Bioinformatics

[5th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Biotechnology	3-1-0, (4)	PC	BT105101BT

[Pre Requisite- Basic understanding molecular biolgy, basic computers knowledge and databases.]

Course Objectives

1. The objectives are to explain students with basics of biology.
2. To know about different biological at molecular or celluar level.
3. To be able to learn biological databses and sequence alignment algorithms
4. To be able to learn basics of Genome analysis of various living

organisims Course Content

UNIT 1:

Aim and Tasks of Bioinformatics, Major bioinformatics resources (NCBI, EBI, ExPASy), Sequence analysis (biomolecular sequence file formats, sequence alignment, phylogeny), Introduction to Sequences, Web-based tools for sequence searches and structure prediction, motif analysis and presentation.

UNIT 2:

Introduction to data types and Source, Nucleic acid databases (DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum). Secondary structure and 3D structure prediction; Knowledge discovery in biochemical databases; Metagenomics; Metabolic engineering and systems biology.

UNIT 3 :

Alignments and Dynamic Programming; Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm), Multiple sequence alignment (Clustal W & X), Scoring Matrix, Phylogenetic analysis (dendrograms, phylograms, cladograms), Comparative genomics in bioinformatics (Clustering and trees).

UNIT 4 :

Introduction to Genomic analysis, Elements of DNA Sequences, ORF finding, DNA Motifs and Patterns, Bioinformatics strategies for Large scale genome sequencing; Understanding DNA microarrays and protein arrays from bioinformatics point of view; Molecular modeling and simulations (basic concepts including concept of force fields).

Reference Books

1. Introduction to Bioinformatics, Arthur Lesk, Oxford University Press.
2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins,
Baxevanis AS and Ouellette BF, Wiley International Science.
3. Introduction to Bioinformatics Algorithms" by Neil Jones and Pavel Pevzner.
4. Bioinformatics" by David Mount (2nd edition)

Heat and Mass transfer

[5th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Biotechnology	3-1-0, (4)	PC	BT105102BT

[Pre Requisite- Concept of conductive & convective heat transfer, Mass transfer operations for biotechnology.]

Course Objectives

1. To demonstrate the concept of conduction, convection, heat exchangers and heat exchangers design
2. To define the principles of diffusion, adsorption, absorption, leaching and drying extraction, distillation, crystallization operations

Course

Content

UNIT I:

Modes of heat transfer, Fourier's Law, thermal conductivity, fundamental equations of conduction, one dimensional steady-state
heat conduction, heat flow through cylindrical and spherical systems, compound systems, compound resistance in series, critical radius of insulation, Logarithmic mean radius in heat flow through a cylinder

UNIT II:

Introduction to convective heat transfer; concept of heat transfer coefficient, over all heat transfer coefficient, Boundary layer concept, natural and forced convection, Temperature gradients in forced convection, Nusselt number in convective mass transfer, Fouling and Fouling factors in heat flow Dimensionless groups in convective heat transfer, Heat exchangers, double pipe heat exchangers, Counter current and parallel flows in heat flow in fluids, Enthalpy balances in heat exchangers, shell- and tube type heat exchangers, Heat exchanger analysis, LMTD and Effectivness-NTU methods, Evaporators and condensers, Plate type heat exchangers and their design, Heat Transfer in agitated vessels, Evaporators- Single and Multiple Pass Evaporators Different type of Evaporators and Evaporator economy, Radiation heat transfer, Black body radiation and emissivity

UNIT III:

Concept of molecular diffusion, Fick's law, molecular diffusion in liquids and gas mixture, Diffusion in spherical geometry, concept of convective mass transfer, mass transfer coefficient, dimensionless group in mass transfer, correlations for the convective mass transfer coefficient, theories of mass transfer, Theories of Mass Transfer, surface renewal, penetration and two film theory – Importance of Two film theory in bioprocess systems with respect to oxygen transfer in bioreactors, momentum, heat and mass transfer analogies

UNIT IV:

Concept of distillation, Relative Volatility, calculation of number of plates by McCabe-Thiele method, Steam distillation, Azeotropic & Extractive Distillations, batch distillation with reflux, Flash distillation of binary mixtures, Material balances for two component systems, Azeotrpic distillation w.r.t alcohol distillation principles of gas absorption, Leaching, solid-liquid equilibrium, Drying, drying equilibria, batch and continuous drying equipments; Extraction, liquid-liquid equilibrium, Liquid extraction, Crystallization, preliminary idea of crystallization; Description of adsorption processes and their applications, types of adsorption, nature of adsorbents adsorption equilibria

Reference Books

1. Fundamentals of heat transfer by R.C Suchdeva
2. Principles of mass transfer and separation process by B.K. Dutta
3. Heat and Mass transfer by McCabe Smith
4. Treybal R.E. Mass Transfer Operations.IIIrd edition. Mcgraw Hill, 1981.

