

Solapur University,

Solapur

M.Sc.- Genetics

(Semester pattern)

Syllabus 2010- 2011

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. Antigenicity;. antigen processing and presentation. Cytokines, monokines, lymphokines and their functions. [4]

III. Immunoglobulins: Structure and functions of immunoglobulins. Types- isotypes and idiotypes, T and B lymphocytes, origin, differentiation, characteristics and functions, nature of surface receptors, isoantibodies. Methods of raising antibodies. Monoclonal antibodies, production and purification. [5]

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.
- Immune System; M.C. Connel et al., [Eds.] (1981) Blackwell Science.
- Immunology at a Glance; J.H.L. Playfare [ed.] (1987), Blackwell Science.
- Immunology; Jan Klein [Ed.] (1990), Blackwell Science.
- Introduction to Immunology; Kim Bell [Ed.] (1990) 3 Ed. McMillan.
- NMS for Immunology; Hyde and Patnide [Eds.] (1990) John Wiley.
- Microbiology; Prescott, Harley and Klein, (2003) McGraw-Hill.
- Kuby-Immunology; Goldsby et al., (2000), WH Freeman &Co.
- Basic Immunology; Carpenter
- Medical Immunology; Nagoba and Vedpathak.

Section I

Mutagenesis:

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

II. Mutation- Definition, Induction and detection of mutations, screening procedures. Visible, Lethal, conditional mutations in *Drosophila*. Molecular basis of mutation, Types of mutation, Nutritional and dependency mutations (*Neurospora* and Bacteria). Clastogens and Carcinogens. [6]

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

IV. DNA Repair mechanism- Nucleotide excision repair, Base excision repair, Mismatch repair, SOS repair, Recombinational repair, Photoreactivation. Repair defects in human diseases. [8]

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-

1. Moore M.M. 1987, Mammalian Mutagenesis, Banbury report 28.
2. Bishob J. A. 1982, Retrovirus ,Cancer genes, Advances in Cancer Research.
3. Vogel F. Chemical mutagenesis Spinger and Verlag.
4. Sanberg A. A. 1980, The Chromosome in Human Cancer And Leukemia
5. Stich H. F. Carcinogens and Mutagens in EnvironmentCRC press.

Paper - Gen 303 : Analytical Techniques in Genetics

Total lectures: 45

Section I

I. Chromatography: Introduction. Principle, procedure and applications of - Adsorption chromatography, Thin Layer Chromatography (TLC), Paper, Counter Current Distribution (CCD), Gas Liquid Chromatography (GLC), Ion-exchange Chromatography, Molecular Sieve Chromatography, Chromatofocussing, Affinity Chromatography, High Performance Liquid Chromatography (HPLC) and Fast Protein Liquid Chromatography (FPLC). [8]

II. Centrifugation: Principle. Types of centrifuges. Differential, continuous and density gradient centrifugation. Preparative and analytical ultracentrifugation. Sedimentation velocity and equilibrium analysis and its applications. [6]

III. Electrophoresis: Principle, procedure and applications of - Isotachopheresis, Paper, Cellulose acetate, High - Voltage, Starch, Agarose, PAGE, SDS-PAGE, IEF and Pulsed field- electrophoresis. [6]

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

Section II

I. Radioisotopes: Nature of radioactivity - detection and measurement. Construction and use of scintillation counters. Autoradiography, preparation of labeled compounds. Application in biological sciences. Use of non-radioactive isotopes in biochemistry. [8]

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

III. Manometry : Introduction. Types of manometry- the Warburg Constant Volume Manometer and Gilson's Differential Respirometer and Applications. [4]

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

References

- Analytical Biochemistry; D.J.Holme and H. Pick, 3rd Ed.(1998) Longman.
Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work (1969) Vol. I & II, North Holland.
Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, (1993), Blackwell Science.
Methods of Enzymatic Analysis; Berg Meyer (1974) Vol. 1-X,
Practical Biochemistry ; Principles and Techniques; K.Wilson and J. Walker (1995) 4 thEdn. Cambridge University Press.
Principles of Instrumental Analysis, (1980) 2nd Edn.Holt- Saunders.
Principles and Techniques of Practical Biochemistry; Williams and Wilson (1981) 3rd Edn. Edward Arnold.
Protein Purification Applications, S.L.V. Harris and Angal (1990) IRL Press.
Protein Purification, Robert, K. Scopes (1988) 2 nd Edn. Springer-Verlag.
Protein Purification Methods, S.L.V. Harris and Angal (1989) IRL Press.
Techniques in Molecular Biology, Walker and Gastra (1983) Croom Helm.
Principles and techniques of Biochemestey and Molecular Biology; Keith Wilson and John Walker; 6th Edn. (2005) Cambridge University Press.

