(Applicable to the batch of students admitted in the academic year 2025-26 onwards)

B.Sc., Genetics (CBCS) FACULTY OF SCIENCE, SU

B.Sc. (GENETICS)
Syllabus (CBCS)
(w.e.f. 2025-2026)

FACULTY OF SCIENCE
SATAVAHANA UNIVERSITY
KARIMNAGAR – 505002

2025

Telangana Council of Higher Education, Govt. of Telangana
B.Sc CBCS Common Core Syllabus for all Universities in Telangana
B.Sc. – Genetics (w.e.f.2025-26)

FIRST YEAR SEMESTER I				
Code	**Course Title**	**Course Type**	**HPW**	**Credits**
BS	**Optional – I Transmission Genetics & Cell Biology**	DSC1A	4+3=7	4+1=5
FIRST YEAR SEMESTER II				
BS	**Optional - I Biochemistry &Microbial Genetics**	DSC1B	4+3=7	4+1=5
SECOND YEAR SEMESTER III				
BS	**Optional - I Molecular Genetics & Genetic Engineering**	DSC1C	4+3=7	4+1=5
SECOND YEAR SEMESTER IV				
BS	**Optional - I Biostatistics, Population Genetics & Bioinformatics**	DSC1D	4+3=7	4+1=5

THIRD YEAR SEMESTER V				
Code	**Course Title**	**Course Type**	**HPW**	**Credits**
BS	**Basic & Applied Genetics**	MDC	4	4
BS505	**Optional – I Plant Genetics & Biotechnology**	DSC1E	4+3=7	4+1=5
THIRD YEAR SEMESTER VI				
	Cytogenetics- Lab Processing and Analysis/ Biophysical and Molecular Biology Techniques/ DNA technology in health care & Transgenics	SEC-4		
BS603	**Optional - I Human Genetics & Immunology**	DSC1F	4+3=7	4+1=5
	Internship/Project		4	4

Skill Enhancement Course

- Paper 1: Communication Skilla/Professional Development Skills/Entrepreneurship & Startups
- Paper-2: Professional Development Skills/ Communication Skills/Entrepreneurship & Startups
- Paper-3: Fundamentals of AI Tools/Ability Skills(Cometitive Mathematics)
- Paper4: Cytogenetics- Lab Processing and Analysis/ Biophysical and Molecular Biology Techniques/ DNA technology in health care & Transgenics

B.SC GENETICS I YEAR
SEMESTER- I
DSC-PAPER- I: TRANSMISSION GENETICS & CELL BIOLOGY

Credit- 1: Mendelian inheritance and its extensions

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,

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

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

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

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

1.6. Non-medelian inheritance: Plastid inheritance – Variegation in *Mirabilusjalapa;* Maternal effects and inheritance – Shell coiling in snails, Poky mutants in *Neurospora.*

Credit- 2: Linkage, Crossing over and Gene mapping

2.1 Discovery of linkage – Phases of linkage

2.2 Chiasmata and Crossing over formation– Recombination

2.3 Cytological proof for crossing over – Curt Stern and McClintock experiments

2.4 Linkage analysis – Recombination frequencies, Two-point and Three-point crosses

2.5 Gene mapping – Coincidence and Interference, Determination of gene order

2.6 Gene mapping in neurosporra– Tetrad analysis, Mitotic recombination in *Aspergillus* and Drosophila.

Credit- 3: Cell division and Cell fate Mechanisms

3.1Eukaryotic Cell cycle – Phases of cell cycle G0, G1, S,G2

3.2 Regulation of cell cycle cyclins, CDK proteins, role of p^{53} in cell cycle

3.3 Mitosis – Stages in mitotic cell division- significance ofmitosis

3.4 Meiosis – Formation of Synaptonemal complex, crossing over, chiasma formation,

significance ofmeiosis

3.5Apoptosis- Extrinsic and intrinsic pathways and significance

3.6 Senescence, Necrosis-Characteristics and mechanisms.

Credit- 4: Chromosome structure, chromatin organization and variation

4.1 Chromosome morphology- size and shape; Euchromatin and Heterochromatin-constitutive and facultative heterochromatin

4.2 Components of chromatin, histones & non-histones

4.3 Packing of DNA into chromatin – Nucleosome and higher orderorganization

4.4 Specialized Chromosomes – Lampbrush chromosomes, Polytene Chromosomes

4.5 Strucrural chromosomal aberrations – duplications, deletions, inversions& translocations with examples, Genetic consequences.

