Examination Scheme of M.Sc. GENETICS (Semester System) w.e.f. the Academic Session 2008-09

Paper No.	Nomenclature of Paper	Marks of Internal Assessment	Marks of Th.Paper/ Practical	Total Marks	Duration of Th.Exam./ Pract.Exam.
SEMESTER – I					
GENET 401	Medical Genetics	20	80	100	3 hours
GENET 402	Microbial Genetics	20	80	100	3 hours
GENET 403	Ecological Principles for Genetic Studies	20	80	100	3hours
GENET 404	Transmission Genetics	20	80	100	3 hours
GENET 405	Labcourse- I			100	6 hours
			Total	500	
SEMESTER- II					
GENET 406	Molecular Cell Biology	20	80	100	3 hours
GENET 407	Fundamental of Molecular Genetics	20	80	100	3 hours
GENET 408	Population Genetics	20	80	100	3 hours
GENET 409	Immuno Genetics	20	80	100	3 hours
GENET 410	Lab. course – II	-	100	100	6 hours
	Total			500	
SEMESTER – III					
GENET 501	Applied Human Genetics	20	80	100	3 hours
GENET 502	Methods in Genetics	20	80	100	3 hours
GENET 503	Biomolecular interaction	20	80	100	3 hours
GENET 504	Eukaryotic Gene Structure and Function	20	80	100	3 hours
GENET 505	Lab. Course – III	-	100	100	6 hours
	Total			500	
SEMESTER – IV					
GENET 506	Developmental Genetics	20	80	100	3 hours
GENET 507	Evolutionary Principles for Genetic Studies	20	80	100	3 hours
GENET 508	Genetic Engineering	20	80	100	3 hours
GENET 509	Plant Molecular Genetics & Germ Plasm Conservation	20	80	100	3 hours
GENET 510	Lab. Course – IV	-	100	100	6 hours
	Total			500	
	Grand Total			2000	

Chairman,
PG Board of Studies in Biochemistry & Genetics

M.Sc. Previous Genetics

Semester – I

GENET 401 **Medical Genetics**

M. Marks: 80
Time: 3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

1.1 History and development of human genetics; pedigree- gathering family history symbols, construction of pedigree, pedigree analysis in monogenic traits;

1.2 Autosomal dominant and recessive inheritance; sex linked dominant and recessive inheritance; consanguinity and its effects; Sex linked anomalies –haemophillia, colour blindness.

1.3 Sex linked and sex influenced traits, sex determination in Man, TDF & SRY, testicular feminization syndrome; Single active X hypothesis ,Sex chromatin and drum sticks, genetic mosaics .

UNIT-II

2.1 One gene one enzyme hypothesis, Beadle and tautum experiment with neurospora;

2.2 Inherited enzyme defects in man; Disorders of amino acid metabolism: Phenylketoneuria, Alkaptoneuria;

2.3 Disorder of transport system: Cystinuria, Galactosaemia;

2.4 Diseases of pigment metabolism (Albinism).

UNIT-III

3.1 Human karyotypes: Banding, nomenclature of banding, nomenclature of aberrant karyotypes;

3.2 Chromosome numerical alterations; Haplody , diplody , polyplody, anuiplody,(nullisomy , monosomy, telosomy, trisomy and tetrasomy)

3.3 Common syndromes due to numerical chromosome changes; clinical features and genetics of Klinefilter, Down's, Edward and Turner syndrome;

3.4 Chromosomal structural alterations: Translocation-types and origin; Duplication - origin, types, position effect, breaking reunion and exchange hypothesis terminal and interstitial deletions, Fragile sites, Common syndromes due to structural alterations; Achondroplasia, Cridu chat and Polydactyly;

UNIT-IV

4.1 Genetic factors in some common diseases: Schizophrenia, Diabetes mellitus, Alzeimeir's disease; Huntington's disease and Cystic fibrosis.

4.2 ABO blood system, Rh blood group system;

4.3 Haemoglobinopathies (Sickle cell anaemia) Thalassaemia syndromes

Suggested Books:

- Molecular Diagnostics 2nd edition – George P. Patrinos, Wilhelm J. Ansorge, Academic press 2010.
- Molecular Diagnosis of Genetic Disease: v. 1 (Methods in Molecular Medicine) - R. Mountford, Humana Press Inc. , 2003.
- The New Clinical Genetics - Andrew Read, Dian Donnai, Scion Publishing Ltd, 2006.
- Applications of Genetics - Jennifer Gregory, Cambridge University Press, 2000.
- Medical Genetics - Lynn B. Jorde, John C. Carey, Michael J. Bamshad, Elsevier Health Sciences, 2009.
- Inherited Metabolic Diseases - Georg F Hoffmann, Johannes Zschocke, William L. Nyhan, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG publications, 2009.

