New

## I - SEMESTER

## CELL BIOLOGY

| | | | |
|---|---|---|---|
| Program Name | B.Sc., | Semester | I |
| Course Title | CELL BIOLOGY | | |
| Course Code: | DSC- GT1 | No. of Credits | 3 |
| Contact hours | 56 Hours | Duration of SEA/Exam | 3 hrs. |
| Formative Assessment Marks | 20 | Summative Assessment Marks | 80 |

**Course Out comes (COs)**: After the successful completion of the course, the student will be able to:

**CO1.** understand the basic principles of different types of Microscopes and its application
**CO2.** understand the structure and function of all the cell organelles.
**CO3.** comprehend the mechanism of cell division, cellular aging and cell death and its regulation.
**CO4.** develop comprehensive understanding on the organization of Prokaryotic and Eukaryotic chromosome.

| Contents | 56 Hrs. |
|---|---|
| **Unit-I: Microscopy** | **14** |
| Introduction, History, 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<br>Types of Microscopes: Light microscopes -Simple, Compound and Stereo zoom.<br>Phase contrast, fluorescent microscope, Electron microscope- TEM and SEM, Confocal and Optical pathway in different microscopes.<br>Applications of Microscopy: High resolution imaging, immune histochemistry, high-content screening and high throughput imaging. Clinical and Forensic applications. | |
| **Unit-II: Cell Structure and Dynamics** | **14** |
| **Concept of cell: -** Discovery of cell, cell theory, Cell as a basic unit, Classification of cell types – Virus, Prokaryotes, Eukaryotes, Comparison between plant and animal cells.<br>**Plasma membrane** –Fluid mosaic model, chemical composition, functions of plasma membrane –Osmosis, Diffusion, Active and Passive transport, Bulk transport.<br>**Ultrastructure and functions of Cytoplasmic organelles**: Mitochondria, -Kreb's cycle, BIS oxidative phosphorylation, Endoplasmic reticulum, Golgi bodies, Lysosomes, and Peroxisomes. Chloroplast: its role in Photosynthesis. Nucleus: Morphology, nuclear envelope, nucleoplasm, nucleolus. | |
| **Unit-III: Cell Cycle and Regulation** | **14** |
| **Cell division in Bacteria and Archaea** – Process of Binary fission.<br>**Cell Cycle Regulation**: Cell cycle, Interphase-G1, S, G2 and M phase, Checkpoints. Mitosis: Stages, Mitotic apparatus, Role of cyclins and Cdks. Mitogens and Inhibitors, Significance. Meiosis: Stages, Synaptonemal complex, Crossing over and Chiasma formation, Significance. Cytokinesis in plant and animal cells.<br>**Endocycle and Endomitosis.**<br>**Cell senescence and Cell death:** Cellular features of Senescence- Spontaneous and induced, Mechanism of Programmed cell death and its significance. Necrosis. | |

New

| Unit-IV: Chromosome Organization | 14 |
|---|---|
| **Chromosomes** – Introduction, Chromatin structure in Prokaryotes (Supercoiling), Eukaryotic Chromosome: Macro-molecular organization. Primary and Secondary constriction, Sat-bodies, Telomeres, Histones, non-histones of DNA, Nucleosome, Heterochromatin and Euchromatin and its significance.<br>**Karyotype and Idiogram.**<br>**Special types of Chromosomes**: Structure and Significance of Special type of Chromosomes: Polytene, Salivary gland chromosome in *Drosophila*, Lamp brush chromosome in amphibian oocyte. Supernumerary B Chromosome. | |

# III SEMESTER B.SC., GENETICS (HONS) THEORY SYLLABUS
# DISCIPLINE SPECIFIC CORE COURSE DSCC
# THEORY PAPER: BIOMOLECULES AND MOLECULAR GENETICS

## 1. Course Description

| | |
|---|---|
| Semester: III | Course Title: **Biomolecules and Molecular Genetics** |
| Course Code: | Course Type: **DSCC5GENT3** |
| Course Credits | 4 |
| Total hours : | 56 |
| Formative Assessment Marks: **40** | Summative Assessment Marks:**60** |
| Duration of DSC | **4Hours** |

## 2. Course Objectives:

- Understand concepts of biomolecules and gene organization
- Comprehend the central dogma of molecular biology.
- Understand gene structure and expression.
- Appraise DNA repair mechanism.

## 3. Course Outcome:

**Course Outcome (Cos): After completing this course, the student will be able to:**

- Describe the structure and function of biomolecules.
- Appreciate and illustrate the chemical composition of the genetic material and its replication.
- Describe the process of gene expression in prokaryotes and eukaryotes.
- Explain the concept of transposition, mutation and DNA repair mechanism.