4.6 Numerical chromosomal aberrations – Aneuploidy, euploidy, auto-polyploidy and allo-polyploidy, Genetic consequences.

Credit- 5: Practicals

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
4. Problems on linkage and mapping of genes
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 abberations

Recommended Books

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

B.Sc. GENETICS I YEAR
SEMESTER- II
DSC-PAPER- II: BIOCHEMISTRY & MICROBIAL GENETICS

Credit 1:Structure of Biomolecules

1.1. Overview of biomolecules carbohydrates, proteins, aminoacids, fatty acids,lipids, vitamins, hormones, enzymes and nucliec acids

1.2. Carbohydrate structure and classification

1.3. Aminoacid structure and classification

1.4. Lipids structure and classification (saturated and unsaturated fatty acids)

1.5. Protein - Primary, secondary/tertiary and quaternary

1.6. Nucleic acids-structure, forms of DNA, forms of RNA

Credit 2: Metabolism of Biomolecules

2.1. Carbohydrate Metabolism- Overview of glycolysis, Citric acid cycle, Glycogenesis and glycogenolysis, pentose phosphate pathway

2.2. Aminoacid metabolism- General reaction of amino acid metabolism, transamination oxidative deamination and decarboxylation. Urea cycle, Glycogenic and ketogenic amino acids

2.3. Fatty acid Metabolism- beta oxidation of fatty acids

2.4. Nucleic acid metabolism-purine and pyramidine synthesis

2.5. Enzymes- structure and functions, enzyme kinetics

2.6.Hormones Endocrine system, Mechanism of hormone action: Peptide hormones, Secondary messengers

Credit 3: Recombination and mapping of genes in Bacteria

3.1. Overview of Bacteria Structure, Bacerial phenotypes-auxotrophs, prototrophs, antibiotic resitance and sentivity

3.2. Growth curve-lag,log, stationery and decline phases

3.3. Transformation-Mechanism of transformation, Transformation mapping

3.4. Transduction - Lytic cycle, lysogeny, factors governing lysogeny

3.5. Generalised transduction, Specialized Transduction- Transduction mapping

3.6. Conjugation-F^+F^-Hfr strains, Interrupted conjugation experiment

Credit 4: Fine structure analysis of gene

4.1. One gene-one enzyme hypothesis - arginine biosynthesis in Neurosporacrassa

4.2. Collinearity between gene-protein-Tryptophan synthase gene in *E. coli*

4.3. Analysis of r-II locus of T4-phage - rII screening techniques-host restriction, permissive host

4.4. Genetic recombination in phage crosses

4.5. Complentation-cis-trans test, Intra codon recombination.

4.6. Deletion mapping - elucidation of fine structure of r-II locus using point and deletion mutants.

Credit 5: Practicals GEN 212

1.Isolation and separation of DNA

2. Estmation of DNA by UV spectrophotmetry

3.Estimation DNA by DPA method

4.Estimation RNA by Orcinol reagent

5. Estimation of protein-biurette method

6. Methods of sterilization, media preparation

7. Bacterial growth curve

Recommended Books

1. Biochemistry-U.Satynarayana
2. Biochemistry-Voet & Voet
3. Microbiology-Prescot
4. Microbiology –Pelczar
5. Microbial Genetics - David Friefelder

B.Sc GENETICS II YEAR
SEMESTER- III BS
MOLECULAR GENETICS & GENETIC ENGINEERING

Credit-1: Nucleic acids, DNA replication & DNA repair

1.1 DNA as the genetic material-Griffith's transformation experiment, Avery, MacLeod and McCarty's experiments and Hershey & Chase phage-labelling experiment; RNA as genetic material- tobacco mosaicvirus

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&IRNA)

1.3DNA replication-conservative, semi-conservative and dispersive models, Meselson-Stahlexperiment; Mechanisms of DNA replication-linear, circular, rolling circle, D-loop and θ-models

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

1.5 Mutations: types of mutations- transition, transversion, frame shift, silent, mis-sense andnon-sense; Induced mutations- physical and chemicalmutagens, spontaneous mutations

1.6 DNA damage and repair mechanisms direct, excision and mismatch, SOS, non-homologous end joining(NHEJ)

Credit-2: Gene expression in Prokaryotes & Eukaryotes

2.1 Structure of prokaryotic gene, Structure of eukaryotic gene, Structure and functions of RNA polymerase & it's subunits in prokaryotes

