Course Structure:

M.Sc. Biotechnology Course Programme				
		Marks		
		Sessional Exams	End of Semester Exams	Total
	Semester I			
MBT- 747	Macromolecules and Basic Enzymology	**30**	**70**	**100**
MBT- 748	Molecular Cell Biology	**30**	**70**	**100**
MBT- 749	Microbial Physiology and Genetics	**30**	**70**	**100**
MBT- 750	Bioanalytical Tools and Techniques	**30**	**70**	**100**
MBT- 751	Biotechnology Lab course-I	-	-	**100**
MBT- 752	Biotechnology Lab course-II	-	-	**100**
	Semester II			
MBT- 853	Immunology	**30**	**70**	**100**
MBT- 854	Molecular Biology	**30**	**70**	**100**
MBT- 855	Genetic Engineering	**30**	**70**	**100**
MBT- 856	Bioprocess Engineering and Technology	**30**	**70**	**100**
MBT- 857	Biotechnology Lab course-III	-	-	**150**
MBT- 858	Seminar & Interactive Course -I	-	-	**50**
	Semester III			
MBT- 959	Animal Cell Science and Technology	**30**	**70**	**100**
MBT- 960	Plant Biotechnology	**30**	**70**	**100**
MBT- 961	Environmental Biotechnology	**30**	**70**	**100**
MBT- 962	Computational Biology & Bio-informatics	**30**	**70**	**100**
MBT- 963	Biotechnology Lab course-IV	-	-	**100**
MBT- 964	Biotechnology Lab course-V	-	-	**100**
	Semester IV			
MBT- 1065	Project Work/Dissertation	-	-	**500**
MBT- 1066	Seminar & Interactive Course -II	-	-	**100**
	Total	**360**	**840**	**2400**

M.Sc. Biotechnology Programme

Semester I

MBT- 747: Macromolecules and Basic Enzymology

(M.Sc.; Paper-I)

M. M. 100

Unit I

Macromolecules: Carbohydrates, Lipids, Nucleic Acids and Porphyrins: Classification, structure, function and properties, Chemical bonds and functional groups in biological molecules.

Unit II

Supramolecular assemblies: molecular assemblies like membranes, ribosomes, extracellular matrix, organization of macromolecular complexes-chromatin and ribosomes.

Unit III

Conformational properties of polynucleotides and polysaccharides: Structural analysis, biological studies and methods of compositional analysis (theoretical and experimental). Protein-protein and protein-ligand interactions and physical and chemical methods for their study.Sequencing of proteins.

Unit IV

Proteins: Classification, hierarchy in structure: Primary, secondary, tertiary and quaternary structure, Ramachandran map, Protein folding: Biophysical and cellular aspects. Protein denaturation. Glycoproteins and lipoproteins: Structure and function.

Unit V

Introduction and Classification of enzymes: Kinetics and thermodynamic analysis, concept of Activation energy, Michaelis-Menten and Lineweaver Burk graphs for single substrate enzyme catalyzed reaction, unit of enzyme activity. Catalytic antibodies and functional proteins: Structure and drug targets (enzymes and receptors).

MBT- 748: Molecular Cell Biology
(M.Sc.; Paper-II)

M. M. 100

Unit I

General structure of Cell, Historical origins of cell biology: The discovery of cell, development of the cell theory, the molecular evolution, Intercellular communication- Gap junctions, tight junction and Desmosomes.

Unit II

Structure of prokaryotic and eukaryotic cells: Isolation and growth of cells, Cellular organelles: Plasma membrane, cell wall, cytoskeleton, their structural organization, mitochondria, chloroplast, nucleus and other organelles and their organization, genetic constitution of mitochondria and chloroplast, lysosome, membrane models.

Unit III

Membrane transport: passive and facilitated diffusion, active transport, symport, antiport, transport of nutrients, ion and macromolecules across membranes, lipsomes, molecular biology of some important pathogen of AIDS, malaria, hepatitis, tuberculosis, filaria, kalazar.

