# SRIDEV SUMAN UTTARAKHAND UNIVERSITY
# TEHRI GARHWAL

# SYLLABUS FOR

# M.SC
# (BIOTECHNOLOGY)

# COURSE STRUCTURE & ORDINANACES FORM.Sc. BIOTECHNOLOGY

Course duration : Four semester (two years)

1. Objectives and Rules: Four semesters (two years) M.Sc. Programme is formulated for developing competent Biotechnologist who are confident enough to take up various jobs. The course is based on interdisciplinary nature of Biochemistry, Chemistry, Quantitative Biology, Genetics, Microbiology and Biophysics. The programme obliges students to read original publications and envisages significant inputs in laboratory work, communication skill, creativity, planning, execution and critical evaluationof the scientific data.

*2* Eligibility for admission: Bachelor in Biochemistry, Chemistry, Microbiology, Biotechnology Life Sciences, ZBC, PCM, BVSc, B.Pharm & MBBS are eligible for admission to the course.

Marks requirement : Minimum 55% of aggregate (General Category), Minimum 50% of aggregate (SC, ST Category) or as per University / Government norms.

*3* There shall be five theory papers (Paper I, II, III, IV & V), two lab. Courses (Paper VI & VII) and a seminar & internal assessment in M.Sc. First semester.

*4* There shall be five theory papers (Paper VIII, IX, X, XI & XII), two lab. Courses (Paper XIII & XIV) and a seminar & internal assessment in M.Sc. Second semester.

*5* There shall be five theory papers (Paper XV, XVI, XVII, XVIII & XIX), two lab. Courses (Paper XX & XXI) and a seminar & internal assessment in M.Sc. Third semester.

*4* There shall be a dissertation (Paper XXII) in M.Sc. Fourth Semester.

*5* Student will be assigned dissertation under the supervision of acompetent faculty member (having Ph.D. degree) of the Institute in the fourth semester at the beginning of the semester which will continue till the end of the session. In some special cases where the department decides then a major topic may be assigned for maximum two students

for dissertation work. The dissertation work will be evaluated by the examiners appointed by the University.

***6*** Evaluation of seminar will be done as per given Performa. Evaluation of seminar will be done separately by individual teachers & average of all theassessment by all the teachers will be considered as final marks. Dissertation will be evaluated on the basis of Thesis Writing, Presentation& Defense**.**

*7* The minimum passing marks shall be 50% in aggregate and 40% in each individual paper of theory, practical, seminar & internal assessment and dissertation / project work.

*8* The division shall be determined on the basis of aggregate marks of all the papers ( theory, practical, seminar, internal assessment and dissertation / project work) of both previous and final year prescribed for the degree.

*9* Conduct of examination and award of division will be as per following :-

| | | |
|---|---|---|
| *a)* | First division | 60% and above |
| *b)* | Second division | 48% and above but less than 60% |
| *c)* | Third division | 40% and above but less than 48% |

*10* The details of papers and scheme of examination is given on following pages.

# SRIDEV SUMAN UTTARAKHAND UNIVERSITY

STUDY AND EVALUATION SCHEME

M.Sc. BIOTECHNOLOGY Ist YEARSEMESTER-I

| S.No. | Course Code | Subject Name | Period (Hours) | | Sessional Exam | ESE | Subject Total | Credit hours |
|---|---|---|---|---|---|---|---|---|
| | | THEORY | L | P | | | | |
| 1. | MBT-511 | BIOCHEMISTRY | 4 | 0 | 30 | 70 | 100 | 4 |
| 2. | MBT-512 | MEMBRANE BIOLOGY & BIOPHYSICS | 4 | 0 | 30 | 70 | 100 | 4 |
| 3. | MBT-513 | MICROBIOLOGY & MICROBIAL GENETICS | 4 | 0 | 30 | 70 | 100 | 4 |
| 4. | MBT-514 | MATHS,BIOSTAT &COMPUTER | 4 | 0 | 30 | 70 | 100 | 4 |
| 5. | MBT-515 | BIOANALYTICAL TECHNIQUES | 4 | 0 | 30 | 70 | 100 | 4 |
| PRACTICALS DAY TO DAY EVALUATION | | | | | | | | |
| 1. | MBT-551 | PRACTICAL-I (PAPER 1 & 2) | 0 | 8 | 30 | 70 | 100 | 4 |
| 2. | MBT-552 | PRACTICAL-II ( PAPER 3, 4 & 5) | 0 | 8 | 30 | 70 | 100 | 4 |

