FACULTY OF ENGINEERING & TECHNOLOGY

KHWAJA MOINUDDIN CHISHTI LANGUAGE UNIVERSITY, LUCKNOW, UTTAR PRADESH

B.TECH. BIOTECHNOLOGY

Curriculum Structure

THIRD YEAR

(V & VI Semesters)

SEMESTER- V

GENETIC ENGINEERING

Course Objectives:

The course has been designed to make students aware of

- DNA manipulative enzymes and Gene cloning vectors
- Screening and selection of recombinants & Application of r-DNA techniques
- Techniques used as Polymerase chain reaction (PCR), Site directed mutagenesis (SDM), Nucleic acid sequencing

Course Outcomes:

- Get proper knowledge about the DNA manipulative enzymes: Restriction enzymes and DNA ligases, and Gene cloning vectors.
- Gain knowledge about In vitro construction of recombinant DNA molecules, passenger and vector DNA, and Transformation & Gene expression in prokaryotes & eukaryotes
- Learn about the basics of Polymerase chain reaction (PCR), Site directed mutagenesis (SDM), molecular markers, Nucleic acid sequencing: Blotting techniques.
- Knowledge of Application of r-DNA technique in human health, Production of Insulin, Production of recombinant vaccines: Hepatitis B, Production of human growth hormone.
- Application of cell signalling in the r-DNA technique to understand the cell's ability to receive, process, and transmit signals with its environment and itself

Unit I

Gene cloning- concept and basic steps; Restriction modification enzymes used in recombinant DNA technology, endonucleases, ligases and other enzymes useful in gene cloning; Vectors: plasmid, bacteriophage and other viral vectors, cosmids, artificial chromosomes, yeast artificial chromosome, Bacterial Artificial Chromosome, Ti plasmid, shuttle vectors, expression vectors; DNA delivery methods; Construction of genomic and cDNA libraries; Techniques for selection, screening and characterization of transformants (hybridization based techniques, expression & interaction based techniques).

Unit II

Concept of PCR; DNA polymerases; primer designing, linkers, adapters, setting up PCR reactions; Various types of PCR; Applications of PCR in disease diagnostics, forensic sciences and genetic engineering.

Unit III

Gene expression in prokaryotes & eukaryotes, Tissue specific promoter, wound inducible promoters, Strong and regulatable promoters, promoter analysis (EMSA and DNA footprinting), gene expression profiling (real time PCR, SAGE, differential display, Microarray); DNA sequencing methods; Molecular markers: RAPD, RFLP, AFLP, SNP; Site directed mutagenesis, gene silencing techniques.

Unit IV

Applications of genetic engineering; Creation of recombinant microorganisms, transgenic plants and animals; cloning of sheep (Dolly) & other mammals; applications in conservation; therapeutic vs. reproductive cloning; ethical issues and the prospects for human cloning; Gene therapy; DNA drugs and vaccines.

Unit V

Basic concepts of cell signaling, Extracellular signal molecule and their receptors, Operation of Signaling molecules over various distances, Cellular response to specific combinations of extracellular signal molecules; Nuclear receptor; Ion channel linked, G-protein mediated receptors, Relay of signal by activated cell surface receptors via intracellular signaling proteins, Intracellular Signaling proteins as molecular switches.

Text Books/Reference Books

1. T.A Brown (2006). Gene cloning and DNA analysis, WILEY-BLACKWELL
2. Genetic Engineering by Dr Smita Rastogi & Dr Neelak Pathak, Oxford University Press
3. S.B Primrose (2001). Molecular biotechnology. Panima Publishing corporation, 2nd edition
4. Molecular Cloning, A laboratory Manual. Sambrook, J., Fritsch, E.F., Mariatis.3rd edition
5. Genetic Engineering, Priciples & Practice by Sandhya Mitra, McGraw Hill Educat

FERMENTATION BIOTECHNOLOGY

Course objectives:

- Understand the basic skills applied in fermentation biotechnology and use of biological resources as input to biobased processes which are economically and environmentally sustainable
- To give an insight and advanced learning of application of fermentation technology in research development in various field.

Course outcomes:

- Learn the history of fermentation process, types of fermentation, examples of fermentation industry and production of primary and secondary metabolites.
- Describe how fermentation biotechnology is used to understand and protect the environment, treat sewage and understand the concept of biodegradation, bioremediation and biotransformation, Domestic waste water treatment.
- Know about different fermenters, isolation of industrially important microbes and their screening, production of cheese, and study quality assurance in food and pharmaceutical industry.
- Familiarize with microbial analysis of industrial production of food viz. cheese, bread etc., antibiotics, enzymes and biopharmaceuticals so that students can perform these things while they go to any industry further.
- Gain knowledge about industrial awareness on quality control and good practices in manufacturing processes in industry.

