Program: M.Tech. Biotechnology (BT) (Batch 2009)

Course Code	Course Title	Credit	LTP
Deficiency courses			
MBFT 451	Microbial Genetics	3	3-0-0
MBFT 452	Microbial Metabolism	2	2-0-0
MAS 312	Elementary Mathematics	4	3-1-0
BCBT- 408	Chemical Thermodynamics	3	3-0-0
ME 305	Fluid Mechanics and Transport Process	3	3-0-0
EEE 301	Basic Electrical Engineering	3	2-0-1
ECE 310	Basic Electronics	3	2-0-1
MAS 411	Engineering Mathematics - I	4	3-1-0
MAS 490	Engineering Mathematics - II	4	3-1-0
Basic Supporting Courses			
MAS 714	Engineering Statistics	3	3-0-0
COMP 805	Computer Programming	3	2-0-1
APFE 875	Quality Management	3	3-0-0
MAS 814	Applied Biostatistics	3	2-0-1
PHY 701	Molecular Biophysics	2	2-0-0
ME-749	Design Theory and Methodology	3	3-0-0
Core courses			
MCE - 701	Molecular Cell Biology	3	2-0-1
TEG 802	Animal Tissue Culture Technology	3	2-0-1
MCE - 807	Applied Genetic Engineering	3	2-0-1
MCE - 801	Instrumentation in Biotechnology	3	2-0-1
BCBT 714	Pharmaceutical Biotechnology	3	2-0-1
MCE - 705	IPR and Engineering Ethics	3	3-0-0
BCBT 716	Bioprocess Engineering	3	2-0-1
MCE - 805	Nanobiotechnology	2	2-0-0
MCE – 780	Seminar - I	1	0-0-1
MCE - 804	Medical Biotechnology	3	2-0-1
MCE - 706	Themes in Bioengineering	3	3-0-0
MCE - 707	Biomechanics and Robotics	3	3-0-0
CBBI 709	Bioinformatics and Computational Biology	3	2-0-1
MCE - 781	Seminar - II	1	0-0-1
MBFT 784	Enzyme and Microbial Technology	3	2-0-1
CBBI 704	Genomics and Proteomics	3	2-0-1
Specilized courses			
BCBT 835	Bioreactor Design and Analysis (BT)	3	2-0-1
BCBT 836	Bioseparation Technology (BT)	3	2-0-1
BCBT 837	Bioprocess Integration (BT)	3	2-0-1
BCBT 838	Design of Effluent Treatment Plant (BT)	3	2-0-1

BCBT 839 Bioconversion Technology (BT) 3 2-0-1

DEFICIENCY COURSES

MBFT 781 MICROBIAL GENETICS 4(3-0-2)

Introduction to nucleic acids, chemistry of DNA, replication, transcription, translation and genetic code
Genetics of bacteria and bacteriophages, bacterial phenotypes, genotypes.
Transformation, Transduction and Conjugation. Regulation of bacterial gene activity, transposable elements and mapping of bacterial chromosomes
Bacteriophages: characteristics, fine structure and mapping of genes
Mutation: characteristics, and types in bacteria and viruses
Introduction to genetic engineering: vectors, plasmids, cosmids, phage derivatives, phagemids. Restriction and modification systems, restriction endonucleases, enzymes used in gene cloning and their applications. Recombinant DNA technology and nucleotide sequencing.
Genetics of Nitrogen fixation.
Genetic control of sexual development and macromolecular structures
Molecular markers

Practical

Induction of mutation by chemical and physical methods
Isolation and characterization of mutants
Plasmid detection and isolation
Transformation in bacteria
Fractionation of nucleic acid by centrifugation

MBFT 452 MICROBIAL METABOLISM 2(2-0-0)

Bacterial Enzymes: Classification, Properties, Factors affecting enzyme activity, Inhibition of enzyme action, Regulation of enzymes.

Carbohydrate metabolism: Anabolism- Photosynthesis (oxygenic and anoxygenic). Catabolism- EMP pathway, Pentose pathway, Kreb's cycle, Fermentation Electron transport system, ATP production

Metabolism of proteins: Metabolic pathways of nitrogen utilization, Urea cycle, Protein synthesis.

Catabolism of lipids.

MAS-313 ELEMENTARY MATHS-I 4(3-1-0)

Algebra: Theory of Quadratic equations, Partial fractions, Binomial theorem (for positive index), Exponential and Logarithmic series, Elementary concepts of Permutation and Combination.