# SRIDEV SUMAN UTTARAKHAND UNIVERSITY

STUDY AND EVALUATION SCHEME

M.Sc. BIOTECHNOLOGY Ist YEARSEMESTER-II

| S.No. | Course Code | Subject Name | Period (Hours) | | Sessional Exam | ESE | Subject Total | Credit hours |
|---|---|---|---|---|---|---|---|---|
| | | THEORY | L | P | | | | |
| 1. | MBT-521 | CELLULAR & MOLECULAR IMMUNOLOGY | 4 | 0 | 30 | 70 | 100 | 4 |
| 2. | MBT-522 | CELL & DEVELOPMENTAL BIOLOGY | 4 | 0 | 30 | 70 | 100 | 4 |
| 3. | MBT-523 | MOLECULAR BIOLOGY AND MOLECULAR GENETICS | 4 | 0 | 30 | 70 | 100 | 4 |
| 4. | MBT-524 | ADVANCES IN GENETIC ENGINEERING (RDT) & GENOMICS | 4 | 0 | 30 | 70 | 100 | 4 |
| 5. | MBT-525 | GENOMICS ,PROTEOMICS & ENZYMOLOGY | 4 | 0 | 30 | 70 | 100 | 4 |
| PRACTICALS DAY TO DAY EVALUATION | | | | | | | | |
| 1. | MBT-561 | PRACTICAL-I (PAPER 1 & 2) | 0 | 8 | 30 | 70 | 100 | 4 |
| 2. | MBT-562 | PRACTICAL-II (PAPER 3,4 & 5) | 0 | 8 | 30 | 70 | 100 | 4 |

# SRIDEV SUMAN UTTARAKHAND UNIVERSITY

STUDY AND EVALUATION SCHEME

M.Sc. BIOTECHNOLOGY IInd
YEAR SEMESTER-I

| S.No. | Course Code | Subject Name | Period (Hours) | | Sessional Exam | ESE | Subject Total | Credit Hours |
|---|---|---|---|---|---|---|---|---|
| | | THEORY | L | P | | | | |
| 1. | MBT-611 | PLANT BIOTECHNOLOGY | 4 | 0 | 30 | 70 | 100 | 4 |
| 2. | MBT-612 | ANIMAL BIOTECHNOLOGY | 4 | 0 | 30 | 70 | 100 | 4 |
| 3. | MBT-613 | ENVIRONMENTAL BIOTECHNOLOGY | 4 | 0 | 30 | 70 | 100 | 4 |
| 4. | MBT-614 | BIOPROCESS ENGINEERING & TECHNOLOGY | 4 | 0 | 30 | 70 | 100 | 4 |
| ONE OPTIONAL COURSE AS PER THE CHOICE OF STUDENT | | | | | | | | |
| 5A. | MBT-615A | FOOD & BEVERAGE BIOTECHNOLOGY | 4 | 0 | 30 | 70 | 100 | 4 |
| 5B. | MBT-615B | PHARMACEUTICAL BIOTECHNOLOGY | 4 | 0 | 30 | 70 | 100 | 4 |
| 5C. | MBT-615C | MOLECULAR DIAGONOSTICS & IMMUNOTECHNOLOGY | 4 | 0 | 30 | 70 | 100 | 4 |
| PRACTICALS DAY TO DAY EVALUATION | | | | | | | | |
| 1. | MBT-661 | PRACTICAL-I (PAPER 1 & 2) | 0 | 8 | 30 | 70 | 100 | 4 |
| 2. | MBT-662 | PRACTICAL-II (PAPER 3,4 & 5) | 0 | 8 | 30 | 70 | 100 | 4 |

# SRIDEV SUMAN UTTARAKHAND UNIVERSITY

STUDY AND EVALUATION SCHEME

M.Sc. BIOTECHNOLOGY IInd YEARSEMESTER-I

| S.No. | Course Code | Subject Name | Period (Hours) | | Session al Exam | ESE | Subject Total | Credit hours |
|---|---|---|---|---|---|---|---|---|
| | | THEORY | L | P | | | | |
| 1. | MBT-621 | PROJECT/DISSERTATION | 0 | 48 | 200 | 200 | 400 | 24 |

FIRST YEAR

TOTAL MARKS SEMESTER-I 700

TOTAL MARKS SEMESTER-II 700

SECOND YEAR

TOTAL MARKS SEMESTER-I 700

TOTAL MARKS SEMESTER-II 400

AGGREGATE 2500

**M.Sc BIOTECHNOLOGY I Year**
**Semester ICourse Code: MBT 511**
**BIOCHEMISTRY**

Note:

1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attemptQuestion No. 1 & five more selecting one question from each Unit.
   As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution ofmarks will be indicated part - wise.

**Unit I**

Introduction to biochemistry and its scope. Types and strength of solutions, acidbase and salts, pH, solutions and their importance, redox potentials, bonding in

Biomolecules.

**Unit II**

Carbohydrates: classification, structure, chemistry, properties and function. Proteins: Types of amino acids, structure, properties and functions. Chemical bonding in proteins. Primary, secondary, tertiary and quaternary structure of proteins and Ramachandran plot. Lipids: classification, nomenclature, properties and function. **Unit III**

Enzymes: Classification, structure, kinetics and mechanism of action. Coenzymes, isoenzymes and ribozymes.

**Unit IV**

Thermodynamics and bioenergetics-concept of entropy and free energy changes in biological reactions, redox reactions. Role of high energy phosphates, structural basis of free energy change of ATP hydrolysis. Carbohydrate metabolism: Glycolysis, Kreb's cycle, oxidative phosphorylation and pentose phosphate pathway, Gluconeogenesis, glycogenesis, and glycogenolysis.

