MSCBT-101: Introductory Biology
2. Kingdoms of life, or Biological Classification, species and population, Biotic community, Biosphere.
3. Cell as a unit of life: Prokaryotic and Eukaryotics cell, Plant and animal cell, cell structure, membrane organization and cell organelles. Cell function, cell division mitosis and meiosis, cell cycle.
4. Introduction to Bio Molecules:
Structure and properties of monosaccharides, disaccharides, and polysaccharides.
Structures and properties of fatty acids, glycerolipids, phospholipids, glycolipids, steroids.
Structures and Properties of amino acids peptides and protein.
Structure and properties of purines, Pyrimidines, nucleosides, nucleotides, polynucleotides, Ribonucleic acids and Deoxyribonucleic acids, nucleoprotein complexes.

SEMESTER I
MSCBT-102: Molecular Biology - I
Unit I-:-Cell: - Cell organelles: Structure function, structure of mitochondria and organization of respiratory chain, organization of cytoskeleton and nucleic.
Unit II-:- STRUCTURE & PROPERTIES OF DNA
Discovery of DNA as the genetic material, Structure of DNA (A,B&Z forms), concept & definition of the genome, C-value paradox, denaturation & renaturation of DNA, repetitive & non-repetitive DNA, reassociation kinetics. Cot curve, Rot curve, chemical & kinetic complexity of DNA, supercoiling in DNA.
Unit III -:- PROKARYOTIC AND EUKARYOTIC GENOME ORGANIZATION:-Organization of viral genome, organization of bacterial genome, chromosome structure in eukaryotes, nucleosome model, chromatin structure, satellite DNA, polytene chromosomes, lambrush chromosomes, B chromosomes-Evolution of the gene concept, definition of gene, interrupted genes, multigene families & pseudogenes, overlapping genes, nested genes, open reading frames.
Unit IV:-DNA REPLICATION:- General features of DNA replication in prokaryotes & eukaryotes, enzymology of DNA replication, regulation of DNA replication
Unit V:- GENE MUTATION, REPAIR & RECOMBINATION:-Definition & types of mutation, mutagenic agents & their mode of action, reversion & suppression of mutation.
DNA recombination mechanisms: holliday model, Rec A, Rec BCD, gene conversion.
MSCBT-103: Bioenergetics & Metabolism

Unit I
Introduction to Biochemistry, define Carbohydrate, nomenclature, classification, structure, chemistry and properties.
Biological functions of carbohydrate.
Carbohydrate metabolism: Basic concept, glycolysis, krebs cycle, pentose phosphate pathway and regulation.
Polysaccharides: Bacterial cell wall, peptidoglycans and glycolipid.

Unit II
Lipid: Define Lipid, nomenclature, classification structure, chemistry and properties.
Lipids with specific biological function. Lipoproteins and biological membrane, micelles and liposomes.
Lipid metabolism: Biosynthesis and degradation of fatty acid.
Prostaglandins, leukotrienes and thromboxanes.

Unit III
Amino acid: Structure, classification, properties and function.
Protein: Classification and properties.
Fluorimetric method for determination of N-terminal amino acid.

Unit IV
Nucleic acid: Structure, chemistry and properties of purines, pyrimidines, nucleosides & nucleotides,
Polynucleotide.
Biosynthesis and degradation of purines and Pyrimidines.
Enzyme: Basic concept.
Vitamins and their deficiency.

Unit V
First and second laws of thermodynamics & concept of free energy.
High energy phospho Compounds, ATP cycle, structural basis of free energy during hydrolysis of ATP.
Hormones: Hormones receptors and intracellular messengers, Adenylate cyclase, Protein kinase and phosphodiesterase.
Porphyrrins: Classification and Structure.