Unit-IV

Cell cycle: Molecular events and regulation in model systems, Genes for social control of cell, Cellular responses to environmental signals in bacteria, plants and animals: Mechanism of signal transduction, Exocrine, Endocrine, Paracrine and Synaptic strategies of chemical signaling, surface receptor mediated transduction (DAG, Ca+2, c-AMP, G-Proteins), intracellular protein traffic, secretory and endocytic pathway.

Unit-V

Cellular basis of differentiation and development: Cell division, gametogenesis and fertilization, differential gene activity and cell differentiation, morphogenetic determinants in egg cytoplasm and programmed cell death- apoptosis, Heterocyclic compounds and secondary metabolites in living system: Nucleotides, pigments, isoprenoids

MBT- 749: Microbial Physiology and Genetics
(M.Sc.; Paper-III)

M. M. 100

Unit I

History, development and scope of microbiology, Structure and function of prokaryotic cells, classification of bacteria: modern approaches of bacterial taxonomy (Numerical Taxonomy, 16S rRNA analysis), prokaryotic diversity, Bacteria: General properties, structure and classification, Viruses: General properties, structure and classification of viruses based on their genomes, bacterial viruses (phage Lambda), plant viruses (CaMV), animal viruses (Hepatitis A and B, retroviruses), viroids and prions.

Unit II

Methods in Microbiology: Theory and practice of sterilization, pure culture techniques, principles of microbial nutrition, construction of culture media, enrichment of culture techniques, isolation and culture of aerobic and anaerobic bacteria. Microbial growth: growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, growth affected by environmental factors, culture collection, preservation and maintenance of cultures, Antibiotics and Chemotherapy: Antimicrobial agents, sulfa drugs, Penicillins and Cephalosporins, broad-spectrum antibiotics, antibiotics from prokaryotes, antifungal antibiotics, mode of action of antibiotics, resistance to antibiotics.

Unit III

Microbial diseases: Disease reservoirs, epidemiological terminologies, infectious disease transmission, respiratory infections caused by bacteria and viruses, tuberculosis, sexually transmitted diseases, diseases transmitted by animals (rabies, plague), insects and ticks (rickettesias, chalamydal and lyme diseases), food and water borne diseases, pathogenic fungi, Host-parasite relationships, normal microflora of skin, oral cavity, gastrointestinal tract, Entry of pathogens into the host: colonization and factors predisposing to infections. Types of toxins: Exotoxins, endotoxins, enterotoxins, their structure and mode of action, virulence and pathogenesis.

Unit IV

Overview of basic metabolism.Metabolic diversity among microorganisms. Photosynthesis in microorganisms: Role of chlorophylls, carotenoids and phycobilins, Calvin cycle. Chemolithotrophy, hydrogen-iron-nitrite-oxidizing bacteria, nitrate and sulphate reduction, methanogenesis and acetogenesis. Fermentation: Diversity, syntrophy and role of anoxic decompositions, nitrogen metabolism, nitrogen fixation, hydrocarbon transformation.

Unit V

Bacterial genetic system, recombination transformation, conjugation, transduction, plasmids and transposons, bacterial genetic map with reference to *E. coli*. Viruses and their genetic system, Phage I and its life cycle, RNA phages, RNA viruses, retroviruses, Genetic Systems of yeast and Neurospora, extra-chromosomal inheritance.

MBT- 750: Bioanalytical Tools and Techniques, Biostatistics and Computer application
(M.Sc.; Paper-IV)

M. M. 100

Unit-I

Chromatography techniques: Paper chromatography, thin layer chromatography, column chromatography, gas chromatography, gel filtration and ion exchange chromatography, Centrifugation: Concept of centrifugation, sedimentation coefficient, Ultracentrifugation

Unit-II

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

Unit-III

Electrophoresis: Agarose gel electrophoresis, SDS polyacrylamide electrophoresis, immunoelectrophoresis, Isoelectric focusing, pulse field gel electrophoresis, two-dimensional electrophoresis, Radioisotope Techniques, Autoradiography.

Unit-IV

Macroscopic techniques for studying cell structure: Principles and applications of light, phase contrast, fluorescence, scanning and transmission electron microscopy, electron cryomicroscopy, scanning tunneling microscopy, cytophotometry and flow cytometry. Protein Separation, criteria of homogeneity and end group analysis.

