## MSC. BIO-TECHNOLOGY

### FIRST YEAR

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<th>PAPERS</th>
<th>Subject</th>
<th>Max. Marks</th>
<th>Exam Hrs</th>
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<tr>
<td>1</td>
<td>Cytogenetics &amp; Molecular Biology</td>
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<td>Biological Techniques &amp; Instrumentation</td>
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<td>Enzymology &amp; Enzyme Technology</td>
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<td>General Micro-Biology &amp; Bio-Chemistry</td>
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<td>Immunology &amp; Medical Bio-Chemistry</td>
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### SECOND YEAR

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<td>Plant &amp; Animal Bio-Technology</td>
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<td>Bio-Engineering Technology</td>
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<td>Recombinant DNA Technology</td>
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<td>Project Work</td>
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FIRST YEAR

PAPER I CYTOGENTICS AND MOLECULAR BIOLOGY

UNIT I

UNIT II
Variation in chromosome number : Euploidy-monoploidy, diploidy, polyploidy- examples of polyploidy in plants. Examples of polyploidy in animals. Induction of polyploidy, kinds of polyploidy, effects of polyploidy on the organism.

Unit III
Cytological mapping: construction of linkage map or genetic mapping- determination of linkage groups, determination of map distance, determination of gene order. Uses of genetic maps. Genomic study of HIV, Mycobacterium sp., and Hepatitis virus.

UNIT IV
Organization of DNA into chromosomes Histones – Association of histones to the DNA (Nucleosomes) – Position of nucleosomes, chromatin. DNA molecules in a series of looped domains – units of function. Extra nuclear DNA Mitochondrial and Chloroplast DNA.
Cell Signaling – Communication between the cells and their environment : Characteristics of the cell signaling system, Second messenger (Plant and animal cells ) and G protein coupled receptors. Receptors of tyrosine kinases, Signals that originate from contact between cell structure and substratum, Convergence, divergence and crosstalk among different signaling pathways, other signaling pathways.
UNIT V
Recombination: Mechanism; forms of recombination

References:
UNIT I
Chromatography – Principle, operative technique and applications of paper, TLC, adsorption chromatography, GLC, and HPLC. Ion-Exchange, molecular sieve.

UNIT II
Electrophoretic techniques - Principle and technique of gel, SDS, high voltage and discontinuous electrophoresis, Isoelectric focussing. Pulsed field gel electrophoresis and capillary electrophoresis.

UNIT III
Spectrophotometry- Basic principles, instrumentation and applications of UV, Visible, IR spectrophotometers and Mass Spectrometry. Flame Photometry - Principles and applications.

UNIT IV
Centrifugation techniques – Principle, methodology and application of analytical centrifugation, differential centrifugation, density gradient centrifugation, ultra- centrifuge.

UNIT V
X-Rays - X-Ray diffraction, crystals and detectors, quantitative analysis and applications. Radio chemical methods - Basic concepts, counting methods and applications. Autoradiography.

UNIT VI
Tracer and other techniques- radioactive decay, units of radioactivity, detection and measurement of radio activity, Geiger-Muller counter, Scintillation counter. Applications of radioisotopes in biology.

References:-
1. An introduction to practical biochemistry by David T. Plummer.
2. Laboratory Manual in biochemistry by Pattabiraman and Acharya.
3. Practical biochemistry by J. Jayaraman.


PAPER III ENZYMEOLOGY AND ENZYME TECHNOLOGY

Unit I

Unit II

Unit III
Coenzymes: Coenzymes & Cofactors, substrate enzyme relationship. Classification of co-enzymes as group transfer, hydrogen transfer, coenzymes, structure of coenzymes function of nucleotide coenzymes, CoA, NAD/NADP, FMN/FAD, Biotin, Folic acid, vit. B12, Biosynthesis of puridine and flavin nucleotides and CoA.

Unit IV

Unit V
Enzyme Technology: Application in Food and Pharmaceutical industries- large scale enzyme extraction, purification and stabilisation. Industrial application of carbohydrates, proteolytic enzyme, lignocellulose degrading enzyme, pectin and pectic enzyme. Applications of enzymes

**References**

1. Enzymes - Dixon & Webb  
2. Biological Chemistry - Mahler & Cordes  
3. Principles of Biochemistry - Lehninger  
4. Human Nutrition - Biochemical Basis of Inherited Diseases Fredrickson et. al.  
PAPER IV GENERAL MICROBIOLOGY AND BIOCHEMISTRY

Unit 1:
Definition and historical account of microbiology. Diversified microbial world- Classification of microbes based on Whittaker’s five kingdom system of classification. Structures of Bacteria, viruses, Fungi, and algae.

