

II SEMESTER B.Sc. – GENETICS

Theory Syllabus

(Paper – GNT 201: Principles of Genetics)

56 Hrs.

UNIT I

15Hrs

a. History of Genetics:

- Definition and scope of Genetics.
- Pre-mendelian genetic concepts- Pre-formation, Epigenesis, Pangenesis, Inheritance of acquired characters, Germplasm theory.
- Heredity and Environment; Genotype and Phenotype; Heredity and Variation.
- Clones, Purelines and Inbred lines.
- Norms of reaction and Phenocopies.

b. Biography of Mendel and his experiments with pea plant.

c. Law of segregation:

- Monohybrid cross, back cross and test cross.
- Dominance and Recessive ness,
- Co-dominance and Incomplete dominance.
- Genetic problems related

d. Law of Independent Assortment:

- Dihybrid cross in Pea plant and *Drosophila*,
- Back cross and test cross.
- Genetic problems related.

UNIT II

14 Hrs

a. Multiple alleles:

- Definition, Eye color in *Drosophila*, Blood groups and Rh factor in Human.
- Genetic problems related.

b. Gene interactions:

- Deviations from Mendelism:
 - Inter allelic-
 - Complementary gene interaction (9:7) Ex. *Lathyrus odoratus*
 - Supplementary gene interaction (9:3:4) Ex. Grain color in Maize.
 - Epistasis: - Dominant –Ex. Fruit color in *Cucurbita pepo*.
 - Epistasis:- Recessive –Ex. Coat color in Mice.
 - Inter allelic Non Epistatic: Ex. Comb pattern in Fowl.

UNIT III

15Hrs

Elements of biometry:

- Measures of Central tendency – Mean, Median and Mode.
- Measures of Dispersion – Range, Variance, Standard deviation and Standard error.
- Test of Hypothesis – Student's 't' test, Chi square test.
- Probability- Basic concepts; Distribution- Normal, Binomial and Poisson.

UNIT IV

12Hrs

Sex determination:

- Chromosomal theory of sex determination-XX-XY, XX-XO, ZZ-ZW; Genic balance theory of Bridges, Y chromosome in sex determination in *Melandrium*.
- Environment and sex determination.
- Hormonal control of sex determination (free martin).
- Gynandromorphs / Intersexes, Super sexes in *Drosophila*.
- Sex differentiation and Dosage compensation (*Drosophila* and Man).

II SEMESTER B.Sc. GENETICS
Practical Syllabus
(Paper – GNP 201)

15 Prs.

- | | |
|--|---------|
| 1. Study of floral structure of: | 02 Prs. |
| a) Pea / <i>Crotolaria</i> / <i>Pongamia</i> , | |
| b) Maize | |
| c) <i>Arabidopsis</i> / <i>Brassica juncea</i> . | |
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| 2. Temporary squash preparation of: | 03 Prs. |
| a) Onion flower buds and | |
| b) Grasshopper testes. | |
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| 3. Study of: | 01 Pr. |
| a) Flower color in <i>Antirrhinum</i> / <i>Mirabilis</i> , | |
| b) Coat color in Mice | |
| c) Comb pattern in fowl. | |
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| 4. Blood typing. | 01Pr. |
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| 5. Computation of: | 02 Prs. |
| a) Mean, median and mode, | |
| b) Standard deviation and standard error. | |
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| 6. Problems on: Student's 't' test and Chi square test. | 02 Prs. |
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| 7. Genetic Problems: a) Multiple alleles | 02 Prs. |
| b) Gene Interaction. | 02 Prs. |

References:

- Principle of Genetics by Robert H. Tamarin, Tata-McGraw Hill, Seventh Edition (2002).
- Genetics, Principles and Analysis by Daniel Hart and E.W. Jones. 4th Edition 1998; Jones and Bartlett Publication.
- The Science of Genetics by Atherly, A.G.; Girton, J.R. and MC Donald, JF.(1999). Sounders College Publication / Harcourt Brace.
- Genetics by M.W. Strickberger. McMillan Publication, New York.
- A History of Genetics by Sturtevant, A.H. (1965). Harper and 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.
- Theory and problems of Genetics – W.D.Stansfield (Schaum's Outline Series). McGrawHill 2002.
- History of Genetics by Stubbe. H. (1972), Harper and Row New York.
- Fundamentals of Biostatistics by Satguru Prasad (1993). Emkay publications, New Delhi.
- Fundamentals of Biostatistics by Khan & Khanum (2004), II Revised Edition, Ukaaz Publication.

