



**MSc BIOTECHNOLOGY**  
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**DEPARTMENT OF GENETICS & BIOTECHNOLOGY, OSMANIA UNIVERSITY**  
Schedule for Instruction and Examination  
(Proposed Scheme for Academic year 2022 onwards)

SEMESTER – I			
S No	Syllabus Ref No	Subject	Credits
<b>THEORY</b>			
1.	BT 101 T	Cell Biology and Genetics	3
2.	BT 102 T	Biological chemistry	3
3.	BT 103 T	Microbiology	3
4.	BT 104 T	Statistics, laboratory management & safety, entrepreneurship	3
<b>PRACTICALS</b>			
1.	BT 151 P	Cell Biology, Genetics	2
2.	BT 152 P	Biological chemistry	2
3.	BT 153 P	Microbiology	2
	BT 154 P	Biostatistics	2
		<b>Total</b>	<b>20</b>

SEMESTER – II			
S No	Syllabus Ref No	Subject	Credits
<b>THEORY</b>			
1.	BT 201 T	Molecular Biology- The Genome	3
2.	BT 202 T	Molecular Biology- Genes to Proteins	3
3.	BT 203 T	Immunology	3
4.	BT 204 T	Microbial technology	3
<b>PRACTICALS</b>			
1.	BT 251 P	Molecular Biology- The Genome	2
2.	BT 252 P	Molecular Biology- Genes to Proteins	2
3.	BT 253 P	Immunology	2
4.	BT 254 P	Microbial technology	2
		<b>Total</b>	<b>20</b>

SEMESTER – III			
S.No	Syllabus Ref No	Subject	Credits
<b>THEORY</b>			
1.	BT 301 T	Recombinant DNA Technology	3
2.	BT 302 T	Bioinformatics and its Applications	3
3.	BT 303 T	<b>Elective:</b> A. Advance in Plant Biotechnology (or) B. Food Biotechnology	3
4.	BT 304 T	<b>Elective:</b> A. Animal Biotechnology (or) B. Protein Engineering	3
<b>PRACTICALS</b>			
5.	BT 351 P	Recombinant DNA Technology	2
6.	BT 352 P	Bioinformatics and its Applications	2
7.	BT 353 P	A. Advance in Plant Biotechnology (or) B. Food Biotechnology	1
8.	BT 353 P	A. Animal Biotechnology (or) B. Protein Engineering	1
<b>SEMINAR</b>			2
<b>Total</b>			<b>20</b>

SEMESTER – IV			
S No	Syllabus Ref No	Subject	Credits
<b>THEORY</b>			
1.	BT 401 T	Bioprocess Engineering	3
2.	BT 402 T	Medical Biotechnology	3
3.	BT 403 T	<b>Elective:</b> A. Environmental Biotechnology (or) B. Bio-pharmacology	3
4.	BT 404 T	Project Work	4
<b>PRACTICALS</b>			
1.	BT 451 P	Bioprocess Engineering	2
2.	BT 452 P	Medical Biotechnology	2
3.	BT 453 P	A. Environmental Biotechnology (or) B. Bio-pharmacology	1
4.	BT 454 P	Project Thesis Presentation	2
<b>TOTAL</b>			<b>20</b>
<b>GRAND TOTAL</b>			<b>80</b>

T-theory, P-practical

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**M. Sc (BIOTECHNOLOGY)**  
**SEMESTER-I**  
**THEORY PAPER-I**  
**BT 101 T- CELL BIOLOGY AND GENETICS**

**UNIT I - CELL STRUCTURE AND FUNCTION**

**1.1 Membrane System and Transport**

- A. Membrane Structure and Transport
- B. Endomembrane System and Transport- Golgi complex, Endoplasmic Reticulum and Lysosomes
- C. Nuclear Envelop and Transport Between Nucleus and Cytoplasm

**1.2 Organization, Genetic Systems and Function of Organelles involved in Cell Energetics and Metabolism**

- A. Mitochondria -
- B. Chloroplast
- C. Peroxisome

**1.3 Structure and Organization of Cytoskeleton and Cell Movements**

- A. Actin Filaments -
- B. Intermediate Filaments
- C. Microtubules

**1.4 Internal Organization in Nucleus**

- A. Chromosomes and Higher Order Chromatin Structure-
- B. Nucleolus
- C. Functional Domains within the Nucleus

