SEMESTER-I

FIRST SEMESTER EXAMINATION

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
MSBT101	Microbiology	40	60	100
MSBT102	Cell Biology	40	60	100
MSBT103	Biochemistry & Biophysics	40	60	100
MSBT104	Genetics and Molecular Biology	40	60	100
PRACTICAL				
MSBT105	Microbiology Lab	60	40	100
Total		**380**	**420**	**800**

SECOND SEMESTER EXAMINATION

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
MSBT201	Biology of the Immune	40	60	100
MSBT202	Enzymology & Enzyme Technology	40	60	100
MSBT203	Genetic Engineering	40	60	100
MSBT204	Plant Biotechnology	40	60	100
PRACTICAL				
MSBT205	Lab	60	40	100
Total		**340**	**360**	**700**

THIRD SEMESTER EXAMINATION

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
MSBT301	Animal Cell Culture	40	60	100
MSBT302	Bioprocess Engineering & Technology	40	60	100
PRACTICAL				
MSBT306	Lab	60	40	100
Total		**380**	**420**	**800**

FOURTH SEMESTER EXAMINATION

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
MSBT401	Environmental Biotechnology	40	60	100
MSBT402	Bioinformatics & Biostatistics	40	60	100
PRACTICAL				
MSBT406	Major Project (Research Dissertation)	60	40	100
Total		**340**	**360**	**700**

Semester I

BTM 101 : Microbiology

1. History of Microbiology, Discovery of the microbial world.
2. Isolation, pure culture techniques, Methods of sterilization and Enrichment culture techniques.
3. Bacterial identification, nomenclature and classification, New approaches to bacterial taxonomy / classification including ribotyping and ribosomal RNA sequencing.
4. General structure and features, Brief account of all group of bacteria and cyanobacteria, Rickettsias, Chlamydias and Mycoplasmas,
Archaea : Archaebacteria and extremophilic microbes – their biotechnological potentials
5. The definition of growth, growth curve, measurement of growth and growth yields, Culture collection and maintenance of cultures.
6. Different modes of nutrition in bacteria, Sulfate reduction, Nitrogen metabolism – nitrate reduction, nitrifying and denitrifying bacteria, Nitrogen fixation and Microbes used as biofertilizer.
7. Viruses : Classification, morphology and composition of viruses in general,
Plant viruses (TMV, Gemini Virus), Animal viruses (baculoviruses),
Bacteriophages : Lambda, φX 174, cyanophages,
8. Viroids and Prions.

BTM 102 : Cell Biology

1. Principles of Microscopy: Optical (including Phase contrast and Differential interference); Fluorescence, Confocal and Electron Microscopy.
2. Structure of Cell (Bacterial, Plant and Animal): Cell membranes, Composition & architecture of Cell Wall,
3. Structure and function of organelles (mitochondria, chloroplast, Nucleus, Golgi apparatus, Lysosomes, Ribosomes) and Cytoskeletal elements.
4. Cell adhesion; cell junctions, cell adhesion molecules & extra-cellular matrix.
5. Basic concepts of signal transduction.
6. Transport across biomembranes: facilitated transport, group translocation, Active transport, Na^+-K^+ ATPase pump.
7. Cell cycle and its control.
8. Oncogenesis.
9. Brief introduction to the biology of following pathogens: AIDS, Malaria, Tuberculosis and Kalajar.
10. Animal cloning and in vitro fertilization

BTM103 : Biochemistry & Biophysics

1. Carbohydrates; Glycolysis, Gluconeogenesis, Krebs' Cycle, Electron transport chain, Oxidative Phosphorylation.
2. Fatty acids; general properties and ß- oxidation.
3. Nitrogen metabolism: Amino acids (general properties); Amino acid sequencing and composition; end group analysis.
4. Proteins: Protein structure (primary, secondary, tertiary & quartenary), Globular, Fibrous proteins; Ramachandran plot, Circular Dichroism, Hydrophobic and hydrophilic interactions. PAGE, SDS-PAGE, Diagonal Electrophoresis, MALDI.
5. Protein folding (Introduction / Tools to study folding – unfolding phenomenon)
6. DNA - protein interactions; DNA-drug interactions.
7. Photosynthesis; carbon fixation and photorespiration

BTM 104 : Genetics and Molecular Biology

1. Introduction to cell division, Mendelian Laws and physical basis of inheritance, dominance and its molecular basis.
2. Basics of gene interaction, cis-trans-test and complementation test, lethal genes, polygenic traits, linkage and gene maps.