Trigonometry: Elementary concepts of Complex numbers, De-Movier's theorem and its application.

Co-ordinate Geometry: Equation of standard curves and their identification.

Differential Calculus: Function, Limit, Continuity and Differentiability, Differentiation of standard functions, Method of Differentiation, Trangent and Noraml, Maxima and Minima.

Integral Calculus: Indefinite integration of standard functions, Integration by substitution, by parts, by partial fraction.

Vector Analysis: Scalar and Vectors, sum and Difference of Vectors, Dot and Cross product. (double, triple).

BCBT– 404 CHEMICAL THERMODYNAMICS 3(3-0-0)

Introduction To Thermodynamics Terms (System, surrounding, boundaries etc.) open and closed loop systems, isolated systems, thermodynamic variables, extensive and intensive properties.

Thermodynamic process- lost thermal, adiabatic process, isobaric, isochoric, cyclic and irreversible processes.

Laws of thermodynamics- thermal equilibrium, zero law, first law, second law of thermodynamics, energy concept, law of conservation of energy, concept of enthalpy, entropy.

Reactive systems, degree of reaction, reaction equilibrium, laws of mass action, Gibbs functional change heat of reaction, fugacity + reactivity, construction, enthalpy of formation, laws for reaction systems.
Air cycle, Otto cycle, work done in cycles, thermal efficiency.

Refrigeration- Introduction to principles of vapors compression cycle.

ME-305 FLUID MECHANICS & TRANSPORT PROCESS 3(3-0-0)

Introduction to principles of engineering and units: classification of unit operation and transport process and basic system of units, methods of expressing temperature and composition gas law and vapour pressure, conservation of mass and material balances, energy and heat unit, conservation of heat energy and heat balances

Principles of momentum transfer: introduction, fluid statics, and viscosity of fluid s, mass energy and momentum balances, and non-Newtonian fluids

Principles of steady state heat transfer: Introduction and mechanism of heat transfer, conduction, conduction through solid in series, forced convection heat, transfer in fluids, natural convection heat transfer and heat transfer of non Newtonian fluids

Principle of mass transfer: Introduction the mass transfer and diffusion, molecular diffusion in gas and liquid biological solution and cells, mass transfer in cellular systems

Book: Transport process and unit operation by Christie j. geankoplis.

MAS-411 ENGINEERING MATHEMATICS-I 4(3-1-0)

Matrices: Theory of Matrices, Types, Addition, Subtraction, Multiplication, Transpore, Ad joint and Inverse of Matrices, Rank of Matrix, Solution of simultaneous equations, Eigun values, Cayley-Hamilton theorem.

Differential Calculus: Partial Differentiation, Euler theorem, Total differential coefficient, Partial higher order derivatives, Application of partial differentiation, Maxima-Minima of function of two variables, Jacobians.

Integral Calculus: Definite integrals and their properties, Application of determining are length, area, surface and volume. Simpson's rule for approximate integration, Mean values, Root mean square values.

Differential Equations: Ordinary differential equations their order, degree and formation, Solution of the equation of the first order, first degree, Homogenous differential equations, Linear differential equations, Exact differential equations, Linear differential equations of second order with constant coefficient, Homogenous linear equations, Applications.

ECE 301 Basic Electronics 4 (2-1-1)

1. **Energy Bands in Solids:** Energy band theory of solids. Concept of forbidden gap. Insulators, metals and semiconductors.
2. **Transport Phenomenon in Semiconductors:** Mobility and Conductivity, electrons and holes in intrinsic semiconductors. Donor and acceptor impurities, Fermi level, carrier densities in semiconductors, electrical properties of semiconductors, Hall effect and diffusion
3. **Junction Diode:** P-N junction, depletion layer, V-I characteristics, diode resistance, capacitance, switching time, diode application as Rectifiers (half wave and full wave), diode circuits (clipper, clamper, voltage amplifiers). Breakdown mechanism, Zener and Avalanche, breakdown characteristics, Zener diode and its applications
4. **Bi-junction Transistor:** Bipolar junction transistor, CE, CB, CC configurations. Characteristic curves (cut off, active and saturation region), Requirements of biasing, biasing types and biasing analysis, stability.
5. **Transistor as an Amplifier:** Graphical analysis of CE amplifier, concept of voltage gain, current gain and power gain, h-parameter (low frequency), computation of A, R_I, R_0 and approximate formulae.
6. **FET & UJT:** Construction and characteristics of JFET-parameters of JFET-MOSFET-depletion, enhancement modes, FET in CS, CD, CG configurations. Equivalent circuit of FET at low frequencies. FET model at high frequencies. FET specifications, construction, theory of operation and characteristics of UJT, PUT.
7. **Operational Amplifiers:** Concepts of ideal op-amp, inverting, non-inverting and unity gain amplifiers, Integrators.
8. **Switching theory and Logic Gates:** Number system, conversion of bases, Boolean algebra, logic gates, concept of universal gates, canonical forms and minimization using K-maps.
9. **Electronic Instruments:** Multimeter, CRO and its applications.