Recombinant DNA Technology

[5th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Biotechnology	3-1-0, (4)	PC	BT105103BT

[Pre Requisite- Cell & Molecular Biology.]

Course Objectives

1. Build a strong foundation on the gene cloning methods and analysis.
2. Acquainted with the tools and techniques involved in genetic engineering.

Course Content

UNIT-1: INTRODUCTION TO RDT/GE

Basic concept of recombinant DNA Technology (RDT) and Genetic Engineering (GE); Gene cloning-types and process; Tools of RDT; Basic techniques involved in RDT (PCR, RFLP, RAPD, Blotting techniques); Mutations in DNA.

UNIT-2: VECTORS AND HOST

Vector & cloning capacity; Plasmids; Bacteriophages- M13 & λ phage; Cosmid, Phagmid,
Artificial Chromosomes: BAC, YAC; Cloning vectors; Expression vectors; Prokaryotic and eukaryotic host systems.

UNIT-3: DNA LIBRARY AND PROBES

DNA Libraries: Genomic DNA library preparation & c-DNA library preparation; Difference between c-DNA library and Genomic DNA library; Types and application of gene probes; Chromosomal walking; Screening of DNA libraries; Usages of DNA library.

UNIT-4: GENE TRANSFER AND TRANSGENICS

Understanding of gene transfer; Transgene stability; Reporter gene; Methods of gene transfer-natural and artificial methods; Transgene, transgenesis, and transgenic (GMO); Uses of GMO; Procedures for RDT based production; Details declaration for GMOs development

Text Books:-

1. Gene Cloning and DNA Analysis: An Introduction by T. A. Brown.
2. Principle of gene cloning by Old and Primrose.

Reference Books :-

1. Glick , B.R. and J.J. Pasternak. “Molecular Biotechnology : Principles and Applications of Recombinant DNA”. ASM.
2. From gene to Genomes “Concept & Application of DNA Technology” by J.W.Dale & M.V. Schartz.

Food Biotechnology

[5th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Biotechnology	3-0-0, (3)	PE 1	BT105201BT

[Pre Requisite- Microbiology and Plant Biotechnology]

Course Objectives

1. To comprehend the microbiological and technological principles of industrial application of microorganisms in food production
2. To comprehend major fermented food product technologies.
3. To furnish industrial processes and technologies for the production, processing and preservation of food and related

products Course Content

UNIT I

Role and significance of micro-organisms in food. Microbial Cultures to make food – from baker's and brewery yeast to cheese starters; Food spoilage, Food borne illness. Unit operations in Food Processing – Sterilization and Sterilization procedures

UNIT II

Fermented food products, Fermentations to make food ingredients acetic acid, citric acid; amino acids and vitamins; emerging food processing and preservation technologies Process development w.r.t Fermented food products. Shake flask fermentation. Bioreactors in food processing Solid state fermentation Downstream processing in Fermented food processing

UNIT III

Natural food colours, food flavour enhancing agents; Nutraceuticals and Probiotics; Single-Cell Protein;Genetically engineered food; Growing animal cells, tissues and production of meat Safety and Norms in the use of food colours and flavour Advantages and Disadvantages of the use of Genetically engineered food; Mushroom production

UNIT IV

Food Quality Assurance; Analysis of major food ingredients; Analysis of preservative, chemical safety measurement-heavy metals, fungal toxins, bacterial toxins, herbicide and pesticide detection, Adulteration, Quality control Tests; Risk Assessment studies with respect to the use of herbicides and pesticides, preferable use of bioherbicides and biopesticides

Course Materials

Required Text: Text

Books

1. Shetty, K., Plaiyath, G., Pometto, A. and Levin, R.E., Functional Foods & Biotechnology, CRC Press (2006).
2. Byong H. Lee, (2014)- Fundamentals of Food Biotechnology, 2nd Edition, WileyBlackwell.