Unit 2:
Nutritional requirements and growth cycles of the above mentioned groups. Media for growth: Types, preparation, methods of sterilization. Isolation and enumeration of microorganisms in soil, water and air. Isolation of microorganisms from contaminated food. Techniques of pure culture, maintenance and preservation; Staining: stains and dyes, types of staining; General techniques involved in Virology and Protozoology.

Unit 3:
Microbial physiology: Factors influencing the growth of microbes- classification based on that. (Temperature, pH, Nutrition ). Symbiotic associations, commonsals, Saprophytes, etc.. Microbiology of fermented foods-dairy products, meat and fish, alcoholic beverages-beer, wine etc. Food spoilage and preservation processes. Microbes as source of food. Application of microbes in industries production of antibiotics, amino acids organic acids, bioconversion process, microbial insecticides.

Unit 4:
Biochemistry of Metabolism : Carbohydrates and energy metabolism- fermentation or glycolysis, TCA cycle and oxidative phosphorylation, Ammonia metabolism. Biosynthesis of glutamate. Purine and pyrimidine biosynthesis. Synthesis of DNA and RNA. Biosynthesis of cell wall - Peptidoglycan, and Teichoic acid.

Unit 5 :
Reference Books:

1. Fundamental principles of Bacteriology - A.J. Salle
3. Microbial physiology -- Albert G. Moat and John W. Foster - Wiley-interscience publication

UNIT I

UNIT II
Antigen - antibody interaction in vitro - precipitation, agglutination, RIA, ELISA, complement fixation techniques and applications. Preparation of antigens for animal inoculation. Purification of antibodies from serum for agglutination and precipitation tests.
Principles and methods of vaccine preparation.

UNIT III
Structure and functions of immune system: Central thyroid organs and peripheral lymphoid organs. Cells of lymphoreticular system- lymphocytes, T-cell maturarion, B-cell maturation.
Null cells, phagocytic cells. Antigen processing and presentation. MHC - Organization, MHC molecules and genes, cellular distribution, regulation of MHC and immune Antigens. MHC and disease. Transplantation and rejection.

UNIT IV

UNIT V
Immunological techniques: RIA, ELISA, Immunocytochemistry, Immunoblotting , Fluorescence antibody techniques.
Reference:-

2. Immunology- Roitt Ivan, Jonathan Brastoff, David male, 1993
4. Immunology- Janis kuby, 3 rd edition.
PRACTICAL I – PAPER I, II, and III

1. Instrumentation methods of cell biology
2. Microtomy
3. Observation of Prokaryotic and Eukaryotic cells and cell types.
4. Living Cells/Temporary/ Permanent preparations. Histochemical techniques
7. Subcellular fractionation and biochemical/enzymyological analysis.
8. Cytochemical study of cells/cell types using specific dyes/reagents.
9. Immunocytochemical analysis for specific cellular constituents.
10. Metaphase chromosome preparations and preliminary banding techniques.
11. Isolation, determination, purification and separation of protein, carbohydrates,
12. lipids, DNA and RNA.
13. Production of enzyme (amylase)
14. Immobilization of cells and enzymes by Calcium alginate method
15. Kinetic analysis of enzymes
16. Thin layer chromatography
17. Paper chromatography
18. Poly acrylamide gel electrophoresis

References:

2. Laboratory techniques in Biochemistry and Molecular Biology, Work and Work.
PRACTICAL II – PAPER IV, AND V

1. Culture media preparation liquid and solid medium
2. Selective differential Media
3. Methods of sterilization and testing of sterility
4. Enumeration of bacteria, fungi and actinomycetes from soil
5. Pure culture technique – pour plate, spread plate and looping method
6. Maintenance and preservation of cultures.
7. Staining of Bacteria – gram, spore and AFB, Fungal wet mount – LPB
8. Motility test-hanging drop and soft agar inoculation
9. Water quality test – MPN
10. Effect of different parameters on bacterial growth kinetics (Substrate, pH, Temperature
11. Batch and Fed Batch fermentation
12. Continuous fermentation
14. Production of alcohol from molasses.
15. Production of organic acid (citric acid).
16. Purification of a fermentation product by Chromatography
17. Quantitation of total free amino acids
18. Quantitation of cholesterol
19. Quantitation of proteins
20. Quantitation of sugars
22. Radial immunodiffusion.
23. Ouchterlony double diffusion.
24. Immunoelectrophoresis.
25. Rocket Immunoelectrophoresis.
26. Immunodiagnostics (ELISA and Western Blotting).
27. Hemolysis.
References:
3. Laboratory techniques in Biochemistry and Molecular Biology, Work and Work.
Paper VI Bioinformatics and Environmental biotechnology

UNIT – I

UNIT – II

UNIT III
Study of microbial population in soil, water, and air: – isolation, screening, and enumeration. Food microbiology – types of microorganisms in meet, and meat products. vegetables, dairy products; production of baker’s yeast, and other dairy products.