Unit-V

Statistical analysis of biochemical data: Standard deviation, variance, mean, median, mode, range, least-square analysis, student's T-test, ANOVA. Introduction to commercial computers:internet application, Softwares and their uses in biological studies.

MBT- 751: Biotechnology Lab course-VII
(M.Sc.)

M. M. 100

1. To Determine the isoelectric point of casein
2. To titrate a strong acid (HCl) with standard NaOH by potentiometry
3. Experiment on amino acids and proteins
   - i. To perform Sodium Nitroprusside test with amino acids
   - ii. To perform Xanthoproteic test with amino acids and proteins
   - iii. To perform Millons and Nasse test with amino acids and proteins
   - iv. To perform ninhydrin test with amino acids and proteins
   - v. To perform Sakaguchi test with amino acids and proteins
4. Experiment on Carbohydrates
   - i. To perform Benedict's test with various carbohydrates
   - ii. To perform Bial's test with pentoses
   - iii. To perform Selivanoff's test with pentoses
   - iv. To perform Barfoed's test with mono and disaccharides
   - v. To perform iodine test on polysaccharides and to observe the effect of temperature, acid and alkali on the colour produced
   - vi. To perform Molosch's test with different carbohydrates
   - vii. To perform Fehling's test with different carbohydrates
5. Experiment on Lipids
   - i. To perform acrolein test for fat detection
   - ii. To perform Baudoin test with lipids
   - iii. To determine sapnification value of oils
   - iv. To determine Acid number of oils
   - v. To determine Iodine value of oils
6. To plot a curve for estimation of glucose by phenol sulphuric acid and Nelson and Somogyi method
7. To separate amino acids by TLC using silica gel 'G' for identification and calculation of their respective R_f values
8. To determine blood group and Rh factor in a given sample of blood
9. To determine RBC and WBC count in a double oxalated blood sample
10. To extract nucleic acids from the given plant tissues
11. To estimate and quantify DNA and RNA in the given plant tissue by diphenylamine method and orcinol method respectively
12. To plot a curve for estimation of BSA by Biuret method and Folin-Lowry method

MBT- 752: Biotechnology Lab course-VIII
(M.Sc.)

M. M. 100

1. To prepare suitable liquid media for the routine cultivation of bacterial culture
2. To prepare suitable solid media for the routine cultivation of bacterial culture
3. Isolation and maintenance of microorganisms from soil by the serial dilution-agar plating method
4. Isolation of Azotobacter species from soil
5. Isolation of algae from soil
6. To prepare suitable media for fungal culture
7. To prepare pure culture of microorganisms by streak palte method, pour plate method, spread plate method.
8. Maintenance of pure cultures by paraffin method
9. Preparation of bacterial smear
10. Preparation of agar slants for culture of microorganisms
11. Measurement of bacterial growth by turbidity measurements (Spectrophotometric method) & preparation of growth curve
12. Measurement of bacterial population by serial dilution methods
13. Effect temperature & pH on growth of microorganisms
14. Microscopic examination of bacteria, yeast and moulds and study of organisms by simple stain, negative stain, gram stain, Acid fast stain and staining for spores
15. Demonstration of antibiotic resistance. Isolation of antibiotic resistant bacterial population
16. Bacteriological examination of water by multiple-tube fermentation test or multiple tube test (MPN)

Semester II

MBT- 853: Immunology

(M.Sc.; Paper-I)

M. M. 100

Unit I

Immunology: Introduction, active and passive immunity, primary and secondary immune response and clonal nature of immune response, Antigens and superantigens.

Unit II

Structure of immune cells and organs, structure and function of immunoglobulins, B-lymphocytes, T-lymphocytes, macrophages, dendritic cells, natural killer and lymphokine activated killer cells, eosinophils, neutrophils and mast cells.

Unit III

Antigen-antibody interactions, Antibody diversity, BCR & TCR, Cell-mediated cytotoxicity: Mechanism of T-cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity.