I B.Sc. GENETICS
Semester II (Paper – GNP 201)

Time : 3 hrs.	Practical Examination	Max. Marks – 35
1.	Prepare a temporary smear of given material. Identify the stage, and comment.	08
2.	Dissect and display the given floral material, draw floral diagram and write floral formula.	06
3.	Detect the blood group of the given sample 'a' and 'b. Report the result and comment on the result.	04
4.	Spotters: Identify and comment on any two: a. One spotter from : Antirrhinum / Mirabilis / Comb Pattern in fowl / Coat color in mice b. Meiotic stage.	3 x 2 = 06
5.	Genetic problems: a. Biometry b. Multiple alleles / Gene Interaction.	2 x 3 = 06
6.	Class Record.	05

I B.Sc. GENETICS
Semester II

Scheme of Valuation of Practical Examination

1.	Preparation of a temporary smear. (Preparation– 04, Identification of stage – 01, Comment on stage With diagrams – 03)	08
2.	Dissect and display the given floral material, draw floral diagram and write floral formula. (Dissect and Display – 02, Floral diagram – 03, Floral formula – 01)	06
3.	Blood typing. (Performance 2, Result – 01, Comment on result – 01)	04
4.	Spotters: Identify and comment on any two: [(Spotters 'a' -Identification – 01, Comment with diagram – 2, Spotter "b" (meiotic stage) Identification – 1, Comment with diagram–2)]	3 x 2 = 06
5.	Problems: Any Two One from biometry One from multiple alleles/gene interaction	3+3=6
6.	Class Record.	05

V SEMESTER B.Sc. – GENETICS
Theory Syllabus

(Paper – GNT 502: Basic Human Genetics)

40 Hrs.

UNIT I

14 Hrs

a. Human Chromosomes:

Normal Human Karotype: Paris Nomenclature , Flow karyotyping (Quantification of DNA of individual chromosomes) FACS-Fluorescence activated cell sorter

b. Genetic Diseases and Inheritance Pattern:

- **Autosomal inheritance- Dominant**
(Ex.- Adult polycystic kidney, Achondroplasia and Neurofibromatosis)
- **Autosomal inheritance- Recessive**
(Ex.- Albinism, Sickle cell anemia , Phenylketonuria)
- **X-linked – Recessive:** (Ex.- Duchenne muscular dystrophy-DMD)
- **X-linked ; Dominant** (Ex.- Xg blood group)
- **Y-linked inheritance** (Holandric gene Ex.- Testes determining factor - TDF)
- **Multifactorial inheritance**
(Ex.-Congenital malformations- Cleft lip and palate , Rheumatoid arthritis and Diabetes)
- **Mitochondrial diseases:** (Ex.- Leber's hereditary optic neuropathy)

c. Pedigree studies and Genetic Counseling:

- Symbols used in pedigree studies, Pedigree analysis & construction, Pedigree analysis for the inheritance pattern of genetic diseases,
- Genetic Counseling.
 - Stage 1: History and pedigree construction
 - Stage 2: Examination
 - Stage 3: Diagnosis
 - Stage 4: Counseling
 - Stage 5: Follow up

UNIT II

14 Hrs

a. Immunology and Immunogenetics:

- Introduction to immunology,
- Cells of immune system,
- Genetics of immune system,
- Immune response, immunity-innate & acquired.
- Inherited immunodeficiency- Ex. – X- linked agammaglobulinaemia.
- Major Histocompatibility Complex- Study of twins (MHC),
- HLA disease associations.
- Transplantation, graft-versus-host disease.

b. Oncogenetics:

Properties of malignant cells,

- Types of genes - Proto oncogenes, Oncogenes, Cellular oncogenes, Tumor Suppressor genes,
- Chromosomal abnormalities associated with the specific malignancies- APL, CML & Retinoblastoma

UNIT III

12 Hrs

a. Dermatoglyphics:

- Introduction and classification, Flexion creases.
- Dermatoglyphics in clinical disorders.
- Clinical applications, its advantages and limitations.

b. Prenatal Diagnosis:

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

c. Genetics and Society:

- Eugenics: Positive and negative, Euthenics, Euphenics
- Human genome project
- Gene therapy with reference to Haemophilia
- Stem cells- Definition, types & sources.
A brief account on Cord blood banking and Stem cell therapy.

V SEMESTER B.Sc. – GENETICS

Practical Syllabus (Paper – GNP 502)

15 Prs.

- 1. Study of Mendelian traits:** 2 Prs.
Straight hair (recessive), Curly hair, Widow's peak,
Dimpled cheeks, Mid digital hair, Hitchiker's thumb,
Clasping of hands, Attached earlobe.
- 2. Study of Karyotypes I: Normal Karyotyping in Humans** 1Pr.
 - Male (46,XY)
 - Female (46, XX).
- 3. Study of Karyotypes II: Abnormal Karyotypes** 1Pr.
 - Down syndrome (autosomal).
 - Turner syndrome (sex chromosomal)
 - Klinefelter syndrome (sex chromosomal)
- 4. Sex chromatin:** 2Prs.
 - Buccal smear study and staining methods for Barr bodies
 - Blood smear study of drum sticks in Neutrophils
- 5. Blood Cell counting:** using Haemocytometer (RBC and WBC) 3 Prs.
- 6. Pedigree analysis:** 2 Prs.
Symbols used in autosomal recessive disorder autosomal dominant disorder,
Sex chromosomal (X & Y linked).
- 7. Dermatoglyphics:** 2 Prs.
Recording of print of fingertips and palm.
Classify ridges on the Finger tips arch, loop, and whorl.
Palm print - area demarcated as hypothenar, thenar and inter - digital areas
Record presence or absence of Simian crease.
Ridge Counting and angle calculation.
- 8. Immunology:** 2 Prs
Demonstration of
 - i. Ouchterlony Double Diffusion (ODD)
 - ii. Radial Immuno Diffusion (RID)