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

2.3 Genetic code-properties, deciphering of genetic code, Wobble hypothesis

2.4 Transcription mechanism-initiation, elongation& proof reading, termination (Rho independent & Rho dependent)

2.5 Transcription in eukaryotes-Initiation, elongation & termination factors

2.6 Translation mechanism- initiation, elongation andtermination

Credit-3: Gene regulation in prokaryotes &eukaryotes

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

3.2 Prokaryotic transcriptional regulation (repressible system) tryptophanoperon

3.3 Post-transcriptional modifications capping, poly-adenylation

3.4 Splicing and alternate splicing, rRNA andtRNA splicing

3.5Post-translational modifications-glycosylation, lipidation, acetylation, ubiqutination & chaperones

3.6 Gal locus regulation in yeast-regulation of mating type

Credit-4: Genetic Engineering

4.1 Introduction to r-DNA technology; enzymes used in molecular cloning- restriction Endo nucleases, DNA modifying enzymes- methylases, polymerases, ligases and phosphatases

4.2 Vectors used in cloning: *E.coli*, plasmid vectors- pBR322, pUC vectors; cosmids; Shuttle vectors- yeast vectors

4.3 Strategies for construction of genomic and cDNA libraries

4.4 Screening for detection of cloned genes-antibiotic resistance, blue-white screening; Blotting techniques (Southern, Western & Northern)

4.5Applications of genetic engineering in agriculture, medicine and environment

Credit-5: Practicals

1. Extraction of genomic DNA
2. Quantification of DNA byspectrophotometer
3. Agarose gel electrophoresis ofDNA
4. Estimation of DNA by DPAmethod
5. Estimation of RNA by orcinolmethod
6. Effect of UV on bacterialgrowth
7. Preparation of competent cells of bacteria
8. Problems on restrictionmapping

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/TA Brow

B.Sc. GENETICS II YEAR
SEMESTER- IV BS
BIOSTATISTICS, POPULATION GENETICS & BIOINFORMATICS

Credit 1 Basic concepts and applications of Biostatistics in Genetics

1.1. Population, Random sample, Methods of sampling

1.2. Variable-qualitative, quantitative,examples from genetics experiments

1.3 Probability,combining probabilities, sum rule, product rule, binomial theorem, Poisson distribution for rare events in Biology.

Introduction to normal distribution, Standard Normal Variate.

1.4. Goodness fit Chi-square for Mendelian segregation ratios. Level of significance, degrees of freedom , test of independence of attributes 2x2 contingency, rxc contingency

1.5. Estimation of mean, standard deviation, standard error for a quantitative variable, testing difference between means using Z, t test for large and small samples, Concept of ANOVA

1.6 Bivariate data- scatter diagram, correlation-Pearson correlation coefficient, regression equation and fitting a straight line for prediction of unknown values of a variable.

Credit 2:Hardy-Weinberg equilibrium and forces affecting equilibrium.

2.1 Concept of population- deme, genetic and phenotypic variation, gene pool, allelic frequencies, genotypic frequencies. HW equilibrium – genetic structure of populations and panmixis, HW equilibrium assumptions, implications and applications.

2.2 Establishment of HW equilibrium to single gene loci, multiple alleles of blood groups, sex linked loci

2.3 Factors affecting equilibrium: mutation, selection-patterns of selection, joint effects of mutation and selection, migration and gene flow

2.4 Small populations- genetic drift, Wahlund effect, inbreeding coefficient, effects of inbreeding on genotypic frequencies and consequences in terms of quantitative traits, components of variance heritability and inbreeding depression, genetic load- mutational and segregation

2.5 Effective population size

2.6 Pedigree construction -Raw pedigree, fork line pedigree, calculation of inbreeding coefficients from pedigrees

Credit 3: Introduction to bioinformatics and biological databases

3.1 Bioinformatics definition, history, scope and applications.

3.2 Bioinformatics tools and resources – internet basics, role of internet, free online tools, downloading free softwares and installation.

3.3 Introduction to Artificial intelligence and bioinformatics web portals – NCBI, EBL, ExPASy

3.4 Biological databases: Classification of databases – primary (GenBank), secondary (PIR) and tertiary or composite (KEGG) databases.