Unit IV

Major Histocompatibility Complex: Antigen processing and presentation, B-cell receptor and T-cell receptor, complement system. Regulation of immune response: Generation of humoral and cell mediated immune responses, activation of B- and T- lymphocytes, cytokines and their role in immune regulation, immunological tolerance.

Unit V

Immunoprophylaticintervetion: Basic concepts of vaccination and different types of vaccines. Hypersensitivity, autoimmune disorders, tumor immunology, AIDS and other immunodeficiencies.Immunotechnology: Immuodiffusion, immunoelectrophoresis, RIA, ELISA, hybridoma technology and monoclonal antibodies, along with their applications.

MBT- 854: Molecular Biology
(M.Sc.; Paper-II)

M. M. 100

Unit I

Introduction to molecular biology, DNA replication: Prokaryotic and eukaryotic DNA replication, mechanisms of DNA replication, enzymes and accessory proteins involved in DNA replication, DNA repair and recombination, Homologous Recombination: Holliday junction, gene targeting, gene disruption, FLP/FRT and Cre/Lox recombination, RecA and other recombinases.

Unit II

Transcription: Prokaryotic and eukaryotic transcription, RNA polymerase, general and specific transcription factors, regulatory elements and mechanisms of transcription regulation, transcriptional and post transcriptional gene silencing, Modifications in RNA: 5'-Cap formation, Transcription termination, 3'end processing and polyadenylation, splicing, editing, nuclear export of mRNA, mRNA stability.

Unit III

Translation: Prokaryotic and eukaryotic translation, the translation machinery, mechanisms of initiation, elongation and termination, regulation of translation, co- and post-translational modifications of proteins. Protein localization: Synthesis of secretory and membrane proteins, import into nucleus, mitochondria, chloroplast and peroxisomes, receptor mediated endocytosis.

Unit IV

Biology of Cancer: Molecular biology and biochemistry of cancer, oncogenes, mutation, chemical carcinogenesis, viral and cellular oncogenes, tumor suppressor genes from humans, structure, function and mechanism of action of pRB and p53 tumor suppressor proteins. Antisense and Ribozyme Technology and their applications: Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, biochemistry of ribozyme, hammer head, hairpin and other ribozymes, strategies for designing ribozymes.

Unit V

Molecular mapping of Genome: Genetic and physical maps, simple sequence repeat loci, Southern and FISH for genome analysis. Molecular markers in genome analysis: RFLP, RAPD analysis, molecular markers linked to disease resistance genes, application of RFLP in forensic, disease prognosis, genetic counselling pedigree, varietal etc. Animal trafficking and poaching, germplasm, maintenance, taxonomy and biodiversity.

MBT- 855: Genetic Engineering
(M.Sc.; Paper-III)

M. M. 100

Unit I

Molecular tools and their application: Restriction endonucleases, polymerase nucleases, kinases, topoisomerases, gyrases, methylases, ligases and alkaline phosphatases. Nucleic Acid purification, amplification, yield analysis and applications. Gene Cloning vectors: Plasmids, bacteriophages, cosmids, phagemids, artificial chromosomes. Construction of c-DNA and Cloning: mRNA enrichment, reverse transcriptase, DNA primers, linkers, adaptors and their chemical synthesis, genomic libraries, c-DNA libraries and screening of libraries for selection of desired clones.

Unit II

Nucleic acid hybridization: Principles and techniques. Polymerase chain reaction: Principles, variations and applications. Techniques of *in vitro* mutagenesis and protein engineering, restriction mapping of DNA fragments and map construction, nucleic Acid sequencing. Techniques for studying gene expression: DNA transfection, Northern and Western blotting, DNA footprinting, primer extension, SI mapping, Rnase protection, Reporter assays. Radioactive and non-radioactive labelling.

Unit III

Expression strategies for heterologous genes: Vector engineering and codon optimization, host engineering, *in vitro* transcription and translation, expression in bacteria, yeast, insects, mammalian cells and plants. T-DNA and transposon tagging: Role of gene tagging in gene analysis and identification and isolation of genes through T-DNA or transposon tagging.

