutagenesis:
I. Mutagens- Definition, Types; physical mutagens(Ionizing and non-ionizing radiation), Chemical mutagens; their effect on the cell and chromosome. [6]


III. Structural Chromosomal abberations- Deletion, duplication, inversion, translocations. [2]


Section II

Cancer Genetics-

I. Introduction- Cancer cells and their characteristics, tumor viruses; types and examples. Cell proliferation and death machinery, machinery for PDC (Apoptosis) oncogenes. [8]

II. Oncogenes and Tumor suppressor genes- Oncogenes in human cancer and their genetic relevance, Tumor suppressor genes. Role of protooncogenes during drosophila development, [5]

III. Chromosomal and Genetic Basis metastasis; genetic basis of carcinogenesis, correlation between mutagenecity and carcinogenicity. Genetics of Leukemias , lymphomas, myelomas. [4]

IV. Diagnostics and Therapy- Methods of diagnosis, Radiotherapy, chemotherapy, use of immunotoxins in cancer therapy, retroviral drugs. [6]

References-
3. Vogel F. Chemical mutagenesis Spinger and Verlag.
Paper - Gen 303 : Analytical Techniques in Genetics

Total lectures: 45

Section I


IV. Blotting technique- Principle, procedure and applications of Western, Northern, and Southern blotting. Dot, Blot [4]

Section II


II. Spectrophotometry: Principle and biochemical applications of UV-Vis spectrophotometry, fluorimetry, turbidometry and flame spectrophotometry. [6]


IV. Dialysis: Principle and applications of Dialysis, equilibrium Dialysis and Ultra filtration. [3]

References
Methods of Enzymatic Analysis; Berg Meyer (1974) Vol. 1-X,
Cambridge University Press.
Protein Purification Applications, S.L.V. Harris and Angal (1990) IRL Press.
Protein Purification Methods, S.L.V. Harris and Angal (1989) IRL Press.
Paper - Gen 304 : Human Biomedical Genetics and Research Methodology

Section I

Human Biomedical Genetics
I. Blood and Blood group Antigens- Hematopoiesis, Formation of RBCs, WBCs, Platelets etc. ABO, Lewis, Rh, MN, Xg antigens, leukocytes and platelet isoantigens. Blood Transfusion and Erythroblastosis foetalis. [5]


III. Cellular and Molecular Cytogenetic Technologies and Prenatal Diagnosis - Conventional and specialized Chromosome staining protocols, FISH and GISH techniques. Amniocentesis, Chorionic villi biopsy, Cytogenetics of prenatal Chromosomal aberrations with clinical citations, Genetic counseling. [7]

IV. Single Gene Disorders and Inborn Errors Of Metabolism - Cystic fibrosis, Duchenne muscular dystrophy, Sickle Cell Anemia. Molecular and Biochemical basis of Phenylketonuria, Alkaptonuria, Maple Syrup urine, Albinism. [5]

Section II

Research Methodology


IV. Project Architecture- Preparation of manuscripts for publication in national and international journals. Computer application in Research, Use of internet in search of References, Presentation techniques -Power point presentation and poster presentation in scientific conferences and workshops [5]

References
3. Frank A. Barile, 2004, Clinical toxicology-Principle and mechanism, CRC press
Practical Papers:
Practicals for M.Sc. – II (Genetics)
Semester – III

Practical Paper – 305
Immunology, Mutagenesis and cancer Genetics

Immunology-
Qualitative and quantitative analysis of antibodies-
1. Ouchterlony Immuno-diffusion.
3. Blood typing
4. Rocket Electrophoresis
5. ELISA

Agglutination Test-
6. WIDAL test
7. VDRL test
8. Study of Mutagens-
   a. Physical mutagens
   b. Chemical mutagens
10. RBC counting
11. WBC counting

Practical Paper – 306
Genetic Analytical Techniques

Paper chromatography:– 50-Marks
1. Ascending Paper chromatography Peas
2. Ascending Paper chromatography Leaf Pigment
3. Ascending Paper chromatography Drosophila eye pigment
5. Descending Paper chromatography
6. Circular Paper chromatography
7. Column chromatography
   Electrophoresis;

10. SDS-PAGE;
11. Determination of Molecular weight of proteins by using Gel documentation system.
Syllabus for M.Sc. – II (Genetics)  
Semester - IV  
Paper - Gen 401: Genetic Engineering  
Total lectures:45  

Section I  
I. Introduction to Genetic Engineering.  
III. In Vitro construction of Recombinant DNA Molecules- Isolation of Vector and donar DNA and its purification, assembly of gene of interest and vector DNA, Amplification of Recombinant DNA Molecules. DNA sequencing methods (Sanger’s, Gilberts)  
IV. Transformation of cells with r-DNA- Principle and applications of transformation methods- Cacl₂ method, Electroporation, Microinjection, Gene-gun.  

Section II  
I. Screening and isolation of recombinant cells- Direct Screening, Indirect Screening, Colony hybridization, Immuno-Screening.  
II. Gene Libraries- Definition and introduction to genomic library, Construction of Genomic library. C-DNA library construction, Preparation of primers and probes, RFLP, RAPD, Microarray, DNA chips.  
III. Expression of cloned DNA in E.coli- Designing of E.coli Expression vector; Promoter, terminator, origin of replication, regulation of gene expression by promoter. Fusion protein.  
IV. r-DNA Technology and Human Health- Production of recombinant hormones; insulin, HGH, Hepatitis-B recombinant vaccine production.  

