

# **MAHAKAUSHAL UNIVERSITY JABALPUR**

**As per model syllabus of U.G.C. New Delhi, drafted by  
Central Board of Studies and Approved by Higher  
Education and the Governor of M.P.**



**Faculty of Science**  
**Syllabus & Prescribed Books**  
**Subject- Biotechnology**  
**M.Sc. Semester Examination**

**I to IV Semester**

## M.Sc. FIRST SEMESTER Biotechnology

### Paper - I

MBTC0101-T ; Cell Biology

#### UNIT-I:

General structure of Cell. Historical origins of cell biology: The discovery of cell, development of the cell theory. The molecular evolution. Chemical bonds and functional groups in biological molecules.

#### UNIT-II:

The structural and functional organization of cell membrane, ionic transport (Passive and active transport) the extra cellular matrix of eukaryote's cell wall.

#### UNIT-III:

Structure and functions of endoplasmic reticulum, golgi complex, ribosome lysosomes, peroxisomes (glyoxysomes), plastids and mitochondria. Biogenesis of mitochondria and chloroplast.

#### UNIT-IV:

Steps in cell cycle, cell cycle check points, yeast as model system, cell division control and regulation yeast *cdc* gene. Genes for social control of cell, proto-oncogenes.

Cell signaling: Exocrine, Endocrine, Paracrine and Synaptic strategies of chemical signaling, surface receptor mediated transduction (DAG,  $Ca^{+2}$ , c-AMP, G-Proteins)

#### UNIT-V:

Cytoskeleton and cell motility: Microtubules, microfilaments and intermediate elements. Nuclear ingredients: Nuclear membrane, Nature of the genetic material, proteins associated with nuclei. Packaging of genetic material: nucleosome model, Organization of Chromatin: chromosome structure.

#### RECOMMENDED BOOKS:

1. Molecular Biology of Cells, (2002), 4th Edition; Albert's *et al.*
2. Molecular Cell Biology (2004), Lodish *et al.*
3. Cell and Molecular Biology; Concepts & Experiments (2004). Karp, G.
4. The Cell: A molecular Approach (2004), Cooper, G.M
5. Cell & Molecular biology, de Robertis & df Robertis.
6. Cell proliferation and apoptosis (2003); Hughes & Mehnet.
7. Biochemistry & Molecular Biology of plants (2004); Buchanan *et al.*
8. Lehninger Principles of Biochemistry, (2005) Nelson & Cox.

## M.Sc. FIRST SEMESTER Biotechnology

### Paper - II

#### MBTC0102-T : Structure, Function & Metabolism of Biomolecules

##### UNIT-I:

**Some important properties of water:** The law of Mass action; Dissociation of water and its ion product. pH, Bronsted Acids, ionization of weak acids and bases; Henderson-Hasselbalch equation, Titration curves and buffering action, physiological buffers. Principle of Thermodynamics.

##### UNIT-II:

**Carbohydrates:** Classification, structure, function and properties of sugars, storage polysaccharides and cell walls. Glycolysis, gluconeogenesis, HMP shunt and glycogen metabolism. Synthesis of cellulose and starch. Oxidative phosphorylation, compartmentation on respiratory metabolism. Regulation of carbohydrate metabolism.

##### UNIT-III:

**Proteins- Amino Acids:** essential and non essential amino acids; common, rare and non-protein amino acids; acid base properties and chemical reactions of amino acids; stereochemistry and absorption spectra of amino acids. Biosynthesis and degradation of following amino acids: alanine, serine, lysine, cysteine, arginine, methionine, tryptophan, phenylalanine, glutamine. Proteins: Primary, secondary, tertiary and quaternary structure of proteins. Optical and chemical properties of peptides and small proteins. Hydrolysis of proteins: Action of different proteases. Regulation of amino acid metabolism.

##### UNIT-IV:

**Nucleic acids:** general structure and functions of purines, pyrimidines, nucleosides, nucleotides; hydrolysis of nucleic acids. Biosynthesis of purines and pyrimidines, nucleosides and nucleotides. Degradation of purines and pyrimidines. Nucleic acid-protein supramolecular complexes, Salvage pathway

## **UNIT-V:**

**Lipids:** Classification, nomenclature and structure of fatty acids, triacylglycerols, sphingolipids and phospholipids, waxes, glycolipids and sterols. Beta-oxidation of fatty acids, biosynthesis of fatty acids and triacylglycerols. Lipid proteins system and transport of lipoproteins of blood plasma. Regulation of lipid metabolism.