Unit IV

Genome Sequencing: Genome sizes, organelle genomes, genomic libraries, YAC, BAC libraries, strategies for sequencing genome, packaging, transfection and recovery of clones, application of sequence information for identification of defective genes.

Unit V

Microarray: Printing of oligonucleotides and PCR products on glass slides, nitrocellulose paper. Genome analysis for global patterns of gene expression using fluorescent-labeled c-DNA or end-labeled RNA probes.Analysis of single nucleotide polymorphism using DNA chips.

MBT- 856: Environmental Biotechnology
(M.Sc.; Paper-IV)

M. M. 100

Unit I

Environment: Basic concept and issues. Environment pollution: Types of pollution, methods for the measurement of pollution. Methodology of environmental management: The problem solving approach, its limitations. Air pollution, different pollutants, their monitoring and control. Water pollution and its control: Water as a scarce natural resource, need for water management, measurement of water pollution, sources of water pollution.

Unit II

Waste water treatment- physical, chemical and biological treatment processes. Aerobic process: Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic processes: Anaerobic digestion, anaerobic filters, upflow, anaerobic sludge blanket reactors. Treatment schemes for waste waters from dairy, distillery, tannery, sugar, antibiotic industries.

Unit III

Biodegradation of Xenobiotics in environment: Ecological considerations, decay behaviour&degradative plasmids. Degradation of chlorinated hydrocarbons, substituted hydrocarbons, petrol, petroleum products, surfactants, pesticides and other industrial effluents.Solid waste management.

Unit IV

Bioremediation of contaminated soils and wasteland.Bioaccumulation, Biomagnification, Biostimulation, Biopesticides in integrated pest management, Rural Biotechnology with special reference to biofertilizers, biocomposting, organic forming, vermiculture and methane production.

Unit V

Global environmental problems: Ozone depletion, UV-B, green house effect and acid rain, their impact and biotechnological approaches for their management.

MBT- 857: Biotechnology Lab course-IX
(M.Sc.)

M. M. 150

1. Preparation and centrifugation of rat/mouse liver homogenate and assay of glutamate dehydrogenase/ succinate dehydrogenase, acid phosphatase, glucose-6-phosphatse and lactate dehydrogenase using visible and UV spectrophotometry
2. To separate and visualize various proteins in cell free homogenate of mouse/rat liver by SDS-PAGE
3. Colorimetric determination of pKa
4. To perform qualitative tests on urine for protein, sugar, creatine, urobilinigen, urea
5. To raise Ab against the given antigen or protein in an experimental animal
6. To perform immunoelectrophoresisfro BSA and egg albumin separately and their mixture
7. Radial immunodiffusion
8. Western blotting and ELISA
9. Mitosis and Meiosis (Slides)
10. To visualize the precipitation line formed on the agar gel slide by Ouchterlony's double immuno-diffusion technique
11. Bacterial transformation
12. Isolation of Plasmids
13. Southern blotting
14. RFLP analysis
15. Northern blotting
16. Preparation of probes
17. in vitro Transcription
18. in vitro Translation
19. To isolate plasmid DNA from bacterial culture by alkaline lyses method
20. To isolate plasmid DNA from bacterial culture by Quick method
21. To isolate plant genomic DNA
22. To quantitate the plant genomic DNA by spectrophotometer
23. To quantitate the plant genomic DNA by agarose gel electrophoresis
24. To isolate RNA from plant leaf
25. To prepare competent cells of bacteria
26. To transform the competent cells
27. To run polymerase chain reaction of plant genomic DNA
28. RAPD analysis of plant samples using random primers
29. To digest the plant genomic DNA with restriction endonuclease

MBT- 858: Seminar and Interactive Course
(M.Sc.)

M. M. 50

Semester III

MBT- 959: Animal Cell Science and Technology

(M.Sc.; Paper-I)

M. M. 100

Unit I

Totipotency, nuclear transfer experiments, molecular events during fertilization, role of maternal contribution in early embryonic development, culture medium and role of serum, measurement of viability and cytotoxicity.