Reference :  
Paper - Gen 402: Molecular Medicine

Total lectures: 45

Section I

I. Biology and genetics of Stem cells- Definition and characteristics of stem cells, stem cell concept origin and nature of pluripotent stem cells, hematopoietic stem cells, neural stem cells, adult and embryonic stem cells, cancer stem cells, Cell based therapy. [8]

II. Genetic disorders - Cystic fibrosis, Duchenne muscular dystrophy, Severe Combined Immune Deficiency (SCID), [3]


IV. Epigenetics- Reprogramming of genomic function through epigenetic inheritance, Epigenetic asymmetry between parental genomes, Genetic reprogramming in the (a) germ line (b) zygote (c) somatic nuclei in oocyte. [8]

Section II

I. Molecular pathology- Genetics of human pathology, classes of genetic mutations in human, human mitochondrial diseases, loss of function and gain of function mutations in human, Agammaglobulinemia, diseases of collagens, Genetic basis of hemoglobinopathies. [8]

II. Molecular Diagnostics for Human Diseases- Minisatellites, DNA profiling based on STRs and FISH. [6]

III. Pharmacogenomics - Human genome project and molecular detection of human diseases [3]


References-
Paper - Gen 403: Animal and Environmental Biotechnology  Total lectures:45

Section I

Animal Biotechnology

I. Culture Media; Simulating natural conditions for growth of animal cells: Natural media – Plasma Clot, biological fluids tissue extract, Chemical defined media. Culture Methods a) **Primary Culture** – Cell lines, disaggregation of tissue, isolation of tissue, enzyme disaggregation, and mechanical disaggregation. b) **Secondary Culture** – transformed animal cells and continuous cell lines. [7]

II. Transfection of animal cell lines. Transfection techniques, transformation of cell HAT selection, Hybridoma technology, Production and applications of monoclonal antibodies, Selectable Makers and Transplantation of Cultural Cells. [8]

III. Expression of Cloned proteins in animal cell – Expression vector, over production and downstream processing of the expressed proteins. [4]

IV. Transgenic Animals; Techniques of transgenic animal production and their application. (Fish, mice, Sheep, Pigs) [4]

Section II

Environmental Biotechnology

I. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol and Gasohol [7]

II. Bioremediation

III. Treatment of municipal waste and Industrial effluents. [3]

IV. Bioleaching Enrichment of ores by microorganisms (gold, copper, and Uranium) Environmental significance of genetically modified microbes, plants and animals [5]

Reference: Animal Cell Biotechnology
1. Ian Freshney (4th Edition)
2. Buttler.

ENVIRONMENTAL BIOTECHNOLOGY
Paper - Gen 404: Bioinformatics and Intellectual property rights.
   Total lectures:45

Section I

Introduction to Bioinformatics-
I. Introduction to Bioinformatics-
   Applications of Bioinformatics, introduction to genomics and proteomics. [6]

II. Biological Databases-
    Significance, primary and secondary databases. Nucleotide and protein database and genome databases Database querying software. [6]

III. Sequence Analysis-
    Nucleotide and protein sequence analysis, homology sequence analysis-BLAST, FASTA, pair wise sequence analysis, multiple sequence analysis (CLUSTALW) [6]


Section II

Intellectual property rights-


III. Plant breeder’s right- UPOV, Breeders exemption, Plant variety protection in India. Farmer’s right, advantages and disadvantages of PBR. Quartine act. [6]

IV. Intellectual property rights and Biotechnology. [5]

References-
1. Data analysis for Bimolecular Science, Jhon Maber, (1999), Longman.
6. Introduction to Bioinformatics; T K Attwood & D J Parry-Smith, (2002), Pearson Education
7. Plant Biotechnology, Dr Chawala, for IPR.
Practical Papers:

**Semester – IV**

**Practical Paper – Gen 405**

Genetic Engineering and Recombinant DNA Technology and Molecular Medicine.

1. Isolation of DNA (Mitochondrial/ Chloroplast/ Yeast)
2. Study of physical property of DNA- DNA melting using U.V. Spectrophotometry.
3. Calculation of T_m of isolated DNA.
4. Study of effect of pH on DNA melting/Strand separation
5. Study of Conjugation.
6. Study of Sickled RBCs.
7. PCR - DNA amplification by PCR
8. Ligation

Animal and Environmental Biotechnology and Bioinformatics.

1. Isolation of liver parenchyma cells.
2. Separation of Serum and plasma from blood.
3. Estimation of BOD from water sample.
4. Estimation of COD from water sample.
5. Effect of industrial effluents on seed germination and plant growth.
6. Introduction to Genome Information resources- EMBL, DDBJ, GENBANK
7. Introduction to Protein Information resources- PIR, SWISS-PROT, PRINTS, PFAM
8. Structure of database entry.
9. Analysis of biological data using
   - BLAST
   - FASTA
   - Clustal W

**Practicals for M.Sc. – II (Genetics)**

**Semester – IV**

**Practical Paper – 406**

**Project - 100 Mark**

Students have to start the research project during III semester and submit and present during the practical examination of IV semester.