Scheme of Examination for M.Sc. Biotechnology (Two Year Course) 2009-2010

1st Semester

Sr. No.	Course No.	Subject	Periods			Evaluation Scheme Sessional		
			L	Tu	P	Th	IA	Total
1.	BT-111	Cell biology	4	0	4	80	20	100
2.	BT-112	Biomolecules and metabolism	3	0	4+4	80	20	100
3.	BT-113	Microbiology	3	0	4	80	20	100
4.	BT-114	Bio-statistic	3	0	4	80	20	100
5.	BT-115	Molecular Biology	3	0	4	80	20	100
6.	BT-116	Communication Skill	2	0	0	25		25
7.	BT-117	Lab Course - I Cell biology, Biomolecule			4x3			50
8.	BT-118	Lab Course-II Microbiology, Molecular Biology, Bio-statistic			4x3			50
	Total				24		Total	625

2nd Semester

Sr. No.	Course No.	Subject	Periods			Evaluation Scheme Sessional		
			L	Tu	P	Th	IA	Total
1.	BT-211	Immunology	4	0	4	80	20	100
2.	BT-212	Bioinformatics	3	0	4+4	80	20	100
3.	BT-213	Enzymology	3	0	4	80	20	100
4.	BT-214	Human Physiology and Developmental Genetics	3	0	4	80	20	100
5.	BT-215	Nano Biotechnology	3	0	4	80	20	100
6.	BT-216	Seminar	2	0	0	25		25
7.	BT-217	Lab Course - I Immunology, Bioinformatics, Nano Biotechnology				4x3		50
8.	BT-218	Lab Course-II Human Physiology, Developmental Genetics, Enzymology			4x3			50
	Total				24		Total	625

Scheme of Examination for M.Sc. Biotechnology (Two Year Course) 2009-2010

3rd Semester

Sr. No.	Course No.	Subject	Periods			Evaluation Scheme Sessional		
			L	Tu	P	Th	IA	Total
1.	BT-311	Plant Phyisology & Developmental genetics	4	0	4	80	20	100
2.	BT-312	Plant biotchnology	3	0	4	80	20	100
3.	BT-313	Microbiology Technology	3	0	4	80	20	100
4.	BT-314	Genetics Engg.	3	0	4+4	80	20	100
5.	BT-315	Envionmental Biotechnology	3	0	4	80	20	100
6.	BT-316	Seminar	2	0	0	25		25
7.	BT-317	Lab Course - I Plant Bio. Envior, Biotech. Plant Physiology,			3x4			50
8.	BT-318	Lab Course-II Microtech., Genetics Engg.			3x4			50
	Total		22		24		Total	625

4th Semester

Sr. No.	Course No.	Subject	Periods			Evaluation Scheme Sessional		
			L	Tu	P	Th	IA	Total
1.	BT-411	Bioprocess Engg.	4	0	4	80	20	100
2.	BT-412	Metabolic Engg.	4	0	4	80	20	100
3.	BT-413	Animalbiologytechnology	4	0	4	80	20	100
4.	BT-414	Social, Ethical, Legal and Managment issues in Bitechnology	4	0	4+4	80	20	100
5.	BT-415	Lab Course - I	4	0	4	80	20	100
6.	BT-416	Summer Training/ Dissertation./ Project Report			4x3			50
	Total				24			625

The theory practical exams. of 4th semester be completed in all circumstances by March. The project work will be done between April to July for three months. The project work can be domn in any lab/ Industry in India.

** L-Lecture, T- Theory IA - Internal Assessment

M.Sc. Biotechnology

SEMESTER—I

Course No. BT 111 **MM. 80 + IA 20**

Course Title: Cell Biology **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

Diversity of cell size and shape.

Cell Theory.

Structure of Prokaryotic and Eukaryotic cells- Isolation and growth of cells.

Microscopic techniques for study of cells.

Sub-cellular fractionation and criteria of functional integrity

UNIT II

Cellular organelles- Plasma membrane, cell wall, their structural organization Mitochondria, Chloroplast; Nucleus and other organelles and their organization.

Transport of nutrients, ions and macromolecules across membrane.

UNIT III

Cellular energy transactions - role of mitochondria and chloroplast

Cell cycle - molecular events and model systems

Cellular responses to environmental signals in plants and animals-mechanisms of signal transduction

UNIT IV

Cell motility - cilia, flagella of eukaryotes and prokaryotes

Biology of cancer

Metabolite pathways and their regulation

Biosynthesis of proteins in Eukaryotic cell, Co- and post-translational modification, intracellular protein traffic.

Cellular basis of differentiation and development-mitosis, gametogenesis and fertilization. Development in Drosophila and Arabidopsis, Spatial and temporal regulation of Gene expression.

Brief introduction to the Life Cycle and Molecular Biology of some important pathogen of AIDS, Malaria, Hepatitis, Tuberculosis, Filaria, Kalazar.

Practicals

Microscopy: Bright field, phase contrast & Fluorescence Microscopy.

Microtomy

Instrumental methods for Cell Biology

Sub cellular fractionation and marker enzymes.

Histochemical techniques

Mitosis & Meiosis

Course No. BT 112 **MM. 80 + IA 20**

Course Title: Biomolecule and metabolism **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

Chemical foundations of Biology –pH, pK, acids, bases, buffers, weak bonds, covalent bonds.Principles of thermodynamics.

Classes of organic compounds and functional groups-atomic and molecular dimensions, space filling and ball and stick models.Macro molecular and supra moecular assemblies

UNIT II

Amino acids and peptides-classification, chemical reactions and physical properties

Sugars - classification and reactions

Heterocyclic compounds-and secondary metabolites in living systems - nucleotides, pigments, isoprenoids

Separation techniques for different biomolecules

UNIT III

Physical techniques in proteins, nucleic acis and polysaccharides structure analysis (UV, IR,MMR, LASER, MASS, Flurescence spectroscopy, Differential calorimetry,

X-ray Crystallgraphy, Ultra Centrifugation, Electron cryomicrography, Scanning Tunneling microscopy.

UNIT IV

Lipids- classification, structure and functions

Proteins-classification and separation, purification and criteria of homogeneity, end group analysis, hierarchy in structure, Ramachandran map.

Polysaccharides - types, structural features, methods for compositional analysis

Analytical techniques in biochemistry and biophysics for small molecules and macromolecules for quantitation.

UNIT V

Water and its properties, enzymes coenzymes, metabolism of carbohydrate, amino acids and lipids, in born errors of metabolism.

Bio-energetics and oxidative phosphorylation. Blood clotting – biochemistry, body fluids – pH and acid base balance and their importance in clinical biochemistry, muscle contraction. Techniques in the study of proteins, carbohydrates and lipids.

Practicals

Titration of amino acids

Colorimetric determination of pK

Model building using space filling/ball and stick models

Reactions of amino acids, sugars and lipids

Isolation, purity determination and quantitation of cholesterol, DNA and mRNA

Quantitation of Proteins and Sugars

Analysis of oils-iodine number, saponification value, acid number

UV, Visible, Fluorescence and IR spectroscopy, Absorption spectra

Separation techniques - Centrifugation, Chromatography (Gel permeation, Ion exchange, TLC etc. and Electrophoresis.

Course No. BT 113 **MM. 80 + IA 20**

Course Title: Microbiology **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

The Beginning of Microbiology Discovery of the microbial world by Antony van Leeuwenhoek: Controversy over spontaneous generation, Role of microorganisms in transformation of organic matter and in the causation of diseases Development of pure culture methods Enrichment culture methods, developments of microbiology in the twentieth century

Methods in Microbiology Pure culture techniques; Theory and practice of sterilization; Principles of microbial nutrition Construction of culture media; Enrichment culture techniques for isolation of chamoautotrophs, chemoheterotrophs and photosynthetic microorganisms

Microbial Evolution, Systematics and Taxonomy, Evolution of earth and earlier life forms; Primitive organisms and their metabolic strategies and molecular coding; New approaches to bacterial taxonomy classification including ribotyping Ribosomal RNA sequencing; Characteristics of primary domains Taxonomy, Nomenclature and Bergey's Manual

Microbial Growth The definition of growth, mathematical expression of growth, growth curve, measurement of growth and growth yields; Synchronous growth; Continuous culture; Growth as affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen; Culture collection and maintenance of cultures

Overview of Basic Metabolism & Microbial Nutrition

Metabolic Diversity among Microorganisms Photosynthesis in microorganisms; Role of Chlorophylls, carotenoids and

phycobilins; Calvin cycle; Chemolithotrophy; Hydrogen - iron - nitrite - oxidizing bacteria; Nitrate and sulfate reduction; Methanogenesis and acetogenesis; Fermentations - diversity, syntrophy, role of anoxic decompositions; Nitrogen metabolism; Nitrogen fixation; Hydrocarbon transformation

Prokaryotic Diversity Bacteria: Purpl and green bacteria; Cyanobacteria; Homoacetogenic bacteria; Acetic acid bacteria; Budding and appendaged bacteria; Spirilla; Spirochaetes; Gliding and sheathed bacteria; Pseudomonads; Lactic and propionic acid bacteria; Endospore forming rods and cocci: Mycobacteria: Rickettsias, Chlamydies and Mycoplasma. Archaea: Archaea as earliest Life forms: Halophiles; Methanogens;' Hyperthermophilic urchaea; Thermoplasma

Eukarya : Algae, Fungi, Slime molds and Protozoa.