Unit II

Biology and characterization of the cultured cells, measurement of growth, basic techniques of mammalian cell culture, primary and established cell line cultures, disaggregation of tissue and primary culture, monolayer, suspensions and immobilized culture. Maintenance of cell culture, cell separation, application of animal cells culture, scaling-up of animal cell culture.

Unit III

Cell cloning, micromanipulation, synchronization and transformation, stem cell culture, organ culture, embryonic stem cells and their applications, nuclear transplantation, apoptosis.

Unit IV

Gene Therapy and Transgenic animals: Genetic disorders, vector engineering, somatic and germline manipulations, strategies of gene delivery, targeted gene replacement/augmentation, gene correction, gene editing and gene silencing, construction and application of transgenic animals, chromosome engineering.

Unit V

Molecular markers linked to disease resistance genes, application of RFLP in forensic disease prognosis, genetic counseling, pedigree, etc. ethical and biosafety considerations and IPR issues.

MBT- 960: Plant Biotechnology
(M.Sc.; Paper-II)

M. M. 100

Unit I

Conventional plant breeding, introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids, tissue culture media (composition and preparation), initiation and maintenance of callus and suspension culture, single cell clones. Organogenesis: somatic embryogenesis, artificial seeds, transfer and establishment of whole plants in soil. Shoot-tip culture: Rapid clonal propagation and production of virus-free plants, Embryo culture and embryo rescue. Protoplast isolation, culture and fusion, selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrids, cybrids, anther, pollen and ovary culture for production of haploid plants and homozygous lines.

Unit II

Cryopreservation, slow growth and DNA banking for germplasm conservation. Metabolic engineering and industrial products: Plant secondary metabolites, control mechanism and manipulation of phenylpropanoid pathway, shikimate pathway, alkaloids, biodegradable plastics, therapeutic proteins, antibodies, edible vaccines, purification strategies.

Unit III

Plant transformation technology: Basis of tumor formation, features of Ti and Ri plasmids, mechanisms of DNA transfer, role of virulence genes, use of Ti and Ri as Vectors, binary vectors, use of 35 S and other promoters, genetic markers, use of reporter genes, reporter gene with introns, use of scaffold attachment regions. Methods of nuclear transformation: Particle bombardment, electroporation, microinjection, transformation of monocots. Viral vectors and their applications, multiple gene transfers, transgene stability and gene silencing. Chloroplast transformation: Advantages, vectors, success with tobacco and potato.

Unit IV

Application of plant transformation for productivity and performance: With reference to engineered resistance to herbicides (phosphinotricin, glyphosphate, sulphonylurea, atrazine), insect (Bt genes), non-Bt like protease inhibitors, alpha amylase inhibitor, virus resistance, coat protein mediated, nucleocapsid gene, disease resistance, chitinases, 1-3 β-glucanase, RIP, antifungal proteins, thionins, PR proteins, nematode resistance, abiotic stress (salinity, drought), post-harvest losses, long shelf life of fruits and flowers, use of ACC synthase, polygalactouranase, ACC oxidase, male sterile lines, bar and barnase systems, carbohydrate composition and storage, ADP glucose pyrophosphatase.

Unit V

Molecular marker-aided breeding: RFLP RAPD, AFLP, STS, SSR, SCAR, SSCP markers, linkage analysis, QTL, marker assisted selection, arid and semi-arid plant biotechnology, green house and green-home technology.

MBT- 961: Bioprocess Engineering and Technology
(M.Sc.; Paper-III)

M. M. 100

Unit I

Introduction to bioprocess engineering, bioreactors, isolation, preservation and maintenance of industrial microorganisms, kinetics of microbial growth various substrates for industrial fermentation, and sterilization of media, air and fermenter

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Unit II

Strain development: screening, mutation, protoplast fusion, hybridization and recombinant DNA technique. Types of fermentation process: Batch, fed-batch and continuous bioreactors, stability of microbial reactors with mixed microbial populations, specialized bioreactors (pulse, fluidized, photo bioreactors, etc.). Online monitoring and control of bioprocess parameters.

