Bhavan's Vivekananda College of Science, Humanities and Commerce, Sainikpuri Autonomous College (Affiliated to Osmania University)
Re Accredited with "A" Grade by NAAC

Template for B Sc Programme under CBCS
Prescribed by TSCHE for implementation from 2023-24 onwards

BSc GENETICS

FIRST YEAR- SEMESTER I

Code	Course Title	Course Type	Hours per week			Credits		
			Theory	Practical	Total	Theory	Practical	Total
	Environmental Science	AECC-1	2		2	2		2
	English	CC-1A	4		4	4		4
	Second language	CC-2A	4		4	4		4
GT132/GT132P	**Optional I- Transmission Genetics**	DSC-1A	4	3	7	4	1	5
	Optional II	DSC-2A	4	3	7	4	1	5
	Optional III	DSC-3A	4	3	7	4	1	5
	TOTAL				**31**			**25**

FIRST YEAR- SEMESTER II

Code	Course Title	Course Type	Hours per week			Credits		
			Theory	Practical	Total	Theory	Practical	Total
	Computer Skills	AECC-2	2		2	2		2
	English	CC-1B	4		4	4		4
	Second language	CC-2B	4		4	4		4

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GT 232/GT232P	Optional I- **Molecular Genetics & Genetic Engineering**	DSC-1B	4	3	7	4	1	5
	Optional II	DSC-2B	4	3	7	4	1	5
	Optional III	DSC-3B	4	3	7	4	1	5
	TOTAL				**31**			**25**

SECOND YEAR- SEMESTER III

Code	Course Title	Course Type	Hours per week			Credits		
			Theory	Practical	Total	Theory	Practical	Total
SE332	**Medicinal Plants**	SEC-I	2		2	2		2
	Communication Skills	AECC-3						
	English	CC-1C	3		3	3		3
	Second language	CC-2C	3		3	3		3
GT 332 /GT332P	Optional I- **Biostatistics & Bioinformatics**	DSC-1C	4	3	7	4	1	5
	Optional II	DSC-2C	4	3	7	4	1	5
	Optional III	DSC-3C	4	3	7	4	1	5
	TOTAL				**31**			**25**

SECOND YEAR- SEMESTER IV

Code	Course Title	Course Type	Hours per week			Credits		
			Theory	Practical	Total	Theory	Practical	Total
SE432	**Genetic Counselling**	SEC-2	2		2	2		2

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	Universal Human values	AECC-4	2		2	2		2
	English	CC-1D	3		3	3		3
	Second language	CC-2D	3		3	3		3
GT 432/GT432P	Optional I- **Population Genetics & Evolution**	DSC-1 D	4	3	7	4	1	5
	Optional II	DSC-2 D	4	3	7	4	1	5
	Optional III	DSC-3 D	4	3	7	4	1	5
	TOTAL				**31**			**25**

THIRD YEAR- SEMESTER V

Code	Course Title	Course Type	Hours per week			Credits		
			Theory	Practical	Total	Theory	Practical	Total
	English	CC-1E	3		3	3		3
	Second language	CC-2E	3		3	3		3
GE532	**Basic & Applied Genetics**	GE	4		4	4		4
GT532A/GT532AP GT532B/GT532BP	**Optional I- A/B** **A. Plant Genetics & Biotechnology** **(OR)** **Animal Cell Technology & AnimalGeneticA**	DSE -1E	4	3	7	4	1	5
	Optional- II **A/B**	DSE -2E	4	3	7	4	1	5
	Optional- III **A/B**	DSE -3E	4	3	7	4	1	5
	TOTAL				**31**			**25**

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THIRD YEAR- SEMESTER VI								
Code	**Course Title**	**Course Type**	**Hours per week**			**Credits**		
			Theory	Practical	Total	Theory	Practical	Total
GT632_PW GT632_O	**Project in Genetics/Advanced Techniques in genome Analysis (Optional)**		4		4	4		4
	English	CC-1F	3		3	3		3
	Second language	CC-2F	3		3	3		3
GT 632A/632AP GT632B/GT632BP	**Optional I- A/B** **A. Human Genome & Human Genetics** **(or)** **Cellular & Molecular Immunology**	DSE-1F	4	3	7	4	1	5
	Optional- II **A/B**	DSE -2F	4	3	7	4	1	5
	Optional- III **A/B**	DSE -3F	4	3	7	4	1	5
	TOTAL				**33**			**25**