## **RECOMMENDED BOOKS:**

1. Lehninger Principles of Biochemistry (2005), Nelson & Cox.
2. Biochemistry (2004); Stryer, L.
3. Text book of Biochemistry (1997), Devlin, Thomas, M.
4. Biochemistry (1993) Zubay, G.
5. Biochemistry Fundamentals, Voet *et al.*
6. Biochemistry, Friedfider, D.
7. Practical Biochemistry, Plummer.

## M.Sc. FIRST SEMESTER Biotechnology

### Paper - III

#### MBTC0103-T : General & Applied Microbiology

##### UNIT-I:

**Introduction to Microbiology:** Historical background & scope, structure of peptidoglycan, Difference between prokaryotic and eukaryotic organisms, Method of Microbiology: Pure culture techniques, sterilization techniques, principle of microbial nutrition, perpetration of culture media, enrichment culture techniques for isolation of microbes.

##### UNIT-II:

**Classification of Bacteria:** Basic principle and techniques used in bacterial classification. Phylogenetic polyphasic taxonomy and numerical taxonomy. New approaches of bacterial taxonomic classification including genetic methods, Ribotyping, Ribosomal RNA sequencing characteristic of primary domains.

##### UNIT-III:

**Viruses:** General characteristics, Morphology, Classification and structure of plant, animal and bacterial viruses, Cultivation of viruses, a brief account of Adenoviruses, Herpes, Retrovirus, Viroids and prions.

**Microbial Growth:** The definition of growth, bacterial generation time, specific growth rate and yield measurement, Monoauxic, Diauxic and synchronized growth curve. Factor affecting microbial growth. Culture collection & maintenance of culture. Sporulation in bacteria.

##### UNIT-IV:

**Control of Microorganism by Physical & chemical agents:** Antimicrobial agents, Sulfa drugs, Antibiotics (penicillin and cephalosporin) Broad Spectrum antibiotics, antibiotics from prokaryotes, Anti fungal antibiotics, Mode of action (a brief account), resistance of antibiotics (a brief account)

##### UNIT-V:

**Microbial Ecology:** *Microbial flora of soil, Interaction among soil microorganisms. Nitrogen fixation (a brief account), Symbiotic association-types, functions and establishment of symbiosis. A. niger, yeast, pseudomonades putida,*

## RECOMMENDED BOOKS:

1. Alcamo's Fundamental of Microbiology, (2004); Pommerville *et al.*
2. Microbiology (1996); Prescott, Harley & Klein
3. Microbiology (2004); Tortora, F.
4. Foundation in Microbiology (1996); Talaro & Talora.
5. Food Microbiology (2004); Adam, M.R.
6. Principles of Microbiology (1994); Atlas, R.M.
7. Pharmaceuticals Microbiology (2003); Purohit & Saluja.
8. Microbiology: A Lab Manual, Cappuccino *et al.*
9. Brock Biology of Microbiology, Martinko, M.T & Parker, J.

## M.Sc. FIRST SEMESTER Biotechnology

### Paper - IV

MBTC0104-T : Analytical Techniques in Biotechnology

#### UNIT-I:

**Microscopic Techniques:** Principles and Applications of Light, Phase Contrast, Fluorescence Microscopy, Scanning and Transmission Electron Microscopy, Confocal Microscopy, Cytophotometry and Flow Cytometry, patch clamping, advances of microscopy.

**Centrifugation:** Preparative and Analytical Centrifuges, Sedimentation analysis RCF, Density Gradient Centrifugation.

#### UNIT-II:

**Chromatography Techniques:** Theory and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC and HPLC.

#### UNIT-III:

**Electrophoretic Techniques:** Theory and Application of PAGE, Agarose Gel Electrophoresis 2DE, Iso-electric Focusing, Immuno diffusion, Immuno Electrophoresis , ELISA , RIA , Southern , Northern and Western Blotting .

#### UNIT-IV:

**Spectroscopic Techniques :** Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, MS , NMR, ESR, Atomic Absorption Spectroscopy, X- ray Spectroscopy, LASAR , Raman Spectroscopy . MALDI

#### UNIT-V:

**Radio-isotopic Techniques :** Introduction to Radioisotopes and their Biological Applications , Radioactive Decay – Types and Measurement , Principles and Applications of GM Counter , Solid and Liquid Scintillation Counter, Autoradiography, RIA , Radiation Dosimetry .

#### RECOMMENDED BOOKS:

1. Physical Biochemistry: Application to Biochemistry and Molecular Biology – Freilder.
2. Biochemical Technique : Theory and Practice , - Robyt & White
3. Principle of Instrumental Analysis – Skoog & West
4. Principle & Technique – Practical Biochemistry 5<sup>th</sup> Ed. (2000) - Walker J. & Wilson K.
5. Biochemical Technique Theory & Practical- White, R.
6. Principle of Instrumental Analysis – Skoog *et al.*
7. Microbiology – Fundamental & Application (1995) -Atlas, R.M.
8. Biophysical Chemistry – Upadhyay & Nath.

