

II SEMESTER B.SC., GENETICS (HONS) THEORY SYLLABUS
DISCIPLINE SPECIFIC -DSC
THEORY PAPER: DSCC5GENT2- BIOINSTRUMENTATION AND ANIMAL CELL CULTURE

Course Title: Bioinstrumentation and Animal Cell Culture Code: DSCC5GENT2	Course Credits: 04
Total Contact Hours: 56	Duration of ESA: 3 Hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60

Course Outcomes (COs):

At the end of the course, the students will be able to:

- Understand the basic principles of different laboratory equipments.
- Know the uses of the analytical equipments in various biological applications.
- Understand the cell lines and culture media and cell culture methods

Course Content

Chapter	Content	Hours
	Unit - 1 (PPA)	56
		14
1.	Microscopy: Introduction, and history of Microscopy Principle and Optical Components of microscope: Eye piece, Eye piece tube, Objective lenses, Coarse and Fine Focus knobs, Stage and stage clips, Aperture, Illuminator, Condenser, Condenser Focus Knob, Iris Diaphragm.	
2.	Types of microscopes: Simple and Compound microscopes, Light microscopes, Fluorescence, electron microscopy (transmission and scanning), Phase contrast, Confocal, Stereo microscopy, Optical pathway in different microscopes.	
3.	Uses of microscopy and biological applications: High resolution imaging, immune histochemistry, high-content screening and high-throughput imaging, Medical science, Forensic laboratories.	
Chapter	Unit - 2 (PPA)	14
04	Analytical Instruments: pH meter-principle and components of pH meter. Thermometer: principle, types of thermometers-digital, mercury, strip-type, Infrared, Axillary.	
05	Colorimeter: principles of measurement and applications. Spectrophotometer: Beer-Lambert's Law in spectrometry, UV spectrophotometers, Atomic absorption spectroscopy (AAS), Electron Spin Resonance (ESR), Nuclear Magnetic Resonance (NMR)	

Spectrophotometer, Atomic Spectrometer

06	Different types of sterilization methods: Autoclave, steam sterilizers, dry heat sterilizers and ovens and UV chambers.	14
Chapters	Unit - 3 (55)	
07	Instruments used in separation techniques: Centrifugation: Principle and applications of centrifuge, types of centrifuge-high speed centrifuge, ultra-centrifuge, Refrigerated centrifuge. Rotors: Types of rotors- vertical, Swing-out, Fixed angle.	
08	Chromatography: Principle, types and application of Chromatography- paper chromatography, ion exchange, gel filtration, HPLC, affinity chromatography.	
09	Electrophoresis: Principle and applications of electrophoresis. Types of electrophoresis: vertical and horizontal. — Agarose gel electrophoresis Components: Electrodes, Power supply, electrophoresis chamber	

Chapter	Unit - 4 (15)	14
10	Animal cell culture: Principles of cell culture, cell types, cell lines, Primary culture, secondary culture, cryopreservation, contaminations, organotypic culture	14
11	Requirements in Animal Cell Culture: Equipments used in Cell culture, Culture vessels, Aseptic techniques. Cell culture media: Natural and defined, role and components of serum in culture. <i>In vitro</i> transformation of animal cells, Types of cell culture.	
12	Applications of cell culture: Cell culture in biomedical research, karyological studies, amniocentesis, mutagenesis, Cytotoxicity assays.	

IV SEMESTER B.SC., GENETICS (HONS) THEORY SYLLABUS
DISCIPLINE SPECIFIC CORE COURSE DSCC
THEORY PAPER: DSCC5GENT4: HUMAN GENETICS AND GENETIC
COUNSELLING

1. Course Description:

Semester: IV	Course Title: Human Genetics and Genetic Counselling
Course Code:	Course Type: DSCC5GENT4
Course Credits	4
Total hours :	56
Formative Assessment Marks: 40	Summative Assessment Marks:60
Duration of DSC	4Hours

2. Course Objectives:

- Study the Human chromosome and chromosomal Inheritance pattern in Human.
- Understand the components of immune system and the role of genes in immune development.
- Comprehend prenatal diagnosis method and use of cell therapy and gene therapy for genetic disease.
- Understand the objective of Genetic counseling and its steps involved.

3. Course Outcomes:

After the successful completion of the course, the student will be able to:

- Understand the nomenclature of Human chromosome and chromosomal inheritance pattern.
- Understand cells of immune system, structure of immunoglobulin and role of MHC in transplantation.
- Understand Prenatal diagnosis method and gene therapy for treating Genetic disease.
- Appreciate Genetic counselling and steps involved in it.

4. Course Content

Content	56 Hrs
<p>UNIT I: Human chromosomes and chromosomal Inheritance Pattern</p> <p>a. Human Chromosomes: Normal and abnormal Human Karyotype: Paris Nomenclature, Flowkaryotyping, FACS - Fluorescence Activated Cell Sorter.</p> <p>b. Genetic Diseases and Inheritance Pattern: Autosomal inheritance- Dominant (Eg. Adult polycystic kidney and Neurofibromatosis) Autosomal inheritance- Recessive (Eg. Albinism, Sickle cell anemia) X-linked – Recessive: (Eg. Duchene muscular dystrophy) X-linked Dominant- (Eg. Hypophosphatemia) Y-linked inheritance- Holandric gene (E.g. Testes determining factor - TDF) Multifactorial inheritance: (Eg. Congenital malformations: Cleft lip and palate, Rheumatoid arthritis and Diabetes) Mitochondrial diseases: (Eg. Leber's hereditary optic neuropathy).</p>	14