Viruses: Bacterial, Plant, Animal and Tumor viruses; Discovery, classification and structure of viruses; Lysogeny: DNA viruses; Positive strand Negative strand, and double stranded RNA viruses; Replication: Examples of Herpes, Pox, Adenoviruses, Retroviruses, Viroids and Prions

Prokaryotic Cells: Structure-function Cell walls of eubacteria (peptidoglycan) and related molecules; Outer-membrane of Gram negative bacteria; Cell wall and cell membrane synthesis; Flagella and motility; Cell inclusions like end spores, gas vesicles

Chemotherapy/Antibiotics

Antimicrobial agents; Sulfa drugs; Antibiotics: Pencillins and Cephalosporins; Broad spectrum antibiotics; Antibiotics from prokaryotes; Antifungal antibiotics; Mode of action; Resistance to antibiotics

Genes, Mutation and Mutagenesis UV and chemical mutagenesis Types of mutation; Ames test for mutagenesis; Methods of genetic analysis

Bacterial Genetic System Transformation, Conjugation, Transduction, Recombination, Plasmids and Transposons,

Bacterial genetics map with reference to E.coli

Viruses and Their Genetic System Phage I and its life cycle: RNA phages RNA viruses; Retroviruses

Genetic systems of Yeast and Neurospora

Extra-Chromosomal Inheritance

Practicals

Preparation of liquid and solid media for growth of microorganisms

Isolation and maintenance .of organisms by plating, streaking and serial dilution methods. Slants and stab cultures. Storage of microorganisms.

Isolation of pure cultures from soil and water

Growth; Growth curve; Measurement of bacterial population by turbidometry and serial dilution methods. Effect of temperature, pH and carbon und nitrogen sources on growth.

Microscopic examination of bacteria, yeast and molds and study of organisms by Gram stain, Acid fast stain and staining for spores

Study of mutations by Ames test.

Assay of antibiotics and demonstration of antibiotic resistance

Analysis of water for potability and determination of MPN

Bacterial transformation

Biochemical characterization of selected microbes

Transduction

One step growth curve of coliphage

Isolation of Plasmids

$^{14}C0_2$ fixation by photosynthetic microbes.

Course No. MBT 114 **MM. 80 + IA 20**
Course Title: Biostatistics **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

Permutation and Combination, Functions, limits and continuity, Exponential and Logarithmic functions, Vector and Matrices, Algebra of Matrics, Determinants and their simple properties, Rank of matrix, Consistency of system of linear equations and soultion of linear system of equations. Characteristic equation, Eigen values and Eigen vectors.

UNIT II

Differential Calculus, Rules of differentiation, Derivatives of implicit fucntions, parametric differentiation, Higher derivatives Taylor's theorem, Maclaurin's theorem (without proofs), Maxima and minima, Partial differentiation

Integration, Integration by parts, Definite integral, Properties of definite integrals,

Differential Equations :, Separable varaible, homogenous, exact and linear equations of second order.

UNIT III

Concepts in statistics, Types iof Data, presentation ofdata, types of graphics, relative frequency, cummulative frequency, Measuremnt of central tendency, Measures of variation, coefficient of vrariation, measures of Skewness and Kurtosis, Probability and its applications, Laws of Addition and Multiplication, Compound probablity, Baye's Theorem.

UNIT IV

Random Varaibles and Distribution. Binomial, Poisson, Exponential and Normal Distributions and their applications. Samples and Sampling Distribution, Standard Error, significance level, Degrees of freedom,

tests of significance, tests for proportion, t an F tests Confidence Intervals.

UNIT V

Contingency tables of X^2 (Chi square) tests of goodness of fit and homogeneity

Correlation : Simple, Partial and Multiple Correlation, Methoids of averages and least squares, polynomial fitting, Regression Analysis, Analysis of variance for one and two way classification Design of experiments, randomaxization, replication local control, completely randomized and randomized block design.

PRACTICALS

Descriptive statistics : Systematic tabular summarization of data (before analysis), measures of central tendency, measures of dispersion, measures of skeness (using calculators).

Correlations (product-moment coefficient, Spearman's rank coefficient) and regression (linear regression, curve fitting).

Data presentation (tables/ figures) : 1-D and 2-D bar charts, pie diagrams, graphs (using computer software packages).

Statistical distributions : fitting discrete uniform, binomila, Poisson and normal probability distribution to given data

Testing of hypotheses : Tests of significance (mean, standard deviation, correlation coefficient), chi- squard test for goodness of fit, test for independence of attributes, non-parametric tests (run test) using calculators and printed tables and using minitab sampling (drawing random samples using random numbers, tables, chits, computer programmes for random number generation), design of experiments, ANOVA (one-way and two way).

Course No. BT 115 **MM. 80 + IA 20**

Course Title: Molecular Biology **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

DNA Replication: Prokaryotic and eukaryotic DNA replication, Mechanics of DNA replication, enzymes and accessory proteins involved in DNA replication

DNA Repair and Recombination

Transcription: Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Regulatory elements in mechanisms of transcription regulation, Transcriptional and post-transcriptional gene silencing

Modifications in RNA: 5'-Cap formation, Transcription termination, 3'-end processing and .polyadenylation, Splicing, Editing, Nuclear export of mRNA, mRNA stability

UNIT II

Translation: Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co- and post translational modifications of proteins.

Protein Localization: Synthesis of secretory and membrane protein, Import into nucleus, mitochondria, chloroplast and peroxisomes, Receptor mediated endocytosis

Oncogenes and Tumor Suppressor Genes: Viral and cellular oncogenes, tumor suppressor genes from humans, Structure, Function and mechanism of action of pRB and p53 tumor suppressor proteins

UNIT III

Antisense and Ribozyme Technology: Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of ribozyme; hammer head, hairpin and other ribozymes, strategies for designing ribozymes, Applications of Antisense and ribozyme technologies

Homologous Recombination: Holliday junction, gene targeting, gene disruption, FLP/FRT and' Cre/Lox recombination, RecA and' other recombinases

Molecular Mapping of Genome: Genetic and physical maps,. physical mapping and map-based cloning, choice of mapping population, Simple sequence repeat loci, Southern and fluorescence in situ hybridization for genome analysis, Chromosome micro dissection and micro cloning.

UNIT IV

Molecular markers in genome analysis: RFLP, RAPD and AFLP analysis, Molecular markers linked to disease resistance genes, Application of RFLP in forensic, disease. prognosis, genetic counseling, Pedigree, varietal etc. Animal trafficking and poaching; Germplasm maintenance, taxonomy and Bio-diversity

UNIT V

Genome Sequencing: Genome sizes., organelle genomes, Genomic libraries, YAC, BAC libraries, Strategies for sequencing genome, Packaging, transfection and recovery of clones, Application of Sequencing sequence information for identification of defective genes

Practicals

Isolation of genomic DNA

Southern blotting

RFLP analysis

Isolation of RNA

Isolation of polyA + RNA

Northern blotting

Preparation of probes

In vitro Transcription

In vitro translation

Metabolic labeling of proteins and immuno precipitation.

SEMESTER-I

Course No. BT 116 **MM. 25**
Course Title: Communication Skills **Time: 30 min.**

NOTE: Seminars

Lectures : prepartion, objectives, concepts, contents, sequence, formal proof, interrelationships, logic, conclusions, time management using audiovisual aids Giving a talk : body language : extempore and prepared talks.

Praparation for interviews, CV/ biodata.

Vocabulary : word power, pronuniations, guessing the meaning of words from the context an body language and using a dictionary

Review of basic grammar Punctuation marks comma, colon, semicolon, full stop, inverted comma.