Optional Materials:Reference books

1. Food Microbiology- Fundamentals & Frontiers by M.P.Doyle, L.R. Beuchal &Thorna J. Montville(2001) A.S.M.Press.
2. Potten N.M." Food Science" the AVL Publishing Co.2002. 2. Shetty, K., Plaiyath, G., Pometto A. and Levin, R.E., Food Biotechnology, CRC press, (2005).

Computational biology

[5th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Biotechnology	3-0-0, (3)	PE1	BT105202BT

[Pre Requisite- Basic knowledge on computers, coding , molecular biolgy]

Course Objectives

1. Student will know about the properties of DNA, RNA, and proteins, the relationships among these molecules, and some biological questions that have puzzled researchers.
2. Student will learn will know how to convert a biological question into a computational problem that can be solved using computers and will be able how to read and comprehend solutions to computational problems, which will be formalized as a series of tasks (an algorithm).

Course

Content

UNIT 1:

Biology in time and space. Current and emerging areas in the field of computational Biology, Compositions of functions, Algorithms
and Complexity, Algorithm design techniques and the different types of algorithms, Biological versus computer algorithms, Iterative versus Recursive Algorithms.

UNIT 2 :

Modeling basic life science scenarios. Adequateness, advantages of computational modelling, Basic notion for computational models, model scope, statements, system state, variables parameters constants, behaviour, classification, steady states.

UNIT 3:

Motif finding, Structural modelling and structure prediction Network modelling: Genomic regulation, Genetic variation, RNA world Systems Biology (gene, protein and membrane machine); Cancer genomics (Tumor complexity): Gene regulatory network Codon optimization Algorithmic Drug designs.

UNIT 4:

Graph Types in Biology -bar graphs, line graph, area graph, scatter plot, pie and 3-dimensional graphs and generation using simple programs like Excel, Octave or Matlab. Advanced use of computers like scientific libraries, scripting etc.

Reference Book:

1. Introduction to computational biology: an evolutionary approach Bernhard
houbold, Thomas Wiehe, Blkhauserverlag press.
2. Waterman, Michael S. Introduction to computational biology: maps, sequences and genomes. CRC Press, 1995.

Environmental Biotechnology

[5th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Biotechnology	3-0-0, (3)	OE1	BT105301BT

[Pre Requisite- Microbial metabolism, Ecology and Ecosystem]

Course Objectives

1. To understand how biotechnology can help in monitoring or removing the pollutants.
2. To learn the principles of biological waste treatment methods.
3. To develop an understanding of new trends such as biofuels, renewable energy sources, or microbial technologies in minimizing the harmful impact of pollutants in the environment.

Course

Content

UNIT I

Environmental pollution: An overview, Land, water , air , Thermal Pollution, Nuclear and Radiation Pollution, their sources and
effects. Application of biotechnology in environment protection. Microbial Ecosystems and Environmental sustainability

UNIT II

Waste water characteristics:, Biological Waste Treatment Processes with respect to attached growth process and suspended growth process for Aerobic Waste Treatment process (Activated Sludge process and Trickling Filter process) and Anaerobic Waste Treatment process (Fluidized Bed Biofilm Reactor studies and Upflow Anaerobic Sludge Blanket Reactor studies) Biogas formation as alternate source of energy in Anaerobic process

UNIT III

Solid waste management: landfills, recycling and processing of organic residues, minimal national standards for waste disposal, composting technologies. Gaseous pollution: removal of SOx, NOx,CO_2 sequestration. Acid Mine Drainage

UNIT IV

Bioremediation and Biodegradation: Introduction and types of bioremediation; Development of Microorganisms for Biodegradation of Xenobiotic compounds;bioconversion of agricultural and other biodegradable organic waste materials into gainfully utilizable products.

Course Materials

Required Text: Text

Books

1. Rittmann, B. and McCarty, P., Environmental Biotechnology: Principles and Applications, McGraw-Hill (2006)
2. Wastewater Engineering: Treatment and Disposal, Second edition, Metcalf and Eddy, Inc Tata McGraw-Hill publishing Company, New Delhi, 1987

Optional Materials: Reference Books

1. Scargg, A., Environmental Biotechnology, Longman (1999).
2. Environmental Microbiology & Biotechnology, D.P. Singh, S.K. Dwivedi, New Age International Publishers, 2004.
3. Environmental Biotechnology, B.C. Bhattacharya & Ritu Banerjee, Oxford Press, 2007.
4. Wainwright, M., An Introduction to Environmental Biotechnology, Kluwer Academic Press (1999).
5. Environmental Microbiology & Biotechnology, D.P. Singh, S.K. Dwivedi, New Age International Publishers, 2004.

