M.Sc. Biotechnology

Course Code	Course Title	Credit	LTP
SEMESTER I			
MCE 701	Molecular Cell Biology	3	2-0-1
BCBT 701	Biochemistry	3	2-0-1
MAS 711	Statistics I	3	2-0-1
COMP 705	Computer Orientation	3	2-0-1
MBFT 720	General Microbiology	3	2-0-1
MCE 704	Environmental Biotechnology	3	2-0-1
			18
SEMESTER II			
MCE 703	Molecular Genetics	3	2-0-1
BCBT 813	Enzyme Technology	3	2-0-1
MAS 715	Statistics II	2	2-0-0
CBBI-801	Bioinformatics	3	2-0-1
MCE 804	Medical Biotechnology	3	2-0-1
MCE 702	Advanced Molecular Biology Techniques and Instrumentation	3	2-0-1
MCE 780	Seminar I	1	0-0-1
			18
SEMESTER III			
Specialization – Plant Biotechnology			
MCE-805	Nano - Biotechnology	2	2-0-0
CBBI-708	Biomolecular Modeling	3	2-0-1
MCE 806	Genetic Engineering	3	2-0-1
TE 801	Plant Tissue Culture Technology	3	2-0-1
MBFT 814	Microbial Biotechnology	3	2-0-1
MCE 802	Plant Biotechnology	3	2-0-1
MCE 880	Seminar II	1	0-0-1
			18
Specialization – Animal Biotechnology			
MCE-805	Nano-Biotechnology	2	2-0-0
CBBI-708	Biomolecular Modeling	3	2-0-1
MCE 806	Genetic Engineering	3	2-0-1
TE 801	Animal Tissue Culture Technology	3	2-0-1
MCE 803	Animal Biotechnology	3	2-0-1
MBFT 814	Microbial Biotechnology	3	2-0-1
MCE 880	Seminar II	1	0-0-1
			18

SEMESTER I

MCE 701 MOLECULAR CELL BIOLOGY 3 (2-0-1)

Unit 1. Macromolecules: Biochemical and molecular aspects of living cells, Carbohydrates, Proteins and Nucleic acids. Cell fractionation procedure.
Unit 2. Cell organelles: Molecular organization of cell organelles (structure and function), cell wall, plasma membrane (various models), endoplasmic reticulum, mitochondria, chloroplast, nucleus, etc.
Unit 3. Cytoskeleton and Extra Cellular Matrix: Microtubules, intermediate filaments and micro filaments. ECM- definition, significance and biomolecules involved in ECM.
Unit 4. Cell growth and division: Cell cycle, mitosis, meiosis, DNA replication, apoptosis, cancer.
Unit 5. Cell signaling and cell- cell interactions: signal transduction, endocrine, paracrine and autocrine signalling, surface receptor mediated transduction, chemistry and function of signaling molecules.
Practicals

Mitosis of Onion Root Tips
Tissue Types in Dicot Stem
Tissue Types in Monocot Stem
Tissue Types in Dicot Root
Tissue Types in Monocot Root
Gram Staining of Bacteria

BCBT- 701 BIOCHEMISTRY 3(2-0-1)

Unit-1: Bioenergetics: energy and its transformation in living system, thermodynamic principle : introduction to metabolism, methods to study metabolism, high energy compounds.
Unit-2: Carbohydrate metabolism: introduction, digestion, absorption, glycolysis, HMP, gluconeogenesis, glyoxalate pathway, glycogenolysis, energy aspects and its regulation. Glycogenesis, starch biosynthesis, citric acid cycle, energy aspects and importance.
Unit 3: Lipid metabolism: introduction, digestion and absorption, TAG, phospholipids, sphinolipids, glycerolipids, biosynthesis.
Fatty acid oxidation: importance and regulation .
Fatty acid biosynthesis, importance and regulation
Cholesterol biosynthesis : pathway, importance and regulation.
Unit 4: Amino acid metabolism: introduction, digestion and absorption, amino acid degradation reactions, urea cycle, linking to TCA cycle. Biosynthesis of essential and non essential amino acids, regulation and importance.
Unit 5: Nucleotide metabolism: introduction, denovo and salvage pathways of pyrimidine and purine. Nucleotide synthesis and catabolism and importance and regulation.