3.5 DNA sequence databases (ENA & DDBJ)

3.6 Protein sequence databases (Swissport& PROSITE)

Credit 4: Sequence Alignment

4.1 Basics of sequence alignment – match, mismatch, gaps, gap penalties, scoring alignment.

4.2 Types of sequence alignment – pairwise and multiple alignment, local and global alignment.

4.3 Scoring matrices – PAM and BLOSUM., Dot matrix comparison of sequences

4.4 Pairwise sequence similarity search by BLAST and FASTA, multiple sequence alignment (Clustal W).

4.5 Concepts of phylogenetic tree – character based (maximum likelihood & maximum parsimony method)

4.6 AI& ML in Bioinformatics- Genome sequencing and variant detection, Protein structure prediction (AlphaFold and AI-based models), AI in drug-target interaction prediction

Credit 5: Practicals GEN 414

1. Application of probability to Mendelian segregation-monohybrid, dihybrid- Goodness of fit Chi square.
2. Application of binomial theorem for sex, disease distribution and Poisson distribution for rare events in biology.
3. Problems - Z and t-test for differences in mean values
4. Scatter diagram, calculation of correlation coefficient and fitting straight line for quantitative traits.
5. Calculation of gene and genotypic frequencies -gene counting, testing HW equilibrium diallelic locus with dominance,Frequency of recessive alleles by square rooting method and estimation of carriersunder complete dominance for rare recessive disorders.
6. Testing equilibrium for multiple alleles of blood group locus ,Testing HW equilibrium of sex linked genes for females and oscillating equilibrium
7. Exploring web portals – NCBI, EBI &ExPASy,Literature search through PubMed and PubMed Central,Sequence retrieval from GenBank, ENA, Swissport.
8. Pairwise homology search by BLAST and FASTA

References

1. Principles of Genetics -Robert H.Tamarin
2. Genetics -Monroe W.Strickberger
3. Biostatistics –W.Daniel
4. Biosatatistical Analysis by Jerrold H Zar
5. .Introduction to Quantitative Genetics-DS Falconer
6. Population Genetics -V.VenugopalRao and PratibhaNallari
7. Population genetics by C.C.Li
8. Introduction to Bioinformatics by Aurther M LeskDeveloping Bioinformatics computer Skills by: Cynthia Gibas, Per Jambeck
9. Bioinformatics second edition by David Mount
10. Essential Bioinformatics by Jin Xiong
11. Bioinformatics Computing by Bryan Bergeron
12. Bioinformatics: Concepts, Skills & Applications by R.S. Rastogi P

B.Sc. GENETICS III YEAR
SEMESTER V MDC
BASIC & APPLIED GENETICS

Unit 1: Introduction to Genetics

1.1. Genotype & phenotype; homozygous & heterozygous, dominant & recessive, gene & allele

1.2. Mendelian geneties Principle of dominance, Principle of segregation, Principle of Independent Assortment

1.3. Trait Inheritance- ABO blood groups in human, eye color in *Drosophila*

1.4. Polygenic Inheritance-Kernel colour in Maize, skin colourim man

1.5. Sex-linked Inheritance-haemophilia and colour blindness in man

1.6. Non-Mendelian inheritance-Maternal inheritance-Variegation in leaves of higher plants-Mirabilis Jalapa

Unit 2: Cellular & Molecular basis of Inheritance

2.1. DNA structure and its alternative forms (A. B & Z)

2.2. RNA- Types of RNA (rRNA, mRNA & tRNA)

2.3. Ultra structure of prokaryotic cell (cell membrane and plasmids, Nucleoid)

2.4. Ultra structure of eukaryotic cell (nucleus, mitochondria, chloroplast, endoplasmic reticulum, Golgi apparatus)

2.5. Chromosomes: Packaging of DNA into Chromosomes, structure (centromere and telomere), karyotype

2.6. Cell division- stages of mitosis, meiosis I&II& fertilization

Unit 3: Genomes & Genetic Engineering

3.1. Prokaryotic genomes genome size & organization

3.2. Eukaryotic genomes-features of eukaryotic nuclear and organellar genomes

3.3. Human genome project-goals and achievements

3.4. Genetic Engineering- Transgenic plants-Bt cotton, Golden rice

3.5. Genetic Engineering - Transgenic animals -Molecular pharming-Buffalo and Goat

3.6. Genetic Engineering: Environment- bioremediation

Unit 4: Human Genetics

4.1. Human nuclear genome -general features

4.2. Human chromosome anomalies: Down's syndrome and Klinefelter's syndrome

4.3. Single gene disorders-Hemoglobinopathies (Sickle cell disease, Thalassemias)

4.4. Complex genetie diseases-Hypertension, Diabetes mellitus

4.5. Genetic testing: Prenatal screening (Invasive methods and Non- invasive techniques, Neonatal screening (PKU), Preclinical screening (Alzheimer's)