GENET 402 **Microbial Genetics**

M. Marks: 80
Time : 3 hours

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit -I

Genetic recombination in Bacteria

1.1 Genome organization in Bacteria,

1.2 Identification & selection of mutants,

1.3 Transformation: Discovery of transformation – competence of bacterial cells; mechanism of transformation, Gene mapping by transformation,

1.4 Transduction: Generalized and specialized transduction; gene mapping by generalized & specialized transduction,

1.5 Conjugation: Unidirectional gene transfer, F^+ & F^-, High frequency recombination & gene mapping.

Unit -II

Regulation of gene expression in Bacteria

2.1 General features of regulation (control points of gene expression, induction & repression in prokaryotes)

2.2 Regulation of lactose utilization (lactose as a carbon source, organization of lactose operon genes, experimental evidence for the regulation of lac operon, model for regulation of lac operon, positve control of lac operon by CAP and cyclic AMP).

2.3 Regulation of tryptophan biosynthesis (regulation of trp. operon , attenuation).

Unit -III

Genetic of Bacteriophages.

3.1 Structure & classification.

3.2 Lytic cycle- Infection of host cells, formation of viral components, maturation & release of viral particles,

3.3 Lysogeny- nature of lysogeny, life cycle of lamda phage, integration of viral genome into host genome, lysogenic stage & prophage cycle, factors governing lysogeny.

Unit- IV

Fine structure analysis of Gene

4.1 Genetic recombination in phages (Effect of parental ratio on recombination frequencies, reciprocity in genetic recombination, recombination by breakage & rejoining of DNA molecules, effect of deletion on recombination)

4.2 Genetic mapping of phage T4 (genetic map of T4, phage heterozygote, packaging & production of phage)

4.3 Fine structure mapping of T4 r II locus,

4.4 Lamda DNA and its gene organization, recombination in lamda life cycle.

Suggested Books:

1. Microbial Genetics 2nd Edition, Stanely R. Maloy, John E. Cronan and David Freifelder, Narosa Publishing House, 2006
2 Molecular Genetics of Bacteria - Larry Snyder and Wendy Champness, 3rd edition, ASM Press, Washington, D.C. 2002.
3 Fundamental Bacterial Genetics - Nancy Trun, Janine Trempy , Wiley-Blackwell publications, 2003.
4 Microbial Genetics - David Freifelder, Cold Spring Harberer Lab. Press, New York
5 Essential Genetics - Russell, P.J, Blackwell Scientific Publishers

GENET 403 Ecological Principles for Genetics Studies

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Max. Marks: 80
Time: 3 Hrs.

Unit-I

1.1 **The Environment:** Physical environment; biotic environment; biotic and abiotic interactions.

1.2 **Habitat and niche:** Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

1.3 **Population ecology:** Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

Unit - II

2.1 **Species interactions:** Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

2.2 **Community ecology:** Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

2.3 **Ecological succession:** Types; mechanisms; changes involved in succession; concept of climax.

Unit - III

3.1 **Ecosystem:** Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

3.2 **Biogeography:** Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

Unit - IV

4.1 **Applied ecology:** Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

4.2 **Conservation biology:** Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Suggested Books:

1. Genes in the Environment - Rosie S. Hails, John E. Beringer, H. Charles J. Godfray, Wiley- Blackwell publications,2003.
2. Ecological Genetics – Andrew Lowe, Stephen Harris, Paul Ashton, Blackwell publications, 2004.
3. A Primer of Ecological Genetics - Jeffrey K. Conner, Michigan State University, and Daniel L. Hartl, Harvard University press, 2004.

GENET 404 Transmission Genetics

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Max. Marks: 80
Time: 3 Hrs.

Unit-I

1.1 **Mendelian principles:** Dominance, segregation, independent assortment, deviation from Mendelian inheritance.

1.2 **Concept of gene:** Allele, multiple alleles, pseudoallele, complementation tests.

1.3 **Extensions of Mendelian principles:** Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over(Genetic recombination and construction of genetic maps in Drosophila, Interference and coincidence, Cytological demonstration of crossing over in Drosophila, Mitotic recombination), sex linkage, sex limited and sex influenced characters.

Unit - II

2.1 **Gene mapping methods:** Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

2.2 **Extra chromosomal inheritance:** Inheritance of mitochondrial and chloroplast genes, maternal inheritance.

Unit - III

3.1 **Quantitative genetics:** Polygenic inheritance, Continuous and discontinuous variation, Genetic variance, heritability (narrow sense and broad sense) and genetic advance under selection, QTL mapping.

3.2 **Mutation:** Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.

3.3 **Recombination:** Homologous and non-homologous recombination, including transposition, site-specific recombination.