SEMESTER I
MSCBT-104: Microbiology
Unit I: THE WORLD OF BACTERIA:
General characteristics & classification of bacteria according to Bergey's manual of systematic bacteriology.
Nutritional requirements & physical conditions necessary for cultivation of bacteria, properties of bacteriological media.
Unit II: HISTORY AND SCOPE OF MICROBIOLOGY: Milestone in Microbiology - Recent development and future trends.
Unit III: MICROBIAL METABOLISM & STAINING TECHNIQUES
Classification of bacteria on the basis of their nutritional requirements, transport of substances across membranes.
Procedure and principle involved in gram's staining, acid fast staining, flagella staining, endospore staining.

Unit IV: Microbial growth & nutrition:
Definition of growth, mathematical expression of growth, measurement of growth field; synchronous growth, continuous culture, effect of environmental factor on growth.

Unit V: Microbial Ecology:
Rhizosphere, phylloplane & role of microorganism is productivity of ecosystem. Interaction between microorganism, and with plants and animals. Biogeochemical cycle.
Microbes & bio-deterioration.

SEMESTER I
MSCBT-105: Biophysical Chemistry & Instrumentation

Unit I
Free radicals in biological systems, antioxidants.
Isomerism: Structural and steroisomerism optical activity, meso compounds. Specific rotation, chirality, chiral, enantiomers, conformation and configuration. Conformational analysis of monosacharides, boat and chair forms, eclipsed. Mutarotation, glycosides epimers.

Unit II
Centrifugation: Principle, types, analytical and prepared centrifugation, differential density, gradient centrifugation, sedimentation and coefficient centrifuge and its application.
Electrophoresis: Principles, types and application (paper, starch, gel polyacrylamide and agar electrophoresis).
Chromatography: Principle type and application, (Paper, thin layer, gas ion exchange and molecular sieve).
Affinity chromatography, HPLC, FPLC.

Unit III
Photometry: Basic Principle of UV-Vis spectrophotometry and colorimetry.
Fluorimetry: Principle, instrument and application.
Flame techniques, atomic absorbtion spectroscopy.
Isoelectric focusing and Isotachophoresis.

Unit IV
Microscopy: Light, phase contrast, interference and electron microscopy.
X-ray crystallography.
Radioactivity: Radioisotopes, half life, units. Geiger Mueller counter.
Scintillation; Liquid, Crystal and gamma counter.

Unit V
ESR: Principle, instrumentation and its application.
NMR: Principle, instrumentation and its application.
ORD and CD: Principle, instrumentation and its application.
Polarimetry: Principle, instrumentation and its application.

**INSTRUMENTATION PRACTICAL**

**Practical course of Semester I**

Verification of Beer's law.

Determination of absorption maxima.

Electrophoresis of Proteins - native and under denaturing conditions.

Amino acid and carbohydrate separations by paper and thin layer chromatography.

Separation of blood cells by density gradient centrifugation.

Chromatographic method for separation of macromolecules.

Separation of subcellular organelles by differential centrifugation.

Electrophoresis of DNA - linear, circular and super coiled.

**SEMESTER I**

**MSCBT-106: Communication & Soft Skills**

**UNIT I**

**Essentials of Grammar:**

• Parts of Speech
• Punctuation
• Vocabulary Building
• Phonetics

**UNIT II**

**Office Management:**

• Types of Correspondence
• Receipt and Dispatch of Mail
• Filing Systems
• Classification of Mail.
• Role & Function of Correspondence
• MIS
• Managing Computer

**UNIT III**

**Letter & Resume Writing:**

• Types of Letters-Formal / Informal
• Importance and Function
• Drafting the Applications
• Elements of Structure
• Preparing the Resume
• Do’s & Don’ts of Resume
• Helpful Hints

**UNIT IV**

**Presentation Skills:**

• Importance of Presentation Skills
• Capturing Data
• Voice & Picture Integration
• Guidelines to make Presentation Interesting
• Body Language
• Voice Modulation
UNIT V
Interview Preparation:
- Types of Interview
- Preparing for the Interviews
- Attending the Interview
- Interview Process
- Employers Expectations
- General Etiquette
- Dressing Sense
- Postures & Gestures

UNIT VI
Group Discussion & Presentation:
- Definition
- Process
- Guidelines
- Helpful Expressions
- Evaluation

(Note: Every student shall be given 15 minutes of presentation time & 45 minutes of discussion on his/her presentation.)