**Unit V**

Lipid metabolism: Transport of fatty acid, oxidation of fatty acids (α, β, w) Oxidation of unsaturated and odd chain fatty acidsCholesterol metabolism and its regulation, Regulation of fatty acid metabolism. Ketone bodies. Biosynthesis of amino acids, amino acid breakdown and urea cycle. Biosynthesis and breakdown of purine and pyrimidine nucleotides.

## M.Sc. BIOTECHNOLOGY I Year

## Semester ICourse Code: MBT 512

## MEMBRANE BIOLOGY & BIOPHYSICS

Note:

1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short – answer type covering the entire syllabus, will be compulsory.
4. The remaining ten questions Shall be set Unit wise with two questionsfrom each Unit I, II, III, IV & V. The candidates shall be required to attempt Question No. 1 & five more selecting one question from each Unit.

As far as possible, the questions shall be short answer type and not essay type.

4. Each question will be subdivided into 2 – 4 parts & the distribution ofmarks will be indicated part – wise.

**Unit 1**

Biological membranes: Structure, organization, lipid bilayer, proteins( Integral, peripheral & lipid anchored) & glycoconjugates, liposomes, membrane fluidity, asymmetry, phase transition, lateral and tranverse diffusions Intracellular compartmentalization: structure and functions of organelle membranes: nucleus, mitochondria, lysosome, golgi, endoplasmic reticulum, chloroplast Plasma membranes of specialized cells: erythrocytes, neurons and muscle cells

**Unit-2**

Cell motility & Shape: structure and functions of microfilaments, microtubules and intermediate filaments. Integrating cells into tissues: cell adhesion and communications, cell matrix adhesion, extracellular matrix, collagen and non collagen components, intra-cellular communications.

**Unit-3**

Molecular mechanism of vesicular transport: Vesicular traffic in secretory and endocytic pathways, transport from ER through Golgi network to lysosome, endocytosis, excocytosis
Cell signaling: general principles (Types of signaling), cell surface receptor mediated signaling (ion channels, G-protein and enzyme linked)

**Unit-4**

Membrane transport: Facilitated diffusion, Ionic transport, types of transport (symport, antiport, active & passive), channel proteins, transport across epithelia, functions of nuclear pore

**Unit-5**

Equilibrium potential in biological memberanes, Nernst equation, Gibbs-Donnan equilibrium, resting potential, Golman-Hodgkin-Katz equation, propogation of nerve impulse: nature phases, temporary dynamics and main properties, Synapse.

## M.Sc. BIOTECHNOLOGY I Year
## Semester ICourse Code: MBT 513
## MICROBIOLOGY & MICROBIAL GENETICS

**UNIT I**

Microbial world: Classification and general account of microorganisms: Bacterial, Fungi, Algae, Protozoa, Viruses, Yeast and Mycoplasma. Introduction to Bacteriology: Fine Structure of Bacteria; Laboratory Identification and staining techniques. Introduction to Virology: classification, general structure, lysogenic and lytic cycle of Bacteriophage (T-2) Media for microbial culture: selective and differential media, enriched media. Pure culture technique. Action mechanism of Antibiotics.

**UNIT-II**

Microbial growth: Synchronous & Diauxic, Factors affecting Microbial Growth. Measurement of microbial growth (cell number & cell count). Modes of Nutrition:

Photoautotrophs, photoorganotrophs, chemolithotrophs, chemoorganotrophs. Microbial metabolism: Overview of Energy production and utilization, $N_2$ fixation. General microbiology of water, air, soil & sewage.

**UNIT III**

Modes of genetic recombination in Bacteria: Conjugation- distinct sexes in E.coli, F-factor,conjugal transfer process, interrupted mating and time of entry mapping, high frequency recombination (hfr) strains. Transformation- competence, DNA uptake by competent cells.Mechanism of transformation. Gene mapping by transformation. Transduction- types of transduction, mechanism of generalized transduction, abortive transduction, formation of specialized transduction particles, transfection.

**UNIT IV**

Mutation and mutagenesis: phenotypes and genotypes, auxotrophic mutants, conditional and lethal mutants. Spontaneous Mutation- the random nature of mutations, evidences for spontaneous mutations, mutation rate, the origin of spontaneous mutations. Induced Mutation- chemical mutagens, alkylating agents (EMS and nitrosoguanidine), intercalating agents (acridine orange) and physical agents. Plasmids and Transposable elements: Types of plasmids, detection of plasmids, F-Plasmids in E.coli, conjugative and non conjugative plasmids. Control of plasmid copy number, plasmid amplification incompatibility, plasmid DNA, replication, curing of plasmids. Transposable Sequences- insertion sequences (IS), composite transposons (Tn10, Tn5), Phage Mu as transposon, conjugative transposons.

**UNIT V**

Genetics of Bacteriophages: Lytic and Lysogenic cycle, expression of phage genes in regulation of lytic and lysogenic circuit. Maintenance of lysogen by autogenous circuit, repressor structure and repressor synthesis.

**M.Sc BIOTECHNOLOGY I Year**
**Semester IICourse Code : MBT 514**
**Biomaths, Biostatistics and Computer Application**Note:

1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attempt Question No. 1 & five more selecting one question from each Unit. As far as possible, the questions shall be short answer type and not essay type.
4. Each question will be subdivided into 2 - 4 parts & the distribution of marks will be indicated part - wise.

