

New

I - SEMESTER

CELL BIOLOGY

Program Name	B.Sc.,			Semester	I
Course Title	CELL BIOLOGY				
Course Code:	DSC- GT1				
Contact hours	56 Hours		No. of Credits	3	
Formative Assessment Marks	20		Duration of SEA/Exam	3 hrs.	
			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 Types of Microscopes: Light microscopes -Simple, Compound and Stereo zoom. Phase contrast, fluorescent microscope, Electron microscope- TEM and SEM, Confocal and Optical pathway in different microscopes. 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. Plasma membrane -Fluid mosaic model, chemical composition, functions of plasma membrane -Osmosis, Diffusion, Active and Passive transport, Bulk transport. 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. 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. Endocycle and Endomitosis. Cell senescence and Cell death: Cellular features of Senescence- Spontaneous and induced, Mechanism of Programmed cell death and its significance. Necrosis.	

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Unit-IV: Chromosome Organization

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.
Karyotype and Idiogram.
Special types of Chromosomes: Structure and Significance of Special type of Chromosomes: Polytenic, Salivary gland chromosome in *Drosophila*, Lamp brush chromosome in amphibian oocyte. Supernumerary B Chromosome.

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

Course Outcome	Program Out comes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	1	3	1	-	1	3
CO2	3	3	3	3	3	3	3	3	1	2	3	3
CO3	3	3	3	3	3	3	3	3	1	1	2	3
CO4	3	3	3	3	3	3	3	3	1	1	3	3

Course Articulation Matrix relates course outcomes of course with the corresponding program out comes whose attainment is attempted in this course. The strength of correlation is indicated as 3- Substantial (High), 2- for moderate (Medium), 1 for slight (low) correlations

Pedagogy: Lectures, Presentations, Videos, Assignments and Weekly Formative Assessment Tests

Formative Assessment for Theory

Assessment Occasion/type	Marks
House Examination/Test	10
Written Assessment/Presentation/Project/Term Papers/Seminars	05
Classroom Performance/Participation	05
Total	20 Marks

III SEMESTER B.Sc., GENETICS THEORY SYLLABUS MOLECULAR GENETICS

Program Name:	B.Sc., Genetics	Semester:	III
Course Title:	Molecular Genetics		
Course Code:	DSCGT-3	No. of Credits:	3
Contact hours:	56 Hours	Duration of SEA/Exam:	3 hrs
		Hours / Week:	4 hrs
Formative Assessment Marks:	20	Summative Assessment Marks:	80

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

Course Outcomes (COs)/(POs)	DSCGT-3
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 inter section cell if a course outcome addresses a particular program

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

- CO1:** Describe the structure and function of biomolecules.
- CO2:** Appreciate and illustrate the chemical composition of the genetic material and its replication.
- CO3:** Describe the process of gene expression in prokaryotes and eukaryotes.
- CO4:** Explain the concept of transposition, mutation.

$$\begin{array}{r}
 5/7 \quad - 5 \times 3 = 15 \qquad 2 \times 10 = 20 \\
 5/7 \quad \quad 5 \times 5 = 25 \qquad 6 \times 5 = 30 \\
 10 \times 2 = \quad \quad \quad 30 \quad // \qquad 10 \times 3 = 30 \\
 \qquad \qquad \quad \quad \quad \underline{70} \qquad \qquad \quad \underline{80} \\
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 \end{array}$$

Content	56 Hrs
Unit-I	14 hrs
<p>DNA as genetic material: Proof of transforming principle: Griffith's transformation experiment; Transforming principle: Avery, McLeod, McCarty & Hershey and Chase experiments; Central Dogma of Molecular Biology. RNA as genetic material - Fraenkel and Singer experiment.</p> <p>Structure and Functions of Nucleic Acids: Structure of DNA: Watson and Crick's double helical structure of DNA (Watson-Crick model); Chargaff's rule; Alternative forms of DNA - A, B and Z; Denaturation and renaturation of DNA. Types and structure of RNA: mRNA, tRNA (Clover leaf model), and rRNA.</p> <p>DNA replication:</p> <p>Prokaryotic replication: Enzymes and proteins involved in replication; Initiation: Origin of replication, Replication fork, Primosome, Replisome; Elongation- Synthesis of leading and lagging strands; Termination. Types of Replications- Rolling circle and theta mode of Replication.</p> <p>Eukaryotic replication: Enzymes and proteins involved in replication; Mechanism - Initiation, elongation, termination and linear replication.</p>	
Unit-II	14 hrs
<p>Transcription in Prokaryotes: RNA Polymerase; Promoter region; Role of sigma factors. Mechanism of transcription- Initiation, Elongation and termination ("rho" dependent and "rho" independent).</p> <p>Transcription in Eukaryotes: Eukaryotic RNA Polymerases; Transcription factors; Promoters and enhancers. Mechanism of transcription- Initiation, Elongation and Termination. Post-transcriptional modifications- Methylation, polyadenylation, and splicing.</p> <p>Translation: Genetic code and its general characteristics; Wobble's hypothesis. Components of translation machinery- mRNA, tRNA (charging of tRNA, aminoacyl tRNA synthetases); ribosome structure and assembly. Mechanism of translation in both prokaryotes and Eukaryotes. Post-translational modification of proteins.</p>	
Unit-III	14 hrs
<p>Gene expression in Prokaryotes and Eukaryotes: Inducible operon - Structure, mechanism and catabolite repression of Lac Operon. Repressible operon - Structure, mechanism and Attenuation of Trp Operon. Regulation of Gene expression in Eukaryotes.</p>	
Unit-IV	14 hrs

Transposable Elements:

Introduction, types and classification; Class I (Retrotransposons), Class II (DNA transposons), Autonomous vs non autonomous TEs, Mechanism of transposition- DNA transposon transposition and retrotransposon transposition, controlling elements in Bacteria (IS elements), *Drosophila* (p elements), Maize (AC-DS elements), Evolutionary role of transposal elements.