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) McGrawHi; Boston.
- Basic Human Genetics by EJ. Manage and A.P. Manage (1997 India Reprint) Rastogi Publications, Meerut.
- Molecular Basis of Inherited Diseases, (6th Edition-1989) by Scriver, C.R. A.L. Beudit, W.S. Sty abnd D. Valle (EdsO 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, 5 Edition, W.B. Saunders Company, London.
- Emery's Elements of Medical Genetics- Peter Turnpenny, Slan Ellard.
- Medical Genetics- Jorde, Carney, Bamshad, White.
- Human Genetics – Bruce.R.Korf.
- Genetic basis of common diseases by R. A. King et al, Oxford University Press.
- Mendelian inheritance in Man by-Mc. Kusick V.A, (1998), 12 Edition, John Hopsins University Press.
- Human Cytogenetics – Rooney.

**III B.Sc. GENETICS
Semester V (Paper – GNP 502)**

Time : 3 hrs.	Practical Examination	Marks 35
	1) Prepare a Buccal smear / Blood smear for sex chromatin and comment.	07
	2) Count the RBC / WBC in the given sample	07
	3) Construct the pedigree for the given data / analysis the given Pedigree	06
	4) Identify and comment on given Karyotype	04
	5) Identify and comment on the given Spotters (Two).	2 x 3=06
	i) Mendelian Trait - 1	
	ii) Dermatoglyphic pattern /ODD/RID	
	6) Record	05

**III B.Sc. GENETICS
Semester V**

Scheme of Valuation of Practical Examination

1) Buccal smear / Blood smear (Slide Preparation 05, Comment 02)	07
2) Count the RBC / WBC Procedure — (Preparation - 03, calculation - 03, Report 01)	07
c) Pedigre Construction with explanation / Analysis of Pedigree	06
d) Karyotype (Identification – 01, Comment – 03)	04
e) Spotters (Identification – 1 , Comment – 2)	2 x 3=06
f) Record	05

III SEMESTER B.Sc. – GENETICS

Theory Syllabus

(Paper – GNT 301: Cytogenetics)

56 Hrs.

UNIT I

14Hrs

a. Physical Basis of inheritance:

- Chromosome theory of inheritance.
- Eukaryotic Chromosome- Macro-molecular organization. Primary and Secondary constriction, Sat-bodies, telomeres.
- Heterochromatin and Euchromatin and its significance.
- Ultra structure of chromosome- Nucleosome model and Nucleosome Structure. Karyotype and Idiogram.

b. Special types of Chromosome:

- Polytene chromosome- Salivary gland chromosome in *Drosophila*,
- Lampbrush chromosome in amphibian Oocyte
- B Chromosome.

UNIT II

a. Sex Linkage:

15 Hrs

Meiotic behavior of chromosome 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.

b. Extra Chromosomal Inheritance / Cytoplasmic Inheritance:

- Introduction to Cytoplasmic Inheritance.
- Mitochondrial DNA,
- Chloroplast DNA,
- Kappa articles in *Paramoecium*,
- Sigma factor in *Drosophila*,
- Cytoplasmic Male Sterility (CMS) in maize

UNIT III

15Hrs

a. Linkage:

- Introduction and definition of Linkage,
- Coupling and Repulsion hypothesis,
- Linkage group- *Drosophila*, maize and man,
- Types of linkage-complete linkage and incomplete linkage,
- Factors affecting linkage- distance between genes, age, temperature, radiation, sex, chemicals, nutrition, etc.

b. Crossing over:

- Crossing over- definition and types of crossing over-germinal and Somatic crossing over,
- Cytological basis of crossing over- Sterns experiments in *Drosophila*, Creighton and Mc Clintock experiment in maize,
- Mechanism of crossing over- Chiasma type theory, the breakage first theory, the contact first theory, strain or torsion theory,
- Molecular mechanism of crossing over- Holiday model, single strand breaks,
- Crossing over in *Drosophila* and Tetrad analysis in *Neurospora*,
- Interference and coincidence, Construction of genetic maps(*Drosophila* and maize)

UNIT IV

12Hrs

Chromosomal aberrations:

- Numerical- Euploidy (Monoploidy, Haploidy and Polyploidy)
Polyploidy- Autopolyploidy and Allopolyploidy.
Aneuploidy- Monosomes, Nullisomes and Trisomes.
- Structural- Deletions, Duplication, Translocation and Inversions.
- Evolutionary significance of chromosomal aberrations.s

III SEMESTER B.Sc. – GENETICS
Practical Syllabus

(Paper – GNP 301)

