Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for B. Tech in Biotechnology
(Applicable from the academic session 2018-2019)

Course Code	OE-BT401					
Category	Open Elective Course					
Course title	Numerical Methods and Biostatistics					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	3	1	0	4	40	
Pre-requisites/Co-requisites (if any)	- Linear Algebra, Calculus, Two years of high school Mathematics, Statistics and probability in daily life					

Course Objectives:

This course is an introduction to a broad range of numerical methods for solving mathematical problems that arise in Science and Engineering. The goal is to provide a basic understanding of the derivation, analysis and use of these numerical methods along with a rudimentary understanding of finite precision arithmetic. This will help you choose and apply the appropriate numerical techniques for your problem, interpret the results and assess accuracy.

In Biostatistics course students will learn how to effectively collect data, describe data, and use data to make inferences and conclusions about real world phenomena.

Course Contents:

Module1 (6 L):
Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors.
Calculus of Finite Differences: Forward Differences, Backward differences, Fundamental theorem of difference calculus, Shift Operator, Evaluation of missing terms in given data, central difference and average operator, divided differences, propagation of errors in a difference table.
Module 2 (8 L):
Interpolation: Newton forward/backward interpolation, Newton's divided difference Interpolation.
Numerical differentiation: Numerical differentiation based on interpolation formulae
Numerical integration: Trapezoidal rule, Simpson's 1/3 rule
Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods,

Module 3 (6 L):
Numerical solution of a system of linear equations:
Gauss elimination method, LU Factorization method, Gauss-Seidel iterative method.
Numerical solution of Algebraic equation:

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Bisection method, Regula-Falsi method, Newton-Raphson method.

Module 4 (20 L):
Biostatistics: Mean, median; mode, standard deviation, variance, discrete and continuous probability distributions, Poisson, normal and binomial distributions, mathematical expectancy; Correlation and regression analysis, curve fitting, T test, chi-square Analysis.

Text Books:
1. Numerical Methods, Balaguruswamy, McGraw Hill
2. Computer Oriented Numerical Methods, R.S. Salaria, Khanna Publishing House
3. Numerical Methods and Programming: Bikash Chandra Bhui & Dipak Chatterjee.
4. Numerical Methods Theory and Practical: K Das
5. Introduction to Biostatistics: Dr. Pranab Kumar Banerjee
6. Statistical Methods: N.G. Das

References:
1. Baburam: Numerical Methods, Pearson Education.
2. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
3. Rastogi V. B: Fundamental of Biostatistics
4. Harvey Motulsky: Essential Biostatistics

Course Outcomes:

After completion of the course, the student will be able to:

1. **Calculate** different type of errors & establish the relationship of different operators

2. **Find** interpolation, differentiation, integration and solve a differential equation using an appropriate numerical method
3. **Solve** a linear system of equations using an appropriate numerical method
4. **Find** roots of non-linear equations using an appropriate numerical method

5. **Construct** central tendency of science/engineering data & interpret the role of such data and employ appropriate regression models to determine statistical relationships
6. **Apply** basic statistical inference techniques, including confidence intervals, hypothesis testing and analysis of variance, to science/engineering problems.

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Course Code	OE-BT402				
Category	**Open Elective Course**				
Course title	**Data Structure and Algorithms**				
Scheme and Credits	**L**	**T**	**P**	**Cr. Points**	**Lec. Hrs.**	**Semester: IV**
	3	**0**	**0**	**3**	**40**	
Pre- requisites/Co-requisites (if any)	- **Numerical Methods**				

Course Objective:

The objectives of the course are:

1. To compose the students aware of the concepts data structure like Stack, Queue, Circular Queue and D- queue, linearly linked lists, Circularly linked lists, Doubly linked lists and also their applications.

2. To be familiar with Binary Trees, Binary Search Trees, Height-balanced and Weight-balanced trees.

3. To recognize the magnitude of Breadth first search (BFS), Depth first search (DFS), Prim's and Kruskal's Algorithm and different types of sorting techniques in IT industry.

Course Content:

Module I: 10L
Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Linear Data Structures: Sequential representations, Arrays and Lists, Stacks, Queues , Circular Queue and D- queues and their applications. Link Representation: Linearly linked lists, Circularly linked lists, Doubly linked lists and applications.

