

BANGALORE UNIVERSITY
CENTRE FOR APPLIED GENETICS SYLLABUS
(SEMESTER SCHEME)

I B.Sc. GENETICS
Theory syllabus

Semester I Paper I : Microscopy, Cell Biology & Model Organisms 60 Hrs

1.Scope of Genetics	01 Hr.
2.Microscopy :	06 Hrs
Use of Microscopes in Cytology, Principles, Magnification, Resolving Power and Handling of Different Microscopes – Compound, Dark field, Bright field, Phase Contrast, Fluorescent, and Electron Microscopes.	
3.Model organisms	14 Hrs
Life cycles of : Viruses 0 TMV : Bacteriophage – Lambda phage : Bacteria – E coli, Parmecium, Yeast, Coenorhabites ; Neurospora, Drosophila, Mosquitoes (Anopheles & Culex), Rat, Maize and Pea Plant, Arabidopsia	
4.Ultrastructure of Cell and Cell Organelles :	24 Hrs
Cell Theory : Prokaryotic cell and Eukaryotic cell.	
Cell wall : Ultrastructure. Chemical composition and Function ; Extracellulat matrix : Cytoskeletal structure – Actins and Microtubules.	
Plasma a membrane : Chemical composition, Utrastructure – Fluid mosaic Mode, and Functions – Osmosis, Phagocytosis, Pinocytosis, Active Transport, Microvilli and Demosomes.	
Ultrastructure Chemical composition, Functions of Cytoplasmic Organelles : Endoplasmic reticulum, Ribosomes, Centrosomes, Lysosomes, Golgi complex, and Peroxisomes.	
Mitochondria : Ultrastructure, Chemical composition, Enzymes and Co – enzymes, and Functions – Kreb’s cycle, Electron – transport system and Oxidative Phospheylation	
Plastids : Types, Ultra structure of Chloroplast and role in Photosynthesis.	
Nucleus : Morphology, Nuclear – envelope ; Nucleolus ; Nucleoplasm, Chromatin.	

Cell cycle & Cell division : 15 Hrs

Cell cycle :

Mitosis : Essentials of mitosis, plan and variants, Mitotic apparatus, its structure and chemistry ; Cytokinesis, Physiology of dividing cell, Mitotic cycle, Mitotic rhythms, blockage and stimulation of cell division, Significance of Mitosis.

Meiosis : Stages, Synaptonemal complex, Crossing over, Chiasma formation, Mollecular mechanism of Crossing over, Variations in meiotic phenomena & Significance of Meiosis ;

Cell senescence & Cell death (Apoptosis) : Death of specified cells, Programmed cell death, Mechanism of cell Death & is significance.

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Semester I Practicals1	15 Prs.
Microcopy :	03 Prs.
Handling of dissection, sterio and compound microscopes.	
Demonstration of Phase contrast, Bright field, Dark Field, Fluorescence, and Electron microscopes.	
2. Model Organisms and their significance in Genetic studies :	05 Prs.
Virus – TMV (Tobacco leaves)	}
Bacteria – E coil (slide)	}
Neurospora and Yeast (slides)	} 1 Pr
Paramecium (slides)	}
Coenorhabites elegans.	}
Drosophila melanogaster – Life Cycle	1 Pr
Mosquito (Anopheles and Culex) – Life cycle	1 Pr
Dssected reproductive system of Rat - and	1 Pr

Maize, Pea, Arabidopsis – Life Cycle	1 Pr
Staining Techniques :	03 Pr
RNA & DNA – Methyl green and Pyronin	
Mitochondria – Janus green	
Lactobacillus / E-coil – Gram Staining	
4. Observation of mitotic stages in permanent slide	01 Pr
5. Temporary squash preparation of onion root up for mitosis	03 pr

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Semester I	Scheme of Examination of Practicals I	Marks
1.	Preparation of temporary squash of the given material	06
2.	Stain, mount and comment on the given materials Any two of RNA / DNA / Mitochondria / E. coli	06
3.	Spotters : Identify and comment on any six spotter	3 x 6 = 18
	i) Microscope	1
	ii) Mitotic stage	1
	iii) Model Organism	4

References :

Cell and Molecular Biology 2nd Edition. P. K. Gupta (2003) Rastogi, Meerut.
Molecular Biology of the cell – (1989) Bruce Alberts et al. Garland Publications.
Cell Biology by Ambrose & Dorotty. M. Esty. ELBS Publications.
Cell Biology & Molecular Biology by EDF Robertis & EMF Robertis. Saunder College.
Cell Biology by C. B. Powar Himalaya Publication.
Instant notes in Microbiology by J. Nicklin et al. 2003. Viva Books.
Plant cell Biology : Structure and Function. Jones & Bartlett, Boston.
Arabidopsis by Anderson. M and Roberts J. (edition 1998) Academic press / CRC Press.
Arabidopsis : a Practical Approach Wilson Z.A. (ed) 200. Oxford University press.
Introductionary plant Biology, 8th Edition by Stern K.R. Mc-Graw Hill, Boston.
Molecular Cell Biology (2 Edition)-Darnell J.H. Lodih & D. Baltimore. Scientific American Books, New York.