Unit I

Introduction to fermentation technology: Interaction between Bio-chemical engineering, Microbiology and Biochemistry. History and development of fermentation industry: Introduction to submerged and solid state fermentation, Microbial culture selection for fermentation processes. Primary and Secondary metabolites.

Unit II

Raw material availability, quality, processes and pretreatment of raw materials. Major alcoholic raw materials. Applications of the nonconventional raw materials (cellulosic material and hydrocarbons).

Unit III

Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes. Induction, nutritional repression, carbon catabolite repression, crabtree effect, feedback inhibition and feedback repression.

Unit IV

Creation/procedures for developing mutants of the desired microbes with the stable capacity of producing desired metabolites. Isolation and preservation of different types of mutants induction resistant, feedback inhibition resistant. Concept for over production of primary and secondary metabolites.

Unit V

Details of the process, parameters and materials -for the industrial manufacture of Antibiotics (β-lactum), Solvents (acetone) Amino acid (Lysine), Organic acids (Citric acid), Alcohols (Ethanol), Ind. Enzymes (Protease/Amylase) and Biopharmaceuticals (Insulin/Interferon etc.)- Microbial Transformations, Microbial leaching.

Text Books/Reference Books

1. Murray Moo -Young , Comprehensive Biotechnology, Vol. 1 & III-latest ed.
2. Microbes & Fermentation, A. Lel and Kotlers Richard J. Mickey, Oriffin Publication
3. Industrial Fermentations- Leland, N. Y. Chemical Publishers.
4. Prescott and Dunn's- Industrial Microbiology, 4 th, ed.
5. Biotechnology Series, Rehm, Reed & Weinheim, Verlag-Chemie.
6. Biochemical Engg., Aiba, Humphrey & Miller, Academic Press.
7.Fermentations & Enzyme technology,Wang & Humphrey, Wiley & Inter Scienceiotechnology

BIOINFORMATICS-I

Course objectives:

- To introduce to the field of bioinformatics via an array of publically available tools and resources.
- To study and deduce the molecular characterization of human genome.
- To study the techniques involved in structural and functional proteomics.
- To utilize the bioinformatic tools to design and development of novel drugs.

Course outcomes:

- Students should be able to apply basic bioinformatics tools for the studies and research in other areas of their biotechnology and microbiology programs, such as finding gene/protein homologs, designing primers, identifying mutations, etc.
- Commemorating the molecular techniques involved in characterization of genomes and proteomes
- Recognizing and interpret the techniques involved in genomics, proteomics, bioinformatics
- Administering the principles of genomics, proteomics, bioinformatics to discovery novel drug development
- Analyzing the molecular markers and its applications.

Unit I

Introduction to Bioinformatics; Biological databases: Nucleotide databases, Protein databases, Specialized databases; Laboratory data submission and data retrieval; Various file formats for biomolecular sequences: Genbank, EMBL, Fasta, GCG, msf, nbrf-pir etc.; Basic concepts of sequence similarity: identity and homology, definitions of homologues, orthologues, paralogues; Sequence patterns and profiles: Basic concept and definition of sequence patterns, motifs, domains and profiles; various types of pattern representations viz. consensus, regular expression (prosite-type) and profiles.

Unit II

Sequence Alignment: Pairwise sequence alignments: Dot matrix for sequence alignment, Dynamic programming for Local and Global alignment; Multiple sequence alignment: progressive method and Iterative method; Applications of pairwise and multiple sequence alignment; Tools for multiple sequence alignment: CLUSTALW and Pileup (Algorithmic concepts).

Unit III

Scoring Matrics: Basic concept of a scoring matrix, Similarity and distance matrix, Substitution matrices: Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, principles based on which these matrices are derived; Sequence-based database searches: Need of sequence based database search, BLAST and FASTA algorithms, Various versions of basic BLAST and FASTA, Advance version of BLAST: PHI-BLAST and profile-based database searches using PSIBLAST.

Unit IV

Phylogenetics: Phylogeny and concepts in molecular evolution; nature of data used in taxonomy and phylogeny; definition and description of Phylogenetic trees and various types of trees; Different methods of Phylogenetic tree construction: UPGMA and Fitch-Margoliash Algorithm; case studies in phylogenetic sequence analysis.

Unit V

Protein structure prediction: Secondary structure prediction (Statistical method: Chou Fasman and GOR method, Neural Network and Nearest neighbor method) and Tertiary structures prediction (Homology Modeling); Structure visualization methods (RASMOL, CHIME etc.); Protein Structure alignment and analysis. Application of bioinformatics in drug discovery and drug designing.