UNIT IV
Industrial– microbial synthesis of commercial products, organic acids, alcohols, alcoholic beverages and industrial enzymes; biofertilizers and bioinsecticides. vaccine production from microbes; antibiotics production.

UNIT V

References:
3. Casida, Industrial Microbiology
4. Prescott, Industrial Microbiology
Paper VII Plant and animal biotechnology

UNIT I
Plant genome expression. Interaction between nuclear and organellar genome. Plant genes.

UNIT II
Cultivation: Tissue culture media. Different types of culture methods: Primary culture cell line; cell clones; callus and suspension culture. Embryo culture. Protoplast fusion and somatic hybridization. Micropropagation; organogenesis; Somatic embryogenesis; Protoplast fusion and somatic hybridization. Cybrids; Anther, pollen and ovary culture for production of haploid plants and homozygous lines. DNA banking for germplasm conservation.

Unit III

Unit IV
Animal cell culture: Different types of Culture media. Factors affecting the cell growth( nutrition, growth factors, temperature, pH, etc..). Cell transformation; Physical, chemical and Biological methods; manipulation of genes; Hybridoma technology and its applications.

Unit V
Application of biotechnology: Transgenic animals in livestock improvement, Transgenic animals as models for human diseases; transgenics in industry.

Text book
University Press

References:

8. Ta, Fu, G. Singh and R. Curtis Plant cell and tissue culture in the production of food ingredients Kluwer Academic / Plenum Press.
12. M. Butler, Mammalian cell biotechnology; A practical approach, Oxford university press.
13. Maxine Singer and Paul Berg, Exploring Genetic Mechanism,
UNIT I

UNIT II
Restriction endonuclease - types and function, restriction mapping. Nucleic Acid probes - cloned probes, oligonucleotide probes and labeling of nucleic acid probes. Nucleic acid hybridisation blotting - liquid and dot blot technique; southern, northern and western hybridisation reactions. In situ hybridisation. Polymerase chain reaction - applications. DNA finger printing technique - paternity testing, use of VNTR, DNA foot printing technique. Comet Assay and Ames test. Chemical synthesis of genes. Human Genome project - human genome mapping and sequencing.

UNIT III

UNIT IV

UNIT V

**Reference Books:**
(4) Levine, B., 2000, Genes VII. Oxford University Press.
(7) Peter Westhoff, Molecular Plant Development from Gene to Plant.
(8) Howell, S.H. Molecular Genetics of Plant Development.
UNIT I
Introduction: vectors as cloning vehicles – plasmids, cosmids, Ti and Ri plasmids, BAC, YAC, expression vectors, shuttle vectors, Transposons. Enzymes – exonucleases, endonucleases – restriction endonucleases, ligases, polymerases; DNA modification enzymes – methylase, alkaline phosphatase; reverse transcription ; topoisomerase; Vector host cells like – E. coli, Bacillus, yeast, plant cells and animal cells.

UNIT II

UNIT III
Genetic expression analysis of cloned genes: Selection of cloned genes – antibiotics, GUS expression; blotting techniques – Southern blot and Northern blot; PCR; DNA Finger printing – Restriction fragment length polymorphism (RFLP); Random amplified polymorphic DNA (RAPD); DNA Foot printing; genomic library construction – cDNA, genome mapping.

UNIT IV
rDNA Technology in plants : Transgenic plants with reference to virus and pest resistances, herbicide tolerance and stress tolerance (cold, heat and salt); fruit ripening; resistance to pathogenic fungi and bacteria

UNIT V
rDNA Technology for human welfare: Transgenic animals – insulin, interferon and other pharmaceutical production; recombinant bovine growth hormone; farm animal protection; Gene therapy – haemopoietic cells, genetically engineered bone marrow cells, skin fibroblasts, hepatocytes, myoblast and genetically modified lymphocytes – Recombinant Technology in the production
of vaccines. In industry- amino acid synthesis, vitamin production, and other secondary metabolite synthesis.