List of Experiments

1. **Study of Lab Equipments and Components:** CRO, Multimeter, Function Generator, Power Supply, active and passive components, Bread Board
2. **P-N Junction Diode:** Characteristics of P-N Junction diode, static and dynamic resistance measurement from graph.
3. **Application of P-N Junction Diode:** Half and Full wave rectifier, measurement of V_{rms}, V_{dc} and ripple factor, RC filter, Clipper clamper
4. **Properties of Junctions:** Zener diode characteristics, heavy doping alters the reverse characteristic. Graphical measurement of forward and reverse resistance.
5. **Application of Zener Diode:** Zener diode as voltage regulator, measurement of percentage regulation by varying load resistor.
6. **Characteristic of BJT:** BJT in CB, CE configuration. Graphical measurement of h-parameters from input and output characteristics. Measurement of A_v, A_I, R_o and R_i of CE amplifier with potential divider biasing.
7. **Characteristic of FET:** FET in common source configuration,. Graphical measurement of its parameters gm, rd & m from input and output characteristics.
8. **Characteristic of Silicon-**controlled rectifier
9. **Plot V-I characteristics of DIAC**
10. **Draw V-I characteristics of TRIAC for different gate currents**

MAS-490 ENGINEERING MATHEMATICS-II 3(3-0-0)

Differential calculus: partial differentiation, Euler theorem, total differential coefficient, partial higher order derivatives, application of partial differentiation approximation problems, error determination, maxima – minima functions of two variables, Jacobeans

Integral calculus: definite integrals and their properties, their application in determining arc length and surface area, Simpson rule for approximation, integration, mean values and root mean square values. Multiple integrals – double and triple integrals, their application in determining area and volume

Differential equations : Ordinary differential equations, their order degree and formation, solution of the equations of the first order and first degree. Homogenous and differential equations, linear differential equations, exact differential equations, linear differential equation of second order with constant equations, homogenous linear equations.

Vector calculus: vector differentiation, gradient, divergence and curl, their physical interpretation directional and normal derivatives vector integration, line surface and volume integrals, green theorem, gauss theorem and stoke s theorem

Fourier series: periodic functions, fouriers series fourier series and their coefficients and their determination (euler formula) ,change of interval , half range sine and cosine series.

BASIC SUPPORTING COURSES

Comp-805 Computer Programming 3(2+0+1)

1. Algorithms & Flow Charts
2. 'C' Programming
- (i) Preliminaries
- (ii) Constants & Variables
- (iii) Arithmetic Expressions
- (iv) Input-Output Statements
- (v) Control Statements
- (vi) Looping Statements

(vii) Subscripted Variables
(viii) Elementary Format Specifications
(ix) Logical Statements & Decision Tables
(x) Functions & Subroutines

3. Computer Oriented Numerical Methods
- (a) Solution of Non Linear Equation
  - (i) Bisection Method
  - (ii) Newton Method
- (b) Numerical Integration
  - (i) Trapezoidal Method
  - (ii) Simpson's 1/3 & 3/8 rule
- (c) Curve Fitting
  - (i) Construction of forward, backward difference table
  - (ii) Interpolation

4. Application of statistical packages

Reference Books:

Let Us C by Yashwant Kanetkar BPB publications

Computer Oriented Numerical Methods by R. S. Salaria, Khanna Book Publishing Co.