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Semester – II Paper II : Mendelian Genetics & Biology	60 Hrs
1.History of Genetics	07 Hrs
Definition and scope of Genetics Premendelian genetic concepts – Performance, Epoigenesis, Inheritance of acquired characters, Germplasm theory. Hereditary and Environment, Genotype and Phenotype ; Heredity and Variation. Clones, Purelines and Inbred lines Norms of reaction and Phenocopies.	
2.Biography of Mendel and his experiments with pea plant	03 Hrs
3.Law of Segregation :	
Monohybrid cross, back and test cross, Dominance and Recessive, Co-dominance and Incomplete dominance.	
4.Law of Independent Assortment :	05 Hrs
Dyhybrid crosses in pea and Drosophila, back and test cross Genetic problems.	

Elements of Biometry :	15 Hrs
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Probability, Binomial Methods, Testing of Goodness, Chi-square test and its application in segregation ratio, detection of linkage & study of gene frequency. Measurement of variation : Analysis of polygenic traits, Normal curve, Mean, Mode, Median, Srandard Deviation, Standard Error, t test and F Test.

Multiple alleles :

Definition, Color Ioci in Corn, Eye color in Drosophila, Blood groups & Rh factor in Human, and Genetic problems.

Gene interactions :

10 Hrs

Inheritance of comb shape in fowls Epistasis – Dominant Epistasis (12:3:1), Recessive Epistasis (9:3:4), Supplementary genes – Cumulative effect (9:6:1), Duplicate Dominant genes (15 : 1) Duplicate Recessive genes (9 :7), Dominant Recessive interaction (13:3)

8. Sex determination : 10 Hrs

Chromosomal theory of sex determination – XX-XY, XX-XO, ZZ-ZW, Genic balance theory of Bridges, Y chromosome in sex determination in Melan drium and Sphaerocarpus. Environment and Sex determination, Hormonal control of sex determination (free martin) Gynandromorphs / Intersexes, Supersexes in Drosophila : Sex differentiation and dosage compensation.

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Semester II

Practical II

17 Prs.

1. Floral structure of pea plant and Maize/Arabidopsis	01 Pr.
2. Temporary squash preparations f Onion flower buds and Grasshopper tests	06 Prs.
Study of variations in Pea Plant : Flower Color in Antirrhinum & Mirabilis	01 Pr.
Study of variants [mutants] in Drosophila	02 Prs.
Computation of man, mode, median, standard deviation and standard error.	01 Pr
Genetic Problems : a) Multiple alleles	01 Pr.
Application of Chi-square test, t test and F test	02 Prs.

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Semester II Scheme of Examination of Practicals II

Marks 30

1. Prepare temporary squash of the given material	06
2. Draw the diagram of the given floral material and comment.	05
3. Spotters : Identify and comment on any three spotters.	3 x 3 = 09

Pea Plant Variation (Flower/Seed) OR

Coat Colour in mice OR

1. Comb pattern1	
2. Drosophila Mutants1	
3. Meiotic Stages1	
4. Genetic Problems : Any two	2 x 5 = 10

Biometry,
Multiple alleles and
Gene Interaction.

References :

§ Principles of Genetics by Robert H. Tamarin. Tata-McGraw Hill, Seventh Edition 2002) .
§ Genetics, Principles and Analysis by Daniel Hartl & E.W. Jones. 4th Edition 1998 ; Jones & Barlett Publication.
§ The science of Genetics by Atherly, A. G. Girton, J. R & MC Donald, J. F. (1999(Saunders College Publications / Harcourt Brace.
§ Genetics – M.W. Strickberger Macmillan Publications New York.
§ A History of Genetics by Sturtevant, A.H (1965) Harper & Row, New York.
§ Gregor Mendel :The First Geneticist by Orel V. (1996) Oxford University Press, New York.
§ A first course in Probability by Ross S (1994) 4th edition Mcmillan, New York,
§ History of Genetics by Stubbe H. (1972) Harper and Row, New York.
§ Theory and problems of Genetics - W.D. Stansfield (Schaum’s outline series) McGrawHill 2002.
§ Fundamentals of Biostatistics by Satguru Prasad (1993) Emkay publications. New Delhi.

