NIZAM COLLEGE

(AUTONOMOUS)

OSMANIA UNIVERSITY

HYDERABAD-500001

B.Sc GENETICS

(I, II, and III Year Syllabus)

2011-2012

B.Sc GENETICS

(*Pattern of Examination and Syllabus*)

Pattern of Examination

Course pattern

Year	*Seeister*	*Paper*	*Marks Allotted*			
			Theory	*Theory*	*Total*	*Practical*
			Internal Exams	*Annual Exams*		
I	*I*	*Paper-1 (Genetic Analysis-1)*	*10*	*40*	*50*	*25*
	II	*Paper-2 (Genetic Analysis-2)*	*10*	*40*	*50*	*25*
II	*III*	*Paper-3 (Microbial And Molecular Genetics-1)*	*10*	*40*	*50*	*25*
	IV	*Paper-4 (Microbial And Molecular Genetics-2)*	*10*	*40*	*50*	*25*
III	*V*	*Paper-5 (Genetics Of Population And Breeding Principles)*	*10*	*40*	*50*	*25*
		Paper-6 (Biometry And Evolutionary Genetics)	*10*	*40*	*50*	*25*
	VI	*Paper-7 (Applied Genetics-1)*	*10*	*40*	*50*	*25*
		Paper-8 (Applied Genetics-2)	*10*	*40*	*50*	*25*

Total Marks
400+200=600

SEMESTER –I

Paper –I
Genetics Analysis –1
Theory

Unit –I Mendelian inheritance and physical basis of heredity .

1.1 Mendels experiments – choice of material, characters
1.2 Terminology and definitions –Mendel`s factors , phenotype, Genotype, locus ,allele, homozygotes ,heterozygotes, purelines, filial generations ,reciprocal cross, back cross, testcross
1.3 Law of segregation –Monohybrid crosses with examples
1.4 Law of Independent assortment –Dihybrid cross and trihybrid cross with example.
1.5 Eukaryotic cell cycle –phases of cell cycle Go, G1 S and G2 - Genes determining cell cycle – cyclins, C D K proteins
1.6 Mitosis – stages in mitotic cell division – significance of mitosis
1.7 Meiosis – Formation of synaptonemal complex, crossing over, chaisma formation, significance of meiosis.
1.8 Chromosomal theory of Inheritance.

Unit - II - Extension to Mendelian segregation patterns .

2.1 Codominance, Incomplete dominance, Lethals, Sublethals
2.2 Epistasis – modified Dihybrid ratios, types of epistasis, difference between dominance and epistasis
2.3 Multiplealleles- ABO blood groups in man, Inheritance of coat colour in mice, rabbits, eye colour in drosophila
2.4 Environment and gene expression- penetrance and expressivity.
2.5 Phenocopies, paramutation. , pleiotropism.
2.6 Temperature effect – Infra and ultra bar eye in drosophila, light effect – coat colour in rabbits.
2.7 Environmental effects on twins.

Unit - III Genetics of sex determination and sex linked Inheritance.

3.1 Sex determination mechanisms –Bonelia , sciara ,Insects Drosophila , birds, and man.
3.2 Sex linked inheritance – e.g.:- Colour blindness, Haemophilia, Duchenne muscular dystrophy
3.3 Y linked genes (Holandric genes), partial sex – linkage.
3.4 Sex limited and sex –influenced characters with examples

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PRACTICALS

1. Culturing and identification of normal and mutant stock of Drosophila
2. Monohybrid segregation in Drosophila and maize
3. Dihybrid segregation in Drosophila and maize
4. Study of gene interactions and modified Dihybrid ratios, significance testing.
5. Problems on sex – determination, sex – linked, sex – limited and sex – influenced characters

SEMESTER II

Paper –II
Genetic analysis –2
Theory

Unit – I chromosome structure, chromatin organisation and variation.

1.1 Chromosome morphology – size and shape
1.2 Components of chromatin – Histones and nonhistones.
1.3 Packing of DNA into chromatin –nulcleosome, higher order organization.
1.4 Euchromatin and heterochromatin – constitutive and facultative hetero chromatin.
1.5 Specialised chromosomes, lamp brush chromosomes, polytene chromosomes, supernumerary chromosomes.
1.6 Chromosome variation – Genetic consequences.
1.7 Structural – Duplications, Deletions, Inversions and Translocations, Robertsonian translocation with examples.
1.8 Numerical Aberrations – Aneuploidy , Euploidy, Autopolyploidy, and Allopolyploidy with examples.