Avoiding repetitious statments, double positive, double negatives, circular argumants. Dealing with questions : avoiding circumvention and circular arguments, answering after braeking down long question into parts.

MS power pont -based presentations

Analysis of formal presentations in the course 3a in terms ofactual presentations.

SEMESTER—II

Course No. BT 211 **MM. 80 + IA 20**

Course Title: Immunology **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT -I

Introduction

Phylogeny of Immune System-

Innate and acquired immunity

Clonal nature of immune response

Organization and structure of lymphoid organs

Nature and Biology of antigens and super antigens.

UNIT -II

Antibody structure and function

Antigen - antibody interactions

Major histocompatibility complex

BCR & TCR, generation of diversity. Complement system

Cells of the Immune system: Hematopoiesis and differentiation

UNIT -III

Lymphocyte trafficking, B-Iymphocytes, T-Iymphocytes, Macrophages, Dendritic cells, Natural killer and Lymphokine - activated killer cells, Eosinophils, Neutrophils and Mast Cells

Regulation of immune response: Antigen processing and presentation, generation of humoral and cell mediated immune responses: Activation of B and T-Lymphocytes

UNIT -IV

Cytokines and their role in immune regulation:T-cell regulation, HHC restriction Immunological tolerance

Cell - mediated cytotoxicity; Mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity

Hypersensitivity

UNIT -V

Autoimmunity

Transplantation

Immunity to infectious agents (interacellular parasites, he1minthes & viruses)

Tumor Immunology

AIDS and other Immunodeficiency

Hybridoma Technology and Monoclonal antibodies

Practicals

Blood film preparation and identification of cells

Lymphoid organs and their microscopic organization

Immunization, Collection of Serum

Double diffusion and Immune-electrophoresis

Radial Immuno diffusion

Purification of IgG from serum

Separation of mononuclear cells by Ficol1-Hypaque

Con-A induced proliferation of thymocytes (by MTT method)

Western-blotting

ELISA

Hapten Conjugation and quantitation

Immunodiagnostics (demonstration using commercial kits).

Course Title: Bioinformatics **MM. 80 + IA 20**

Course No. BT 212 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

Computers

An overview of computers, microcomputers, VDUs and printer

What is programming? Algorithms. Languages amd packages : Introduction to MS Offfice, MS Access, Front Page and introduction to C. Java and SQL (structured query language) Handling arrays, procedures.

Colour, sound and pgraphics. Use of standard packages.

UNIT II

Introduction to PERL : Sacalar variables, strings and numbers, Assignment statements, Arrays, Hashes, Operators, Input from file, Standard Input, Conditional and logical operators, loops, I/O/ Input from file named in command line, Regular expression, Pattern matching, Aeta symbols,Pattern modifiers, Subroutins.

Applications of PERL in Bioformatics : Storing DNA sequence, DNA to RNA transcription, Finding motifs, Counting nucleotides, Genrating random numbers, simulating DNA mutation generating random DNA, Analyzing DNA.

UNIT III

Biological Sequence Databases : Overview of various primary and seconadry databases that deal with protein and nucleic acid sequences. Databases to be covered in detail are Gen bank, EMBL, DDBJ, Swiss Prot, PIR and MIPS for primary sequences, Various specialized databases like TIGR, Hovergen, TAIR, Palsmo DB,

ECDC etc., wil also be discussed. Preliminary ideas of query and analysis of sequence information.

UNIT IV

Sequence Comparison Methods : Method for the comparison of two seuqences viz. Dot matrix plots, Needleman Wusch & Smith Waterman algorithms. Analysis of computational complexities and the relative merits demerits of each method. Theory of scoring matrics and their use for sequence comparison.

UNIT-V

Database Search Algorithms : Methods for searching sequence databases like FASTA and BLAST algorithms.

Statistical analysis and evauation of BLAST results.

Pattern Recognition Methods in Sequence Analysis :

Concept of a sequence pattern, regular expresion based patterns. The use of pattern databases like PROSITE and PRINTS. Concept of position specific weight matrics and their use in sequence analysis. Theory of profiles and their use with special reference to PSIBLAst. Markov chains and Markov models and their use in gene Baum Wech algorithms for training a HMM. Use of profile HMM for protien family classification

Practical : Computational modeling of genomic proteomic, evolutionary tree designing ob databases, network search on genomic and proteomic databases.

Course Title: Enzymology **MM. 80 + IA 20**

Course No. BT 213 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

Enzymes : Introduction and scope, Nomenclature, Mechanism of Catalysis

Chemical and Physical properties of enzymes. Information from comparison and sequence.

Staructural Details : Determining the Molecular Weight, Size and Shape by modern technique; De Novo structure prediction from sequence; Solution structure from NMR measurements; Solution of X-ray diffraction pattern, Modelling from acose homolog, Comparing different structures.

UNIT II

Enzymes Kinetics : Single steady state kinetic Altman's methods; Inhibitors and activators; Multi substrate systems; Effect of pH and temperature; Allosteric enzymes, Mnemonial enzyme.

UNIT III

Immobilization of Enzymes : Advantages, Carriers, absorption, covalent coupling, cross linking and emntrapment methods, Micro environmental effects.

Enzyme Reactors : reactors for batch/ continuous enzymes processing, Choice of reacstor type : idealized enzymes reactor systems; Mass Transfer in Enzmes Reactors; Steady state analysis of mass transfer and biochemical reaction in enzymes reactors.

UNIT IV

Bio-process Design : Physical parameters, reactor operational stability; Immobilized cells Types of enzymes preparations and their characterization

Enzyme in food, fodder, textile and tanning industry, medicine, production of biodetergents.

UNIT V

Challenges and futre trends : Enzymes catalysis in organic media; Catalytic antibodies and Non protein biomolecules as catalysts, Biocatalysts from Extreme Thermophllic and Hyperthermophilic Archaea and Bacteria.

PRACTICALS

Electrophoresis of Proteins- native and under denaturing conditions

N-and C- terminal analysis of proteins

Peptie mapping

Sepration techniques (HPLC, GPC, FPLC)

Chemical modification of proteins

Enzymes : purification and kinetic analysis

Hydrodynamic properties measurement and application

Methods for immobililzation of enzymes

Techniques for analysis of Secondary, tertiary and quaternary structures of proteins

Electrophoresisof DNA linear, circular and super coiled

Protein acid hybridization

Determinatioon of Tm of nucleic acid.

Semester-II

Course Title: Human Physiology and Developmental Genetics

Course No. BT 214 **MM. 80 + IA 20**

Time: 3h

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

Introduction to brain and neurobioogy.

Slight and perception, hearing and balance, smell, taste, touch, pain, analgesics, Skin, hair. Muscles, movemet, rheumatoid disorders, nervous system, skin, glands.

Heart and blood circulation,blood clotting, microvasuclature.

Lungs, sufactants. Body fluids, fluid balance, parenteral soultions, renal phyisology.

UNIT II

Hormones and homeostatis

Digestive system, reproductive system, nervous system.

Genital system, reproductive biology and contraception.

Diseases of the digestive system, brething, circulation, Mechanisms of rug action.

UNIT III

Structure, chemistry, dynamics and regulation of sperm locomotion,capacitation and egg-surface targeting

Molecular biology, cytology and biochemistry of ovogenesis : Synthesis and storage of maternal transcripts, proteins and cell organells, rDNA

amplification in amphibia; transcription on lampbrush chromosomes, ovultion and hormonal control in mammals.

UNIT IV

Molecular and cellular biology of fertilization : acrosome reaction and signal transduction, monopermy and species - specificity.

Egg activation, early cleavages and bastocyst formation in mammals and biochemical and cellular changes during the passage down the oviduct to the uterus.

UNIT V

Implantation and formation of the placenta in mammals

Gastrulation in mammals- formulation of primitive streak, morphognetic movements and neural induction,. Organogenesis and foetal development.

Pattern forming genes and expression in Drosophila and mammalian embryos Development of the mammalian brain- cerebral cell lineages

Lens development fibre differentiataion, programmed morphogenetic histogenetic cell death(apoptosis). Erythropoeisis, myelopoeisis. Ageing.