II B.Sc. GENETICS

Theory syllabus

Semester III : Paper III : Cytogenetics	60 Hrs
1.Physical Basis of inheritance :	12 Hrs
Chromosome theory of inheritance. Eukaryotic Chromosome – Macro – molecular Organization. Chromosome types – primary and secondary constrictions., Sat – bodies, Telomeres. Heterochrom at in and Euchromatin and its significance. Ultrastructure of Chromosome – Karyotype and Idiogram.	
2.Special types of chromosomes	04 Hrs
Polytene chromosomes – Salivary gland chromosomes in Drosophila, Lampbrush Chromosomes in amphibian Oocytes & B Chromosomes.	
3.Sex Linkage :	08 Hrs
Meiotic behaviour of chromosomes and non-disjunction. Bridges theories of non-disjunction . Sex-linkage in Drosophila. Sex linked genes in Poultry and Moths. Sex related genes in maize. Attached X-chromosome	
4.Linkage :	10 Hrs
Coupling and repulsion hypothesis. Linkage in maize and Drosophila, Linkage groups, Complete linkage, incomplete linkage, factors affecting linkage – distance, age, temperature, X-rays, etc. Theories of linkage, differential multiplication theory and chromosome theory. Measurement of linkage from T2 Bacteriophage. Cis-Trans arrangement. Linkage maps in Maize and Drosophila.	
5.Crossing over :	10 Hrs
Mechanism of crossing over. Cytological theories of crossing over. Germinal and Somatic crossing over. Crossing over in Drosophila, absence of crossing over in male Drosophila. Frequency and percentage of crossing over. Tetrad analysis in Neurospora. Interference and Coincidence. Construction of genetic maps (Drosophila and Maize)	
6.Chromosomal aberrations :	
Numerical : Euploidy (Monoploidy, Hap loidy and Polyloidy)	10 Hrs.
Polyploidy – autopolyploidy and allopolyploidy	
Aneuploidy – Monosomes, Nullisomes, & Trisomes.	
Structural : Deletions, Duplications, Translocations and Inversions. Evolutionary significance of chromosomal aberrations.	
7.Extra Chromosomal Inheritance / Cytoplasmic Inheritance :	6 Hrs
Mitochondrial DNA, Chloroplast, DNA, Kappa particles in Paramecium, Sigm a factor in Drosophila. Mitochondrial diseases in Human. Cytoplasmic Male Sterility (CMS) in crop plants and its commercial exploitation.	

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Semester III PRACTICALS – III	17 Prs.
1.Culturing and Handling of Drosophila	
Media preparation	
Cleaning and sterilization of bottles	
Handling of Drosophila	
Isolation of virgin flies.	
2.Drosophila : a) Breeding Experiments : 08 Prs.	
Law of Segregation : Inheritance of Vg/b/e/se	
Independent Assortment – se & vg / c/ bw	
Sex linkage – w/y/ct/bb/rb/v	
Salivarygland Chromosomes :	
Dissection of Salivarylands	
Preparation of Polytene Chromosomes	
3.Study of chromosomal aberrations :	03 Prs.
Observation of permanent slides of chromosomal aberrations	
Inversion – Salivarygland chromosomes of Drosophila nasuta.	
Translocation – Flower buda pf khoen discolor.	

Induction of polyploidy in Onion root tips.

4.Genetic Problems on Linkage & Crossing Over :

03 Prs.

Drosophila

Maize

Human (Sex Linkage)

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Semester II Scheme of Examination of Practicals III

30 Marks

1. Preparation of Salivary gland Chromosomes 06
2. Preparation of another squash of Rhoec. 05
3. Identify and comment on the spotters (Three mutants). 3 x 3 = 09
4. Problems on linkage – construction of linkage map 2 x 5 = 10
(Provide data of two print / three point crosses and also on sex linkage) Two problems.

References :

Book1:Genetic Maps. 6th edition by O'Brien, S (1993)

Books2 : Lower Eukaryotes.

Book 3 : Nonhuman Vertebrates.

Book 4 : The human maps :

Book 5 : plants. Cold spring Harbor Lab press New York.

§ Cytology, Genetics and Molecular Biology by P.K. Gupta (2002), Rastogi.

§ Instant notes in Genetics by P.C. Winter, G.I. Hickey & H.L. Fletcher (2003) Viva Books Pvt. Ltd.,

§ Genetics, 2nd edition, by Weaver, R.F. and Hendrick, P. W. (1992) W.C. Brown.

§ Cytogenetics, Plant Breeding and Evolution by U. Sinha and Sunita Sinha, Vikas publishing House.

§ Elements of Genetics by Phundan Singh, Kalyani Publishers.

§ Genetics by Edgar Altenburg - Oxyford & IBH Publications.