Practical List:

1. To find the largest among three numbers
2. To check whether a given string is a palindrome or not.
3. To find factorial of a given number by iteration.
4. To find whether the given integer is a prime number.
5. To find sum of n terms of series:
   a. n – n*2/2! + n*3/3! - n*4/4! + ...
6. To find sum and average of n integers using a linear array.
7. To read n numbers from the keyboard and display these numbers in the reverse order their entry.
8. To search a given number within a linear array.
9. To generate the fibbonacci series.
10. To find factorial of a given number using a function.
11. To deduce error involved in polynomial equation.
12. To Find out the root of the Algebraic and Transcendental equations using Bisection, Regula-falsi, Newton Raphson and Iterative Methods. Also give the rate of convergence of roots in tabular form for each of these methods.
13. To implement Newton's Forward and Backward Interpolation formula.
14. To implement Gauss Forward and Backward, Bessel's, Sterling's and Evertt's Interpolation formula
15. To implement Newton's Divided Difference and Lang ranges Interpolation formula.
16. To implement Numerical Differentiations.
17. To implement Numerical Integration using Trapezoidal, Simpson 1/3 and Simpson 3/8 rule.
18. To implement Least Square Method for curve fitting.

APFE-875 QUALITY MANAGEMENT 3(3-0-0)

Quality concept, service quality; quality planning, control and improvement; quality gurus, ISO 9000 standards, Malcolm baldrige award; quality and financial performance, quality failure, design of quality control system, Process quality control, attitude control, variables control, control charts, continuous improvement, six sigma, lean and six sigma, quality control and improvement in industry.

MAS 814 Applied Biostatistics 3 (2-0-1)

1. **Analysis of Variance Technique:** Definition, assumptions, one way classification, two way classification with one observation and more than one observation per cell. Analysis of Covariance.
2. **Design of Experiments:** Principles of Experimental design, completely randomized design (CRD), Randomized block design (RBD), Latin square design (LSD). Missing plot technique in RBD and LSD.
3. **Factorial Designs (Experiments):** Definition and applications. 2^2 and 2^3 factorial designs, 3^2 and 3^3 factorial designs, 2x3 factorial. Simple concept of confounding m factorial experiments. Concept of contrast and orthogonal contrast in factorials.
4. **Sampling Technique:** Definition, simple random sampling (with and without replacement), Stratified random sampling, and Systematic sampling.

PHY-701 INTRODUCTION TO MOLECULAR BIOPHYSICS 3(3-0-0)

Unit1*:* Physical Techniques

Diffusion/Sedimentation: determination of molecular weight of macromolecules using Diffusion & sedimentation.

Unit 2: X-Ray Diffraction.

X-Ray Diffraction, principles of X-Ray scattering, the unit cell & space group, Bragg's law, structure determination, the Patterson Method.

Unit 3: Spectroscopy.

UV, IR & Raman spectroscopy, basic principles, instrumentation & application.

NMR/ESR: classical description of magnetic resonance, spin lattice relaxation process, spin labeling in biological molecules.

Unit 4: Nucleic Acid.

Introduction to Nucleic Acid. Definition of terms for nucleic acid. Watson-Crick hypothesis of DNA structure and its biological implication.

Reference:

1. Methods in Modern biophysics

   Bengt Nölting

2. Essentials of Biophysics

   P. Narayanan

3. Biophysics- An Introduction

   Rodney Cotterill

4. Biophysics

   Pittabhi & Gautham

(CORE COURSES)

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

TE - 802 ANIMAL TISSUE CULTURE TECHNOLOGY 3 (2-0-1)

UNIT1: Biology of cells in culture: Origin and characterization of different cell types, Subculture, selection of medium, Chemically defined and serum free media, Development of serum free media Advantages and disadvantages of serum free media

UNIT 2: **Cultured cells-Biology and characterization:** Characteristics of cultured cells, Cell bank, Measurement of growth parameters of cultured cells, Cell adhesion, Cell proliferation and differentiation, Identification of specific cell lines

UNIT 3: **Genetic engineering of mammalian cells:** Mammalian cell lines, Mammalian cell expression system, Gene transfer techniques in mammalian cells, Sexing of embryos, Somatic cell nuclear transfer and transgenic animals.

Unit 4: **Hybridomas and cell transformation:** The basis of hybridoma technology, Storage of hybridoma cells, Monoclonal antibodies and their commercial production, Commercial production of monoclonal antibodies and their use for mankind.

Practicals

- Maintenance of Animal Cell Culture Laboratory.
- To develop cell lines from egg embryo.
- Maintenance of cell lines and to check their viability by Haemocytometer.
- To check % cell viability by MTT assay.
- To check the effect of Pesticides on Cell lines.

MCE 807 APPLIED GENETIC ENGINEERING 3 (2-0-1)

Unit 1. General introduction to the concepts of genetic engineering, use of various enzymes and vector system used in recombinant DNA work.