Reference Books:

(1) OLD & PRIMROSE, 1989, Principles of gene manipulation 3rd EDITION PUBLISHERS BUSINESS SERVICE.
(2) J.D. WATSON, M.GILMAN, J.WITKOWSKI & M.ZOLLER, 1992, Recombinant DNA Technology, 2nd EDITION, SCIENTIFIC AMERICANS BOOKS, NEWYORK.
(3) S. MAULIK AND S.D. PATEL, 1997, Molecular Biotechnology, WILEY–LISS.
(4) K.KREUZER & A.MASSEY, 1996, r-DNA technology and Biotechnology, ASM PRESS, WASHINGTON. D.C.
(5) D.BERG & M.SINGER, 1992, Dealing with genes, BLACKWELL SCIENTIFIC PUBLICATION
(6) B.R.GLICK J.J.PASTERNAK, 1994, Molecular Biotechnology, ASM PRESS, WASHINGTON
(7) B.LEWIN, 2000, Gene VII, OXFORD UNIVERSITY PRESS, NEWYORK.
(8) T.KOSUGE, C.P. MEREDIT, 1989, Genetic engineering of plants HOLLAENDER PLENUM PRESS.
(9) BUTTERWORTH – HEINEMANN, 1993, Genome management in prokaryotes, OPEN UNIVERSITEIT NEDERLAND
(10) BUTTERWORTH – HEINEMANN, 1993, Techniques for Engineering Genes, OPEN UNIVERSITEIT NEDERLAND.
Practical III for

Paper VI - Bioinformatics and environmental biotechnology

Paper VII - Plant and animal biotechnology

1. Isolation and characterization of industrially important microorganisms.
2. Determination of Thermal Death Point (TDP) and Thermal Death Time (TDT) of microorganisms of design of a sterilizer.
3. Determination of growth curve of a supplied microorganisms
4. Comparative studies of Ethanol production.
5. Microbial production of Citric Acid using Aspergillus niger
7. Analysis of water samples (pH, turbidity, color, total solids, suspended solids, dissolved solids) Estimation of BOD and COD, Turbidity & Viscosity and Electrical Conductivity of different effluents.
8. Quality of milk checking (Methyl blue dye reduction test).
   Microbial spoilage of food.
10. Tissue Culture Techniques
11. Media composition and preparation
12. Micropropagation through node and shoot tip explants
13. Organ development from cultured tissue
14. Initiation and maintenance of callus
15. Measurement of plant cell growth, (PCV, cell number, Wet and Dry Weights)
16. Detecting antibacterial secondary metabolite production by cultured tissue
17. Preparation of Tissue culture medium and membrane filtration.
18. Preparation of primary cells from Chick embryo.
20. Isolation of DNA from animal cells.
Practical IV for

Paper VIII – Bioengineering technology

Paper IX - Recombination DNA technology

1. Plasmid extraction: Alkaline lysis, *E. coli* and *Agrobacterium*.
2. Chromosomal DNA Isolation in blood by agarose gel electrophoresis method.
3. Chloroplast DNA Isolation in plant tissue such as Mulberry, Cotton by submerged agarose gel electrophoresis method.
4. Quantification of DNA in *E.coli* by spectrophotometric method.
5. Estimation of DNA in animal tissue such as Blood, Liver, Spleen and thymus (Laboratory Rat).
7. DNA Restriction.
8. DNA Digestion.
9. DNA Ligation.
10. DNA Transformation.
11. Southern and Northern Blotting.

Reference Books:

A Master of Science or MSc is a graduate degree with a focus in science, medicine, or engineering. The MSc in Biotechnology combines two of these disciplines, focusing on biology and chemistry along with principles of design and engineering. Exactly what is an MSc in Biotechnology? The field of biotechnology uses living organisms to generate controlled processes or even final products. Students puâ€¦ Read more. A Master of Science or MSc is a graduate degree with a focus in science, medicine, or engineering. The MSc Biotechnology Programme insights students with the knowledge of key research areas and Advances in Plant Biotechnology and Fermentation Technology. Apply now. About the Programme. M.Sc. Biotechnology is a two-year postgraduate programme initiated with an impetus to impart advanced knowledge on biology and chemistry along with the principles of design and engineering. The MSc programme in Biotechnology is designed for life science/chemistry graduates and aims to develop the studentsâ€™ specific knowledge and skills in biotechnology, positioning them for employment in bio-based industries or PhD research. The graduates of the MSc Biotechnology programme will be very well informed on a range of biotechnology-related topics and the problems encountered within a commercial biotechnology environment.