Practical - I MBTC0101-P ( Based On Paper -I )

Practical - II MBTC0103-P ( Based On Paper - III )

## M.Sc. SECOND SEMESTER Biotechnology

### Paper - I

#### MBTC0201-T : Molecular Genetics

##### UNIT-I:

History, Scope of genetics, Mendelian law of inheritance, Variations of mendelian analysis, Linkage and crossing over, Linkage mapping, Sex determination and Sex linked inheritance, Gene Mapping.

##### UNIT-II:

**Microbial Genetics:** gene transfer mechanism in microbe transformation, transduction, conjugation and recombination, Horizontal gene transfer, genetics of model organism- Neurospora, Yeast and *E.coli*.

##### UNIT-III:

**Mutation:** Types of mutation, molecular mechanism of mutation, chromosomal mutations changes-changes in the structure and number of chromosomes, polyploidy, types of DNA repair.

##### UNIT-IV:

**Gene concept:** Classical concept, fine structure of gene, molecular concept of the gene, transposons. Pseudo genes, overlapping gene, oncogene, repeated gene, gene amplification, tumor suppressor, genes, molecular basis of cancer.

##### UNIT-V:

Lytic and Lysogenic cycles, IS, and Tn elements in bacteria, Bacterial plasmids, gene regulation during development, *E coil* recombination system.

##### RECOMMENDED BOOKS:

1. Genetics: Strickberger, M. W.
2. Principle of Genetics (2001) 8<sup>th</sup> Ed. - Gardener *et al*.
3. Microbial Genetics (1994) 2nd Ed. - Maloy *et al*
4. Concept of Genetics 7<sup>th</sup> Ed. (2003) - Klug & Cummings.
5. Microbial Genetics-Fridfleder
6. Advanced Genetics (2002) - Miglani, G. S.
7. Bacterial Genetics (2004) – Nancy Trun

## M.Sc. SECOND SEMESTER Biotechnology

### Paper-II

#### MBTC0202-T: Basic Enzymology & Enzyme Technology

##### UNIT-I:

**Introduction to Enzymes:** Enzyme nomenclature, enzyme commission numbers, and classification of enzymes. Isolation and purification of enzymes, preparation of purification chart, Enzyme activity, Specific activity and turn over number, Marker enzymes.

##### UNIT-II:

**Enzyme Kinetics:** Steady state, pre-steady state, equilibrium kinetics, Michaelis and Menten Equation and its derivation, Different methods to calculate the  $K_m$  and  $V_{max}$  and their significance.

##### UNIT-III:

**Factor affecting enzyme activity and catalysis:** pH, substrate and enzyme concentration, temperature, coenzyme and cofactors, Mechanism of action of enzymes involving two/more substrates. Role of metal ions in enzyme catalysis. Enzyme inhibition, different types of inhibitors and activators.

##### UNIT-IV:

**Structure and function of enzymes:** Lysozyme, chymotrypsin, DNA polymerase, RNase, proteases. Enzyme regulation and control of their activity. Introduction to allosteric enzymes and isozymes.

##### UNIT-V:

**Enzyme Technology:** Immobilization of enzymes and their application, commercial production of enzymes, RNA- catalysis, Catalytic antibodies-abzymes, Protein and Enzyme engineering: Design and construction of novel enzymes. Computer aided drug designing and structural analysis of nanoparticles. Structure and Application of protease, lipases, papain, structure dynamics.

## RECOMMENDED BOOKS:

1. Enzyme Kinetics (1995) – Palmer
2. Enzyme Kinetics - Dixon
3. Fundamental of Enzymology – Price & Steven
4. The Enzymes Vol. 1 & 2 – Boyer
5. Enzyme Structure & Mechanism – Alan Fersht
6. Enzyme Biotechnology – Tripathi, G.
7. Industrial Enzyme & their Application (1998) –Uhlig, H.
8. Enzyme 3<sup>rd</sup> Ed. (1979) – Dixon M. & Webb, E.C.
9. Enzyme Kinetics –Voet & Voet

## M.Sc. SECOND SEMESTER Biotechnology

### Paper - II

MBTC0203-T : MOLECULAR BIOLOGY

#### UNIT-I:

**DNA Structure:** DNA as genetic material, Chemical structure and base composition of nucleic acids, Double helical structures. Different forms of DNA, Forces stabilizing nucleic acid structure. Super coiled DNA. Properties of DNA, Renaturation and denaturation of DNA. T<sub>m</sub> and C<sub>ot</sub> curves, Structure of RNA.