Module II: 10L
Algorithms for creating and manipulating different linear data structures, Non-linear Data Structure: Trees – Binary Trees, Binary Search Trees, Insertion and Deletion algorithms, Height-balanced and Weight-balanced trees.

Module III: 10L
Graph Representations, Breadth first search (BFS) and Depth first search (DFS), Graph Theoretic Algorithms – Incidence Matrix, Adjacency Matrix, Algorithms for Minimal Spanning Tree (Prim's and Kruskal's Algorithm).

Module IV: 10L
Sorting and Searching Algorithms: Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort. File structures: Record & Table Structures.

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Textbook:

1. Aho Alfred V, Hopperoft John E., Ullman Jeffrey D. , "Data Structures and algorithms", Pearson
2. R.S. Salaria, "Data Structures and Algorithms Using C", Khanna Publishing House
3. Yaswant Kanitkar, "Data Structures through C", BPB House

Reference books:

1. Horowitz Ellis & Sartaj Sahani , "Fundamentals of Data Structures" , Galgotria Pub.
2. Tenenbaum A. S., "Data Structures using C",Pearson
3. N. Deo, Graph Theory -, PHI.

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. **Define** and understanding introductory concepts of data structure, abstract data types and array
2. **Illustrate** the concept and implementation of stack, queue, dequeue, circular queue
3. **Understanding** linear data structures with its applications and operations on different Linked lists.
4. **Describe** non-linear data structure such as trees, height-balanced and graph.
5. **Analyze and evaluate** various searching and sorting algorithms, problem analysis and representation of graphs such as BFS and DFS.
6. **Analyze and evaluate** the importance of data structure and be able to correlate future programming structure, and its market issues specific to complex engineering problems.

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Course Code	MC-BT401					
Category	**Mandatory Course (non-credit)**					
Course title	**Environmental Science/Engg**					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	2	0	0	0	26	
Pre-requisites/Co-requisites (if any)	-					

Course Objective:

The objectives of the course are:

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two type of activities.

Course Contents:

MODULE I: Awareness Activities (10 L)
i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
ii) Slogan making event
iii) Poster making event
iv) Cycle rally
v) Lectures from experts

MODULE II: Actual Activities (16 L)
i) Plantation
ii) Gifting a tree to see its full growth
iii) Cleanliness drive
iv) Drive for segregation of waste
v) To live some big environmentalist for a week or so to understand his work
vi) To work in kitchen garden for mess
vii) To know about the different varieties of plants
viii) Shutting down the fans and ACs of the campus for an hour or so

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Course Code	**ES-BT401**					
Category	**Engineering Science**					
Course title	**Transfer Operation-I**					
Scheme and Credits	**L**	**T**	**P**	**Cr. Points**	**Lec. Hrs.**	**Semester: IV**
	3	**0**	**0**	**3**	**40**	
Pre-requisites/Co-requisites (if any)	- **Engineering Thermodynamics and fluid Mechanics**					

Course Objective:
The objectives of the course are:

1. To make the students aware of the principles and the basic concepts on fluid Mechanics, Heat transfer and Mechanical operations along with its' applications in the main course of Engineering and also to be confident at the end of the course in all above mentioned areas.
2. To realize the importance and applicability of Transfer operation –I subject in the other allied area/field of the main course.

Course Content:
Module I: [10 Lectures]

Basic concepts of Fluid Mechanics:
Basic equations of Fluid Flow, Similarity of mass, momentum, and energy transfer, Navier-Stoke's equation, flow analysis using N-S equation for flow down in inclined plane.Hagen Poiseuille equation, Bernoulli Equation: significance and applications, Friction in flow through packed beds, fundamentals of fluidisation.

Module II:[5 Lectures]
Flow measurements and machineries:
Flow through pipes and open channels, Orifice and Venturi meters, Pitot Tube, Weirs, Rotameters and other types of meters, Transportation of fluids, Pipe Fittings and valves, Pumps – classification, centrifugal and positive displacement type - peristaltic. Blowers and Compressors (oil-free).

Module III:[9Lectures]

Heat transfer:
Classification of heat flow processes, conduction, Thermal conductivity. Unsteady state heat transfer by conduction :one dimensional heat flow equation with constant surface temperature. Heat flow in fluids by conduction and convection.Countercurrent and parallel flow. Enthalpy balance in heat exchange equipment. Individual heat transfer coefficients, overall coefficient, Boiling: analysis of boiling curve,nucleate boiling, filmboiling; Condensation: comparative analysis between dropwise and filmwise condensation Heat transfer equipment.