§ Principles of Genetics by E.J. Gardener, M.J. Simmons and D.P. Snustad J. Wiley & Sons pubs (1998)

§ Chromosomal Aberrations : Basic and Applied aspects by Obe. G & A.T. Natarajan (1990) Springer Verlag, Berlin.

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Theory Syllabus

Semester IV Paper IV : Molecular genetics

60 Hrs.

1. Introduction of Molecular Genetics 01 Hrs.
2. Chemical basis of Heredity : 05 Hrs.
DNA as genetic material ; Experiment. of Griffith Avery, Mc Cleod and Mc Carthy.
3. Nucleic Acids : 08 Hrs.
ii)RNA as genetic material ; Expt. of Harshey & Chase
DNA Structure, Types and replication in
Prokaryotes and Eukaryotes
RNA Types and Structure
4. Genetic Code : 04 Hrs.
Features of genetic code : Triplet code, Wobbling hypothesis, Universality, Degeneracy, Non-overlapping, Initiation and Termination.
5. Gene Action : 12 Hrs.
Protein synthesis – Transcription in Prokaryotes & Eukaryotes.
Translation in Prokaryotes and Eukaryotes.
- 1.Regulation of Gene Expression : 06 Hrs.
Lac Operon : Galactose & Tryptophane
- 2.Fine structure of Gene : 04 Hrs.

- i) Classical concept of gene.
 - ii) Lozenge in Drosophila
 - iii) RH in T4 phase ;
 - iv) Cistron, Recon and Muton.
9. Genetics of Bacteria : 10 Hrs.
 Transfrom action ; Transduction – generalized, and specialized; Conjugation : F factor mediated, Hfr Mediated and Sexduction.

1. Gene Mutation : 10 Hrs.
 Definition ; Types of mutations; Physical & Chemical Mutagens ; Measurement of mutation rate in Bacteria, Drosophila and Human. Types of gene mutations – substitution, insertion, inversion and deletion. Reverse mutation in bacteria, insects and human. Site directed mutagenesis.

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Semester IV 15 Hrs.

1. Instrumentation : 5 Hrs.
 Centrifuge, Ultracentrifuge, Spectrophotometer, pH meter, Microtome, Chromatography – Paper, Electrophoretic Unit, Micropipette, Glass Homogenizer, Glass bead sterilizer, Incubator Shaker, Aspirator, Laminar Air Flow and Autoclave.

2. Extraction of DNA : 02 Hrs.

- § Cauliflower
- § Coconut Endosperm, and
- § Bacteria.

3. Paper Chromatography (Protein) : 02 Hrs.

- § Peas
- § Leaf Pigment
- § Drosophila eye pigment, and
- § Egg protein.

4. Gel Electrophoresis : 02 Hrs.

- § Protein Profile,
- § DNA Profile.

5. Chemical Mutagens : (Demonstration in Plants) 01 Hr.

- § EMS
- § MMS

6. Physical Mutagens : (Demonstration on Drosophila) 01 Hr.

- § UV rays.
- § X – rays.

1. Induction of mutation in Drosophila and detection of sex linked lethals by Muller 5 Stock. 02 Hrs.

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Semester IV **Scheme of Examination of Practicals IV** 30 marks.

- 1. DNA Extraction from the given Material 12
 - 2. Paper Chromatography 06
 - 3. Identify and comment on the Spotters : (Any three) 3 x 4 = 12
 - § Instrument
 - § Protein Profile
 - § DNA Profile
 - § Chemical Mutagens
 - § Muller – 5 Stock
-

Reference :

1. Molecular Biology of the Gene, 4th edition by Watson J.D., N.H. Hopkins, J.W. Roberts, J.A. Steitz & A.M. Weiner (1987) Benjamin/Cummings.
2. A short course in Bacterial Genetics by Miller J. (1992) Cold Spring Harbor Laboratory press.
3. Organization of the Prokaryotic Genome by Charlebois R. (Ed) 1999 ASM pres., WashingtonD.C.
4. The RNA World (2 edition) Gesteland R. , T. Cech and J. Atkins (edition)1999 Cold Spring Harbor, New York.
5. Cell Biology & Molecular Biology by EDP Robertis and EMF Robertis, Saunder College,
6. Advanced Molecular Biology by Twyman R.M. (1998) Viva Books Ltd.
7. Instant Notes in Biochemistry 2 edition B.D. Hames & N.M. Hooper (2002) Viva Books.
8. Instant Notes in Biochemistry 2 edition B.D. Hames & N.M. Hooper (2002) Viva Books
9. Genomes by T.A. Brown (2002) Viva Books
10. Molecular cell Biology, 2nd edition by Darnell. J. H. Lodish and D. Baltimore (1990) Scientific American Books, New York.