**1.5 Cell cycle and cell processes**

- A. Eukaryotic cell cycle
- B. Mitosis and meiosis
- C. Cell Signalling and Cell Communication

**UNIT II MENDELIAN AND NON-MENDELIAN INHERITANCE**

**2.1 Mendelian Inheritance**

- A. Mendel's Laws
- B. Chromosome Theory of inheritance
- C. Mendelian Genetics in Humans -

**2.2 Extensions to Mendelian Inheritance**

- A. Allelic Interactions
- B. Non allelic Interactions-
- C. Complex Loci

**2.3 Sex-linked inheritance and sex determination**

- A. Sex-Linked Inheritance in Drosophila
- B. Sex-linked Inheritance in Man
- C. Sex Determination

**2.4, Genes and Environment**

- A. Penetrance and Expressivity, Phenocopy.
- B. Polygenic Inheritance
- C. Norm of Reaction

**2.5 Extranuclear Inheritance**

- A. Maternal Inheritance-
- B. Cytoplasmic Inheritance
- C. Uniparental Inheritance

*Amila*      *S. S.*      *H. S. S. S. S.*      *D. S. S. S. S.*      *A. S. S.*

### **UNIT III. LINKAGE, GENE MAPPING AND CYTOGENETICS**

#### **3.1 Discovery of Linkage**

- A. Early Evidence for Linkage and Genetic Recombination
- B. Cytological Proof of Crossing Over
- C. Constructing Genetic Maps

#### **3.2 Gene mapping**

- A. Gene Mapping with Two-point Test Crosses -
- B. Genetic Mapping with Three-point Test Crosses
- C. Constructing Genetic Linkage Maps in Humans

#### **3.3 Tetrad Analysis and Mitotic Crossing Over**

- A. Tetrad Analysis in Neurospora
- B. Tetrad Analysis in Yeast
- C. Mitotic Crossing Over

#### **3.4 Chromosomes-**

- A. Chromosomes Morphology and Classification.
- B. Specialized Chromosomes
- C. Karyotype Analysis

#### **3.5 Chromosome aberrations**

- A. Variation in Chromosome Number- Euploidy
- B. Variation in Chromosome Number- Aneuploidy.
- C. Variation in Chromosome Structure

### **PRACTICALS**

#### **BT 151 P: CELL BIOLOGY AND GENETICS**

##### **UNIT I**

1. Preparation of Blood Smear and Differential Staining of Blood cells.
2. Isolation of Chloroplasts.
3. Chromatin Extraction and Electrophoresis
4. Study of Mitosis Stages.
5. Study of Meiosis Stages.
6. Identification of Blood Groups
7. Solving Problems on Monohybrid and Dihybrid ratios, Multiple alleles, Epistasis.
8. Pedigree Analysis and Inheritance Patterns in Man.

##### **UNIT II**

1. Growth of Neurospora, analysis of cross and ascospore observations.
2. Solving Problems on Gene Mapping– Three-point Test Crosses,
3. Solving Problems on Tetrad Analysis–
4. Study of Polyploidy in Onion Root Tips
5. Karyotyping of Normal & Abnormal Chromosome Sets in Humans
6. Preparation of Polytene Chromosomes
7. Preparation of *Hordeum vulgare* Karyotype

## REFERENCE BOOKS

1. An introduction to Genetic Analysis by Anthony, J.F. J.A. Miller, D.T. Suzuki, R.C. Richard Lewontin, W.M-Gilbert, W.H. Freeman publication.
2. Principles of Genetics by E.J.Gardner and D.P. Snusted. John Wiley & Sons, New York.
3. The Science of Genetics, by A.G. Atherly J.R. Girton, J.F. Mcdonald, Saundern College publication
4. Principles of Genetics by R.H. Tamarin, International edtn McGrawhill
5. Theory & problems in Genetics by Stansfield, Schaum out line series McGrawhill
6. Cell & Molecular Biology. E.D.D De Robertis & E.M.F De Robertis, Waverly publication.
7. Molecular Biology of the cell. Alberts, B; Bray, D, Lews, J., Raff, M., Roberts, K and Watson, J.D. Garland publishers, Oxford
8. Molecular Cell Biology Lodish, H., Baltimore, D; Fesk, A., Zipursky S.L., Matsudaride, P. and Darnel American Scientific Books. W.H. Freeman, NewYork
9. Cell and molecular biology by Gerald Karp, Wiley
10. The cell: a molecular approach by Goeffrey Cooper and Robert Hausmann