PRACTICALS

1. Culture in *vitro* of chick embryo by New's technique and neural induction by transplanted Hensen's node.
2. Filter-paper ring culture of chick embryos.
3. Chick embryo limb bud organ culture and observation of cell death in interdigital regions by neutral red staining.
4. Sex- linked inheritance in Drosphila
5. Non-allelic and allelic interaction indrosphila.
6. Linkage study in Drosophila.
7. Allelic and heterozygotic frequencies in human populations.
8. Analysis of quantitatitive traits : frequency distribution, standard deviation and variance.
9. Karyotyping human cells and chromosomal in situ localization of genes.
10. Cell division : mitosis and meiosis.
    Mutants of Drosophila. Sex linked lethals in Drosphila.

Semester-II

Course Title: Nanobiotechnology

Course No. BT 214 **Time: 3h**

UNIT I

Bionanotechnology - An Overview : What can engineers learn from biology ? From bitechnology to Bionanotechnology. Bionanomachines in actions A Molecular recognition : How molecular recognition underlies cellular communication, material transfer into and within cells, and bitransformation. Information : How information is stored in the cell an how it is read ?

UNIT II

Biophysics : Bioelectromagnetism, bioenergetics, biomechanics, Neuro transport, Biological Rhythyms.

Modren Biomaterials : Proteins, Nucleic acids, Lipids, Polysaccharides.

Biomolecular Design and Biotechnology : Molecular Modelling and Biomolecular structure determination.

UNIT III

Strcutural Principles of Bionanotechnology : Natural Bionano-Macinery, Hierarchical strategy, raw material, Protein folding, self-organization, Molecular recognition flexibility.

UNIT IV

Functional Principles of Bionanotechnology : Information driven nano assembly, Energetics , chemical transformation, regulatio, Biomolecular motors, Biomolecuar motors, Biomolecular sensing, self replication and machine - phase Bionanotechnology.

UNIT V

Bionanotechnology Today and Future : basic capabilities, Nanomedicine today, DNA computers, hybrid materials, artificial life and biosensors.

Course Title: Plant Physiology and development biology

MM. 80 + IA 20

Course No. BT 311 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

UNIT I

Photosynthesis : Light harvesting complexes; mechanisms of electron transport; photo protective mechanisms; CO_2 fixation- C 3, C4 and CAM pathways.

Resperation and Photorespiration : Citric acid cycle; plant nitochondrial elelctron transport and ATP synthesis; alternate oxidase; photo respiratory pathway.

UNIT II

Nitrogen Metabolism : Nitrate and ammonium assimilation; amino acid biosynthesis.

Plant Hormones : Biosynthesis, storage, breakdown and trasport; phyisological effects and mechanisms of action. Structure, function and mecahnism of action of polytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

Solute Transport and Photoassimilate Translocation : Uptake, transport and translocation of water, ions, soultes and macromolecules from soil, through cells, across membranes, through xylem and phloem.

UNIT III

Cellular Movements and Body Plan : Laying of body axis planes; Differentiation of germ layers; Cellular polarity, cell size and their importance in model plants like *Fucus* and *Volvox;* Concept of positional information and intercalation.

Embryonic Patern Formation : Maternal gne effects; Zygotic gene effects; Homeotic gene effects in *Drosophila;* Embryogenesis and early patern formation in plants.

UNIT IV

Post-embryonic development : Regeneration and totopotency; Organ differentiataion and development; Cell lineages and development control genes in Caenorhabditis and maize.

Differentiation of Sopecialized Tissues : Stem cell differentiataion; Blood cell formation; Fibroblasts and their differentiataion; Cellular basis of immunity; Differentiataion of cancerous cells of role of proto-oncogenes.

UNIT V

Generation of Specialization Cell Types : Phase changes in *Salmonella;* Mating cell types in yeast; Surface antigen changes in Trypanosomes; Immunoglobuin diversity and production; heterocyst differentiation in *Anabaena;*

Special Aspects of Plant development and Differentiation : Pollen germination and pollen tube guidance; Phloem differentiataion; Sex determination in Plants; Self incompatibility, and its genetic control; Heterosis and apomixis.

Course Title: Plant Biotechnology **MM. 80 + IA 20**

Course No. BT 312 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

UNIT I

Conventional Plant Breeding, Introduction to cell and Tissue Culture, tissue culture as a technique to produce novel plant and hybrids. Tissue culture media (cmposition and prparation), Initiation and maintenance of callus and suspension cultures; single cell clones, Organogenesis; somatic embrygenesis; transfer and establishemnt of whoe plants in soil. Shoot tip culture; rapid clonal propagation and production of virus free plants. Embryo culture and embryo rescue.

UNIT II

Protoplast isolation; culture and fusion; selction of hybrid cells and regeneration of hybird plants; symmetric and asymmetric hybrids, cybrids, Anther,pollen and ovary culture for production of haploid plants and homozygooes lines, Cryopreservation, slow growth and DNA banking for germ plasm conservation.

UNIT III

Plant Transformation technology : Basis of tumour formation, hairy root featires of Ti and Ri plasmids, meachisms od DNA transfer, role of virulence genes, use of Ti and Ri as vectors, binary, use of 35S and other promoters, genetic Markers use of repoerter genes, reporter gene with introns, use of scaffolf attachment region methods of nuclear transformation, viral vectors and their applications, multiple gene transfer,Vectors- less or direct DNA transfer, particle bombardment, electroporation, microinjection, transformation of monocots. Trnsgene stability and gene silencing. Chloroplast Trsnformation :Advantages, vectors, success with tobacco and potato.

UNIT IV

Basic Techniques in rDNA Technology Application of Plant transformation for productivity and performnace : Herbicide resistance, phosphoinothricin, glyphosate, sulfonyl urae, atrazine, insect resitance Bt genes, Non- Bt like protease inhibitors, alpha amylase inhibitor, virus resitance, coat protin mediated, nucleocapsid gene, disease resitance, chitinase, 1-3beta glucanase, RIP, anti fungal proteins, thionins, PR proteins, nematode resiatnce, abiotic stress,post harvest losses, long shelf life of fruits and flowers, use of ACC synthase, polygalacturance, ACC oxidase, male sterile lines, bar and barnase systems.

UNIT V

Molecular Marker aided Breeding : RELP maps, linakge analysis, RAPD markers, STS, microsatellites, SCAR (sequence chaarterized amplified), SSCP(single starnd conforational polymorphism), AFLP, QTL, map based cloning, molecular marker assisted selection, Arid and semi-arid plant biotechnology, Green House and Green- House technology.

PRACTICALS

Preparation of media

Surface sterilization

Organ Culture

Callus propagation, organogenesis, transfer of plants to soil

Protoplast isolation and culture

Anther culture, production of Haploids

Cytological examintion of regenerated plants

Agrobacterium culture, selection of transformation, reporter gene (GUS) assay.

Developing RFLP and RAPD maps

Course Title: Microbial Technology **MM. 80 + IA 20**

Course No. MBT 233 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

UNIT I

History of microbial exploitation in Industry for production of rug, Nutraceutials and cosmetics. Microbes in food industries : Microbial growth pattern, phyiscal and chemical factors influencing destruction of micreo- oragnisms. Types of micro- organism normally associated with food- mold, yeast, and bacteria.Micro organisms in natural food products and their control. Contaminants of food -stuffs, vegetables, cereals, pulses,oilseeds, milk and meat during handling and processing.

UNIT II

Biochemical changes caused by micro- organisms, determination of various types of food product. Food poisoning and microbial toxins,microbial food fermentation, standards for different foods.

UNIT III

Microbial pharmaceutical industries : Production of antibiotics like penicillin, streptomycin, tetracyline, immunosupressor.

Microbial production of anti-cancer and antioxidant drug : production of CoQ10, betacaretonid, astaxatine, demethylated cholochine and its derivative, grocosaamine.

Microbial production of alcohol, methanol and unsaturated fatty acid. Use of microbe in mineral recovery.

UNIT IV

Bacteral and viral vectors

Biological warfare agents

Mode of action of antibiotics : molecular mechanism of during resitance (MDR) Anti- viral cheotherapy. Anti fungal chemotheraphy.

UNIT V

Viral vaccines : conventional : killed . attenuated ; DNA;peptide; recombinant proteins. Sterilization techiques : biohazard hoods ; containment facilities, BSL 2,3,4

PRACTICALS

Production of antibiotics at shake flsk level :

Production of alcohol at shake flask level.

Operation of biorecator.

Isolation of antibiotics from mirobail broth

Isolation of antioxidants from mirobial broth.

Microbial transfer technique.