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Theory Syllabus

Semester V

Paper V : Genetic Engineering & Cloning

45 Hrs.

1. Introduction to Genetic Engineering & Cloning 01 Hr.
2. Instrumentation : 01 Hr.
PCR and UV Transiluminator
3. Recombinant DNA and Cloning : 24 Hrs.

§ Restriction Enzymes in Cloning :

Restriction endonucleases – Types and Characteristic features ; Nomenclature. DNA ligase and co-factors.

§ Techniques in Recombinant DNA Technology :

Gel Electrophoresis (PAGE), Southern, Northern, and Western Blotting ; Dot blots and Slot blots.

§ Cloning Vectors :

Plasmids : pBR 322, Ti and Cosmids. Viruses : CMV, TMV, Gemini, Simian (SV 40), Vaccina and Retroviruses, Bacteriophages : Lambda and MB.

§ Isolation, sequencing and synthesis of gene :

Isolation : Isolation of gene of interest; fragmentation method to break DNA, shot gun methods, reverse transcriptase.

§ Sequencing : Sequencing of genes – Maxam and Gilbert; Sanger's Dideoxy method.

Synthesis of gene : Organo – chemical synthesis of t RNA, precursor t RNA and interferon gene.

Gene transfer Methods.

10 Hrs.

Vector mediated gene transfer including agrobacterium. Direct gene Transfer; Liposomes ; Electrophoration; and Particle shot gun method.

5. Selection, Screening and Analysis of Recombinants : 07 Hrs.

Identification and Selection of transformed cells – direct and indirect methods. Use of selectable and scorable reporter genes. Expression of cloned genes.

6. Application of Recombinant DNA Technology : 07 Hrs.

Transgenic crops – resistance to herbicides, insecticides, viruses and pathogens; n if gene transfer.

Transgenic animals – Chicken, Cow, Pig, Rabbit, Sheep etc. with value added attributes.

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Semester V	Practicals V	15 Prs.
1.	Instrumentation : PCR, Microneedle, Electronic Balance, Magnetic Stirrer, UV Transillumination.	05 Prs.
2.	Demonstration of :	10 Prs.
	a) Isolation of genomic DNA (Animal tissue)	
	b) Isolation of Plasmid DNA	
	c) Restriction Enzyme digestion.	
	d) Ligation of DNA fragment	
	e) Agarose Gel Electrophoresis of DNA.	
	f) Quantification of DNA and RNA	
	g) PCR amplification of DNA.	
	h) Transformation.	

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Semester V	Scheme of Examination of Practical V	15 Prs.
1.	Isolate and comment on the Genomic DNA of the given material	15
2.	Explain the working principle of the given Instrument	06
3.	Identify and comment on the given three Spotters (a) Instrument, (b) Protein Profile and (c) DNA Profile	3 x 3 = 09

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.

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Theory Syllabus

Semester V	Paper VI : Human Genetics	45 Hrs.
1.	Introduction to Human Genetics	01 Hrs.
2.	Human Chromosomes :	08 Hrs.
	i) Normal human karyotype : Paris Nomenclature; Flow Karyotyping (Quantification on DNA of individual chromosomes); FACS – Fluorescence activated cell sorter.	
	ii) Chromosomal aberration :	
	Numerical : Aneuploidy, Polyploidy (Eg. : Turner, Down & Klinefelter Syndromes).	
	Structural : Translocation, Duplication, Inversion, Ring Chromosome and Deletion (Ex. : Cri-du-chat syndrome)	
	Others : Mosaic, Chimera [Individual with two cell lines]	
3.	Mendelian Traits :	05 Hrs.
	Strait hair, Curly hair, Widow's peak, Dimpled Cheeks, Mid digital hair, Hitchhiker's thumb, Claspiling of hands, and Hypertrichosis.	

4.Genetic Diseases and Inheritance Pattern : 05 Hrs.

- § Autosomal inheritance – Dominant [Eg.: Adult polycystic kidney, Achondroplasia & neurofibromatosis.]
- § Autosomal inheritance – Recessive [Eg. : Albinism, Sickle Cell Anemia, Phenyl Ketonuria]
- § X-linked : Recessive {Eg. : Duchenne muscular dystrophy – DMD}
- § X-linked : Dominant (Eg. Xg blood group)
- § Y-linked inheritance [Holandric – Eg. Testes determining factor]
- § Multifactorial inheritance (Eg. : Congenital malformations – Cleft lip & palate, Rheumatoid arthritis and Diabetes.

5.Pedigree studies 04 Hrs.

Symbols used in pedigree analysis. Pedigree analysis of important genetic diseases like Haemophilia, Color blindness, Duchenne Muscular Dystrophy (DMD),

6.Immunogenetics : 05 Hrs.