Unit 2. Gene libraries, construction of genomic and cDNA libraries. Screening of Library for a particular gene. Identification and characterization of cloned DNA fragments chromosomal walking and chromosomal localization of genes.

Unit 3. Gene cloning and expression and cloned gene. Transient and stable integration of cloned DNA in to mammalian cells. Application of Genetic engineering in plants, live stock improvement and human health. Production of commercial products including vaccine and insulin. Terminator gene technology, ethical issue and biosafety regulations.

Unit 4. Nucleic acid blotting (southern, northern, dot and slot blotting) and western blotting. Sequencing of DNA (Sangers, Maxam and Gilbert and Automated) PCR and Non-PCR marker systems (RAPD, SSR, AFLP, RFLP etc.)

Unit 5. Applications of genetic engineering in solving environmental problems, medical diagnosis, drug designing and discovery, development of artificial intelligence in microbes

Practicals

Electrophoresis of DNA - Agarose Gels and Polyacrylamide Gel
Isolation of Bacterial genomic DNA
Bacterial Transformation
Screening for Transformed Colonies (Recombinant Plasmids) by α-complementation
Restriction profiling of Genomic and Plasmid DNA

MCE 801 INSTRUMENTATION IN BIOTECHNOLOGY 3 (2-0-1)

Unit 1. Centrifugation: Centrifugal forces, sedimentation equilibrium velocity, methods, analytical and preparative centrifuges, application of density gradient, differential centrifugation, ultracentrifugation.

Unit 2. Spectroscopic techniques, measurements of colors and colorimetry, spectrophotometry (UV/VIS and IR), fluorescence spectroscopy, atomic absorption spectroscopy, mass spectroscopy.

Unit 3. Electrophoresis of nucleic acid, agarose gel electrophoresis, polyacrylamide gel elecrophoresis, Pulsed Field Gel Electrophoresis, Isoelectric focusing

Unit 4. Principles and instrumentations of chromatography, TLC, Ion exchange chromatography, affinity chromatography, HPLC, Gas chromatography

Unit 5. PCR basic principles, chemical components of PCR and setup of amplification conditions. NMR, X-ray Diffraction and crystallography, measurement of radioactivity, Scintillation counters, autoradiography

Practicals

Demonstration of Beer-Lambert's Law using potassium dichromate method
Determination of molar extinction coefficient using spectrophotometer
Separation of emulsion using centrifuge
Sedimentation of Red blood cells by centrifugation
Separation of Chlorophyll pigments using TLC technique.
Identification of sugars (fructose, sucrose, sorbose, raffinose/ pentose and uronic acid)
Column chromatography for separation of photosynthetic pigments

BCBT – 703 PHARMACEUTICAL BIOTECHNOLOGY 3(3-0-0)

Unit 1 – Pharmaceuticals, biologics & biopharmaceuticals. Introduction to pharmaceutical products, biopharmaceuticals & pharmaceutical biotechnology, History of pharmaceutical industry, the age of biopharmaceuticals, biopharmaceuticals: current status and future prospects.

Unit 2 – Protein structures. Amino acid sequence determination, polypeptide synthesis, higher structure determination, protein stability and folding, structural prediction, protein post translation modification, glycosylation, caboxylation and hydroxylation, sulfation and amidation.

Unit 3 – Gene manipulation and recombinant DNA technology. Nucleic Acids: Function and structure, genome and gene organization, nucleic acid purification, nucleic acid sequencing, recombinant production of therapeutic proteins, classical gene cloning and identification, cDNA cloning, cloning via PCR, expression vector, protein engineering.

Unit 4 – The drug development process. Discovery of biopharmaceuticals, the impact of genomics and related technologies upon drug discovery, gene chips, proteomics structural genomics, pharmacogenetics, initial product characterization, delievery of biopharmaceuticals – oral, pulmonary nasal, transmucosal and transdermal delievery systems, preclinical studies, pharmacokinetics and pharmacodynamics – protein pharmacokinetics, tailoring of pharmacokinetics profile, protein mode of action and pharmacodynamics, toxicity studies – reproductive toxicity and teratogenicity, mutagenicity, carcinogenicity and other tests, clinical trials, clinical trials design, trial size design and study population, the new drug application world harmonization of drug approvals.