#### UNIT-II:

**DNA Replication:** General features of DNA replication, Enzymes and proteins of DNA replication. Models of replication. Regulations of DNA replication, Prokaryotic and eukaryotic replication mechanism. Replication in phages. Reverse transcription

#### UNIT-III:

**Transcription:** Mechanism of transcription in prokaryotes and eukaryotes. RNA polymerases and promoters. Post-transcriptional processing of tRNA. rRNA and mRNA (5' capping, 3' polyadenylation and splicing). RNA as an enzyme- Ribozyme.

#### UNIT-IV:

**Translation:** Genetic code, General features, Deciphering of genetic code, Code in mitochondria, Translational mechanism in prokaryotes and eukaryotes, Post translational modification and transport, Protein targeting (signalling) Non ribosomal polypeptide synthesis Antibiotic inhibitors and translation.

## UNIT-V:

**Regulation of Gene Expression in Prokaryotes and Eukaryotes:** Operon concept, Positive and negative control, Structure and regulation of lac, trp and arb operon, regulation of gene expression in eukaryotes (a brief account), anti-sense RNA, RNAi

## RECOMMENDED BOOKS:

1. Gene VIII (2005) - Benjamin Lewin
2. Molecular Biology- Turner *et al*
3. The Biochemistry of Nucleic Acid 11<sup>th</sup> Ed. (1992) – Adams *et al*
4. Molecular Biology of Gene (2004) – Watson *et al*.
5. Microbial Genetics – Friedflelder
6. Molecular Cell Biology 5<sup>th</sup> Ed. (2004) – Lodish *et al*.
7. Human Molecular biology (2004) – Stefan, S.
8. Biochemistry & Molecular Biology of Plants (2000) – Buchanan *et al*
9. Plant Biochemistry & Molecular Biology – Lea & Leegood.
10. Cell & Molecular Biology- Karp G.

## M.Sc. SECOND SEMESTER Biotechnology

### Paper – IV

#### MBTC0204-T : Immunology and Animal Cell Culture

##### UNIT-I:

**Immunology:** An introduction and historical perspective , antigens and antigenicity , adjuvants , immune system organs , tissues & cell lymphocytes , lymphoid organs , mono nuclear phagocytic system , myeloid system , immunity – active & passive , Natural humoral and cellular immunity .

**Immunoglobulins:** Structure of IgG (b) , various classes of antibodies , theories of generation of antibodies , Diversity , molecular mechanisms of antibody diversity , monoclonal antibodies ( hybridoma technology) , recombinant antibodies, antigen- antibody interaction, class-switching .

##### UNIT-II:

**Complement System:** Classical and alternate pathways, Major Histocompatibility Complex, recognition of antigens by T & B cells, T – cell receptor complex, B – cells receptor complex. Dendritic cells and N cells.

**Immunological Responses:** Cell mediated immune response, cellular interactions in the immune response – antigen recognition and presentation, cytokines, immunological tolerance, hypersensitivity, anti-immune diseases & AIDS .

##### UNIT-III:

**Autoimmunity:** Mechanism and therapeutic approaches, immunodeficiency syndrome and their diagnosis, vaccines-active and passive immunization, whole organism vaccines , macromolecules as vaccines, recombinant vector vaccines, synthetic peptide vaccines and subunit vaccines, DNA vaccines, Immunodiagnostic: precipitation techniques, agglutination, fluorescence techniques.

## UNIT-IV:

**Animal cell culture:** An introduction, concept of aseptic techniques, animal tissue culture media, cell propagation, preservation and storage of cells, detection of contamination, safety consideration in laboratory cell culture.

**General cell culture techniques:** Dispersion and disruption of tissue, monolayer culture technique, measurement of growth and viability of cell, determination of 50% end point titer, Bulk culturing of animal cells, Concept of bioreactors for mass culture of mammalian cell, Micro carrier culture, harvesting and purification methods for end products recovery.

## UNIT-V:

**Specialized Techniques:** Cell immobilization techniques, cell transmission, Amniocentesis, CEA production and its clinical application, Inter-ferons derived from human cells, 3-D animal cell culture and tissue engineering, FISH and application of animal cell culture.

## RECOMMENDED BOOKS:

1. Essentials of Immunology – Roitt
2. Immunology 3<sup>rd</sup> Ed. (1997) – Kubly J.
3. Immunology – An Introduction (2004) –Tizard, I.R., Thompson Pub.
4. Immunology – Roitt.
5. Principle & Practice of Immunoassay 2<sup>nd</sup> Ed. – Christopher & David
6. Animal Cell Culture (1987) – Freshney, R.T.
7. Culture of Animal Cell (2003) – Freshney, R.T.
8. Animal Cell Culture & Technology – Basic from Background to Bench (2004) Taylor & Francis.