4.6. Therapeutics: Conventional treatment modalities- PKU, Gene therapy types-somatic and germ

line gene therapy, Gene therapy trials: ADA deficiency

RECOMMENDED BOOKS

1. The Foundations of GenetiesBy F. A. E. Crew Elsevier, 2014
2. Concepts of Genetics, 7/E By Klug Pearson Education India, 2002
3. Genetics ByKarvita B. Ahluwalia New Age International, 2009
4. Genetics by M. Yadav Discovery Publishing House, 2003 By M. Yadav
5. Human Genetics: The Basics ByRicki Lewis Taylor & Francis. -2016
6. Essentials of Human Genetics (Rev) By Bhatnagar, S.M. Orient Blackswan, 1999
7. DNA Technology: The Awesome Skill By 1. Edward Alcamo Gulf Professional Publishing. 2001
8. Recombinant DNA Technology Keya ChaudhuriThe Energy and Resources Institute (TERI), 2013
9. Recombinant DNA Technology edited by Sardul Singh Sandhu 1. K. International Pvt Ltd. 2010

B.SC. GENETICS III YEAR
SEMESTER V BS
PLANT GENETICS & BIOTECHNOLOGY

Unit 1: Basis of Plant Life Cycle and Genetics

1.1. Overview of plant development and life cycle-sporogenesis, gametogenesis. pollination, fertilization, embryogenesis (development of monocot & dicot embryos)

1.2. Seed (monocot & dicot) development and seed germination

1.3. Meristems root apical meristems & root development, shoot apical meristems & leaf development; flower and fruit development

1.4. Plant hormones and their actions- auxins, cytokinins, gibberellins, abscisic acid, ethylene, brassinosteroids

1.5. Plant Nuclear Genome Organization- General features, Variation of Genome size among plants, fine structure of plant gene

1.6. Plant Organellar Genome Organization – Mitochondria, Chloroplast

Unit 2: Plant Tissue culture

2.1. Media and culture conditions, sterile technique

2.2. Regeneration methods of plants in culture- organogenesis, somatic embryogenesis; Somaclonal variation

2.3. Induction of callus and cell suspension cultures

2.4. Protoplast culture techniques-production of somatic hybrids and cybrids

2.5. Anther/microspore culture- production of haploids and double haploids and their uses

2.6. Somatic embryo culture and production of synthetic seeds

Unit 3: Plant Breeding& Hybrid seed production

3.1. Mating systems - Self fertilization, Cross fertilization and Apomixis

3.2. Methods of breeding in Self-pollinating species- pedigree breeding, single-seed descent, bulk breeding method

3.3. Methods of breeding in Cross-pollinating species- mass selection, recurrent selection

3.4. Hybrid seed production- genetic male sterility(procedure for hybrid seedproduction by using GMS)

3.5. Hybrid seed production based on cytoplasmic genetic male sterility (seed production of CMS lines (A), maintainer line (B), restorer line (R)

3.6. Hybrid seed production based on functional male sterility system-gametocides and their use in hybrid seed production

Unit 4: Transgenic plants production and applications

4.1. Introduction to genome editing and its significance, Transformation based transgenic plants production-*Agrobacterium tumefaciens* and viral vectors

4.2. Direct gene transfer based transgenic plants production- particle bombardment, electroporation, silicon carbide whiskers, sonication, laser micro puncture, nanofiber arrays, chemical methods

4.3. Genetically modified crops for insect resistance-Bt crops, microbes & plant derived toxins

4.4. Genetically modified crops for Virus resistance- coat protein mediated cross protection, antisense and sense mediated resistance, satellite RNA prolection pathogen targeted protection

4.5. Genetically modified crops for Disease resistance- pathogenesis related proteins, anti microbial proteins, manipulation of disease resistance genes