Genetics of normal immune system. Inherited immunodeficiency, Eg. X-linked agammaglobulinemia. Major Histocompatibility Complex – Study of Twins (MHC), HLA disease associations. Transplantation, graft –versus-host disease.

Pharmacogenetic – definition, gene loci influencing drug metabolism and pharmacogenetic interactions.

7.Dermatoglyphics 03 Hrs.

Introduction, classification, Flexion creases. Dermatoglyphics in clinical disorders. Clinical application & its advantages and limitations.

8.Prenatal Diagnosis : 03 Hrs.

Definition : Various procedures used such as Amniocentesis, Chorionic villus sampling, Ultrasonography and Fetoscopy.

9.Eugenics : 05 Hrs.

Positive and Negative, Euthenics, Euphenics and Genetic Counseling

Stage 1 : History and Pedigree Construction

Stage 2 :Examination

Stage 3 : Diagnosis,

Stage 4 : Counseling ; and

Stage 5 : Follow up

11. Genetics and Society :

- (i) Human genome project ; (ii) Forensic science ; (iii) DNA finger printing ; (iv) Human health care (Growth, hormone, Insulin, Interferon) and (v) Gene therapy.

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Semester V Practical VI 15 Prs.

1. Study of Mendelian traits :

Straight hair (recessive), Curly hair, Widow's peak, Dimpled cheeks, Mid digital hair, Hitchhiker's thumb, Clasp of hands and Hypertrichosis.

2. Gene Frequency : 2 Prs.

Estimation of frequency of PTC taste sensitivity, attached/free Earlobe and Rolling tongue in a known population.

3.Study of Karyotypes I : 2 Prs.

Normal karyotyping in Humans – male (46, XY) and female (46, XX)
G banded metaphase plate.

4.Study of Karyotypes II :

Abnormal Karyotypes – Down syndrome (Autosomal). Turner syndrome and Klinefelter syndrome (sex chromosomal)

5.Sex chromatin : 2 Prs.

Buccal smear study and staining methods for Barr bodies

Blood smear study of drum sticks in Neutrophils

1 Prs.

6.Blood cell counting using Haemocytometer

1 Prs.

7. Pedigree analysis : 3 Prs.
 Symbols used in autosomal recessive disorder autosomal dominant disorder, sex chromosomal (x & Y linked) disorders.

2. Dermatoglyphics :
 Recording of print of fingertips and palm. Classify ridges on the 1 Prs.
 Finger tips arch, loop, and whorl. Palm print – area demark as hypothenar, thenar & inter digital area.
 Record presence or absence of Simian crease

3. Visit to Genetic Clinics

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Semester V Scheme of Examination of Practicals VI 30 Marks

1. Buccal smear / Blood smear for sex chromatin	5
2. Blood typing of any two samples	5
3. Pedigree : Construction and analysis of Chart	5
4. Karyotype : Normal/Abnormal	5
5. Genetics problems on Multiple alleles / Multiple factor	4
6. Comment on the Spotters : (Two)	2 x 3 = 6
a) Mendelian Trait	
b) Dermatoglyphic pattern	

References :

- § Essentials of Human Genetics by S.M. Bhatnagar et al (1999) IV edition. Orient Longman.
- § Human Genetics : Concepts and Applications by Lewis R (2001) McGrawHill; Boston.
- § Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) Rastogi Publications, Meerut.
- § Mendelian inheritance in Man : Catalogs of Autosomal recessive, and x-linked phenotypes. [12th editions – 1998] by Mc Kusick, V.A. Johns Hopkins university press, Baltimore.
- § Principles and Practice of Medical Genetics, by Emery, A.E.H and D.L. Rimoin (Eds_ (1990-2nd edition) Churchill Livingstone, Edinburgh.
- § Molecular Basis of Inherited Diseases, (6th Edition-1989) by Scriver, C.R. A.L. Beudet, W.S. Sly and D. Valle (Eds) McGrawHill, New York.
- § Human Genetics by S.D. Gangane (2nd edition-Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.
- § Genetics in Medicine by M.W. Thompson et al, 5th Edition, W.B. Saunders Company, London
- § Genetic basis of common diseases by R. A. King et al, Oxford University Press.
- § Mendelian inheritance in Man by Mc. Kusick V.A. (1998), 12th Edition, John Hopsins University Press, Baltimore.

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Semester VI Paper VII : Advanced Genetics 45 Hrs.