Practical - I      MBTC0202-P                      ( Based On Paper -II )

Practical - II      MBTC0204-P                      ( Based On Paper - IV)

## M.Sc. Biotechnology

### Semester – III

#### MBTC0301-T

#### Paper – I : Genetic Engineering

##### UNIT-I:

**Introduction:** Historical background, Restriction enzymes and modifying enzymes, Restriction mapping, Construction of chimaeric DNA- staggered cleavage, Addition of poly dA and dT tails, Blunt end ligation, Gene cloning.

##### UNIT-II:

**Cloning and Expression Vectors:** Vehicles for gene cloning, Plasmids, Bacteriophages, Cosmids and Phagemids as vectors, P1 vectors, F- factor based vectors, Plant and animal viruses as vector, Artificial chromosomes as vectors (YAC, BAC, PAC and MAC vectors), Expression vectors- use of promoters and expression cassettes, Baculoviruses as expression vectors, Virus expression vectors, Binary and shuttle vectors.

##### UNIT-III:

**Isolation Sequencing and Synthesis of Genes:** Methods of gene isolation, Construction and screening of genomic and cDNA libraries, Chromosome walking, Chromosome jumping, Transposone tagging, Map based cloning, DNA sequencing Techniques (Maxam Gilbert's chemical degradation methods and Sanger's dideoxy chain termination method), Automated DNA sequencing, and Organochemical gene synthesis.

##### UNIT-IV:

**Molecular Probes and PCR:** Molecular probes, Labeling of probes, Radioactive vs. Non radioactive labeling, Uses of molecular probes. Polymerase Chain Reaction- basic principle, Modified PCR (Inverse PCR, Anchored PCR, PCR for mutagenesis, asymmetric PCR, RT-PCR, PCR walking), Gene cloning Vs. Polymerase chain reaction; Applications of PCR in biotechnology, Ligase chain reaction.

##### UNIT-V:

**Molecular Markers and DNA Chip Technology:** Molecular-Markers-types and applications, Construction of molecular maps (genetic and physical maps), DNA chip Technology & Microarrays (a Brief account).

**Genomics and Proteomics:** Whole genome sequencing and functional genomics (a brief account), Applications of genomics and Proteomics with special reference to *Arabidopsis* and Rice.

## RECOMMENDED BOOKS:

1. Genomes (2002) 2<sup>nd</sup> edition Brown, T.A.
2. Principles of Gene Manipulation (1994), Old and Primerose
3. Gene Cloning: An introduction, Brown
4. A Passion for DNA: Genes, Genome & Society (2000), Watson
5. Genetic Engineering: An Introduction to Gene Analysis and Exploitation  
In eukaryotes (1998), Kingsman & Kingsman
6. Molecular Cloning: A Laboratory Manual (2000), Sambrook & others
7. Molecular Genetics of Bacteria- Dale
8. Genes & Genomes (1991), Singer & Berg
9. Molecular Biotechnology (1996), Glick & Pasternak
10. Plant Molecular Biology (Vol. I and II 2002), Gilmartin & Bowler
11. Recombinant DNA (1992), Watson *et al*

**M.Sc. Biotechnology**  
**Semester – III**  
**MBTC0302-T**

**Paper – II : Biostatics and Bioinformatics**

**UNIT-I:**

**Introduction and definition of Biostatistics.** Concept of variables in biological systems. Collection, classification, tabulation graphical and diagrammatic representation of numerical data. Measures of central tendency: mean, median and mode and their relationship, measures of dispersion: Range, quartile deviation, mean deviation, standard deviation. Coefficient of variation, skewness and kurtosis. Probability: Random experiment, events, sample space, mutually exclusive events, independent and dependent events. Various definitions of probability, addition and multiplication theorems of probability (only statement), Random variables (discrete and continuous). Probability density functions and its properties.

**UNIT-II:**

Some probability distributions such as binomial, Poisson and normal (Basic idea about these distributions) and their applications. Concept of populations and sample. Simple random sampling without replacement. Definition of simple random sample. Chi-square ( $X^2$ ), student's t and f-distributions (derivations not required) their properties and uses. Concept of standard error. Correlation and Regression, linear and quadratic regression Analysis of variance: One-way and two-way classifications with single observation per cell.

