

UTTARAKHAND
TECHNICAL UNIVERSITY,
DEHRADUN

SYLLABUS

MASTER OF SCIENCE
IN
BIOTECHNOLOGY

COURSE STRUCTURE & ORDINANCES FOR M.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 evaluation of the scientific data.
2. Eligibility for admission: Graduates in Biotechnology, Biochemistry, Chemistry, Microbiology, Life Sciences, 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 a competent 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 the assessment 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.

CERTIFICATE

This is to certify that the Dissertation entitled “.....”. submitted byEnrollment no. University roll no.....in partial fulfillment of the degree of Master of Science in Biotechnology (Name of the Institute) of Uttarakhand Technical University, Dehradun, Uttarakhand is a bonafide and original research work carried out by her/him under my / our supervision and guidance during the academic year No part of this dissertation has been submitted to any other university for any other degree or diploma.

SUPERVISOR

UTTARAKHAND TECHNICAL UNIVERSITY

STUDY AND EVALUATION SCHEME

M.Sc. BIOTECHNOLOGY 1st YEAR

SEMESTER-I

| S.No. | Course Code | Subject Name | Period (Hours) | | Sessional Exam | ESE | Subject Total | Credit hours | |
|------------|-------------|-----------------------------------|----------------|---|----------------|------------|---------------|--------------|--|
| | | | 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, BIOSTATISTICS & 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 | 20 | 80 | 100 | 4 | |
| 2. | MBT-552 | PRACTICAL-II (PAPER 3, 4 & 5) | 0 | 8 | 20 | 80 | 100 | 4 | |

UTTARAKHAND TECHNICAL UNIVERSITY

STUDY AND EVALUATION SCHEME

M.Sc. BIOTECHNOLOGY 1st YEAR

SEMESTER-II

| S.No. | Course Code | Subject Name | Period (Hours) | | Sessional Exam | ESE | Subject Total | Credit hours | |
|------------|-------------|---------------------------------|----------------|---|----------------|------------|---------------|--------------|--|
| | | | L | P | | | | | |
| 1. | MBT-521 | IMMUNOBIOLOGY | 4 | 0 | 30 | 70 | 100 | 4 | |
| 2. | MBT-522 | CELL & DEVELOPMENTAL BIOLOGY | 4 | 0 | 30 | 70 | 100 | 4 | |
| 3. | MBT-523 | MOLECULAR BIOLOGY | 4 | 0 | 30 | 70 | 100 | 4 | |
| 4. | MBT-524 | RDT & GENOMICS | 4 | 0 | 30 | 70 | 100 | 4 | |
| 5. | MBT-525 | ENZYMOLGY & PROTEIN ENGINEERING | 4 | 0 | 30 | 70 | 100 | 4 | |
| PRACTICALS | | | | | | DAY TO DAY | | | |
| EVALUATION | | | | | | | | | |
| 1. | MBT-561 | PRACTICAL-I (PAPER 1 & 2) | 0 | 8 | 20 | 80 | 100 | 4 | |
| 2. | MBT-562 | PRACTICAL-II (PAPER 3,4 & 5) | 0 | 8 | 20 | 80 | 100 | 4 | |

UTTARAKHAND TECHNICAL 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 |
|-------------------------------------|-------------|-------------------------------------|----------------|---|----------------|-----|---------------|--------------|
| | | | 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 |
| 5. | MBT-615 | FOOD & DAIRY BIOTECHNOLOGY | 4 | 0 | 30 | 70 | 100 | 4 |
| PRACTICALS DAY TO DAY EVALUATION | | | | | | | | |
| 1. | MBT-661 | PRACTICAL-I (PAPER 1 & 2) | 0 | 8 | 20 | 80 | 100 | 4 |
| 2. | MBT-662 | PRACTICAL-II (PAPER 3,4 & 5) | 0 | 8 | 20 | 80 | 100 | 4 |

UTTARAKHAND TECHNICAL 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 |
|-------|-------------|----------------------|----------------|----|----------------|-----|---------------|--------------|
| | | | 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 I

Course 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 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

1. Introduction to biochemistry and its scope.
2. Types and strength of solutions, acid base and salts, pH, solutions and their importance, redox potentials, bonding in Biomolecules.

Unit II

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

Unit III

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

Unit IV

1. 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.
2. Carbohydrate metabolism: Glycolysis, Krebs's cycle, oxidative phosphorylation and Pentose Phosphate Pathway, Gluconeogenesis, glycogenesis, and glycogenolysis.

Unit V

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

M.Sc BIOTECHNOLOGY I Year Semester I

Course Code : MBT 513

MICROBIOLOGY & MICROBIAL GENETICS

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

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, N₂ 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, transfect ion.

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.

Course Code : MBT 514

Molecular Biology and Molecular Genetics

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

- Chemical and physical properties of nucleic acid: nitrogenous bases, sugars, nucleosides and nucleotides.
- Structure and types of RNA and DNA.
- DNA as genetic material: Experiments.
- 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

- Post transcriptional processing of RNA: (Capping, polyadenylation, splicing, RNA editing). Protein targeting.
- Transposable elements.
- Introduction to various types of DNA damage and repair.
- Retrovirus and cancer.

