2007-2008

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
KAKINADA

B.TECH. CHEMICAL ENGINEERING

I YEAR
COURSE STRUCTURE

	Subject		**T**	**P**	**C**
	English		2+1*	0	4
	Mathematics-I		3+1*	0	6
	Engineering Physics		2+1*	0	4
	Classical Mechanics		2+1*	0	4
	Physical Chemistry			2+1*	0
4					
	C Programming and Data Structures	3+1*	0	6	
	Introduction to Chemical Engineering		2+1*	0	4
	Engineering Graphics		0	6	8
	Computer Programming Lab		0	3	4
	Chemistry Lab		0	3	4
	English Language Communication Skills Lab		0	3	4
	Engineering Work Shop Practice		0	3	4
	Total		23	18	56

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B.TECH. CHEMICAL ENGINEERING

II YEAR I semester

COURSE STRUCTURE

Subject	T	P	C
Mathematics-II	4+1*	0	4
Electrical Engineering	4+1*	0	4
Momentum Transfer	4+1*	0	4
Environmental Studies	4+1*	0	4
Analytical Chemistry	4+1*	0	4
Chemical Process Calculations	4+1*	0	4
Momentum Transfer Lab	0	3	2
Analytical Chemistry Lab	0	3	2
Total	30	6	28

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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III YEAR I SEMESTER
COURSE STRUCTURE

Subject		T	P	C
Data Base management Systems		4+1*	0	4
Material Science for Chemical Engineers		4+1*	0	4
Chemical Engineering Thermodynamics-II		4+1*	0	4
Chemical Reaction Engineering-I		4+1*	0	4
Mass Transfer Operations-I		4+1*	0	4
Process Instrumentation		4+1*	0	4
Advanced English Communication Skills Lab	0	3	2	
Process Heat Transfer Lab	0	3	2	
Total		30	6	28

III YEAR II SEMESTER
COURSE STRUCTURE

Subject	T	P	C
Management Science	4+1*	0	4
Chemical Technology	4+1*	0	4
Mass Transfer Operations – II	4+1*	0	4
Chemical Reaction Engineering-II	4+1*	0	4
Process Dynamics and Control	4+1*	0	4
Biochemical Engineering	4+1*	0	4
Chemical Reaction Engineering Lab	0	3	2
Mass Transfer Operations Lab	0	3	2
Total	30	6	28

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B.TECH. CHEMICAL ENGINEERING

IV YEAR I SEMESTER
COURSE STRUCTURE

Subject	T	P	C
Transport Phenomena	4+1*	0	4
Chemical Engineering Plant Design and Economics	4+1*	0	4
Chemical Process Equipment Design	4+1*	0	4
Process Modeling and Simulation	4+1*	0	4
Elective - I	4+1*	0	4
Advanced Data Structures and Algorithms			
Polymer Technology			
Petroleum and Petro-Chemical Technology			
Fluidization Engineering			
Elective-II	4+1*	0	4
Membrane Technology			
Industrial Biotechnology			
Unix and Shell Programming			
Chemical Engineering Mathematics			
Process Dynamics and Control Lab	0	3	2
Simulation Lab	0	3	2
Total	30	6	28

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B.TECH. CHEMICAL ENGINEERING

IV YEAR II SEMESTER
COURSE STRUCTURE

Subject		T	P	C
Industrial Pollution Control Engineering		4+1*	0	4
Elective-III		4+1*	0	4
Industrial Safety and Hazard Management				
Design and Analysis of Experiments				
Technology of Pharmaceuticals and Fine Chemicals				
Computer Organization				
Elective – IV		4+1*	0	4
Optimization of Chemical Processes				
Operations Research				
Energy Engineering				
Operating Systems				
Industry Oriented Mini Project		0	0	2
Seminar	0	0	2	
Project Work		0	0	10
Comprehensive Viva		0	0	2
Total		15	0	28

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I Year B.Tech. Ch.E	**T**	**P**	**C**
	2+1*	**0**	**4**

ENGLISH

1. INTRODUCTION :

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire communicative competence, the syllabus has been designed to develop linguistic and communicative competence of Engineering students. The prescribed books and the exercises are meant to serve broadly as students' handbooks.

In the English classes, the focus should be on the skills of reading, writing, listening and speaking and for this the teachers should use the text prescribed for detailed study. For example, the students should be encouraged to read the texts/selected paragraphs silently. The teachers can ask comprehension questions to stimulate discussion and based on the discussions students can be made to write short paragraphs/essays etc.

The text for non-detailed study is for extensive reading/reading for pleasure by the students. Hence, it is suggested that they read it on their own with topics selected for discussion in the class. The time should be utilized for working out the exercises given after each section , as also for supplementing the exercises with authentic materials of a similar kind for example, from newspaper articles, advertisements, promotional material etc.. *However, the stress in this syllabus is on skill development and practice of language skills.*

2. OBJECTIVES:

a. To improve the language proficiency of the students in English with emphasis on LSRW skills.
b. To equip the students to study academic subjects with greater facility through the theoretical and practical components of the English syllabus.
c. To develop the study skills and communication skills in formal and informal situations.

3. SYLLABUS :

Listening Skills:

Objectives

1. To enable students to develop their listening skill so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation
2. To equip students with necessary training in listening so that can comprehend the speech of people of different backgrounds and regions

Students should be given practice in listening to the sounds of the language to be able to recognise them, to distinguish between them to mark stress and recognise and use the right intonation in sentences.

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills :

Objectives

1. To make students aware of the role of speaking in English and its contribution to their success.
2. To enable students to express themselves fluently and appropriately in social and professional contexts.

- Oral practice
- Describing objects/situations/people
- Role play – Individual/Group activities (Using exercises from all the nine units of the prescribed text: *Learning English : A Communicative Approach*.)
- Just A Minute(JAM) Sessions.

Reading Skills:

Objectives

1. To develop an awareness in the students about the significance of silent reading and comprehension.
2. To develop the ability of students to guess the meanings of words from context and grasp the overall message of the text, draw inferences etc.

- Skimming the text

- Understanding the gist of an argument
- Identifying the topic sentence
- Inferring lexical and contextual meaning
- Understanding discourse features
- Recognizing coherence/sequencing of sentences

NOTE : *The students will be trained in reading skills using the prescribed text for detailed study. They will be examined in reading and answering questions using 'unseen' passages which may be taken from the non-detailed text or other authentic texts, such as magazines/newspaper articles.*

Writing Skills :

Objectives

1. To develop an awareness in the students about writing as an exact and formal skill
2. To equip them with the components of different forms of writing, beginning with the lower order ones.

- Writing sentences
- Use of appropriate vocabulary
- Paragraph writing
- Coherence and cohesiveness
- Narration / description
- Note Making
- Formal and informal letter writing
- Editing a passage

4. TEXTBOOKS PRESCRIBED:

In order to improve the proficiency of the student in the acquisition of the four skills mentioned above, the following texts and course content, divided into **Eight Units**, are prescribed:

For Detailed study

1. **LEARNING ENGLISH:** ***A Communicative Approach***, KAKINADA: Orient Longman, 2006. (Six Selected Lessons)

For Non-detailed study

2. **WINGS OF FIRE:** ***An Autobiography – APJ Abdul Kalam***, Abridged version with Exercises, Universities Press (India) Pvt. Ltd., 2004.

A. STUDY MATERIAL:

Unit –I

1. Astronomy from LEARNING ENGLISH: *A Communicative Approach,* Orient Longman, 2005.
2. Chapters 1-4 **from** Wings of Fire**:** An Autobiography **– APJ Abdul Kalam, an abridged version with Exercises, Universities Press (India) Pvt. Ltd.,2004**

Unit –II

3. Information Technology **from** LEARNING ENGLISH: *A Communicative Approach,* **Orient Longman, 2005.**
4. Chapters 5-8 **from** Wings of Fire**:** An Autobiography **– APJ Abdul Kalam, an abridged version with Exercises, Universities Press (India) Pvt. Ltd.,2004**

Unit –III

5. Humour **from** LEARNING ENGLISH: *A Communicative Approach,* **Orient Longman, 2005.**
6. Chapters 9-12 **from** Wings of Fire**:** An Autobiography **– APJ Abdul Kalam, an abridged version with Exercises., Universities Press (India) Pvt. Ltd.,2004**

Unit –IV

7. Environment **from** LEARNING ENGLISH: *A Communicative Approach,* **Orient Longman, 2005.**
8. Chapters 13-16 **from** Wings of Fire**:** An Autobiography **– APJ Abdul Kalam, an abridged version with Exercises, Universities Press (India) Pvt. Ltd.,2004**

Unit –V

9. Inspiration **from** LEARNING ENGLISH: *A Communicative Approach,* **Orient Longman, 2005.**
10. Chapters 17-20 **from** Wings of Fire**:** An Autobiography **– APJ Abdul Kalam, an abridged version with Exercises, Universities Press (India) Pvt. Ltd.,2004.**

Unit – VI

11. Human Interest **from** LEARNING ENGLISH: *A Communicative Approach,* **Orient Longman, 2005.**
12. Chapters 21-24 **from** Wings of Fire**:** An Autobiography **– APJ Abdul Kalam, an abridged version with Exercises, Universities Press (India) Pvt. Ltd., 2004.**

* Exercises from the lessons not prescribed shall also be used for classroom tasks.

Unit – VII

Exercises on

Reading and Writing Skills
Reading Comprehension
Situational dialogues
Letter writing
Essay writing

Unit – VIII

Practice Exercises on Remedial Grammar covering

Common errors in English, Subject-Verb agreement, Use of Articles and Prepositions, Tense and aspect

Vocabulary development covering

Synonyms & Antonyms, one-word substitutes, prefixes & suffixes, Idioms & phrases, words often confused.

REFERENCES :

1. **Strengthen Your English,** Bhaskaran & Horsburgh, Oxford University Press
2. **Basic Communication Skills for Technology**, Andrea J Rutherfoord, Pearson Education Asia.
3. **Murphy's English Grammar with CD,** Murphy, Cambridge University Press
4. **English Skills for Technical Students** by Orient Longman
5. **Everyday Dialogues in English** by Robert J. Dixson, Prentice-Hall of India Ltd., 2006.
6. **English For Technical Communication**, Vol. 1 & 2, by K. R. Lakshmi Narayanan, Sci tech. Publications.
7. **A Hand book of English for Engineers & Technologists** by Dr. P. Eliah, B. S. Publications.
8. **Developing Communication Skills** by Krishna Mohan & Meera Benerji (Macmillan)
9. **Speaking and Writing for Effective Business Communication,** Francis Soundararaj, MacMillan India Ltd., 2007.
10. **The Oxford Guide to Writing and Speaking,** John Seely, Oxford

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I Year B.Tech. Ch.E	**T**	**P**	**C**
	3+1*	**0**	**6**

MATHEMATICS – I

UNIT – I
Differential equations of first order and first degree – exact, linear and Bernoulli. Applications to Newton's Law of cooling, Law of natural growth and decay, orthogonal trajectories.

UNIT – II
Non-homogeneous linear differential equations of second and higher order with constant coefficients with RHS term of the type e^{ax} , Sin ax, cos ax, polynomials in x, e^{ax} V(x), xV(x), method of variation of parameters.

UNIT – III
Rolle's Theorem – Lagrange's Mean Value Theorem – Cauchy's mean value Theorem – Generalized Mean Value theorem (all theorems without proof) Functions of several variables – Functional dependence- Jacobian- Maxima and Minima of functions of two variables with constraints and without constraints

UNIT – IV
Radius, Centre and Circle of Curvature – Evolutes and Envelopes Curve tracing – Cartesian , polar and Parametric curves.

UNIT – V
Applications of integration to lengths, volumes and surface areas in Cartesian and polar coordinates multiple integrals - double and triple integrals – change of variables – change of order of integration.

UNIT – VI
Sequences – series – Convergences and divergence – Ratio test – Comparison test – Integral test – Cauchy's root test – Raabe's test – Absolute and conditional convergence

UNIT – VII
Vector Calculus: Gradient- Divergence- Curl and their related properties of sums- products- Laplacian and second order operators. Vector Integration - Line integral – work done – Potential function – area- surface and volume integrals Vector integral theorems: Green's theorem-Stoke's and Gauss's Divergence Theorem (With out proof). Verification of Green's - Stoke's and Gauss's Theorems.

UNIT – VIII
Laplace transform of standard functions – Inverse transform – first shifting Theorem, Transforms of derivatives and integrals – Unit step function – second shifting theorem – Dirac's delta function – Convolution theorem – Periodic function - Differentiation and integration of transforms-Application of Laplace transforms to ordinary differential equations Partial fractions-Heaviside's Partial fraction expansion theorem.

Text Books:

1. A text Book of Engineering Mathematics, Vol-1 T. K. V. Iyengar, B. Krishna Gandhi and Others, S. Chand & Company.
2. A text Book of Engineering Mathematics, C. Sankaraiah, V. G. S. Book Links.
3. A text Book of Engineering Mathematics, Shahnaz Bathul, Right Publishers.
4. A text Book of Engineering Mathematics, P. Nageshwara Rao, Y. Narasimhulu & N. Prabhakar Rao, Deepthi Publications.