UNIT – II Linkage and crossing over

2.1 Discovery of linkage.
2.2 Phases of linkage
2.3 Chaismata and crossing over
2.4 Cytological proof for crossing over
2.5 Recombination frequencies
2.6 Linkage analysis – two point , three point test crosses
2.7 Gene mapping – interference –ordering of gene sequences
2.8 Gene mapping in Neurospora – tetrad analysis.

UNIT – III Non – Mendelian Inheritance

3.1 Maternal Inheritance –leber's optic atrophy, snailing
3.2 Extrachromosomal Inheritance –Paramaecium, Yeast , Drosophila , poky strain in Neurospora.
3.3 Chloroplast and Mitochondrial Inheritance.
3.4 Evolutionary significance.

PRACTICALS

1 Study of Mitosis in root tips cells of Alliumcepa.
2 Study of Meiosis in Grass hopper /Maize.
3 Study of Salivary gland chromosomes in Drosophila
4 Study of Ring chromosome in Rheodiscolour
5 Problems based on linkage and crossing over

SEMESTER III
Paper III
Microbial and Molecular Genetics – 1
Theory

UNIT -I – Bacterial cell structure and cell cycle

1.1 Structure of bacteria – growth phases
1.2 Induction and isolation of bacterial mutants – Replica plating
1.3 Fluctuation test – detection of mutation frequencies.
1.4 Recombination in Bacteria – transformation - linkage information from transformation.
1.5 Transduction – general, specialized and abortive, chromosome mapping by transduction.
1.6 Conjugation – F and H fr strains unidirectional transfer interrupted mating experiment
1.7 Circularity of Bacterial chromosome, F – factor , plasmid , chromosome mapping by conjugation

UNIT II –Nucleic Acids

2.1 Structure of DNA-Watson crick Model, Forms of DNA.
2.2 Structure of RNA-mRNA,tRNA,rRNA.
2.3 DNA as genetic material transforming Principle, Hershey and Chase Experiment
2.4 RNA as genetic material TMV
2.5 Replication of DNA
2.6 Messelson and Stahl`s experiment.
2.7 Replication of circular DNA
2.8 Enzymes involved in DNA replication.

UNIT – III Fine structure of gene and Trans posable genetic elements.

3.1 One gene one enzyme hypothesis – example from Man, Neurospora
3.2 Analysis of r – II locus, fine structure of the gene.
3.3 Colinearity between gene and polypeptide – tryptophan – biosynthesis.
3.4 Intra codon Recombination – cistron, muton and recon.
3.5 Gene action studies – Anthocyanin Biosynthesis in maize, eye pigments in Drosophila, Arginine Biosynthesis in Neurospora.
3.6 Tansoposable elements – structure and function.
3.7 Maize Ac / Ds and Spm / dSpm system.
3.8 Drosophila P elements and hybrid dysgenesis.
3.9 Bacteria – IS elements transposons and plasmids
3.10 Yeast – Ty elements.

PRACTICALS

1 Sterilization methods, isolation and culturing of Bacteria.
2 Techniques of bacterial staining (gram staining).
3 Isolation of Bacteria from different sources.

4 Quantitative estimation of Bacteria – bacterial growth curve.
5 Effect of UVon Bacterial growth
6 Sensitivity test for antibiotics in bacteria
7 Replica plating.
8 Problems on bacterial mapping.

SEMISTER IV

Paper IV
Microbial and Molecular Genetics – 2

UNIT – I Genome organization

1.1 Denaturation and Renaturation, Dissociation and reassociation of DNA, reassociation kinetics of DNA-melting temperature (Tm values) and cot curves.
1.2 Kinetics classes of DNA, single copy sequences, repeated sequences – moderately repetitive sequences, highly repetitive sequences – Inverted, tandem and palindromic repeats.
1.3 Satellite DNA.
1.4 Organisation of eukaryotic gene – exon ,intron , promoters and termination sequences
1.5 Gene families and clusters – examples – Histones and globin genes.
1.6 Mitochondrial and chloroplast genome organization.

UNIT - II Gene expression and Regulation

2.1 Transcription - RNA transcript, sense and antisense strands.
2.2 Post transcriptional processing – m RNA splicing in eukaryotes.
2.3 Translation – Genetic code, properties of genetic code.
2.4 Polypeptide synthesis – Distinguishing features between prokaryotes and eukaryotes during peptide synthesis.
2.5Gene regulation in prokaryotes-lac operon, positive and negative control –CRP and cAMP complex.
2.6 Gene regulation in eukaryotes – Gal Locus in yeast.