**UNIT-III:**

**Introduction to Bioinformatics:** Definition, role, scope and limitation of Bioinformatics. Different branches of Bioinformatics. Terminologies: Internet Browser, Software, hardware, database, Network NicNet, Inlibnet, EMBnet, Operating System, algorithm. Biological data & databases: Biological data type, Classification of biological database, sequence database: GenBank, EMBL, DDBJ, PIR, SWISS-PROT. Secondary nucleotide and protein sequence databases: ExInt, TIGR, EPD, CUTG, GOBASE, PROSITE, PRINTS, BLOCKS, Pfam, PRODOM. Structure database: PDB, CSD, CATH, SCOP, FSSP, Specialised Database: KEGG, ENZYME, REBASE. Study of data entry formats: GenBank, EMBL, DDBJ, Swiss-Port, PIR, PDB, FASTA, MSA, PHYLIP

**UNIT-IV:**

**Sequence Analysis:** Introduction, methods (HMM & ANN) and significance. Nucleic acid sequence analysis: Principle and software tools. Protein Sequence Analysis: Principle and software tools. Sequence Comparison: Pair wise algorithms-Introduction and significance. Methods of alignment: Dot matrix, Dynamic Programming, Heuristic algorithm (FASTA & BLAST). Scoring matrix: PAM and BLOSUM, Concept of Gap penalty. Multiple Sequence Alignment:

Introduction, Significance and various algorithms. Phylogenetic Analysis:  
Introduction & Importance, Phylogenetic tree, methods of Phylogenetic analysis.

## **UNIT-V:**

**Structural Bioinformatics:** Introduction & Importance. Experimental Structure determination: X-ray, NMR and electron microscopy. Coordinate systems. Visualization & presentation of structure. Geometric Analysis of structure. Structure comparison. Protein structure prediction: secondary structure prediction, tertiary structure prediction. Protein folding. Nucleic acid structure: RNA structure prediction: principle and tools: DNA structural polymorphism. Molecular modeling and dynamics, computer aided drug designing.

## **RECOMMENDED BOOKS:**

### **Statistics:**

1. An Introduction Biostatistics Glover
2. An Introduction Biostatistics- Mishra & Mishra, Kalyani Publication

### **Bioinformatics:**

1. Bioinformatics databases and Algorithms -N. Gantham
2. Bioinformatics- David Mount
3. Emerging trends in Bioinformatics Irfan A. Khan
4. Introduction to Bioinformatics- Arther Lark.

## M.Sc. Biotechnology

### Semester – III

MBTC0303-T

### Paper – III : Plant Biotechnology

#### UNIT-I:

**Plant tissue culture:** Cleaning, sterilization, sterile handling of tissue culture of plant. Nutritional requirement for in vitro culture. Concept of cellular totipotency, single cell culture, micro propagation, somoclonal variation and its application for plant improvement, somatic embryogenesis, anther and ovule culture, haploid and double-haploid production.

#### UNIT-II:

**Protoplast culture:** Isolation, fusion and culture, somatic hybridization, selection system for hybrids, cybrid production and their application in crop improvement, cryobiology of plant cell culture and establishment of gene banks, production of virus free plants using meristem culture.

#### UNIT-III:

**Plant cloning vectors:** Ti and Ri plasmid and viral vectors (CaMV based vectors, Gemini virus, TMV based vectors). Mechanism of DNA transfer, role of virulence genes, use of 35S promoters, genetic markers, use of reporter genes, methods of nuclear transfer, particle bombardment, electroporation, microinjection, transformation of monocots, transgene stability and gene silencing, herbicide, insect and salt resistance, Plant DNA fingerprinting - Hybridization and PCR based markers ( RFLP, SSRs, RAPD, QTLS, SCARS, AFLP etc. )

#### UNIT-IV:

Biological nitrogen fixation and biofertilization, molecular mechanism of nitrogen fixation, genetics of nif gene.

Plant diseases- general account, biological control of pests and disease, biopesticides, seed production technique, plant cell culture for the production of useful secondary metabolism-pigments, perfumes, flavor, pharmacologically important compounds, biodegradable plastics. Automation in Plant Tissue Culture for its commercial application.

#### UNIT-V:

Transgenic plants, commercial status and public acceptance, Bio-safety guidelines for research involving GMO's, benefits and risks. Socio economic impact and ecological consideration of GMO's, Gene flow, IPR and IPP. Patenting of biological.

## RECOMMENDED BOOKS:

1. Plant Tissue Culture: Theory & practice a revised edition(2004) Bhojwani & Rajdan
2. Plant Biotechnology (2000),Hammond *et al*
3. Plant Tissue Culture –Bhojwani, S.S.
4. Plant Cell & Organ culture(2004) Gamberg, O.L
5. Principles of Plant Biotechnology, Montell, *et al*
6. Plant Cell Culture (2003) Evans D.A.
7. Plant Molecular Biology- vol.I and II, Gimartin & Bowler
8. Genetic Engineering of Crop Plants, Lycett G.W. & Grierson D.