References:

1. A text Book of Engineering Mathematics, B. V. Raman, Tata Mc Graw Hill.
2. Advanced Engineering Mathematics, Irvin Kreyszig, Wiley India Pvt. Ltd.
3. A text Book of Engineering Mathematics, Thamson Book Collection.

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ENGINEERING PHYSICS

UNIT I

OPTICS : Interference - Superposition of waves - Young's double slit experiment – Coherence - Interference in thin films by reflection - Newton's rings - Diffraction - Fressnel and Fraunhofer diffractions - Fraunhofer diffraction at a Single slit – Double slit - Diffraction grating - Grating spectrum - Resolving power of a grating - Rayleigh's criterion for resolving power – Polarization - Types of Polarization – Double refraction – Nicol prism.

UNIT II

ULTRASONICS : Introduction - Production of ultrasonic waves - Magnetostriction method – Piezo electric method - Detection of ultrasonic waves - Properties of ultrasonic waves - Use of ultrasonics for nondestructive testing - Applications of ultrasonics.

ACOUSTICS OF BUILDINGS: Basic requirement of acoustically good hall - Reverberation and time of reverberation – Sabine's formula for reverberation time - Measurement of absorption coefficient of a material - Factors affecting the architectural acoustics and their remedy.

UNIT III

MAGNETIC PROPERTIES: Permeability - Magnetization - Origin of magnetic moment – Classification of magnetic materials - Dia, para and ferro magnetism - Hysteresis curve - Soft and hard magnetic materials.

SUPERCONDUCTIVITY: General properties - Meissner effect - Penetration depth - Type I and Type II superconductors - Flux quantization – DC and AC Josephson effect –BCS Theory - Applications of superconductors.

UNIT IV

CRYSTAL STRUCTURES AND X-RAY DIFFRACTION: Introduction -Space lattice - Basis - Unit cell - Lattice parameter - Bravais lattices – Crystal systems - Structure and packing fractions of Simple cubic - Body centered cubic – Face centered cubic crystals - Directions and planes in crystals – Miller indices - Separation between successive [h k l] planes - Diffraction of X-rays by crystal planes - Bragg's law - Laue method - Powder method.

UNIT V

LASERS : Introduction - Characteristics of lasers - Spontaneous and stimulated emission of radiation - Einstein's coefficients - Population inversion - Ruby laser - Helium-Neon laser – CO_2 laser - Semiconductor laser - Applications of lasers in industry, scientific and medical fields.

UNIT VI

FIBER OPTICS AND HOLOGRAPHY: Introduction - Principle of optical fiber - Acceptance angle and acceptance cone - Numerical aperture – Types of optical fibers and refractive index profiles – Attenuation in optical fibers - Application of optical fibers – Basic principles of holography – Construction and reconstruction of image on hologram – Applications of holography.

UNIT VII

DIELECTRIC PROPERTIES: Introduction - Dielectric constant - Electronic, ionic and orientational polarizations - Internal fields in solids – Clausius - Mossotti equation – Dielectrics in alternating fields – Frequency dependence of the polarizability - Ferro and Piezo electricity.

THERMAL PROPORTIES : Introduction - Specific Heat of Solids – Einstein Model – Debye Model – Lattice Vibrations – Phonons – Thermal Conductivity.

UNIT VIII

SCIENCE & TECHNOLOGY OF NANOMATERIALS: Introduction to Nano materials - Basic principles of Nanoscience & Technology – Fabrication of nano materials – Physical & chemical properties of nanomaterials – Carbon nanotubes – Applications of nanotechnology.

TEXT BOOKS :

1. Physics Volume 2 by Halliday, Resnick and Krane; John Wiley & Son.
2. Applied Physics 2nd Edition by Dr. P. Appala Naidu & Dr. M. Chandra Shekar, V.G.S. Book links.
3. Engineering Physics by R.K.Gaur & S.L. Gupta; Dhanpat Rai and Sons.

REFERENCES:

1. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.
2. Introduction to solid state physics by C. Kittel; Wiley Eastern Ltd**.**
3. Materials Science and Engineering by V. Raghavan; Prentice-Hall India.
4. Engineering Physics by Dr. M. Arumugam; Anuradha Agencies.
5. Nanomaterials by A.K. Bandyopadhyay; New Age International Publishers.
6. Engineering Physics by M.N. Avadhanulu & P.G. Kshirasagar; S. Chand & Company Ltd.

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I Year B.Tech. Ch.E	**T**	**P**	**C**
	2+1*	**0**	**4**

CLASSICAL MECHANICS

UNIT – I

Introduction to Engg. Mechanics – Basic Concepts.

Systems of Forces : Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems.

UNIT – II

Equilibrium of Systems of Forces : Free Body Diagrams, Equations of Equilibrium of Coplanar Systems, Spatial Systems for concurrent forces. Lamis Theorm, Graphical method for the equilibrium of coplanar forces, Converse of the law of Triangle of forces, converse of the law of polygon of forces condition of equilibrium.

UNIT – III

Centroid : Centroids of simple figures (from basic principles) – Centroids of Composite Figures

Centre of Gravity : Centre of gravity of simple body (from basis principles), centre of gravity of composite bodies, pappus theorem.

UNIT – IV

Area moments of Inertia : Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia.

Mass Moment of Inertia : Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

UNIT – V

Analysis of perfect frames (Analytical Method) – Types of Frames – Assumptions for forces in members of a perfect frame, Method of joints, Method of sections, Force table, Cantilever Trusses, Structures with one end hinged and the other freely supported on rollers carrying horizontal or inclined loads.

UNIT – VI

Kinematics : Rectilinear and Curvelinear motions – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion.

Kinetics : Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.

UNIT – VII

Work – Energy Method : Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method.

UNIT – VIII

Mechanical Vibrations : Definitions, Concepts – Simple Harmonic Motion – Free vibrations, simple and Compound Pendulums and its Applications –

TEXT BOOKS :

1. Engg. Mechanics / Irving. H. Shames Prentice – Hall.
2. Engg. Mechanics / S.S. Bharikati & J.G. Rajasekharappa

REFERENCES :

1. Engineering Mechanics / Fedinand . L. Singer / Harper – Collins.
2. Engg. Mechanics / Timoshenko & Yound.
3. Engg. Mechanics Umesh Regl / Tayal.
4. Engg. Mechanics / R.V. Kulkarni & R.D. Askhevkar
5. Engg. Mechanics/Khurmi/S.Chand.
6. Engg. Mechanics / KL Kumar / Tata McGraw Hill.

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	2+1*	**0**	**4**

PHYSICAL CHEMISTRY

UNIT I: Distribution Law:
Distribution Law – Nernst Distribution Law – Distribution Coefficient – Explanation and Limitations of Distribution Law - Modification of Distribution Law – Determination of Equilibrium Constant from Distribution Coefficient – Applications of Distribution Law.

UNIT II: Phase Rule:
Phase Rule – Terms involved in Phase Rule – Types of Liquids – Derivation of Phase Rule – Phase Diagrams of One Component (Water and Sulphur system), Two Component System – Eutectic Point (Lead Silver System) and three component system. Applications of Phase Rule.

UNIT III: Chemical Kinetics:
Introduction to Chemical Kinetics – Theories of Reaction Rates – Collision Theory – Modified Collision Theory – Absolute Reaction Rate Theory (Transition State Theory) – Reaction between Ions – Influenece of Solvent (Double Sphere Activated Complex and Single Sphere Activated Complex) – Influence of Ionic Strength on the Rate of the Reactions - Chain Reactions – Hydrogen and Bromine, Hydrogen and Oxygen (Steady State Treatment) – Explosion Limits.

UNIT IV: Colloidal State:
Definition of Colloids, Classification of Colloids, Solids in liquids (sols) – Properties, kinetics, optical and Electrical; Stability of Colloids, Protective Action, Hardy – Schultz Law, Gold Number. Liquids in Liquids (Emulsions) – Types of Emulsions, Preparation , Emulsifier, Liquid in Solids (gels) – classification, Preparation and Properties, General Applications of Colloids.

UNIT V: Electrochemistry – I:
Ohms Law – Conductance – Specific Conductance – Equivalent Conductance – Molecular Conductance and its determination – Transport Number and its Determination – Kohlrauschs Law, its Application – Conductometric Titrations – Applications of Conductivity Measurements.

UNIT VI: Electrochemistry – II:
EMF; Galvanic cells, Spontaneity, Reversible & irreversible cells, Measurement of EMF, Standard Electrode potential, concentration cells, batteries, fuel cell, hydrogen oxygen fuel cell, photgalvanic cell, photovoltaic cells.

UNIT VII: Catalysis:
Homogeneous Catalysis – Catalysis by electron and group transfer in solution – Acid-Base Catalysis – Protolytic and Prototropic Mechanism, Enzyme Catalysis – Specificity – Examples – Influence of Concentration (Michaelis Constant) – Influence of pH – Influence of Temperature.

UNIT VIII: Voltammetry:
Principle of Micro electrolysis, polarization, Dropping Mercury Electrode, Polarograph, Half Wave Potential, IIlkovic Equation, Qualitative analysis and Quantitative analysis, Standard addition technique and Applications, amperometric titrations.

TEXT BOOKS:

1. Physical Chemistry – Thomas Engel & Philip Reid, Pearson Education Inc. (2006).
2. Physical Chemistry – Glasston & Lewis.
3. Advanced Physical Chemistry – Gurudeep Raj, Goel Publishing House.

REFERENCE:

1. Physical Chemistry – Ira N. Levine, Tata McGraw Hill, 5th edition, 2002.
2. Physical Chemistry – Atkins.
3. Physical Chemistry – Walter J. Moore.
4. Physical Chemistry – Puri, Sharma and Pathania.
5. Physical Chemistry – Castalin.

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	3+1*	**0**	**6**

C PROGRAMMING AND DATA STRUCTURES

UNIT - I
Algorithm / pseudo code, flowchart, program development steps, structure of C program, A Simple C program, identifiers, basic data types and sizes, Constants, variables, arithmetic, relational and logical operators, increment and decrement operators, conditional operator, bit-wise operators, assignment operators, expressions, type conversions, conditional expressions, precedence and order of evaluation.

Input-output statements, statements and blocks, if and switch statements, loops- while, do-while and for statements, break, continue, goto and labels, programming examples.

UNIT - II
Designing structured programs, Functions, basics, parameter passing, storage classes- extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, header files, C preprocessor, example c programs.

UNIT - III
Arrays- concepts, declaration, definition, accessing elements, storing elements, arrays and functions, two-dimensional and multi-dimensional arrays, applications of arrays. pointers- concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory managements functions, command line arguments, c program examples.

UNIT - IV
Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bitfields, C program examples.

UNIT - V
Input and output – concept of a file, text files and binary files, streams, standard I/o, Formatted I/o, file I/o operations, error handling, C program examples.

UNIT - VI
Searching – Linear and binary search methods, sorting – Bubble sort, selection sort, Insertion sort, Quick sort, merge sort.

UNIT – VII
Introduction to data structures, singly linked lists, doubly linked lists, circular list, representing stacks and queues in C using arrays and linked lists, infix to post fix conversion, postfix expression evaluation.

UNIT - VIII
Trees- Binary tress, terminology, representation, traversals, graphs- terminology, representation, graph traversals (dfs & bfs)

TEXT BOOKS :

1. Computer science, A structured programming approach using C, B.A. Forouzan and R.F. Gilberg, Third edition, Thomson.
2. DataStructures Using C – A.S.Tanenbaum, Y. Langsam, and M.J. Augenstein, PHI/Pearson education.

REFERENCES :

1. C& Data structures – P. Padmanabham, B.S. Publications.
2. The C Programming Language, B.W. Kernighan, Dennis M.Ritchie, PHI/Pearson Education
3. C Programming with problem solving, J.A. Jones & K. Harrow, dreamtech Press
4. Programming in C – Stephen G. Kochan, III Edition, Pearson Eductaion.
5. Data Structures and Program Design in C, R.Kruse, C.L. Tondo, BP Leung, Shashi M, Second Edition, Pearson Education.

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	2+1*	**0**	**4**

INTRODUCTION TO CHEMICAL ENGINEERING
(Qualitative Treatment Only)

Unit-I:
Introduction, Unit operations, basic laws, units and dimensions,

Unit-II:
Energy, equivalent mass, solutions, humidity and saturation. Material balance, energy balance

Unit-III:
Flow of fluids: Introduction, nature of fluid, viscosity, velocity profile, flow field, types of fluid motion, laminar and turbulent flow, flow of a fluid past a solid surface, Reciprocating, rotary, and centrifugal pumps

Unit-IV:
Heat transfer: Conduction, convection (omit correlations for calculation of heat transfer coefficients, heat transfer with change in phase) and radiation. Flow arrangement in heat exchangers, variation of fluid temperatures in heat exchangers, heat transfer equipment (double pipe & Shell and tube heat exchanger), evaporation, long tube vertical type and forced circulation type evaporators, multiple effect evaporation, methods of feeding

Unit-V:
Mass transfer: Diffusion, mass transfer operation, absorption, Vapour-Liquid Equilibrium, Relative Volatility, Boiling point diagram.