The student will be evaluated on the basis of:
- his/her presentation style
- Feedback of Faculty & Students
- General Etiquette
- Proficiency in Letter Drafting / Interview Preparation

The paper is internal and at least 3 tests will be taken. Best 2 of 3 shall account for final grades (70% Test & 30% Presentation)

SEMESTER I
MSCBT-107: Practical
Introductory Biology: 15 Marks
Molecular Biology - I: 15 Marks
Bioenergetics & Metabolism: 15 Marks
Microbiology: 15 Marks
Biophysical Chemistry & Instrumentation: 15 Marks
Internal Assessment: 25 Marks
SEMESTER II

MSCBT-201: ENZYMEOLOGY & ENZYME TECHNOLOGY

Unit I
(i) Enzyme: Historical aspects, nomenclature and classification.
(ii) General properties of enzymes and the factors that affect their activity and the associated changes.
(iii) Extraction assay and purification of enzymes.
(iv) Sub-cellular localization and organization of enzymes.

Unit II
(i) Enzyme kinetics (steady state), determination of Km value and studying, kinetics using, Lineweaver-Burke plot, Eady Hofstee plot and Hans-Woolf equations.
(ii) Enzyme inhibitors-Presteady state kinetics-fast kinetics to elucidate the intermediate and rate limiting steps (Low and relaxation techniques). Complex kinetics and analysis.
(iii) Allosteric enzyme.
(iv) Rapid reaction techniques.

Unit III
(i) Enzyme specificity- Evidences for enzyme substrate complex Nucleophilic and electrophilic attack.
(ii) Role of metal ions in enzyme catalysis.
(iii) Mechanism of enzyme action - (Lysozyme, chymotrypsin), DNA polymerase, RNAse etc.
(iv) Zymogens and enzyme activators, active site determination.
(iii) Regulation of enzymes
(iv) AllostERIC interactions and product inhibition.

Unit IV
(i) Coenzymes
(ii) Isoenzymes & metalloenzymes.
(iii) Membrane bound enzymes-their extraction assay.
(iv) Lipid-protein interaction and the effect of fluidity on enzyme activity.

Unit V
(i) Immobilisation; Principle, kinetics of immobilised systems.
(ii) Enzyme immobilisation: Principle, method, activity and application.
(iii) Effect of immobilisation on: activity, kinetics parameters and stability.
(iv) Application of immobilized enzyme.

Practical
Q1. Study of transduction, transformation, conjugation in E.coli.
Q2. Study of mutation in E.coli.
Q3. Assay of Enzyme activity.
Q4. Kinetic studies on enzyme.
Q5. ALkaline phosphatase estimation.
Q6. ELisa test.
Q7. Immobilization of Enzymes.
Q8. Urease estimation by colorimetric method.

MSCBT-202: BINFORMATICS
Overview of Bio-Informatics- Database types, sequence database-nucleotide and protein sequence database, primary and secondary database, Gene Bank, Structure database-protein Data Bank (PDB),
Visualization of structural information, Genomics and the genome. Project sequencing and sequence assembling using computers.

SEMESTER II
MSCBT-203: MOLECULAR BIOLOGY-II

Unit - I :- TRANSPOSABLE GENETIC ELEMENTS
Discovery & definition of transposons, simple transposons (IS elements), composite transposons (Tn3, Tn5, Tn9, TnI0), Ac/Ds elements in maize, P elements in drosophila, Retxotransposons, mechanisms of transposition.

Unit II:- Gene Expression:- Structure, classes & function of RNA. RNA transcription and processing in Eukaryotes and prokaryotes genetic code and protein synthesis. Transcription and translational controls.


Unit IV:- Gene as unit of Mutation & Recombination :- Physical and Chemical Basis of Mutation: Mechanism of mutagenesis, Mutation of DNA & protein levels. Recombination is Bacteria - Transformation, transduction and conjugation, mechanism of gene transfer and application.