Total credits= 164-12 (AECC 4 + SEC 8) =15

AECC: Ability **E**nhancement **C**ompulsory Course
***SEC: S**kill **E**nhancement **C**ourse*
***DSC: D**iscipline **S**pecific **C**ourse*
***DSE: D**iscipline **S**pecific **E**lective*
***GE: G**eneric **E**lective*

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Autonomous College
Affiliated to Osmania University, Hyderabad.
(Accredited with 'A' grade by NAAC)
Department of Genetics and Biotechnology
Program Name: BSc MbGC & BtGC (w.e.f. 2020-'21)
Genetics (Optional)

Course Name: Transmission Genetics

Paper Code: GT132 | **No of Classes: 60**
Year/Semester: I/I | **No of Credits: 4**

Skill Development: Knowledge of Mendelian inheritance, linkage, gene mapping and Cytogenetic analysis of chromosomal aberrations will lay a strong foundation in the field of Genetics.

Course Objective: To demonstrate the concepts of Classical Genetics, chromosomal segregation during cell division, basics of recombination, gene mapping, and organization of chromatin.

Unit wise Course Objectives:

Cob1: To interpret the concepts of Mendelian Genetics.

Cob2: To develop the fundamentals of recombination and gene mapping.

Cob3: To explain the Genetics of cell division and chromosomal segregation.

Cob4: To distinguish different levels of organization of chromatin.

Unit- 1: Mendelian inheritance and its extensions **15 Hours**

1.1. Mendel's experiments; Law of segregation, monohybrid cross, reciprocal cross, back cross, test cross; Law of independent assortment, dihybrid cross; Chromosomal theory of Inheritance. (3)

1.2. Variations to dominance- Co dominance and Incomplete dominance; Lethal and Sub lethal genes, Penetrance and Expressivity; Pleiotropism; Multiple alleles- Eye colour in Drosophila, ABO blood groups in human; Rh Blood group incompatibility; Self incompatibility in plants. (3)

1.3. Gene interactions– types of epistasis (9:7; 9:3:4; 9:6:1; 12:3:1; 15:1). (2)

1.4. Multifactorial inheritance: Features of quantitative inheritance- additive effect, Kernel colour and size in wheat /maize, skin color in man. (2)

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1.5. Sex linked inheritance – X-linked and Y-linked traits – holandric genes, SRY gene; Sex limited and sex influenced traits; Sex determination –mechanisms of sex determination in Drosophila and Human. (3)

1.6. Non-Mendelian inheritance: Plastid inheritance – Variegation in Mirabilis jalapa; Maternal effects and inheritance – Shell coiling in snails, Poky mutants in Neurospora. (2)

Unit- 2: Linkage, Crossing over and Gene mapping **15 Hours**

2.1 Discovery of linkage – Phases of linkage. (1)

2.2 Chiasmata and Crossing over formation– Recombination. (2)

2.3 Cytological proof for crossing over – Curt Stern and McClintock experiments. (2)

2.4 Linkage analysis – Recombination frequencies, Two-point and Three-point crosses. (3)

2.5 Gene mapping – Coincidence and Interference, Determination of gene order. (3)

2.6 Gene mapping in Neurospora – Tetrad analysis; Mitotic recombination in Aspergillus and Drosophila. (3)

Unit- 3: Cell division and Chromosome segregation. **15 Hours**

3.1 Eukaryotic Cell cycle – Phases of cell cycle G0, G1, S and G2. (2)

3.2 Regulation of cell cycle cyclins, CDK proteins, role of p53 in cell cycle. (3)

3.3 Mitosis – Stages in mitotic cell division- significance of mitosis. (2)

3.4 Meiosis – Formation of Synaptonemal complex, crossing over, chiasma formation, significance of meiosis. (3)

3.5 Apoptosis – extrinsic & intrinsic pathways, & significance. (2)

3.6 Senescence, Necrosis –characteristics & mechanisms. (2)

Unit- 4: Chromosome structure, chromatin organization and variation **15 Hours**

4.1 Chromosome morphology- size and shape; Euchromatin and Heterochromatin- constitutive and facultative heterochromatin. (2)

4.2 Components of chromatin, histones &non-histones. (1)

4.3 Packing of DNA into chromatin – Nucleosome and higher order organization. (2)

4.4 Specialized Chromosomes – Lampbrush chromosomes, Polytene Chromosomes. (2)

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4.5 Structural chromosomal aberrations - duplications, deletions, inversions & translocations with examples, Genetic consequences. (4)

4.6 Numerical chromosomal aberrations – aneuploidy, euploidy auto-polyploidy and allo-polyploidy, Genetic consequences. (4)

Course Outcomes:

By the end of this course, student will be able to

GT132. CO1: Apply Mendelian laws and genetic notation for problem-solving.