Unit-VI:
Distillation, reflux, Equipment for gas-liquid operations, selection of equipment for gas-liquid operations,

Unit-VII:
Liquid-liquid extraction, extraction schemes, distribution coefficient, triangular diagram, selection of disperse phase, classification of industrial liquid-liquid contactors, industrial liquid-liquid contactors. Selection of liquid-liquid extraction contactors.

Unit-VIII:
Introduction of humidification and dehumidification - equipments, introduction of drying, equipment for drying, Introduction to crystallization, classification of crystallization equipment, crystallization equipment, adsorption, adsorption equipment. Types of reactions and reactors.

TEXT BOOK:
1. Introduction to chemical engineering by S. K. Ghosal, S. K. Sanyal and S. Dutta, TMH publications, 1993.

REFERENCE:
1. Unit operations in chemical engineering by W.L. McCabe and J.C. Smith and Peter Harriott, Mc Graw Hill 5th ed. 1993.

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ENGINEERING GRAPHICS

UNIT – I

INTRODUCTION TO ENGINEERING DRAWING : Principles of Engineering Graphics and their Significance – Drawing Instruments and their Use – Conventions in Drawing – Lettering – BIS Conventions. Curves used in Engineering Practice & their Constructions -Conic Sections including the Rectangular Hyperbola (General method only) - Cycloid, Epicycloid and Hypocycloid - Involute. – Helices – scales used in engineering practice and representive fraction- the principals – construction of plain diagonal and vernier scales

UNIT – II

DRAWING OF PROJECTIONS OR VIEWS ORTHOGRAPHIC PROJECTION IN FIRST ANGLE PROJECTION ONLY : Principles of Orthographic Projections – Conventions – First and Third Angle Projections Projections of Points and Lines inclined to both planes, True lengths, traces.

UNIT – III

PROJECTIONS OF PLANES & SOLIDS : Projections of regular Planes, auxiliary planes and Auxiliary projection inclined to both planes. Projections of Regular Solids inclined to both planes – Auxiliary Views. Sections and Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views.

UNIT – IV

DEVELOPMENT AND INTERPENETRATION OF SOLIDS: Development of Surfaces of Right Regular Solids – Prisms, Cylinder, Pyramid Cone and their parts. Interpenetration of Right Regular Solids – Intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone.

UNIT – V

ISOMETRIC PROJECTIONS : Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts.

UNIT –VI

TRANSFORMATION OF PROJECTIONS : Conversion of Isometric Views to Orthographic Views – Conventions.

UNIT – VII

PERSPECTIVE PROJECTIONS : Perspective View : Points, Lines, Plane Figures and Simple Solids, Vanishing Point Methods(General Method only).

UNIT – VIII

Introduction to Computer aided Drafting: Generation of points, lines, curves, polygons, simple solids, dimensioning.

TEXT BOOKS :

1. Engineering Drawing, N.D. Bhat / Charotar
2. Engineering graphics with Auto CAD- R.B. Choudary/Anuradha Publishes
3. Engineering Drawing, Narayana and Kannaiah / Scietech publishers.

REFERENCES :

1. Engineering Drawing and Graphics, Venugopal / New age.
2. Engineering Drawing- Johle/Tata Macgraw Hill.
3. Computer Aided Engineering Drawing- Trymbaka Murthy- I.K. International.

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COMPUTER PROGRAMMING LAB

Objectives:

- To make the student learn a programming language.
- To teach the student to write programs in C solve the problems
- To Introduce the student to simple linear and non linear data structures such as lists, stacks, queues, trees and graphs.

Recommended Systems/Software Requirements:

- Intel based desktop PC
- ANSI C Compiler with Supporting Editors

Week I.
a) Write a C program to find the sum of individual digits of a positive integer.
b) A Fibonacci Sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
c) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

Week 2.
a) Write a C program to calculate the following Sum:
Sum=$1-x^2/2! +x^4/4!-x^6/6!+x^8/8!-x^{10}/10!$
b) Write a C program toe find the roots of a quadratic equation.

Week 3
a) Write C programs that use both recursive and non-recursive functions
i) To find the factorial of a given integer.
ii) To find the GCD (greatest common divisor) of two given integers.
iii) To solve Towers of Hanoi problem.

Week 4
a) The total distance travelled by vehicle in 't' seconds is given by distance = $ut+1/2at^2$ where 'u' and 'a' are the initial velocity (m/sec.) and acceleration (m/sec^2). Write C program to find the distance travelled at regular intervals of time given the values of 'u' and 'a'. The program should provide the flexibility to the user to select his own time intervals and repeat the calculations for different values of 'u' and 'a'.
b) Write a C program, which takes two integer operands and one operator form the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)

Week 5
a) Write a C program to find both the larges and smallest number in a list of integers.
b) Write a C program that uses functions to perform the following:
i) Addition of Two Matrices
ii) Multiplication of Two Matrices

Week 6
a) Write a C program that uses functions to perform the following operations:
i) To insert a sub-string in to given main string from a given position.
ii) To delete n Characters from a given position in a given string.
b) Write a C program to determine if the given string is a palindrome or not

Week 7
a) Write a C program that displays the position or index in the string S where the string T begins, or – 1 if S doesn't contain T.
b) Write a C program to count the lines, words and characters in a given text.

Week 8
a) Write a C program to generate Pascal's triangle.

b) Write a C program to construct a pyramid of numbers.

Week 9
Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression:
$1+x+x^2+x^3+\ldots\ldots\ldots\ldots+x^n$
For example: if n is 3 and x is 5, then the program computes 1+5+25+125.
Print x, n, the sum
Perform error checking. For example, the formula does not make sense for negative exponents – if n is less than 0. Have your program print an error message if n<0, then go back and read in the next pair of numbers of without computing the sum. Are any values of x also illegal ? If so, test for them too.

Week 10
a) 2's complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2's complement of 11100 is 00100. Write a C program to find the 2's complement of a binary number.
b) Write a C program to convert a Roman numeral to its decimal equivalent.

Week 11
Write a C program that uses functions to perform the following operations:
i) Reading a complex number
ii) Writing a complex number
iii) Addition of two complex numbers
iv) Multiplication of two complex numbers
(Note: represent complex number using a structure.)

Week 12
a) Write a C program which copies one file to another.
b) Write a C program to reverse the first n characters in a file.
(Note: The file name and n are specified on the command line.)

Week 13
Write a C program that uses functions to perform the following operations on singly linked list.:
i) Creation ii) Insertion iii) Deletion iv) Traversal

Week 14
Write a C program that uses functions to perform the following operations on doubly linked list.:
i) Creation ii) Insertion iii) Deletion iv) Traversal in both ways

Week 15
Write C programs that implement stack (its operations) using
i) Arrays ii) Pointers

Week 16
Write C programs that implement Queue (its operations) using
i) Arrays ii) Pointers

Week 17
Write a C program that uses Stack operations to perform the following:
i) Converting infix expression into postfix expression
ii) Evaluating the postfix expression

Week 18
Write a C program that uses functions to perform the following:
i) Creating a Binary Tree of integers
ii) Traversing the above binary tree in preorder, inorder and postorder.

Week 19
Write C programs that use both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers :
i) Linear search ii) Binary search

Week 20
Write C programs that implement the following sorting methods to sort a given list of integers in ascending order:
i) Bubble sort ii) Quick sort

Week 21
Write C programs that implement the following sorting methods to sort a given list of integers in ascending order:

i) Insertion sort ii) Merge sort

Week 22
Write C programs to implement the Lagrange interpolation and Newton- Gregory forward interpolation.

Week 23
Write C programs to implement the linear regression and polynomial regression algorithms.

Week 24
Write C programs to implement Trapezoidal and Simpson methods.

Text Books
1. C programming and Data Structures, P. Padmanabham, Third Edition, BS Publications
2. Data Structures: A pseudo code approach with C, second edition R.F. Gilberg and B.A. Forouzan
3. Programming in C, P.Dey & M. Ghosh, Oxford Univ.Press.
4. C and Data Structures, E Balaguruswamy, TMH publications.

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CHEMISTRY LAB

1. Determination of rate constant of hydrolysis of ester.
2. Study of reaction between persulphate and iodide.
3. Conductometric titration (a) strong acid v/s strong base.
4. Conductometric titration (b) Weak acid v/s strong base.
5. Determination of distribution coefficient of iodine between water and carbon tetrachloride.
6. Potentiometric titration between potassium dichromate and ferrous iron.
7. Study of inversion of sucrose by Polarimeter.
8. Phase diagram of phenol - water system.
9. Qualitative analysis of simple organic compounds by following systematic procedure.
Preparation of organic / medicinal compounds.
a) Asprin
b) Azodye
c) Acetanilide
d) Thiokol Rubber
e) Paracetamol.

TEXT BOOKS:

1. Vogels Text Book of Qualitative Organic Analysis.
2. Experiments in Physical Chemistry, 7th edition by David P Shoemaker, Joseph W Nibler, Tata Mc Graw Publications (2003).
3. Laboartory Techniques in Organic Chemistry by V.K.Ahluwalia, Pooja Bhagat, Renu Aggarwal, I.K.International Publishing House Pvt. Ltd.

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ENGLISH LANGUAGE COMMUNICATION SKILLS LAB

The **Language Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations and contexts.

Objectives:

1. **To expose the students to a variety of self-instructional, learner-friendly modes of language learning.**
2. **To help the students cultivate the habit of reading passages from the computer monitor, thus providing them with the required facility to face computer-based competitive exams such GRE, TOEFL, GMAT etc.**
3. **To enable them to learn better pronunciation through stress on word accent, intonation, and rhythm.**
4. **To train them to use language effectively to face interviews, group discussions, public speaking.**
5. **To initiate them into greater use of the computer in resume preparation, report writing, format-making etc.**

SYLLABUS :

The following course content is prescribed for the **English Language Laboratory** sessions:

1. Introduction to the Sounds of English- Vowels, Diphthongs & Consonants.
2. Introduction to Stress and Intonation.
3. Situational Dialogues / Role Play.
4. Oral Presentations- Prepared and Extempore.
5. 'Just A Minute' Sessions (JAM).
6. Describing Objects / Situations / People.
7. Information Transfer
8. Debate
9. Telephoning Skills.
10. Giving Directions.

Minimum Requirement:

The English Language Lab shall have two parts:

i) **The Computer aided Language Lab** for 60 students with 60 systems, one master console, LAN facility and English language software for self- study by learners.

ii) **The Communication Skills Lab** with movable chairs and audio-visual aids with a P.A System, a T. V., a digital stereo –audio & video system and camcorder etc.

System Requirement (Hardware component):

Computer network with Lan with minimum 60 multimedia systems with the following specifications:

i) P – IV Processor
   a) Speed – 2.8 GHZ
   b) RAM – 512 MB Minimum
   c) Hard Disk – 80 GB

ii) Headphones of High quality

Suggested Software:

• Cambridge Advanced Learners' English Dictionary with CD.
• The Rosetta Stone English Library
• Clarity Pronunciation Power – Part I
• Mastering English in Vocabulary, Grammar, Spellings, Composition
• Dorling Kindersley series of Grammar, Punctuation, Composition etc.
• Language in Use, Foundation Books Pvt Ltd with CD.
• Oxford Advanced Learner's Compass, 7th Edition
• Learning to Speak English - 4 CDs
• Microsoft Encarta with CD
• Murphy's English Grammar, Cambridge with CD
▪ English in Mind, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge

Books Suggested for English Language Lab Library (to be located within the lab in addition to the CDs of the text book which are loaded on the systems):

1. **Spoken English** (CIEFL) in 3 volumes with 6 cassettes, OUP.

2. **English Pronouncing Dictionary** Daniel Jones Current Edition with CD.
3. **Spoken English**- R. K. Bansal and J. B. Harrison, Orient Longman 2006 Edn.
4. **English Language Communication : A Reader cum Lab Manual** Dr A Ramakrishna Rao, Dr G Natanam & Prof SA Sankaranarayanan, Anuradha Publications, Chennai
5. **Speaking English Effectively** by Krishna Mohan & NP Singh (Macmillan)
6. **A Practical Course in English Pronunciation**, (with two Audio cassettes) by J. Sethi, Kamlesh Sadanand & D.V. Jindal, Prentice-Hall of India Pvt. Ltd., New Delhi.
7. **A text book of English Phonetics for Indian Students** by T.Balasubramanian (Macmillan)
8. **English Skills for Technical Students,** WBSCTE with British Council, OL

DISTRIBUTION AND WEIGHTAGE OF MARKS

English Language Laboratory Practical Paper:

1. The practical examinations for the English Language Laboratory shall be conducted as per the University norms prescribed for the core engineering practical sessions.
2. For the Language lab sessions, there shall be a continuous evaluation during the year for 25 sessional marks and 50 year-end Examination marks. Of the 25 marks, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The year- end Examination shall be conducted by the teacher concerned with the help of another member of the staff of the same department of the same institution.