15 Prs.

- | | | |
|-----------|--|---------|
| 1. | Culturing and Handling of <i>Drosophila</i>: | 02 Prs. |
| | a) Media Preparation. | |
| | b) Cleaning and Sterilization of bottles. | |
| | c) Handling of <i>Drosophila</i> . | |
| 2. | Study of at least five types of <i>Drosophila</i>: | 02 Prs. |
| | a) Body color mutant- Ebony body and Yellow body. | |
| | b) Wing mutant- Curly wing and vestigial wing. | |
| | c) Eye color mutant- Bar eye, white eye, sepia eye. | |
| 3. | Mounting of Sex Comb of <i>Drosophila melanogaster</i>. | 01 Prs. |
| 4. | Salivary gland Chromosome- | 04 Prs. |
| | a) Dissection of Salivary glands. | |
| | b) Preparation of Polytene chromosome. | |
| 5. | Study of Chromosomal Aberrations: | 03 Prs. |
| | a) Observation of permanent slides of chromosomal aberrations. | |
| | b) Inversion- Salivary gland chromosomes of <i>Drosophila nasuta</i> . | |
| | c) Translocation- Flower buds of <i>Rhoeo discolor</i> . | |
| | d) Induction of polyploidy in Onion root tips. | |
| 6. | Genetic Problems on Linkage & Crossing over: | 03 Prs. |
| | a) <i>Drosophila</i> . | |
| | b) Maize. | |
| | c) Human (Sex Linkage). | |

References:

- Genetic Maps, 6th edition by O'Brien, S (1993) Book 3: Lower Eukaryotes. Book 4: Nonhuman Vertebrates. Book 5: The Human maps. Book 6: 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-Oxford & IBH Publications.
- Principles of Genetics by E.J.Gardener, M.J.Simmons and D.P.Snustad.J.Wiley and Sons pubs (1998).
- Chromosomal Aberrations: Basic and Applied aspects by Obe.G. and A.T. Natarajan (1990) Springer Verlag, Berlin.

II B.Sc. GENETICS
Semester III (Paper – GNP 301)

Time : 3 Hrs.	Practical Examination	Marks 35
1. Prepare the Salivary gland Chromosomes from the given material and comment on its salient feature.		08
2. Prepare a temporary anther squash of <i>Rhoeo</i> for catenation ring and comment OR mount the Sex comb of <i>Drosophila melanogaster</i> and comment on it.		08
3. Identify and comment on the spotters given a) Any Two mutants of <i>Drosophila melanogaster</i> . b) Any One Chromosomal Aberration.		3 X 3= 9
4. Solve the given problem on Linkage map / Sex Linkage.		05
5. Class Records.		05
Note: For construction of linkage map data of two point / three point crosses should be provided.		

II B.Sc. GENETICS
Semester III

Scheme of Valuation of Practical Examination

1. Preparation of Salivary gland Chromosomes and comment. (Preparation - 05, Comment with diagram – 03)	08
2. Preparation of a temporary anther squash of <i>Rhoeo</i> OR Mounting of the Sex comb of <i>Drosophila melanogaster</i> and comment. (Preparation / Mounting – 05, Comment with diagram– 03)	08
3. Spotters. (Identification – 01, Comment with diagram – 03)	3 X 3= 9
4. Problem	05
5. Class record	05

VI SEMESTER B.Sc. – GENETICS

Theory Syllabus

(Paper – GNT 601: Developmental and Evolutionary Genetics) 40 Hrs.

UNIT I

13 Hrs

Developmental Genetics:

- General topics: - Role of Nuclear transplantation in development: Ex.:Amphibians and *Acetabularia*.
Switching genes on and off during development- Tissue specific methylation.
Ex. Differential expression of haemoglobin genes.
Fate mapping.
- The genetics of development in plants- *Arabidopsis*.: Flower development (floral morphogenesis and Homeotic gene expression).
- The genetics of development in Animals- *Drosophila*: Early development; Origin of anterior-posterior polarity:- Role of Maternal genes, Segmentation genes (gap, pair rule and segment polarity genes) and Homeotic selector genes; Establishment of dorso -ventral polarity.

UNIT II

14 Hrs

a. Evolutionary Genetics:

Darwinism, Mutation theory and Neo Darwinism, Synthetic Theory.
Evolution at molecular level: - Nucleotide sequence.
Isolation Pre-mating and post mating isolating mechanisms, role of isolation in Speciation.
Speciation: Methods of speciation-Allopatric and sympatric

b. Population Genetics:

Gene pool, Gene and genotype frequencies: Hardy-Weinberg principle,
Evolutionary agents:- Selection – differential selection, gametic selection, zygotic selection, fitness;
Migration; Mutation and Random drift.
Problems related.

c. Quantitative characters & inheritance:

- Quantitative Characters:-Types- Continuous, meristic and threshold characters with examples.
- Quantitative inheritance:-Features of polygenic traits in relation to oligogenic traits. Assumptions of polygenic inheritance. Inheritance of kernel color in wheat, and skin colour in human.
- Transgressive inheritance. Environmental effects.