3. Double helix: Physico-chemical considerations.
4. Organization of prokaryotic and eukaryotic genomes, supercoiling, repetitive DNA.
5. DNA replication: Mechanism of replication of Prokaryotic & Eukaryotic Chromosome.
6. Mutation: Types and molecular mechanisms of mutations, mutagens, DNA Repair.
7. Transposition: Mechanisms of transposition, role of transposons in mutation.
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8. Gene transfer in prokaryotes: Transformation, conjugation, transduction, construction of genetic maps in bacteria.
9. Recombination: Homologous and site - specific recombination.
10. Gene expression in bacteria: Transcription and its regulation; operons, attenuation, anti-termination and anti-sense controls.
11. Prokaryotic translation machinery, mechanism and regulation of translation.
12. Gene expression in eukaryotes: Transcription, general and specific transcription factors, regulatory elements and mechanism of regulation, processing of transcripts.

BTM 105 (Practicals)

Semester II

BTM201 : Biology of the Immune

1. Introduction: Innate and acquired immunity, clonal nature of immune response.
2. Nature of antigens.
3. Antibody structure and function.
4. Antigen - antibody reactions and applications.
5. Major histocompatibility complex.
6. Complement system.
7. Hematopoiesis and differentiation.
8. Regulation of the immune response: Activation of B and T-lymphocytes, Cytokines, T-cell regulation, MHC restriction, Immunological tolerance.
9. Cell-mediated cytotoxicity : Mechanism of cytotoxic T cells and NK cells mediated target cell lysis, Antibody dependent cell mediated cytotoxicity, macrophages mediated cytotoxicity.
10. Hypersensitivity.
11. Autoimmunity.
12. Transplantation.
13. Immunity to infection and tumours.

BTM 202 : Enzymology & Enzyme Technology

1. Classification and nomenclature of enzymes.
2. Isolation, purification and large-scale production of enzymes.
3. Coenzymes and Cofactors.
4. Steady state kinetics: Methods for estimation of rate of enzyme catalyzed reaction with special reference to Michaelis-Menten equation. Effects of substrate, temperature, pH and inhibitors on enzyme activity and stability.
5. Mechanism of enzyme action (active site, chemical modification) and regulation (Zymogens, Isozymes).
6. Enzyme engineering.
7. Applications of enzymes.
8. Immobilization of Enzymes.

BTM 203 : Genetic Engineering

1. Restriction endonucleases, Modification methylases and other enzymes needed in genetic engineering.
2. Cloning vectors: Plasmids and plasmid vectors, Phages and Phage Vectors,
phagemids, cosmids, artificial chromosome vectors (YAC, BAC), CHEF analysis.
Animal virus derived vectors - SV40 and retroviral vectors.
3. Molecular cloning: Recombinant DNA techniques, construction of genomic DNA and cDNA libraries,

screening of recombinants.
4. Expression strategies for heterologous genes.
5. DNA analysis: labeling of DNA and RNA probes. Southern and fluorescence in situ hybridization, DNA fingerprinting, chromosome walking.
6. Techniques for gene expression: Northern and Western blotting, gel retardation technique, DNA footprinting, Primer extension, Sl mapping, Reporter assays.
.42
7. Sequencing of DNA, chemical synthesis of oligonucleotides; techniques of in vitro mutagenesis. Site-directed mutagenesis, gene replacement and gene targeting.
8. Polymerase chain reaction and its applications.
9. Use of transposons in genetic analysis: Transposon and T-DNA tagging and its use in identification and isolation of genes.
10. Applications of genetic engineering: Transgenic animals, production of recombinant pharmaceuticals, gene therapy, disease diagnosis.
11. Biosafety regulation: Physical and Biological containment.