Molecular Modeling & Drug Designing

[5th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Biotechnology	3-0-0, (3)	Open Elective	BT105302BT

[Pre Requisite- Biochemistry/Chemistry, Physics.]

Course Objectives

1. Train the students for computational modeling at molecular level
2. Acquainted with the tools and techniques of drug designing

Course Content

UNIT I

Imperial Force fields molecular mechanism: Bond Stretching — Angle Bending — Torsional terms — Out plane bonding motions — Electrostatic interactions — Van Der Waalsinteractions—EffectivepairPotentials—HydrogenBonding—Simulationofliquidwater

UNIT II

Computer simulation methods: Calculation of thermodynamic properties — Phases pace — Practical aspects of computer simulation — Boundaries monitoring Equilibrium — Long range Process—Analyzing result of simulation and estimating errors, Metropolis methods — Monte Carlo Simulation of molecules —Monte Carlo Simulation of polymers — Calculating chemical potentials.

UNIT III

Moleculardynamics: Molecular Dynamics using simple modules—Molecular Dynamics with continuous potentials — Running Molecular Dynamics simulation — Constant dynamics —Time dependent properties —Molecular Dynamics at constant temperature and pressure, Monte Carlo simulation methods - Monte Carlo or Molecular Dynamics.

UNIT IV

Molecular modeling to discover and design new molecules: Molecular modeling in drug discovery — deriving and using 3D Pharma cores — Molecular docking — Structure Based methods to identify lead components-Denovo ligand design

Name of Text Books:

1. A.R Leach, Molecular Modeling Principles and Applications, 2nd Edition, 2001
2. Kun Zhou and Bo Li, Molecular Dynamic : Fundamental and Applications, Elsevier, 2022

Bioinformatics Lab

[5th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Biotechnology	0-0-0, (0)	Laboratory	BT105401BT

[Pre Requisite- Basic understanding molecular biolgy, basic computers knowledge and databases.]

Course Objectives

3. To make students comprehend the vital features of the interdisciplinary field of science for better understanding biological data.
4. To study about the bioinformatics databases and data format data retrieval from the online sources.

Course Content

1. Pairwise Alignment of nucleotide sequences using BLAST/FASTA software.
2. Use of FASTA searching – effect of different substitution matrices, change in gap penalties,different ktup values. Comparison of same search with BLAST.
3. Pairwise Alignment of protein sequences using BLAST/FASTA software.
4. Sequence alignment of two given sequences with FASTA and BLAST. Evaluate the statistical significance of the match with a web program. Effect of presence of low complexity regions in the sequence and filtering.
5. Multiple sequence alignment of nucleotide/protein sequences using CLUSTALW software.
6. Multiple sequence alignment of Nucleotide/Protein sequences using T-Coffee software.
7. Phylogenetic prediction of Nucleotide/Protein sequences using WORKBENCH software.
8. Identification of functional domains using Interproscan software.
9. Identification of gene using GENSCAN. To develop a simple “gene finder program” for identifying introns and exons. 10.Identification of 3D-structures of proteins using Geno3D software.

Heat and Mass transfer Lab

[5th Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Biotechnology	0-0-2, (2)	Laboratory	BT105402BT

[Pre Requisite- Conduction, convection, Heat exchangers, diffusion, absorption coloumn & wetted wall coloumn.]

List of Experiments

1. To determine the heat transfer coefficient of double pipe heat exchanger for cocurrent flow.
2. To determine the heat transfer coefficient of a double pipe heat exchange for counter current flow.
3. To determine the heat transfer coefficient of shell and tube heat exchanger
4. To study the temperature distribution along the length of pin fin in natural convection
5. To study the temperature distribution along the length of pin fin in forced convection
6. To determine the Diffusivity coefficient of Acetone in air by natural diffusion.
7. Study of Wetted Wall Column.
8. To determine the diffusivity of Acetone by forced diffusion.
9. To study the characteristics of steam distillation.
10. Study of fluidized bed system

List of Equipments/Machine Required:

1. Double pipe heat exchanger
2. Shell & tube heat exchanger
3. Absorption Column
4. Wetted Wall Column
5. Fluidized bed system.

Recommended Books:

1. McCabe and Smith, Unit Operation of Chemical Engg
2. Gavhane Unit operation Chemical Engineering,.
3. Treyball, Mass Transfer Operation