Unit 6: Oxidative phosphorylation: Introduction, ETS, ATP formation, Importance and regulation.

Practicals:

1. Estimation of lactic acid from milk.
2. Determination of protein in milk.
3. Determination of fat from milk.
4. Determination of lactose from milk.
5. Determination of acid number of oil.
6. Determination of saponification number of oil.
7. Extraction and estimation of starch from potato.
8. Estimation of protein from unknown biological sample.

MAS 711 Statistics I 3 (2-0-1)

Standard – deviation, Coefficient of variation, standard error of mean.

Theory of Probability : equally likely, mutually exclusive events , definitions of probability, addition & multiplication theorems of probability & problems based on them.

Normal & Binomial Distributions.

Simple correlation & regression, Multiple- regression, Multiple & Partial- Correlation.

Testing of Hypothesis : Concept of Hypothesis, Degrees of freedom, Level of significance. Type I & Type II errors. X^2 , t, Z & F – tests. (definition, applications & problems based on these tests).

COMP 705 Computer Orientation 3 (2-0-1)

1. **Information Concepts**
2. **Computer Appreciation –** a) Definition, Characteristics and Application of Computers
   b) Computer Hardware, I/O Devices, Memory CPU
   c) Software Concepts
3. **Operating System:** DOS, Windows
4. **Application Software:** MS Word, MS Excel
5. **Computer Programming:** Concepts of Algorithm & Flowchart, Introduction to 'C' Language. History, Input and Output Statements, Variables and Constants, Expressions and Operators, Control Statements, Branching Statements (if, if-else, nested if), Looping Statements (while, do-while, for-next), Functions and arrays.
6. **Internet concepts and search engine**.

MBFT 720 GENERAL MICROBIOLOGY 3(2-0-1)

History and scope of Microbiology

General characteristics, classification, morphology and reproduction of Bacteria, Mycoplasma, Chlamydia, Rickettsiae, and Actinomycetes

General characteristics, classification, morphology and reproduction of Fungi, Algae, Protozoa

Control of microorganisms by physical and chemical agents

Practical

Familiarity with equipment and apparatus used in Microbiology

Methods of isolation, purification and maintenance of microorganisms

Staining techniques (Simple, Differential, Special) in bacteria

Preparation of media and reagents and their sterilization

Study of cultural and morphological characteristics of important groups of: Fungi, Algae, Protozoa

Effect of physical agents (viz. temperature, osmotic pressure, UV radiation etc.) on microorganisms

Effect of chemicals (viz. alcohol, phenol, halogens, heavy metals etc.) on microorganisms

MCE 704 ENVIRONMENTAL BIOTECHNOLOGY 3 (2-0-1)

Unit 1. Sampling and analysis techniques of waste water, solid waste and their disposal, environmental quality standards and indices.

Unit 2. Measurement of the level of pollution-BOD, COD, suspended solids, ammoniacal nitrogen, phosphates, biological indicators.

Unit 3. The process of aerobic waste water treatment, preliminary treatment, primary, secondary treatment, tertiary treatment, sludge treatment, anaerobic waste water treatment.

Unit 4. Landfill, hazards of landfill, uses of landfill sites, trench method, cell emplacement method.

Unit 5. Biodegradation of xenobiotic compounds, general features, hydrocarbon degradation of halogenated compounds, contribution of biotechnology in waste treatment and environmental management.

Practicals

Determination of dissolved oxygen of sewage water

Determination of biological oxygen demand of sewage water

Determination of chemical oxygen demand of the given water sample

Determination of total dissolved solids of water

To study the inhibitory effect of various environmental temperature on microbial growth

SEMESTER II

MCE 703 MOLECULAR GENETICS 3 (2-0-1)

