JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD

B.TECH. CHEMICAL ENGINEERING

II YEAR II SEMESTER
COURSE STRUCTURE

Subject	T	P	C
Probability and Statistics	4+1*	0	4
Process Heat Transfer	4+1*	0	4
Object Oriented Programming	4+1*	0	4
Organic Chemistry	4+1*	0	4
Chemical Engineering Thermodynamics-I	4+1*	0	4
Mechanical Unit Operations	4+1*	0	4
Object Oriented Programming Lab	0	3	2
Mechanical Unit Operations Lab	0	3	2
Total	30	6	28

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PROBABILITY AND STATISTICS

UNIT-I

Probability: Sample space and events – Probability – The axioms of probability – Some
Elementary theorems - Conditional probability – Baye's theorem.

UNIT-II

Random variables – Discrete and continuous – Distribution – Distribution function. Distribution

UNIT-III

Binomial and poison distributions Normal distribution – related properties.

UNIT-IV

Sampling distribution: Populations and samples - Sampling distributions of mean (known and unknown) proportions, sums and differences.

UNIT-V

Estimation: Point estimation – interval estimation - Bayesian estimation.

UNIT-VI

Test of Hypothesis – Means– Hypothesis concerning one and two means– Type I and Type II errors. One tail, two-tail tests.

UNIT-VII

Tests of significance – Student's t-test, F-test, χ^2 test. Estimation of proportions.

UNIT-VIII

Queuing Theory: Pure Birth and Death Process M/M/1 Model and Simple Problems.

Text Books:
1. Probability & Statistics, T. K. V. Iyengar, B. Krishna Gandhi and Others, S. Chand & Company.
2. A text book of Probability & Statistics, Shahnaz Bathul, V. G. S. Book Links.

References:
1. Probability & Statistics, Arnold O. Allen, Academic Press.
2. Probability & Statistics for Engineers, Miller and John E. Freund, Prentice Hall of India.
3. Probability & Statistics, Mendan Hall, Beaver Thomson Publishers.
4. Probability & Statistics, D. K. Murugeson & P. Guru Swamy, Anuradha Publishers.

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PROCESS HEAT TRANSFER

UNIT I

Introduction

Nature of heat flow, conduction, convection, natural and forced convection, radiation.

Heat transfer by conduction in Solids

Fourier's law , thermal conductivity, steady state conduction in plane wall & composite walls, compound resistances in series, heat flow through a cylinder, conduction in spheres, thermal contact resistance, plane wall: variable conductivity

Unsteady state heat conduction

Equation for one-dimensional conduction, Semi-infinite solid, finite solid.

Unit- II:

Principles of heat flow in fluids

Typical heat exchange equipment, countercurrent and parallel current flows, energy balances, rate of heat transfer, overall heat transfer coefficient, electrical analogy, critical radius of insulation, logarithmic mean temperature difference, variable overall coefficient, multi-pass exchangers, individual heat transfer coefficients, resistance form of overall coefficient, fouling factors, classification of individual heat transfer coefficients, magnitudes of heat transfer coefficients, effective coefficients for unsteady-state heat transfer.

Unit- III:

Heat Transfer to Fluids without Phase change

Regimes of heat transfer in fluids, thermal boundary layer, heat transfer by forced convection in laminar flow, heat transfer by forced convection in turbulent flow, the transfer of heat by turbulent eddies and analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes.

Unit- IV:

Natural convection

Natural convection to air from vertical shapes and horizontal planes, effect of natural convection in laminar-flow heat transfer, free convection in enclosed spaces, mixed free & forced convection.

Unit- V:

Heat transfer to fluids with phase change

Heat transfer from condensing vapors, heat transfer to boiling liquids.

Unit VI:

Heat exchange equipment

General design of heat exchange equipment, heat exchangers, condensers, boilers and calendrias, extended surface equipment, heat transfer in agitated vessels, scraped surface heat exchangers, heat transfer in packed beds, heat exchanger effectiveness (NTU method)

Unit VII:

Evaporators

Evaporators, performance of tubular evaporators, capacity and economy, multiple effect evaporators, vapor recompression.