Unit V:- Oncogenes and their properties ; classification, characteristics and significance in development, Differentiation and Carcinogens . An overview of Apoptosis its phases and significance, Apoptosis in pathogenesis & therapeutic implication.

Practical
Q1. Isolation of genomic DNA from bacterial cells.
Q2. Isolation of plasmid DNA from bacterial cells.
Q3. Isolation of genomic DNA from plant cells.
Q4. Transformation of CaCl2

MSCBT-204: GENETIC ENGINEERING

Unit I
Core techniques in gene manipulation ; Cloning strategies ; Construction of-gene libraries; Probe construction; recombinant selection and screening -DNA sequencing, RFLP, DNA finger printing;
Expression analysis; sequencing mutagenesis Engineering genes; Polymerase chain reaction; Ligase chain reaction.

Unit II
Expression systems and their applications; Production of protein from cloned genes; gene cloning in research, medicine and agriculture; Intellectual Property Rights (IPR) and patents, biosafety, containment facilities for
Genetic Engineering experiments. Regulations on field experiments and release of GMO's (Genetically Modified Organisms), labelling of GM (Genetically Modified) Foods.

Unit III

Unit IV

Unit V

Practical
Q1. Study of transduction, transformation, conjugation in E.coli.
Q2. Study of mutation is E.coli.

MSCBT-205: PRACTICAL
EnzymoLogy & Enzyme TechnoLogy - 20 Marks
Bioinformatics - 15 Marks
MoLecuLar BioLogy - II - 20 Marks
Genetic Engineering - 20 Marks
Internal Assessment - 25 Marks
SEMESTER III

MSCBT-301: Immunology

Unit I
Immune response: Type of Immunity, Antigens and haptens.
Anatomy of Lymphoid organs; primary and secondary Lymphoid organs.
Immunoglobulin Structure, function and synthesis, memory cells Lymphocyte differentiation.
Cell of the immune system: Mononuclear cells and granulocytes, Lymphocytes and their subsets.

Unit II
Biology of complement systems: structure and function of MHC class I & II molecules.
Antigen recognition and presentation, cell mediated immune responses.
Hypersensitivity reactions; Immune suppression and Immune Tolerance immune disorders, Transplantation.
Role of complement system in immune responses.

Unit III
Antigen - Isolation, purification and characterization of various antigens and haptens from pathogens
and other biological molecules by biophysical and chemical and affinity separation methods.
Production of antibodies, purification of antibodies, Quantitation of immunoglobulins by RID, EID and nephelometry. Hybridoma and monoclonal antibody production.
Immuno-diagnosis and Applications of monoclonal antibodies in biomedical research; human monoclonal antibodies, Catalytic antibodies; complement fixation test; assessment of immune complex in tissues.

Unit IV
Purification of mononuclear from peripheral blood; isolation and characterization of T cell subsets; B cells and macrophages.
Fluorescent Activated cell sorter (FACS); Mitogen and Antigen induced Lymphoproliferation assay.
Cell mediated Lympholysis; Mixed Lymphocyte reaction.
Assessment of delayed hypersensitivity reactions; Macrophage cultures.
Assay for Macrophage activation; Isolation of dendritic cells; In situ and in vivo characterization of cells from tissues; Generation of T cell HLA typing.

Unit V
Cytokines: Structure and functions, Cytokine receptors, Biology and assay of cytokininess.
Cytotoxic T cells and their mechanism of action, NK cells and mechanism of target cell destruction.
Vaccine technology including DNA vaccines; identification of T & B epitopes for vaccine developments, Immunotechnolog and infectious diseases. Immunoscreening of recombinant Library.