Unit 5– Product Analysis. Protein – based contaminants –removal of altered forms of the protein of interest from the product stream – product potency, determination of protein concentration, detection of protein based product impurities –capillary electrophoresis, HPLC, mass spectrometry, immunological □hosphor□□ to detection of contaminants – amino acid analysis, peptide mapping, N- terminal sequencing, analysis of secondary and tertiary structure, endotoxin and other pyrogenic contaminants – endotoxin, the molecule, DNA, microbial and viral contaminants, viral assays, miscellaneous contaminants.

MCE 705 IPR AND ENGINEERING ETHICS 3 (3-0-0)

Unit 1. Intellectual property rights, history of IPR in India, Legislations covering IPR in India. World organizations of IPR including GATT, TRIPS, WIPO, UPOV and WTO.

Unit 2. Protection of IPR, Forms of protections including copyright, trademarks, trade secrets,
geographical indications, design of Know-how's, Plant breeders right, plant variety protection, farmers right, case studies on plant patents.

Unit 3. Engineering ethics; ethics and engineering profession, moral values and its definitions, code of ethics, NSPE, IEEE and ASME code of ethics, Principles of ethical power
for individuals and organizations. The concept of whistle blowing. Moral guidelines in whistle blowing. Classical ethical theories and important case studies.

Unit 4. Biotechnology and Ethical issues in medicine, industry, human, agriculture, food energy and environmental aspects. Facing problems and finding solutions through bioethics.

BCBT -707 **BIOPROCESS ENGINEERING** 3(2-0-2)

Unit1:Cell growth, parameters of cell growth and analysis growth of data, Environmental effects on cell growth, Microbial kinetics of growth
cultivation systems: closed, semi open and, maintenance energy and yield concept..

Unit 2: Microbial pellet formation, dynamics of pellet formation, oxygen transfer in bioreactor, measurement of KLa in bioreactor.

Unit 3: Scale up of bioreactors: general aspects and scale methods. Physical process & importance for scale up.

Unit 4: Sterilization concept and methods. Sterilization and medium, kinetics of thermal death of microorganism. Batch sterilization, continuous sterilization of air method, filters and design of depth filters.

Practicals

1. Determination of bacterial growth curve.
2. Determination of generation time and specific growth rate.
3. Determination of oxygen uptake rate.
4. Measurement of KLa.
5. Effect of temperature on bacterial growth
6. Effect of substrate concentration of bacterial growth.

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

MCE-780 SEMINAR -1 1(0-0-1)

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 706 THEMES IN BIOENGINEERING 3 (3-0-0)

Unit 1. Introduction and basic concepts of bioengineering. The core areas and applications of bioengineering.

Unit 2. Tissue engineering and organ cultivation. Stem cell tissue engineering, signals for tissue engineering. Development of different tissues and organs.

Unit 3. Regulation of engineered tissues. Human and cellular tissue based products, FDA regulation and product approval; regulation of pharmaceutical, medical, human tissue products in USA, Europe and Japan, ownership of human tissues.

Unit 4. Bioengineering of crop plants with special emphasis on rice genomics for enhancing crop productivity. Biobanking and Biomedical Engineering

MCE 707 BIOMECHANICS AND ROBOTICS 3 (3-0-0)

Unit 1. Introduction and basic definition of Biomechanics, concept of Biomechanics, foundation and objectives of Biomechanics.

Unit 2. Physical therapy and Biomechanics; key elements of biomechanics including biological systems, physical therapy and mechanics; applications of biomechanics.

Unit 3. Automation and Robotics, brief history and development of robotics, technology of

robots, economics and social issues related to robotics, present and future applications.

Unit 4. Fundamentals of robot technology, general characteristics of robot technology, basic components of robots.

CBBI-709 BIOINFORMATICS & COMPUTATIONAL BIOLOGY 3 (2-0-1)

Unit-1
Introduction to Bioinformatics, philosophical, directional and application oriented background of
bioinformatics.Information network – Internet, web Browser and address (NCBI, EBI etc).

Unit-2
Databanks – Nucleotide databanks – Genbank, NCBI, EMBL, DDBJ, protein databanks – Sequence databanks – PIR, SWISSPROT, TrEMBL – Structural databases – PDB, SCOP, CATH, PDB_SELECT – Sequence storage – Sequence accuracy – EST, STS – Sequence retrieval systems Entrez –SRS – Sequence query refinement using Boolean operators, limits, preview, history and index.

Unit-3
Phylogenetic Analysis: Fundamental of Phylogenetic model, Tree interpretation – Paralogues and orthologues, Tree building and tree evaluation, Phylogenetic software.