Biometrical Genetics:

- An introduction to Correlation, Regression and ANOVA (Analysis of Variance)
- Genetic analysis of quantitative trait:- Ear length in Corn
- Variances in polygenic traits: - Phenotypic, genotypic, environmental, additive, dominance and Epistatic variance; Genotype and environmental interaction.
- Heritability: - Broad sense and Narrow sense heritability, Methods of estimation of heritability, Response to selection.
- Quantitative trait loci (QTL).
- Significance of polygenic inheritance in as animal breeds.
- Problems related to Variance and Heritability.

VI SEMESTER B.Sc. – GENETICS

Practical Syllabus

(Paper – GNP 601)

15 Prs.

1. Differential staining of blood sample 02 Prs.
2. Genetics of development in *Arabidopsis* –Homeotic gene expression (Slide/Chart) 02 Prs.
3. Genetics of development in *Drosophila*- Anterior and posterior polarity/Meternal genes/
Segmentation genes/Homeotic genes/ dorsoventral polarity (Slide/Chart) 02 Prs.
4. Study of Quantitative inheritance in
Kernel color in wheat/Skin colour in man(Char) 01Pr.
5. Biometrical problems: Minimum 5 problems in each topic 08 Prs.
 - Quantitative Inheritance: Problems on Kernel color in Wheat, Ear length in Corn and Skin color in Human.
 - Genetic problems on polygenic variance and Heritability.
 - Problems in Population Genetics.

Reference:

- Genetics and Analysis of Quantitative traits by Lynch. M and B. Walsh (1997). Sinauer 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 Evolution 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.
- Ecomics by S.R. Pennington and M. J. Dunn (2002) Viva Books.
- Principles of Genome Analysis by Primrose, S. B. (1995) Blackwell, Oxford.
- Elements of Plant Breeding by Phundhan Singh, 2nd Edition (2001) Kalyani Publishers, New Delhi.
- Genetics: A molecular approach by Peter J.Russell.2nd Edition. Pearson education.
- Developmental biology by Scott.F.Gilbert. Sinauer Associates,Sunderland.
- Principles of Development by Lewis Wolpert et al.2nd Edition.Oxford University press.
- Concepts of genetics by William S. Klug & Michael R. Cummings 7th Edition. Pearson education
- Evolutionary Biology by Dr. Veerbala Rastogi.
- General Biology Dr. B.S. Tomar and Dr. S.P. Singh.

III B.Sc. GENETICS
Semester VI (Paper – GNP 601)

Practical Examination

Time: 3 Hrs.

Genetics Paper VII

Marks 35

1. Conduct differential staining for the given blood sample 06
2. Identify and comment on the given spotters (Three) 3X3=09
 - i) Genetics of development of *Arabidosis*
 - ii) Genetics of development of *Drosophila*
 - iii) Quantitative inheritance of Kernal color in wheat/ skin color in man
3. Genetic Problems: 3x5=15
 - a) Gene and genotype frequencies
 - b) Polygenic variability and Heritability
 - c) Quantitative inheritance – Problems on Kernel color in Wheat, Ear length in Corn and Skin color in Human.
4. Class Records 05

IV SEMESTER B.Sc. – GENETICS
Theory Syllabus
(Paper – GNT401: Molecular Genetics)

56 Hrs.

UNIT I

13Hrs

a. Chemical Basis of Heredity:

- DNA as genetic material, Experiments of Griffith; Avery, Mc Cleod; Mc Carthy and Harshey Chase.
- RNA as genetic material- Experiment of Fraenkel and Singer.

b. Nucleic acids:

- DNA structure and types
- RNA types and structure
- Ribozymes

c. DNA Replication:

- DNA Replication in prokaryotes and rolling circle model
- DNA Replication in eukaryotes

UNIT II

15 Hrs

Gene Expression:

- Genetic code: Brief account.
- Protein synthesis in prokaryotes and eukaryotes.
 - Transcription (“rho” dependent and “rho” independent termination)
 - Post Transcriptional modifications
 - Translation
- Regulation of Gene expression:-
 - Inducible operons – Galactose
 - Repressible operon – Tryptophan

UNIT III

14Hrs

a. Genome organisation and Fine structure of the Gene :

- Prokaryotic genome:- Chromosomal and plasmid
- Eukaryotic genome:- Chromosomal and organellar
- Fine structure of the Gene: Cistron, muton and recon

b. Bacterial Genetics :

- Transformation,
- Transduction-Generalized and specialized:
- Conjugation: F factor mediated, Hfr and Sexduction.

c. Introduction to Genomics and Proteomics

UNIT IV

14 Hrs

a. Transposable elements :

Maize and *Drosophila*

b. Mutations:

- Introduction and Types of Gene mutations - Base substitution, Frame shift mutation (insertion, deletion, missense, nonsense mutation).
- Mutagens - Physical and chemical.
- Reverse mutation in bacteria.
DNA repair mechanism (Mismatch repair photoreactivation, excision and SOS repair)
- Beneficial and harmful effects of mutations.