Unit 1. Gene concept and Gene analysis: The gene and gene concept, cistron as a unit of genetic function. Prokaryotic genome, eukaryotic genome, viral genome, genetic code, central
dogma including reverse transcription.
Unit 2. Transcription: Enzymatic synthesis of RNA, classes of RNA molecules, mechanism of transcription in prokaryotes and eukaryotes- RNA polymerases, promoter sequences for RNA polymerases, enhancers and silencers, transcription factors and initiation of transcription, basal transcription apparatus, elongation and termination of transcription. Post transcriptional modifications (mRNA processing reactions- 5' capping, polyadenylation, splicing).
Unit 3. Translation: Introduction to protein synthesis (ribosomes, codon- anticodon interaction). Protein synthesis in prokaryotes and eukaryotes. Translational factors and their functions. Initiation, elongation and termination phases of translation. Comparison of protein synthesis in prokaryotes and eukaryotes. Post translational modification of proteins (protein folding and protein trafficking). Antibiotics as inhibitors of protein synthesis.
Unit 4. Gene regulation: Gene regulation in prokaryotes, transcriptional control (lac operon model, catabolite repression, tryptophan operon model). Regulation of gene expression in eukaryotes (transcriptional and translational controls). Gene regulation in plant cells.
Unit 5. Mutation: Study of mutation at molecular level. Types of mutation (gene mutation and chromosomal abberations); Molecular basis of gene mutation, tautomeric shifts and abnormal base pairing (transitions and transversions); Frame shift mutations (deletions or additions); Mutagenesis, physical and chemical mutagenic agents; DNA damage and DNA repair mechanisms.

Practicals

1. Estimation of DNA by Diphenylamine Method
2. Screening of auxotrophic mutants in *E. coli*
3. Study of UV induced mutagenesis in bacteria
4. Quantification of microbial growth
5. Study of thermal death kinetics

BCBT-813 ENZYME TECHNOLOGY 3(2-0-1)

Unit1: Introduction of enzymes:General properties and significance, classification and nomenclature.Terms and definition in enzymology, co-factors, coenzymes, active site concept, isoenzymes, allosteric enzymes, marker enzymes, multienzyme complex, ribozyme, abzyme, synzyme, extremozyme, therapeutic enzymes and immobilized enzymes etc.
Unit 2: Enzyme kinetics:steady rate kinetics, Derivation of Michaelis-menten equation using steady state/equilibrium kinetics, plots of lineweaver- Bruke, Hanes, Eadie- Hofster etc. Mechanism of bisubstrate and multisubstrate enzyme catalyzed reaction, Enzyme inhibitors, mechanism of enzyme action-lysozyme, chymotrypsin, alcohol DH.
Unit 3: Regulation of enzyme activity: Covalent modification, allosteric model concerted

and sequential, cooperativity. Feedback inhibition.

Unit 4: Enzyme Technology: Commercial production of enzymes, immobilization of enzymes, example of enzyme engineering, application of enzyme(therapeutic uses, analytical uses, manipulated uses etc.), uses of enzyme reactors.

Unit 5: Isolation, purification and localization of enzymes. Various methods to estimate the enzyme activity.

Practical:

1. Effect of temperature, pH, substrate concentration and enzyme concentration and enzyme concentration on enzyme activity.
2. Action of salivary amylase on starch.
3. Determination of acid posphatase activity in sample.
4. Determination of alkaline phosphatase activity in sample.
5. Determination of SGOTin serum.
6. Determination of SGPT in serum.
7. Determination of urease in plant sample.
8. Assay of protein by lowry method.
9. Assay of catalase in vegetables.
10. Hydrolysis of egg protein by pepsin

MAS 715 Statistics- II 3 (2-0-1)

Analysis of variance technique: Definition & assumptions, One way classification, two way classification with more than one observation per cell.

Designs of experiments: Principles of Experimental- Design, Randomized Block Design (R.B.D),

Latin Square Designs (L.S.D)., Missing Plot Technique in R.B.D & L.S.D. Critical-difference (C.D) Split plot design.

Factorial – Experiments: 2^2 , 2^3, 3^2, & 3^3 , factorial-designs. (Yates method of Analysis), 2 x 3 & 2 x 4 factorials.

Durcan's Multiple Range Test. Newman's Kuel's Test

Sampling techniques: Simple Random Sampling, Stratified Random Sampling & Systematic Sampling.

CBBI-801 BIOINFORMATICS 3 (2-0-1)

Unit 1

Introduction to Bioinformatics, philosophical, directional and application oriented background of
bioinformatics.