4.6. Transgenic plants for product quality- improved storage, longer shelt life, nutritionalquality (Golden Rice).

PRACTICALS

1. Histological studies of embryos at different stages
2 Seed testing for germination
3. Introduction to Plant tissue culture laboratory -equipment
4. Sterilization methods in plant tissue culture laboratory-aseptic technique
5. Preparation of stock solutions of MS basal medium and plant growthregulators
6. Isolation of explants, establishment and maintenance of callus
7. Culture of anthers and establishment of haploid plants
8. Preparation of synthetic seeds

RECOMMENDED BOOKS

1 Principles of Plant Geneties and Breeding (2012) by George Acquaah. SecondEdition Wiley-Blackwell Publishers

2 Plant Tissue Culture: Techniques and Experiments (2013) by Roberta H. Smith. Academic Press, U.K

3 Plant Tissue Culture and Biotechnology: Emerging trends (2003) by P.BKaviKishor. Universities Press

4 Plant Tissue Culture: Basic and Applied (2005) by TimirBaranJha. Universities Press

5. Plant Biotechnology: Practical Manual (2007) by C. C. Giri. ArchanaGiri.LKInternational Publishers

6. From Plant Genomics to Plant Biotechnology (2013) edited by PalmiroPoltronieri, NatalijaBurbulis. CorradoFogher, Woodhead Publishing Limited, New Delhi

8. Plant Genomics and Biotechnology (2016) Isabelle Nickel. SyrawoodPublishing House

9. Plant Biotechnology and Agriculture: Prospects for the 21st Century (2012)edited by Arie Altman, Paul M. Hasegawa, Elsevier

10. Plant Cell Biotechnology by Rudolf Endress, Springer-Verlag Berlin

B.SC. GENETICS II YEAR
SEMESTER VI BS SEC
CYTOGENETIC ANALYSIS

Unit 1: Preparation of Chromosomes

1.1. Cell culture - sterilizing techniques, growth media, variables affecting cell growth. contamination in tissue culture, preservation of cells

1.2. Sample collection and handling peripheral blood, bone marrow, amniotic fluid, sold tissues

1.3. Culture mitiation, harvesting, hypotonic treatment, slide preparation

1.4. Chromosome staining and banding -G-banding, Q-banding. R-banding. C-banding

1.5. Karyotyping-metaphase spread, counting of chromosomes

Unit 2: Chromosome Analysis

2.1. Microscopy-Bright-field microscopy, inverted and fluorescence microscopy

2.2. Chromosomal analysis chromosome number, size & shape in humans, karyotyping chromosomes- ideogram

2.3. Chromosome abnormalities Structural (breaks, gaps. deletions, insertions. duplications. inversions, translocations), numerical: aneuploidy (monosomy. trisomy &tetrasomy); polyploidy (triploidy, tetraploidy)

2.4. FISH&SKY- principle, applications and limitations

2.5. Screening Analysis amniotic fluid sampling, chorionic villi sampling, bone marrow aspiration & biopsy analysis

RECOMMENDED BOOKS

1.AGT cytogenetics Laboratory Manual (2017) Arsham. Barch & Lawee. Wiley Blackwell publications

2. Human cytogenetics-A practical approach (2001) Rooney, Oxford University press

3. Manual of cytogenetics in Reproductive Biology (2014). PankajTalwar, Jaypee Brothers Medical Publishers (P) Ltd.

4. Chnical Biochemistry (2013) Gaw. Cowan, Murphy. Srivastava and O'Reilly. Elsevier

B.SC. GENETICS II YEAR
SEMESTER VI BS SEC
BIOPHYSICAL AND MOLECULAR BIOLOGY TECHNIQUES

Unit 1: Biophysical techniques

1.1. Spectroscopy principle, instrumentation, ultraviolet and visible light spectroscopy, applications

1.2. Chromatography-types of chromatographie techniques (paper, ion exchangechromatography, size exclusion chromatography)- principle & applications

1.3. Centrifugation-principles of sedimentation, preparative centrifugation (differential centrifugation & density gradient centrifugation), applications