Text Books/Reference Books

1. D.W.Mount; Bioinformatics- Sequence and genome analysis; Cold Spring Harbour Labpress.
2. B.N.Mishra; Bioinformatics: Concept and application, Pearson Education
3. O' Reilly; Developing Bioinformatics computer skills-1st Indian edition, SPDpublication.
4. Westhead, P; instant notes in bioinformatics; viva publications.
5. Stephen Misner & Stephen Kraeetz;bioinformatics-Methods and protocols,Humana press.
6. Hooman H Rasid; Bioinformatics basics-Application in biol. sci.& medicine; CRC press.

METABOLIC ENGINEERING

Course objectives:

The course is designed to understand the metabolic pathways, their energetic and regulatory mechanism inside the cell.

Course outcomes:

- Students should be able to understand general concept, principle & regulation of metabolism.
- Understand and depict the metabolic pathways of glucose including glycolysis, gluconeogenesis, citric acid cycle, pentose phosphate pathway and their regulation
- Analysis of ETC, its energetics & ATP synthesis
- Knowledge of processes involving light energy and metabolism of Fatty Acids.
- Familiarise with various products (metabolites) of metabolic pathways and their regulations and relate with industrial processes, signal transduction & protein targetting

UNIT I

Concept of metabolism, anabolism & catabolism, General Principles of Intermediary Metabolism, Regulation of Pathways, Strategies for Pathway Analysis.

UNIT II

Glycolysis: Electron and ATP Tracking, Regulation of glycolysis; Gluconeogenesis: Reaction basis, Regulation of gluconeogenesis; Pentose Phosphate Pathway: Control of Pentose Phosphate Pathway. The Tricarboxylic Acid Cycle: Discovery of the TCA Cycle, Steps in the TCA Cycle, Stereochemical Aspects of TCA Cycle Reactions, Regulation of TCA Cycle Activity.

UNIT III

Electron Transport and Oxidative Phosphorylation : The Mitochondria Electron - Transport Chain, Oxidative Phosphorylation, Transport of Substrates, Pi, ADP and ATP into and out of Mitochondria, Electron Transport and ATP Synthesis in Bacteria.

UNIT IV

Photosynthetic Processes Involving Light: Photosynthesis, Other Biochemical Processes Involving Light. Metabolism of Fatty Acids: Fatty Acid Degradation, Biosynthesis of Saturated Fatty Acids, Regulation of Fatty Acid Metabolism.

UNIT V

Metabolic Organization and Regulation of metabolism, Signal Transduction, Regulation of Metabolism for the production of Primary and Secondary Metabolites with Case studies, Plasma Membrane: Structure and Transport, Protein Targeting

Reference Book:

1. Wang D. I. C., Cooney C. L., Demain A. L., Dunnil P., Humphrey A. E., Lilly M. D., Fermentation and Enzyme Technology, John Wiles and Sons., 1980.
2. Stanbury P. F. and Whitaker A., Principles of Fermentation Technology, Pergamon Press, 1984.
3. Zubay G., Biochemistry, Macmillan Publishers, 1989.
4. Metabolic engineering edited by Sang Yup Lee and Eleftherious T. Papoutsakis
5. Metabolic engineering - Principles and Mehodologies by Gregory N. stephanopoulos, Aristos A. Ariostidou and Jens Nielsen.

INDUSTRIAL MANAGEMENT

Course Objectives:

The objectives of this course are:

- To help the students gain understanding of the functions and responsibilities of managers.
- To provide them tools and techniques to be used in the performance of the managerial job.
- To enable them to analyze and understand the environment of the organization.
- To help the students to develop cognizance of the importance of management principles.

Course Outcomes:

The students will be able to

- Understand the concepts related to Business.
- Demonstrate the roles, skills and functions of management.
- Analyze effective application of PPM knowledge to diagnose and solve organizational problems and develop optimal managerial decisions.
- Understand the complexities associated with management of human
- To understand the work of the industry and understand the principles of management and management theories and also understand the types of productive systems in the early industrialism period.

Unit	Topic
I	Introduction: Concept, Development, application and scope of Industrial. Management. Productivity: Definition, measurement, productivity index, types of production system, Industrial Ownership. .
II	Management Function: Principle of Management – Time and motion study, work simplification – process charts and flow diagrams, Production Planning.
III	Inventory Control: Inventory, Cost, Deterministic Models, Introduction to supply chainmanagement.
IV	Quality Control: Process control, SQC, Control charts, Single, Double and Sequential Sampling, Introduction to TQM.
V	Social Relations in Industry, Social Organization in Industry- Bureaucracy, Scientific Management and Human Relations, Early Industrialism – Types of Productive Systems – The Manorial or Feudal system. The Guild system, The domestic or putting-out system,and the Factory system. Characteristics of the factory system. Causes and Consequences of industrialization. Obstacles to and Limitations of Industrialization.