## **M.Sc. Biotechnology Semester – III**

MBTC0304-T

### **Paper – IV : Bioprocesses & Biochemical Engineering**

#### **UNIT-I:**

Introduction to Bioprocesses Engineering. Isolation, Preservation & Maintenance of Industrial microorganisms. Factors that influence solid- state fermentation. Kinetic of microbial growth and death, Media for industrial fermentation.

#### **UNIT-II:**

Air and media sterilization, safety in fermentation laboratory. Strain improvement of industrially important microorganism. Bioreactors: Principle, Kinetics, types, design, analysis and application. Types of fermentation processes: analysis of batch, Fed-batch and continuous Bioreactions, stability of microbial reactions.

#### **UNIT-III:**

Aeration and Agitation systems for bioreactor. Flow behavior of fermentation fluids Gas-Liquid mass transfer, Solid and Liquid-phase mass transfer and Heat transfer. Measurement and control of bioprocess parameters.

#### **UNIT-IV:**

Downstream processing: Introduction, removal of microbial cells and solid matter. Foam reparation, precipitation, centrifugation, cell disruption, chromatography. Product recovery processes and Unit operations. Safety consideration in downstream processing Bioprocess economics

#### **UNIT-V:**

Classification of product formation, Product synthesis kinetics, Mass balance in bioprocesses system, Energy balance in Bioprocess system.

## RECOMMENDED BOOKS:

1. Biochemical Engineering, Aiba *et al*
2. Biochemical Engineering Fundamentals, Baily and Ollis
3. Principles of Fermentation Technology (1997), Stanbury P.F, and Whitaker
4. Fermentation Biotechnology-Principles, Process and Products(1998), Ward,O.P
5. Process Engineering in Biotechnology, Jackson A.T.
6. Bioreaction Engineering Principles, Nielson & Villadson
7. Industrial Microbiology (1992)4<sup>th</sup> edition, Prescott & Dunn
8. Microbial Biotechnology (1998) Glazer & Nikaido
9. A Text Book of Industrial Microbiology, 2<sup>nd</sup>s edition (2002), Cruger and Cruger
10. Manual of Industrial Microbiology & Biotechnology 2<sup>nd</sup> edition (1999),  
*Arnold et al*

## M.Sc. Biotechnology Semester – III

MBTC0302-P & MBTC0304-P

I – Max. M. – 50

II – Max. M. –50

### Practical - I & II

1. Bacterial culture and antibiotic selection media. Preparation of competent cells.
2. Isolation of phage DNA.
3. Restriction mapping of plasmid DNA.
4. Preparation of single stranded DNA template.
5. Gene expression of *E.coli* and analysis of gene product.
6. Preparation of helper phage and its titration.
7. PCR.
8. Calculation of the mean, median, mode and standard deviation using MS –Excel.
9. Graphical representation of various types of biological data using MS – Excel.
10. Biological data resources and data retrieval.
11. Sequence analysis using BioEdit software tools and other online tools.
12. Structural bioinformatics.
13. Protein structure prediction.
14. Isolation of industrially important microbes from environment.
15. Determination of TDP and TDT of microorganisms for design of a sterilizer.
16. Determination of growth curve of industrial organism and substrate degradation profile, also compute specific growth rate and growth yield.
17. Comparative study of ethanol production using different substrates.
18. Microbial production of citric acid using *Aspergillus niger*.
19. Preparation of media for plant tissue culture.
20. Sterilization of plant tissue.
21. Study of the effect of different tissue sterilizing agents.
22. Study of antifungal properties of plant extracts.
23. Callus induction from different explants: - seed, root & shoot.
24. Determination of organogenesis in mulberry.
25. Isolation of protoplast and culture.
26. Agrobacterium culture, selection of transformants, reporter genes (GUS) assays
27. Genomic DNA isolation from seed and plant tissue and their electrophoretic analysis
28. Restriction digestion of plant genomic DNA
29. Viability testing of seeds under different environmental conditions
30. Isolation of nitrogen fixing organisms like Cyanobacteria and Rhizobium and their characterization.
31. Measurement of nitrate reductase from *Nostoc muscorum*.
32. Analysis of total protein content of seeds by TCA precipitations method.
33. Isolation of VAM from soil by wet sieving and decanting method.
34. Isolation and cultivation of mushroom.
35. Determination of pesticide /metal detoxification by microbial species
36. Isolation of bacteriophage from sewage water.
37. Isolation and study of fungus responsible for food spoilage.
38. Detection of coliforms from determination of purity of potable water.
39. Determination of BOD of a sewage sample.
40. Determination of COD of a sewage sample.
41. Survey of degradative plasmid in microbes growing in polluted environment
42. Bioinsecticide isolation, purification and assay.