Unit 2

HGP – influence area in Bioinformatics, Application in different industries, and its Indian scenario, as a business, problem and future aspects.

Unit 3

Information network – Internet, web Browser and address (NCBI, EBI etc).

Unit 4

Databases – information resources for Proteins and Genomics.

Unit 5

SRS, Algorithms, Alignment.

Unit 6

Phylogenetic Analysis: Fundamental of Phylogenetic model, Tree interpretation – Paralogues and orthologues, Tree building and tree evaluation, Phylogenetic software.

Unit 7 Comparative Genome Analysis: Introduction, application, genome analysis and annotation.

Unit 8

Molecular structure Predication and visualization (X-ray crystallography/NMR/Bioinformatics).

Unit 9

Micro array data analysis.

Unit 10

Different analysis packages and other Miscellaneous Tools etc.

MCE 804 MEDICAL BIOTECHNOLOGY 3 (2-0-1)

Unit 1. Introduction: History and scope of medical biotechnology, current status and future prospects.

Unit 2. Disease diagnostics and Immunotechnology: Detection of genetic diseases. Molecular Diagnosis- genetic markers, DNA diagnostics, PCR based diagnostics, array-based diagnostics and nucleotide polymorphisms. Antigen-antibody interaction- complement fixation, agglutination, immunoelectrophoresis, immunofluorescence, enzyme-linked immunosorbant assay (ELISA) and radioimmunoassay (RIA).

Unit 3. Monoclonal antibodies: Hybridoma technology and monoclonal antibody production, applications of monoclonal antibody.

Unit 4. Drug development and gene therapy: Molecular drug designing- disease targets, methods of drug delivery, designing of drug delivery system for biotechnological products,; Mode of action of antibiotics and antivirals; molecular mechanism of drug resistance (MDR). Germ line gene therapy, Somatic gene therapy, cellular targets for somatic gene therapy, gene targeting and delivery.

Unit 5. Animal health care and biotechnology: Methods of immunization, preparation of vaccines, type of vaccines, DNA vaccines, Viral vaccines (conventional: killed/attenuated) peptide vaccines and recombinant proteins.

Unit 6. Applications of gene profiling, microarray techniques and DNA fingerprinting in medical science. Stem cell technology and their potential applications

Practicals

Determination of Blood groups

Agglutination Test – The Widal Test

Determination of Blood Glucose by Hagedorn- Jenson method

Identification of pathogen using double diffusion method of Antigens and Antobodies

Isolation and characterization of bacterial pathogens from provided samples.

In-silico drug designing; enzyme and inhibitor action and docking protocol.

MCE 702 ADVANCED MOLECULAR BIOLOGY TECHNIQUES AND

INSTRUMENTATION

3 (2-0-1)

Unit l. Molecular biology techniques: Isolation and purification of DNA, RNA and Plasmids. DNA finger printing, polymerase chain reaction (PCR), Southern blotting, Northern blotting, dot blot and slot blot. DNA sequencing techniques.
Unit 2. Chromatographic techniques: Principles, instrumentation and applications of adsorption, partition, exclusion, ion exchange, affinity, column chromatography, chromatofocussing, TLC, HPLC, FPLC and GLC.
Unit 3. Electrophoretic techniques: Principles, instrumentation and applications of gel electrophoresis (AGE and PAGE), Pulse field gel electrophoresis (PFGE).
Unit 4. Centrifugation techniques: Principles, instrumentation and applications of differential, zonal, density gradient and ultra centrifugations.
Unit 5. Principles, instrumentation and applications of colorimetry, spectrophotometry, atomic absorption photometry, mass spectroscopy. Detection and measurement of radio active
isotopes (GM counter and Scintillation counter), autoradiography.
Practicals
Estimation of chlorophyll pigments using colorimetry
Separation of cell organelles by centrifugation
Separation of nucleic acids by agarose gel electrophoresis
Qualitative and quantitative determination of DNA by UV spectroscopy.
Study of pipetting techniques

MCE 780 SEMINAR I

SEMESTER III

Specialization – Plant Biotechnology

MCE 805 NANOBIOTECHNOLOGY 3 (3-0-0)