Practical
QL. Blood film preparation and identification of cells.
Q2. Separation of serum proteins by electrophoresis.
Q3. Study of antigen and antibody interaction by double diffusion method.
Q4. Study of antigen and antibody interaction by immuno-electrophoresis.
Q5. Study of antigen and antibody interaction by counter-current immuno-electrophoresis.
MSCBT-302: Plant Biotechnology

PLant genome organisation, structure of representative pLant genes and gene famiLies in pLants -

Organisation of chLoropLast genome, nucl ear encoded and chLoropLast encoded genes for chLoropLast proteins, targeting of oroteins to chLoropLast - Organisation of mitochondria! genome - encoded genes for mitochondriaL proteins - RNA editing for pLant mitochondria - cytopLasmic maLe steriLity - Seed storage proteins - maize transposable eLements, their organisation and function, transposable eLements in transgenic pLants - ReguLation of gene expression in pLant deveLopment - PLant hormones and phytochrome.

Unit II


Unit III

Genetic engineering in pLants, seLectabLe' markets, reporter genes and promoter used in pLants by physical means - Genetic engineering of pLants for construction of genome Libraries and CDNA Libraries, moLecuLar breeding.

Practical

Preparation of fissure culture medium for plants
Preparation of single cell suspension from spleen or thymus & plants.
PrototPlast fusion.
Cell counting & cell viability.
Callus Propagation, organogensis, transfer of plant to soil.

SEMESTER III

MSCBT-303: Environmental Biotechnology

Unit-I

Environment: basic concepts and issues ; environmental poLLution : types and methods for the measurement; methodology of environmental management- probLem solVing approach, its Limitations;
air poLLution and its control through biotechnolOgy, aLgae bLooms and human heaLth.

Unit - II

Water poLLution and its control: water as a scarce natural resource, need for water management,
sources and measurement of water poLLution, waste water treatment-physical, chemical and bioloGical treatment processes; aLgae bLooms and human heaLth.

Unit-III

MicrobioLogy of waste water treatments : aerobic process- activated sludge, oxidation switches, trickling filTer, towers, rotating discs, rotating drums, oxidation ponds; anaerobic processes- anaerobic
digestion, anaerobic filters, upflow anaerobic sludge blanket reactors; treatment schemes for waste waters of dairy, distillery, tannery industries; biotechnological applications of microbes from extreme environment.

Unit-IV

Microbial degradation of xenobiotics in the environment - ecological considerations, decay behaviour & degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides; bioaccumulation of metals and radio-nuclerds and detoxification; bioremediation.

Unit-V

Biological N2 fixation, H2 production, biofertilizers and biopesticides; solid wastes: sources and management (composting, wormiculture and methane production). Single cell protein (Spin/Una, yeast, mushroom); global environmental problems- ozone depletion, UV-B, greenhouse effect and acid rain, their impact and. biotechnological approaches for

Practical

Isolation of industrially important microorganism for microbial processes. Determination of thermal death point (TDP) and thermal death time (TDT) of microorganism for design of a sterilizer. Comparative study of Ethanol production using different substrate.

SEMESTER III

MSCBT-304: Bioprocess Engineering & Technology

Unit-I

Introduction to bioprocess engineering, bioreactors, isolation, preservation and maintenance of industrial microorganisms; kinetic of microbial growth and death; media for industrial fermentation, air and media sterilization.

Unit-II

Types of fermentation processes, analysis of batch, fed-batch and continuous bio-reactides, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photobioreactors etc.); measurement and control of bioprocess parameters.

Unit-III

Downstream processing: introduction, removal of microbial cells and solid matter, foam reparation, precipitation/filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography; membrane process, drying and crystallization; effluent treatment- D.O.C. and C.O.D. treatment and disposal of effluents; whole cell immobilization and their industrial applications.

Unit-IV

Industrial production of chemicals: alcohol (ethanol), acids (citric acetic and gluconic) solvents, (glycerol acetone butenol) , antibiotics (penicillin), amino acids (lysine), single cell-protein.

Unit-V

Use of Microbes in mineral beneficiation and oil recovery; Introduction to food technology: Elementary idea of canning and packing, sterilization and pasteurization of food products, technology of typical food / food products( Bread, Cheese, Idli ), food Preservation.