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Evaporation:Classification,evaporation capacity,steam economy.
Radiation: Fundamental facts ,emission of radiation,laws of blackbody radiation, Kirchoff's law, overview :radiation between surfaces,attenuation.

Module IV [15 Lectures]

Mechanical Operations & Transport Phenomena:
Principles of comminution, Types of comminuting equipment, Laws of Energy and power requirement, Crushers, Grinders, Mixing and Agitations, Power consumption in mixing, Screening, Types of screen, Screening efficiency Filtration: Principle, Constant pressure and constant rate filtration; Settling classifiers, Floatation, Centrifugal Separations.

Textbook:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition

2. Unit Operations of Chemical Engineering, Mechanical Operations:Prof. R. S. Hiremath,Prof. A.P. Kulkarni,EPH.

Reference books:

1. Geankopolis, Transport Processes & Unit operations: 3rd edition, PHI.

2. Coulson & Richardson, Chemical Engineering, Vol-I & II:, Butterworth Heinemann

3. D.Q. Kern, Heat Transfer, MGH

3. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, MGH

4. Foust, A.S., Wenzel, L.A, et.al. Principles of Unit Operations, 2nd edition, JWS

5. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH

6. R. Byron Bird, Warren E. Stewart and Edwin N. Lightfoot: Transport phenomenon, John Wiley & Sons Inc. Asian students Edition.6.

7. O.P. Gupta, Chemical Process Technology, Khanna Publishing House, 2019

Web Reference:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_ch05/preview
2. NPTEL: https://onlinecourses.nptel.ac.in/noc18_me25/preview

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. **Understand** fundamental of fluid mechanics, heat transfer, mechanical operation and also to gain basic knowledge on working principle of flow measuring devices..
2. **Identify, select** and **apply** the basic principles of transfer operation and solve engineering problems through teamwork.
3. **Learn** and **understand** the skills towards the problems related to transfer operation I and in turn the approach to solve it by applying basic concepts.
4. **Understand**, **identify** and **illustrate** the different modern tools & techniques based on

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fundamental of fluid mechanics, heat transfer, mechanical operation.

5. **understand** the professional ethics and responsibility in aspects of safety and environmental protection
6. **Communicate** effectively through technical writing and viva voce.

Course Code	PC-BT402				
Category	Professional Core				
Course title	Molecular Biology				
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	3	0	0	3	40	
Pre-requisites/Co-requisites (if any)	- Chemistry (10 + 2 level) - Biochemistry				

Course Objective:
The objectives of the course are:

- The Objective of the course is to teach students about the basic machinery of Molecular Biology Dogma in details (all the steps, preconditions, role of various enzymes, factors, regulators, inhibitors) etc.
- Replication, Transcription and translation processes would be discussed in details in both Prokaryotic and Eukaryotic system.
- Mutation, DNA repair, regulation of gene expression in prokaryotes in the light of *lac* operon, *ara* and *trp* operons would be taught.
- Splicing along with all RNA modifications, RNA editing, etc would be discussed.

Course Content:

Module-I (10L) Introduction to Molecular Biology, Replication & repair:

Introduction: Chromatin structure, Central Dogma of molecular biology, **Replication in prokaryotes and eukaryotes:** Mechanism, Model, structure and function of different Enzymes in DNA replication. Initiation, Elongation & Termination of replication; Inhibitors of DNA replication, DNA damage (Physical and chemical induced mutagenicity), Ames test, **DNA Repair in Prokaryotes and Eukaryotes:** Nucleotide excision repair, base excision repair, mismatch repair, photo-reactivation repair, recombination repair and SOS repair.

Module-II (10L) Transcription:
Components of transcriptional machinery in prokaryotes and eukaryotes: Structure of mRNA, promoter, RNA polymerases and transcription factors, terminators. **Process of transcription in prokaryotes and eukaryotes:** Initiation, Elongation & Termination of transcription (Rho dependent and independent). **Post transcriptional processing of RNA**: capping, splicing (different types), polyadenylation and RNA editing, Inhibitors of transcription, Ribozyme.