Unit 1. Introduction, History and basic concepts of Nanotechnology; Man made and natural nano-materials; future scopes of nanotechnology
Unit 2. Solid state physics; crystal structure; quantum mechanics and nanostructure analysis
Unit 3. Methods of measuring properties; Atomic structure, particle size determination, surface structure, Microscopy (TEM, SEM and Field Ion), Spectroscopy (IR, Raman and X-ray)
Unit 4. Nanomaterials, Metal nanocluster, Semiconducting nanoparticles. Molecular clusters; DNA nanowires; Methods for synthesis
Unit 5. Carbon nanocluster; Nanotube; Mechanism and applications
Unit 6. Nanobiotechnology- Catalysis: Nanocrystals; Biological building blocks; Nucleic acids; Biological nanostructures
Unit 7. Nanomachines and Nano devices; NEMS; NEM (Fabrications) supermolecular switches
Unit 8. Nano-medicine; synthesis; drug delivery; application

CBBI-708 BIMOLECULAR MODELING 3 (2-0-1)

Unit 1
Concepts of Molecular Modeling, Simulation of molecular mechanics and dynamics, Empirical representation of molecular energies, Simulations of Free Energy changes, Force fields, Use of Force Fields. A Energy minimization of small molecules, Local and global energy minima. Molecular Mechanics methods, Techniques in Molecular Dynamics, Monte Carlo Simulation for conformational analysis and semi-empirical methods, Application of molecular graphics.

Unit 2
Methods for Prediction of Secondary and Tertiary structures of Proteins - Knowledge-based structure prediction, Principles of Protein Folding, Fold recognition, Methods for comparison of 3D structures of proteins; Methods to predict three dimensional structures of nucleic acids.

Unit 3
Analysis of structures and correctness of structures, Submission of data to PDB: atomic coordinates and electron density maps; Anatomy of Proteins - Ramachandran plot. Evaluation of stereo-chemical properties of protein structures.

Unit 4
Internal and external co-ordinate system; Generation of co-ordinates of biopolymers in Cartesian and cylindrical polar co-ordinate system; Methods of single crystal X-ray diffraction of macromolecules: molecular replacement method and direct method - Fiber diffraction. Structural data banks - Protein Data Bank, Cambridge small molecular crystal structure data bank.

Practicals:
1. Introduction to the structure database PDB.
2. Visualization of the protein structure using VMD.
3. Secondary structure prediction using GOR algorithm.
4. Tertiary structure prediction using SWISS-MODEL, ModWeb and Geno3D.
5. Homology modeling of a protein by using the MODELLER software.
6. Protein Structure validation using SAVS server.
7. Protein active site prediction using CastP and Pocket Finder.
8. Automated docking using PATCH DOCK webserver.
9. Structural alignment using DaliLite and SSAP.

MCE 806 GENETIC ENGINEERING 3 (2-0-1)

Unit 1. Biology of cloning vectors and enzymes used in genetic engineering: Plasmids, cosmids, phagemids, *Agrobacterium tumifaciens* based vectors (binary and cointegrate vector stratergy) and artificial chromosomes (BAC, YAC). Enzymes used in genetic engineeringexonucleases, endonucleases- S1 nucleases, restriction endonucleases, ligases, polymerases, reverse transcriptase, terminal deoxynucleotidyl transferase, kinases and alkaline phosphatases.

Unit 2. Principles of recombinant DNA technology: Construction of recombinant DNA, construction of genomic and cDNA libraries, selection and screening of desired clones by hybridization method, genetic method and immunological method.

Unit 3. Recombinant DNA expression: Requirements of gene expression vectors, transient vs stable expression, expression of heterologous gene in bacteria (*E. coli*), detection of

expression of foreign genes, maximizing the expression of recombinant DNA.
Unit 4. Marker genes: Selectable and screenable marker genes (reporter genes)- luciferase, β galactosidase, chloramphenicol acetyl transferase. Transfection methods – electroporation, microinjection, particle gun bombardment.
Practicals
Restriction Digestion of DNA with Restriction Endonuclease
Ligation of Restriction Digested Fragments using Ligase Enzyme
Preparation of Competent Cells
Transformation of Competent Cells
Selection of Recombinants using Blue-White Screening