IV SEMESTER B.Sc. – GENETICS

Practical Syllabus

(Paper – GNP 401)

15 Prs.

- 1. Instrumentation:** 03 Prs.
 - a) Centrifuge,
 - b) Ultra centrifuge,
 - c) pH meter
 - d) Electrophoretic unit,
 - e) Micropipette,
 - f) Glass homogenizer,
 - g) Autoclave,
 - h) Shaker incubator.

- 2. Extraction of DNA: From** 04 Prs.
 - a) Cauliflower ,
 - b) Coconut endosperm,
 - c) Bacteria
 - d) Liver Tissue

- 3. Paper Chromatography for Separation of:** 03 Prs.
 - a) leaf pigments,
 - b) *Drosophila* eye pigments
 - c) Amino acids

- 4. Electrophoresis (Demonstration)** 02 Prs.
 - a) Agarose gel electrophoresis
 - b) PAGE (Polyacrylamide gel electrophoresis)

- 5. Mutations :** 03 Prs.
 - a) Study of examples of mutations
 - Sickle cell Anaemia – Mis – sense mutation.
 - Thalassemia – frame shift mutation.
 - Identification of point mutation types based on the given representation
 - b) Induction of Mutation in *Drosophila* and detection of sex linked lethal by Muller 5 stock

References:

- Molecular Biology of the Gene, 4th edition by Watson J.D, N.H.Hopkins, J.W.Roberts, J.A.Steitz and A.M.Weiner (1987) Benjamin/Cummings.
- The RNA World (2 edition) Gestel and R, T.Cech and J.Atkins (edition) 1999 Cold Spring Harbor, New York.
- Cell Biology and Molecular Biology by EDP Robertis and EMF Robertis, Saunder College.
- Advanced Molecular Biology by Twyman R.M (1998) Viva Books Ltd.
- Instant Notes in Molecular Biology by P.C.Turner etal (2002) Viva Books.
- Instant Notes in Biochemistry 2 edition B.D.Hames and N.M.Hooper (2002) Viva Books.
- Genomes by T.A. Brown (2002) Viva Books.
- Molecular cell Biology, 2nd edition by Darnell.J, H.Lodish and D.Baltimore (1990), Scientific American Books, New York.
- GENES – IX by Benjamin Lewin
- Recombinant DNA Technology by Watson
- Molecular Genetics by D.N.Bharadwaj
- Advanced Genetics by G.S.Miglani
- Molecular Biology Techniques by Naik
- Genetics – Analysis of Gens and genomes – V edition - Daniel L – Hartl and W. Jones.
- Genetics – from genes to genomics – Leland.Hartwell etal.
 - Mc grow Hill publications.
- Bioinformatics - methods and applications – Sc. Rastogi.
- Bioinformatics – Approaches and applications – Chiranjib Chakraborty.

II B.Sc. GENETICS
Semester IV (Paper – GNP 401)

Time: 3 hrs.	Practical Examination	Marks 35
1. Extract the DNA from the given material write the protocol.		10
2. Perform the Paper Chromatography for given mixture, calculate the Rf value and comment on the principle.		08
3. Identify and comment on any four		3 x 4 = 12
i) Instrument (Any two),		
ii) DNA / Protein Profile,		
iii) Spotter from Mutation Study		
4. Records		05

II B.Sc. GENETICS
Semester IV

Scheme of Valuation of Practical Examination

1. Extraction of DNA (Extraction – 07 marks, Protocol-03)	10
2. Paper Chromatography (Performance – 02, Calculation of Rf value -04, Principle of Chromatography – 02)	08
3. Spotters [Identification – 01, Comment – 02 (for instrument Comment should be written on the working principle)]	3 x 4 = 12
4. Class Records	5

VI SEMESTER B.Sc. – GENETICS

Theory Syllabus

(Paper – GNT 602: Applicative Genetics)

40 Hrs.

UNIT I

13 Hrs

a. Genetics in Medicine & Industry:

- Production of recombinant Insulin, Interferon and Human Growth hormone (HGH)
- Vaccines- Hepatitis B vaccine.
- Preparation of DNA probes, Monoclonal antibodies and Diagnostic kits (Typhoid, Syphilis).

b. DNA Fingerprinting:

- Methodology of DNA fingerprinting.
- Molecular markers-RFLP & RAPD, Micro satellite, SNPs, STR.
- Applications with examples in forensic science, medico legal aspects, wild life crying.

c. Bioinformatics:

- Introduction, World Wide Web – Types of Web sites
- Internet - Types of information
- Bioinformatics in Genome analysis

UNIT II

14 Hrs

a. Genetic Resources and Biodiversity:

- Germplasm, classification, Germplasm activities, and organizations associated with germplasm (NBPGR, IBPGR).
- Genetic Erosion, biodiversity, centers of Diversity, Vavilovian Centers of Diversity, Law of Parallelism,
- Gene sanctuaries, Gene bank and Cryopreservation.

b. Introduction to plant tissue culture

- Embryo, Anther and Ovary Cultures
- Shoot and Root Meristem Cultures
- Callus Culture from Undifferentiated cells
- Protoplast Culture
- Economic benefits of Tissue Culture—Resistance to pests and Pathogens, Improvement in Nutritive value etc.