Reference:

1. Becker, W. M., & Kleinsmith, L. J. (2017). *World of the cell* (9th ed.). Benjamin Cummings.
2. Cooper, G. M. (2013). *The cell* (6th ed.). Sinauer Associates.
3. Griffiths, A. J. F., Miller, J. H., Suzuki, D. T., Lewontin, R. C., & Gelbart, W. M. (2007). *An introduction to genetic analysis* (9th ed.). Freeman.
4. Hames, B. D., & Hooper, N. M. (2011). *Instant notes in biochemistry* (4th ed.). Viva Books.
5. 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.
6. Harvey, L., Arnold, B., Lawrence, S., Zipursky, P. M., David, B., & James, D. (2018). *Molecular cell biology* (6th ed.). Freeman.
7. Lodish, J. H., & Baltimore, D. (2016). *Molecular cell biology* (8th ed.). Scientific American Books.

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	
01	<p>DNA repair:</p> <ul style="list-style-type: none"> • Single strand and double strand DNA damage • Direct DNA repair -Photo reactivation, 3'-5' exonuclease activity of DNA polymerase (proof reading), O6 methyl guanine, methyl transferase • Excision repair- Base excision repair, Nucleotide excision repair, Mismatch repair, SOS repair • Mitochondrial DNA repair. 	14 hrs PPR

	<ul style="list-style-type: none"> • Repair defects- Gene defect, symptoms and incidence involved in Xeroderma pigmentosum, Ataxia Telengetasia, Fanconi anemia and Cocyane syndrome (SM) 	
02	<p style="text-align: center;">Unit II</p> <p>Epigenetic Gene regulation:</p> <ul style="list-style-type: none"> • Introduction to Epigenetic Gene regulation and its types- transcriptional and translational regulation. • DNA Modification- Cytosine modification-CpG island, role of DNA methyl transferases (DNMT) in DNA methylation, DNA methyl binding proteins, DNA demethyl transferases; Genomic imprinting. • Histones and Epigenetic Modification- Organisation of eukaryotic DNA- Nucleosome model, process of Histone methylation, acetylation and phosphorylation, nucleosome remodelling • 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. <p>— Mechanism of X chromosome inactivation in human female.</p>	<p>16 hrs</p> <p>PPA</p>
03	<p style="text-align: center;">Unit III</p> <p>Regulation of gene expression:</p> <ul style="list-style-type: none"> • Spatial and temporal gene regulation of gene expression. • Transcriptional control: RNA polymerases, cis-elements, transcription factors, • Post Transcriptional Control: RNA editing -Adenosine to inosine, cytoplasmic control of mRNA stability • Environmental impact on transcription: Heat shock genes • RNA interference: mechanisms and enzymology; RISC complex formation; regulation of gene expression by miRNP pathway, Antisense RNA technology 	<p>16 hrs</p> <p>JS</p>
04	<p style="text-align: center;">Unit IV</p> <p>Gene expression analysis:</p> <ul style="list-style-type: none"> • RNA expression analysis-DNA microarray, RT-PCR method • Promoter Analysis- Expression of Reporter gene/ promoter fusion in host cells, chromatin Immunoprecipitation method • Protein Expression Analysis: Western blotting, 2D-Gel Electrophoresis • Methylation sensitive restriction enzymes and Fluorescence <i>in situ</i> hybridization 	<p>14 hrs</p> <p>JS</p>

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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


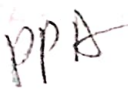
- Understand the basic principles of plant tissue culture
- Explain the role of media, sterilization, and methodology of tissue culture.
- Comprehend various types of plant tissue culture
- Apply plant tissue culture technique in crop improvement.

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: <ul style="list-style-type: none"> • Definition, History of plant tissue culture research, Totipotency of cells, differentiation, dedifferentiation and redifferentiation. • Methods of sterilization -physical and chemical methods, • Media preparation - Murashige and Skoog's (MS medium), phytohormones, medium for micro-propagation. • Role of chemicals -Macronutrients, micronutrients, Vitamins, amino acids and growth regulators in plant tissue culture. Callus subculture maintenance and growth measurements. 	14 hrs

02	Unit II	16 hrs
	<p>Basic Principles of Plant Tissue Culture:</p> <ul style="list-style-type: none"> • Techniques of cell and tissue culture: Preparation of explant materials, initiation of cultures, micro propagation. • Direct and indirect organogenesis and Somatic embryogenesis, artificial (synthetic) seeds, embryo culture, callus culture, meristem culture and organ culture. • Clonal Propagation: Shoot-tip and axillary bud culture of ornamental and horticulturally important plants. 	
03	Unit III	16 hrs
	<p>Types of Plant Tissue Culture and Application:</p> <ul style="list-style-type: none"> • Methods and Applications of Suspension culture, Protoplast isolation, culture and fusion, Endosperm culture, Embryo culture and Embryo rescue technique. • Anther Culture: Development of haploids, diploidization and its applications. • Production of somaclones and gametoclones, Somaclonal variation and <i>in vitro</i> selection for crop improvement. • Production of secondary metabolites and Industrial application of plant tissue culture for production of Secondary metabolites. • Cryopreservation and Germplasm conservation. 	
04	Unit IV	14hrs
	<p>Plant Biotechnology and Crop Improvement:</p> <ul style="list-style-type: none"> • Applications of Plant Genetic Engineering – crop improvement, fiber quality, herbicide resistance, insect resistance and virus resistance. • Agrobacterium mediated gene transfer. • 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. 	