GENETIC ENGINEERING LAB

1. Estimation of DNA by diphenylamine reaction
2. Determination of RNA by orcinol method
3. To isolate plant DNA using CTAB.
4. Elution of plant DNA fragment from agarose gel
5. To perform restriction digestion of λ DNA
6. Dephosphorylation of restriction enzyme digested vector pUC18.
7. To make bacterial cells competent for transformation
8. To perform of transformation of the desired bacterial strain with plasmid DNA
9. SDS-PAGE of proteins under reducing conditions (SDS-PAGE)
10. To perform Southern Hybridization
11. To perform ligation of λ *EcoR*I digest using T_4 DNA *ligase*

FERMENTATION BIOTECHNOLOGY LAB

1. Fermentative production of Ethanol using *Saccharomyces cerevisiae.*
2. To study the induction effect of β-galactosidase enzyme in *E.coli.*
3. Upstream and Downstream of bioprocess for the production of Citric acid by *Aspergillus niger*
4. Fermentative production of Penicillin Antibiotics using *Penicilium chrysogenum.*
5. Microbial production of enzymes by (a) solid state and (b) submerged fermentation.
6. Wine Fermentation.
7. Microbial production of Biopolymer using suitable Strain.

BIOINFORMATICS-I LAB

1. Get five nucleotide and five protein sequences in FASTA format from NCBI and EMBL.
2. To find out five similar sequences for any nucleotide and protein query sequence using BLAST and FASTA.
3. Access and use of different online nucleotide and protein alignment tools (Pairwise and Multiple sequence alignment).
4. Genes and Exons identification related search for a given genome sequence in order to predict the gene.
5. ORF prediction in the given nucleotide sequence.
6. Secondary structure prediction for given amino acid sequences of a given protein using Chou Fasman, GOR method and Neural Network method.
7. Visualize tertiary structure of any given protein sequence.
8. Carry out the alignment of genomes of given organisms.
9. Predict the homology model of any protein sequence.

Text/ References Books

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Andreas D. Baxevanis
2. Structural Bioinformatics by Philip E Bourne, John Wiley & Sons
3. Analytical Tools for DNA, Genes & Genomes: by Arseni Markoff, New Age.

METABOLIC ENGINEERING LAB

1. Molecular techniques to enhance the product yield
2. Generalized knowledge on the principles and regulation of metabolic pathways
3. Processes for ATP synthesis & utilization
4. Analyze different methods to obtain improved production strains
5. Various methods to synthesize primary and secondary metabolites

SEMESTER- VI

PHARMACEUTICAL BIOTECHNOLOGY

Course objectives:

To acquire knowledge of steps involved in new drug discovery, drug designing, development and production of biopharmaceuticals, mechanism of action of drugs, approval process and their quality control in pharmaceutical industry.

Course outcomes:

Students will be able to:

- explain the process of new drug discovery.
- apply the concepts of production of biopharmaceuticals in pharmaceutical industry.
- apply the knowledge of pharmaceutical manufacturing in the production of biopharmaceuticals.
- carry out quality control of pharmaceuticals.
- comprehend the regulatory aspects involved in the development of biopharmaceuticals.

Unit I

Development of Drug and Pharmaceutical Industry: History and development of drugs and introduction of different pharmaceutical industries including nutraceuticals.

Unit II

Drug metabolism and pharmacokinetics: Drug metabolism and physio-chemical principles, radioactivity-pharmacokinetics action of drugs in human bodies.

Unit III

Important unit process and their applications: Bulk drug manufacturers, Type of reactions in bulk drug manufacture and processes, Special requirement for bulk drug manufacture.

Unit IV

Manufacturing principles: Coating and packing of tablets, capsules, sustained action dosage forms- parental solution, oral liquids-injections-ointment-topical applications, Preservation.

Unit V

Pharmaceutical product and their control: Therapeutic categories such as vitamins, laxatives, analgesics, Antibiotics, biologicals, hormones, Non-steroidal contraceptives.

TextBook:

Leon Lachman et al: Theory and practice of Industrial Pharmacy, 3Edition, Lea and febiger,1986.

Reference Books:

Remington’s Pharmaceutical sciences, Mark publishing and Co.