Module-III (10 L) Translation:

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Components translational machinery in prokaryotes and eukaryotes: Structure and function of ORF, tRNA, rRNA, aminoacyl synthetases, Ribosomes, RBS, **Process of Translation in prokaryote and eukaryote:** Initiation, Elongation & Termination, Concept of genetic code and Wobble hypothesis, Post translational modifications of protein, Inhibitors of translation, Protein targeting.

Module-IV (10 L) Regulation of Gene Expressions:
Gene regulation in prokaryote: Concept of operon model, (*lac*, *trp* and *ara* operon), Phage regulatory strategy and antitermination in lambda phage, negative and positive regulation, inducer, repressor, corepressor, activators, co-activators, silencers, insulators, enhancers, DNA binding protein-protein interacting domain of gene regulatory protein. **Gene regulation in eukaryotes:** DNA looping model, hormonal control of gene expression (steroid and non steroid), regulations at level of translation.

Text books:

1. Molecular Biology of the Gene – by Watson
2. Gene IX -by B. Lewin.
3. Essentials of molecular Biology, by Malacinski and Freifelder Jones and Bartlelt Publishers

Reference Book:

1. Molecular and Cellular Biology- by Stefen Wolfe
2. Genomes, by T. A. Brown, John Wiley and Sons PTE Ltd.
3. Cell and molecular Biology, Concepts and experiments by Gerald Karp, John Wiley and Sons
4. The Cell - A molecular approach, by Gm Cooper Asm Press

Web Reference:

Paper/Course: P-15.Molecular biology, genetic engineering, and biotechnology
ePgPathshala:http://epgp.inflibnet.ac.in/view_search.php?&category=21446&ft=et

Course Outcome:

After completion of the course, students will be able to
1. **Remember, define, and repeat the concept** of Chromatin structure, Replication, Mutation and repair.
2. **Conceptualize the essence of** Transcription process as a whole.
3. **Understand various** Post transcriptional processing of RNA.
4. **Demonstrate, discuss and associate** Translational machinery and its mechanism with its impact on living system.
5. **Understand** the Regulation of Gene Expressions.
6. **Investigate and develop** new ideas in Molecular Biology based projects exhibiting their creative potential.

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Course Code	PC-BT403					
Category	Professional Core					
Course title	Industrial Microbiology and Enzyme Technology					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	3	0	0	3	40	
Pre-requisites/Co-requisites (if any)	- Microbiology - Basic chemistry					

Course Objective:

The objective of the course is:

To develop skills of the Students in the area of Basic Industrial Biotechnology. This will be very helpful in understanding courses like Bioprocess technology, genetic engineering. etc.

Course Content:

Module I: [3 lectures]
INTRODUCTION TO INDUSTRIAL BIOPROCESS
Historical overview of industrial fermentation process. A brief survey of organisms, processes, products relating to modern biotechnology. Process flow sheeting – block diagrams, pictorial representation.

Module II: [10 lectures]
COMMERCIAL STRAIN DEVELOPMENT & MICROBIAL PROCESSES
Cellular control regulating production of microbial metabolites, Primary and secondary metabolite, Induced mutation technique, Analogue resistant mutant,Genetically engineered strain--Protoplast fusion technique.
Microbial production of Citric acid, Penicillin/Tetracycline/Streptomycin production, Alkaline Protease, Xanthan gum, Alcohol, bakers yeast, Single Cell Protein.

Module III: [10 lectures]
INTRODUCTION TO FERMENTATION TECHNOLOGY
Basic idea on fermentation process, Brief overview of a Bioreactor and its different parts, Surface, submerged and solid state fermentations, Media sterilization, air sterilization, Media optimization and Downstream processing.

Module IV: [10 lectures]
APPLICATION OF ENZYME AND ENZYME TECHNOLOGY
Brief Enzyme Overview; Classification & Nomenclature, Units of Activity, Environmental Effects on Enzyme Activity, Stability of enzyme, Strain selection (thermophilic, halophilic, alkalophilic producer strain), Protein engineering to improve enzyme stability,Chemical

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modification of enzyme to improve physico-chemical properties, Enzyme applications – (Industrial, medical and analytical).

Module V: [7 lectures]
ENZYME IMMOBILIZATION TECHNOLOGY
Physical and Chemical techniques for enzyme Immobilization –adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding – examples. Advantages and disadvantages of different Immobilization techniques. Overview of applications of immobilized enzyme systems, Design of Immobilized Enzyme Reactors: Packed- bed, Fluidized-bed and Membrane reactors.

