Course Content

Chapter	Content	Hours 56
	Unit - 1	14
01	Ultrastructure, chemical composition and functions of Plasma membrane. Ultrastructure and functions of Cytoplasmic organelles: Mitochondria, Kreb's cycle, BIS oxidative phosphorylation, Endoplasmic reticulum, Ribosomes, Lysosomes, Golgi bodies and Cytoskeleton.	
02	Nucleus: Morphology, nuclear envelope, nucleoplasm, nucleolus and chromatin.	

03	Ultra structure of Eukaryotic Chromosome: Macro-molecular organization-Nucleosome model. Primary and Secondary constriction, SAT-bodies, Special chromosomes- structure and function of Polytene and Lampbrush chromosome	JS
Chapter	Unit – 2	14
04	Molecular Basis Cell Cycle and Cell Division: G1, S, G2 and M phase, Checkpoints. Mitosis: Stages, Mitotic apparatus, cytokinesis, Mitogens and Inhibitors, Significance. Meiosis: Stages, Synaptonemal complex, crossing over and chiasma formation, Significance.	8hrs.
05	Cell senescence and Cell death: cellular features of Senescence- spontaneous and induced, Programmed cell death, Mechanism of cell death and significance.	JS
06	Cancer Biology: Introduction to cancer, Benign and malignant, Sarcoma, Carcinoma, Lymphoma and leukemia, Properties of malignant cells.	
Chapter	Unit – 3	14
07	Biography of Mendel and his experiments: Law of Segregation: Monohybrid cross, back cross and Test cross, Genetic Problems related. Law of Independent Assortment: Dihybrid cross, Back cross and Test cross, Genetic Problems related.	JS
8	Multiple Alleles: Definition, ABO blood groups and Rh factor in Human, Genetic Problems related.	PPA
9	Gene Interactions: Deviations from Mendelism: Incomplete inheritance and co-dominance, Complementary gene interaction (9:7), Supplementary gene interaction(9:3:4), Recessive Epistasis, Non-Epistasis (with an example for each trait)	PPA
Chapter	Unit – 4	14
10	Linkage: Linkage definition, cis and trans arrangement of genes, Linkage group in *Drosophila* and man. Types of linkage – complete and incomplete linkage maps. Linkage map – E.g. *Drosophila,* construction of linkage maps. Crossing over - Types, mechanism of crossing over, interference and coincidence, Factors affecting linkage and crossing over, significance of linkage and crossing over.	PPA
11	Human Cytogenetics: Normal Human karyotype (Male & Female)	JS
12	Clinical features and Karyotype of Syndromes: Cri-du-chats, Down's, Edward's, Patau's, Turner's, and Klinefelter's.	JS

Text Books:

1. Karp, G. (2009). *Cell and molecular biology: concepts and experiments*. John Wiley & Sons.
2. Russell, P. J., Hertz, P. E., McMillan, B., & Benington, J. (2020). *Biology: the dynamic science*. Cengage Learning.

4. **COURSE CONTENT**

Content	Hours 56
Unit 1: Biomolecules: a. Carbohydrates: Structure, classification and functions of carbohydrates b. Lipids: Saturated and unsaturated fatty acids, Tri-acyl glycerol, phospholipids, glycolipids, steroids and omega family fatty acids c. Proteins: Structure, classification, and general properties of α-amino acids, organizations of protein-simple and conjugate protein. Peptide Linkages- d. Enzymes: Properties, classification and functions, Enzymes kinetics, Enzyme inhibitors, Allosteric enzymes	14

Unit 2: Chemical basis of Heredity **a. Introduction:** DNA (Hershey and Chase experiment) and RNA (Fraenkel and Singer experiment) as genetic material. **b.** Structure and functions of DNA: Structure of DNA, Chargaff's rule, forms of DNA - A, B and Z; Functions of DNA and RNA including ribozymes. **c.** DNA replication in Prokaryotes and Eukaryotes, Initiation, continuous and discontinuous synthesis and termination. Enzymes and proteins involved in replication, Theta model and rolling circle model.	14
Unit 3: Protein synthesis and gene regulation **a.** Protein biosynthesis: Types of RNA, structure of tRNA, aminoacyl-tRNA synthetase; Transcription: initiation elongation, termination in prokaryotes and eukaryotes, Post-transcriptional modifications: Methylation, polyadenylation and RNA splicing. Gene-silencing by RNA interference; Genetic code; Translation and post translational modification of Proteins. **b.** Regulation of gene expression in bacteria- Lac Operon and Trp Operon; Overview of regulation of gene expression in eukaryotes, regulation of galactose metabolism in yeast.	14
Unit 4: Transposons, Mutations and DNA repair mechanism a. Transposons – Insersion sequence (IS) elements in bacteria, p elements in *Drosophila,* AC-DS in Maize; b. Mutations- Types of point mutations -Transition and transversion, base substitution Mutation- missense, non-sense, neutral and silent mutation; Frame shift Mutation-Insertion and deletion Mutations., Mutagens- physical and chemical, Detection of mutation - Ames test; Beneficial and harmful effects of mutation. c. DNA repair mechanism- photo reactivation, Mismatch repair, excision and SOS repair.	14