Unit – IV

Statistical Methods: Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); sampling distribution; difference between parametric and non-parametric statistics; confidence interval; errors; levels of significance; regression and correlation; t-test; analysis of variance; X^2 test;; basic introduction to Muetivariate statistics, etc.

Suggested Books:

1. Transmission and Population Genetics, 3rd edition - Benjamin Pierce, Benjamin Pierce publications, 2008.
2. Biostatistical Analysis 5th edition – Jerrold H.Zar, Pearson publication, 2010.
3. Evolutionary Analysis, 4th edition - Scott Freeman Evolution publications, 2008.
4. Statistical Genetics: Gene Mapping Through Linkage and Association –Ben Neale, Danielle Posthuma, Sarah Medland, Manuel Ferreira, Taylor & Francis Ltd, 2007.

GENET 405 Lab Course- I PRACTICALS BASED ON PAPERS I to IV

1. To Study the different types of Microscopy, uses and care of microscope.
2. To study the different methods of sterlisation
3. Microscopic examination of of living bacterial preparation
4. Microscopic Measurement of microorganisms
5. To perform the simple staining of bacteria to compare the morphological shapes and arrangement s of bacterial shapes.
6. To demonstrate Gram's staining of bacteria.
7. Preparation of media for Fungus and Bacteria culture.
8. Isolation of pure culture of microorganisms by streak plate and pour plate methods.
9. To plot a growth curve and determine the generation time of bacterial cultures.
10. Preparation of different stains of bacteria.
11. To determine the number of bacteria and fungi present in soil sample.
12. Pedigree, symbols, analysis, inheritance pattern in monogenic traits, Demonstration of Bar body, Genetic variability in human populations (morphogenetic, behavioral, serogenetics and PTC testing), Hematological studies in humans. Principles of quantitative genetics principles practicals
13. To determine the minimum size of the quadrat by species- area curve.
14. To study the community by quadrat method by determining frequency, density and abundance of different species present in the community.
15. Determination of species diversity index and importance value index of local vegetation.
16. To study the physical characteristics (temperature, colour and texture) of soil.
17. To determine water holding capacity of soils collected from different locations.
18. To determine pH and conductivity of soils collected from different locations.
19. To determine the pH and conductivity of water samples collected from different locations.
20. Chemical testing of soil for phosphorus, potassium and nitrate.
21. To determine percentage organic carbon and organic matter in the soils of crop land, grassland and forest.
22. Numerical problems on mean, median and mode.
23. Calculation of standard deviation and coefficient of variation.
24. Applications of t and chi- square tests in real life examples.

Semester – II

GENET 406 **Molecular Cell Biology**

Max. Marks: 80
Time: 3 Hrs.

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Unit-I

1.1 Microscopy: - Principle and application of light phase contrast, fluorescence, scanning and transmission electron microscopy.

1.2 Cytometry & flow cytometry.

1.3 Fixation & staining.

Unit - II

2.1 Membrane transport processes-free diffusion, osmosis, mediated permeability-fascilitation diffusion, active transport, shuttle processes.

2.2 Electrical potential across membrane.
Transport molecules: Transport molecule in fascilitated diffusion. Transport molecules in active transport, transport molecule inhibitors.

2.3 Ion gradient & energy exchange,

2.4 Proton pumps: proton pump in oxidative phosphoration, proton pump in photosynthesis, proton pump in bacteria.

2.5 Cytoskeleton: microfilament-structural organization, cell motility & cell shape, Microtubules- structural & functional organization, cilia, flagella, centriole.

Unit - III

3.1 Mitochondria: ultra structure, chemiosmotic theory and respiratory chain complexes,

3.2 Chloroplast: structure and genetic organization,

3.3 Structure & function of peroxisome,

3.4 Structure & biosynthesis of ribosome

3.5 Cell cycle: regulation of cell division- control of cell cycle in dividing cells, factors that stimulate cell division,

3.6 Mitosis- chromosomal events, role of spindle, chromosome movements,

3.7 Meiosis- chromosomal events, genetic recombination molecular theory, cytokinesis in animal & plant cell.

Unit - IV

4.1 Cell-cell interaction: cell adhesion, gap junction, Extra cellular matrix,

4.2 Signal transduction: - Intracellular receptor & cell surface receptors: Signaling via G protein linked receptors (PKA, PKC, CAM kinase); Enzymes linked receptor signaling (growth factor receptor signaling)

4.3 Cancer biology: Characteristic of cancer cells, Chemical carcinogenesis, Type of cancer, Metastasis, Oncogenes & Tumor suppressor genes

Suggested Books:

1. The Cell (2000)-A Molecular approach Cooper, Geoffrey M. Sunderland MA) Sinauer Associates Inc.
2. Cell and Molecular Biology(2007) :Concepts and Experiments 5th ed.Gerald Karp Wiley
3. Essential of Molecular Biology: David Frifieder, Jones and Barllelt Publications
4. Molecular Cell Biology (1994) 2nd ed. J.Darnell H.Lodish and Baltimore Scientific American Books,inc.USA,.
5. Molecular Biology of cell (1994) 2nd ed. B.Alberts, D.Bray, J.Lewis, M.Raff K.Roberts and J.D. Watson, Garland Publishing Inc. New york.
6. The Cell A Molecular Approach 5th edition- Geoffrey M.Cooper, Robert E. Hausman, ASM press, 2009.