GT132. CO2: Solve problems using gene mapping and recombination.

GT132. CO3: Examine the molecular mechanisms in cell cycle and chromosomal Segregation.

GT132. CO4: Identify chromosome structure and chromosomal aberrations.

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Paper I – Practicals

Paper Code: GT132 P **30 hrs (2 hrs/ week)**
Credits: 1

Skill Development: To comprehend and develop skills in maintaining and handling Drosophila and Cytogenetic analysis.

Objective: To acquire basic skills like handling the microscope, preparation of slides for microscopic observation and problem solving using Mendelian laws.

1. Identification of normal and mutant stocks of Drosophila.
2. Drosophila- monohybrid and dihybrid segregation.
3. Problems on Mendelian segregations- monohybrid, dihybrid and trihybrid crosses; multiple alleles, non-allelic interactions, multi-factorial inheritance; linkage and mapping of genes.
4. Neurospora – tetrad analysis.
5. Study of Mitosis in Onion root tips.
6. Study of Meiosis in Maize/Grasshopper.
7. Preparation of Drosophila salivary gland chromosomes – Polytene chromosomes.
8. Identification of structural and numerical aberrations.

Outcome: Students learn genetic annotations and develop analytical skills for problem solving.

Recommended Books

1. Genetics by Gardner
2. Theory and problems in Genetics by Stansfield
3. Introduction to Genetic Analysis by Suzuki, Griffith, Richard and Lewontin
4. Genetics by Strickberger
5. Genetics by Snustad & Simmons
6. Principles of Genetics by Tamarin
7. Cell & Molecular Biology – E.D.D. De Robertis And E.M.F. De Robertis
8. Molecular Biology of the Cell – Bruce Alberts

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Department of Genetics and Biotechnology
Program Name: BSc MbGC & BtGC (w.e.f. 2020-'21)
Genetics (Optional)
Course Name: Molecular Genetics and Genetic Engineering

Paper Code: GT232 **No of Classes: 60**
Year/Semester: I/II **No of Credits: 4**

Skill development: The theoretical and practical application of Molecular genetics and Genetic engineering help students to acquire skills in understanding and analyzing genomics, proteomics, genetic manipulation of microbes and their protein expression. .

Course Objective: To compare the structure of nucleic acids, mechanism of gene expression and regulation in Prokaryotes and Eukaryotes, methods of recombination in bacteria and Genetic Engineering.

Unit wise Course Objectives:

Cob1: To analyze the biochemical structure of nucleic acids and molecular mechanisms of mutation.

Cob2: To compare gene expression in Prokaryotes and Eukaryotes at the molecular level.

Cob3: To differentiate the different mechanisms of gene regulation in Prokaryotes and Eukaryotes.

Cob4: To examine different strategies used in Microbial Genetics and Genetic Engineering.

Unit-1: Nucleic acids, DNA replication & DNA repair **15 Hours**

1.1 DNA as the genetic material-Griffith's transformation experiment, Avery, MacLeod and McCarty's experiments and Hershey & Chase phage-labeling experiment; RNA as genetic material- tobacco mosaic virus. (3)

1.2 Chemistry of Nucleic acids- Nucleotides, Franklin's X-ray crystallography, Chargaff's rule, Watson-Crick model and forms of DNA (A, B & Z); types of RNA (rRNA, mRNA & tRNA). (2)

1.3 DNA replication-conservative, semi-conservative and dispersive models, Meselson– Stahl experiment; Mechanisms of DNA replication-linear, circular, rolling circle, D loop and θ- models. (2)

1.4 DNA replicative enzymes (DNA polymerases, helicase, primase, ligase, telomerase, nuclease & topoisomerases) and proteins (initiator protein & single strand binding proteins). (3)