Text Books:
1. Stanbury and Whitaker, Principles ofFermentation Technology, 2nd edition
2. L.E. Cassida.Jr, Industrial Microbiology, New Age International Publisher
3. Prescott's and Dunn's, A. Industrial Microbiology, 4th edition. CBS Publishers, New Dehli, India, 1987

References:
1. Shuler and Kargi, Bioprocess engineering: Basic concepts, 2nd edition, Prentice Hall publisher
2. Bailey &Olis, Biochemical Engineering Fundamentals, MGH.

Web reference:

1. https://onlinecourses.nptel.ac.in/noc18_bt05/announcements?force=true

Course Outcome (CO):
After completion of the course, the student will be able to:

1. **Understand** and **explain** the basic principles of fermentation technology followed by statistical optimization of media components and its downstream processing for purification of the product.
2. **Be familiar** with different mutation techniques **applied** for enhanced metabolite yield.
3. **Apply** the molecular techniques for manipulation of metabolic pathways to **select** the thermostable enzyme with higher activity.
4. **Compare** between different enzyme immobilization techniques and its application as biosensors in industry.
5. **Analysis** of packed bed and membrane reactor data for enzyme catalyzed reaction and use of different plots to **design** appropriate kinetic model

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Course Code	OE-BT491					
Category	Open Elective Course					
Course title	Numerical Methods and Biostatistics Lab					
Scheme and Credits	L	T	P	Cr. Points	Lec. Hrs.	Semester: IV
	0	0	3	1.5	36	
Co-requisites and Pre requisites (if any)	-Numerical Methods and Biostatistics Theory - Knowledge of any Programming language.					

Course Objectives:

This course is an introduction to a broad range of numerical methods for solving mathematical problems that arise in Science and Engineering. The goal is to provide a basic understanding of the derivation, analysis and use of these numerical methods along with a rudimentary understanding of finite precision arithmetic. This will help you choose and apply the appropriate numerical techniques for your problem, interpret the results and assess accuracy.

In Biostatistics course students will learn how to effectively collect data, describe data, and use data to make inferences and conclusions about real world phenomena.

Course Content:

1. Assignments on Newton forward /backward interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule
3. Assignments on numerical solution of a system of linear equations using Gauss elimination and Gauss-Seidel iterations.
4. Assignments on numerical solution of Algebraic Equation by Regular-falsi and Newton Raphson methods.
5. Assignments on ordinary differential equation: Euler's and Runga-Kutta methods.
6. Calculate descriptive statistics and draw different type of graphs.

Text Books:
1. Computer Oriented Numerical Methods, R.S. Salaria, Khanna Publishing House
2. Numerical Methods and Programming: Bikash Chandra Bhui & Dipak Chatterjee.
3. Numerical Methods Theory and Practical: K Das
4. Introduction to Biostatistics: Dr. Pranab Kumar Banerjee
5. Statistical Methods: N.G. Das

References:
1. Balagurusamy: Numerical Methods, McGraw Hill

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2. Baburam: Numerical Methods, Pearson Education.
3. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.
4.Rastogi V. B: Fundamental of Biostatistics
5. Harvey Motulsky: Essential Biostatistics

Course Outcomes:

After completion of the course, the student will be able to:

Demonstrate understanding and implementation of numerical solution algorithms applied to the

1. **Code** a numerical method in a modern computer language.
2. **Select** appropriate numerical methods to apply to various types of problems in engineering and science inconsideration of the mathematical operations involved, accuracy requirements and available computational resources.
3. **Demonstrate** understanding and implementation of numerical solution algorithms applied to the course content.
4. **Make** appropriate use of statistical software.
5. **Analyze** quantitative and qualitative data using biostatistical methods and software.
6. **Communicate** the results of statistical analyses accurately and effectively.

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Course Code	**OE-BT492**				
Category	**Open Elective Course**				
Course title	**Data Structure and Algorithms Lab**				
Scheme and Credits	**L**	**T**	**P**	**Cr. Points**	**Lec. Hrs.**	**Semester: IV**
	0	**0**	**3**	**1.5**		
Pre-requisites/Co-requisites (if any)	- **Numerical Methods**				

Course Objective:

The objectives of the course are:

1. To understand the application of different types of data structures for programming at the end of the course.
2. To distinguish the sorting with searching in IT industry.

