

**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 absorption spectroscopy, Nuclear Magnetic Resonance

06	Different types of sterilization methods: Autoclave, steam sterilizers, dry heat sterilizers and ovens and UV chambers.	14
Chapters	Unit - 3 (SS)	
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	

SPS PAGE

Chapter	Unit - 4 (IS)	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>Invitro</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
Theory Syllabus
Paper – GNT 401: MOLECULAR GENETICS

52Hrs.
13 Hrs.

UNIT I

a. Chemical Basis of Heredity:

DNA as genetic material- Experiments of Griffith; Avery, McLeod and McCarty; Hershey and Chase.
RNA as genetic material- Experiment of Fraenkel and Singer.

b. Nucleic acids:

Molecular structure of DNA, Chargaff's rule, Forms of DNA- A, B and Z forms.

RNA types and structure – mRNA, tRNA (clover leaf model), rRNA.
Ribozymes

c. DNA Replication:

Meselson and Stahl Experiment.

DNA Replication in prokaryotes – Initiation, Continuous and discontinuous synthesis, Events at the replication fork, Termination, Enzymology.

Rolling circle replication in ϕ X174 virus.

DNA Replication in eukaryotes.

13 Hrs.

UNIT II

a. Genome organization

Fine structure of the Gene- Cistron, muton and recon.

Organization of Chloroplast and mitochondrial genome.

b. Gene expression:

Transcription: initiation, elongation and termination (rho- dependent and rho- independent).

Post transcriptional modifications: methylation, polyadenylation, RNA splicing.

Translation: Genetic code and its properties; process of translation- Initiation, elongation and termination. Post-translational modifications of proteins.

13 Hrs.

UNIT III

a. Gene regulation:

Concept of operon, Inducible operon - Lac operon – structure and mechanism, Catabolite repression. Repressible operon - Tryptophan operon - structure and mechanism.

b. Bacterial Genetics:

Transformation, Transduction-Generalized and specialized;

Conjugation: F factor mediated, *Hfr* and Sexduction.

c. Introduction to Genomics, Proteomics, metabolomics, microbiome.

UNIT IV

13 Hrs.

a. **Transposable elements:** Bacteria, Yeast, Maize and *Drosophila*.

b. **Mutations:**

Introduction and Types of Gene mutations - Base substitution (Transition and transversion), Frame shift mutation, insertion, deletion, missense, nonsense, reverse, suppressor and lethal mutations).

Pleiotropy- definition and examples.

Mutagens - Physical (ionizing and non- ionizing radiations) and chemical (Base analogs, Alkylating agents, Acridine dyes, Deaminating agents, Hydroxylating agents, Tobacco carcinogens); Oncogenic Viruses.

DNA repair mechanisms (Mismatch repair, photoreactivation, excision and SOS repair).

Mutation as raw material for evolution.

Beneficial effects of mutation.

Analogs

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

40 Hrs.

14 Hrs.

UNIT I

- 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

Unit I

40 Hrs.

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.