Unit-4
Comparative Genome Analysis: Introduction, application, genome analysis and annotation.

Unit-5
Molecular structure Predication and visualization

Unit-6
Bioinformatics in micrroarrays, target selection, ustomised microarray design,Image processing and quantification, Normalization and filtering, Exploratory statistical analysis, Public Microarray data resources.

Unit-7
Different analysis packages and other Miscellaneous Tools etc.

Practicals:
1. Understanding Linux Operating System and Commands.
2. Introduction to NCBI.
3. Using Entrez to search Literature Databases.
4. Retrieving DNA sequence from GenBank and analyzing various formats of the data stored.

5. Retrieving Protein sequence from GenPept (NCBI) and Expasy.
6. Analyzing Protein Sequences.
7. Analyzing DNA sequence.
8. Sequence alignment using BLAST (Basic Local Alignment Search Tool).
9. Sequence alignment using FASTA.
10. Multiple sequence alignment using ClustalW.
11. Introduction to the structure database PDB.
12. Visualization of the protein structure using VMD.
13. Secondary structure prediction using GOR algorithm.

MCE-781 SEMINAR-II 1(0-0-1)

MBMT 784 ENZYMES & MICROBIAL TECHNOLOGY 3(2-0-1)

Microbial Growth kinetics: Introduction. Cell growth in batch culture, growth phases, kinetics of growth culture, growth kinetics for continuous culture, material balance for CSTR, rate of product formation, continuous culture, disadvantages of batch culture, advantages of continuous culture, growth kinetics, biomass and products yield, Y x/s and Y p/s, biomass balances (cells) in a bioreactor. Material balance in terms of substrate in a chemostat, modified chemostat, fed batch culture.

Enzyme kinetics: Enzyme reaction kinetics, mechanisms of single enzymes with dual substrate, kinetics of reversible reactions with dual substrate reactions, reaction mechanism with competitive inhibition, non-competitive inhibition rate model

Medium Engineering for Microbial Cell Cultivation: Basic concept in medium design, design procedure, basics of material balance, engineering medium in cell growth and product formation, bioorganic reaction medium engineering

Solid state fermentation: SSF, characteristics of SSF, advantages & disadvantages of SSF, factors influencing SSF and substrate for SSF

Microbial enzymes: Production & industrial application of some important microbial enzymes viz. proteases, xylanases, lipases.

Practical:

To study the action and activity of amylolytic microorganisms on starch digestion
Determination of amylase enzyme activity
Effect of substrate concentration on α-amylase activity
Effect of pH on enzyme activity
Effect of temperature on enzyme activity
Construction of maltose calibration curve
Determination of enzyme concentration

CBBI-704 GENOMICS AND PROTEOMICS 3 (2-0-1)

Unit-1

Overview- Structure and organization of Prokaryotic and eukaryotic genome, gene structure and gene density of prokaryotes and eukaryotes, variations in the general structure and organization in genomes expression profiles.

Unit-2
Brief outlook of various genome projects and their outcome, Nucleotide and protein sequencing, Genome sequencing; various techniques: shot gun, clone contig approach, chromosome walking, primer walking, chromosome jumping, contig assembly, genome marking and mapping techniques, genomic DNA-library, cDNA-library.

Unit-3
Mapping and Sequence Assembly, Genetic markers– RFLP, STR, SSLP, VNTR. Physical markers, ESTs, STS, FISH, Radiation hybrid, Sequence marker, SNP'S, Expression analysis, Obtaining & Evaluating gene expression profiles with mircoarray.

Unit-4
Human genome project – transcript on structural and functional genomics, comparative and population genomics, Pharmacogenomics and Phylogenetics, Functional Proteomics, genotype-phenotype relationship, polygenic nature of proteins

Unit-5
Proteomics experimental techniques: 2-D electrophoresis, Mass spectrometry & Protein Microarray, Drug-Design, Empirical Methods and prediction techniques, X-ray and NMR-structures, Post-translational modification prediction: protein sorting, proteolytic cleavage, glycosylation and phosphorylation.

Practicals:
1. Retrieval of genomic & proteomic data through different biological databases.
2. Prediction of ORF in DNA sequence.
3. Prediction of Amino Acid sequence from predicted ORF.
4. Calculation of physio-chemical properties of protein sequence.
5. Prediction of post translational modifications for a given protein.
6. Prediction of restriction sites in a given sequence of neucleotide by using different restriction enzymes

SPECIALIZED COURESES

BCBT- 835 BIOREACTOR DESIGN & ANALYSIS 3(2-0-1)

UNIT 1: Concept of ideal and non ideal bioreactor, residence time distribution.