BTM 204 : Plant Biotechnology
1. Tissue culture media, Initiation and maintenance of callus and suspension cultures; single cell clones.
2. Biochemical production.
3. Totipotency: Organoganesis; somatic embryogenesis; transfer and establishment of whole plants in soil (hardening).
4. Rapid clonal propagation and production of virus -free plants.
5. In vitro pollination; embryo culture and embryo rescue.
6. Protoplast fusion, selection of hybrid cells; symmetric and asymmetric hybrids, cybrids.
7. Nuclear cytology of cultured plant cells and somaclonal variations.
8. Production of haploid plants and their utilization.
9. Cryopreservation and slow growth for germ plasm conservation.
10. Gene transfer in nuclear genome and chloroplasts; Agrobacterium-mediated gene transfer, direct gene transfer, antibiotic marker-free transgenics.
11. Transgenic plants: insect resistance, virus resistance, abiotic stress tolerance, longer shelf life (including strategies for suppression of endogenous genes), male sterility, enhanced nutrition (golden rice), edible vaccines.
12. Molecular markers: RFLP, RAPD, AFLP, applications of molecular markers
BTM 205 (Practicals) : Based on BTM 201 & BTM 202 Credits 3
BTM 206 (Practicals) : Based on BTM 203 & BTM 204 Credits 4
BTM 205 (Minor Elective) Immunobiology (For students of other PG programs) Credits 3

Semester III
BTM 301 Animal Cell Culture
1. Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium.
2. Biology and characterization of the cultured cells.
3. Measuring parameters of growth.
4. Basic techniques of mammalian cell cultures in vitro.
5. Serum & protein free defined media and their applications.
6. Measurement of viability and cytotoxicity.
7. Apoptosis
8. Cell synchronization
9. Cell transformation.
10. Applications of animal cell culture: cell culture based products, vaccines, Hybridoma technology and monoclonal antibodies, stem cells and their applications,.
11. Organ, organotypic and histotypic cultures.

BTM 302: Bioprocess Engineering & Technology

1. Screening and improvement of industrially important microorganisms.
2. Microbial Growth and Death Kinetics.
3. Media for Industrial Fermentation.
4. Air and Media Sterilization.
5. Types of fermentation processes - Analysis of batch, Fed-batch and continuous bioreactions, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photobioreactors etc.,)
6. Measurement and control of bioprocess parameters.
.43
7. Downstream Processing
8. Whole cell Immobilization and their Industrial Applications.
9. Industrial Production of Chemicals - Ethanol, Acids (citric, acetic and gluconic), solvents (glycerol, acetone, butanol), Antibiotics (penicillin, streptomycin, tetracycline), Semisynthetic antibiotics, Amino acids (lysine, glutamic acid), Single Cell Protein.
10. Aeration and agitation: requirement of Oxygen in industrial processes. Concept of volumetric Oxygen transfer coefficient and its determination ($k_L a$). Factors affecting ($k_L a$)
11. Use of microbes in mineral beneficiation and oil recovery.
12. Introduction to Food Technology
- Elementary Idea of canning and packing.
- Sterilization and Pastuerization of Food Products.
- Technology of Typical Food/Food products (bread, cheese, idli).

BTM 303 (Practicals): Based on BTM 301 & BTM 302 Credits 3
BTM 304 (Major Elective): Research Project (Part I): Based on Research Techniques
Credits 6
BTM 305 Term Paper Based on Review + Seminar Credits 2
BTM 306M: (Minor Elective) Genomics & Proteomics (Open to all PG students) Credits 3

Semester IV

BTM 401 Environmental Biotechnology

1. Environment: Basic Concepts; Environmental Pollution; Types of Pollution; Measurement of Pollution; Environmental Management
2. Water Pollution and Its Control: Water as a Resource; Water Bodies; Need for Water Management; Sources of Water Pollution; Measurement of Water Pollution
Waste Water Treatment- Basic Concepts; Physicochemical and biological Treatment Processes, Tertiary Treatment; Disinfection and Disposal
3. Biological Treatment Processes: Biochemistry and Microbiology of Aerobic and Anaerobic Treatment Processes; Suspended and Attached Growth Type Aerobic Processes- Activated Sludge, Oxidation Ditch, Aerated Lagoons, Oxidation Ponds and Their Variations; Trickling Filters, Rotating Biological Contactors, Other Aerobic Processes.
Suspended and Attached Growth Type Anaerobic Processes- Anaerobic Digesters, Fixed and Fluidized Types of Anaerobic Bioreactors, UASB Bioreactors
Treatment of Typical Industrial Effluents- Diary, Distillery, Sugar, and Antibiotic Industries
4. Degradation of Xenobiotic Compounds in Environment: Decay Behaviour and Degradative Plasmids; Hydrocarbons; Substituted Hydrocarbons; Oil Pollution; Surfactants; Bioremediation of Contaminated Soils.
5. Biopesticides and biofertilizers; their role in pest and nutrient Management; Wormiculture
6. Solid Wastes: Sources and Management; Composition; Methane Production; Food, Feed and Fuel from Biomass
7. Global Environmental Problems: Ozone Depletion; UV-B and Green House gases and Biotechnological Approaches of their Management