**Unit –I**

Introduction: relationship of life science with Mathematics, Linear Function concept
Periodic Function: Introduction, Coordinate System, Elementary Trigonometry & Trigonometric relations, Trigonometric Polynomials. Differential & Integration Concept.

**UNIT-II**

Mathematical study of single & interacting species behaviour. Growth Rate concept & Exponential Growth, Logistic Model, Mathematical Technique- Trajectories & Equilibra. Logarithm: Conversion and Plotting of Graph.

**UNIT- III**

Importance of biostatics in biomedical research. Mean, Mode & median, Range, Variance, Standard deviation Standard error. Graphs: Bargraphs, Histogram, polygons, Scatter, Pie , line. Concepts of co-efficient of variation. Skewness & curtosis. Correlation, Regression (scatter diagram, regression co-efficientregression lines ).

**UNIT- IV**

Elementary idea of probability and its application. Random variables and their distribution (elementary idea). Binomial, Poisson & Normal distribution. The t tests, f test Chi- square tests.

**UNIT-V**

Introduction to computers : Mini, micro, main frame and super computers . components of computer system(CPU, I/O units). Data storage device, Memory concepts. Software and types of software. Introductory concepts of computer language. Elementary idea of disk operating system (DOS). Elementary ideas of application of common packages, WINDOWS(3.1, 95, 98). Computer application in biology and information communication (database , e-mail and local networks).Applications of common packages, Microsoft word, Microsoft excel, Microsoft Powerpoint.

**M.Sc. BIOTECHNOLOGY I Year**
**Semester ICourse Code: MBT 515**
**Bio-Analytical**
**TechniquesUnit I**

Analytical separation methods: Principles and techniques. Chromatography- General principle, application and types. Adsorption chromatography, Partition chromatography, Gas chromatography, liquid chromatography, paper chromatography, thin layer chromatography, Gel filtration chromatography, ionexchange chromatography, affinity chromatography, HPLC(High performance/ Pressure Liquid chromatography)

**Unit II**

Electrophoresis- General principle, application and types: Paper electrophoresis,moving boundary method, Gel electrophoresis (native, denaturing & reducing), Disc Gel electrophoresis, Slab Gel electrophoresis, isoelectrofocussing (IEF), isotachophoresis, molecular weight estimation. Centrifugation: Basic principles, common centrifuges used in laboratory (clinical, high speed & ultra centrifuges). Types of rotors (fixed angle, swung bucket). Types of centrifugation: Preparative,differential & density gradient, Ultra centrifugation: sedimentation rate: zonal centrifugation, equilibrium density gradient centrifugation sedimentation constants.

**Unit III**

Basic knowledge of the principles and applications of Microscopy: Light, Phase contrast, fluorescence, confofac microscopy Scanning and transmission. Electron microscopy (SEM, TEM). Biosensors: Introduction & Principle, first, second & third generation instruments, cell based biosensors, enzyme immunosensors. Spectroscopic methods: Principle and applications of UV- visisble, IR, NMR, ES Round, X-ray, spectroscopy.

**Unit IV**

Application of radioisotopes in biology. Properties and units of radioactivity. Radioactive isotopes and half life. Measurement of radioactivity : (Basic knowledge) GM counter, gamma counter, liquid scintillation counter. Tracer techniques (basic knowledge): Autoradiography, radioimmunoassay, pitfalls of immunoassays, radioreceptor assay. Safety rules in handling of radioisotopes and hazardous chemicals.

**Unit V**

General patent information: US patent laws, patentable subject matter. Requirement for patentability: utility, novelty, Nonobviousness, sufficiency of disclosure. Rights of a patent, infringement of a patent. Procedures for patent applications: Provisional & regular Parts of patent application: Patent prosecution, appeals & interference proceedings, Applying for foreign patent protection. Unique aspects of biotechnology patent laws & procedures: fulfillment of the Utility, novelty, Nonobviousness, sufficiency of disclosure.

**Recommended Books:** Sharma V.K: techniques in Microscopy and cell biology Tata McGraw Hill, 1991, Alberts et al: Molecular biology of the cell, garland, 1989, Biochemical Techniquie: Theory & Practical, Waveland press, Wilson & Walker: Practical Biochemistry, Cambridge university press, Jayraman: Laboratory Manual in Biochemistry.

## M.Sc BIOTECHNOLOGY I Year

## Semester IICourse Code : MBT 521

## Cellular & Molecular Immunobiology

**Unit I**

Introduction to Immune system, Innate and Acquired immunity, Cells and organs of immune system, Development of T and B cells, Structure of TCR and BCR, Antibody structure and Function, Immunogenicity, Haptens and Epitopes, Antigens and Antigenicity

**Unit II**

Cytokines, MHC structure and interaction with peptides, Antigen processing and presentation, Generation of antibody diversity and T cell diversity.