UNIT IV

- Gene expression and regulation in prokaryotes (Lac operon and tryptophan operon)
- Gene expression and its regulation in eukaryotes.
- 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 chromosome mapping in eukaryotes.

Recommended Books:

Lewin: Genes, Vol.VII Oxford, 1998, Inded.
 Straehan and Read: Human Molecular Genetics
 Snustad et al: Principle of Genetics
 De Robertes & Robertes: Cell and Molecular biology
 Strickberger:Genetics
 Freifelder: Molecular Biology
 Voet & Voet: Biochemistry
 Stryer: Biochemistry
 Lodish et al: Molecular Cell Biology

M.Sc BIOTECHNOLOGY I Year Semester I

Course Code : MBT 515

Bio-Analytical Techniques

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

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), isotachopheresis, 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, confocal 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-visible, 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 Technique: Theory & Practical, Waveland press

Wilson & Walker: Practical Biochemistry, Cambridge university press

Jayraman: Laboratory Manual in Biochemistry

Demain & Davies: Manual of Industrial Microbiology & Biotech 2nd ed.

M.Sc BIOTECHNOLOGY I Year Semester II

Course Code : MBT 521

Immunobiology

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 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, Immunofluorescence and Flow cytometry

Suggested books

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

M.Sc BIOTECHNOLOGY I Year Semester II

Course Code : MBT 522

Cell and Developmental biology

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

Basic organization of cell, Plasma membrane: Structure and Organization

Intracellular compartmentalization: Structure, organization and functions of nucleus, 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 of 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 II

Course Code : MBT 523

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 to 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 behavior. Growth Rate concept & Exponential Growth, Logistic Model, Mathematical Technique- Trajectories & Equilibria. Logarithm: Conversion and Plotting of Graph.

UNIT- III

Importance of biostatistics 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-efficient regression lines).

UNIT-IV

Elementary idea of probability and its application , Random variables and their distribution (elementary idea). Binomial, Poisson & Normal distribution.

The T- test, 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. 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 II

Course Code : MBT 524

Recombinant DNA Technology and Genomics

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 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, Ribonuclease 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 II

Course Code : MBT 525

Enzymology & Protein engineering

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

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 K_m and V_{max} and their physiological significance, factors affecting initial rates, E, S, temp & pH. Collision and transition state theories, Significance of activation energy and free energy.

Unit II

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of K_i , suicide inhibitor

Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanism of action, chemical modification of active site groups, specific examples: chymotrypsin, lysozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase

Enzyme regulation: Product inhibition, feedback control, covalent modification

Unit III

Allosteric enzymes with special reference to aspartate transcarboxylase and phosphofructokinase. Qualitative description of concerted and sequential models, Negative cooperativity and half site reactivity. Enzyme-Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and Scatchard plots, kinetics of allosteric enzymes.

Unit IV

Isoenzymes- multiple forms of enzyme with special references to lactate dehydrogenase. Multienzyme complex, Multifunctional enzyme-FAD synthases.

Enzyme Technology: Methods for large scale production of enzymes

Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors, application of immobilized and soluble enzyme in health and industry. Application to fundamental studies of biochemistry. Artificial enzyme, enzyme electrode.

Unit V

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*.

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 I

Course Code : MBT 611

Plant 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 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 1

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

Unit 2

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 3

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 4

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 Molecular diversity; 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 5

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, Biosafety in relation to transgenic research of applications.

M.Sc BIOTECHNOLOGY II Year Semester I

Course 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 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

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 CO₂ 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 stem cells

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 I

Course Code : MBT 612

Environmental 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 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

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 Environmental 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 I

Course Code : MBT 614

Note:

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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.

Bioprocess Engineering & Technology

Theory

1. Introduction to bioprocess engineering
2. Bioreactors
3. Isolation, preservation and maintenance of industrial microorganisms
4. Kinetic of microbial growth and death
5. Media for industrial fermentation
6. Air and media sterilization
7. Types of fermentation processes: Analysis of batch, fed-batch and continuous bioreactions, biotransformation, Stability of microbial reactors, analysis of microbial populations, specialized bioreactors (pulsed, fluidized, photobioreactors etc.)
8. Measurement and control of bioprocess parameters
9. 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 treatment: DOC and COD treatments and disposal of effluents.
10. Enzyme and whole cell immobilization and their industrial applications
11. Industrial production of chemicals. Alcohol (ethanol), acids (citric, acetic & gluconic), solvents (glycerol, acetone, butanol), antibiotics (penicillin, streptomycin, tetracycline), aminoacids (lysine, glutamic acid), single cell protein.
12. Use of microbes in mineral beneficiation and oil recovery
13. 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.)

M.Sc BIOTECHNOLOGY II Year Semester I

Course Code : MBT 615

Food & Beverage 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 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

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 juices & 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 juices, 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 outbreaks, 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.