PLANT BIOTECHNOLOGY

Course objectives:

- To make students aware of various tissue culture techniques and their application in biotechnology for commercial purpose and to acquaint students with applications of genetic engineering like transgenic plants
- Provide complete exposure as how plant and animal cells are isolated, cultured and genetically manipulated in laboratory
- Have an understanding about plant secondary metabolites and its applications

Course outcomes:

- Understand principles of plant culture, media preparation and can explain *in vitro* fertilization and embryo transfer technology, meristem culture and clonal propagation of plants
- Students can give specific examples of agricultural and horticultural biotechnology applications, including genetically modified organism (GMO) crops, hydroponics, and plant-made pharmaceuticals
- Students can purify proteins of interest from plant samples and perform assay of DNA or protein samples for their concentration and purity
- Students describe the role that *Agrobacterium tumefaciens* plays in producing genetically modified plant crops will know the methods used to produce transgenic plants, and explain the selection processes for identifying transformed plant cells
- Appreciate the plethora of plant secondary metabolites and its benefits

UNIT-I

Introductory history of plant biotechnology: Laboratory organization; Principles of Plant Tissue Culture. Concepts of totipotency, competency, determinism, explants, inoculums, Acclimatization.. Nutrition of plant cells; Nutrient media: Composition of commonly used nutrient culture media with respect to their contents like inorganic chemicals, organic constituents. An appraisal of different media, selection of media, Sterilisation of the media. Hormones: Auxins, cytokinins, Gibberellins, Abscisic Acid, ethylene etc. Explant preparation and Surface sterilization. Basic procedure for Aseptic Tissue transfer.

UNIT-II

Culture of plant materials- explants selection and technique of culturing. Organogenesis, Embryogenesis, Somaclonol variation, germiclonal variation Establishment, growth and maintenance of Callus and cell suspension culture, Methods of sub culturing and transfer of regenerated plants to the field. Tissue and organ culture; Cellular differentiation and regulation of morphogenesis;. Somatic embryogenesis; Control of organogenesis and embryogenesis; Single cell culture

Unit III

Haploid production -Androgenesis; Anther and microspore culture; Gynogenesis; Embryo culture and rescue in agricultural and horticultural corps; Protoplast isolation; Culture–regeneration; Somatic hybrid-cybrids; *In vitro* selection of mutants – mutants for salts, disease, cold, drought, herbicide and other stress conditions; Micropropagation: Application of micropropagation in agriculture and forestry . Meristem culture and virus elimination; Shoot tip culture.

Unit IV

Improved crop varieties through somaclonal variation in *in vitro* cultures -- Causes- stability and utilization – genetic and epigenetic basis; Establishment of cell lines and evaluation. Application of tissue culture for crop improvement in agriculture, horticulture and forestry. Cryopreservation and slow growth cultures, Freezing and storage, thawing, reculture. Application of plant tissue culture in transgenic plants and production of secondary metabolites and industrial products.

Unit V

Genetic transformation using Ti plasmid Manipulation of gene expression in plants; Production of marker free transgenic plants. Developing insect-resistance, disease-resistance, herbicide resistance; stress and senescence tolerance in plants. Genetic manipulation of flower pigmentation, Developing quality of seed storage, Provitamin A, iron proteins in rice, Modification of food plant taste and appearance, yield increase in plants

References:

1. H.S. Chawla. Plant Biotechnology, Oxford IBH publications
2. Hudson T Hartmann: Plant Propagation-Principle and Practices
3. Principles of Plant Biotechnology- An Introduction of Genetic Engineering in Plants by S.H. Mantell, J.W. Mathews and R.A. Mckee, Blackwell Scientific Publications.
4. Chopra V L, Sharma R P & Swaminathan M S: Agricultural Biotechnology
5. Razdan M K: An Introduction to Plant Tissue Culture

BIOMEDICAL INSTRUMENTATION

Course objectives: This course will help students to venture in to the different types of invasive & non invasive diagnostic & monitoring instruments used in biomedical sciences.

Course outcomes:

- Hands-on experience with regard to different instrumentations and techniques. ·
- Understand the Instrumentation and Control of different types of biomedical techniques.
- Understand the basic principles of engineering knowledge to solve a critical problem.
- Understand the technical aspects of different medical instruments.
- To learn about the processes involved in detection or measurement of different diseases and parameter of human health.

UNIT I

History and development of biomedical instrumentation, biometrics, Basic transducer principles: active and passive transducers, transducers for biomedical applications; origin of bio potential and its propagation, sources of bioelectric potentials, electrocardiogram, electro encephalogram, electromyogram and other bioelectric potentials. Bio potential Electrodes: types of electrodes surface, needle and microelectrodes, biochemical transducers.

UNIT II

The Cardiovascular system, Cardiovascular measurements: electrocardiography, measurement of blood pressure, measurement of blood flow and cardiac output, plethymography, measurement of heart sounds; Patient care and monitoring: elements of intensive care unit, pacemakers and defibrillators ,Measurements in the respiratory system: mechanics of breathing, gas exchange and distribution, respiratory therapy equipment.