GENET 407 Fundamentals of Molecular Genetics

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Max. Marks: 80
Time: 3 Hrs.

Unit-I

DNA replication, repair and recombination: Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms.

Unit - II

RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

Unit - III

Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post- translational modification of proteins.

Unit - IV

Control of gene expression at transcription and translation level: Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

Suggested Books:

1. Gardener et.al. (2001) Princial of Genetics 8th Ed. John Wiley, New York.
2. Hartl D.L (1999) Essential of Genetics 2nd ed. Jones and Barlett Publishers, London.
3. Klug,W.S and Cumming M.R. (2003) Concepts of Genetics 7th Ed. Pearson Education, Singapore.
4. Miglani G.S. (2002) Advanced Genetics, Narosa Publishing House New Delhi.
5. Watson et al. (2004) Molecular Biology of Gene 5th ed. Pearsons Education, New Delhi.
6. Concepts of Genetics 9th edition- Klung, Cummings, Spencer, Palladino, Pearson publication, 2009.
7. Principles of Genetics 5th edition – D. Peter Snustad, Michal J.Simmons, Wiley publication, 2010.
8. i Genetics A Molecular Approach 3rd edition – Peter J.Russel, Benjamin Cumming publication,2008.
9. Lewin's Genes X – Krebs, Goldstein, Kilpatrick, Jones and Bartlett publication, 2008.

GENET 408 **Population Genetics**

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Max. Marks: 80
Time: 3 Hrs.

Unit-I

1.1 Concept and theories of evolution

1.2 Microevolution in Mendelian population:

Mendelian Population; Allele frequencies and genotype frequencies; Hardy-Weinberg equilibrium and conditions for its maintenance

1.3 Elemental forces of evolution:

Mutation, Selection (Types of selection, selection coefficient, selection in natural populations), Genetic drift, Migration

Unit - II

2.1 Genetic variability in natural populations

2.2 Chromosomal and allozyme polymorphism

Adaptive genetic polymorphism; Balanced polymorphism and heterosis;

Genetic coadaptation and linkage disequilibrium

2.3 DNA polymorphism

Unit - III

3.1 Concept of species and modes of speciation :sympatric, allopatric, stasipatric .

3.2 Molecular population genetics
Molecular evolution (neutral theory, punctuated equilibrium)

3.3 DNA-based phylogenetic trees

3.4 Molecular clock

Unit - IV

4.1 Nonrandom breeding
Inbreeding and assortative mating

Path diagram construction and inbreeding coefficient, allelic identities by descent

4.2 Human phylogeny: Hominid evolution: anatomical, Geographial, Cultural; Molecular phylogenetics of Homo sapiens; Peopling of continents (Europe, Africa, Asia)

Suggested Books:

1. Principles of Population Genetics, Fourth Edition - Daniel L. Hartl and Andrew G. Clark, Sinauer Associates publications, 2007.
2. A Primer of Population Genetics, Third Edition - Daniel L. Hartl, Harvard University press, 2000.
3. Population Genetics – Matthew B.Hamilton, Willey-Blackwell publications,2009.
4. Conservation and the Genetics of Populations - Fred W. Allendorf, Gordon Luikart, Wiley-Blackwell publications, 2006.
5. Microbial Population Genetics - Jianping Xu McMaster University, Hamilton, Ontario, Caister Academic Press, 2010.

GENET 409 **Immuno Genetics**

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Max. Marks: 80
Time: 3 Hrs.

UNIT-I

1.1 General properties of immune system, Innate and adaptive immunity; Cells & organs of immune system;
1.2 Antigens (Haptens, epitopes, adjuvents) and antibodies; Immunoglobulin classes
1.3 Cytokines, interferons, colony stimulating factor, transforming growth factor.

UNIT-II

2.1 Genetic regulation of immune response: organization of immuno globulin genes,
2.2 Genetic control of light chains ((Lambda & Kappa), Genetic control of heavy chains;
2.3 Genomic rearrangement during B lymphocyte differentiation, somatic recombination events, antibody class switching, allelic exclusion, somatic mutation;
2.4 Genetic control of antibody diversity.