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ENGINEERING WORK SHOP PRACTICE

1. TRADES FOR EXERCISES:

1. Carpentry
2. Fitting
3. Tin-Smithy and Development of jobs carried out and soldering.
4. Black Smithy
5. House-wiring
6. Foundry
7. IT Workshop-I : Computer hard ware , identification of parts , Disassembly, Assembly of computer to working condition, Simple diagnostic exercises.
8. IT workshop-II : Installation of Operating system windows and Linux , simple diagnostic exercises.
9. welding
10. Power tools in construction, Wood working, Electrical Engg & Mechanical Engg

II TRADES FOR DEMONSTRATION & EXPOSURE:

1. Plumbing
2. Machine Shop
3. Metal Cutting (water plasma)

Text Books: Work shop Manual / P.Kannaiah/ K.L.Narayana/ Scitech publishers

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MATHEMATICS – II

UNIT – I
Matrices: Elementary row transformations – Rank – Normal form - Echelon form – Consistency – Solution of system of simultaneous linear homogeneous and non-homogeneous equations.

UNIT – II
Eigen values, Eigen vectors – properties – Cayley-Hamilton Theorem - Inverse and powers of a matrix by Cayley-Hamilton theorem – Diagonolization of matrix. Calculation of powers of matrix – Modal and spectral matrices.

UNIT-III
Real matrices – Symmetric, skew - symmetric, orthogonal, Linear Transformation - Orthogonal Transformation. Complex matrices: Hermitian, Skew-Hermitian and Unitary – Eigen values and Eigen vectors of complex matrices and their properties Quadratic forms- Reduction of quadratic form to canonical form – Rank - Positive, negative definite - semi definite - index - signature - Sylvester law.

UNIT –IV
Fourier Series: Determination of Fourier coefficients – Fourier series – even and odd functions – Fourier series in an arbitrary interval – even and odd periodic continuation – Half-range Fourier sine and cosine expansions.

UNIT-V
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – solutions of first order linear (Lagrange) equation and nonlinear (standard type) equations.

UNIT –VI
Method of separation of variables – Classification of second order linear Partial Differential Equations, solutions of one dimensional heat equation, wave equation and two-dimensional Laplace's equation under initial and boundary conditions.

UNIT –VII
Fourier integral theorem – Fourier sine and cosine integrals. Fourier transforms – Fourier sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms.

UNIT-VIII
Z-transform – inverse z-transform - properties – Damping rule – Shifting rule – Initial and final value theorems. Convolution theorem – Solution of difference equation by z-transforms.

Text Books:

1. A text Book of Engineering Mathematics, Vol-II T. K. V. Iyengar, B. Krishna Gandhi and Others, S. Chand & Company.
2. A text Book of Engineering Mathematics, C. Sankaraiah, V. G. S. Book Links.
3. A text Book of Engineering Mathematics, Shahnaz Bathul, Right Publishers.
4. A text Book of Engineering Mathematics, P. Nageshwara Rao, Y. Narasimhulu & N. Prabhakar Rao, Deepthi Publications.

References:

1. A text Book of Engineering Mathematics, B. V. Raman, Tata Mc Graw Hill.
2. Advanced Engineering Mathematics, Irvin Kreyszig, Wiley India Pvt. Ltd.
3. A text Book of Engineering Mathematics, Thamson Book Collection.

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ELECTRICAL ENGINEERING

UNIT – I

SI Unit's ohm's law, series, and parallel circuits, Kirchhoffs laws, Star-delta transformation (Simple Problems)– Force on a current carrying conductor in magnetic field– electromagnetic induction, Faraday's law, Lenz's law – Self and mutual inductances.

UNIT – II

Generation of an alternating emf – average and rms values of alternating quantity – representation of alternating quantities by phasors – single phase series and parallel circuits (simple problems)– series and parallel resonance – three phase balanced systems – single and three phase power calculations.

UNIT – III

Principle of operation of DC machines – emf equation – types of generators – Magnetization and Load characteristics of DC generators

UNIT-IV

DC Motor: Principle of operation of DC Motor,Types of Motors, Back EMF Equation, Characteristics of DC motor, Torque Equation,DC Motor Starter (Three Point starter),Efficicency Calculation, Swimbrne's Test and speed control.

UNIT –V

Construction and principle of operation of single phase transformer – emf equation O.C. & S.C. tests – efficiency and regulation

UNIT-VI

Principle and operation of three phase induction motors – types of motors,Squirrel cage and slip ring motor – slip torque characteristics.

UNIT-VII

Principle and operation of alternators – O.C. & S.C. tests – regulation by synchronous impedance method.

UNIT – VIII

Electrical Instruments: Basic principles of indicating instruments – moving coil and moving iron instruments (Ammeters and voltmeters).

TEXT BOOKS :

1. Introduction to Electrical Engineering by M.S.Naidu and S.Kamakshiah, TMH
2. Basic Electrical Engineering by T.K. Nagasarkar and M.S.Sukhija, Oxford University Press, 2005

REFERENCES:

1. Theory and Problems of Basic Electrical Engineering by D.P.Kothari & I.J. Nagrath Pearson Education/PHI
2. Essentials of Electrical and Computer Engineering by David V.Kerns,Jr, J.David Irwin; Pearson Education.
3. Basic electrical Engineering, V.N. Mittle, 2nd edition, TMH
4. Principles of electrical engineering, V.K. Mehta, S.Chand publications

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MOMENTUM TRANSFER

UNIT –I
Unit operations and unit processes, unit systems, dimension analysis, basic concepts, nature of fluids, hydrostatic equilibrium, applications of fluid statics.

UNIT- II
Fluid flow phenomena-Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, Boundary layers, Basic equation of fluid flow –Mass balance in a flowing fluid; continuity, differential momentum balance; equations of motion, Macroscopic momentum balances, Mechanical energy equations

UNIT-III
Incompressible Flow in pipes and channels- shear stress and skin friction in pipes, laminar flow in pipes and channels, turbulent flow in pipes and channels, friction from changes in velocity or direction.

UNIT-IV
Flow of compressible fluids- Definitions and basic equations, Processes of compressible flow, Isentropic flow through nozzles, adiabatic frictional flow, and isothermal frictional flow.

UNIT-V
Flow past immersed bodies, Drag and Drag coefficient, flow through beds of solids, motion of particles through fluids.

UNIT-VI
Fluidization, Conditions for fluidization, Minimum fluidization velocity, Types of fluidization, Expansion of fluidized bed, Applications of fluidization. Continuous fluidization; slurry and pneumatic transport

UNIT-VII
Transportation and Metering of fluids- Pipes, fittings and valves, pumps: positive displacement pumps, and centrifugal pumps.

UNIT-VIII
Fans, blowers, and compressors, Measurement of flowing fluids- full bore meters, insertion meters.

Text Books:
1. Unit Operations of Chemical Engineering by W.L.McCabe, J.C.Smith & Peter Harriot, McGraw-Hill, 6th ed, 2001

References:
1. Transport processes and unit operations by Christie J. Geankoplis, PHI
2. Unit operations, Vol-1 –Chattopadhya, Khanna publishers
3. P rinciples of Unit Operations, Foust et. al, 2nd ed., John Wiley, 1999
4. Chemical Engineering, Vol-I, Coulson and Richardson, **Pergamon Press.**

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ENVIRONMENTAL STUDIES

UNIT - I

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance – Need for Public Awareness.

UNIT – II

Natural Resources : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. - Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT – III

Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT – IV

Biodiversity and its conservation: Introduction - Definition: genetic, species and ecosystem diversity. - Bio-geographical classification of India - Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - . Biodiversity at global, National and local levels. - . India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – V

Environmental Pollution: Definition, Cause, effects and control measures of :

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes. - Role of an individual in prevention of pollution. - Pollution case studies. - Disaster management: floods, earthquake, cyclone and landslides.

UNIT – VI

Social Issues and the Environment: From Unsustainable to Sustainable development -Urban problems related to energy -Water conservation, rain water harvesting, and watershed management -Resettlement and rehabilitation of people; its problems and concerns. Case Studies -Environmental ethics: Issues and possible solutions. -Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. -Wasteland reclamation. –Consumerism and waste products. -Environment Protection Act. -Air (Prevention and Control of Pollution) Act. -Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act -Issues involved in enforcement of environmental
legislation. -Public awareness.

UNIT – VII

Human Population and the Environment: Population growth, variation among nations. Population explosion - Family Welfare Programme. -Environment and human health. -Human Rights. -Value Education. -HIV/AIDS. -Women and Child Welfare. - Role of information Technology in Environment and human health. -Case Studies.

UNIT – VIII

Field work : Visit to a local area to document environmental assets River /forest grassland/hill/mountain -Visit to a local polluted site-Urban/Rural/industrial/ Agricultural Study of common plants, insects, birds. -Study of simple eco systems pond, river, hill slopes, etc.

TEXT BOOK:

1 Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2 Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE:

1 Textbook of Environmental Sciences and Technology by M. Anji Reddy, BS Publication.

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ANALYTICAL CHEMISTRY

UNIT – I

Principle of Analytical Methods: Quantitative analysis. Precipitation, types of precipitates, impurities, co-precipitation , post-precipitation, conditions for participation, precipitation from homogeneous solution Gravimetric determination of Fe, Ni and Cu, calculations.

UNIT-II

Volumetric analysis: Acid base titrations: Indicators; Oxidation-reduction titrations; Complexation using ligands, complexometric titration with EDTA, metal ion indicators; simple calculations; analysis of Na_2CO_3, Fe_2O_3 , Brass, Solder etc.

UNIT – III

Molecular Spectrophotometry: Absorption spectra, Lamberts Law, Beer's Law - Combined law equation; Derivations from Beer's Law. Block diagram of a uv- visible spectrophotometer – quantitative analysis ; Direct method for the determination of metal ions; Chromium, Manganese, Iron etc in alloys.

UNIT – IV

Infrared Spectroscopy : Interaction of infra-red radiation with molecules, Sources of IR Radiation ; Spectral regions; Block diagram of IR Spectrometer , Function of each component; Sampling Techniques; Application of IR Spectroscopy to functional group analysis (-OH, $-NH_2$, -CHO, -CO-R, -CONH).

UNIT V:

Chromatographhy: Principles, planar chromatography, paper chromatography, RF value. Thinlayer chromatography, identification of spots by spraying and other methods.

UNIT –VI:

Gas Chromatography: Principles of Gas Chromatography, block diagram of gas chromatograph, Function of each component, Detectors (FID, ECD), stationary phase for column, mobile pahse, chromatogram, qualitative analysis, quantitative analysis, retention time, retention volume, capacity factor, area., normalization method.

UNIT VII:

HPCL: Principles of high performance liquid chromatography, Block diagram of HPCL, Systems, functions of each component, stationary phases, eluting solvents, pumps, detectors, quantitative applications of HPLC.

UNIT –VIII:

Analysis of water: Hardness, definition, Types of Hardness, estimation of hardness by EDTA method, Alkalinity, Acidity, Chlorides, Chlorine, dissolved oxygen, BOD, COD.

Text BOOK:

1. Quantitative analysis, R.A. Day & A.L.Underwood Printice-Hall of India, pvt. Ltd. 5th edition, 2000.
2. Vogels Text book of Quantitative chemical analysis, J.Mendham, R.C Denny, J.D. Barnes, M J.K.Thomas, pearson education, 6th edition, 2002.

REFERENCES:

1. Analytical Chemistry – Y.Anjaneylu, K. Chandrasekhar, V. Manickam- Pharma book syndicate, 2007.
2. Instrumental methods of analysis, Willand merrit and dean, caps publications & Distribution, 1999.
3. Instrumentaiotn methods of analysis, Chatwal & Anand, Himalaya Publ;ications, 2003.
4. Principles of Analytical Chemistry by Vacarcel, Springer Publications, 2005.

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CHEMICAL PROCESS CALCULATIONS

Unit-1:
Stoichiometric relation: basis of calculations, methods of expressing compositions of mixtures and solutions, density and specific gravity, Baume and API gravity scales.

Unit-2:
Behavior of Ideal gases: Kinetic theory of gases, application of ideal gas law, gaseous mixtures, gases in chemical reactions.

Unit-3:
Vapor pressure: Liquefaction and liquid state, vaporization, boiling point, effect of temperature on vapor pressure, Antoine equation, vapor pressure plots, estimation of critical properties, vapor pressure of immiscible liquids and ideal solutions, Roult's law. Non volatile solutes.

Unit-4:
Humidity and Saturation: Relative and percentage saturation or dew point, wet bulb and dry bulb temperature, use of humidity charts for engineering calculations.

Unit-5:
Material balances: Tie substance, Yield, conversion, processes involving chemical reactions.

Unit-6:
Material balance calculation involving drying, dissolution and crystallization. Processes involving recycle, bypass and purge.