**Unit III**
Complement system, Activation of immune response, Cell mediated cytotoxicity, mechanism of T cell and NK cell mediated lysis, Antibody dependent cell mediated cytotoxicity

**Unit IV**
Types of hypersensitivity, Tissue transplantation and graft rejection, Cancer and immune system, Immune response to infectious agents, Diseases of immune system and immunodeficiencies

**Unit V**
Introduction to hybridoma technology, Vaccine production, Ag- Ab precipitin and agglutination reactions, Western blotting, ELISA, RIA, Immunoflouresence and Flow cytometry

**Suggested books**


1. Kuby: Immunology
2. Abbas and Lichtman: Cellular and Molecular Immunology
3. Janaway travers: Immunobiology in Health and Disease
4. Khan F.H: The Element of Immunobiology


**M.Sc BIOTECHNOLOGY I Year**

**Semester IICourse Code : MBT 522**

**Cell & Developmental Biology**

**Unit I**
Basic organization of cell, Plasma membrane: Structure and Organization. Intracellular compartmentalization: Structure, organization and functions of nuleus, mitochondria, lysosome, Golgi body, chloroplast Peroxisome, Endoplasmic reticulum, extracellular membranes of animals and plants.
Integrating cells into tissue Cell cell adhesion and communication, cell matrix adhesion, extracellular matrix: collagen and non collagen components

**Unit II**
Cell motility and shape: Structure and function s of micro filament, microtubules, intermediate filaments.Vesicular traffic in the secretory and endocytic pathway: transport from endoplasmic reticulum through golgi network to lysosome, endocytosis, exocytosis, molecular mechanisms of vesicular transport and the maintenance of compartment diversity

**Unit III**

Cell signaling: Types pf signaling, Cell surface receptor mediated signaling (RTK pathway, JAK-STAT pathway, G-proteins and G- protein coupled receptors) Secondary messengers and intracellular communication, Target cell adaptation.

**Unit IV**

Cell cycle, Molecular events and regulation, Cell division: General strategies and regulation, molecular mechanism of mitosis and meiosis. Cancer biology: Types of cancer, on-set of cancer, protooncogenes and tumor suppressor genes, Oncogenic mutations affecting cell proliferation, cell cycle and genome stability, Programmed cell death

**Unit V**

Developmental Biology: Mechanism of mammalian fertilization , morphological and molecular aspects, Acrosomal and cortical reactions, block to polyspermy, Cellular mechanism of development: morphogenetic cellular movements, , molecular basis of cell fate determination, cell diversity and patterning, control of body segmentation in insects and vertebrates, morphogen gradients, maternal effects. Mechanism of cellular differentiation: Transcriptional regulation of gene expression during differentiation, transcription factors and activation of specific promoters, activation of chromatin, control of development by RNA processing, Translational regulation of developmental processes

## M.Sc BIOTECHNOLOGY I Year

### Semester IICourse Code : MBT 523
### Molecular Biology

**UNIT I**

Chemical and physical properties of nucleic acid: nitrogenous bases, sugars, nucleosides and nucleotides. Structure and types of RNA and DNA. The Watson crick model.
DNA as genetic material. Different forms of DNA. Topological properties of DNA.DNA renaturation kinetics. The cytoplasmic inheritance.

**UNIT II**

The molecular structure of chromosome in eukaryotes: structure of chromatin and higher order packaging in chromosome. Centromere and telomere, giant chromosome, polytene and lampbrush chromosome. Information flow from genes to protein (central dogma of molecular biology), Concept of genetic code. Mechanism of transcription in prokaryotes and eukaryotes. Reverse transcription. Mechanism of translation in prokaryotes and eukaryotes.

**UNIT III**

Mechanism of transcription in prokaryotes and eukaryotes. Post transcriptional processing of RNA: (Capping, polyadenylation, splicing, RNA editing). Protein

targeting. Transposable elements. Introduction to various types odf DNA damage and repair. Retrovirus and cancer.

**UNIT IV**

Gene expression and regulation in prokaryotes (Lac operon and tryptophanoperon). Gene expression and regulation in eukaroytes. Mendelism : the basic principles and applications of inheritance exception to mendelian law. Allelic variation and gene function. The chromosomal basis of mendelism (chromosomal theory of heredity), Sex linked gene in human.

**UNIT V**

Sex chromosome and sex determination. Dosage compensation of X-linked gene. Pedigree analysis in man. Variation in chromosome number and structure: cytological techniques, mitotic chromosome and karyotyping. Polyploidy and aneuploidy. Rearrangements of chromosome structure (inversions, translocations and deletions). Linkage , recombination and chromosomemapping in eukarytotes.

**Recommended Books:**

Lewin: Genes, Vol.VII Oxford,1998,Inded.
Strickberger:Genetics
Voet & Voet: Biochemistry
Stryer: Biochemistry
Lodish et al: Molecular Cell Biology

**M.Sc BIOTECHNOLOGY I Year**

**Semester IICourse Code : MBT 524**

**Advances in Genetic Engineering (RDT) & Genomics**

**UNIT-I**

Introduction to DNA technology and application. Cloning vector (characteristics applications) Plasmids, Phages, Cosmids, YACs, BACs and HACs, Preparation of cloning vectors, suitable markers, Isolation of nucleic acids (Plasmid, RNA & DNA)Nucleic acid modifying enzymes, Restriction endonuclease.