TE- 801 PLANT TISSUE CULTURE TECHNOLOGY 3 (2-0-1)

UNIT 1: **Introduction to plant tissue culture:** Historical developments and landmarks in Plant Tissue Culture. Organization of tissue culture laboratory, aseptic techniques, media formulation, clonal propagation vs tissue culture, Totipotency: growth, differentiation and morphogenesis in tissue culture.
UNIT 2: Micropropagation: Concept, various stages, organogenesis and somatic embryogenesis. Meristem culture: Meristem culture for mass and clonal propagation, production of pathogen free plants, application in forestry.
UNIT 3: **Somatic hybridization**: Isolation, purification and culture of protoplasts, protoplast fusion and somatic hybridization, identification and characterization of somatic hybrids / cybrids, its applications.
UNIT 4: Secondary metabolites: Production of secondary metabolites by plant cell culture, hairy root culture, biotransformation.
UNIT 5: Cell Lines: Cell line selection for resistance to herbicide, stress, insect and diseases
UNIT 6: Haploid culture: Tissue culture methods for haploid production & its applications

Practicals:
Media preparation
Explant selection, sterilization & inoculation
Callus & cell suspension culture: Induction and growth parameters
Androgenesis: Anther & Pollen culture
Plant regeneration from embryo, meristem & callus culture
Synthetic seed preparation

MBFT 814 MICROBIAL BIOTECHNOLOGY 3(2-0-1)

History and scope of Biotechnology. Bioreactors: Types of Bioreactors e.g. packed bed, bubble column, air lift, fluidized bed bioreactor, membrane/hollow fiber, photo-bioreactor etc.

Industrial production of alcohol, glycerol, solvents (acetone, butenol, isopropyl alcohol), vinegar, acids (lactic, citric, gluconic acid), vitamins (Riboflavin, B12), antibiotic (penicillin, streptomycin, tetracycline, griseofulvin) by micro-organisms.

Concept of various types of fermentation: Batch, continuous, semisolid and solid state etc.

Methods of enzyme production, their immobilization and application in therapeutic, analytical manipulation and industrial uses.

Use of microbes in producing SCP, substrates used in producing SCP, their nutritional value.

Biotransformation

Practical

Study of fermentor and fermentor operation.
Isolation and purification of important microbial enzymes.
Production of lipase by submerged fermentation.
Production of lipase by semisolid fermentation.
Effect of pH and temperature on enzyme production.
Isolation of yeast from fruit juice and rice flour.
Quantitative estimation of ethanol produced during yeast fermentation.
Production of wine from grapes by using yeast
Citric acid production by solid state fermentation
Preparation of fungal spore in large scale by bread culture method.
Immobilization of cell on sodium alginate gel

MCE 802 PLANT BIOTECHNOLOGY 3 (2-0-1)

Unit 1. Plant genome, nuclear genome, chloroplast genome and mitochondrial genome
Unit 2. Genetic engineering in plants: Biology of *agrobacterium tumefaciens*, techniques of transferring agronomically important genes using Ti plasmid, protoplast fusion method; methods of direct gene transfer; transfer and expression of cloned DNA in plant cells.

Unit 3. Improving nutritional value of seed storage protein, application of biotechnology in crop improvement, genetic engineering of plants for delay of fruit ripening, herbicides tolerance, salt resistance, and virus pest resistance, role of monoclonal antibodies in agriculture.
Unit 4. Biofertilizers, classification of biofertilizer sand importance of Biofertilizers, nif genes; algal biofertilizer, azolla biofertilizer, vesicular and abruscular mycorrhizae.
Unit 5. Biological control, types of biological control, biocontrol agents agents, microorganisms, viruses, protozoans, production of microbial insecticides.

Practicals

Study of pipetman use and pipetting techniques
Study of labware used for DNA isolation and PCR

Sterilization of glassware, labware and double distilled water for PCR analysis.
Preparation of buffers, reagents and media required for PCR and analysis and its sterilization.
Isolation of plant Genomic DNA using CTAB method and purification of DNA samples.
Quantitative analysis of purified DNA samples through spectrophotometer.
Amplification of DNA samples using Polymerase Chain Reaction, analysis of amplicons, scoring and data analysis.