Unit-7:
Thermophysics: Energy, energy balances, heat capacity of gases, liquid and mixture solutions. Kopp's rule, latent heats, heat of fusion and heat of vaporization, Trouton's rule, Kistyakowsky equation for non polar liquids enthalpy and its evaluation.

Unit-8:
Thermochemistry: Calculation and applications of heat of reaction, combustion, formation and neutralization, Kirchoff's equation, enthalpy concentration change, calculation of theoretical and actual flame temperatures.

TEXTBOOKS

1. Chemical process principles, Part -I, Material and Energy Balance by Hougen O A, Watson K.M. and Ragatz R.A. John Wiley and Sons, New York, 1963, 2nd Ed.

REFERENCES :

1. Basic principles and calculation in chemical engineering by D.H. Himmelblau, 5th Ed. PHI, 2001
2. Stoichiometry by B.I. Bhatt and S.M. Vora (3rd Ed.) Tata McGraw Hill publishing company, Ltd. New Delhi (1996)

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Momentum Transfer Lab

1. Identification of laminar and turbulent flows
   Major equipment - Reynolds apparatus

2. Measurement of point velocities
   Major equipment - Pitot tube setup

3. Verification of Bernoulli's equation
   Major equipment – Bernoulli's Apparatus

4. Calibration of Rotameter
   Major equipment – Rotameter Assembly

5. Variation of Orifice coefficient with Reynolds Number
   Major equipment - Orifice meter Assembly

6. Determination of Venturi coefficient
   Major equipment – Venturi meter Assembly

7. Friction losses in Fluid flow in pipes
   Major equipment - Pipe Assembly with provision for Pressure measurement

8. Pressure drop in a packed bed for different fluid velocities
   Major equipment - Packed bed with Pressure drop measurement

9. Pressure drop and void fraction in a fluidized bed
   Major equipment - Fluidized bed with Pressure drop measurement

10. Studying the coefficient of contraction for a given open orifice
    Major equipment - Open Orifice Assembly

11. Studying the coefficient of discharge in a V-notch
    Major equipment - V-notch Assembly

12. Studying the Characteristics of a centrifugal pump
    Major equipment - Centrifugal Pump

13. Viscosity determination using Stoke's law.
    Major equipment – Terminal Velocity determination column

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ANALYTICAL CHEMISTRY LAB

1. Estimation of ferrous iron (II) in solution using Potassium Dichromate.
2. Estimation of cooper (II) using standard sodium thiosulphate.
3. Estimation of total, permanent and temporary hardness of water by EDTA.
4. Estimation of Total alkalinity of water.
5. Estimation of Iron in cement using Spectrophotometer.
6. Estimation of Zinc using potassium ferrocyanide.
7. Percentage purity of lime stone.
8.Estimation of Chlorides in water.
9. Estimation of Dissolved oxygen in water.
10. Determination of stability constant by Job's method.
11. Determination of sulphates through turbidometry.
12. Assay of paracetamol/ Ibuprofen sample using spectrophotometer.

TEXT BOOKS:

1. Vogel's Text book of Quantitative Chemical Analysis, Sixth Edition – J. Mendham et al, Pearson Education.
2. Chemistry Practical – Lab Manual by Chandra Sekhar and Jayaveera.

APPARATUS AND EQUIPMENT REQUIRED

GLASSWARE:

Burettes, Pipettes (10ml, 20 ml, 25 ml), Conical Flasks (250 ml), Standard Flasks (25 ml, 50 ml, 100 ml, 250 ml, 500 ml, 1000 ml) Graduated Pipettes, Beakers (100 ml, 250 ml, 500 ml, 1000 ml) Reagent Bottels (100 ml, 250 ml, 500 ml,), Test Tubes, Test Tube Stands, Burette Stands, Porcelain Tiles, Brushes, Wash Bottles, Droppers, Conical Flaks (250 ml, 100 ml), Weighing Bottles.

EQUIPMENT :

Colorimeter, UV- Visible Spectrophotometer, Hot Water Bath, Hot Plates, Distilled Water, Plant/De - ionizer, Magnetic- Stirrer, Chemical Balances, Weighing Boxes and Electrical Balance.

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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 ax2 + bx +c = 0. Read in a, b, c and use the quadratic formula. If the discriminant b2 -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

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Data Base Management Systems

UNIT – I

Data base System Applications, data base System VS file System – View of Data – Data Abstraction – Instances and Schemas – data Models – the ER Model – Relational Model – Other Models – Database Languages – DDL – DML – database Access for applications Programs – data base Users and Administrator – Transaction Management – data base System Structure – Storage Manager – the Query Processor

UNIT – II

History of Data base Systems.Data base design and ER diagrams – Beyond ER Design Entities, Attributes and Entity sets – Relationships and Relationship sets – Additional features of ER Model – Concept Design with the ER Model – Conceptual Design for Large enterprises.

UNIT – III

Introduction to the Relational Model – Integrity Constraint Over relations – Enforcing Integrity constraints – Querying relational data – Logical data base Design – Introduction to Views – Destroying /altering Tables and Views.

Relational Algebra – Selection and projection set operations – renaming – Joins – Division – Examples of Algebra overviews – Relational calculus – Tuple relational Calculus – Domain relational calculus – Expressive Power of Algebra and calculus.

UNIT – IV

Form of Basic SQL Query – Examples of Basic SQL Queries – Introduction to Nested Queries – Correlated Nested Queries Set – Comparison Operators – Aggregative Operators – NULL values – Comparison using Null values – Logical connectivity's – AND, OR and NOT – Impact on SQL Constructs – Outer Joins – Disallowing NULL values – Complex Integrity Constraints in SQL Triggers and Active Data bases.

UNIT – V

Schema refinement – Problems Caused by redundancy – Decompositions – Problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF – Lossless join Decomposition – Dependency preserving Decomposition – Schema refinement in Data base Design – Multi valued Dependencies – FORTH Normal Form.

UNIT – VI

Transaction Concept- Transaction State- Implementation of Atomicity and Durability – Concurrent – Executions – Serializability- Recoverability – Implementation of Isolation – Testing for serializability- Lock – Based Protocols – Timestamp Based Protocols- Validation- Based Protocols – Multiple Granularity.

UNIT – VII

Recovery and Atomicity – Log – Based Recovery – Recovery with Concurrent Transactions – Buffer Management – Failure with loss of nonvolatile storage-Advance Recovery systems- Remote Backup systems.

UNIT – VIII

Data on External Storage – File Organization and Indexing – Cluster Indexes, Primary and Secondary Indexes – Index data Structures – Hash Based Indexing – Tree base Indexing – Comparison of File Organizations – Indexes and Performance Tuning- Intuitions for tree Indexes – Indexed Sequential Access Methods (ISAM) – B+ Trees: A Dynamic Index Structure.

TEXT BOOKS :

1. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition
2. Data base System Concepts, Silberschatz, Korth, McGraw hill, V edition.

REFERENCES :

1. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate Pearson Education
3. Introduction to Database Systems, C.J.Date Pearson Education

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MATERIALS SCIENCE FOR CHEMICAL ENGINEERS

UNIT-I

INTRODUCTION: Engineering Materials – Classification – levels of structure**,** A brief review by atomic Structure and chemical bonding: ionization potential, electron affinity and electro negativity. Chemical bonding: ionic, covalent, metallic and secondary bonding. Property relation to bond characteristics.

UNIT-II

CRYSTAL GOEMETRY AND STRUCTURE DETERMINATION:

Space lattice and Unit cell. Bravais lattices, crystal systems with examples. Lattice coordinates, Miller indices, Bravais indices for directions and places: crystalline and non crystalline solids; ionic, covalent and metallic solids; packing efficiency, ligancy and coordination number; structure determination by Bragg's X-ray diffraction and powder methods.

UNIT-III

CRYSTAL IMPERFECTION:

Point defects, line defects-edge and screw dislocation, Berger's circuit and Berger's vectors, dislocation reaction, dislocation motion, multiplication of dislocations during deformation , role of dislocation on crystal properties; surface defects, dislocation density and stress required to move dislocations.

UNIT-IV

Basic thermodynamic functions; phase diagrams and phase transformation: Primary and binary systems-general types with examples; tie line& lever rules, non equilibrium cooling: phase diagrams of Fe-Fe3 C, Pb-Sn Cu-Ni systems.

UNIT-V

Phase transformations in Fe-Fe3 C steels, Time-Temperature-Transformation (TTT) curves for eutectoid steels and plain carbon steels; effect of alloying elements on properties of steels; types of steels, alloys and other metals used in chemical industry.

UNIT-VI

Elastic, an elastic and plastic deformations in solid materials; rubber like elasticity, viscoelastic behaviour (models),; shear strength of real and perfect crystals work hardening mechanisms cold working, hot working; dynamic recovery, recrystllisation, grain growth, grain size and yield stress Brief description of heat treatment in steels.

UNIT-VII

Fracture in ductile and brittle materials creep: mechanism of creep and methods to reduce creeping in materials, creep rates and relations. Fatigue-mechanisms and methods to improve fatigue resistance in materials. Composite materials: types; stress-strain relations in composite materials, applications.

UNIT-VIII

OXIDATION AND CORROSION:

Mechanisms; types of corrosion; methods to combat corrosion.

TEXT BOOK:

1. Materials Science and Engineering; V. Raghavan.; Prentice Hall of India Pvt. Ltd.,

REFERENCES:

1. Science of Engineering Materials Vol. 1 &2; Manas chanda; McMillan Company of India Ltd.
2. Elements of materials science, Van Vlack, L.R.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
KAKINADA

III Year B.Tech. Ch.E. I Sem	**T**	**P**	**C**
	4+1*	**0**	**4**

CHEMICAL ENGINEERING THERMODYNAMICS –II

Unit -I:
Heat effects: Sensible heat effects, Internal energy of ideal gases: Microscopic view, Latent heats of pure substances, heat effects of industrial reactions, heat effects of mixing processes.

Unit-II:
Standard heat of reaction, Standard heat of formation, Standard heat of combustion, temperature dependence of heat of reaction

Unit-III:
Solution thermodynamics: Theory: Fundamental property relation, chemical potential as a criterion for phase equilibrium, partial properties, ideal gas mixtures, fugacity and fugacity coefficient for pure species, fugacity and fugacity coefficient for species in solutions, generalized correlations for Fugacity coefficient, The ideal solutions, excess properties.

Unit –IV:
Solution thermodynamics: applications: the liquid phase properties from VLE data, models for the excess Gibbs energy, property changes of mixing

Unit -V:
VLE at low to moderate pressures: The nature of equilibrium, the phase rule, Duhems theorem, VLE: Qualitative behavior, the gamma /Phi formulation of VLE, Dew point and bubble point calculations, flash calculations, solute (1)/solvent (2) systems

Unit -VI:
Thermodynamic properties and VLE from equations of state: properties of fluids from the virial equations of state, properties of fluids from cubic equations of state, fluid properties from correlations of the Pitzer type, VLE from cubic equations of state

Unit –VII:
Topics in phase Equilibria: Equilibrium and stability, liquid-liquid equilibrium (LLE), vapor- liquid–liquid equilibrium (VLLE), solid-liquid equilibrium (SLE), solid vapor equilibrium (SVE), equilibrium absorption of gases on solids

Unit –VIII:
Chemical reaction equilibria: The reaction coordinate, application equilibrium criterion to chemical reactions, the standard Gibb's energy change and the equilibrium constant, effect of temperature on equilibrium constants, relation of equilibrium constants to composition, equilibrium conversion for single reactions, Phase rule and Duhem's theorem for reacting systems.

Text book:
1. Introduction to chemical engineering thermodynamics by J.M. Smith, H.C. Van Ness and M.M. Abbott, 5th ed. Mc Graw Hill 1996
Reference:
1. Chemical and Process Thermodynamics, BG Kyle, 3rd Edition, Pearson Education
2. A Text book of chemical engineering thermodynamics by K.V. Narayanan. PHI, 2001.

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CHEMICAL REACTION ENGINEERING – I

Unit–I
Overview of chemical reaction engineering- classification of reactions, variables affecting the rate of reaction definition of reaction rate. Kinetics of homogenous reactions- concentration dependent term of rate equation, Temperature dependent term of rate equation, searching for a mechanism, predictability of reaction rate from theory.

Unit–II
Interpretation of batch reactor data- constant volume batch reactor:- Analysis of total pressure data obtained in a constant-volume system, the conversion, Integral method of analysis of data– general procedure, irreversible unimolecular type first order reactions, irreversible bimolecular type second order reactions, irreversible trimolecular type third order reactions, empirical reactions of nth order, zero-order reactions, overall order of irreversible reactions from the half-life, fractional life method, irreversible reactions in parallel, homogenous catalyzed reactions, autocatalytic reactions, irreversible reactions in series.