V Semester B.Sc., GENETICS
Theory Syllabus
Paper – GNT 501: RECOMBINANT DNA TECHNOLOGY

40 Hrs.

UNIT I **14 Hrs.**

a. Introduction to RDT:

Overview of major steps involved

b. Tools for RDT:

Enzymes:

Restriction endonucleases: Types, Nomenclature, Recognition sequences, cleavage pattern; Modification of cut ends DNA ligases

Other enzymes: A brief account of alkaline phosphatase, Polynucleotide kinase, Exonuclease III, DNase I, Klenow fragment, Terminal nucleotidyl transferase, RNA dependent DNA polymerase and S_1 endonuclease.

Vectors:

Properties of an ideal vector, Cloning and expression vectors in prokaryote and eukaryotes.

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

Non integrative- DNA transfer-Plant viral vectors (CaMV)

For animals: Animal viral vectors- SV 40, SV- GT5, Retroviruse and Adenoviruse.

UNIT II **13 Hrs.**

a. Isolation and construction of a desired gene:

mRNA isolation

cDNA library

Genomic library

b. Gene transfer methods:

Agrobacterium mediated gene transfer- Binary and Cointegration method.

Direct gene transfer methods:

Chemical method-Calcium phosphate method and DEAE - **(Diethylaminoethyl) Dextran mediated DNA transfer**

Lipofection

Electroporation

Microinjection

Gene gun method

c. **Synthesis of gene:**
Sangers di deoxy method
Organo chemical synthesis

d. **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 **13 Hrs.**

a. **Technique for RDT:**
Gel electrophoresis: AGE and SDS-PAGE
PCR - Principle and applications
Hybridization: Southern; Northern; Western;
Autoradiography – Principle and applications
DNA foot prints
DNA microarray and DNA chips.

b. **Applications:**
Transgenic animals: Methodology to create transgenic animals (mouse).
Applications of Transgenic Knock-out Mouse, Sheep, Fish, Cow.
Transgenic Plants: Resistance to diseases (Pathogen resistance to viral, fungal and bacterial); insects (*Bt* gene transfer).
Fertilizer management – organization of *nif* gene in *Rhizobium*.

V Semester B.Sc., GENETICS
Theory Syllabus
Paper – GNT 502: BASIC HUMAN GENETICS

40 Hrs.

13 Hrs.

UNIT I

a. Human Chromosomes:

Normal Human Karyotype: 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 anaemia, 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 Counselling:

Symbols used in pedigree studies, Pedigree analysis and construction, Pedigree analysis for the inheritance pattern of genetic diseases, Genetic Counselling.

- Stage 1: History and pedigree construction
- Stage 2: Examination
- Stage 3: Diagnosis
- Stage 4: Counselling
- Stage 5: Follow up

UNIT II **14 Hrs.**

a. Immunology and Immunogenetics:

Introduction to immunology- antigens, antibodies, B and T Cells

Immunity- Innate and acquired.

Immune response - Humoral and Cell mediated

Genetics of immune system – Antibody gene rearrangement and class switching.

Inherited immunodeficiency- Ex. X- linked agammaglobulinaemia.

Major Histocompatibility Complex- Types,

HLA disease associations.

Transplantation, graft-rejection and immunosupressors

Concept of immunization

b. Oncogenetics:

A brief account of cancer-definition, types-Benign and Malignant; Sarcoma, Carcinoma, Lymphoma and Leukaemia 5M

Properties of malignant cells,

Types of genes - Proto oncogenes, Oncogenes, 3M Difference between V-onc and C – onc oncogenes, Tumor Suppressor genes-p53, pRb.

Chromosomal abnormalities associated with the specific malignancies- Acute Promyelocytic Leukaemia(APL),Chronic Myeloid Leukaemia(CML) and Acute lymphoblastic leukaemia (ALL)

13 Hrs.

UNIT III

Dermatoglyphics:

Introduction and Patterns.

Dermatoglyphics in clinical disorders- Down's syndrome, Turner's syndrome, Klinefelter's syndrome and Cri du chat syndrome.

Clinical applications, Advantages and Limitations.

b. Prenatal Diagnosis:

Introduction and types

Invasive Prenatal diagnosis - Amniocentesis, Chorionic villus sampling.

Non – Invasive Prenatal diagnosis – Ultrasonography.

c. Genetics and Society:

Eugenics: Positive and negative, Euthenics, Euphenics 5M

Human genome project – introduction and significance

Gene therapy with reference to SCID

Stem cells- Properties, types and sources.

A brief account on Cord blood banking and Stem cell therapy.