**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**

| CODE | COURSE TITLE | COURSE TYPE | HPW | CREDITS |
|---|---|---|---|---|
| **FIRST YEAR- SEMSTER I** | | | | |
| 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 sectored 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 & it's 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, ubiqutination 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 Frefielder
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 (Burkitts 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 Prescot
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