<b>Class</b>	:	<b>M.Sc</b>
<b>Semester</b>	:	<b>IV</b>
<b>Subject</b>	:	<b>Bio-Technology</b>
<b>Title of the Paper</b>	:	<b>Food Biotech</b>
<b>Paper No.</b>	:	<b>MBTC0403-T</b>

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- Unit -I** Prokaryotic & Eukaryotic based products fermented meats, milk products, yoghurt, cheese, cereal, wine, beer.
- Unit -II** Impact of biotechnology on microbial testing of food, current/traditional methodology and new approaches.
- Unit-III** Use of gene probes, RDT, Bioluminescence, safety evaluation of genetically engineered enzyme/novel food products.
- Unit-IV** Natural control of microorganism and preservation
- Unit-V** Bio gums, Bio-colors Fnumeric acid and sweetener, Fat Substitutes natural and modified starch, fats, soil food.

<b>Class</b>	:	<b>M.Sc</b>
<b>Semester</b>	:	<b>IV</b>
<b>Subject</b>	:	<b>Bio-Technology</b>
<b>Title of the Paper</b>	:	<b>Industrial Biotechnology</b>
<b>Paper No.</b>	:	<b>MBTC0402-T</b>

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- Unit-I** Industrially Important microorganisms.
- Unit-II** Microbial production of chemotherapeutic and antibiotics, mode of action & resistance to antibiotic.
- Unit-III** Industrial production of Vitamins, Amino acids and Enzymes.
- Unit-IV** Microbial production of alcoholic beverages and organic acids.
- Unit-V** SCP and Biotransformation of steroids.

<b>Class</b>	:	<b>M.Sc</b>
<b>Semester</b>	:	<b>IV</b>
<b>Subject</b>	:	<b>Bio-Technology</b>
<b>Title of the Paper</b>	:	<b>Environmental Biotech</b>
<b>Paper No.</b>	:	<b>MBTC0401-T</b>

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- Unit-I** Environment – Basic concepts and issues.
- Unit-II** Environmental Pollution and their management, concept of global warming and ozone depletion.
- Unit-III** Microbiology of waste water treatments, Aerobic and Anaerobic processes and treatment schem of dairy, Tannery, distillery, sugar and antibiotic industries.
- Unit-IV** Microbiology of xenobiotics in environment and bioremediation of contaminated soi / and waste land.
- Unit-V** Biotechnological approaches for preserving biodiversity, gene banks, germ plasm Banks & their management. Biotessorism.

<b>Class</b>	:	<b>M.Sc</b>
<b>Semester</b>	:	<b>IV</b>
<b>Subject</b>	:	<b>Bio-Technology</b>
<b>Title of the Paper</b>	:	<b>Agriculture Biotèchnology</b>
<b>Paper No.</b>	:	<b>MBTC0404-T</b>

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- Unit-I** Role of biofertilizers and biopesticides in sustainable development, petro crops, aquaculture.
- Unit -II** Improvement of nutritional value of seed storage protein, Starch, Oil.
- Unit -III** Transgenic plants for increased shelf life, molecular mapping of genes of agriculture importance chloroplast transformation.
- Unit-IV** Sericulture, Pisciculture, and transgenesis, arid and semiarid plant biotechnology.
- Unit-V** Plant variety protection Act, plant breeders rights, International convention on biological diversity.

**Class** : **M.Sc**  
**Semester** : **IV**  
**Subject** : **Bio- Technology**  
**Title of the Paper** : **Practical**  
**Max. Marks** :  
**mark)**

**MBTC0402-P & MBTC0404-P**

- 1 Isolation of industrially important microorganisms from.
  - 1 Dairy
  - 2 Food Industry
  - 3 Pharmaceutical Industry
  - 4 Distillery Industry
- 2 Production & estimation of alkaline proteases.
- 3 Use of alginate for Cell/Enzyme immobilization.
- 4 Cytological examination of agriculture plants.
- 5 Genomic and plasmid DNA isolation from industrial microorganisms & biodegradative microbes.
- 6 Detection of coliform for determination of the purify of potable water.
- 7 Isolation of xenobiotic degrading bacteria by selective enrichment techniques.
- 8 Estimation heavy metals from waste water.
- 9 Estimation of heavy metals from contaminated soil.
- 10 Estimation of Nitrate from drinking water.
- 11 Estimation of chloride from drinking water.
- 12 Quality testing of milk.
- 13 Analysis of mycotovin in fungal contaminated food materials.
- 14 Determination of phosphatase activity in milk and butter.