Unit- VIII:

Radiation

Introduction, properties and definitions, black body radiation, real surfaces and the gray body, absorption of radiation by opaque solids, radiation between surfaces, radiation shielding, radiation to semi transparent materials, combined heat transfer by conduction, convection and radiation.

TEXT BOOKS

1. Unit Operations of Chemical Engineering by McCabe, Smith and Peter Harriot, McGraw-Hill 5th edition 1993

REFERENCES
1. Process heat transfer D.Q.Kern, McGraw-Hill
2. Heat Transfer by J.P.Holman
3. Y.V.C.Rao, Heat Transfer, University Press.
4 Heat transfer-Schaum's series, McGraw-Hill publications
5. Chemical Engineering, Vol-I, Coulson and Richardson
6. Transport processes and Unit operations, Christie J. Geankoplis, PHI

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OBJECT ORIENTED PROGRAMMING

UNIT-I
Object oriented thinking :- Need for oop paradigm, A way of viewing world – Agents, responsibility, messages, methods, classes and instances, class hierarchies (Inheritance), method binding, overriding and exceptions, summary of oop concepts, coping with complexity, abstraction mechanisms.

UNIT-II:-
Java Basics History of Java, Java buzzwords, datatypes, variables, scope and life time of variables, arrays, operators, expressions, control statements, type conversion and costing, simple java program, classes and objects – concepts of classes, objects, constructors, methods, access control, this keyword, garbage collection, overloading methods and constructors, parameter passing, recursion, string handling.

UNIT-III:-
Inheritance – Hierarchical abstractions, Base class object, subclass, subtype, substitutability, forms of inheritance- specialization, specification, construction, extension, limitation, combination, benefits of inheritance, costs of inheritance. Member access rules, super uses, using final with inheritance, polymorphism- method overriding, abstract classes.

UNIT-IV:-
Packages and Interfaces : Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, differences between classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces.
Exploring packages – Java.io, java.util.

UNIT-V:-
Exception handling and multithreading - Concepts of exception handling, benefits of exception handling, Termination or resumptive models, exception hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception sub classes.
Differences between multi threading and multitasking, thread life cycle, creating threads, synchronizing threads, daemon threads, thread groups.

UNIT-VI:-
Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes, inner classes.
The AWT class hierarchy, user interface components- labels, button, canvas, scrollbars, text components, check box, check box groups, choices, lists panels – scrollpane, dialogs, menubar, graphics, layout manager – layout manager types – boarder, grid, flow, card and grib bag.

UNIT-VII:-

Applets – Concepts of Applets, differences between applets and applications,life cycle of an applet, types of applets, creating applets, passing parameters to applets.

Swing – Introduction, limitations of AWT, MVC architecture, components, containers, exploring swing- JApplet, JFrame and JComponent, Icons and Labels, text fields, buttons – The JButton class, Check boxes, Radio buttons, Combo boxes, Tabbed Panes, Scroll Panes, Trees, and Tables.

UNIT-VIII:-

Networking – Basics of network programming, addresses, ports, sockets, simple client server program, multiple clients, Java .net package
Packages – java.util,

TEXT BOOKS :

1. Java; the complete reference, 7th editon, Herbert schildt, TMH.
2. Understanding OOP with Java, updated edition, T. Budd, pearson eduction.

REFERENCES :

1. An Introduction to programming and OO design using Java, J.Nino and F.A. Hosch, John wiley & sons.
2. An Introduction to OOP, second edition, T. Budd, pearson education
3. Introduction to Java programming 6th edition, Y. Daniel Liang, pearson education
4. An introduction to Java programming and object oriented application development, R.A. Johnson- Thomson.
5. Core Java 2, Vol 1, Fundamentals, Cay.S.Horstmann and Gary Cornell, seventh Edition, Pearson Education.
6. Core Java 2, Vol 2, Advanced Features, Cay.S.Horstmann and Gary Cornell, Seventh Edition, Pearson Education

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ORGANIC CHEMISTRY

UNIT I:
Polar effects – Inductive effect, electromeric effect, resonance, Hyper conjugation, steric inhibition of resonance – examples.