**UNIT-II**

Basic steps of gene cloning, Cloning Strategies, Screening strategies of recombinants,Synthesis of cDNA, Construction of cDNA and genomic libraries, Blotting techniques (Methodologies and applications) southern, northern and western blotting
Probe labeling and hybridization

**UNIT-III**

DNA sequencing: chemical and enzymatic methods, PCR, Transposon tagging, Site directed mutagenesis, Genomic analysis: Exon-intron trapping, R-loop analysis, S-1 mapping, RFLP, RAPD, AFLP, Chromosome walking, Ribonuclese protection assay, Gel retardation assay, DNA foot printing, DNA finger printing, DNA profiling, Antisense and ribozyme technology, Expression of cloned gene in heterologous system: Prokaryotes and Eukaryotes, Potential hazards of recombinant DNA technology.

**UNIT-IV**

Transgenic technology: Types, approaches and application (Plant & animals), Gene Therapy: Principles, strategies and ethics of human gene therapy, Gene therapy for inherited disorders and neoplastic disorders.

**UNIT-V**

Introduction to genome and genome analysis: (Prokaryotes and Eukaryotes), Human Genome Project: Strategy and implications, genomics in relation to proteomics.

## M.Sc BIOTECHNOLOGY I Year

### Semester IICourse Code: MBT 525
### Genomics, Proteomics & Enzymology

**Unit I**

Historical perspectives, Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation, methods of enzyme analysis. Enzyme classification (rationale, overview and specific examples) zymogens and their activation (Proteases and prothrombin), Enzyme substrate complex: concept of ES complex, binding sites, active site, specificity. kinetics of enzyme activity, Michaelis-Menten equation and its derivation, Different plots for the determination of Km and Vmax and their physiological significance, factorsaffecting initial rates, E, S, temp & pH. Collision and transition state theories, Significance of activation energy and free energy. Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of Ki, suicide inhibitor. Mechanism of enzyme action: General mechanistic principle, facteors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanism of motion, chemical modification of active site groups, specific examples: chymotropin, lysozyme, GPDH, aldolase, Rnase, Caboxypeptidase and alcohol dehydrogenase. Enzyme regulation: Product inhibition, feed backcontrol, covalent modification

**Unit II**

Allosteric enzymes with special refrence to aspartate transcarbomylase

andphosphofructokinase. Qualitative description of concerted and sequential models.
Negative co-operativity and half site reactivity. Enzyme-Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and scatchard plots, kinetics of allosteric enzymes. Isoenzymes- multiple forms of enzyme with special refrences to lactate dehydrogenase. Multienzyme complex, Multifunctional enzyme-FA synthases.

**UNIT-III**

Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering-selected examples. Delivery system for protein pharmaceuticals structure function relationship in enzymes, structural motifs and enzyme evolution. Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes. Protein folding invivo & invitro.

**UNIT-IV**

Genome evolution and phylogenetics. Origin of Genomes, Acquisition of new Genes. DNA sequencing- chemical and enzymatic methods. The Origin of Introns. Restriction mapping, DNA & RNA fingerprinting. The Human Genome.

**UNIT-V**

Basic principles of protein structure. Modelling of three-dimensional structure ofa protein from aminoacid sequence. Modeling mutants.

**Recommended Books:** Zubay, parsan & Vance: Principles of Biochemistry, Voet & Voet : Biochemistry, John wiley, Dixon & Waco: Enzymes, academic Press, Fersht: Enzyme structure and mechanism, freeman, Segel: Enzyme Kinetics

## M.Sc BIOTECHNOLOGY II Year

## Semester ICourse Code : MBT 611

## Plant Biotechnology

**Unit I**

History of Biotechnology, Conventional methods for crop improvement- Pedegree, Heterosis and Mutation breeding. Tissue culture in crop improvement Micropropagation for virus-free plants, Somaclonal variation, Somatic hybridization. Artificial seed production, Haploids in plant breeding.

**Unit II**

Basic concepts and genetic engineering for increasing crop productivity by manipulation of Photosynthesis, Nitrogen fixation , Nutrient uptake efficiency, biotic stress tolerance- Insects, fungi, bacteria, viruses, weeds, Abiotic stress- drought, flooding, salt and temperature and for quality improvement- Protein, lipids, carbohydrates, vitamins & mineral nutrients

**Unit III**

Plants as bioreactor or Molecular farming- value added crops, edible vaccines,

industrial enzymes, antibodies, medicines. Cell cultures for secondary metabolite production; Concept of Molecular breeding; Constructing molecular maps; Physical maps of chromosomes; The concept of map-based cloning and their use in transgenic; Marker-assisted selection of qualitative and quantitative traits

**Unit IV**

In silico discovery of genes, gene synteny, High throughput approach in molecular Marker technology. Plant genomes and comparative genomics. Diversity; Historical and geographical causes for diversity; Genetic and Moleculardiversity; Species and population biodiversity; Biodiversity and its centres of origins of plants; Biodiversity hot spots in India; Collection and conservation of biodiversity; Morphological and molecular characterization of biodiversity.

