

**Telangana State Council of Higher Education, Govt. of Telangana
B.Sc., CBCS Common Core Syllabi for all Universities in Telangana**

**PROPOSED SCHEME FOR CHOICE BASED CREDIT SYSTEM IN
BSc GENETICS**

FIRST YEAR- SEMSTER I

CODE	COURSE TITLE	COURSE TYPE	HPW	CREDITS
BS 101	Communication	AECC-1	2	2
BS 102	English	CC-1A	5	5
BS 103	Second language	CC-2A	5	5
BS 104	Optional II	DSC-1A	4T=2P=6	4+1=5
BS 105	Optional II	DSC-2A	4T=2P=6	4+1=5
BS 106	Optional III- Classical Genetics	DSC-3A	4T=2P=6	4+1=5
	TOTAL			27

FIRST YEAR- SEMSTER II

BS 201	Environmental studies	AECC-2	2	2
BS 202	English	CC-1B	5	5
BS 203	Second language	CC-2B	5	5
BS 204	Optional I	DSC-1B	4T=2P=6	4+1=5
BS 205	Optional II	DSC-2B	4T=2P=6	4+1=5
BS 206	Optional III- Cytogenetics	DSC-3B	4T=2P=6	4+1=5
	TOTAL			27

SECOND YEAR- SEMSTER III

BS 301	Basic Statistics and Genetic Analysis	SEC-I	2	2
BS 302	English	CC-1C	5	5
BS 303	Second language	CC-2C	5	5
BS 304	Optional I	DSC-1C	4T=2P=6	4+1=5
BS 305	Optional II	DSC-2C	4T=2P=6	4+1=5
BS 306	Optional III- Molecular Genetics	DSC-3C	4T=2P=6	4+1=5
	TOTAL			27

SECOND YEAR- SEMSTER IV

BS 401	Cytogenetics- Lab Processing and Analysis	SEC-2	2	2
BS 402	English	CC-1D	5	5
BS 403	Second language	CC-2D	5	5
BS 404	Optional I	DSC-1D	4T=2P=6	4+1=5
BS 405	Optional II	DSC-2D	4T=2P=6	4+1=5
BS 406	Optional III- Microbial Genetics & Genetic Engineering	DSC-3D	4T=2P=6	4+1=5
	TOTAL			27

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**Department of Genetics
Scheme Pattern in Genetics for BSc Course- CBCS**

Year	Semester	Course Type	Credits/ Theory	Teaching hours/ week- Theory	Credits- Practicals	Lab hours/ week- Practical	Dept. workload/ week/ section
FIRST YEAR	ONE	BS106- Classical Genetics	4	4	1	2	6
	TWO	BS206- Cytogenetics	4	4	1	2	6
SECOND YEAR	THREE	BS306- Molecular Genetics	4	4	1	2	6
	FOUR	BS406- Microbial Genetics & Genetic Engineering	4	4	1	2	6

**BSc GENETICS II Year
SEMESTER- III
SKILL ENHANCEMENT COURSE-1 (SEC-1)
BS301: BASIC STATISTICS AND GENETIC ANALYSIS**

Unit 1: Basic Statistics in Genetics

- 1.1 Introduction to Biostatistics: methods of sampling- random & non-random; types of variables (quantitative and qualitative variables); types of estimates (point, interval estimates), parameters and sample statistics.
- 1.2 Data representation- Diagrammatic (line diagram, bar diagram, pie diagram) and graphic representation of data (histogram, frequency polygon & frequency curve)
- 1.3 Kind of events (mutually exclusive, dependent and independent events in genetics); Concepts of probability, Applications of probability to mendelian crosses
- 1.4 Descriptive analysis of data: Measures of central tendency (mean, median & mode); measures of dispersion (range, mean deviation, variance & standard deviation)
- 1.5 Hypothesis testing - null and alternate hypothesis, level of significance, steps in hypothesis testing, t-test, test statistic (z test), Comparison of means of two samples by t-test (paired & unpaired)
- 1.6 Features of chi square test, applications of chi square test (for goodness of fit, for linkage)

Unit 2: Genetic Analysis

- 2.1 Drosophila genetics – stages of life cycle, identification of male & female, identification of mutants, drosophila sex determination, sex-linked inheritance in drosophila, monohybrid and dihybrid crosses, chi-square analysis
- 2.2 Maize genetics – maize biology, genetic crosses using corn, monohybrid cross, dihybrid cross, test cross, chi-square analysis
- 2.3 Yeast genetics – nomenclature and gene symbols, inheritance in yeast – mitosis, meiosis; mitotic recombination in yeast – formation of sectorized colonies, gene conversion
- 2.4 Zebra fish – early development of zebrafish, zebrafish breeding and husbandry
- 2.5 Inheritance in man - patterns of inheritance, probability and risk estimation, multiple alleles - blood groups; polygenic inheritance: finger print ridge count

RECOMMENDED BOOKS

1. Fundamentals of Biostatistics: Khan and Khanum. Ukaaz publications, India
2. Biostatistics by: N.T.J. Bailey
3. Biostatistics; Jayasree publishers by: Vishweswara Rao K
4. Biostatistics; Himalaya publishing house by: Arora, P.N & Mashan P.K.
5. Biostatistics by: S. Prasad
6. Concepts of Genetics (2010) Seventh Edition Klug & Cummings, Pearson publications
7. Introduction to Genetic Analysis (2008) Griffiths, W.H. Freeman publications.