UNIT III

13Hrs

Heterosis in Animals and Plants:

Introduction to Heterosis and characteristics

In Animals:

- Animal breeding – Introduction to animal breeds, inbreeding, grading, cross breeding.
- Fish breeding (Selection, Induced Polyploidy, Gynogenesis and Androgenesis, Inbreeding)
- Production of breeds: crossing of inbred lines for commercial production.
- Breeding strategies for improvement of livestock for milk, meat, wool production.
- Breeding strategies for improvement of Poultry.

In Plants:

- Genetic concepts- dominance – over dominance. Estimation of heterosis- Heterobeltosis, Economic heterosis, Standard heterosis .
- Hybridization techniques – intergeneric and interspecific hybridization. Identification of hybrid plants.
- Inbreeding depression.
- Hybrid vigor exploitation in Rice, Tomato.

VI SEMESTER B.Sc. – GENETICS

Practical Syllabus

(Paper – GNP 602)

15 Prs.

1. **Tissue culture techniques:** 6 Prs.
 - Sterilization
 - Explants preparation
 - Media Composition and preparation
 - Culturing of all kinds of explants for callus induction, multiple shoot proliferation.
 - Synthetic seed preparation
2. **Study of different techniques in plant hybridization** 1 Pr.
3. **Study of pollen fertility** 2 Prs.
4. **Study of diagnostic kits – WIDAL & VDRL** 2 Prs.
5. **Study of hybrid plants-** Rice, Cotton, Chilly, and Tomato. 1Pr.
6. **Study of hybrid animals-** Poultry, dairy, fishery. 1Pr.
7. One day field visit to Plant/ animal breeding Insitutes. 2Prs.
Report to be submitted during practical exam

References:

- DNA Technology. The Awesome Skill 2nd edition by Alcamo I.E. (2000) Harcourt / Academic press.
- Elements of Biotechnology by P.K. Gupta (2002-2003) Rastogi.
- Biotechnology by Singh B.D. (2002) Kalyani Publication.
- Molecular Biotechnology, 2nd edition by Glide, B.R. and Pasternak, J. J. (1998) AS press, Washington.
- An Introduction to GENETIC ENGINERIG Second Edition-Desmond S.T. Nicholl (2002) Cambridge University Press.
- An Introduction to plant tissue culture by Razdan M.K.(1993), Oxford & IBH,New Delhi.
- Genetics of Livestock Improvement by J.E. Lasley. Prentice India.
- Elements of Plant Breeding by Phundan Singh. 2nd Edition (2001), Kalyani Pulications.
- Biotechnology Application of Plant Tissue and cell culture by Ravishanker G.A. and Venkataraman L.V.(997) BH Publications.
- Introduction to Genetic Engineering by Desmond S.T. Nichill 2nd Edition (2002), Cambridge University Press.

**III B.Sc. GENETICS
Semester VI (Paper – GNP 602)**

Time : 3 hrs.	Practical Examination	Marks 35
1.	Prepare the Synthetic seeds. Write the protocol and its significance.	06
2.	Perform the Diagnostic test for the given sample by WIDAL / VDRL.	06
3.	Perform an experiment to test the pollen fertility of the given material.	04
4.	Identify & comment on the given spotters 1. Hybrid plant (Rice / Tomato) – Any one 2. Hybrid Animal (Fish/ Poultry/ Cattle) -Any one 3 Tissue Culture-Any one	3 x 3 = 9
5.	Class Record and field report	05+05=10

**III B.Sc. GENETICS
Semester VI**

Scheme of Valuation of Practical Examination

1.	Preparation of Synthetic seed (Performance - 4, Protocol, Significance - 2)	06
2.	Diagnostic test for the given sample (WIDAL/VDRL) (Performance- 3, Principle -2, Result and Interpretation - 1)	06
3.	Pollen fertility of the given material (Performance-3, Calculation of % of fertility -1)	04
4.	Identify & comment on the given spotters (Identification – 01, Comment - 02)	3 x 3 = 9
5.	Class Record and Field report	5+5=10

V SEMESTER – GENETICS

Theory Syllabus

(Paper – GNT 501: Recombinant DNA Technology)

40 Hrs.

UNIT I

15 Hrs

a. Introduction to RDT:

Overview of major steps involved

b. Tools for RDT:

- **Enzymes:**

- Restriction endonucleases: Types and characteristic features; Nomenclature; Modification of cut ends
- DNA ligases
- Other enzymes: A brief account of Alkaline phosphatase, Polynucleotide kinase, Exonuclease III, DNase I, DNA polymerase and Klenow fragment, Terminal nucleotidyl transferase, RNA dependent DNA Polymerase.