## 4. COURSE CONTENT

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

| | |
|---|---|
| **Unit 2: Chemical basis of Heredity**<br>**a. Introduction:** DNA (Hershey and Chase experiment) and RNA (Fraenkel and Singer experiment) as genetic material.<br>**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.<br>**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**<br>**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.<br>**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**<br>a. Transposons – Insersion sequence (IS) elements in bacteria, p elements in *Drosophila*, AC-DS in Maize;<br>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.<br>c. DNA repair mechanism-photo reactivation, Mismatch repair, excision and SOS repair. | 14 |

## 5. Resources

a) Reference Books:


- Becker, W.M. & Klein smith, L. J. (2017), World of the cell (9th Ed.), Benjamin
- Cummings, Washington DC.
- Cooper, G.M. (2013), The Cell (6th Ed.).SinauerAssociates,Sunderland.
- Griffiths, A. J. F., Miller, J. H., Suzuki, D. T., Lewontin, R. C. &Gelbart, W. M.(2007) AnIntroduction Genetic Analysis (9th Ed.), Freeman, New York.
- Hames, B. D. & Hooper, N. M. (2011). Instant Notes in Biochemistry (4th Ed.). Viva Books.
- Hartwell, L. H., Hood, L., Goldberg, M. L., Reynolds, A. E., Silver, L. M. &Veres, R. C. (2016)
- Genetics: From Genes to Genomes,Tata–McGraw Hill, New Delhi.
- Harvey, L., Arnold, B., Lawrence, S., Zipursky, Paul, M., David, B., & James, D. (2018). Molecular C Biology (6th Ed.). Freeman. New York.
- Lodish, J. H & Baltimore, D. (2016). Molecular Cell Biology (8th Ed.), Scientific American Books, Ne York.

# V SEMESTER B.Sc. GENETICS

| Program Name | B.Sc. Genetics | | Semester | V |
|---|---|---|---|---|
| Course Title | GENE REGULATION AND DNA REPAIR (Theory) | | | |
| Course Code: | DSCC5GENT5 | | No. of Credits | 4 |
| Contact hours | 60 Hours | | Duration of SEA/Exam | 2.5 hours |
| Formative Assessment Marks | 40 | | Summative Assessment Marks | 60 |

**2. Course outcome: After completion of the course, students will be able to:**

CO1. Comprehend various types of DNA repair mechanisms and the associated diseases
CO2. Interpret epigenetic gene regulation
CO3. Summarise gene expression profile
CO4. Comprehend gene expression at various levels

**3. Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)**

| Course Outcomes (COs) / Program Outcomes (POs) | | T5 | P5 | T6 | P6 | T7 | P7 | T8 | P8 | T9 | P9 | T10 | P10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. | Core competency | x | | | | | | | | | | | |
| II. | Critical thinking | x | | | | | | | | | | | |
| III. | Analytical reasoning | x | | | | | | | | | | | |
| IV. | Research skills | x | | | | | | | | | | | |
| V. | Team work | x | | | | | | | | | | | |

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X" in the intersection cell if a course outcome addresses a particular program outcome.

| Unit | Content | Hours:60 |
|---|---|---|
| | **Unit I** | **14 hrs** |
| 01 | **DNA repair:**<br>• Single strand and double strand DNA damage<br>• **Direct DNA repair** -Photo reactivation, 3'-5' exonuclease activity of DNA polymerase (proof reading), O6 methyl guanine, methyl transferase<br>• **Excision repair-** Base excision repair, Nucleotide excision repair, Mismatch repair, SOS repair<br>Mitochondrial DNA repair. | |

| | | |
|---|---|---|
| | • **Repair defects-** Gene defect, symptoms and incidence involved in Xeroderma pigmentosum, Ataxia Telengetasia, Fanconi anemia and Cocyane syndrome | |
| 02 | **Unit II** | **16 hrs** |
| | **Epigenetic Gene regulation:**<br>• Introduction to Epigenetic Gene regulation and its types- transcriptional and translational regulation.<br>• **DNA Modification-** Cytosine modification-CpG island, role of DNA methyl transferases (DNMT) in DNA methylation, DNA methyl binding proteins, DNA demethyl transferases; Genomic imprinting.<br>• **Histones and Epigenetic Modification-** Organisation of eukaryotic DNA- Nucleosome model, process of Histone methylation, acetylation and phosphorylation, nucleosome remodelling<br>• **RNA based Epigenetic Modification** -Role of small noncoding RNAs –miRNA, si RNA, sno RNA in translational regulation, Role of Long non –coding RNA in gene regulation.<br>Mechanism of X chromosome inactivation in human female. | |
| 03 | **Unit III** | **16 hrs** |
| | **Regulation of gene expression:**<br>• Spatial and temporal gene regulation of gene expression.<br>• Transcriptional control: RNA polymerases, cis-elements, transcription factors,<br>• Post Transcriptional Control: RNA editing –Adenosine to inosine, cytoplasmic control of mRNA stability Environmental impact on transcription: Heat shock genes<br>• RNA interference: mechanisms and enzymology; RISC complex formation; regulation of gene expression by miRNP pathway, Antisense RNA technology | |
| 04 | **Unit IV** | **14 hrs** |
| | **Gene expression analysis:**<br>• RNA expression analysis-DNA microarray, RT-PCR method<br>• Promoter Analysis- Expression of Reporter gene/ promoter fusion in host cells, chromatin Immunoprecipitation method<br>• Protein Expression Analysis: Western blotting, 2D-Gel Electrophoresis<br>• Methylation sensitive restriction enzymes and Fluorescence *in situ* hybridization | |