UNIT -III Gene mutations ,repair and r- DNA technology

3.1 Molecular basis of mutations – transition and transversions, spontaneous and induced mutations.
3.2 Detection of mutations –SLRL, attached X in Drosophila, CLB technique in Drosophila.
3.3 DNA damage and repair mechanisms.
3.4 Photo reactivation excision repair , SOS repair , Recombinational repair and error prone repair
3.5 Restriction enzymes and their modifications.
3.6 Vectors used for gene transfer – Plasmids, Cosmids and lambda phage.
3.7 Cloning strategies – Genomic libraries and c – DNA libraries.

PRACTICALS

1) Extraction of DNA from animals / plant tissue.
2) Estimation of DNA.
3) Extraction of RNA from Animals /plant tissue.
4) Estimation of RNA.
5) Screening for SLRL mutations.
6) Reassociation kinetics and calculation of cot values
7) RFLP mapping-single digestion and double digestion

SEMISTER-V

PAPER-5

Genetics of population And breeding principles

Theory

UNIT-1 Structure of population

1.1. The Concept of Population, Demes and Mendelian Population.
1.2 Random mating population-genetic Equilibrium, Hardy-Weinberg law.
1.3 Establishment of Equilibrium for diallelic Locus, Multiple Alleles, X-Linked genes.
1.4 Factors affecting equilibrium-Mutations, Migration, Selection and Random Genetic Drift.
1.5 Inbreeding and Its Effects.
1.6 Estimation of inbreeding coefficient using Pedigrees.
1.7 Inbreeding Depression.
1.8 Genetic load - mutational and segregational.

UNIT-2 Quantitative Traits and Population Improvement

2.1 Quantitative Character's Vs Qualitative Characters.
2.2 Features of qualitative Inheritance-Additive effects.
2.3 Kernal Color in Maize, Skin Color, Height and IQ in man.
2.4 Normal distribution, Types of Gene Action, Heritability of trait.
2.5 Selection and Breeding Methods in Animals.
2.6 Inbreeding-Cross Breeding-Heterosis-Hybrid Vigour.
2.7 Modes of Selections-Progeny testing And Pedigree Analysis.

UNITS-3 Selection and Breeding methods in plants

3.1 Self pollinated crops, purelines, backcross, Line breeding.
3.2 Cross pollinated crops.
3.3 Hybrids.
3.4 Cross breeding And Heterosis.
3.5 Mutation-spontaneous and induced Mutations - utility in Plant breeding.
3.6 Chromosome Engineering in Plants-Role of Different types of ploidy in crop improvement

PRACTICALS

1. Problems based On Hardy-Weinbery Law of Equilibrium
2. Estimation of Inbreeding Coefficient from Pedigrees.
3. Calculation of Gene Frequencies under Different Types of Selections.
4. Estimation of Snyder's Ratio
5. Estimation of Genetic Load
6. Problems based on Quantitative Traits

SEMISTER V

PAPER 6
Biometry and Evolutionary Genetics
Theory

UNIT I Statistical Analysis in Genetics

1.1 Frequency distribution – Grouping and graphical presentation of biological data.
1.2 Measures of central tendency – Mean, Median, Mode.
1.3 Meaure of dispersion – variance, standard deviation, standard error and coefficient of variance.
1.4 Test of hypothesis – chi square test, small sample test, student t test, paired t test.
1.5 Probability theory – mutually exclusive events and independent event
1.6 Use of probability in testing segregation of genes.
1.7 Probability distributions – binomial, Poisson and normal distribution.
1.8 Discrete and Continuous genetic variables.

UNIT II Organic Evolution.

2.1 Theories of Organic Evolution –Lamarckism, Darwinism, Wiesmann`s germplasm theory De-Vries theory on mutation
2.2 Origin of life and molecular evolution – theories of origin of life , Organismal concept – Millers experiment - Interdependence of nucleic acids and proteins – leading to formation of first organism – proto cell model – oparins coacervates – protenoid microspheres - Evolution of genetic code.

UNIT III Phylogenetic Analysis.

3.1 Genetic polymorphism – theories on maintainance of genetic polymorphism.
3.2 Evidences based on biochemical polymorphism.
3.3 Protein evolution – Evolution of Haemoglobin and Cytochrome – c
3.4 Molecular clocks.
3.5 DNA hybridisation studies – construction of phylogenetic trees.