Unit–III
Constant volume batch reactor– first order reversible reactions, second order reversible reactions, reversible reactions in general, reactions of shifting order, Differential method of analysis of data. Varying volume batch reactor–differential method of analysis, integral method of analysis, zero order, first order, second order, nth order reactions, temperature and reaction rate, the search for a rate equation.

Unit–IV
Introduction to reactor design- general discussion, symbols and relation ship between C_A and X_A.
Ideal reactors for a single reaction- Ideal batch reactor, Steady-state mixed flow reactor, Steady-state plug reactors.

Unit–V
Design for single reactions- Size comparison of single reactors, Multiple- reactor systems, Recycle reactor, Autocatalytic reactions.

Unit–VI
Design for parallel reactions- introduction to multiple reactions, qualitative discussion about product distribution, quantitative treatment of product distribution and of reactor size.

Unit–VII
Irreversible first order reactions in series, quantitative discussion about product distribution, quantitative treatment, plug flow or batch reactor, quantitative treatment, mixed flow reactor, first-order followed by zero-order reaction, zero order followed by first order reaction.

Unit–VIII
Temperature and Pressure effects- single reactions- heats of reaction from thermodynamics, heats of reaction and temperature, equilibrium constants from thermodynamics, equilibrium conversion, general graphical design procedure, optimum temperature progression, heat effects, adiabatic operations, non adiabatic operations, comments and extensions. Exothermic reactions in mixed flow reactors-A special problem, multiple reactions.

TEXT BOOK :
1. Chemical Reaction Engineering by Octave Levenspiel, 3rd ed. John Wiely & Sons,1999.

REFERENCES:
1. Elements of chemical reaction engineering by H.S. Fogler, 2nd ed. PHI, 1992.
2. Chemical engineering kinetics by J.M.Smith, 3rd ed. Mc Graw Hill, 1981.

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MASS TRANSFER OPERATIONS-1

UNIT- I
The Mass Transfer Operations: Classification of the Mass-Transfer Operations, Choice of Separation Method, Methods of Conducting the Mass-Transfer Operations, Design Principles, Molecular Diffusion In Fluids: Molecular Diffusion, Equation of Continuity, binary solutions, Steady State Molecular Diffusion in Fluids at Rest and in Laminar Flow, estimation of diffusivity of gases and liquids,

UNIT- II
Momentum and Heat Transfer in Laminar flow Diffusion: Diffusion in Solids, Fick's Diffusion, Unsteady State Diffusion, Types of Solid Diffusion, diffusion through polymers, diffusion through crystalline solids, Diffusion through porous solids & hydrodynamic flow of gases.

UNIT-III
Mass Transfer Coefficients: Mass Transfer Coefficients, Mass Transfer Coefficients in Laminar Flow (Explanation of equations only and no derivation), Mass Transfer Coefficients in Turbulent Flow, eddy diffusion, Film Theory, Penetration theory, Surface-renewal Theory, Combination Film-Surface-renewal theory, Surface-Stretch Theory, Mass, Heat and Momentum Transfer Analogies, Turbulent Flow in Circular Pipes. Mass transfer data for simple situations.

UNIT-IV
Inter phase Mass Transfer: Concept of Equilibrium, Diffusion between Phases, Material Balances in steady state co-current and counter current stage processes, Stages, Cascades, Kremser – Brown equations (No derivation)

UNIT-V
Equipment For Gas-Liquid Operations: Gas Dispersed, Sparged vessels (Bubble Columns), Mechanical agitated equipments(Brief description),Tray towers, General characteristics, Sieve design for absorption and distillation (Qualitative Treatment), Different types of Tray Efficiencies, Liquid Dispersed venturi Scrubbers, Wetted-Wall Towers, Packed Towers, Counter current flow of Liquid & Gas through packing, Mass transfer coefficients for packed towers, End effects and Axial Mixing Tray tower vs Packed towers.

UNIT-VI
Absorption And Stripping: Absorption equilibrium, ideal and non ideal solutions selection of a solvent for absorption, one component transferred: material balances. Determination of number of Plates (Graphical), Absorption Factors, estimation of number of plates by Kremser Brown equation, Continuous contact equipment; HETP, Absorption of one component, Determination of number of Transfer Units and Height of the Continuous Absorber, overall coefficients and transfer units, dilute solutions, overall height of transfer units.

UNIT-VII
Humidification Operations: Vapor-Pressure Curve, Definitions, Psychometric Charts, Enthalpy of gas-vapor Mixtures, Humidification and Dehumidification, Operating lines and Design of Packed Humidifiers, Dehumidifiers and Cooling towers, Spray Chambers

UNIT-VIII
Drying: Equilibrium, Definitions, Drying Conditions- Rate of Batch Drying under constant drying conditions, Mechanisms of batch drying, Drying time Through Circulation Drying, Classification of Drying Operations: Batch and Continuous Drying Equipment, Material and Energy Balances of Continuous Driers,

Text book:

1. Mass transfer operations by R.E. Treybal, 3rd ed. Mc Graw Hill, 1980.

Reference:

1. Diffusion: mass transfer in fluid system by E. L. Cussler.
2. Transport processes and unit operations by Christie J. Geankoplis
3. Principles of mass transfer and separation processes, B.K. Dutta, PHI, India

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PROCESS INSTRUMENTATION

Unit –I:
Elements of instruments, static and dynamic characteristics, basic concepts of response of first order type instruments, mercury in glass thermometer, bimetallic thermometer, pressure spring thermometer, static accuracy and response of thermometers.

Unit-II:
Thermo electricity: Industrial thermocouples, thermocouple wires, thermo couple wells and response of thermocouples.

Unit –III:
Thermal coefficient of resistance, industrial resistance thermometer bulbs and circuits, radiation receiving elements, radiation, photoelectric and optical pyrometers.

Unit-IV:
Composition analysis, spectroscopic analysis by absorption, emission, mass and color measurement spectrometers, gas analysis by thermal conductivity, analysis of moisture, gas chromatography, refractometer.

Unit-V:
Pressure vacuum and head: liquid column manometers, measuring elements for gauge pressure and vacuum, indicating elements for pressure gauges, measurement of absolute pressure, measuring pressure in corrosive liquids, static accuracy and response of pressure gauges.

Unit -VI
Head, density and specific gravity, direct measurement of liquid level, pressure measurement in open vessels, level measurements in pressure vessels, measurement of interface level, density measurement, and level of dry materials.

Unit -VII
Head flow meters, area flow meters, open channel meters, viscosity meters, quantity meters, flow of dry materials, viscosity measurements.

Unit -VIII
Recording instruments, indicating and signaling instruments, transmission of instrument readings, control center, instrumentation diagram, process analysis.

Text Book:
1. Industrial instrumentation by Donald P.Eckman, Wiley eastern, 1950.

REFERENCE:
1. Principles of industrial instrumentation by Patra Nabis, TMH.
2. Instruments for measurements and control by Holbrock W.C. Van Nostrand East West.
3. Hand book Instrumentation, Considine, McGraw Hill,
4. Instrumentation for Process measurement and Control, Norman A. Anderson, 3rd Edition, CRC press

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	0	**3**	**2**

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

1. Introduction
The introduction of the English Language Lab is considered essential at 3rd year level. At this stage the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be an integrated theory and lab course to enable students to use 'good' English and perform the following:

- Gather ideas and information, to organise ideas relevantly and coherently.
- Engage in debates.
- Participate in group discussions.
- Face interviews.
- Write project/research reports/technical reports.
- Make oral presentations.
- Write formal letters.
- Transfer information from non-verbal to verbal texts and vice versa.
- To take part in social and professional communication.

2. Objectives:
This Lab focuses on using computer-aided multimedia instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.

3. Syllabus:
The following course content is prescribed for the Advanced Communication Skills Lab:

- Functional English - starting a conversation – responding appropriately and relevantly – using the right body language – role play in different situations.
- Vocabulary building – synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, analogy, idioms and phrases.
- Group Discussion – dynamics of group discussion , intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence.
- Interview Skills – concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele and video-conferencing.
- Resume' writing – structure and presentation, planning, defining the career objective, projecting ones strengths and skill-sets, summary, formats and styles, letter-writing.
- Reading comprehension – reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading.
- Technical Report writing – Types of formats and styles, subject matter – organization, clarity, coherence and style, planning, data-collection, tools, analysis.

4. Minimum Requirement:
The English Language Lab shall have two parts:

i) **The Computer aided Language Lab** for 60 students with 60 systems, one master console, LAN facility and English language software for self- study by learners.

ii) **The Communication Skills Lab** with movable chairs and audio-visual aids with a P.A System, a T. V., a digital stereo –audio & video system and camcorder etc.

System Requirement (Hardware component):
Computer network with Lan with minimum 60 multimedia systems with the following specifications:

iii) P – IV Processor
   a) Speed – 2.8 GHZ
   b) RAM – 512 MB Minimum
   c) Hard Disk – 80 GB

iv) Headphones of High quality

5. Suggested Software:

The software consisting of the prescribed topics elaborated above should be procured and used.

Suggested Software:

- **Clarity Pronunciation Power** – part II
- **Oxford Advanced Learner's Compass**, 7th Edition
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**
- **Lingua TOEFL CBT Insider**, by Dreamtech
- **TOEFL & GRE**(KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- **The following software from 'train2success.com'**
  - **Preparing for being Interviewed,**
  - **Positive Thinking,**
  - **Interviewing Skills,**
  - **Telephone Skills,**
  - **Time Management**
  - **Team Building,**
  - **Decision making**
- **English in Mind**, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge

6. Books Recommended:

1. **Effective Technical Communication**, M. Ashraf Rizvi, Tata Mc. Graw-Hill Publishing Company Ltd.
2. **A Course in English communication** by Madhavi Apte, Prentice-Hall of India, 2007.
3. **Communication Skills** by Leena Sen, Prentice-Hall of India, 2005.
4. **Academic Writing- A Practical guide for students** by Stephen Bailey, Rontledge Falmer, London & New York, 2004.
5. **English Language Communication : A Reader cum Lab Manual** Dr A Ramakrishna Rao, Dr G Natanam & Prof SA Sankaranarayanan, Anuradha Publications, Chennai
6. **Body Language- Your Success Mantra** by Dr. Shalini Verma, S. Chand, 2006.
7. **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice**, New Age International (P) Ltd., Publishers, New Delhi.
8. Books on **TOEFL/GRE/GMAT/CAT** by Barron's/cup
9. **IELTS series with CDs** by Cambridge University Press.
10. **Technical Report Writing Today** by Daniel G. Riordan & Steven E. Pauley, Biztantra Publishers, 2005.
11. **Basic Communication Skills for Technology** by Andra J. Rutherford, 2nd Edition, Pearson Education, 2007.
12. **Communication Skills for Engineers** by Sunita Mishra & C. Muralikrishna, Pearson Education, 2007.
13. **Objective English** by Edgar Thorpe & Showick Thorpe, 2nd edition, Pearson Education, 2007.
14. **Cambridge Preparation for the TOEFL** Test by Jolene Gear & Robert Gear, 4th Edition.
15. **Technical Communication** by Meenakshi Raman & Sangeeta Sharma, Oxford University Press.

DISTRIBUTION AND WEIGHTAGE OF MARKS:

Advanced Communication Skills Lab Practicals*:*

1. The practical examinations for the English Language Laboratory practice shall be conducted as per the University norms prescribed for the core engineering practical sessions.

2. For the English Language lab sessions, there shall be a continuous evaluation during the year for 25 sessional marks and 50 End Examination marks. Of the 25 marks, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The End Examination shall be conducted by the teacher concerned with the help of another member of the staff of the same department of the same institution.

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PROCESS HEAT TRANSFER LAB

1. Determination of total thermal resistance and thermal conductivity of composite wall.
   Major equipment - Composite wall Assembly

2. Determination of thermal conductivity of a metal rod.
   Major equipment - Thermal Conductivity apparatus

3. Determination of natural convective heat transfer coefficient for a vertical tube.
   Major equipment - Natural convection heat transfer apparatus

4. Determination of critical heat flux point for pool boiling of water.
   Major equipment- Pool boiling apparatus

5. Determination of forced convective heat transfer coefficient for air flowing through a pipe
   Major equipment – Forced convection heat transfer apparatus

6. Determination of overall heat transfer coefficient in double pipe heat exchanger.
   Major equipment - Double pipe heat exchanger apparatus

7. Study of the temperature distribution along the length of a pin-fin under natural and forced convection conditions
   Major equipment - Pin fin apparatus

8. Estimation of un-steady state film heat transfer coefficient between the medium in which the body is cooled.
   Major equipment - Heat transfer coefficient determination apparatus

9. Determination of Stefan – Boltzmann constant.
   Major equipment - Stefan Boltzmann apparatus

10. Determination of emissivity of a given plate at various temperatures.
    Major equipment - Emissivity determination apparatus

11. Determination of radiation constant of a given surface.
    Major equipment - Emissivity determination apparatus.

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III Year B.Tech. Ch.E. II Sem

T	P	C
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MANAGEMENT SCIENCE

Unit I: ***Introduction to Management*****:** Concepts of Management and organization- Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management.