Course Content:

Implementation of Array Operations: (using C/C++ languages)
Stacks and Queues: Adding, Deleting elements, Circular Queue: Adding and Deleting elements.
Implementation of linked lists: Inserting, Deleting ,
Sorting and Searching Algorithms,
Prim's, Kruskal's and Dijkstra's Algorithm.
Implementing Breadth first search (BFS) and Depth first search (DFS).

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. **Define** different operations on data structure such as insertion, deletion, merging using arrays.
2. **Demonstrate** implementation of stacks and queues: insertion, deletion of elements, circular queue: insertion, deletion of elements using array.
3. **Construction and implementation** of linked lists: inserting, deleting and traversal
4. **Analyze** implementation of stacks & queues using linked lists.
5. **Implementation** of binary tree traversal.
6. **Design and implement** of different searching and sorting algorithms.

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Course Code	**ES-BT491**					
Category	**Engineering Science**					
Course title	**Transfer Operation I Lab**					
Scheme and Credits	**L**	**T**	**P**	**Cr. Points**	**Lec. Hrs.**	**Semester: IV**
	0	**0**	**3**	**1.5**	**36**	
Pre-requisites/Co-requisites (if any)	**Transfer Operation I Theory**					

Course Objective:

1. To explore the fundamental principles of fluid mechanics through experimentation.
2. To learn the fundamental principles of operation of grinding equipments.
3. To train the students practically to utilize the knowledge of various heat transfer processes.

Course content:

1. Experiments on Reynold's Apparatus-Determination of flow regime.
2. Experiments on flow measuring devices in closed conduit using (a) Venturi meter, (b) Orifice meter and (c) Rotameter.
3. Determination of Pressure drop for flow through packed bed & verification of Ergun Equation.
4. To study the working characteristics of a Hammer Mill.
5. To study the working characteristics of a Ball Mill.
6. Determination of thermal conductivity of a metal bar using Fourier's equation.
7. To Determine the Overall heat transfer coefficient of a concentric pipe heat exchanger based on the inside diameter of the tube.

Course Outcome (CO):

After successful completion of this course, the student will be able to:

1. **Identify**, name, and characterize different flow patterns and regimes.
2. **Understand** the operations of various types of flowmeters used to measure the internal flow, & their applications.
3. **Understand** the performance and calculation of a packed beds and their application in chemical/biochemical industries.
4. **Explain** the working characteristics of Ball Mill and Hammer Mill, their application and calculation related with their performance.
5. **Estimate** the thermal conductivity of a metal bar and its importance in heat flow.
6. **Understand** the performance difference of a concentric pipe heat exchanger operating under various flow patterns.

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Course Code	PC-BT491					
Category	Professional Core					
Course title	Molecular Biology Lab					
Scheme and Credits	L	T	P	Cr. Points	Lecs. Hrs.	Semester: IV
	0	0	3	1.5	36	
Pre-requisites/Co-requisites (if any)	- Chemistry (10 + 2 level) - Biochemistry - Molecular Biology					

Course Objective:

- The Course is helpful for the students with theoretical knowledge on Molecular Biology making them familiar with the conventional isolation techniques of genetic materials. Based on it, the course teaches them to isolate and estimate DNA, RNA, plasmids etc.

- Apart from that, it trains the students with basic principles of autoclaving, gel electrophoresis, working with various genetic materials, like RNA, DNA, plasmid and enzymes like DNAse, mutagens etc.

- This course paves the pathway for building confidence among the students to work independently in various summer training programes and B.Tech level research projects of higher semesters.

COURSE CONTENT:

1. Spectroscopic analysis of DNA/RNA
2. Isolation of Genomic DNA from blood, plant cell and bacteria (any one)
3. Isolation of RNA
4. Isolation of Plasmids
5. Preparation of Agarose Gel and electrophoresis
6. Formaldehyde gel electrophoresis of RNA
7. Induced mutation by: Chemical agent
8. Induced mutation by physical agent like Ultraviolet light
9. Mini Project: Relevant to the techniques taught

Books:

Molecular Cloning: A Laboratory Manual by Russel and Sambrook (2001)