Course Title: Genetic engineering **MM. 80 + IA 20**

Course No. BT 314 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

UNIT I

Scope of Genetic Engineering

Milestones in Genetic Engineering

Isolation of enzymes, DNA sequencing, synthesis and mutation, detection and separation cloning, gene expression. Cloning and patenting of life forms. Genetic engineering guidelines

Molecular Tools and Their Applications

Restriction enzymes, modification enzymes, DNA and RNA markers

UNIT II

Nucleic Acid Purification, Yield Analysis

Nucleic Acid Amplification and its Applications

Gene Cloning Vectors

Restriction Mapping of DNA Fragments and Map Construction, Nucleic Acid Sequencing

cDNA Synthesis and Cloning

mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening

Alternative Strategies of Gene Cloning

UNIT III

Cloning interacting genes-Two-and three hybrid systems, cloning differentially expressed genes. Nucleic acid microarray arrays

Site-directed Mutagenesis and Protein Engineering

How to Study Gene Regulation? DNA transfection, Northern blot, Primer extension, S1 mapping, RNase protection assay, Reporter assays

Expression strategies for heterologous genes

Vector engineering and codon optimization, host engineering,in vitro transcription and translation, expression in bacteria expression in yeast, expression in insect cells, expression in mammalian cells, expression in plants.

UNIT IV

Processing of recombinant proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins.

Phage Display

T-DNA and Transposon Tagging

Role of gene tagging in gene analysis, T-DNA and Transposon Tagging, Identification and isolation of genes through T-DNA or Transposon.

UNIT V

Transgenic and gene knockout technologies

Targeted gene replacement, chromosome engineering.

Gene therapy: Vector engineering strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing.

Practicals

Bacterial culture and antibiotic selection medias. Prepration of competent cells.

Isolation of plasmid DNA.

Isolation of lambda phage DNA .

Quantitation of nucleic acids.

Agarose gel electrophoresis and restriction mapping of DNA

Construction of restriction map of plasmid DNA.

Cloning in plasmid/phagemid vectors.

Preparation of helper phage and its titration

Preparation of single stranded DNA template

DNA sequencing

Gene expression in E. coli and analysis of gene product

PCR and Reporter Gene assay (Gus/CAT/b-GAL)

Course Title: Environmental Biotechnology

MM. 80 + IA 20

Course No. BT 315 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

UNIT I

Environment : Basic Concepts and issues, Enviornmental Pollution : types of pollution, Methods for the measurement of pollution; Methodology of environmental management - the problem solving approach, its limitation. Air polution and its control through Biotechnology.

UNIT II

Water Pollution and its Control : Water as a scarce natural resource, need for water management, Measurement of water pollution, sources of water pollution, Wsate water collection, Waste water treatment - physical, chemical and biological treatment process. Microbiology of Waste Water Treatments, Aerobic Process; activated sludge, Oxidation ditches, trickling filter, towards, rotating discs, rotating drums oxidation ponds. Anaerobic Processes :

UNIT III

Anaerobic digestion, aaerobic fiters Up flow anaerobic sldge blanket recators. Treatment schems for waste of dairy, distillery, tannery, sugar, antibiotic industries.

UNIT IV

Microbiology of degradtion of Xenobiotics in Environment Ecological considerations, decay behaviour & degradative plasmids; Hydrocarbons, substituted hydroscarbons, oil, pollution, surfactants, pesiticides, Bioremediation of contaminated soils and waste land.

UNIT V

Biopesticides in Integrated pest management. Solid wastes; sources and management (composting wormicuture and methane production)

Global Environmental Problems : Ozone depletion UV- Br green-house efects and acid rain their impact and biotechnological approaches for management.

Practicals

Detection of coliforms for determination of the purify of potable water

Determination of total dissolved soilds of water

Determination of dissolved oxygen concentration of water sample.

Determination of biological oxygen demand (BOD) of a sewage sample.

Determination of chemical oxygen demand (COD) of sewage sample

Determine the efficiency of removal of air pollutant using fibrous air filter.

Isolation of xenobiont degrading bacteria by selctive enrichment techniques.

test for degradation of a aromatic hydrocarbons by bacteria

Survey of degradative plasmids in microbes growing in polluted environment.

Effect of sulphur dioxide on crop plants

Estimation of heavy metls in water/ soil by Atomic absorption spectrophotometry

Estimation of nitrate in drinking water

Study on biogenic methane production in different habitats.

Course Title: Bioprocess Engineering MM. 80 + IA 20

Course No. BT 411 Time: 3h

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

UNIT I

Engineering units, state of system, density, concentration, temperature pressure, ethalpy, material balance thermodynamics energy balance in open and closed system.

Fluid flow in biomass processing, liquid transport system,properties, handling system and Newtonian liquids, energy equation for steady flow of fluids, pump slection and performance, flow measurement, flow charactersitics of Newtonian fluds, measurement of viscosity.

UNIT II

Energy for biotechnology industry : generation of stem fuel utilization, electric power utilization. Concept on heat tranfer n biomass processing : type of heat exchanger mode of heat transfer, steady and unsteady state heat transfer. Microwave heating.

Preservation process for biological products : influence of external agents, thermal death point, spoilage probability, pasteurization and commercial sterilization.

UNIT III

Concept on refrigeration system used in biotechnology inductry, freezing, storage of food and biopolymers, biological products through freezing, concentratoion of broth through various type of evaporator.

Concept on Mass transfer of Biological product during processing i.e. steady state diffusion of gaseous through solid, convective mass transfer, laminar flow past a flat plate, turbulent flowa past a flat plate.

UNIT IV

Membrane separation process for separation of biological products, basis concept on dehydration, dehydation systems, dehydration system design.

Types of fermentation processes : Analysis of batch, Fed batch and continuous bioreactions stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluilized, photobioreactors etc.)

UNIT V

Measurement and control of bioprocess parameters,

Downstream Processing: Introduction, Removal of microbial cells and solid mater, foam separation, precipitation filtration, centrifugation, cell disruptions, liquid- liquid extraction, chromatography, Effluent treatment: D.O.C. and C.O.D treatment and disposal of effluents

Practical

Isolation of industrially important microorganisms for microbial processes

Determination of thermal death point (TDP) and thermal death time (TOT) of microorganism for design of a sterilizer

(a) Determination of growth curve of a supplied microorganism and also determine substrate degradation profile.

(b) Compute specific growth rate (m), growth yield (Yx/s) from the above

Comparative studies of Ethanol production using different substrates

Microbial production of Citric acid using Aspergillus niger.

Microbial production of antibiotics (Penicillin)

Production and estimation of Alkaline Protease

Sauer Krant fermentation.

Course Title: Metabolic Engineering MM. 80 + IA 20

Course No. BT 412 Time: 3h

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

UNIT I

Basic concepts of Metabolic Enginerring - Overview of cellular metabolism l; Differnt models for cellular reaction.

PRIMARY METABOLITES giving special attention to following aspects of sugars, amino acids and lipids

Chemistry : The basic structure, Stereochemistry, Chemical synthesis of different intermediates

Biochemistry : The biochemical pathway, Carbon flow

Different regulatory points (regulation at enzyme at enzyme level and whole cell level, Alteration of fee back regulation, Limiting accumulation of end products)

Intermediate pools and their significance in horticulture, agriculture and medicine.

Molecular genetics : Regulatory genes, Gene expression in response to environmental stimuli, Regulation of gene expression.

UNIT II

SECONDARY METABOLITES giving special emphasis to following computers Flavanoid pathway, Terpenoid pathway, Polyketoid pathway :

Chemistry : The basic structure, Stereochemistry, Chemical synthesis of different intermediates

Biochemistry : The biochemical pathway, Carbon flow, Different regulatory points (regulation at enxyme level whole cell level, Alteration of feed back regulation, Limiting accumulation of end products.)

Intermediate pools and their significance in horticulture, agriculture and medicine.

Molecular genetics : Regulatory genes, Gene expression in response to environmental stimuli, regulation of gene expression.

UNIT III

Metabolic Profiling & Transription Factors for metabolic Engineering

Metabolic Engineering to improve tolerance of plants to abiotic factors,/ climate change.

UNIT IV

Metabolic flux & modelling - Intergration of anbolism and catabolism, metabolic flux distribution analyis bioprocess, material, kinetic types, equilibrium reaction. Experimental determination method of flux distribution, metabolic flux analysis and its applications, Thermodynamics of cellular processes

Metabolic engineering. with Bioinformatics, Metabolic pathway modeling, Analysis of metabolic control and the structure,metabolic networks, metabolic pathway synthesis algorithms

UNIT V

Applicvations of metabolic Engineering - in pharmaceuticals, chemicals bioprocess food technology, nutriceuticals, agriculture, biofuels, environmental bioremediation and biomass conversion.