1. Development Genetics : 10 Hrs
 Factors controlling development. Nuclear changes during development (Nuclear transplantation) Switching genes on and off during development. Fate mapping ; Tissue specific methylation. Differential expression of haemoglobingenes. The genetics of development in Drosophila and Arabidopsis.
 Homoeotic genes in genetic control of flower. Flower morphogenesis (Rice and Arabidopsis thaliana)
2. Evolutionary Genetics : 05 Hrs
 Mutation theory : Neo Darwinism ; Synthetic Theory. Evolution at molecular level; Nucleotide sequence. Speciation : Races and Specied, Methods of speciation
3. Population Genetics :

Gene pool and gene frequencies : Hardy-Weinberg principle, Evolutionary agents : Selection – differential selection, fitness, game selection, zygotic selection ; Migration and Random drift.

Biometrical Genetics

1. Quantitative Characters : 02 Hrs.
Description of continuous variation in quantitative or economic characters in crop plants and animals : Grain/Crop yield, Milk yield, Egg size and number. Litter size in pigs, Wool yield and Body weight in Sheep.
2. Quantitative inheritance : 05 Hrs.
Features of polygenic traits in relation to oligogenic traits. Inheritance of kernel color in wheat, Ear length in maize, body size in rabbits and poultry and skin colour in human. Transgressive inheritance. Assumptions of polygenic inheritance. Environmental effects.
3. Partitioning of polygenic variability ; 03 Hrs
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- Phenotypic, genotypic and environmental variability. Additive Variance, Dominance variance and Epistatic variance.
4. Phenotypic & Genotypic Coefficients of Variation (PCV & GCV) 05 Hrs.
Heritability in broad sense. Genetic advance, genotypic and phenotypic correlations. Path coefficient analysis.
Selection index.
Significance of polygenic inheritance in evolution and improvement of crop varieties as well as animal breeds.
5. Cancer Genetic : 10 Hrs.
Regulation of mitotic cell cycle in eukaryotes and intercellular communication in multi cellular eukaryotes. Properties of cancer cells. Proto oncogenes, Oncogenes, Cellular oncogenes, Tumor suppressor genes, Viral oncogenes.
Chromosomal abnormalities associated with the specific malignancies-CML, APL, ALL, ANLL, CLL & Retinoblastoma.
6. Introduction to Genomics and Proteomics : 02 Hrs.

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Semester VI Practicals VII 15 Prs.

1. Project Work : 05 Prs.
Field study on gene and genotype frequency of autosomal and sex linked Mendelian traits in Human. Data need to be generated by each student from among the college students and submit the project report.
2. Use of Models : 02 Prs.
Marbles of different colors are to be used to demonstrate the effect of Selection Pressure and Genetic drift on gene and genotype frequency in Mendelian population.
3. Biometrical problems : 08 Prs.
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- § Quantitative Inheritance : Problems on Kernel color in Wheat, Ear length in Maize, Body size in Poultry & Rabbits.
- § Genetic problems on partitioning polygenic variability,
- § Genetic problems on Heritability, Genetic Advance and Correlations.
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III B.Sc. GENETICS

Semester VI Scheme of Examination of Practical VIII 30 Marks.

1. Project work report 10
2. Genetic Problems : 3 x 5 = 15
- a) Quantitative Inheritance
- b) Polygenic variability
- c) Heritability, Genetic Advance and Correlations.
3. Viva Voce 05
-

Reference :

- Genetics and Analysis of Quantitative traits by Lynch. M and B. Walsh (1997). Senauer Associates, Sunderland.
 Evolutionary Genetics by Maynard Smith J (1989), Oxford University press.
 Genes in Population by Spiess. E (1989) 2nd Edition. Wiley-Liss, New York.
 Evolutionary Biology by Futuyma. D (1997) 3rd edition, Sinauer Associates.
 The causes of Molecular Evolutio by Gillespie, J (1994) oxford university press, New York.
 Natural Selection : Domains, Levels and Challenges by Williams G. (1992) Oxford University Press, New York.
 Introduction to Quantitative Genetics by Falconer, D (1995) 4th edition Longman, London.
 Evolution – Stickberger, M. W (1990) Jones and Bartlett, Boston.
 Proteonics by S.R. Pennington & M. J. Dunn (2002) Viva Books.
 Principles of Genome Analsis by Primrose, S. B. (1995) Blackwell, Oxford.
 Elements of Pant Breeding by Phundhan Sing, 2nd Edition (2001) Kalyani Publishers, New Delhi.

III B.Sc. Genetics**Theory Syllabus****Semester VI PAPER VIII : APPLIED GENTCS**

45 Hrs.

Recombinant DNA Technology Application in Medicine & Industry :

06 Hrs.

Production of recombinant insulin, interferon & human growth hormone [HGH], antibiotics, steroid drugs, and vaccines. Preparation of DNA probes, monoclonal antibodies and diagnostic kits.