UNIT-III

3.1 MHC complex: Class I, II, III molecules;
3.2 Genetic map of H-2 complex & HLA Complex;
3.3 T cell receptor complex, Subtractive hybridization; Ig gene super family;
3.4 Humoral & cell mediated immune response;
3.5 Hypersensitivity reactions (I, II, III & IV types).

UNIT-IV

4.1 Disorders of immune system: Self tolerance & auto immunity;
4.2 Defects of B & T lymphocytes, Thyroiditis, IDDM, SLE, Rhematoid arthritis;
4.3 Immuno suppression, Immuno deficiency involving only B cells, only T cells; Severe combined immuno deficiency (SCID), AIDS;
4.4 Primary antigen, antibody reaction, Radio immunoassay Enzyme linked immunosorbant assay; Secondary antigen antibody reaction, precipitation & agglutination, immuno electrophoresis.

Suggested Books:

1. Benjamin E.(1996)- Immunology- A short course 3rd ed., John Wiley, New York.
2. Kuby, J. (1997) Immunology 3rd ed. W.H.Freeman and Co. New york.
3. Roitt, I.M. Immunology (1995)-An Introduction 9th ed. Oxford Blackwell Science ,London.
4. Immunology –Understanding the Immune sytem –Klaus D.Elgert.
5. Gupta P.K. (2003) .Biotechnology and Genomics, Rastogi Publications Merrut.
6. Roitt's Essential Immunology 9th edition-Peter J. Delves, Seamus J. Martin, Dennis R. Burton and Ivam, M.Roitt, Oxford University press, 2010.
7. Kuby Immunology 6th edition- Kindt, Goldsby, Osborne, Freeman publication, 2007.

GENET 410 Lab Course- II PRACTICALS BASED ON PAPERS VI to IX

Study different stages of mitosis in root tips of A*llium* species.

Study meiotic behaviour of chromosomes in Anthers of A*llium* sp. or *Tradescantia.*

Separation of membrane and demonstration of permeability.

Isolation and demonstration of mitochondria activity.

Heamagglutination, precipitation reactions, estimation of TLC, DLC, Quantitative estimation of antigen/antibody (ELISA, ODD,RID,IEP, QPA etc).

Extraction of total nucleic acid from plant tissues.

Determination of RNA by orcinol method.

Quantitative determination of DNA and RNA by spectrophotometric method.

Quantitative determination of individual bases in DNA

Demonstration of Mendelian principles using Drosophila/plant systems; Modification of dihybrid ratios using maize as model system; Multiple alleles ; Analysis of penetrance and expressivity;

Linkage and gene mapping using Drosophila/Neurospora;

Numerical exercises related to Mendelian principles, gene interactions, Linkage and gene mapping; Induction and detection of sex-linked recessive lethals (Drosophila); Analysis of quantitative inheritance in plant (variation in seed weight); DNA Isolation and analysis of size variation among genomes (bacteria, phage and plants)

M.Sc. Final Genetics

Semester – III

GENET 501 Applied Human Genetics

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Max. Marks: 80
Time: 3 Hrs.

UNIT-I

1.1 Organization of genome in humans: General features of chromosomes, reiterated sequences and their detection, protein coding genes, pseudogene;

1.2 Gene mapping: Gene mapping by somatic cell hybridization, top down approach to molecular mapping, restriction maps and contig construction (the bottom up approach);

1.3 Engineering chromosomes: Yeast artificial chromosome, making YACs, MACs (mammalian artificial chromosomes) and satellite DNA's artificial chromosomes (SAT ACS).

Unit-II

2.1 Molecular explanation of dominance, recessiveness, incomplete peneterance and variable expressivity.

2.2 Identifying the genetic basis of disease: Positional analysis experimental strategy;

2.3 Identification of specific disease gene in Huntington's disease, DMD and cystic fibrosis

Unit-III

3.1 Genetic screening: Prenatal, neonatal and adult screening;

3.2 Prenatal diagnosis: RFLP and prenatal counseling;

3.3 Treatment of genetic disease: Gene therapy (criteria and technical aspects), gene delivery systems; viral vectors and micro injection; germ line therapy.

Unit-IV

4.1 Studying the whole genome: Pulse field gel electrophoresis (to make large scale maps) , cloning of huge DNA segment, automated DNA sequencing;

4.2 Human genome project: History & concepts human genome project, gateways to access human genome, goals, role of sequencing, distribution of GC content, cpg islands & recombination rules, main conclusisons, current activities, STS proposal;

4.3 Social and ethical issues in human genome research.

Suggested Books:

- Human Molecular Genetics 3- Tom Srechan and Andrew P.Read, Garland Science publications, 2004.