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1.5 Mutations: types of mutations- transition, transversion, frame shift, silent, mis-sense and nonsense; Induced mutations- physical and chemical mutagens; spontaneous mutations 1.6 DNA damage and repair mechanisms - direct, excision and mismatch, SOS non homologous end joining(NHEJ). **(5)**

Unit-2: Gene expression in Prokaryotes & Eukaryotes **15 Hours**

2.1 Structure of prokaryotic gene; Structure of eukaryotic gene; structure and functions of RNA polymerase & it's subunits in prokaryotes. **(2)**

2.2 Transcriptional machinery in eukaryotes (RNA polymerases) and their structural and functional features. **(1)**

2.3 Genetic code-properties, deciphering of genetic code, wobble hypothesis. **(2)**

2.4 Transcription mechanism-initiation, elongation & proofreading, termination (rho independent & rho dependent). **(4)**

2.5 Transcription in eukaryotes-Initiation, elongation & termination factors. **(3)**

2.6 Translation mechanism- initiation, elongation and termination. **(3)**

Unit-3: Gene regulation in prokaryotes & eukaryotes **15 Hours**

3.1 Prokaryotic transcriptional regulation (inducible system) - Operon concept- lac operon & glucose effect. **(3)**

3.2 Prokaryotic transcriptional regulation (repressible system) – tryptophan operon. **(3)**

3.3 Post-transcriptional modifications- capping, poly- adenylation. **(2)**

3.4 Splicing and alternate splicing, rRNA and tRNA splicing. **(2)**

3.5 Post-translational modifications-glycosylation, lipidation, acetylation, ubiquitination and chaperones **(3)**

3.6 Gal locus regulation in yeast- regulation of mating type. **(2)**

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Unit-4: Microbial Genetics & Genetic Engineering **15 Hours**

4.1 Transformation- competence of bacterial cells; mechanism of transformation; gene mapping by transformation; Transduction: generalized transduction, co-transduction and linkage; Mapping by co transduction, Specialized transduction. (2)

4.2 Conjugation- unidirectional gene transfer- F+ and F- High frequency recombination, Gene mapping by conjugation (1)

4.3 Introduction to r-DNA technology; enzymes used in molecular cloning- restriction endonucleases, DNA modifying enzymes- methylases, polymerases, ligases and phosphatases. (3)

4.4 Vectors used in cloning: E Coli, plasmid vectors- pBR322, pUC vectors; cosmids; shuttle vectors- yeast vectors. (3)

4.5 Strategies for genomic libraries and cDNA libraries construction (2)

4.6 Screening for detection of cloned genes-antibiotic resistance, blue-white screening; Blotting techniques (Southern, Western & Northern), Applications of genetic engineering in agriculture and medicine. (4)

Course Outcomes :

By the end of this course, student will be able to

GT232.CO1: To distinguish structures of DNA and RNA.

GT232.CO2: Learn the fundamental aspects of gene expression such as transcription, translation and mRNA splicing.

GT232. CO3: Identify different mechanisms of gene regulation

GT232.CO4: Recognize the significance of rDNA technology in agriculture and medicine.

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Paper II – Practicals

Paper Code: GT232 P **30 hrs (2 hrs/ week)**
Credits: 1

Skill Development: To acquire skills in Molecular and Biochemical techniques.

Objective: To give hands-on experience in basic techniques used in Molecular Biology.

1. Extraction of genomic DNA.
2. Quantification of DNA by spectrophotometer.
3. Agarose gel electrophoresis of DNA.
4. Estimation of DNA by DPA method.
5. Estimation of RNA by Orcinol method.
6. Effect of UV on bacterial growth.
7. Preparation of competent cells of bacteria.
8. Problems on restriction mapping.

Outcome: Students understand the underlying principle involved in extraction of DNA, estimation of DNA/RNA, basic techniques used in Microbial Genetics.

Recommended Books

1. Principles of Genetics- Irwin Herscowitz
2. Molecular Biology of the gene- Watson, Hopkins, Roberts, Steitz and Weiner
3. Genes- Benjamin Levin
4. General virology- Luria, Darnell, Baltimore and Campbell
5. Molecular Biology- David Frefielder
6. Practical Microbiology- Aneja
7. Microbial Genetics ByMaloy, Freifelder
8. Molecular Genetics By Gunther and Stent
9. Genetic Analysis By Griffith, Suzuki and others
10. Gene cloning and DNA analysis: an introduction - T.A. Brown

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