UNIT II:
Electrophilic reactions: a) Friedel-Craft reaction b) Riemer- Teimenn Reaction c) Backmann rearrangement.

UNIT –III:
Nucleophillic reaction : a) Aldol condensation b) Perkin Reaction c) Benzoin condensation.

UNIT – IV:

1. Free radical reaction a) Halogenation of Alkane b) Addition of HBr to Alkene in the presence of peroxide.
2. Allylic halogenation Using N-Bromo succinamide (NBS) 3) Thermal halogenation of Alkanes.

UNIT – V:

Stereo isomerism; Optical isomerism; Symmetry and chirality; Optical isomerism in lactic acid and tartaric acid; Sequence rules; Enantiomers, diastereomers; Geometrical Isomerism; E-Z system of nomenclature, conformational analysis of ethane and Cyclohexane.

UNIT – VI:

Polymerization Reactions – Basic concepts. Types of Polymerization – Addtion and Condensation Polymerizations. Plastics- Thermosetting and Thermoplastics - Differences. Compounding, Moulding of Plastics- Compression, injection, transfer, and Extrusion molding methods. Preparation, Properties and Engineering use of the Following: Polyethylene, PVC, Teflon, Bekelite, Nylon, Polyster, Polyurethane and Silicone Resins, Rubber - Procesing of Natural Rubber, Vulcanization and Compunding. Elastomers-Buna S, Buna N, Thiokol, Polyurethane Rubber.

UNIT – VII

Heterocyclic compounds and Nomenclature: Preparation, Properties and uses of (1) Pyrrole (2) Furan (3) Thiophene (4) Pyridine (5) Quinoline (6) Iso-quinoline.

UNIT – VIII

Dyes - Colour and Constituion ; Classification of Dyes, Preparation and uses of (1) Malachite green (2) Rosaniline (3) Congored (4) Bismark brown (5) Flroroscien.

TEXTBOOKS:
1. Text book of Organic chemistry – Ferguson, LN EAST – Westpress.
2. Text book of Organic Chemistry – Morrsion and Boyd.

REFERENCES:
1. Polymer Science – Gaurikar and others.
2. Reaction mechanism – Peter Skyes.
3. Text book of Organic Chemistry – R.K. Bansal.
4. Text book of Organic Chemistry – P.L. Soni.
5. Organic Chemistry Vol- I-IL. Finar.
6. Reactions and Reagents – O.P. Agrawal.
7. Intermediates of Organic Synthesis by V.K. Ahulwalia, Pooja Bhagat, Renu Aggrwal, Ramesh Chandra, I.K. International Publishing House Pvt. Ltd.

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CHEMICAL ENGINEERING THERMODYNAMICS-I

UNIT I
Introduction: The scope of thermodynamics, temperature, defined quantities; volume, pressure, work, energy, heat, Joules Experiments.

Unit-II:
The first law and other basic concepts: The first law of thermodynamics, thermodynamic state and state functions, enthalpy, the steady-state steady-flow process, equilibrium, the phase rule, the reversible process, constant-V and constant- P processes, heat capacity.

Unit-III:
Volumetric properties of pure fluids: The PVT behavior of pure substances, virial equations, the ideal gas, the applications of the virial equations, second virial coefficients from potential functions. Cubic equations of state, generalized correlations for gases, generalized correlations for liquids, molecular theory of fluids.

Unit-IV:
Thermodynamics of flow processes ; principles of conservation of mass and energy for flow systems, analysis of expansion processes ; turbines, throttling ; compression processes –compressors and pumps ; calculation of ideal work and lost work.

Unit-V:
The second law of thermodynamics: Statements of the second law, heat engines, thermodynamic temperatures scales, thermodynamic temperature and the ideal gas scale

Unit-VI:
Entropy, Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics, entropy from the microscopic view point

Unit-VII:
Refrigeration and liquefaction: The Carnot refrigerator, the vapor compression cycle, the comparison of refrigeration cycles, the choice of refrigerant, absorption refrigeration, the heat pump, liquefaction processes

Unit-VIII:
Thermodynamic properties of fluids: Property relations for homogeneous phases, residual properties, two phase systems, thermodynamic diagrams, tables of thermodynamic properties, generalized property correlation for gases

TEXT BOOKS
1. J.M.Smith and HC Van Ness, Introduction to Chemical Engineering Thermodynamics, 5th ed, McGraw Hill,1996.