**BSc GENETICS II Year
SEMESTER- III
DSC-3C
BS306: MOLECULAR GENETICS**

Unit 1: Nucleic acids

- 1.1 DNA as the genetic material- Griffiths transformation experiment, Avery, MacLeod and McCarty's experiments and Hershey & Chase phage-labelling experiment
- 1.2 RNA as genetic material- tobacco mosaic virus
- 1.3 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)
- 1.4 DNA replication- conservative, semi-conservative and dispersive models, Meselson–Stahl experiment
- 1.5 DNA replicative enzymes (DNA polymerases, helicase, primase, ligase, telomerase, nuclease & topoisomerases) and proteins (initiator protein & single strand binding proteins)
- 1.6 Mechanisms of DNA replication- linear, circular, rolling circle, D-loop and θ -models

Unit 2: Gene expression and regulation in prokaryotes

- 2.1 Structure of prokaryotic gene (promoter, initiator & terminator regions), structure and functions of RNA polymerase & its subunits
- 2.2 Transcription mechanism- initiation, elongation & proof reading, termination (rho independent & rho dependent); reverse transcription
- 2.3 Genetic code- properties, deciphering of genetic code, Wobble hypothesis, aminoacylation
- 2.4 Translation mechanism- initiation, elongation and termination
- 2.5 Prokaryotic transcriptional regulation (negative control & positive control)
- 2.6 Operon concept- lac operon & glucose effect, tryptophan operon

Unit 3: Gene expression and regulation in eukaryotes

- 3.1 Structure of eukaryotic gene (promoter, exons, introns, terminator, enhancer & silencer)
- 3.2 Transcriptional machinery in eukaryotes (RNA polymerases) and their structural and functional features
- 3.3 Transcription- initiation, elongation and termination
- 3.4 Post-transcriptional modifications- capping, polyadenylation, splicing and alternate splicing, rRNA and tRNA splicing
- 3.5 Translation- initiation, elongation and termination
- 3.6 Post-translational modifications- glycosylation, lipidation, acetylation, ubiquitination and chaperones

Unit 4: Mutations and repair mechanisms

- 4.1 Mutations- spontaneous mutations (tautomerism, depurination, deamination, slipped strand mispairing, errors in DNA replication and repair),
- 4.2 Induced mutations- mutagens, physical and chemical mutagens
- 4.3 Types of mutations- transition, transversion, frame shift, silent, lethal mutations, mis-sense and non-sense
- 4.4 DNA damage & repair mechanisms- direct, excision and methyl mediated mismatch, recombinational and SOS repair
- 4.5 DNA recombination- homologous, site specific recombination and non-homologous end joining (NHEJ)
- 4.6 Diseases caused due to mutation- sickle cell anaemia and cystic fibrosis

PRACTICALS

PAPER III (BS306): MOLECULAR GENETICS

- 1. Extraction of genomic DNA from plant tissue
- 2. Extraction of genomic DNA from animal tissue
- 3. Quantification of DNA by spectrophotometer
- 4. Agarose gel electrophoresis of DNA
- 5. Estimation of DNA by DPA method
- 6. Estimation of RNA by orcinol method
- 7. Separation of proteins by SDS-PAGE
- 8. Effect of UV on bacterial growth

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 Freifelder
- 6. Practical Microbiology- Aneja
- 7. Principles and Techniques of Biochemistry and Molecular Biology- Keith Wilson, John Walker
- 8. Text book of cell and molecular Biology- Ajoy Paul; Books and allied pvt ltd
- 9. Essentials of molecular Biology by George M. Malacinski; Narosa publications

**BSc GENETICS II Year
SEMESTER- IV
SKILL ENHANCEMENT COURSE-2 (SEC-2)
BS401: CYTOGENETICS - LAB PROCESSING AND ANALYSIS**

Unit 1: Methods for Preparation of Chromosomes

- 1.1 Cell culture – aseptic techniques, media, culture techniques of cell or tissue types, variables affecting cell growth, different cell types in cultured tissues, contamination in tissue culture, preservation of cells
- 1.2 Specimen collection and handling – peripheral blood specimens, bone marrow samples, amniotic fluid, solid tissue sources
- 1.3 Culture initiation and harvest techniques – growth media, culture vessels, harvest for chromosomal analysis- slide making
- 1.4 Chromosome staining and banding - G-banding, Q-banding, R-banding, C-banding, T-banding, Cd staining, G-11 banding
- 1.5 Microscopy – operation and maintenance of bright-field microscopy, inverted and fluorescence microscopy