- **Vectors:**

- Properties of an ideal vector
- Types : Cloning and expression vectors

i) Cloning vectors: i) Prokaryotic vectors: Plasmids- pBR 322; pUC 18;

Bacteriophages- Lambda phage, Cosmids.

ii) Eukaryotic vectors: YAC vectors; Shuttle vectors- Yeast and *E. coli*.

iii) For higher plants: Integrative DNA transfer- *Agrobacterium* vectors- Ti plasmid-Binary and Co integrated vectors; Non integrative DNA transfer-Plant viral vectors (CaMV)

iv) For animals: Animal viral vectors- SV 40 (3 types);

ii) Expression vectors in Prokaryotes and Eukaryotes

UNIT II

13 Hrs

a. Isolation of the desired gene:

- cDNA library,
- Genomic library,
- Organo-chemical synthesis,
- Amplification through PCR

b. Direct gene transfer methods:

- Chemical methods,
- Lipofection,
- Electroporation,

- Microinjection,
- Ballistic method (Particle shot gun method)

c. Selection and screening of recombinants:

- Identification and selection of transformed cells:
 - Direct methods-Insertional inactivation, Visual screening method, Plaque formation, Complementation of mutation /nutrition
 - Indirect methods- Colony hybridization, Immunochemical detection
- Use of selectable and scorable genes:
- a) Selectable genes: Plants- npt ; Animals-TK
 - b) Scorable genes: Plants-Gus; Animals-lux

UNIT III

12Hrs

a. Technique for RDT:

- Gel electrophoresis: AGE and SDS-PAGE
- Hybridization: Southern; Northern; Western; Dot blots
- Autoradiography
- DNA sequencing: Sanger's Dideoxy method
- Molecular probes

b. Applications:

- Transgenic animals: Mouse(Knock-out; Methodology, applications); A brief account of Transgenic Sheep, , Poultry, Fish, Cow, , with value added attributes
- Transgenic Plants: Resistance to diseases (Pathogen resistant-viral, fungal and bacterial); insects (Bt gene transfer); Fertilizer management- Nif gene transfer.

V SEMESTER B.Sc. – GENETICS

Practical Syllabus

(Paper – GNP 501)

15 Prs.

1. Instrumentation:

03 Prs.

- a) Microneedle,
- b) Magnetic Stirrer,
- c) UV Transilluminator,
- d) PCR

2. Vecors:

02 Prs.

- a) pBR 322 and Cosmid,
- b) YAC,
- c) Ti plasmid - Binary vector,
- d) SV 40 (any one type),

3. Transgenic organisms:

Plants-Bt cotton and Animals-Knock out Mouse

01 Pr.

4. Experiments:

05 Prs.

- a) Quantification of DNA by DPA method
- b) Quantification of RNA by Orcinol method
- c) Agarose Gel Electrophoresis of DNA

5. Demonstrations:

04Prs.

- a) Isolation of Plasmid DNA
- b) Restriction Enzyme digestion
- c) Ligation of DNA fragment
- d) Transformation- α complementation

References:

- Agricultural Biotechnology- S.S. Purohit.
- An introduction to Genetic engineering (2nd ED). Desmond S.T. Nicholl I South Asian Edition, 2002, Cambridge University Press.
- Biotechnology; B.D. Singh, Kalyani publishers.
- Biotechnology; U. Satyanarayana; Books and Allied (P) Ltd., Kolkata, 2008.
- Biotechnology Fundamentals and applications- S.S. Purohit, student Edition, Jodhpur, 2003.
- Genetic engineering: Principles and practice; Sandhya Mitra, MacMillan India Ltd. 2008.
- Molecular Biotechnology; Principles and practices, Channarayappa, University press (India) Private Limited, 2006.
- Genetics: From Genes to Genomes by Hartwell I.H. et. al. 2000. Mc Graw Hill.
- Genes-Volumes, Benjamin Lewin, Oxford University Press, Oxford.
- Transgenic animals by Ranga.
- Molecular Biology- Primrose.
- Molecular Biology of the gene- Watson.
- Recombinant DNA Technology- Glick Paspornak.
- Gene cloning- T. A. Brown.

III B.Sc. GENETICS
Semester V (Paper – GNP 501)
Practical Examination

Time: 3 hrs.

Marks 35

1. Quantify the DNA / RNA from the given sample and comment on the principle involved. 12
(Standard graph to be prepared by students only)
2. Identify and Comment on the working principle of the given instrument 06
3. Identify and comment on any four of the following spotters: 03x04=12
 - a) Transgenic plant / animal 01
 - b) Vector 01
 - c) DNA Profile: i) Plasmid profile/ ii) Restriction profile/
iii) Ligation profile/ iv) Transformation plate
(Chart / Photograph of any one to be provided)
4. Class records. 05

III B.Sc. GENETICS
Semester V

Scheme of Valuation of Practical Examination

1. DNA / RNA Quantification. 12
**(Principle - 02, Performance and Observation table – 05,
Standard graph- 03, Result- 02).**
 2. Instrument. 06
(Identification - 01, Working Principle with application - 05).
 3. Spotters: 03x04=12
(Identification – 01, Comment – 02).
- Note: Comments for the profile should be pertaining to the profile only
and not on the technique).**
4. Class Record. 05