Practical

Isolation of antibiotic producing microorganism from soil. Use of alginate for cell immobilization.
Detection of coli—for determination of purity of potable water.
Detection of COD/BOD for a sewage sample.
Determination of the efficiency of removal of air. Pollutant by using air samples.
Test for the degradation of aromatic hydrocarbon by bacteria.

SEMESTER III
MSCBT-305: Practical
Immunology: 20 Marks
Plant Biotechnology: 15 Marks
Environmental Biotechnology: 20 Marks
Bioprocess Engineering & Technology: 20 Marks
Internal Assessment: 25 Marks

SEMESTER IV

MSCBT-401: Biostatistics
Unit I: Introduction: definition, scope and limitation of biostatistics; concept of variables in biological systems; collection, classification, tabulation, graphical diagrammatic representation of data, measures of central tendency (arithmetic, harmonic & geometric), median and mode; confidence limit of population mean.
Unit II: Measure of dispersion: range, standard deviation variance, coefficient of variation; definition and basic properties of probability, normal and binomial distribution function, test of significance, hypothesis, error, level of significance; t-statistics: test that a population mean equals a specified value, paired ‘t’ test.
Unit III: F-statistics: one way analysis of variance (sample size equal and unequal), chi-square statistics, test of goodness of fit, test of independence of factor; correlation and its coefficient/Linear regression and its coefficient regression equation & its diagram.
Unit IV: Introduction to database concept, introduction to internet and its application, introduction to MS office software, covering word processing, spreadsheets, introduction to hardware graphics.
Unit V: Computer oriented statistical techniques by using Excel: frequency table of single discrete variable, computation of mean, variance and standard deviation;

SEMESTER IV
MSCBT-402: Animal Biotechnology
Unit - I
Basic principles of Biotechnology as applicable to animal science - Artificial Insemination, pregnancy diagnosis, In-vitro fertilization - Embryo Transfer Technology - Transgenic Animals.
Unit - II
Ethical aspects in Animal Biotechnology.

Unit - III
Biofueling and Control technology. Bioremediation. Use transgenic technology to study fish growth and development

Unit IV
Genetic engineering and ploidy manipulation to enhance growth reproduction and development of disease resistance in aquaculture species. Cryobiology in Marine germlasm preservation Pharmaceuticals from marine organisms.

SEMESTER IV
MSCBT-403: Pharmaceutical Biotechnology

Unit I
Production recombinant pharmaceuticals:
Recombinant insulin
Human Growth factor synthesis
Recombinant factor VIII

Unit II
Synthesis of:
Recombinant vaccine
Recombine Protein
Live recombinant vaccine

Unit III
Identification of genes responsible for human disease.
Breast cancer
Autosomal dominant and recessive disorders.
X-linked disorders.

Unit IV
Gene therapy of somatic cell.
Genetic Manipulation of Germ cell.

Unit V
Prospects and
Ethics of gene therapy

SEMESTER IV
MSCBT-404: Research Methodology

Introduction to Research: Definition, Scope, Limitations, and Types.
Objectives of Research
Research Process
Research Designs
Data Collection: Secondary Data, Primary Data, and Methods of Collection.
Scaling Techniques: Concept, Types, Rating scales & Ranking Scales
ScaLe Construction Techniques, MuLti Dimensional Scaling.
SampLing Designs: Concepts, Types and Techniques
Sample Size Decision
Theory of Estimation and Testing of Hypothesis
Small & Large SampLe Tests, Tests of Significance based on t, F, Z test and Chi-Square Test.
Designing Questionnaire.
Interviewing.
Tabulation, Coding, Editing.
Interpretation and Report Writing.

SEMESTER IV
MSCBT-405: Practical / Training
Biostatistics : 20 Marks
Animal Biotechnology : 20 Marks
Pharmaceutical Biotechnology : 15 Marks
Research Methodology : 20 Marks
Internal Assessment: 25 Marks