<p>Unit 2: Immunogenetics</p> <p>a. Introduction to immunology- types and properties of antigens, antibodies, B and T Cells, Immunity types - Innate and acquired. Immune response - Humoral and Cell mediated.</p> <p>b. Genetics of immune system – antibody gene rearrangement and class switching. Inherited immunodeficiency- Ex. X- linked agammaglobulinaemia.</p> <p>c. Major Histocompatibility Complex: Types, HLA disease associations. Transplantation, graft-rejection and immunosuppressors. Concept of immunization</p>	14
<p>Unit 3: Prenatal diagnosis and gene therapy</p> <p>a. Indications for prenatal diagnosis; Methods- Noninvasive method- Ultrasonography and Fetal echocardiography, Invasive methods - Amniocentesis, Chorionic villus sampling; Pre-conception and pre-implantation genetic diagnosis- Teratogen exposure in early pregnancy, Genetic testing and screening.</p> <p>b. Gene therapy with reference to SCID Stem cells- Properties, types and sources. Cord blood banking and Stem cell therapy</p>	14
<p>Unit 4: Genetic Counseling:</p> <p>a. Symbols used in pedigree studies, Pedigree construction and analysis, Pedigree analysis for the inheritance pattern of genetic diseases.</p> <p>b. Genetic Counseling. –Introduction to Genetic counseling; Historical overview, stages of counseling, scope of genetic counselling.</p> <p>c. Roles and responsibilities of Counselor and Consultant - needs, rights; Ethical, legal and social issues (ELSI), Acts and Amendments.</p>	14

5. References:

VI Semester B.Sc., GENETICS
Theory Syllabus
Paper - GNT 601: DEVELOPMENTAL, EVOLUTIONARY
AND BIOMETRICAL GENETICS

40 Hrs.

UNIT I

14 Hrs.

- a. **Developmental Genetics:** Early embryonic development in Frog- cleavage, blastula and gastrula. Nuclear transplantation experiments in Amphibians and *Acetabularia*
- b. **Genetics of development in plants - *Arabidopsis*:** Flower development (Floral morphogenesis and Homeotic gene expression).
- c. **Genetics of development in Animals - *Drosophila*:** Early development; Origin of anterior-posterior and dorso-ventral polarity: Role of Maternal genes, Zygotic genes- Segmentation genes (gap, pair rule and segment polarity genes) and Homeotic selector genes.
- d. **Switching genes on and off during development-** Ex. Differential expression of haemoglobin

UNIT II

13 Hrs.

- a. **Evolutionary and Population Genetics:**
 Darwinism, Neo Darwinism and Synthetic Theory.
 Evolution at molecular level: - Nucleotide sequence.
 Gene pool, Gene and genotype frequencies: Hardy-Weinberg principle, Evolutionary agents: Selection - differential selection, gametic selection, zygotic selection, fitness; Migration; Mutation and Random drift.)
 Speciation: Methods of speciation-Allopatric and Sympatric, Isolation-Pre-mating and Post mating isolating mechanisms, role of isolation in Speciation.
- b. **Quantitative characters and inheritance:**
 Quantitative Characters:-Types- Continuous, meristic and threshold characters with examples.
 Quantitative inheritance:-Features of polygenic traits in relation to oligogenic traits. Inheritance of Kernel color in wheat, and Skin colour in human.
 Transgressive inheritance in Poultry.
 Environmental effects-IQ in Humans
 Significance of polygenic inheritance-Twin study

UNIT III

13 Hrs.

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, Quantitative trait loci (QTL). Problems related to Variance and Heritability

VI Semester B.Sc., GENETICS

Theory syllabus

Paper – GNT 602: APPLIED AND BEHAVIORAL GENETICS

40 Hrs.

Unit I

a. Genetics in Medicine and Industry

13 Hrs.

Production of recombinant insulin, interferon and human growth hormone (HGH)

Vaccines: Hepatitis B vaccine

Preparation of molecular probes, Monoclonal antibodies and diagnostic kits

Microarray

b. DNA Fingerprinting

Methodology of DNA fingerprinting

Molecular markers – RAPD, RFLP, Microsatellite, SNPs, STR

Applications in Forensic science, Medicolegal aspects.

c. Bioinformatics

Introduction to bioinformatics

Tools of Bioinformatics - FASTA, BLAST, RASMOL

Applications of Bioinformatics

Unit II

a. Genetic resources and Biodiversity

15 Hrs.

Germplasm, Classification, Germplasm activities and organization associated with germplasm (NBPGR, IBPGR) Genetic erosion, biodiversity, Red data book, endangered species, *ex-situ* and *in-situ* conservation, Vavilovian center for biodiversity.

Gene bank and cryopreservation - Types and methods.

b. Behavioral Genetics

Mating behavior in *Drosophila*

Hygienic behavior in Honeybee

Nesting behavior in Ants

Territoriality and conflict behavior in Primates.

c. Molecular markers as diagnostic tools

Her2 testing for breast cancer – (FISH), Frigile X syndrome –

Microsatellite marker analysis

UNIT III

12 Hrs.

Heterosis in animal and plants

Introduction to heterosis and characteristics.

a. In Animals:

Animal breeding – Introduction, inbreeding, grading, cross breeding, artificial insemination in cattle

Fish breeding (Selection, Induced Polyploidy, Gynogenesis and Androgenesis, Inbreeding).

Breeding strategies for improvement of livestock for milk, meat, wool production.

Breeding strategies for improvement of Poultry - Giriraja.

b. In plants:

Genetic concepts - Dominance and Over dominance.

Hybridization techniques - Intergeneric and interspecific hybridization, Identification of hybrid plants.

Inbreeding depression.

Hybrid vigor exploitation in Rice and Tomato.