Practical:

Development of high yielding microbes/plants by chemical mutagens:

Development technique for production for transgenic microbes/ plant:

Cloning technique used in secondary metabolite expression in microbes/plants.

Secondary metabolite extraction and purification from microbes/ plants.

Course Title: Animal Biotechnology MM. 80 + IA 20

Course No. BT 413 Time: 3h

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

UNIT I

Structure and organization of animal cell.

Equipment and materials fo animal cell culture technology

Primary and established cell line cultures

Introduction to the balanced salt solutions and simple growth medium. Brief discussionm on the chemical, physical and metabolic fucntions of different constituents of culture medium, Role of carbon dioxide.

UNIT II

Role of serum and supplements

Measurement of valibility and cytotoxicity

Biology and characterization of the cultured cells,measuring parameters of growth

Basic techniques of mammalian cell culture in vitro disaggregation of tissue and primary clture maintenance of cell cultre cell separation

UNIT III

Scaling-up of animal cell culture

Cell sychronization

Cell cloing and micromanipulation

Cell transformation

UNIT IV

Application of animal cell culture

Stem cell cultures embryonic stem cells and their applications

Cell culture based vaccines.

UNIT V

Somatic cell genetics

Organ and histolypic cultures

Measurement of cell death

Apoptosis

Three diemnsional culture & tissue engineering

Practical:

Preparation of tisue culture medium and membrane filtration

Preparation of single cell suspension from spleen and thyms

Cell conting cell viability\

Macrophage monolayer from PEC and measureemnnt of phagocytic activity

Trypsinization of monolayer and sub culturing

Crypreservation and thawing

Meausremnt of doubling time

Role of serum in cell culture

Preparation of metabphase chromosomes from cultured cells

Osolation of DNA and demonstration of approaches of DNA laddering

MTT assay for cell vioability and growth

Cell fusion with PEG

Course No. MBT 414 **MM. 80 + IA 20**

Course Title: Social, ethical and legal issue Medical Biotechnology **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

IPR -patents and copyrigts, Patentabiity of life forms with special refernce to Microorganisms, Pharmaceutical indutsries, Biodiversity, aturally occuring substances . Human genome and IPR in Public-Private partnership

Availabities of Patent facilitating funds, Substantitive Patent Law Treaty (SPLT), Word Patent, European Patent.

UNIT-II

Social- genetic discrimination: insurance and employment, human cloning, foeticide, sex determination.

Ethical: somatic and germ line gene therapy, clinical trials, the right to information, ethics committee function.Social and ethical issues

UNIT-IV

Biosafety - Definition requirement containment facilities,biohazards, geneticallymodified organisms (GMOs) living modified organisms (LMOs), Biosafety for human health and environment designing and management of laboratory and culture room as per the norm of GLP, GMO and FDA.

UNIT-V

Management- Planning, Organizing, Leading & Controlling; Concepts and characteristics of information ; importance of MIS; Communication - type, channels & barriers; Financial management, planning and control characteristics os agricultural products; Problems of processed food marketing; Procurement & distribution systems; Location factors and other problems inprocessing of agricultural products.

PRACTICAL

Survey and preparation of datasheet social response for use of drug and bio-aids, developed through biotechnology means. Application of statistical methods in data analysis of social response in using drug and healthcare derived from transgenic bacteria, animal and transgenic plants.

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Course No. BT 115 **MM. 75**

Course Title: Computer application, Biomathematics & Biostatistics **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Fundamental of computing; Introduction to operating system: WINDOWS,NT,UNIX,LINUX operating system; comparative advantages of security (hacking, cracking), Installation, portability, and programming of these operating system; computer viruses; use of internet and WWW; searches on MEDLINE, CD, bibliographic database.

Graphics: Visualization technique- Software and Hardware, Interactive graphic; Viewing in the 3D; Raster algorithm; Surface and solid modeling; Rendering; animation; Image processing with stress on Biological system; 3D image reconstruction.

Computer Networking-LAN,WAN,MODEM; Optical Vs; Electronic Networking, Security of the network, Fire-walls, Network goals; Application Network; Networks architecture; Hierarchical networks; Ethernet and TCP/IP family of protocols ; Transport protocol design. Brief description and tabulation of data and its graphical representation

Measures of central tendency and dispersion: mean, median, mode, range, standard deviation, variance, Idea of two types .of errors and level of significance, tests of significance (F&t test); chi-square tests.

Simple lincur regression and correlation

Matrices: Elementary row and column transformations. Linear dependence, Rank of matrix, Consistency of system of linear equations and solution of linear system of equations. Characteristic equation, Cayley-Hamilton theoram, Eiger values and Eigen vectors, Diagonalisation, Complex and unitary matrices.

Differential Calculus I: Leibnitz theoram. Partial differentiation. Euler's theoram, Asymptotes, Curve tracing Change of variables. Expansion of functions of several variables.

Differential Calculus II: Cylindrical and spherical coordinate systems,Jacobians, Approximation of error Extrema of function of several variables, Lagrange's method of multipliers (Simple applications).

Multiple Integrals: Double and triple integral. Change of order, change of variables. Beta and Gamma function Applications of area, volume, Dirichlet integral and applications.

Vector Calculus: IPoint function. Gradient. Divergence and curel of a vector and their physical interpretation. Lin Surface and Volume integrals, Greens, Stoke's and Gauss divergence theoram.

Practical: Exercises on WINDOWS, LINUX,UNIX and Networking , Internet search and Graphics.

Course No. BT 116 **MM. 75**

Course Title: Enzymology **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Enzymes: Introduction and scope, Nomenclature, Mechanism of Catalysis,

Chemical and Physical properties of enzymes. Information from composition and sequence.

Structural Details: Determining the Molecular Weight, Size and Shape by modern technique; De Novo structure prediction from sequence; Solution structure from NMR measurements; Solution of X-ray diffraction pattern, Modeling from a close homolog, Comparing different structures.

Enzyme Kinetics: Single substrate steady state kinetics; King-Altman's method;

Inhibitors and activators; Multi-substrate systems; Effect of pH and temperature;

Allosteric enzymes.

Immobilization of Enzymes: Advantages, Carriers, adsorption, covalent coupling, cross-linking and entrapment methods, Micro-environmental effects

Enzyme Reactors: reactors for batch/continuous enzymatic processing, Choice of reactor type; idealized enzyme reactor systems; Mass Transfer in Enzyme Reactors; Steady state analysis of mass transfer and biochemical reaction in enzyme reactors.

Bio-process Design: Physical parameters, reactor operational stability; Immobilized cells.

Types of enzyme preparations and their characterization

Enzymes in food, fodder, textile and tanning industry, medicine, production of biodetergents.

Challenges and future trends: Enzyme catalysis in organic media; Catalytic antibodies and Non-protein biomolecules as catalysts,

Biocatalysts from Extreme Thermophilic and Hyperthermophilic Archaea and Bacteria..

Practicals

Electrophoresis of Proteins - native and under denaturing conditions

N- and C- terminal analysis of proteins

Peptide mapping

Separation techniques (HPLC, GPC, FPLC)

Chemical modification of proteins

Enzyme: purification and kinetic analysis

Hydrodynamic properties measurement and applications

Methods for immobilization of enzymes

Techniques for analysis of Secondary, tertiary and quaternary structures of proteins

Electrophoresis of DNA linear, circular and super coiled

Protein-DNA interaction

Nucleic acid hybridization

Determination of Tm of nucleic acid.

Course No. BT 212 **MM. 75**

Course Title: Bioinformatics **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Historical introduction and overview: Discovery of first sequencing DNA molecule, History of sequences analysis program, Alignment of sequence, multiple sequence alignment, Importance of database search,

FASTA and BLAST methods, Protein structure prediction and history of genomic sequence.

Collection and storing sequences in the laboratory: Sequencing of DNA, cDNA, Sequence format, and conversion of one sequence to another, multi-sequence format, Using database access program ENTREZ.

Alignment of pairs of sequences: Define sequence alignment its significance and methods of sequence alignment., Dynamic programming, algorithm for sequence alignment, use of scoring matrices in sequence alignments.

Multiple sequence alignment: Genome sequencing, Methods for multiple sequence alignment, statistical method for aiding alignment, Position specific scoring matrices

Prediction of RNA secondary structure: Basic for RNA structure prediction methods, analysis of folding of RNA, secondary structure of RNA and application in modeling

Phylogenetic prediction: Phylogenetic analysis to sequence alignment, concept of evolutionary tree

Database searching for similar sequences: DNA vs protein search, scoring matrices for similarity searches, FASTA sequence search similarity search, basic local alignment tool BLAST.