Paper - Gen 304 : Human Biomedical Genetics and Research Methodology

Total lectures: 45

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]

II. Genetic Basis Of Globin Gene Variations- Gene duplication and evolution of Globin Genes, Genetic disorders of haemoglobin molecules, Haemoglobinopathies. [6]

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

I. Research – Definition, Importance and Meaning of Research, Objectives of research, Characteristics of Research, Types of Research, Steps in Research, Identification, Selection and Formulation of Research Problem, Research Questions, Research Design, Formulation of Hypothesis, Review of Literature. Problems encountered by researchers in India [6]

II. Research methodology: Collection and review of research literature, sources of literature and their evaluation. General strategies for preparation of research proposals. Data representation in technical reports. [6]

III. Sampling Techniques: Sampling theory, Types of Sampling, Steps in Sampling, Sampling and Non-sampling errors, Sample Size, Advantages and limitations of Sampling. Data Collection Methods. [5]

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

1. Max Levitan, 1971, Text Book Of Human Genetics, 2nd Ed, Oxford Uni. Press
2. Sally Moody, 1999, Cell Lineage and Fate determination, Academic press.
3. Frank A. Barile, 2004, Clinical toxicology-Principle and mechanism, CRC press
4. Tom Strachan & Andrew P. Read. 2004, Human Molecular Genetics, 2nd Ed. John Wiley & Sons. (Asia)
5. Ricki Lewis. Human Genetics- Concepts and Applications, 3rd Ed. WCB, McGraw-Hill.
6. Amita Sarkar. 2001, Human Genetics, Dominant Publishers, VOL No-1&2 New Delhi.
7. Michael Baraister and Robin Winter, 1983, A Colour Atlas of Clinicle Genetics, Wolfe medical Publications Ltd

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.
2. Radial 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
9. Differential staining of Blood.
10. RBC counting
11. WBC counting
12. Normal and abnormal karyotype study related to human beings.

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
 4. Ascending Paper chromatography Egg protein.
 5. Descending Paper chromatography
 6. Circular Paper chromatography
 7. Column chromatography
- Electrophoresis ;**
8. Paper electrophoresis - separation of amino acids in serum.
 9. Paper electrophoresis - separation of proteins in serum.
 10. SDS-PAGE;
 11. Determination of Molecular weight of proteins by using Gel documentation system.
 12. Agarose gel electrophoresis.

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Syllabus for M.Sc. – II (Genetics)

Semester - IV

Paper - Gen 401: Genetic Engineering

Total lectures:45

Section I

I. Introduction to Genetic Engineering. [3]

II. Tools for Genetic Engineering- DNA manipulation enzymes- Exonucleases, Endonucleases, Restriction enzymes, Ligase. Gene cloning Vectors-Properties and structure of natural and artificial plasmids, Bacteriophages (λ and M13), Cosmids, animal and plant viruses, Phagmids. [6]

III. In Vitro construction of Recombinant DNA Molecules- Isolation of Vector and donor DNA and its purification, assembly of gene of interest and vector DNA, Amplification of Recombinant DNA Molecules. DNA sequencing methods (Sanger's, Gilberts) [7]

IV. Transformation of cells with r-DNA- Principle and applications of transformation methods- $CaCl_2$ method, Electroporation, Microinjection, Gene-gun. [6]

Section II

I. Screening and isolation of recombinant cells- Direct Screening, Indirect Screening, Colony hybridization, Immuno-Screening. [5]

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. [6]

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. [6]

IV. r-DNA Technology and Human Health- Production of recombinant hormones; insulin, HGH, Hepatitis-B recombinant vaccine production. [5]