**M. Sc (BIOTECHNOLOGY)**  
**SEMESTER-I**  
**THEORY PAPER-II**  
**BT 102 T- BIOLOGICAL CHEMISTRY**

**UNIT I: Biological macromolecules, proteins and enzymes**

- 1.1 Biological molecules
  - A. Biological macromolecules
  - B. Energy molecules
  - C. Vitamins and pigments
- 1.2 Amino acids and proteins
  - A. Classification and structure of amino acids
  - B. Properties of amino acids
  - C. Derivatives of amino acids
- 1.3 Structure of proteins, Ramachandran's plot
  - A. Primary, secondary and tertiary structures of protein
  - B. Ramachandran's plot
  - C. Techniques for studying protein structure
- 1.4 Components of enzymes and classification of enzymes
  - A. Structure and composition of enzymes
  - B. Classification of enzymes
  - C. Properties of enzymes
- 1.5 Michaelis-Menten equation and its applications
  - A. Derivation of Michaelis-Menten equation
  - B. Lineweaver-Burke plots
  - C. Enzyme kinetics for different types of inhibitors

**UNIT 2: Carbohydrate metabolism**

- 1.6 Classification of carbohydrates
  - A. Aldoses and ketoses, classification of monosaccharides
  - B. Disaccharides and polysaccharides
  - C. Glycosylation of proteins
- 1.7 Glycolysis and gluconeogenesis
  - A. Glycolytic pathway and gluconeogenesis
  - B. Glycogen synthesis and glycogenolysis
  - C. Regulation of glycolysis and gluconeogenesis
- 1.8 Citric acid cycle
  - A. Reactions of the citric acid cycle
  - B. Regulation of citric acid cycle
  - C. Glyoxylate pathway
- 1.9 Oxidative phosphorylation
  - A. Components of electron transport chain
  - B. Q-cycle
  - C. Mechanism of ATP synthase activity
- 1.10 Photosynthesis and Pentose phosphate pathway
  - A. Components and function of light reaction
  - B. Calvin cycle, C<sub>4</sub> pathway and CAM pathway
  - C. Pentose phosphate pathway

### **UNIT 3: Fatty acid, amino acid and nucleotide metabolism, and signal transduction**

- 1.11 Fatty acid metabolism
  - A. Beta oxidation and fatty acid biosynthesis
  - B. Oxidation of unsaturated fatty acids
  - C. Cholesterol metabolism
- 1.12 Amino acid metabolism
  - A. Protein degradation and amino acid catabolism
  - B. Urea cycle
  - C. Biosynthesis of amino acids
- 1.13 Nucleotide metabolism
  - A. Purine biosynthesis
  - B. Pyrimidine biosynthesis
  - C. Degradation pathways of nucleotides
- 1.14 Components and reactions of signal transduction
  - A. The logic of signal transduction
  - B. Components of signaling pathways
  - C. Biochemical reactions in cellular signaling
- 1.15 GPCR, RTK and Wnt signaling pathways:
  - A. G-protein coupled receptor pathway
  - B. Signaling pathways of receptor tyrosine kinases
  - C. Wnt-signaling pathway

### **Practicals:**

### **BT 152 P: BIOLOGICAL CHEMISTRY**

#### **UNIT 1:**

1. Preparation of buffers and measurement of pH
2. Qualitative tests for sugars
3. Qualitative tests for amino acids
4. Qualitative tests for lipids
5. Estimation of total sugars
6. Paper chromatography
7. Isolation of proteins

#### **UNIT 2:**

8. Estimation of proteins
9. Immunoprecipitation
10. SDS-PAGE
11. Staining the gels
12. Western transfer of proteins on to membranes
13. Immunoblotting and analysis of protein expression
14. Amylase activity assay
15. Column chromatography