Gene prediction: Testing of reliability of an ORF prediction, gene prediction in microbial genomes, gene prediction in eukaryotic , evolutionary method promoter prediction in pro and eu-karyotes.

Protein classification and structure prediction: Alignment of protein structure, modeling on protein structure

Genome analysis: Genome anatomy for pro and eu-karyotic sequences, comparative genomic, functional classification of gene.

Practical: Computational modeling of genomic proteomic, evolutionary tree designing on databases, network search on genomic and proteomic databases.

Course No. BT 213 **MM. 75**

Course Title: Genetic engineering **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Scope of Genetic Engineering

Milestones in Genetic Engineering

Isolation of enzymes, DNA sequencing, synthesis and mutation, detection and separation cloning, gene expression. Cloning and patenting of life forms. Genetic engineering guidelines

Molecular Tools and Their Applications

Restriction enzymes, modification enzymes, DNA and RNA markers

Nucleic Acid Purification, Yield Analysis

Nucleic Acid Amplification and its Applications

Gene Cloning Vectors

Restriction Mapping of DNA Fragments and Map Construction, Nucleic Acid Sequencing

cDNA Synthesis and Cloning

mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening

Alternative Strategies of Gene Cloning

Cloning interacting genes-Two-and three hybrid systems, cloning differentially expressed genes. Nucleic acid microarray arrays

Site-directed Mutagenesis and Protein Engineering

How to Study Gene Regulation? DNA transfection, Northern blot, Primer extension, S1 mapping, RNase protection assay, Reporter assays

Expression strategies for heterologous genes

Vector engineering and codon optimization, host engineering,in vitro transcription and translation, expression in bacteria expression in yeast, expression in insect cells, expression in mammalian cells, expression in plants.

Processing of recombinant proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins.

Phage Display

T-DNA and Transposon Tagging

Role of gene tagging in gene analysis, T-DNA and Transposon Tagging, Identification and isolation of genes through T-DNA or Transposon.

Transgenic and gene knockout technologies

Targeted gene replacement, chromosome engineering.

Gene therapy: Vector engineering strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing.

Practicals

Bacterial culture and antibiotic selection medias. Prepration of competent cells.

Isolation of plasmid DNA.

Isolation of lambda phage DNA .

Quantitation of nucleic acids.

Agarose gel electrophoresis and restriction mapping of DNA

Construction of restriction map of plasmid DNA.

Cloning in plasmid/phagemid vectors.

Preparation of helper phage and its titration

Preparation of single stranded DNA template

DNA sequencing

Gene expression in E. coli and analysis of gene product

PCR

Reporter Gene assay (Gus/CAT/b-GAL)

Course No. BT 214 **MM. 75**

Course Title: Genomics and Proteomics **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Role of computers in Biology and Medicine, Biological databases: Primary and secondary databases for Proteins, Nucleic acids (DNA/ RNA), Metabolic pathways, Microbial and Cellular data bases, NCBI, EMBL, KEGG, DDBJ, SWISSPROT, PDB, PIR etc.; Tools for DNA sequence analysis, protein sequence analysis; Usage of sequence alignment and searching tools for Gene Identification, Genome Annotation, ORFs, ESTs, Codon biases, Redundancy, Search engines; Conserved motifs, patterns, blocks, domains, Secondary and tertiary Structure prediction tools; FASTA, BLAST, PSI-BLAST, CLUSTALW, Multalign, Dialign, GeneBee, MotifScan, TMPred, GOR, Chou-Fasman, NNPredict, Promoterfinder, NEBcutter, Genscan, ORF Finder, IntronExon finder etc

Using Biological databases; Structure visualization and Building; Protein Sequence Analysis; Genome Analysis; Protein Secondary and Tertiary structure prediction; Homology Modeling; Phylogenetic Analysis Software and Tools: Swiss PDB Viewer, Hyperchem, InsightII,

Viewerlite, Rasmol, BLAST, Alibee, Phylip, CLUSTAL, GLIMMER, TCS Biosuite Special topics: Bioinformatics perspectives on human diseases; SNPs; DNA microarrays

Practical:

Structure prediction of DNA, RNA and protein through different available software tools on Internet.

Course No. BT 215 **MM. 75**

Course Title: IPR and Patent **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory:

Scientific breakthroughs of Biotechnology at national and international level.

Commercial breakthroughs of Biotechnology at national and international level.

Biotechnology and business opportunities.

Concept on IPR, Breakthroughs of IPR at national and international level.

Important facts and figures while updating IPR.

Patentability of life forms with special reference to Microorganisms, Pharmaceutical industries, Biodiversity, Naturally occurring substances.

Human genome and IPR.

Government policies at national and international level in patenting IPR.

Nature of national and international IPR.

Owner ship of Intellectual Property.

IPR related to technology transfer and royalty to inverters.

Issue on IPR in Public-Private partnership.

Availabilities of Patent facilitating funds.

Substantive Patent Law Treaty (SPLT).

Word patent, European Patent.

Course No. BT 216 **MM. 75**

Course Title: Management in Biotechnology, Social, ethic and legal issue **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions the examiner should cover entire syllabus while setting question paper.

Theory:

Planning, Organizing, Leading & Controlling; Concepts and characteristics of information; Importance of MIS; Communication - type, channels & barriers; Characteristics of agricultural products; Problems of processed food marketing; Procurement & distribution systems; Location factors and other problems in processing of agricultural products; Financial management, planning and control; International trade in foods; Patents and trade marks; Export regulations; WTO; Inspection agencies. Bio safety norms as per DBT guideline for safety disposal of genetically modified prokaryotic and eukaryotic organisms, designing and management of laboratory and culture room as per the norm of GLP, GMP and FDA.

Social- genetic discrimination: insurance and employment, human cloning, foeticide,

sex determination.

Ethical: somatic and germ line gene therapy, clinical trials, the right to information,

ethics committee function.

Biosafety containment facilities, biohazards, genetically modified organisms (GMOs),

living modified organisms (LMOs) as per the DBT guideline.

Practical:

Survey and preparation of datasheet social response for use of drug and bio-aids, developed through biotechnology means. Application of statistical methods in data analysis of social response in using drug and healthcare derived from transgenic bacteria, animal and transgenic plants.

SEMESTER—III

Course No. BT 311 **MM. 75**

Course Title: Animal Biotechnology **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Structure and organization of animal cell.

Equipments and materials for animal cell culture technology

Primary and established cell line cultures.

Introduction to the balanced salt solutions and simple growth medium, Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, Role of carbon dioxide. Role of serum and supplements

Serum & protein free defined media and their application

Measurement of viability and cytotoxicity

Biology and characterization of the cultured cells, measuring parameters of growth

Basic techniques of mammalian cell culture in vitro disaggregation of tissue and primary culture maintenance of cell culture cell separation

Scaling-up of animal cell culture

Cell synchronization

Cell cloning and micromanipulation

Cell transformation

Application of animal cell culture

Stem cell cultures, embryonic stem cells and their applications

Cell culture based vaccines.

Somatic cell genetics

Organ and histotypic cultures

Measurement of cell death

Apoptosis

Three dimensional culture & tissue engineering

Practicals

Preparation of tissue culture medium and membrane filtration

Preparation of single cell suspension from spleen and thymus

Cell counting and cell viability

Macrophage monolayer from PEC, and measurement of phagocytic activity

Trypsinization of monolayer and sub culturing

Cryopreservation and thawing

Measurement of doubling time

Role of serum in cell culture

Preparation of metaphage chromosomes from cultured cells

Isolation of DNA and demonstration of apoptosis of DNA laddering

MTT assay for cell viability and growth

Cell fusion with PEG

Course No. BT 312 **MM. 75**

Course Title: Plant Biotechnology **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Conventional Plant Breeding

Introduction to cell and Tissue Culture, tissue culture as a technique to produce novel plant and hybrids.

Tissue culture media (composition and preparation)

Initiation and maintenance of callus and suspension cultures; single cell clones

Organogenesis; somatic embryogenesis; transfer and establishment of whole plants in soil.

Shoot-tip culture: rapid clonal propagation and production of virus-free plants.