Reference :

1. An introduction to Genetic Engineering (Second Edition) by Desmond S.T. Nicholl (Studies in Biology Series) I South Asian Edition 2002. Cambridge University Press.
2. DNA Technology : The Awesome Skill 2nd edition by Alcamo, I.E. (2000). Harcourt / Academic Press.
3. Genomes : Brown T.A. (1999) , Bios Scientific publishers, Oxford.
4. Cell and Molecular Biology 2nd edition by P.K. Gupta, Rastogi Publications.
5. The Science of Genetics by Atherly, A.G. Girton, J.R. & McDonald J.F. (1999) Saunders College Publishing / Harcourt Brace.
6. Genetics ; From Genes to Genomes by Hartwell I.H. et al (2000) McGraw Hill.
7. Human Genetics : Concepts & Applications, by Lewis R. (2001) McGraw Hill, Boston.
8. Human Molecular Genetics by Sudbery P (1998). Addison – Wesley Longman Harbor.
9. Gene IV, V, VI by Benjamin Lewin, Oxford University press, Oxford.
10. Principles of Genome Analysis. Primrose, S.B. (1995). Blackwell, Oxford.

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]

III. Gene Therapy- Types of gene therapy. Molecular diagnostic techniques of genetic diseases. Gene therapy for cystic fibrosis [4]

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]

IV. Pharmacogenetics - drug discovery, cardiovascular diseases, Drug metabolism, pharmacogenetics. Oligopeptide drugs. [5]

References-

1. Leaf Huang, Mien-Chie Hung, Ernst Wagner, 1999, Non viral vectors for gene therapy, Academic press.
2. Max Levitan, Ashley Montagu, 1977, text book of Human Genetics, 2nd Ed. Oxford University press, N.Y.
3. Tom Strachan & Andrew P. Read. 2004, Human Molecular Genetics, 2nd Ed. John Wiley & Sons. (Asia) PTE Ltd.
4. Ricki Lewis. Human Genetics- Concepts and Applications, 3rd Ed. WCB, McGraw-Hill.
5. Amita Sarkar. 2001, Human Genetics, Dominant Publishers, VOL No-1&2 New Delhi.

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
Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes, Phytoremediation. Degradation of pesticides and other toxic chemicals by micro-organisms. [6]

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.
3. Elements of Biotechnology – P.k. Gupta (1st Edition -2000) Rastogi Publications.

ENVIRONMENTAL BIOTECHNOLOGY

1. Microbial Biotechnogy (1995) Alexander n. Glazer Hiroshi Nikaido W.H.Freeman and Company
2. Molecular biotechnogy: Principles a nd Applications of Recombinant DNA –Bernaral R. Glick and Jack J. Pastemak ASM Press. Washington, D.C (1994).
3. Fungal Ecology and Biotechnogy (1993) Rastogi Publicaions, Meerut.

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]

IV Phylogenetic analysis. Application of Phylip. [4]

Section II

Intellectual property rights-

I. Introduction- Protection of intellectual property, World organizations, forms of protection- patent, copyright, trademark, geographical indications, trade secrets, Layout design of integrated circuits. [6]

II. Patent- Criteria and procedure of patenting, patenting biological material. Patent procedure in India. Patenting basmati rice in USA, Revocation of Turmeric and Neem patent. Patenting of biological material with example and case studies. [6]

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

IV. Intellectual property rights and Biotechnology. [5]

References-

1. Data analysis for Bimolecular Science, Jhon Maber, (1999), Longman.
2. Developing Bioinformatics Computer Skills; Cynthia Gibas et al., (2001) Shroff Publishers.
3. Introduction to Bioinformatics; Lesk, A.M. (2002)
4. Introduction to Computational Biology, Michael S. Waterman (1995) Champman -Hall.
5. Introduction to Proteomics; Daniel C. Liebler, (2002), Humana Press.
6. Introduction to Bioinformatics; T K Attwood & D J Parry-Smith, (2002), Pearson Education
7. Plant Biotechnology, Dr Chawala, for IPR.

Practicals for M.Sc. – II (Genetics)

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 P^H 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.