1.4. Electrophoretic techniques-types (Agarose gel electrophoresis, SDS PAGE), principle & applications

1.5. Mass spectrometry principle & applications

1.6. Microscopy-principle & applications of Phase contrast microscope and confocalmicroscopy

Unit 2: Molecular Biology techniques

2.1. PCR -Types (Allele-Specific PCR, ARMS PCR, Reverse Transcriptase PCR) principleand applications

2.2. Quantitative Real Time PCR principle and applications

2.3. DNA Sequencing principle and applications

2.4. Microarray- DNA and protein arrays - principle and applications

2.5. Blotting techniques Southern blot, Northern blot and Western blot- principle and applications

2.6. Fluorescence & Chemiluminescence Imaging- principle and applications

RECOMMENDED BOOKS

1. Principles and Techniques of Biochemistry and Molecular Biology edited by Keith Wilson, John Walker Cambridge University Press, 2010

2. Basie Techniques in Biochemistry and Molecular Biology by R K Sharmal K International Pvt Ltd, 2008

3. Techniques in Molecular Biology Textbook Student Edition, Agrawal S International Book Distributing Company, 2008

4. Analytical Techniques in Biochemistry and Molecular Biology, By RajanKatoch Springer Science & Business Media, 2011

B.Sc. GENETICS III YEAR
SEMESTER VI SEC

DNA TECHNOLOGY IN HEALTH CARE AND TRANSGENICS

Unit1:DNA TechnologyinHealth care

MethodsofDNAanalysis–DNAprobes,PCR,signalamplification,DNAchip, RFLP analysis, DNA fingerprinting.

Diagnosing infectious diseases – AIDS, tuberculosis.

Identifyinggeneticdisease–DMD,Huntingtonsdisease. Gene therapy-

ADA deficiency and Cystic fibrosis.

PharmaceuticalproductsofDNAtechnology–Recombinantinsulin,recombinant growth hormone, recombinant vaccines-Hepatitis-B

Unit2:Applications of TransgenicTechnology

CustomMadeAnimals–Humanmouse,Oncomouse,Alzheimer'smouse,Knockout mouse;

Diagnosing infectious disease – AIDS andtuberculosis.

Animalbioreactors-PharmAnimals.

Enhancing resistance in plants – ice-minus experiments, resistance to biological agents, and resistance to herbicides. Coat protein-mediated protection against virusinfections,geneticengineeringofcropsforinsectresistanceusinggenesof plant origin.

Bioengineeredfoods –Vegetablevaccines, GMfoods.

Energyapplications –biohydrogen,bioethanol,biomethanol,biobutanol

RECOMMENDEDBOOKS

1. DNATechnology:TheAwesomeSkillByI.EdwardAlcamoGulfProfessional Publishing, 2001.
2. RecombinantDNATechnologyKeyaChaudhuriTheEnergyandResourcesInstitute (TERI), 2013.
3. RecombinantDNATechnologyeditedbySardulSinghSandhuI.K.InternationalPvt Ltd, 2010.
4. FromGenes toGenomes: ConceptsandApplications ofDNATechnologyByJeremy W.Dale,Malcolm vonSchantz,John Wiley&Sons, 2011

B.Sc. GENETICS III YEAR
SEMESTER VI BS
HUMAN GENETICS & IMMUNOLOGY

Unit 1: The Human Genome

1.1. Human nuclear genome organisation -gene size and density, organisation of protein coding genes

1.2. Gene families: globin gene family, histone gene family

1.3. Non-coding RNA genes- organisation of rRNA, tRNA & microRNA genes

1.4. Repetetive elements -LINES, SINES, LTR elements, satellites, minisatellites. Microsatellites; Transposons

1.5. Human Mitochondrial genome organization

1.6. Human genome project - Goals and achievements, Applications & Ethics

Unit 2: Gene transmission and molecular basis

2.1. Human Cytogenetics: Human Karyotype, Pathology of human chromosomes -Numerical and structural chromosomal abnormalities

2.2. Gene transmission in families and pedigree analysis, patterns of Inheritance- Autosomal inheritance-(dominant & recessive), Sex-linked inheritance, Sex-limited and sex-influenced traits , Mitochondrial inheritance;

2.3. Monogenic traits and single gene disorders (Huntington's Disease, PKU, Marfan's syndrome, DMD, Cystic Fibrosis, Haemophilia;

2.4. Complex traits (Polygenic inheritance, multifactorial disorders -alcoholism, diabetes mellitus, obesity; Cancer

2.5. Linkage- Physical and genetic mapping, genetic markers; gene polymorphisms

2.6. Clinical genetics: Genetic Testing and Screening- Prenatal Diagnosis, New born Screening (PKU), carrier testing (Sickle cell anemia);Gene Therapy- somatic and germ line gene therapy, Gene therapy trials (ADA deficiency)