UNIT III

Non-invasive diagnostic instrumentation: Temperature measurements ultrasonic measurements, the nervous system and neuronal communication measurement in nervous systems, Instrumentation for sensory measurements and the study of behaviors, psychophysiological measurements, Biotelemetry.

UNIT IV

Instrumentation for the clinical laboratory, Automation of chemical tests, Biomedical instruments for surgery, Hemodialysis machines. X-ray machines and digital radiography.

UNIT V

Medical Imaging equipment, the computer in biomedical instrumentation and applications, microprocessors, Electrical safety of medical equipment, physiological effects of electric current.

REFERENCE BOOKS

1. Biomedical Instrumentation and Measurement by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer
2. Biomedical Instrumentation: Technology and Applications by Raghbir Singh
3. Medical Instrumentation for Health Care by Leslie Cromwell
4. Handbook of biomedical instrumentation R. S. Khandpur Tata McGraw Hill, New Delhi

FOOD BIOTECHNOLOGY

Course objectives:

- To impart an insight into the classification, ingredients and additives of food.
- Providing latest information of food processing and preservation techniques.
- The students will acquire knowledge about the production of fermented food and beverages.

Course outcomes:

- Students will be able to recognize sources of microorganisms and food borne illness.
- Know causes of food spoilage, Spoilage of fruit, Vegetables, Dairy product
- Understand microbial determination in various mediums & enhancers of food quality
- Basic knowledge of food Preservation –Chemical Method, Physical method and apply them in food industries further.
- Gain knowledge about industrial awareness on quality control and good practices in manufacturing processes in industry.

Unit-I

History of Microorganisms in food: Historical Developments. Role and significance of microorganisms in foods. Intrinsic and Extrinsic parameters of foods that affect microbial growth. Basic principles of the equipment involved in the commercially important food processing methods and unit operations.

Unit-II

Microorganisms in food: spoilage of fresh meats and poultry, processed meats, seafood's, fruits and vegetables. Fermented food products, Medical foods, Probiotics and health benefits of fermented milk and foods products. Dehydrated Foods, Enteral Nutrient Solutions (Medical Foods), Single-Cell Protein. Starter cultures, Production process of cheeses, beer, wine and distilled spirits. Process of Brewing, malting, mashing, primary & secondary fermentation. Problems in food industry: catabolic repression, High gravity brewing, B-glucan problem, getting rid of diacetyl.

Unit-III

Determining Microorganisms and/or their Products in Foods: Microbiological Examination of surfaces, Air Sampling, Metabolically Injured Organisms. Enumeration and Detection of Food-borne Organisms. Bioassay and related Methods. Common Food borne diseases. Nutritional boosts and flavor enhancers: Emerging processing and preservation technologies for milk and dairy products.

Unit-IV

Food Preservation: Food preservation by various methods especially Irradiation, Characteristics of radiations in food preservation, principles underlying the destruction of microorganisms by Irradiation. Application of radiations in food (processing for irradiation). Radappertization, Radicidation, and Radurization of Foods. Effect of Irradiation on Food quality and storage ability. Miscellaneous Food Preservation Methods: High- Pressure Processing, Pulsed Electric Fields, Aseptic Packaging, Manothermosonication (Thermo-ultrasonication).

Unit-V

Indicators of Food Safety and Quality: Indicators of Food microbial quality, product quality and food safety. Fecal Indicator Organisms, Predictive Microbiology/Microbial Modeling. The Hazard Analysis Critical Control Point System (HACCP System), Microbiological Criteria. Food borne intoxicants and mycotoxins.

Text / Reference Books:

1. Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4th Edn., McGraw Hill Book Co., New York.
2. Mann &Trusswell , 2007. Essentials of human nutrition. 3rd edition .oxford university press.
3. Jay, J.M., 1987. Modern Food Microbiology, CBS Publications, New Delhi.
4. Lindsay, 1988. Applied Science Biotechnology. Challenges for the flavour and Food Industry. Willis Elsevier.
5. Roger, A., Gordon, B. and John, T., 1989. Food Biotechnology.

BIOPROCESS ENGINEERING II

Course objectives:

- To learn the concepts of screening, optimization and maintenance of cultures and to introduce the students to the various concepts of microbial growth kinetics, fermentation and bioprocess engineering.
- To understand the basics of fermentation techniques and to enable the students to learn about the design of fermenters.
- To know about the principals involved in transport mechanisms and techniques involved in Upstream and downstream bioprocessing.