GENET 502 **Methods in Genetics**

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Max. Marks: 80
Time: 3 Hrs.

Unit-I

Principles and techniques of nucleic acid hybridization and cot curves; sequencing of nucleic acids; Southern, Northern and South -Western blotting techniques; Polymerase Chain reaction; Methods for measuring nucleic acid and protein interaction.

Unit - II

Biophysical methods: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

Unit - III

Principle & application of gel filteration, ion exchange & affinity chromatography; thin layer chromatography ; gas chromatography; High pressure liquid chromatography (HPLC), Electrophoresis (starch, agarose, page); Electrofocussing; Ultracentrifugation (Velocity and buoyant density).

Unit – IV

Radio labeling techniques: Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines

Computational methods: Nucleic acid and protein sequence databases; data mining methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation.

Suggested Books:

Molecular cloning A Laboratory Manual 3rd edition Vol. 1,2, 3- Sambrook and Russell, Churchill press, 2007

GENET 503 Biomolecular Interactions

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Max. Marks: 80
Time: 3 Hrs.

Unit-I

1.1 Structure of atoms, molecules and chemical bonds.

1.2 Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).

1.3 Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).

Unit - II

2.1 Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).

2.2 Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.

Unit - III

3.1 Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes

3.2 Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds).

Unit - IV

4.1 Conformation of nucleic acids (A-, B-, Z-,DNA), t-RNA, micro-RNA).

4.2 Stability of protein and nucleic acid structures.

Suggested Books:

1. Lehinger, (2004) –Principles of Biochemistry 4th. By David L. Nelson and M.M Cox 2005 Maxmillan worth Publishers W.H. freeman and Company
2. Biochemistry by David Rawn Panima Publishing Coorporation New Delhi.
3. Biochemistry (1995), 4th ed. By L. Stryer W.H. Freeman and co. N. Y.

GENET 504 **Eukaryotic Gene Structure and Function**

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Max. Marks: 80
Time: 3 Hrs.

Unit I

Genome size, C- value paradox and repetitive DNA: range of genomic size (C-values) and gene numbers (intraspecific and interspecific variation); C-value paradox and repetitive DNA; reassociation kinetics and "cot" curves (chemical complexity and kinetic complexity); selfish DNA and sat-DNA (including in situ hybridization)

Unit II

Nucleosome concept and solendid model: techniques for study of chromatin; discovery of nucleosome subunits; histones and DNA in a nucleosome subunit; high resolution (2.8 A) nucleosome organization; packaging DNA in chromatin (loops, domains, and scaffolds); acetylation and deacetylation; assembly and disassembly of nucleosome; phasing of nucleosome and gene expression

Unit III

Structure of gene in eukaryotes: Split genes- axons and introns; different kinds of introns and junction sequences; origin of introns (exon early intron early hypothesis); coding potential and overlapping genes; pseudogenes-their origin and function; cryptic. genes-their origin and function; gene transfer between nucleus and other organelles.

Unit – IV

Genetic regulation in eukaryotes; DNA alterations (Gene amplification, programmed DNA rearrangement, DNA methlylation); Spatial and temporal control, Tubulin genes in plant, globin genes in animals); Molecular control of transcription in eukaryotes (Enhancer, silencer, enhancer trap mutagensis, transcription factors, alternate promoters, alternate splicing, molecular organization of transcriptionaally active DNA); Induction of transcriptional activity by environmental and horizontal factors; Translational control.

Suggested Books:

- Eukaryotic Transcription Factors 5th edition – David S.Latchman, AP publication.2008.

GENET 505 Labcourse- III PRACTICALS BASED ON PAPERS XI to XIV

1. Working knowledge of Microsoft Windows.
2. Demonstration of on-line data-base search.
3. Similarity searching using BLAST/FASTA.
4. Demonstration to access full text journals.
5. Determination of melting temperature and base composition of DNA from thermal denaturation characteristics.
6. Separation and identification of amino acid by ascending chromatography.
7. Separation of pigments from leaves or flowers by adsorption chromatography.
8. Determination of molecular weight of agiven protein by gel filteration.
9. SDS polyacrylamide slab gel electrophoresis of protein under reducing condition.
10. Determination of starch in plant tissues.
11. Extraction and estimation of total lipid content in the given sample of oil seed.
12. Determination of proteins by Bradford method.
13. DNA, RNA, protein isolation, qualitative, quantitative estimation, PCR amplification, Northern, Western blotting chromatography, Electrophoresis.
14. Fixing of slides for mitotic, meiotic analysis, demonstration of crossing over/ chaismata , Karyotype analysis, chromosome aberration ,chromosome banding, image analysis ,nucleic acid,Protien sequence database, date mining methods, motif analysis.