Unit II: ***Designing Organisational Structures*****:** Basic concepts related to Organisation - Departmentation and Decentralisation, Types of mechanistic and organic structures of organisation (Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organisation, Cellular Organisation, team structure, boundaryless organization, inverted pyramid structure, lean and flat organization structure) and their merits, demerits and suitability.

Unit III: ***Operations Management*****:** Principles and Types of Plant Layout-Methods of production (Job, batch and Mass Production), Work Study -Basic procedure involved in Method Study and Work Measurement-Statistical Quality Control: $\bar{x}$ chart, R chart, *c* chart, *p* chart, (simple Problems), Acceptance Sampling, Deming's contribution to quality.

Unit IV: ***A) Materials Management*****:** Objectives, Need for Inventory control, EOQ, ABC Analysis, Purchase Procedure, Stores Management and Stores Records - Supply Chain Management

B) Marketing**:** Functions of Marketing, Marketing Mix, Marketing Strategies based on Product Life Cycle., Channels of distribution.

Unit V: ***Human Resources Management (HRM):*** Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs. PMIR, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Placement, Wage and Salary Administration, Promotion, Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating.

Unit VI: ***Project Management (PERT/CPM)*****:** Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

Unit VII: ***Strategic Management*****:** Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, SWOT Analysis, Steps in Strategy Formulation and Implementation, Generic Strategy alternatives.

Unit VIII: ***Contemporary Management Practices*****:** Basic concepts of Just-In-Time (JIT) System, Total Quality Management (TQM), Six sigma and Capability Maturity Model (CMM) Levels, Value Chain Analysis,Enterprise Resource Planning (ERP), Performance Management, Business Process outsourcing (BPO), Business Process Re-engineering and Bench Marking, Balanced Score Card.

Text Book:

1. Aryasri: *Management Science*, TMH, New Delhi.

Reference Books:

1. Kotler Philip & Keller Kevin Lane: Marketing Mangement 12/e, PHI, 2007
2. Koontz & Weihrich: *Essentials of Management*, 6/e, TMH, 2007
1. Thomas N.Duening & John M.Ivancevich *Management—Principles and Guidelines,* Biztantra,2007.
2. Kanishka Bedi, *Production and Operations Management*, Oxford University Press, 2007.
3. Memoria & S.V.Ganker, *Personnel Management*, Himalaya, 25/e, 2007
4. Schermerhorn: *Management*, Wiley, 2007.
5. Parnell: Strategic Management, Biztantra,20073.
6. L.S.Srinath: PERT/CPM,Affiliated East-West Press, 2007.

Pre-requisites: Managerial Economics

***Objective*:** To familiarize with the process of management and to provide basic insights into select contemporary management practices.

Codes/Tables: Normal Distribution Function Table need to be permitted into the examination Hall.

Question Paper Pattern: 5 Questions to be answered out of 8 questions.
Each question should not have more than 3 bits.
Unit VIII will have only short questions, not essay questions.

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CHEMICAL TECHNOLOGY

UNIT I
Soda ash, caustic soda and chlorine, Glass: manufacture of special glasses

Unit – II
Industrial gases: carbon dioxide, hydrogen and oxygen – products of water gas, producer gas. Nitrogen industries: synthetic ammonia, urea, nitric acid (ammonium nitrate), ammonium chloride, ammonium phosphate and complex fertilizers

Unit – III
Sulphur and sulphuric acid, manufacture of sulphuric acids, hydrochloric acid and some other chemicals –Aluminum sulphate and alum, barium salts rare earth compounds.

Unit – IV
Cement manufacture, special cements, miscellaneous calcium compounds, magnesium compounds.

Unit – V:
Manufacture of phenols, formaldehyde, vinyl chloride and vinyl acetate, manufacture of phenol- formaldehyde resin and polyvinyl chloride polymer, SBR.

Unit – VI:
Oils: Definition, constitution, extraction and expression of vegetable oils, refining and hydrogenation of oils.

UNIT-VII:
Soaps and detergents: Definitions, continuous process for the production of fatty acids, glycerin and soap, production of detergents.

Unit – VIII:
Pulp and paper industry: methods of pulping, production of sulphate and sulphite Pulp, production of paper –wet process

TEXT BOOKS:
1. Shreve's Chemical Process Industries edited by Austin, McGraw-Hill.5th ed.1985.
2. Dryden's Outlines of Chemical Technology, edited by M.Gopal Rao and M.Sittig, 2nd ed. 1973.

REFERENCES:
1. Industrial Chemistry by B.K.Sharma
2. Hand book of industrial chemistry Vol 1&II K.H.Davis & F.S. Berner Edited by S.C. Bhatia, CBS publishers

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MASS TRANSFER OPERATIONS-II

UNIT-I

Distillation: Fields of applications, VLE for miscible liquids, immiscible liquids, steam distillation, Positive and negative deviations from ideality, enthalpy-concentration diagrams, flash vaporization and differential distillation for binary and multi component mixtures.

UNIT-II

Continuous rectification-binary systems, multistage tray towers –method of Mc Cabe and Thiele, enriching section, exhausting section, feed introduction, total reflux, minimum and optimum reflux ratios, use of steam, condensers, partial condensers, cold reflux, multiple feeds , tray efficiencies, continuous-contact equipment (packed towers)

UNIT- III

Multistage (tray) towers –the method of Ponchon and Savarit, the enriching and stripping sections, feed tray location, total reflux, minimum and optimum reflux ratios, reboilers, use of open steam, condenser and reflux accumulators, Azeotropic distillation, extractive distillation, comparison of Azeotropic and extractive distillation.

UNIT- IV

Liquid-Liquid operations: fields of usefulness, liquid-liquid equilibrium, equilateral triangular co-ordinates, choice of solvent, stage wise contact, multistage cross-current extraction, Multi stage counter current without reflux

UNIT- V

Multi stage counter current with reflux, Differential (continuous contact) extractors, spray towers, packed towers, mechanically agitated counter-current extractors, centrifugal extractors, dilute solutions, super critical fluid extraction, fractional extraction.

UNIT-VI

Leaching: Fields of applications, preparation of solid for leaching, types of leaching, leaching equilibrium, single stage and multi stage leaching calculations, constant under flow conditions, equipment for leaching operation.

UNIT-VII

Adsorption: Adsorption, types of adsorption, nature of adsorbents, adsorption equilibrium, single gases and vapors, Adsorption Hysteresis, effect of temperature, Heat of adsorption, vapor and gas mixtures: One component adsorbed, Effect of change of temperature or pressure. Liquids, Adsorption of solute from dilute solution, The Freundlich equation, Adsorption from concentrated solutions, adsorption operations, stage wise operation, application of Freundlich equation to single and Multistage adsorption (cross current & counter current).

UNIT -VIII

Adsorption of vapor from a gas, fluidized bed, continuous contact, steady state moving bed adsorbers, unsteady state–fixed bed adsorbers, adsorption wave, elution, adsorption-desorption operations- thermal desorption of gases, activated carbon solvent recovery, pressure swing and vacuum swing adsorption (qualitative treatment), regeneration with purge and desorbent, ion-exchange: principles of ion exchange, techniques and applications, ion-movement theory, ion exclusion.

Text Book:

1. Mass transfer operations by R.E. Tryebal, 3rd ed. Mc Graw Hill, 1980.

Reference:

1. Diffusion: mass transfer in fluid system by E. L. Cussler.
2. Transport processes and unit operations by Christie J. Geankoplis
3. Principles of mass transfer and separation processes, B.K. Dutta, PHI, India

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CHEMICAL REACTION ENGINEERING – II

UNIT I
Basics of non-ideal flow- **E**, the age distribution of fluid, the RTD, Conversion in Non-ideal flow reactors, Diagonizing reactors ills (qualitative discussion only)

Unit–II
The dispersion model-axial dispersion, correlations for axial dispersion, chemical reaction and dispersion.

Unit–III
The tanks in series model- pulse response experiments and the RTD, chemical conversion. The convection model for laminar flow- the convective model and its RTD, chemical conversion in laminar flow reactors

Unit–IV
Earliness of mixing, segregation and RTD- self-mixing of a single fluid, mixing of two miscible fluids.

Unit–V
Catalysis and Catalytic reactors- catalysts, steps in a catalytic reactions, synthesizing a rate law, mechanism and rate limiting step. (From chapter 6 Fogler)

Unit–VI
Heterogeneous reactions -Introduction.
Solid catalyzed reactions- The rate equation for Surface Kinetics- Pore diffusion resistance combined with surface kinetics, Porous catalyst particles, Heat effects during reaction, Performance equations for reactors containing porous catalyst particles.

Unit–VII
Solid catalyzed reactions- Experimental methods for finding rates. Deactivating catalysts- mechanisms of catalyst deactivation, the rate and performance equations.

Unit–VIII
Fluid-fluid reactions: kinetics- the rate equation.
Fluid-particle reactions: kinetics- selection of a model, shrinking core model for spherical particles of unchanging size, rate of reaction for shrinking spherical particles, extensions, determination of rate controlling step.

TEXT BOOK:

1. Chemical Reaction Engineering by Octave Levenspiel 3rd ed. Wiley Eastern Ltd.

REFERENCES:

1. Elements of chemical reaction engineering by H.S. Fogler, 3rd ed. PHI, 1999.
2. Chemical engineering kinetics by J.M.Smith, 3rd ed. Mc Graw Hill, 1981.

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III Year B.Tech. Ch.E. II Sem	**T**	**P**	**C**
	4+1*	**0**	**4**

PROCESS DYNAMICS AND CONTROL

UNIT I
Introduction to process dynamics and control. Response of First Order Systems. Physical examples of first order systems

Unit-II:
Response of first order systems in series, Higher order systems: Second order and transportation lag

Unit-III:
Control systems Controllers and final control elements, Block diagram of a chemical rector control system

Unit-IV:
Closed loop transfer functions, Transient response of simple control systems

Unit-V:
Stability, Root locus

Unit-VI:
Transient response from root locus, Application of root locus to control systems Introduction to frequency response, Control systems design by frequency response

Unit-VII:
Advanced control strategies, Cascade control, Feed forward control, ratio control, Smith predictor, dead time compensation, internal model control.

Unit -VIII:
Controller tuning and process identification. Control valves

TEXT BOOK
1. Process systems analysis and control by D.R. Coughanowr, 2nd ed. Mc Graw Hill 1991

REFERENCE
1. Chemical process control by G. Stephanopolous, PHI,1998

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III Year B.Tech. Ch.E. II Sem	**T**	**P**	**C**
	4+1*	**0**	**4**

BIOCHEMICAL ENGINEERING

Unit-I:
Introduction to microbiology: Biophysics and the cell doctrine, the structure of cells, important cell types, from nucleotides to RNA and DNA, amino acids into proteins.

Unit-II:
Kinetics of enzyme catalyzed reaction: the enzyme substrate complex and enzyme action, simple enzyme kinetics with one and two substrates, other patterns of substrate concentration dependence, modulation and regulation of enzyme activity, other influences on enzyme activity.

Unit-III:
Immobilized enzyme technology: enzyme immobilization, industrial processes, utilization and regeneration of cofactors. Immobilized enzyme kinetics: effect of external mass transfer resistance, analysis of intraparticle diffusion and reaction.

Unit-IV:
Kinetics of cellular growth in batch and continuous culture, models for cellular growth – unstructured, structured and cybernetic models. Thermal death kinetics of cells and spores

Unit-V:
Introduction to metabolic pathways, biosynthesis, transport across cell membranes, end products of metabolism, stoichiometry of cell growth and product formation.

Unit – VI:
Design and analysis of biological reactors: batch reactors, fed-batch reactors, enzyme catalyzed reactions in CSTR, CSTR reactors with recycle and cell growth, ideal plug flow reactors, sterilization reactors, sterilization of gases, packed bed reactors using immobilized catalysts. Fermentation technology: medium formulation, design and operation of a typical aseptic, aerobic fermentation process.

Unit – VII:
Transport phenomena in bioprocess systems: Gas-liquid mass transfer in cellular systems, determination of oxygen transfer rates, overall k_La' estimates and power requirements for sparged and agitated vessels, scaling of mass transfer equipment, heat transfer.

Unit – VIII:
Down stream processing: Strategies to recover and purify products; separation of insoluble products-filtration and centrifugation; cell disruption-mechanical and non-mechanical methods; separation of soluble products: liquid-liquid extractions, membrane separation (dialysis, ultra filtration and reverse osmosis), chromatographic separation-gel permeation chromatography, electrophoresis, final steps in purification – crystallization and drying.