PRACTICALS

1. Presentation of data charts and diagram
2. Measures of central tendency-Problems.
3. Measures of dispersion-Problems
4. Probability – use of binomial expansion-Problems on segregation.
5. Test of hypothesis – chi square test.
6. Test of hypothesis – student t – test and paired t test.

SEMISTER VI

Paper 7
Applied genetics --1
Theory

UNIT I Advanced Techniques in Genome Analysis

1.1 Centrifugation – sucrose gradient and cesium chloride (cscl) centrifugation – principle and applications.
1.2 Chromatography – principles and applications – separation of peptides and amino acids.
1.3 Gel electrophoresis – principle and applications – paper, Agar, starch, PAGE
1.4 Polymerase chain reaction (PCR) and its applications
1.5 Hybridisation techniques – Southern, Western and Northern blotting techniques, FISH principle and application
1.6 Chromosome Banding techniques –G, C, R, Q and nor banding
1.7 Autoradiography-principle and applications
1.8 DNA sequencing-Maxam Gilberts method and Sanger`s method and Automated sequencing
1.9 Hybridoma technology and production of monoclonal antibodies.
1.10 DNA finger printing, RAPD technique, VNTRS

UNIT II Strategies of Gene transfer

2.1 Physical methods – Electroporation - microprojectile bombardment.
2.2 Chemical methods – liposome fusion, calcium precipitation of DNA.
2.3 Gene transfer mediated by vectors Ri vectors, Ti vectors, Viral vectors.
2.4 Engineered embryonic stem cells.

UNIT III Genetic engineering of plants and Animals

3.1 Transgenic plants – Need for developing transgenic plants
3.2 Development of insect and herbicide resistant plant.
3.3 Development of stress resistant plants
3.4 Transgenic Animals – need for developing transgenic animals.
3.5 Nuclear transfer and cloning
3.6 Developing transgenic animals for genetic diseases

PRACTICALS

1 Identification of anino acids, proteins by chromatography
2 Separation of proteins by electrophoresis
3 Separation of Nucleic acids by electrophoresis
4 Restriction digestion analysis
5 Karyotyping and G- Banding of Human chromosomes

SEMESTER VI

PAPER 8

Applied Genetics - 2

Theory

UNIT I Inherited Human disorders

1.1 Some common syndromes
1.2 Sex chromosome anomalies
1.3 Origin of Barr body
1.4 Abberant sexual development - true and Pseudo Hermophrodites
1.5 Abortions and chromosomal anomalies
1.6 Autosomal anomalies –Down's syndrome, Edward & Patau syndromes
1.7 Sex – chromosomal anomalies - Turners syndrome, Kline felter syndrome
1.8 Single gene disorders of autosomes and sex – chromosomes.
1.9 Metabolic disorder – P K U, albinism, alkaptonuria

UNIT II Blood groups Inheritance and Immunology

2.1 Blood groups in man – ABO ,MN, RH , S/s and secretor antigens
2.2 Disorders of Blood - Qualitative –(sickle cell anemia)and quantitative – (Thalassemias) disorders
2.3 Major Histocompatibility (MHC) complex – organ transplantation
2.4 Introduction to immune response – antigen and antibody reactions – Immunoglobulin genes .
2.5 Cell mediated immunity
2.6 Anti – microbial substances in blood and tissue fluids

UNIT III Management of Inherited Human diseases

3.1 Identification of carriers, risk prediction and genetic counseling
3.2 Prenatal diagnosis – methods used in prenatal diagnosis
3.3 Treatment of genetic diseases
3.4 Substrate restriction in diet – example - PKU and galactosemia
3.5 Replacement of different protein ,vitamins , co- enzymes and gene products .Examples alpha – 1 - Antitrypsin, adenosine deaminase
3.6 Gene therapy and its need
3.7 Strategies of gene transfer - somatic and germinal gene therapy ex-vivo and in – vivo gene therapy advantages and disadvantages
3.8 Gene therapy trials - ADA – deficiency ,cystic fibrosis , hypercholesterolemia and cancer .
3.9 Gene therapy and ethical issues.

PRACTICALS

1. Demonstration of Barr body in humans
2. Testing ABO and Rh system
3. Estimation of total and differential count
4. Screening of simple genetic traits in human population by pedigree analysis
5. Estimation of haemoglobin
6. Problems based on blood groups and paternity testing