Semester – IV

GENET 506 Developmental Genetics

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Max. Marks: 80
Time: 3 Hrs.

Unit-I

1.1 Early development

Fertilization

Types of cleavage

Gastrulation: Cell movement and formation of germ layers in frog. Chick and mouse

Concept of determintion, competence and differentiation

1.2 Development of vertebrate nervous system

Formation of neural tube

Formation of brain regions

Tissue architecture of the central nervous system

Unit – II

2.1 Genetics of pattern formation
Caenorhabditis : Vulva formation

Drosophila:

- Maternal genes and formation of body axes
- Segmentation genes
- Homeotic genes function
- Imaginal disc development

Vertebrates

- Axes formation and HOX genes
- Limb formation in chick

Unit - III

3.1 Programmed rearrangements in genes

Chromatin diminution

Endoreplication cycles

Gene amplification

3.2 Genome imprinting

3.3 Genetic determination of sex in *Caenorhabditis*, *Drosophila* and mammals.

3.4 Regeneration

3.5 Senescence

Unit - IV

4.1 Embryonic stem cells and their applications

4.2 Clinical embryology:

Brief account of hormonal control of reproduction

Differentiation of germ. cells and gametogenesis

Fertilization and implen1entation

Gonadal malformation and their genetic basis

Reproductive failure and' infertility

Assisted reproduction

Suggested Books:

1. Developmental Biology 8th edition – Scott F. Gilbert, Sinauer publication, 2007.
2. Principles of Developmental Genetics – Moody, Elsevier publication, 2009.
3. Developmental Genetics - Gurbachan S Miglani, Anshan Publications,2008.
4. Developmental Genetics and Plant Evolution - Quentin C.B. Cronk, Richard M. Bateman, Julie A. Hawkins, Taylor & Francis group ublications, 2002.

GENET 507 Evolutionary Principles for Genetic Studies

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Max. Marks: 80

Time: 3 Hrs.

Unit-I

Emergence of evolutionary thoughts: Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations; the evolutionary synthesis.

Origin of cells and unicellular evolution: Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; concept of Oparin and Haldane; experiment of Miller (1953); the first cell; evolution of prokaryotes; origin of eukaryotic cells; evolution of unicellular eukaryotes; anaerobic metabolism, photosynthesis and aerobic metabolism.

Unit - II

Paleontology and evolutionary history: The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multicellular organisms; major groups of plants and animals; stages in primate evolution including Homo.

Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification; protein and nucleotide sequence analysis; origin of new genes and proteins; gene duplication and divergence.

Unit - III

The Mechanisms: Population genetics – populations, gene pool, gene frequency; Hardy-Weinberg law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; adaptive radiation and modifications; isolating mechanisms; speciation; allopatricity and sympatricity; convergent evolution; sexual selection; co-evolution.

Unit - IV

Brain, Behavior and Evolution: Approaches and methods in study of behavior; proximate and ultimate causation; altruism and evolution-group selection, kin selection, reciprocal altruism; neural basis of learning, memory, cognition, sleep and arousal; biological clocks; development of behavior; social communication; social dominance; use of space and territoriality; mating systems, parental investment and reproductive success; parental care; aggressive behavior; habitat selection and optimality in foraging; migration, orientation and navigation; domestication and behavioral changes.

Suggested Books:

1. Genes in the Environment - Rosie S. Hails, John E. Beringer, H. Charles J. Godfray, Wiley- Blackwell publications,2003.
2. Ecological Genetics – Andrew Lowe, Stephen Harris, Paul Ashton, Blackwell publications, 2004.
3. A Primer of Ecological Genetics - Jeffrey K. Conner, Michigan State University, and Daniel L. Hartl, Harvard University press, 2004.

GENET 508 **Genetic Engineering**

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Max. Marks: 80
Time: 3 Hrs.

UNIT – I

1.1 Restriction endonuclase, types and classification
1.2 Modify enzymes used in molecular cloning, methylases, polymerases, ligases, kinases, phosphatases, nucleases.
1.3 Plasmid and lambada phage vectors.
1.4 Cosmid vectors.
1.5 Yeast and Baculovirus vectors.

UNIT – II

2.1 Preparation and purification of total cell DNA (Bacteria, plasmid and bacteriophage DNA).
2.2 Strategies for construction of genomic libraries.
2.3 Strategies for construction of C DNA libraries.
2.4 Advantages of C DNA libraries.
2.5 Amplification of DNA by PCR.

UNIT – III

3.1 Labeling of nucleic acids and immunological probes.
3.2 Selection of recombinant clones.
3.3 Isolation of individual's genes by complementation techniques and contig assembly.
3.4 Mapping of restriction sites.
3.5 S1 mapping.
3.6 DNA sequencing methods.
3.7 Screening of cloned genes (Hybrid arrest and hybrid released translation).
3.8 Site directed mutagenesis.