**PAPER: PLANT CELL AND TISSUE CULTURE TECHNOLOGY (Theory)**

| | | | |
|---|---|---|---|
| Program Name | **B.Sc. Genetics** | Semester | **V** |
| Course Title | **PLANT CELL AND TISSUE CULTURE TECHNOLOGY (Theory)** | | |
| Course Code: | **DSCC5GENT6** | No.of Credits | **4** |
| Contact hours | **60 Hours** | Duration of SEA/Exam | **2.5 hours** |
| Formative Assessment Marks | **40** | Summative Assessment Marks | **60** |

**Course outcome: By the end of the course the students will be able to**

- Understand the basic principles of plant tissue culture
- Explain the role of media, sterilization, and methodology of tissue culture.
- Comprehend various types of plant tissue culture
- Apply plant tissue culture technique in crop improvement.

Course Articulation Matrix: Mapping of Course Outcomes(COs)with Program Outcomes(POs)

| Course Outcomes(COs)/ Program Outcomes(POs) | | T5 | P5 | T6 | P6 | T7 | P7 | T8 | P8 | T9 | P9 | T10 | P10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I. | Core competency | | | x | | | | | | | | | |
| II. | Critical thinking | | | x | | | | | | | | | |
| III. | Analytical reasoning | | | x | | | | | | | | | |
| IV. | Research skills | | | x | | | | | | | | | |
| V. | Teamwork | | | x | | | | | | | | | |

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X" in the intersection cell if a course outcome addresses a particular program outcome.

| Chapter | Content | Hours:60 |
|---|---|---|
| | **Unit I** | |
| **01** | **Introduction to Plant Tissue Culture:**<br>• Definition, History of plant tissue culture research, Totipotency of cells, differentiation, dedifferentiation and redifferentiation.<br>• Methods of sterilization -physical and chemical methods,<br>• Media preparation - Murashige and Skoog's (MS medium), phytohormones, medium for micro-propagation.<br>• Role of chemicals -Macronutrients, micronutrients, Vitamins, amino acids and growth regulators in plant tissue culture. Callus subculture maintenance and growth measurements. | **14 hrs** |

| | | |
|---|---|---|
| | **Unit II** | |
| 02 | **Basic Principles of Plant Tissue Culture:**<br>• Techniques of cell and tissue culture: Preparation of explant materials, initiation of cultures, micro propagation.<br>• Direct and indirect organogenesis and Somatic embryogenesis, artificial (synthetic) seeds, embryo culture, callus culture, meristem culture and organ culture.<br>• Clonal Propagation: Shoot-tip and axillary bud culture of ornamental and horticulturally important plants. | **16 hrs** |
| | **Unit III** | |
| 03 | **Types of Plant Tissue Culture and Application:**<br>• Methods and Applications of Suspension culture, Protoplast isolation, culture and fusion, Endosperm culture, Embryo culture and Embryo rescue technique.<br>• Anther Culture: Development of haploids, diploidization and its applications.<br>• Production of somaclones and gametoclones, Somaclonal variation and *in vitro* selection for crop improvement.<br>• Production of secondary metabolites and Industrial application of plant tissue culture for production of Secondary metabolites.<br>• Cryopreservation and Germplasm conservation. | **16 hrs** |
| | **Unit IV** | |
| 04 | **Plant Biotechnology and Crop Improvement:**<br>• Applications of Plant Genetic Engineering – crop improvement, fiber quality, herbicide resistance, insect resistance and virus resistance.<br>• Agrobacterium mediated gene transfer.<br>• Genetic modification – transgenic plants for pest resistance (Bt-cotton); herbicide resistance (Round Up Ready Soybean); improved agronomic traits (flavrSavr tomato, Golden rice); Improved horticultural varieties. | **14hrs** |