BTM 402: Bioinformatics & Biostatistics

1. Introduction to Bioinformatics
2. Searching database and locating genes, Alignment of gene sequences, Local and Global.
3. Analysis of DNA sequence: Finding and calculating core nucleotide sequence, Predicting ORFs, location of transcription start point and end point, getting polypeptide sequence of the extracted core nucleotide sequence, designing primers of specific gene, generation of restriction maps,
4. Generating phylogenetic trees based on DNA sequence and evolutionary relationship
5. Analysis of proteins: Protein classification, homology modeling, trading, prediction of protein structure (secondary and 3 dimensional), tools for structure prediction, validation and visualization. .44
6. Computer assisted drug design- concept, methods and practical approaches, various computational methods applied to design the drugs: QSAR and 3DQSAR methods, CADD software demonstration
7. Diagrammatic, graphical and tabular representations of data; measures of central tendency, dispersion, skewness and kurtosis.
8. Linear regression, Pearson correlation coefficient and Rank correlation
9. Basic concepts of hypothesis testing, two kinds of error, level significance, p value, t- Test for mean and difference between two means, partial t-test., and Chi square test for goodness of fit.
10. Analysis of variance for one way and two way classified data

BTM 403 (Practicals): Based on BTM 401& BTM 402 Credits 3

BTM 404 (Major Elective): Research Project (Part II):

Dissertation and Seminar

Credits 7

Minor Electives:

BTM 107M: Microbial Technology

1. Introduction to microbial world. Different groups of microorganisms and their diversity.
2. Industrially important microbes, strain improvement and selection.
3. Isolation and cultivation of microbes and their preservation methods, Growth of microorganisms; batch and continuous culture.
4. Application of microbes in agriculture: PGPB and biofertilizers; microbes as biocontrol agent.
5. Microbes in renewable energy production: Hydrogen, methane and hydrocarbons.
6. Application of microbes in bioremediation of pollutions: Bioremediation of hydrocarbons and xenobiotic compounds, In situ and ex-situ bioremediation.
7. Commercial exploitation of microbes: Production of recombinant proteins, vaccines and enzymes; microbes as source of industrially important enzymes, immobilized enzymes and their applications.
8. Fermentation processes: batch, Fed-batch and continuous bioreactors, large scale production of antibiotics (penicillin,streptomycin) , ethanol and acetic acid.

BTM 205M: Immunobiology Credits 3

1. A brief introduction to the history of Immunology, Variolation and vaccination
2. Features of Immune Responses; Primary and Secondary immune responses; Cells and organs of immune system
3. Immunological Recognition (innate, adaptive, antigen presenting cells, Major Histocompatibility Complex)
4. Lymphocytes & Cytokines
5. Phagocytes: Macrophages, Neutrophils, Oxygen-dependent and Oxygen-independent killing mechanisms
6. Lymphocyte functions; Helper T cells, cytotoxic T cells
7. Antigen properties
8. Immunoglobulins: structure & function
9. Complement system
10. Allergies
11. Immunodeficiency & Cancer Immunology

BTM 306M: Genomics and Proteomics

1. Strategies for genome sequencing: Chain termination method, automated sequencing, pyro-sequencing.
2. Sequence assembly: Clone contig and shotgun approaches.
3. Organization of genomes: main features of bacterial and eukaryotic genome organization.
4. Human genome project and its applications.
5. Locating the genes: ORF scanning, homology searches,
6. Determination of the functions of genes: gene inactivation (knock-out, anti-sense and RNA interference) and gene over expression.
7. Approaches to analyze global gene expression: Transcriptome, Serial Analysis of Gene Expression (SAGE), Expressed Sequence Tags (ESTs), Massively Parallel Signature Sequencing (MPSS), microarray and its applications, gene tagging,
8. Proteome: Methodology to study the proteome, analysis of the functions of proteins, differential display, two hybrid system.
.45
9. Metagenomics: Prospecting for novel genes from metagenomes and their biotechnological applications