Unit 2: Chromosome Analysis

- 2.1 Karyotyping – ideogram, metaphase spread, counting the metaphase spread, karyotyping
- 2.2 Chromosome analysis - chromosome number (in humans); chromosome morphology; karyotyping for clinically significant chromosome abnormalities (Downs syndrome, Edward's syndrome), sex chromosome abnormalities (Klinefelter's Syndrome, Turner's syndrome).
- 2.3 Structural Chromosome abnormalities – translocations (Burkitt's Lymphoma), inversions, insertions, deletions (Cri-du-chat syndrome), duplications, ring chromosomes, marker chromosomes, double minutes; Detection of Sister chromatid exchanges and Fragile sites.
- 2.4 FISH – methodology, probes, chromosome paints, applications (diagnosis of CML), advantages and limitations
- 2.5 Screening Tests - amniotic fluid sampling and analysis, second trimester maternal serum screening, first trimester Down syndrome screen, chorionic villi sampling, bone marrow aspiration and biopsy

RECOMMENDED BOOKS

1. AGT Cytogenetics Laboratory Manual (2017) Arsham, Barch & Lawce, Wiley Blackwell publications
2. Human cytogenetics- A practical approach (2001) Rooney, Oxford University press
3. Manual of Cytogenetics in Reproductive Biology (2014). Pankaj Talwar, Jaypee Brothers Medical Publishers (P) Ltd.
4. Clinical Biochemistry (2013) Gaw, Cowan, Murphy, Srivastava and O'Reilly, Elsevier

**BSc GENETICS II Year
SEMESTER- IV
DSC-3D**

BS406: MICROBIAL GENETICS AND GENETIC ENGINEERING

Unit 1: Bacterial recombination and mapping

- 1.1 Bacteria- structure, techniques of cultivation, counting
- 1.2 Bacterial phenotypes- colony morphology, nutritional requirement, resistance and sensitivity
- 1.3 Transformation: discovery of transformation- competence of bacterial cells; mechanism of transformation; gene mapping by transformation.
- 1.4 Conjugation- unidirectional gene transfer- F⁺ and F⁻
- 1.5 High frequency recombination, interrupted mating experiment
- 1.6 Gene mapping by conjugation

Unit 2: Genetics of bacteriophages

- 2.1 Structure and classification of bacteriophages
- 2.2 Lytic cycle- infection of host cells; formation of viral components; maturation and release of virus particles
- 2.3 Lysogeny- nature of lysogeny; λ -phage, integration of viral genome into host genome; lysogenic stage and prophage cycle; factors governing lysogeny
- 2.4 Transduction: generalized transduction, co-transduction and linkage; Mapping by co-transduction
- 2.5 Specialized transduction- formation of specialized transducing particle from a λ -lysogen
- 2.6 Specialized transduction from λ gal and λ bio

Unit 3: Genetic engineering

- 3.1 Introduction to r-DNA technology; enzymes used in molecular cloning- restriction endonucleases, DNA modifying enzymes- methylases, polymerases, ligases and phosphatases
- 3.2 Vectors used in cloning: *E.Coli*, plasmid vectors- pBR322, pUC vectors; cosmids; shuttle vectors- yeast vectors
- 3.3 Genomic libraries: strategies for construction of genomic libraries
- 3.4 cDNA libraries: strategies for construction of cDNA libraries
- 3.5 Blotting techniques (southern, western & northern) and PCR
- 3.6 Screening for detection of cloned genes- antibiotic resistance, blue-white screening

Unit 4: Applications of genetic engineering

- 4.1 Gene products in medicine- Humulin, Erythropoietin, Growth hormone/Somatostatin, tPA, Interferon- γ
- 4.2 DNA based vaccines; Subunit vaccines- Herpes simplex virus; Attenuated vaccines- Cholera
- 4.3 Environment- genetically engineered microorganisms for bioremediation, phytoremediation
- 4.4 Transgenic plants- Bt cotton, Golden rice
- 4.5 Transgenic animals: Molecular pharming- Buffalo and Goat
- 4.6 Industrial products- Cheese and Yoghurt

PRACTICALS

PAPER IV (BS406): MICROBIAL GENETICS AND GENETIC ENGINEERING

1. Methods of sterilization, media preparation
2. Gram staining
3. Isolation, purification and maintenance of bacteria
4. Bacterial growth curve
5. Induction and isolation of mutants in bacteria
6. Preparation of competent cells of bacteria
7. Amplification of gene of interest by PCR
8. Restriction digestion analysis
9. Problems on restriction mapping

RECOMMENDED BOOKS

1. Microbial Genetics By Maloy, Freifelder
2. Molecular Genetics By Gunther and Stent
3. Microbiology By Prescott
4. Genetic Analysis By Griffith, Suzuki and others
5. Microbiology : Concepts and Applications By John Wiley
6. General Microbiology By Stanier
7. Microbiology By Pelczar
8. Introductory Microbiology By J. Heritage
9. Fundamentals of Medical Biotechnology By Irfan Ali Khan and Atiya Khanum