Embryo culture and embryo rescue

Protoplast isolation; culture and fusion; selection of hybrid cells and regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids

Anther, pollen and ovary culture for production of haploid plants and homozygooes lines

Cryopreservation, slow growth and DNA banking for germ plasm conservation

Plant Transformation Technology: basis of tumour formation, hairy root features of Ti and Ri plasmids, mechanisms of DNA transfer, role of virulence genes, use of Ti and Ri as vectors, binary vectors, use of 35S and other promoters, genetic Markers, use of reporter genes, repoter gene with introns, use of scaffold attachment region methods of nuclear transformation, viral vectors and their applications, multiple gene transfer, Vectors-less or direct DNA transfer, particle bombardment, electroporation, microinjection, transformation of monocots. Transgene stability .and gene silencing.

Chloroplast Transformation: advantages, vectors, success with tobacco and potato. Basic Techniques in rDNA Technology Application of Plant Transformation for productivity and performance: Herbicide resistance, phosphoinothricin, glyphosate, sulfonyl urea, atrazine, insect resistance Bt genes, Non-Bt like protease inhibitors, alpha amylase inhibitor, virus resistance, coat protein mediated, nucleocapsid gene, disease resistance, chitinase, 1-3beta glucanase, RIP, antifungal proteins, thionins, PR proteins,nematode resistance, abiotic stress, post-harvest losses, long shelf life of fruits and flowers, use of ACC synthase, Polygalacturanase,ACC oxidase, male sterile lines, bar and barnase systems.

Molecular Marker-aided Breeding: RFLP maps, linkage analysis, RAPD markers, STS, microsatellites, SCAR (sequence characterized amplified regions), SSCP (single strand conformational polymorphism), AFLP, QTL, map based cloning, molecular marker assisted selection

Arid and semi-arid plant biotechnology

Green House and Green-Home technology

Practicals

Preparation of media

Surface sterilization

Organ Culture

Callus propagation, organogenesis, transfer of plants to soil

Protoplast isolation and culture

Anther culture, production of Haploids

Cytological examination of regenerated plants

Agrobacterium culture, selection of transformants, reporter gene (GUS) assay.

Developing RFLP and RAPD maps

Course No. BT 313 **MM. 75**

Course Title: Industrial microbiology **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

History of microbial exploitation in Industry for production of drug, Nutraceuticals and cosmetics.

Microbes in food industries: Microbial growth pattern, physical and chemical factors influencing destruction of micro-organisms. Types of micro-organism normally associated with food-mold, yeast, and bacteria. Micro-organisms in natural food products and their control. Contaminants of foods-stuffs, vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing. Biochemical changes caused by micro-organisms, deterioration of various types of food product. Food poisoning and microbial toxins, microbial food fermentation, standards for different foods.

Microbial pharmaceutical industries: Production of antibiotics like

penicillin, streptomycin, tetracycline, immunosupressor.
Microbial production of anti-cancer and antioxidant drug: production of CoQ10, beta-caretonid, astaxatine, demethylated cholochine and its derivative, gycosaamine.
Microbial production of alcohol , methanol and unsaturated fatty acid.
Use of microbe in mineral recovery.

Practical

Production of antibiotics at shake flask level:
Production of alcohol at shake flask level.
Operation of bioreactor.
Isolation of antibiotics from microbial broth
Isolation of antioxidants from microbial broth.
Microbial transfer technique.

Course No. BT 314 **MM. 75**

Course Title: Bioprocess Engg. I **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Engineering units, state of a system, density, concentration, temperature pressure, enthalpy, material balances thermodynamics energy, and energy balance in open and closed system.

Fluid flow in biomass processing, liquid transport system, properties, handling system for Newtonian liquids, energy equation for steady flow of fluids, pump selection and performance, flow measurement, flow characteristics of Newtonian fluids, measurement of viscosity.

Energy for biotechnology industry: generation of steam fuel utilization, electric power utilization.

Concept on heat transfer in biomass processing: type of heat exchanger mode of heat transfer, steady and unsteady state heat transfer. Microwave heating.

Preservation process for biological products: influence of external agents, thermal death point, spoilage probability, pasteurization, and commercial sterilization.

Practical:

Concentration of extract through rotary vacuum evaporator, Concentration of extract through falling film evaporator, Concentration of extract through raising film evaporator, Separation of molecule through Reverse osmosis, microbial filtration to concentrate broth.

Course No. BT 315 **MM. 75**

Course Title: Environmental Biotechnology **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Environment: Basic Concepts and issues

Environmental Pollution: types of pollution, Methods for the measurement of pollution; Methodology of environmental management - the problem solving approach, its limitations.

Air pollution and its control through Biotechnology.

Water Pollution and its Control: Water as a 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 process.

Microbiology of Waste Water Treatments, Aerobic Process; activated sludge, Oxidation ditches, trickling filter, towers, rotating

discs, rotating drums oxidation ponds. Anaerobic Processes:

Anaerobic digestion, anaerobic filters Up flow anaerobic sludge blanket reactors.

Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries

Microbiology of degradation of Xenobiotics in Environment Ecological considerations, decay behaviour & degradative plasmids; Hydrocarbons, substituted hydrocarbons, oil, pollution, surfactants, pesticides

Bioremediation of contaminated soils and waste land

Biopesticides in integrated pest management.

Solid wastes; sources and management (composting wormicu1ture and methane production)

Global Environmental Problems: Ozone depletion UV-Br green-house effect and acid rain their impact and biotechnological approaches for management

Practicals

Detection of coliforms for determination of the purify of potable water

Determination of total dissolved solids of water

Determination of dissolved oxygen concentration of water sample.

Determination of biological oxygen demand (BOD) of a sewage sample.

Determination of chemical oxygen demand (COD) of sewage sample

Determine the efficiency of removal of air pollutant using fibrous air filter

Isolation of xenobiont degrading bacteria by selective enrichment

techniques

Test for degradation of a aromatic hydrocarbons by bacteria

Survey of degradative plasmids in microbes growing in polluted environment

Effect of sulphur dioxide on crop plants

Estimation of heavy metals in water/soil by Atomic absorption spectrophotometry

Estimation of nitrate in drinking water

Study on biogenic methane production in different habitats.

SEMESTER—IV

Course No. BT 411 **MM. 75**

Course Title: Bioprocess Engg. II **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Concept on refrigeration system used in biotechnology industry, freezing, storage of food and biopolymers, biological products through freezing, concentration of broth through various type of evaporator.

Concept on Mass transfer of Biological product during processing i.e., steady state diffusion of gaseous through solid, convective mass transfer, laminar flow past a flat plate, turbulent flow in a past a flat plate

Membrane separation process for separation of biological products, basis concept on dehydration, dehydration systems, dehydration system design.

Types of fermentation processes: Analysis of batch, Fed batch and continuous bioreactions, stability of microbial reactors, analysis of

mixed microbial populations, specialized bioreactors(pulsed, flui1ized, photobioreactors etc)

Measurement and control of bioprocess parameters,

Downstream Processing: Introduction, Removal of microbial cells and solid mater, foam separation, precipitation filtration, centrifugation, cell disruptions, liquid- liquid extraction, chromatography, Effluent treatment: D.O.C. and C.O.D treatment and disposal of effluents

Practical

Isolation of industrially important microorganisms for microbial processes

Determination of thermal death point (TDP) and thermal death time (TOT) of microorganism for design of a sterilizer

(a) Determination of growth curve of a supplied microorganism and also determine substrate degradation profile.

(b) Compute specific growth rate (m), growth yield (Yx/s) from the above

Comparative studies of Ethanol production using different substrates

Microbial production of Citric acid using Aspergillus niger.

Microbial production of antibiotics (Penicillin)

Production and estimation of Alkaline Protease

Sauer Krant fermentation.

Course No. BT 412 **MM. 75**

Course Title: Metabolic engineering **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Concept on production of secondary metabolite in pro and eukaryotes. type of secondary metabolite under commercialization.

Mechanism of secondary metabolite regulation in pro and eukaryotes.

Induction for enhancement of secondary metabolites through chemical and physical mutagens. Induction for enhancement of secondary metabolites through rDNA technology.

Alternation in contents and quality of protein (to improve sulpher containing amino acids lysine), starch and lipid in target plants. Introduction & Expression of novel metabolites (Vitamins A, C, &E; anti-oxidants- beta-carotenoid, anthocyanin,) in target plants. Improvement of minerals in crop plants through r DNA technology. Enhancements of phytochemicals of pharmaceutical value in plants. Expression and production of antibodies and vaccines in plants. Expression and production of biodegradable plastics in plants.