Unit 2: Homogenous and heterogeneous reactions.

Unit 3: Kinetic analysis of Bioreactors: stirred tank bioreactor, bubble column, fluidized bed, airlift, plug flow bioreactor, unconventional bioreactors: hollow fiver bioreactor and membrane bioreactor.

Unit 4: practical aspects regarding design and operation of bioreactors.

BCBT- 836 BIOSEPARATION TECHNOLOGY 3(2-0-1)

Unit 1: An overview of separation and bioprocesses principle and operational aspects of separation and bioprocesses.

Unit 2: Filtration and centrifugation, Types centrifuges.

Unit 3: Cell disruption: physical methods-osmotic shock, grinding with abrasives solid shear, liquid shear, chemical methods-alkali reagents and enzymatic methods. Flocculation

Unit 3: Product isolation: extraction and absorption method, solid liquid separation, liquid-liquid separation, distillation, precipitation method using ammonium sulfate, reverse osmosis.

Unit 5: Chromatography for product purification. Different electrophoresis techniques viz isometric focusing, chromatographic techniques, Electrophoresis of proteins and nucleic acids Dialysis, crystallization and drying.

BCBT-837 BIOPROCESS INTEGRATION 3(2-0-1)

Integrated bio-processing – description of range of bio-products, differences between bioprocesses and chemical processes, containments, enzymes and bioconversion used in bioprocesses.
Bioprocess design and operation, nutritional requirement and medium optimization, choice of bioreactors, heat and mass transfer in bioprocesses.
Bioprocess monitoring and control: Physical, chemical, environment factors of bioprocess.
Suspension Vs immobilized cell, operating consideration for bioreactors for suspension and immobilized cultures.

Down stream processing, product recovery and packaging.
1. Demonstration of design and operation of a bioreactor.
2. To understand the sterilization system of a bioreactor.
3. To understand the pH system of a bioreactor.
4. To understand the dissolved oxygen of a bioreactor.
5. To determine the mixing time of a bioreactor.

BCBT- 838 DESIGN OF EFFLUENT TREATMENT PLANT 3(2-0-1)

Water quality objectives, chemical, physical and biological processes, designing and managing waste water treatment plant.
Preliminary and primary: waste water collection, screening and grit chamber, Coagulation, flocculation, sedimentation, filtration and solid handling.
Secondary treatment: Activated sludge process, trickling filter process, Tickling filter process, rotating biological contractors and their design.
Tertiary Treatment- Filtration, chlorination and de-chlorination, UV, Nitrification and denitrification,
Phosphorous removal.
Advance treatment processes- Ion exchange, ozonation, adsorption, membrane process.
Industrial west water treatment design and economic consideration, operation and management factors. Water regulation and management.

Practical:

1- Demonstration of design and operation of bioreactors.
2- To understand the standardization system of a bioreactor.
3- To understand the pH system of a bioreactor
4- To understand the dissolved oxygen of a bioreactor
5- To determine the mixing time of a bioreactor.

BCBT- 839 BIOCONVERSION TECHNOLOGY 3 (2-0-1)

Biomass resources: Classification and characterization, techniques for biomass assessment.

Biomass conversion, non- biological process.
Different processes: direct combustion, incineration, pyrolysis, gasification, and liquefaction, Biological process, enzymatic digestion, degradation of hemicellulose, anaerobic digestion, aerobic digestion.
Biodegradation of substrate; biogas technology in India, biogas production, mechanism of methane formation, factors affecting methane formation, photochemical process of H2 production.
Chemical kinetics and mathematical modeling of bio-methanation process, Economic of biogas plant with their environmental and social impacts.
Bioconversion of substrates into alcohol: Methanol and ethanol production, organic acids, solvents, amino acids, antibiotics, etc.
Hydrolysis and hydrogenation: Solvent extraction of hydrocarbons, solvolysis of wood, bio-crude and bio-diesel.

Practical:

1. Estimation of ethanol production during yeast fermentation.
2. Measurement of fungal growth by biomass method.
3. Production of citric acid by solid state fermentation.
4. Determination of nitrate production from soil cultures.
5. Design and operation of a biogas digester.

SEMESTER –IV

MCE 899	Dissertation	0-0-15

SEMESTER IV

MCE 899	Dissertation	15	0-0-15