**M. Sc (BIOTECHNOLOGY)**  
**SEMESTER-I**  
**THEORY PAPER-III**  
**BT 103 T- MICROBIOLOGY**

**Unit 1: General characteristics of microorganisms**

- 1.A. Microbiology- historical perspective
- B. Microscopy and Applications- Principles and working of bright field, Fluorescent, Phase contrast and Electron microscopes
- C. Classification of microorganisms
  
- 2.A. Concept and methods of sterilization and their application in industry-
- B. dry heat, moist heat, radiation methods, filtration methods, chemical methods
- C. Sterilization at industrial level
  
- 3.A. Concept of containment facility
- B. Types of antimicrobial agents
- C. Development of resistance by microorganisms to various chemicals
  
4. A. Methods of preservation of microbial cultures– repeated subculturing, preservation at low temperature
- B. Sterile soil preservation, mineral oil preservation, deep freezing
- C. Liquid nitrogen preservation, freeze-drying (lyophilization).
  
- 5.A. General characteristics of Algae- Cyanophyta and Chlorophyta
- B. General characteristics of Fungi- Phycomycetes and Ascomycetes
- C. General characteristics of Protozoa- Entamoeba and Plasmodium

**Unit 2: Bacteria and their characteristics**

- 1.A. Identification methods for bacteria- conventional-simple staining methods, differential staining, structural staining
- B. Special staining methods
- C. Molecular based approaches
  
- 2.A. General methods for isolation of bacteria- plating methods-streak, spread and pour plate methods
- B. Serial dilution technique
- C. Membrane filter technique
  
- 3.A. Bacterial growth- typical growth curve- batch and continuous cultures
- B. Synchronous cultures; Measurement of bacterial growth- measurement of cell number and cell mass
- C. Factors influencing bacterial growth- temperature, pH, water activity, oxygen concentration, salt concentration, pressure and radiation
  
- 4.A. Pure cultures- concept of pure culture, methods of pure culture
- B. Enrichment culturing techniques, single cell isolation
- C. Pure culture development
  
5. A. Diseases caused by bacteria in humans-Staphylococcus,
- B. Streptococcus
- C. Mycobacterium tuberculosis



### **Unit-3**

1. A. History of virology (latest Scientific investigations),  
B. Viral classification and nomenclature.  
C. Detection of viruses: physical, biological, immunological and serological methods.
2. A. General characteristics of viruses  
B. Methods of cultivation of viruses- in animal cell inoculation  
C. Chick embryo, Bacteriophage cultivation
3. A. Structure and general characteristics of important viruses-TMV, HIV,  
B. Hepatitis virus  
C. Polio virus
4. A. Isolation and Purification of viruses by Filtration  
B. Precipitation and Centrifugation  
C. Importance of viruses in biotechnology
5. A. Structure and replication of Bacteriophage (T2),  
B. Lambda phage- Lytic and Lysogenic cycles  
C. Classification of viruses

### **PRACTICALS:**

#### **BT 153 P: MICROBIOLOGY**

### **Unit-1**

1. General instructions, Microbiology laboratory and its discipline
2. Staining techniques for bacteria – simple staining
3. Gram staining
4. Sterilization procedures/methods
5. Preparation of microbiological media. Autotrophic media, minimal media,
6. Basic media, enriched media
7. Enrichment media, differential media

### **Unit-2**

9. Isolation and cultivation of pure cultures
10. Identification methods of bacteria
11. Culturing methods of microbes – slant and stab cultures
12. Tube culture, flask cultures
13. Shake flask cultures
14. Study of bacterial growth curve
15. Factors effecting the microbial growth (pH and temperature)

**M. Sc (BIOTECHNOLOGY)**  
**SEMESTER-I**  
**THEORY PAPER-IV**  
**BT 104 T- BIO-STATISTICS, LABORATORY MANAGEMENT &**  
**SAFETY, ENTREPRENEURSHIP**

**UNIT I: BASIC BIOSTATISTICS**

**1.1 Introduction to Biostatistics**

- A. Population and Sample, Random sample, methods of sampling, sampling bias
- B. Study designs
- C. Data and Types of variables, Levels/scales of variables

**1.2 Descriptive analysis of data**

- A. Data alignment and representation,
- B. Measures of central tendency (Mean, median, mode)
- C. Measures of dispersion (Range, standard deviation, mean deviation, variance, coefficient of variation), Skewness and Kurtosis