UNIT - IV

4.1 Application r-DNA technology (Production of recombinant protein, Vaccine and pharmaceutical compounds; application in agriculture).
4.2 Concept of microarrays.
4.3 Fluorescence in situ hybridization (FISH).
4.4 Proteomics: Tools techniques, study of protein- protein interaction, protein analysis for gene identification, post translation modification.

Suggested Books:

- Gene Cloning and DNA analysis An Introduction 6th edition – T.A.Brown, Wiley-Blackwell publication, 2010.
- Genomes 3 – T.A.Brown, Garland Science publication, 2006.
- Gene Control- David S.Latchman, GS press, 2010.

GENET 509 Plant Molecular Genetics & Germ Plasm Conservation

Instructions for paper setter

There will be a total of nine questions. Question No. 1 will be compulsory and shall contain eight to ten short answer type questions without any internal choice and it shall cover the entire syllabus. The remaining eight questions will include two questions from each unit. Candidates will be required to attempt one question from each of the four units. They will attempt five questions in all.

Max. Marks: 80
Time: 3 Hrs.

UNIT-1

Plant Genomics

1.1 Organisation of nuclear and organallar genomes.
1.2 Plant gene structure and DNA domains.
1.3 Molecular markers
1.4 Genome imprinting
1.5 Functional genomics.
1.6 Proteomics, Functional proteomics.

Unit –II

Cryopreservation and conservation of genetic resources

2.1 Preservation of seeds, cells and tissues at low temperatures
2.2 Importance of germplasm storage and establishment of gene banks
2.3 Cryobiology of plant cells and tissues in culture
2.4 Technology of freeze preservation and its advantages

Unit – III

Molecular Basis of Growth and Development

3.1 Genetics of Photosynthesis and Photo-respiration.
3.2 Molecular basis of hormonal action in development.
3.3 Genetic and molecular analysis of embryogenesis.
3.4 Genetic and Molecular analysis of floral development.
3.5 Genetics of biological Nitrogen Fixation.

UNIT –IV

Clonal propagation of plants

4.1 Role of plant growth regulators during differentiation
4.2 Micropropagation of ornamentals, forest trees and horticultural plants directly and via organogenesis and somatic embryogenesis
4.3 Encapsulation and production of synthetic seeds
4.4 Vitrification and hardening of plants

Suggested Books:

1. Plant Molecular Biology - Wilhelm Gruissem, Springer Netherlands publications, 2002.
2. Plant Genomics: Methods and Protocols - J. Perry Gustafson , Daryl J. Somers, Peter Langridge, Humana Pr Inc publications, 2009.
3. Molecular Marker Systems in Plant Breeding and Crop Improvement - G. Wenzel, H. Lorz, Springer-Verlag publications, 2007.
4. Plant Biotechnology: The Genetic Manipulation of Plants - Adrian Slater, Nigel W. Scott, Mark R. Fowler. Oxford University press, 2008.
5. Functional Plant Genomics - J. F. Briat, P. Lea J.F. Morot-jGaudry, Science Pub Inc, 2007.
6. Dna-Based Markers in Plants - Indra K. Vasil , Ronald L. Phillips, Kluwer Academic Pub, 2001.

GENET 510 Labcourse- IV PRACTICALS BASED ON PAPERS XVI to XIX

1. Isolation of DNA from bacteria
2. Isolation of RNA from yeast
3. Isolation of rhizobia from root nodules.
4. Determination of mean generation time of rhizobia.
5. Performing Gram staining reaction with rhizobia.
6. Study meiotic behaviour of chromosomes in Anthers of A*llium* sp. or *Tradescantia.*
7. Isolation of DNA/ RNA from suitable plant material.
8. Quantitative estimation of DNA by diphenylamine method.
9. Isolation of plasmid DNA by alkaline method
10. Isolation quantification of Proteins.
11. To determine the Tm of given sample of DNA.
12. Separation of proteins through electrophoresis
13. Induction of polyploidy using colchicines.
14. Mitotic and meiotic behavior of chromosomes in polyploidy plants
15. Preparation of culture medium (MS medium).
16. Culture of explants on MS medium.
17. Raising haploids by tissue culture techniques.
18. Isolation of protoplasts from various plant tissues and testing their viability
19. Exposure of students to ongoing breeding work of important crops, collection and analysis of data on field trials.
20. Tests for pollen viability using stains and *in vitro* germination. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface cultures.
21. Estimating percentage and average pollen tube length *in vitro.*
22. Role of transcription and translation inhibitors on pollen germination and pollen tube growth.