REFERENCE
1. Y.V. C.Rao, Chemical Engineering Thermodynamics, University publications.
2. K. V. Narayanan, Chemical Engineering Thermodynamics, PHI,2001
3. Chemical and Process Thermodynamics, B.G. Kyle, 3rd edition, Pearson, Prentice Hall, 1999

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MECHANICAL UNIT OPERATIONS

Unit-I:
Properties, handling and mixing of particulate solids: Characterization of solid particles, properties of particulate masses, storage and mixing of solids, types of mixers, mixers for cohesive solids, mixers for free flowing solids.

Unit-II:
Transportation of solid particulate mass, belt, screw, apron conveyers, bucket elevators, pneumatic conveying

Unit-III:
Size reduction: Principles of comminution, computer simulation of milling operations, size reduction equipment-crushers, grinders, ultra fine grinders, cutting machines, Equipment operation.

Unit–IV:
Screening, Industrial screening equipments, Filtration, cake filters, centrifugal filters,

Unit–V:
Principles of cake filtration. Clarifying filters, liquid clarification, gas cleaning, principles of clarification.
Cross flow filtration, types of membranes, permeate flux for ultra-filtration, Concentration polarization, particle rejection of solutes

Unit-VI:
Micro filtration, Separations based on motion of particles through fluids, gravity settling processes and centrifugal settling processes, float and sink method, differential settling, coagulation, Flotation-separation of ores, flotation agents

Unit -VII:
Agitation and mixing of liquids: Agitation of liquids, circulation velocities, power consumption in agitated vessels. Blending and mixing of liquids, suspension of solid particles, dispersion operations.

Unit-VIII:
Crystallization: crystal geometry, principles of crystallization equilibria and yields, nucleation, crystal growth,

Text book:
1. Unit Operations in Chemical Engineering by W.L. McCabe and J.C. Smith and Peter Harriott, Mc Graw Hill 5th ed. 1993.

REFERENCES:
1. Chemical engineers hand book, J.H. Perry, 7th ed. Mc Graw Hill
2.Introduction to Chemical Engineering by J.T.Banchero & W.L.
   Badger.,TMH,1997.
3. Unit Operations by Foust et.al

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OBJECT ORIENTED PROGRAMMING LAB

Objectives:
1. To make the student learn a object oriented way of solving problems.
2. To teach the student to write programs in Java to solve the problems

Recommended Systems/Software Requirements:
(1) Intel based desktop PC with minimum of 166 MHZ or faster processor with atleast 64 MB RAM and 100 MB free disk space
(2) JDK Kit. Recommended

Week1
a) Write a Java program that prints all real solutions to the quadratic equation $ax^2 + bx + c = 0$. Read in a, b, c and use the quadratic formula. If the discriminant $b^2 - 4ac$ is negative, display a message stating that there are no real solutions.
b) The Fibonacci sequence is defined by the following rule:
   The fist two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that uses both recursive and non
   recursive functions to print the nth value in the Fibonacci sequence.

Week 2
a) Write a Java program that prompts the user for an integer and then prints out all prime numbers up to that. integer.
b) Write a Java program to multiply two given matrices.
c) Write a Java Program that reads a line of integers, and then displays each integer, and the sum of all the integers (Use StringTokenizer class of java.util)

Week 3
a) Write a Java program that checks whether a given string is a palindrome or not.
   Ex: MADAM is a palindrome.
b) Write a Java program for sorting a given list of names in ascending order.
c) Write a Java program to make frequency count of words in a given text.

Week 4
a) Write a Java program that reads a file name from the user, then displays information
   about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes.
b) Write a Java program that reads a file and displays the file on the screen, with a line
   number before each line.
c) Write a Java program that displays the number of characters, lines and words in a text file.