Course outcomes:

- Recognizing the basic principles of bioprocess technology and different types of fermenters
- Understanding the different processes involved in bioprocess technology
- Integrating scientific and technological knowledge on the use of bioprocesses for industrial products on the cell and process level
- Developing and assessing the conditions for efficient and sustainable design of bioprocesses.

Unit I

Media Preparation, Media design and optimization. Microbial growth patterns and kinetics in batch culture, Microbial growth parameters, Environmental conditions affect growth kinetics, Kinetics of thermal death of microorganisms, Heat Generation by microbial growth, Quantitative analysis of microbial growth by direct & indirect methods.

Unit II

Sterilization: concept and methods. Type of Sterilizations, Batch heat sterilization of liquids, Estimation of sterilizer efficiency, Continuous heat sterilization of liquids, Sterilization of air: Methods &Mechanism, Design of depth filter and estimation of its efficiency. Stoichiometric calculations, Theoretical prediction of yield coefficients, Stoichiometry of growth and product formation, Maximum possible yield, Theoretical oxygen demand, Stoichiometry of single-cell protein synthesis.

Unit III

Ideal Reactor Operation: Batch, Fed Batch & Continuous operation of mixed bioreactors, Microbial pellet formation, Kinetics and dynamics of pallet formation. Chemostate with immobilized cells, Chemostate with cell recycle, substrate utilization and product formation in bioreactor, Scale up of Bioreactors

Unit IV

Role of diffusion in Bioprocessing, Convective mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures, Factor affecting cellular oxygen demand, Oxygen transfer in bioreactors, Measurement of volumetric oxygen transfer coefficient, Oxygen transfer in large

bioreactor.

Unit V

Bioreactor control mechanism, Physical, Chemical and Biological environment of bioreactor, Manual control system, Role of physical, chemical & biological sensors, Advanced control strategies viz. PID controllers, Fuzzy logic based controllers and artificial neural network based Controllers. Basic concepts of computer modeling and optimization in bioprocess applications.

Text Books and Reference Books

1. Bioprocess Engineering Principles – P. M. Doran, 5th ed.
2. Biochemical Engg. Bailly & Ollis, Academic Press
3. Biochemical & Biological Engg. Science, N. Blakebraugh, Academic Press
4. 7."Principles of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press.
5. "Bioprocess Technology - Kinetics & Reactors" by A Moser, Springer-Verlag.
6. "Biochemical Engineering and Biotechnology Handbook" by B. Atkinson & F. Mavituna, 2nd Ed.Stockton Press.
7. Bioreactors in Biotechnology: A Practical approach by Scragg

BIOINFORMATICS-II

Course objectives:

- To introduce to the field of bioinformatics via an array of publically available tools and resources.
- To study and deduce the molecular characterization of human genome.
- To study the techniques involved in structural and functional proteomics.
- To utilize the bioinformatic tools to design and development of novel drugs.

Course outcomes:

- Students should be able to apply basic bioinformatics tools for the studies and research in other areas of their biotechnology and microbiology programs, such as finding gene/protein homologs, designing primers, identifying mutations, etc.
- Commemorating the molecular techniques involved in characterization of genomes and proteomes
- Recognizing and interpret the techniques involved in genomics, proteomics, bioinformatics
- Administering the principles of genomics, proteomics, bioinformatics to discovery novel drug development
- Analyzing the molecular markers and its applications.

Unit I

Inference problems and techniques for molecular biology. Overview of key inference problems in biology: Homology identification, Genomic sequence annotation (Genes and ORFs identification), Protein structure prediction (Secondary and Tertiary structure prediction), Protein function prediction, Biological network identification, Next generation sequencing, Microarray data analysis.

Unit II

Basics of RNA Structure prediction and its limitations, Features of RNA Secondary Structure, RNA structure prediction methods: Based on self-complementary regions in RNA sequence, Minimum free energy methods, Suboptimal structure prediction by MFOLD, Prediction based on finding most probable structure and Sequence co-variance method. Application of RNA structure modeling.

Unit III

Machine learning: Decision tree induction, Artificial Neural Networks, Hidden Markov Models, Genetic Algorithms, Simulated Annealing, Support vector machines; The relation between statistics and machine learning; Evaluation of prediction methods: Parametric and Non-parametric tests, cross-validation and empirical significance testing (empirical cycle), Clustering (Hierarchical and K-mean).

Unit IV

Basic concept of Force field in molecular modeling (Potential energy calculation); Overview of key computational simulation techniques: Introduction to simulation, Computer simulation techniques, Types of computer simulation (Continuous, Discrete-event and Hybrid simulation), Differential equation solvers, Parameter estimation, and Sensitivity analysis.