**Unit V**

Intellectual property rights (IPR) in relation to biotechnology, sovereignty rights, CBD, bioethics and patenting, General agreement on trade and tariffs, Indian sui-generis system for plant variety and farmer's rights protection act. Biosafety, Biosafety for human health and environment, Social and ethical issues, Biosafetyin relation to transgenic research of applications.

## M.Sc BIOTECHNOLOGY II Year

## Semester ICourse Code : MBT 612

## Animal Biotechnology

Note:

1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attemptQuestion No. 1 & five more selecting one question from each Unit.
   As far as possible, the questions shall be short answer type and not essaytype.
4. Each question will be subdivided into 2 - 4 parts & the distribution ofmarks will be indicated part - wise.

**Unit I**

Structure and organization of animal cell, Equipment and materials for animal cell culture technology & Cryopreservation. Animal cell culture medium: Balanced salt solutions, simple and complex media, role of $CO_2$ and other supplements, Serum and serum free media. Basic techniques of in vitro mammalian cell culture, Methods of tissue disaggregation (Mechanical and enzymatic).

**Unit II**

Primary culture and established cell lines. Maintenance of cultured cells, Viability, cytotoxicity, Necrosis and apoptosis of cultured cells, Biology and characterization of cultured cells, Parameters for measuring growth, cultures of specialized cells (Epithelial, mesenchymal and neuroectodermal cells), Cell synchronization, Cell separation, Scale up

**Unit III**

Stem cells: Embryonic stem cells and adult stem cell cultures, Characterization, maintenance and differentiation of stem cells, Trans-differentiation of adult stemcells

**Unit IV**

Cell cloning and micromanipulation, cell transformation, Enucleation, strategies for gene transfer, Transgenic Technology (fish, birds and mammals), Types, Approaches and Application.

**Unit V**

Applications of cultured animal cells, Genetically engineered hormones, cell culture based vaccines, Gene therapy principles strategies and ethics of human gene therapy, Gene therapy for inherited and neoplastic disorders. Tissue engineering.

## M.Sc BIOTECHNOLOGY II Year

## Semester ICourse Code : MBT 613

## Environmental Biotechnology

**UNIT I**

Environment : Basic concepts and issues. Environment Pollution: Types of pollution, methods for measurement of pollution, methods for environmental management- the problem solving approach, its limitation. Air pollution and its control through biotechnology. Water pollution and its control: water as scarce natural resource, need for water management, measurement of water pollution, sources of water pollution, waste water collection, waste water treatment- physical, chemical and biological treatment processes.

**UNIT II**

Microbiology of waste water treatments, aerobic process: activated sludge, oxidation ditches, trickling filter tower, rotation discs, rotating drums and oxidation ponds. Anaerobic processes: anaerobic digestion, anaerobic filters, upflow anaerobic sludge blanket reactors. Treatment schemes of waste waters of dairy, distillery, tannery, sugar, antibiotic industries. Solid wastes: sources and management (composting, wormiculture and methane production).

**UNIT III**

Introduction to bioprocess engineering, isolation, preservation and maintenance of Industrial microorganisms. Bioreactor types and design: specialized bioreactors (pulsed, fluidized photobioreactors, etc), Types of fermentation process: batch, fed batch.
Introduction to downstream processing.

**UNIT IV**

Microbiology of degradation of xenobiotics in environment: ecological considerations, decay behavior and degradation plasmids, hydrocarbons , substituted hydrocarbons, oil production, surfactants pesticides. Hospital wastes, hazardous wastes and their management. Bioremediation of contaminated soils and wastelands. Biopesticides in integrated pest management.

**UNIT V**

Methodology of environmental management, Basic concepts of Enviromental Impact Assesment (EIA). Restoration of wastelands/ degraded ecosystem. Global environmental problems: ozone depletion, UV-B, green-house effect, acid rain, their impact and biotechnological approaches for management.

**M.Sc BIOTECHNOLOGY II Year**
**Semester ICourse Code : MBT 614**
**Bioprocess engineering & technology**

UNIT I

Introduction to bioprocess engineering, Bioreactors, Isolation, prevention and maintenance of industrial microorganism, 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 Bioreactors, biotransformation, stability of microbial reactors, analysis ofmicrobial photo bioreactors etc.

UNIT III

Measurement and control of bioprocess parameters, Downstream processing; introduction, removal of microbial cells and solid mat foam separation, precipitation , filtration ,centrifugation, cell disruptions, liquid-liquid Extraction, chromatography, membrane process, drying and crystallization, effluent water treatment; doc and cod treatments and disposal of effluents.