**1.3 Probability**

- A. Concept of probability, Types of events, Laws of probability (Addition and multiplication laws)
- B. Bayes theorem and its applications
- C. Probability distributions: Binomial, Poisson, Normal distribution

**1.4 Tests of Hypothesis**

- A. Null and alternate hypothesis, test of significance, p-value, Type I and Type II errors, confidence intervals and confidence levels
- B. Test statistics: Z test (for proportions and means), t- test (students t-test, paired t test)
- C. Analysis of categorical data-Chi-square test (test for goodness of fit, homogeneity test, linkage, test of independence); non-parametric tests

**1.5 Multivariate analysis**

- A. Analysis of variance - One way and Two-way Anova (F- test)
- B. Correlation analysis (Simple and multiple correlation, methods of correlation, Coefficient of correlation (r), Pearson's correlation, Spearman's Correlation)
- C. Regression analysis (simple and multiple regressions, linear and curvi-linear regression, logistic regression)

## **Unit-2: Laboratory Management & Safety**

- 1.A. Administration of Laboratories, Laboratory design, Security measures
  - B. Laboratory bio security concepts
  - C. Laboratory Information management system (LIMS)
- 2.A. Laboratory safety- good laboratory practice (GLP)
  - B. Biosafety levels
  - C. Safety policies
- 3.A. Basic principles of quality control (QC)
  - B. Quality assurance (QA)
  - C. Importance of quality control and quality assurance
- 4.A. Handling of Hazardous compounds- chemicals, solvents
  - B. Poisons, isotopes, explosives
  - C. Biological strains (Bacterial, Fungal etc.)
- 5.A. Storage of hazardous material
  - B. Disposal of biological and
  - C. Radioisotope wastes

## **Unit-3 Entrepreneurship**

- 1.A. Concept, definition, structure
  - B. Theories of entrepreneurship
  - C. Entrepreneurship training and education
- 2.A. Start-ups,
  - B. Types of start-ups
  - C. Successful start-ups
- 3.A. Types of entrepreneurship
  - B. Entrepreneurship resources and financing
  - C. Process of entrepreneurial development
- 4.A. Product planning and development -Project management
  - B. Search for business idea, Concept of projects, Project identification, and Formulation, Design and network analysis
  - C. Project report and project appraisal
- 5.A. Plagiarism, Plagiarism checker
  - B. Legal aspects of plagiarism
  - C. Best practices for avoiding plagiarism

## PRACTICALS

### BT 154 P: BIOSTATISTICS

S.No.	Topics to be covered
<b>Unit I: Descriptive Statistics</b>	
1	Preparation of cross tabs, Construction of bar graphs, histogram, frequency polygon, pie diagram, box plot, scatter plot and data interpretation
2	Estimation of Mean, Median, Mode, Standard deviation, Variance, coefficient of variation and standard error for grouped and ungrouped data
3	Problems on probability
4.	Problems on Binomial and Poisson distributions
5.	Problems on Normal distribution
5.	Calculation of correlation coefficient
6.	Problems on linear Regression, calculation of slope from linear regression graph, Analysis of Logistic regression
7.	Estimation of Sample size
<b>Unit II: Inferential Statistics</b>	
8.	Fisher Z transformation
9.	Hypothesis testing: Z test for means, Z test for proportions
10.	Hypothesis testing using t-test: Paired t-test, Unpaired t-test
11.	Hypothesis testing using Chi-square test: Goodness of fit, test of independence, 2 X 2 contingency, m X n contingency
12.	Hypothesis testing using F test: Problems on one-way ANOVA
13.	Hypothesis testing using F test: Problems on two-way ANOVA
14.	Non-parametric tests
15.	Data analysis using excel and SPSS

### REFERENCE BOOKS

1. Hedrick P.W. Jones & Bartlett, Genetics of Population
2. Danial, W. W, Biostatistics, Wiley
3. Khan & Khanum (2004), Fundamentals of Biostatistics, II Revised Edition, Ukaaz Publication
4. Bailey, N.T.J, Statistical methods in Biology, Cambridge Univ. Press
5. Fundamentals of Biostatistics, P. Hanmanth Rao and K. Janardhan.