Unit III

Downstream processing: Introduction, removal of microbial cells and solid matters, foam separation, precipitation, filtration, distillation, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, membrane process, drying and crystallization.

Unit IV

Enzyme and whole cell immobilization and its industrial application. Industrial production of chemicals: Alcohol (ethanol), acids (citric, acetic and gluconic), solvents (glycerol, acetone, butanol), antibiotics (penicillin, tetracycline), amino acids (lysine, glutamic acid) and single cell protein. Microbial leaching of metals and oil recovery.

Unit V

Introduction to food technology: History and scope of food microbiology. Sources of microorganisms in foods. Intrinsic (pH, moisture, redox potential, nutrients), antimicrobial constituents of foods and biological structure and extensive factors (temperature of srorage, relative humidity of environment, pressure and concentration of gases in environment) affecting growth of microorganisms in food. Elementary idea of canning and packing, sterilization and pasteurization of food products, technology of typical food / food products (bread, cheese, idli), food preservation.

MBT- 962: Computational Biology & Bio-informatics
(M.Sc.; Paper-IV)

M. M. 100

Unit -I

Basic Bioinformatics: Introduction to Internet, Search Engines: Entrez, Pubmed etc. Introduction to Genomics: information flow in biology, DNA sequence data, Experimental approach to genome sequence data, genome information resources.

Unit-II

Functional Proteomics - protein sequence and structural data, protein information resources and secondary data bases. Structural comparison at secondary and tertiary levels. Computer aided drug designing.

Unit-III

Computational Genomics - Internet basics, biological data analysis and application, sequence data bases, NCBI model, file format. Annotation, comparison of different methods; ESTs – databases, clustering, gene discovery and identification, and functional classification.Reconstruction of metabolic pathways; Genome analysis. Genome anatomy, genome rearrangements with inversions, signed inversions, gene identification, gene expression, expression analysis, gene identification and functional classification.

Unit-IV

Sequence alignment & data base search - Protein primary sequence analysis, DNA sequence analysis, pair wise sequence alignment, FASTA algorithm, BLAST, multiple sequence alignment, DATA base searching using BLAST and FASTA.

Unit-V

Structural data bases - Small molecules data bases, protein information resources, protein data bank, Computational techniques in structural analysis, nanoparticles.

MBT- 963: Biotechnology Lab course-X
(M.Sc.)

M. M. 100

1. Metabolic labeling of proteins and immunoprecipitation
2. Chemical modification of proteins
3. Study of mutation by Ames test
4. N- and C- terminal analysis of proteins
5. Peptide mapping
6. Methods for immobilization of enzymes
7. Enzyme: Purification and kinetic analysis
8. Techniques for analysis of secondary, tertiary and quaternary structures of proteins
9. Bacterial culture and antibiotic sensitivity media
10. Construction of restriction map of plasmid DNA
11. Preparation of helper phage and its titration
12. Preparation of Single stranded DNA template
13. Gene expression in *E. Coli* and analysis of gene product

MBT- 964: Biotechnology Lab course-XI
(M.Sc.)

M. M. 100

1. To prepare stock solutions of nutrients for plant tissue culture medium
2. To prepare plant tissue culture medium
3. To surface sterilize the given explant and inoculate the MS medium
4. To see the effect of BAP on shoot multiplication
5. To see the effect of 2,4- D on callusing
6. Subculturing o shoots in fresh medium
7. Rooting of the shoots in IBA containing medium
8. Hardening of the plantlets in soil
9. Culture of Agrobacterium
10. To check the sensitivity of Agrobacterium on kanamycin
11. Cryopreservation and thawing
12. Measurement of doubling time
13. Preparation of metaphase chromosomes from cultured cells
14. Cell fusion with PEG
15. Organ culture
16. Callus propagation, organogenesis, transfer of plant to soil
17. Protoplast isolation and culture
18. Anther culture, Production of Haploids
19. Cytological examination of regenerated plants

Semester IV

MBT- 1065: Project Work/Dissertation
Evaluation, presentation skill and defence of Project work
(M.Sc.)

M. M. 500

MBT- 1066: Seminar and Interactive Course-II

M. M. 100