UNIT IV
Enzyme and whole cell immobilization and their industrial application, Industrial production of chemical, alcohlol (ethalnol), acids (citric acetic and gluconic), solvents(glycerol ,acetone, butanol),antibiotics (penicillin, streptomycin, tetracycline). Amimoacids (lysine, glutamic acid), single cell protein.
UNIT V
Use of microbes in mineral beneficiation and oil recovery, Introduction to food technology, elementary idea canning and packing, -sterilization and pasteurization of food products, technology of typical food/food products (bread,cheese, idli)

## M.Sc BIOTECHNOLOGY II Year

## Semester ICourse Code: MBT 615A

## (Elective)

## Food & Dairy Biotechnology

Note:
1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type

   Covering the entire syllabus, will be compulsory.
3. The remaining ten questions shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attemptQuestion No. 1 & five more selecting one question from each Unit.
   As far as possible, the questions shall be short answer type and not essayType.
4. Each question will be subdivided into 2 - 4 parts & the distribution ofMarks will be indicated part - wise

**Unit I**
Food and Microorganism: Microorganism in food & beverage industry, contamination of food, general principles underlying spoilage and chemical changes

**Unit II**
Contamination and spoilage of different kinds of food and beverages: Cereals & cereals product, sugar and sugar products, vegetable and fruits, meat, fish,poultry and eggs, sea food, milk and milk products, canned foods, alcohol & alcoholic beverages, fruit furies & soft drinks etc.

**Unit III**
Biotechnology of food, feed and beverages, cultures and fermentation, fermentation of food products. Beverage production: alcohol and alcoholic beverages, fruit furies, soft drinks, feed production, SCP, fats, amino acid, food

additives.

**Unit IV**

Food beverages & Diseases: Food borne illness due to bacterial food poisoning, infection and intoxication (non bacterial). Biotechnology of food borne disease out breaks, disease investigation, materials and equipments, laboratory testing, field analysis, interpretation of data and preventive measures

**Unit V**

Food hygiene: food sanitation, bacteriology of water and food products, food manufacturing practice. Hazard analysis critical points (HACCP). Food control: International agencies, federal agency and law of state agencies, processing industry and microbial criteria of food.

Principles of food preservation: general principles of asepsis technology, preservation by high temperatures, drying, food additives and radiation.

## M.Sc BIOTECHNOLOGY II Year

## Semester ICourse Code : MBT 615B

## (Elective) Pharmaceutical Biotechnology

Note:

1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attemptQuestion No. 1 & five more selecting one question from each Unit.
   As far as possible, the questions shall be short answer type and not essaytype.
4. Each question will be subdivided into 2 - 4 parts & the distribution ofmarks will be indicated part - wise.

### Unit I: Genetic Recombination

Transformation, Conjugation, Transduction, Protoplast fusion, and gene cloning and their applications, development of hybridoma for monoclonal antibodies, study of drugs produced by biotechnology such as activase, humulin, humatrope.

### Unit II: Antibiotics

Historical development of antibiotics, Antimicrobial spectrum and methods usedfor their standardization. Screening of soil for organisms producing antibiotics fermenter, its design, control of different parameters, Isolation of mutants, factors affecting mutation.

### Unit III: Microbial Transformation

Introduction, types of reaction mediated by microorganisms. Design of Biotransformation process, selection of organisms, biotransformation processes and its improvement with special reference to steroids.

**Unit IV: Vaccines**

Introduction, multivalent subunit vaccines, purified macromolecules, synthetic peptide vaccines, immune-adhesions, recombinant antigen vaccines, vector vaccines, anti-idiotype vaccines, targeted mutant stimulants, miscellaneous approaches, new generation vaccines, novel vaccine delivery system

**Unit V: Enzyme Immobilization**

Techniques of immobilization of enzymes, factors affecting enzyme kinetics, study of enzymes such as hyaluronidase, pencillinase, streptokinase and streptodaranase, amylases and proteases, immobilization of bacteria and plant cells.

## M.Sc BIOTECHNOLOGY II Year

## Semester I Course Code : MBT 615C

## (Elective) Molecular Diagnostics &

## Immuno-technology

Note:

1. Eleven questions will be set in all.
2. Question No. 1, which will be objective type / short - answer type covering the entire syllabus, will be compulsory.
3. The remaining ten questions Shall be set Unit wise with two questions from each Unit I, II, III, IV & V. The candidates shall be required to attemptQuestion No. 1 & five more selecting one question from each Unit.
   As far as possible, the questions shall be short answer type and not essaytype.
4. Each question will be subdivided into 2 - 4 parts & the distribution ofmarks will be indicated part - wise.

**Unit I**

Biotechnology of immunity: Ab structure, Ab gene, Engineering. Chimeric and hybrid Monoclonal Ab constructed from Ig-gene libraries Chimeric Ab for anti- tumor therapy

**Unit II**

Therapeutic proteins, General physiology of cytokines, Application of cytokine for therapy, Preparation of lymphokines by r-DNA Technology, interferon colony stimulating factor. Future development in cytokine therapy.

**Unit III**

Monoclonal antibodies (mAb) & hybridoma Technology: Introduction, production of monoclonal antibodies, Advantage and limitation of monoclonal Abs. Characterization & storage of monoclonal Abs. Commercial production of monoclonal antibodies.

**Unit IV**

Monoclonal Ab produce by recombinant DNA technology, hybridoma technology. RDT application in diagnosis, cancer therapy, organ transplantation.

**Unit V**

Vaccines: Introduction, Multivalent subunit vaccines, Purified macromolecules, Synthetic peptide vaccines, Immuno-adhesions, Recombinant antigen vaccines, Vector vaccines , Anti-idiotype vaccines, Targeted immune stimulant. Miscellaneous approaches, New generation vaccines, Novel vaccine deliverysystems. Application of vaccines in diagnosis & therapy.