Week 5
a) Write a Java program that:
i) Implements stack ADT. ii) Converts infix expression into Postfix form iii) Evaluates the postfix expression

Week 6
 a) Develop an applet that displays a simple message.
 b) Develop an applet that receives an integer in one text field, and computes its factorial value and returns it in another text field, when the button named "Compute" is clicked.

Week 7
a) Write a Java program that works as a simple calculator. Use a grid layout to arrange
   buttons for the digits and for the +, -,*, % operations. Add a text field to display the
   result.

Week 8
a) Write a Java program for handling mouse events.

Week 9

a)Write a Java program that creates three threads. First thread displays "Good Morning" every one second, the second thread displays "Hello" every two seconds and the third   thread displays "Welcome" every three seconds.

b)Write a Java program that correctly implements producer consumer problem using the concept of inter thread communication.

Week 10

a)Write a program that creates a user interface to perform integer divisions. The user
  enters two numbers in the textfields, Num1 and Num2. The division of Num1 and
  Num2 is displayed in the Result field when the Divide button is clicked. If Num1 or
  Num2 were not an integer, the program would throw a NumberFormatException. If
  Num2 were Zero, the program would throw an ArithmeticException Display the
  exception in a message dialog box.

Week 11

a)Write a Java program that implements a simple client/server application. The client
  sends data to a server. The server receives the data, uses it to produce a result, and
  then sends the result back to the client. The client displays the result on the console.
  For ex: The data sent from the client is the radius of a circle, and the result produced   by the server is the area of the circle. (Use java.net)

Week 12

a)Write a java program that simulates a traffic light. The program lets the user select one of three lights : red, yellow, or green. When a radio button is selected, the light is
  turned on, and only one light can be on at a time No light is on when the program
  starts.

b)Write a Java program that allows the user to draw lines, rectangles and ovals.

Week 13

a)Write a java program to create an abstract class named Shape that contains an empty method named numberOfSides ( ).Provide three classes named Trapezoid, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method numberOfSides ( ) that shows the number of sides in the given geometrical figures.

b) Suppose that a table named Table.txt is stored in a text file. The first line in the file is the header, and the remaining lines correspond to rows in the table. The elements are seperated by commas. Write a java program to display the table using JTable
  component.

TEXT BOOKS :
  1.   Java How to Program, Sixth Edition, H.M.Dietel and P.J.Dietel, Pearson
       Education/PHI
  2.   Introduction to Java programming, Sixth edition, Y.Daniel Liang, Pearson Education
  3.   Big Java, 2nd edition, Cay Horstmann, Wiley Student Edition, Wiley India Private Limited.

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MECHANICAL UNIT OPERATION LAB

1. To determine the time of grinding in a ball mill for producing a product with 80 % passing a given screen.
   Major equipment - Ball mill Apparatus, Sieve shaker, Different sizes of sieves, weighing balance

2. To verify the laws of crushing using any size reduction equipment like crushing rolls or vibrating mills and to find out the working index of the material.
   Major equipment – Jaw Crusher, Sieve shaker, Different sizes of sieves, Weighing Balance, Energy meter

3. To find the effectiveness of hand screening of a given sample by a given screen.
   Major equipment - Vibrating Sieve shaker, Different sizes of sieves, Weighing Balance

4. To separate a mixture of oil into two fractions using froth flotation technique.
   Major equipment - Froth flotation cell

5. To obtain batch sedimentation data and to calculate the minimum thickener area under given conditions.
   Major equipment- Sedimentation apparatus

6. To determine the specific cake resistance and filter medium resistance of a slurry in plate and frame filter press.
   Major equipment - Plate and Frame filter press.

7. To separate a mixture of particles by Jigging.
   Major equipment - Jigging apparatus

8. Studies on cyclone separator.
   Major equipment - Cyclone separator

9. Studies on pulverizer.
   Major equipment - Pulverizer

10. Verification of Stoke's law.
    Major equipment – Stoke's law apparatus

11. Grinding studies on hard/ soft materials.
    Major equipment - Grinder