DNA finger printing

08 Hrs.

Recovery of DNA, Restriction digestion and Electrophoresis [RFLP & RAPD], Southern blotting, Autoradiography and matching with known marker bands. Application : Forensic Science, Medico-legal, Wildlife and Plant Science.

Genetic Resources :

03 Hrs.

Germplasm, Classification, Germplasm activities, Organizations associated with germplasm (NBPGR, National Facility of Drosophila).

Center of Diversity and Gene Bank

03 Hrs.

Introduction, Genetic Erosion, Biodiversity, Centers of Diversity, Vavilovian Centers of Diversity, Law of Parallelism, Gene Sanctuaries, Gene Bank and Cyro-preservation.

Hoterosis breeding in Animals :

04 Hrs.

Identification of Hybrid plants :

03 Prs

Phentypic Identification of Hybrid Plants using Gene marks and computation of Genetic Purity Pot Culturing.

Parents and Hybrids of crops such as Cotton, Chilies, Onion, Tomato, etc., (Source : KSSCA, Bangalore and IIHR, Hesaragatta).

6.Study Tour to Premier Plant and/or Animal Breeding Centres.

02 Prs.

III B.Sc. GENETICS**Semester VI****Scheme of Examination of Practicals VIII**

30 Marks.

1. Submission of three plant tissue cultures

09

2.Dissect and draw the floral parts of the given material

04

3.Identify and comment on the Spotters :

3 x 4 = 12

a)Malarial/Filarial Parasites

b)Hybrid plant with parents.

c)Cross/Exotic Breeds of Poultry/Dairy/Piggary animals (Photos)

4. Educational Tour Report : On the visit to Premier Centers

05

References :

- 1.DNA Technology. The Awesome Skill 2nd edition by Alcamo I.E. (2000) Harcourt / Academic press.
 2.Elements of Biotechnology by P.K. Gupta (2002-2003) Rastogi.
 3.Biotechnology by Singh B.D. (2002) Kalyani Pub.
 4.Molecular Biotechnology , 2nd edition by Glick, B.R. and Pasternak, J.J. (1998) AS press, Washington.
 5.An Introduction to GENETIC ENGINERIG Second Edition-Desmond S.T. Nicholl (2002) Cambridge University Press.

6. An Introduction to plant tissue culture by Razdan M.K. (1993) Oxford & IBH, New Delhi.
7. Genetics of Livestock Improvement by J.E. Lasley. Prentice-Hall of India/
8. Elements of Plant Breeding by Phundan Singh. Kalyani Publications.
9. Biotechnology Application of Plant Tissue and cell culture by Ravishanker G.A. & Venkataraman L.V. (1997) BH Publications.
10. Breeding Field Crops by Berthakur and Phoelman

COMMON REFERENCE BOOKS.

1. Principles of Genetics by Gardner et al, (1991) 3rd Edition, John Wiley & Sons Publications, New York.
 2. Genetics by P.K. Gupta, 3rd Edition, (2001) Rastogi Publications, Meerut.
 3. Fundamental of Genetics by B.D. Singh, Revised Edition (1995), Kalyani Publishers.
 4. Principles of Genetics-Sinnot, Dunn & Dobzhansky (Tata-McGraw Hill India Reprint).
 5. Genetics – M. W. Strickberger Macmillan Publications New York
 6. Theory and Problems of Genetics – W.D. Stansfield (Schum's Outline Series) Mc-Grawhill Publication, latest Edition 2002
 7. Cell and Molecular Biology by P.K. Gupta (2003) Rastogi Publications.
 8. Cell Biology by C.B. Powar, Himalayan Publishers. Genetics, Principles and Analysis by Daniel Hartl & E.W. Jones : (Fourth edition-1998) ; Jones & Barlett Publications.
 9. Introduction to Genetic Engineering by Desmond S.T. Nichill 2nd Edition (2002), Cambridge University Press.
 10. Essentials of Human Genetics by S.M. Bhatnagar et al, 4th Edition, (1999), Orient Longman.
 11. Elements of Plant Breeding by Phundan Singh, 2nd Edition (2001), Kalyani Publishers.
 12. Principles of Genetics by Robert H. Tamarin, Seventh Edition. Tata Mc-Graw Hill, India 2002 Edition.
 13. Genetics : From Genomes by Hartwell L.H. & others Mc. Graw Hill
 14. Laboratory Manual of Genetics 4th Edition by A.M. Winchester and P.J. Wej-Ksnora, University of Wisconsin-Milwaukee.
 15. ACT Cytogenetics Laboratory manual by Barch M. (Ed 1997) Lippincott.
 16. Molecular Biotechnology, 2nd edn (1998) Glick, B.R. and Pasternak J.J. ASM Press, Washington.
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