MCE 880 Seminar ii

SPECIALIZATION –ANIMAL BIOTECHNOLOGY

MCE 805 NANOBIOTECHNOLOGY 3 (3-0-0)

Unit 1. Introduction, History and basic concepts of Nanotechnology; Man made and natural nano-materials; future scopes of nanotechnology
Unit 2. Solid state physics; crystal structure; quantum mechanics and nanostructure analysis
Unit 3. Methods of measuring properties; Atomic structure, particle size determination, surface structure, Microscopy (TEM, SEM and Field Ion), Spectroscopy (IR, Raman and X-ray)
Unit 4. Nanomaterials, Metal nanocluster, Semiconducting nanoparticles. Molecular clusters; DNA nanowires; Methods for synthesis
Unit 5. Carbon nanocluster; Nanotube; Mechanism and applications
Unit 6. Nanobiotechnology- Catalysis: Nanocrystals; Biological building blocks; Nucleic acids; Biological nanostructures
Unit 7. Nanomachines and Nano devices; NEMS; NEM (Fabrications) supermolecular switches
Unit 8. Nano-medicine; synthesis; drug delivery; application

CBBI-708 BIMOLECULAR MODELING 3 (2-0-1)

Unit 1
Concepts of Molecular Modeling, Simulation of molecular mechanics and dynamics, Empirical
representation of molecular energies, Simulations of Free Energy changes, Force fields, Use of Force Fields. A Energy minimization of small molecules, Local and global energy minima. Molecular Mechanics methods, Techniques in Molecular Dynamics, Monte

Carlo Simulation for conformational analysis and semi-empirical methods, Application of molecular graphics.

Unit 2

Methods for Prediction of Secondary and Tertiary structures of Proteins - Knowledge-based structure prediction, Principles of Protein Folding, Fold recognition, Methods for comparison of 3D structures of proteins; Methods to predict three dimensional structures of nucleic acids.

Unit 3

Analysis of structures and correctness of structures, Submission of data to PDB: atomic coordinates and electron density maps; Anatomy of Proteins - Ramachandran plot. Evaluation of stereo-chemical properties of protein structures.

Unit 4

Internal and external co-ordinate system; Generation of co-ordinates of biopolymers in Cartesian and cylindrical polar co-ordinate system; Methods of single crystal X-ray diffraction of macromolecules: molecular replacement method and direct method - Fiber diffraction. Structural data banks - Protein Data Bank, Cambridge small molecular crystal structure data bank.

Practicals:

1. Introduction to the structure database PDB.
2. Visualization of the protein structure using VMD.
3. Secondary structure prediction using GOR algorithm.
4. Tertiary structure prediction using SWISS-MODEL, ModWeb and Geno3D.
5. Homology modeling of a protein by using the MODELLER software.
6. Protein Structure validation using SAVS server.
7. Protein active site prediction using CastP and Pocket Finder.
8. Automated docking using PATCH DOCK webserver.
9. Structural alignment using DaliLite and SSAP.

MCE 806 GENETIC ENGINEERING 3 (2-0-1)

Unit 1. Biology of cloning vectors and enzymes used in genetic engineering: Plasmids, cosmids, phagemids, *Agrobacterium tumifaciens* based vectors (binary and cointegrate vector stratergy) and artificial chromosomes (BAC, YAC). Enzymes used in genetic engineeringexonucleases,
endonucleases- S1 nucleases, restriction endonucleases, ligases, polymerases,
reverse transcriptase, terminal deoxynucleotidyl transferase, kinases and alkaline phosphatases.

Unit 2. Principles of recombinant DNA technology: Construction of recombinant DNA, construction of genomic and cDNA libraries, selection and screening of desired clones by hybridization method, genetic method and immunological method.

Unit 3. Recombinant DNA expression: Requirements of gene expression vectors, transient vs stable expression, expression of heterologous gene in bacteria (*E. coli*), detection of expression of foreign genes, maximizing the expression of recombinant DNA.

Unit 4. Marker genes: Selectable and screenable marker genes (reporter genes)- luciferase, β galactosidase, chloramphenicol acetyl transferase. Transfection methods – electroporation,

microinjection, particle gun bombardment.