Unit 3: Principals of Immunnology & Humoral Immune Responses

1.1. Introduction to Immune System, types of immunity-innate and adaptive

1.2. Innate immunity- anatomical barriers & physiological barriers, phagocytic barrier

1.3. Cells& Lymphoid organs system - Lymphoid cells (B cells, T cells and NK cells). Myeliod cells (Neutrophils, Eosinophils, basophils, mast cells, macrophages and dendritic cells): Primary lymphoid organs (Bonemarrow&thymus); secondary lymphoid organs (lymph node andspleen)

1.4. Antigens- Immunogens, epitopes; Haptens and types of adjuvants

1.5. Basic structure of Immunoglobulin; classes and its functions IgG, IgM, IgA, IgD, IgE & antigenic determinants

1.6. Polyclonal antibodies, Monoclonal antibodies- its production and applications

Unit 4: Cell-mediated Immune responses and Immunotechniques

4.1. Hypersensitivity- Types (I, II, III &IV)

4.2. Autoimmunity and autoimmune diseases (thyroid and Rheumatoid arthritis)

4.3. Immunodefeciency disorders- primary immunodeficiency disorders (SCID). secondary immunodeficiency disorders (AIDS)

4.4. Vaccines- passive & active immunization and Types of vaccines- live attenuated and inactivated killed vaccines, sub-unit vaccines, DNA vaccines, edible vaccines

4.5. Ag-Ab reactions- Agglutination, neutralization. complement fixation, opsonisation; Immunoprecipitation, immunoelectrophoresis, immunodiffusion tests:.

4.6. ELISA (Sandwich, Indireet, Dot ELISA)- Principle and applications & Immuno fluorescence assays (direct & indirect)- Principle and applications

PRACTICALS

1. Karyotyping (normal male/normal female)
2. Identification of chromosome anomalies using Idiograms- Autosomal disorders (Down Syndrome/Edward's syndrome): X-linked disorders -(Klienefelter's syndrome / Turner's syndrome)
3. Construction of pedigrees and identification of mode of inheritance of a trait.
4. ABO blood typing
5. Differential count of lymphocytes
6. Single Radial Immunodiffusion
7. Enzyme Linked Immunnoabsorent Assay (ELISA)

RECOMMENDED BOOKS

1. A.G. Motulsky and F. Vogel (1986) Human Genetics
2. R. F. Mueller and I.D Yound (2001) Emery's Elements of Medical Geneties
3. Gardner. A. and Davies. T. (2009) Human Genetics-Scion Publishing.2nd edition
4. Lewis, R. (2008) Human Genetics: Concepts and Applications, MeGraw Hill Publishing. New York.8thed.
5. Tom Strachan and Andrew Read (1996) Human Molecular Genetics
6. Essential Immunology by 1. Roitt.Publ:Blackwell
7. Immunology by G. Reever& 1. Todd, Publ:Blackwell
8. Immuno diagnostics by S.C.Rastogi, Publ:NewAge
9. Immunology by Richard A.Golds by. Thomas J Kindt, Barbaraa. Osborne. Janiskuby

10. Fundamental immunology by WilliamE.Paul
11. Basic Immunology by Bhoosreddy G.L. and WadherB.J.
12. Text book of immunology by Baruj Benacerraf
13. Immunology by Kuby:Publ: Freeman

QUESTION PAPER PATTERN FACULTY OF SCIENCE

Title of the Paper: B.SC. GENETICS

[Duration: 3 Hours] **[Max Marks-80M]**

SECTION-A

Short Answer type questions

Answer any EIGHT questions (TWO FROM EACH PART) **[8x4=32M]**

PART A:

1. Unit-1
2. Unit-1
3. Unit-1

PART B:

4. Unit-11
5. Unit-11
6. Unit-II

PART C:

7. Unit -III
8. Unit-111
9. Unit-III

PART D:

10. Unit -IN
11. Unit-IV
12. Unit-IV

SECTION-B

Essay Answer type question

Answer all questions **[4x12=48M]**

13.(a) Unit-1

OR

(b)Unit-1

14.(a) Unit-11

OR

(b)Unit-II

15.(a) Unit-III

OR

(b)Unit-III

16.(a) Unit-IV

OR

(b)Unit-IV