Unit V

Overview of key techniques for the management of large document collections and the biological literature: Document clustering, Information retrieval system; Natural Language Processing: Introduction, Major areas of NLP, Natural language information extraction; Insilico Drug Designing: Major steps in Drug Designing, Ligand and Structure based drug designing, Protein-ligand docking, QSAR Modeling, Pharmacodynamics (Efficacy & Potency) & Pharmacokinetics (ADME), Lipinski's rule of five, Pharmacogenomics.

Text/References Books

1. Computational Methods in Biotechnology – Salzberg S. L. et al., Elsevier Science.
2. D.W.Mount; Bioinformatics- Sequence and genome analysis; Cold Spring Harbour Lab

ENGINEERING/MANAGERIAL ECONOMICS

Course Objectives

The objectives of this course are:

- To provide knowledge about Managerial Economics.
- To provide knowledge about Demand Analysis.
- To Determine Production and cost analysis.
- To make aware with pricing and profit management.
- To familiarize the students with the basic concept of microeconomics.

Course Outcomes

The students will be able to

- To understand the concepts of cost, nature of production and its relationship to Business operations.
- To apply marginal analysis to the "firm" under different market conditions.
- To analyse the causes and consequences of different market conditions.
- To integrate the concept of price and output decisions of firms under various market structure
- To apply economic concepts & techniques in evaluating business decision & proper planning by the firm

Unit I

The Scope and Methods of Managerial Economics, Risk, Uncertainty and Probability Analysis.Optimization techniques: Total, Average and Marginal Relationships, Optimization Analysis. Multivariate Optimization – Partial Derivatives; Contraint Optimization – by substitution, by Lagrangion Multiplier Method. Approach to Managerial Decision Making and the theory of firm.

Unit II

Demand Analysis, Basic Concepts, and tools of analysis for demand forecasting. Use of business indicators; Demand forecasting for consumer, Consumer Durable and Capital Goods. Concepts in resource allocation, cost analysis; break even analysis, short run and long run cost functions; production functions; cost-price output relations – Capital InvestmentAnalysis.

Unit III

Market Structure, Pricing and output; General Equilibrium. Pricing – Objectives – Pricing Methods and Approaches Product Line Pricing – Differential Pricing.Advertising – Contribution of Economic Theory, Methods of Determining Total Advertising Budget, Cyclical Fluctuations of Advertising, Measuring the Economic Effects of Advertising

Unit 1

Unit IV

Capital Budgeting – Capital Management and Financial Policy – Monopoly Policy – Restrive Agreements – Price Discrimination – Measurement of Economic Concentration – Policy against Monopoly and Restrictive Trade Practices.

Unit V

National Income and Product; Saving, Consumption, Investment, the theory of income determination.

PHARMACEUTICAL BIOTECHNOLOGY LAB

1) Introduction of instruments used in pharma industries.
2) Antibiotic sensitivity test on bacterial growth.
3) Phytochemical analysis of different food materials.
4) Phytochemical extraction in different solvents.
5) Administration of different drugs and their uses through hospital visit.
6) In vitro pharmacological study of purified molecule through research lab visit.
7) In vitro pharmacological study of natural plant extracts through research lab visit.
8) To learn preservation techniques used for drugs.
9) To learn packaging techniques of drugs.

Recommonded Books: Leon Lachman et al: Theory and practice of Industrial Pharmacy, 3Edition, Lea and febiger,1986.

PLANT BIOTECHNOLOGY LAB

1. Preparation of Stocks solution for plant tissue culture media.
2. Preparation of MS/B5 medium (semi-solid) and sterilization.
3. Explant selection, preparation and surface sterilization.
4. To learn culturing, sub culturing and maintenance using selected explants.
5. Initiation of *in vitro* cultures through axillary bud induction
6. Initiation of callus cultures from different explants.
7. Preparation of artificial seed/synthetic seed for conservation of germplasm
8. Extraction of DNA/RNA from plants and its estimation.
9. Isolation and characterization of plant secondary metabolites from selected medicinal plants.
10. Extraction of proteins from plants and its estimation

BIOMEDICAL INSTRUMENTATION LAB

1. Identify ECG electrodes & Patient cable
2. Measure blood pressure using sphygmomanometer.
3. Measure body temperature using analog and digital thermometer.
4. Calibration and demonstration of X-ray machine.
5. Visits to Industries/ Hospital and prepare a report.

FOOD BIOTECHNOLOGY LAB

1. Estimation of starch adulteration in milk.
2. Estimation of lactose from milk
3. Estimation of ascorbic acid from given food sample.
4. Microscopic examination of Food/Milk.
5. To judge efficiency of pasteurization of milk.
6. Determination of Minimum Inhibitory Concentration (MIC) of Antibiotic.

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