Practicals

Restriction Digestion of DNA with Restriction Endonuclease
Ligation of Restriction Digested Fragments using Ligase Enzyme
Preparation of Competent Cells
Transformation of Competent Cells
Selection of Recombinants using Blue-White Screening

TE- 801 PLANT TISSUE CULTURE TECHNOLOGY 3 (2-0-1)

UNIT 1: **Introduction to plant tissue culture:** Historical developments and landmarks in Plant Tissue Culture. Organization of tissue culture laboratory, aseptic techniques, media formulation, clonal propagation vs tissue culture, Totipotency: growth, differentiation and morphogenesis in tissue culture.
UNIT 2: Micropropagation: Concept, various stages, organogenesis and somatic embryogenesis. Meristem culture: Meristem culture for mass and clonal propagation, production of pathogen free plants, application in forestry.
UNIT 3: **Somatic hybridization**: Isolation, purification and culture of protoplasts, protoplast fusion and somatic hybridization, identification and characterization of somatic hybrids / cybrids, its applications.
UNIT 4: Secondary metabolites: Production of secondary metabolites by plant cell culture, hairy root culture, biotransformation.
UNIT 5: Cell Lines: Cell line selection for resistance to herbicide, stress, insect and diseases
UNIT 6: Haploid culture: Tissue culture methods for haploid production & its applications

Practicals:
Media preparation
Explant selection, sterilization & inoculation
Callus & cell suspension culture: Induction and growth parameters
Androgenesis: Anther & Pollen culture
Plant regeneration from embryo, meristem & callus culture
Synthetic seed preparation

MCE 803 ANIMAL BIOTECHNOLOGY 3 (2-0-1)

Unit 1. Fundamentals of animal genetics: Chromosomes as vehicles of heredity. Structure of chromosomes, chromosome banding.
Unit 2. Gene mapping and gene cloning: Various methods of gene mapping, human genome project, gene mapping of mouse and other animals, basic strategies and methods of gene cloning. Gene knockout and mice model for human genetic disorders.

Unit 3. Animal transgenesis: Mechanism of transferring genes into specific animal tissues and cell lines. Production of transgenic animals (cattle, mice, sheep, goat, pig and fish) and chimeras. Artificial insemination and embryo transfer.

Unit 4. Application of transgenic animals: Production of useful proteins and other products in transgenic animals (production of regulatory proteins, blood products, vaccines, hormones and other therapeutic proteins).

Practicals

Isolation of Macrophages from allergy induced mice
Effect of different allergens on total lymphocyte count.
Isolation of genomic DNA from Blood samples.
Purification and quantification of isolated DNA samples.
RAPD analysis of genomic DNA isolated from different blood samples.

MBFT 814 MICROBIAL BIOTECHNOLOGY 3(2-0-1)

History and scope of Biotechnology. Bioreactors: Types of Bioreactors e.g. packed bed, bubble column, air lift, fluidized bed bioreactor, membrane/hollow fiber, photo-bioreactor etc.

Industrial production of alcohol, glycerol, solvents (acetone, butenol, isopropyl alcohol), vinegar, acids (lactic, citric, gluconic acid), vitamins (Riboflavin, B12), antibiotic (penicillin, streptomycin, tetracycline, griseofulvin) by micro-organisms.

Concept of various types of fermentation: Batch, continuous, semisolid and solid state etc.

Methods of enzyme production, their immobilization and application in therapeutic, analytical manipulation and industrial uses.

Use of microbes in producing SCP, substrates used in producing SCP, their nutritional value.

Biotransformation

Practical

Study of fermentor and fermentor operation.
Isolation and purification of important microbial enzymes.
Production of lipase by submerged fermentation.
Production of lipase by semisolid fermentation.
Effect of pH and temperature on enzyme production.
Isolation of yeast from fruit juice and rice flour.
Quantitative estimation of ethanol produced during yeast fermentation.
Production of wine from grapes by using yeast
Citric acid production by solid state fermentation
Preparation of fungal spore in large scale by bread culture method.
Immobilization of cell on sodium alginate gel

MCE 880 Seminar ii