TEXT BOOK:
1. Biochemical engineering fundamentals by J.E.Bailey and D.F.Ollis, 2nd ed,1986,McGraw Hill.
2. Bioprocess Engineering by Michael L. Shuler and Fikret Kargi, 2nd edition, Pearson education education

REFERENCE:
1. Biochemical engineering by James M.Lee – Prentice-Hall-1992.
2. Biochemical engineering by Aiba, Humphrey and Mells, academic press.
3. Bioprocess engineering principles, Pauline M. Doran, Academic Press.
4. Biochemical Engineering, H.W. Blanch and D.S. Clark, Marcel Dekker, 1997

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	0	**3**	**2**

CHEMICAL REACTION ENGINEERING LAB

1. Determination of the order of a reaction using a batch reactor and analyzing the data by (a) differential method (b) integral method.
   Major equipment - Batch reactor

2. Determination of the activation energy of a reaction using a batch reactor
   Major equipment - Batch reactor

3. To determine the effect of residence time on conversion and to determine the rate constant using a CSTR.
   Major equipment – CSTR apparatus

4. To determine the specific reaction rate constant of a reaction of a known order using a batch reactor.
   Major equipment - Batch reactor

5. To determine the order of the reaction and the rate constant using a tubular reactor.
   Major equipment – PFR apparatus

6. CSTRs in series- comparison of experimental and theoretical values for space times and volumes of reactors.
   Major equipment - CSTRs in series setup
7. Mass transfer with chemical reaction (solid-liquid system) – determination of mass transfer coefficient.
   Major equipment – beaker, stirrer

8. Axial mixing in a packed bed. Determination of RTD and dispersion number for a packed-bed using a tracer
   Major equipment - Packed bed set up

9. Determination of RTD and dispersion number in a tubular reactor using a tracer.
   Major equipment - PFR set up

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	0	**3**	**2**

MASS TRANSFER OPERATIONS LAB

1. Estimation of diffusivity coefficients
   Major equipment - Diffusivity apprartus

2. Distillation, a) Steam distillation b) Differential distillation
   Major equipment – a) Steam Distillation unit,
   b) Differential Distillation unit

3. Packed towers, HETP evaluation
   Major equipment - Packed column unit

4. Vapor Liquid Equilibria
   Major equipment - VLE apparatus

5. Batch Drying
   Major equipment - Tray Dryer

7. Evaluation of Mass transfer coefficients
   (a) Surface Evaporation (b) Wetted wall column
   Major equipment – a) Surface Evaporation unit
   b) Wetted wall column unit
8. (a) Liquid- Liquid Equilibria (Tie line data)
   (b) Ternary Liquid Equilibria (binodal curve)
   Major equipment – LLE setup

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TRANSPORT PHENOMENA

Unit-I:
Viscosity and the mechanisms of momentum transfer: Newton's law of viscosity (molecular momentum transport), generalization of Newton's law of viscosity, pressure and temperature dependence of viscosity, molecular theory of the viscosity of gases at low density, molecular theory of the viscosity of liquids.

Unit-II:
Thermal conductivity and the mechanisms of energy transport: Fourier's law of heat conduction (molecular energy transport), temperature and pressure dependence of thermal conductivity, and theory of thermal conductivity of gases at low density.

Unit -III
Diffusivity and the mechanisms of mass transport: Fick's law of binary diffusion (molecular mass transport), temperature and pressure dependence of diffusivities, theory of diffusion in gases at low density.

Unit-IV:
Shell momentum balances and velocity distributions in laminar flow: shell momentum balances and boundary conditions, flow of a falling film, flow through a circular tube, flow through annulus, flow of two adjacent immiscible fluids, creeping flow around a sphere.

Unit-V:
Shell energy balances and temperature distributions in solids and laminar flow: shell energy balances; boundary conditions, heat conduction with an electrical heat source, heat conduction with a nuclear heat source, heat conduction with a viscous heat source, heat conduction with a chemical heat source, heat conduction through composite walls, heat conduction in a cooling fin, forced convection, free convection.

Unit-VI:
Concentration distributions in solids and laminar flow: shell mass balances; boundary conditions, diffusion through a stagnant gas film, diffusion with a heterogeneous chemical reaction, diffusion with a homogeneous chemical reaction, diffusion into a falling liquid film (gas absorption), diffusion into a falling liquid film (solid dissolution), diffusion and chemical reaction inside a porous catalyst.

Unit-VII:
The equations of change for isothermal systems: the equation of continuity, the equation of motion, the equation of mechanical energy, the equation of angular momentum, the equations of change in terms of the substantial derivative, use of the equations of change to solve flow problems. Velocity distributions in turbulent flow: comparisons of laminar and turbulent flows, time- smoothed equations of change for incompressible fluids, the time- smoothed velocity profile near a wall.

Unit- VIII:
The equations of change for non- isothermal systems: the energy equation, special forms of the energy equation, the boussenis equation of motion for forced and free convection, use of the equations of change to solve steady state problems. The equations of change for multi component systems: the equations of continuity for a multi component mixture.

TEXT BOOK:
1. Transport phenomena by Bird R.B., Stewart W.C., Lightfoot F.N., 2nd ed. John Wiley & Sons Inc,U.S.A,1960.

REFERENCES:
1 Transport phenomena for engineers by L.Theodore, International text book company,U.S.A.1971.
2. Transport processes and unit operations, 3rd, Geankoplis, PHI, 1997.
3. Fundamental of heat, momentum and mass transfer, Welty, Wicks, Wilson, John Wiley.

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	4+1*	**0**	**4**

CHEMICAL ENGINEERING PLANT DESIGN AND ECONOMICS

Unit-I:
Introduction, Process Design development. General design considerations, Cost and asset accounting.

Unit-II:
Cash flow for industrial operations, factors effecting investment and production cost, capital investments, estimation of capital investments, cost indices, cost factors in capital investment,

Unit-III:
Organizations for presenting capital investments, estimates by compartmentalization, estimation of total product of cost direction, production costs, fixed charges, plant overhead costs, financing.

Unit - IV
Interest and investment cost, type interest, nominal and effective interest rates, continuous interest, present worth and discount annuities, cost due interest on investment, source of capital.

Unit-V:
Taxes and insurances, type of taxes: federal income taxes, insurance-types of insurance, self insurance.

Unit – VI
Depreciation : types of depreciation, services life, salvage value, present value, methods for determining depreciation, single unit and group depreciation.

Unit-VII:
Profitability: alternative investments and replacements, profitability standards, discounted cash flow, capitalized cost, pay out period ,alternative investments, analysis with small investments, increments and replacements.

Unit- VIII:
Optimum design and design strategy, incremental cost, general procedure for determining optimum condition, comparison of graphical and analytical methods, optimum production rates, semi continuous cyclic operation, fluid dynamics, mass transfer strategy of linearization

TEXT BOOK
1. Plant Design and Economics for Chemical Engineering; by M.S. Peters and K.D.Timmerhaus, Mc Graw Hill,4th Ed.,1991
Reference:
1. Process Engineering Economics, Schweyer,

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CHEMICAL PROCESS EQUIPMENT DESIGN

Uint-I
Introduction; development of flow diagrams from process description, material and energy balance, sizing of equipment, design preliminaries, design codes, MOC selection procedure, fabrication methods and testing methods.

Uint-II
Stresses in thin and thick walled shells, theories of failure, design of storage vessels.

Unit-III
Design of pressure vessels

Unit-IV
Design of shell and tube heat exchangers

Unit-V
Design of single effect evaporator.

Unit-VI
Design of distillation and absorption columns.

Unit-VII
Design of batch reactor, CSTR and PFR

Unit-VIII
Optimum pipe diameter.

TEXT BOOK:
1. Chemical Engineering: Vol.6, Coulson J.M. and Richardson J.F., Pergamon Press 1983

REFERENCES:
1. Process Equipment Design, M.V. Joshi
2. Process Equipment Design-Vessel Design: Brownell L.E., Wiley Eastern Ltd.,(1986)
3. Introduction to Chemical Equipment Design-Mechanical Aspects: Bhattacharya B.C., CBS Publishers, 1991
4. Process Heat Transfer: Kern Q., McGraw Hill book Co. Inc.,1982
5. Mass Transfer Operations:Treybal R.E., MGH Book Co.Inc, 1982
6. Chemical Engineering Hand Book, Perry, 5th Ed.,

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PROCESS MODELING AND SIMULATION

UNIT-I
Mathematical models for chemical engineering systems, fundamentals, introduction to fundamental laws

UNIT -II
Examples of mathematical models of chemical engineering systems, constant volume CSTRS, two heated tanks, gas phase pressurized CSTR, non-isothermal CSTR.

UNIT -III
Examples of single component vaporizer, batch reactor, reactor with mass transfer, ideal binary distillation column, batch distillation with holdup.

UNIT -IV
Iterative methods, bisection, false position, Newton –Raphson, successive approximation methods, comparison of iterative methods, solution of linear simultaneous algebraic equations, Computation of Eigen values and Eigen vectors, Gauss elimination method, Gauss-Jordan and Gauss-Seidel's method.

UNIT -V
Numerical integration by Trapezoidal and Simpson's rules, numerical solution of differential equations, Euler method, Runge-Kutta fourth order method, Milne predictor corrector method.

UNIT -VI
Interpolation, Lagrange interpolation, forward difference, backward difference and central difference interpolation methods, least square approximation of functions, linear regression, polynomial regression.

UNIT -VII
Computer simulation, examples, gravity flow tank, three CSTRs in series, binary distillation column, batch reactor

UNIT -VIII
Simulation of Non-isothermal CSTR, VLE dew point, bubble point calculations, countercurrent heat exchanger

Textbooks:

1. Process modeling simulation and control for chemical engineers by W. L. Luyben, McGraw Hill, 2nd Ed.,
2. Numerical methods in engineering, S.K. Gupta, Tata McGraw Hill.

Reference:

1. Engineering Mathematics by B. S. Grewal
2. Modeling and analysis of Chemical Engineering processes by K.Balu and K.Padmanabhan, IK International private limited, 2007

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ADVANCED DATA STRUCTURES AND ALGORITHMS
(ELECTIVE – I)

Unit I:-
C++ Class Overview- Class Definition, Objects, Class Members, Access Control, Class Scope, Constructors and destructors, parameter passing methods, Inline functions, static class members, this pointer, friend functions, dynamic memory allocation and deallocation (new and delete), exception handling.

Unit II:-
Function Overloading, Operator Overloading, Generic Programming- Function and class templates, Inheritance basics, base and derived classes, inheritance types, base class access control, runtime polymorphism using virtual functions, abstract classes, streams I/O.

Unit III:-
Algorithms, performance analysis-time complexity and space complexity,O-notation, Omega notation and Theta notation, Review of basic data structures - the list ADT, stack ADT, queue ADT, implementation using template classes in C++, sparse matrix representation.

Unit IV:-
Dictionaries, linear list representation, skip list representation, operations- insertion, deletion and searching, hash table representation, hash functions, collision resolution-separate chaining, open addressing-linear probing, quadratic probing, double hashing, rehashing,extendible hashing, comparison of hashing and skip lists.

Unit V:-
Priority Queues – Definition, ADT, Realizing a Priority Queue using Heaps, Definition, insertion, Deletion, Application-Heap Sort, External Sorting- Model for external sorting, Multiway merge, Polyphase merge.

Unit VI:-
Search trees (part I) : Binary search trees, definition, ADT, implementation, operations-searching, insertion and deletion, Balanced search trees- AVL trees, definition, height of an AVL tree, representation, operations-insertion, deletion and searching.

Search trees (part II) : Introduction to Red –Black trees and Splay Trees, B-Trees-B-Tree of order m, height of a B-Tree, insertion, deletion and searching, Comparison of Search Trees.

Unit VII:-
Divide and Conquer- General method, applications – Binary search, merge sort, quick sort, Strassen's matrix multiplication
Efficient non recursive tree traversal algorithms, Biconnected components. Disjoint set operations, union and find algorithms.

Unit VIII:-
Greedy method and Dynamic programming : General method (Greedy), Minimum cost spanning trees, Job sequencing with deadlines, General method (Dynamic Programming), Optimal binary search trees, 0/1 knapsack problem, Ordering Matrix Multiplications

TEXT BOOKS :
1. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education, second edition.
2. Data structures, Algorithms and Applications in C++,S.Sahni,University press (India) pvt ltd, 2nd edition, Orient Longman pvt.ltd.

REFERENCE :
1. Data structures and Algorithms in C++, Michael T.Goodrich, R.Tamassia and D.Mount, Seventh Edition Wiley student edition, John Wiley and Sons.
2. Data Structures and Algorithms in C++, Third Edition, Adam Drozdek, Thomson
3. Problem solving with C++, The OOP, Fourth edition, W.Savitch, Pearson education.
4. C++, The Complete Reference, 4th Edition, Herbert Schildt, TMH.
5. Data structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI/Pearson Education.

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POLYMER TECHNOLOGY
(ELECTIVE - I)

Unit - I
Introduction; definitions: polymer& macro molecule , monomer, functionality, average functionality, co-polymer, polymer blend., plastic and resin. Classification of polymers: based on source, structure, applications, thermal behavior, mode of polymerization. Concept of average molecular weight of polymers, molecular weight distribution, poly disparity index. Determination of average molecular weights: End group analysis, osmometry, light scattering techniques, viscometer, Gel permeation chromatography.

Unit-II
Natural polymers: brief study of i) Natural rubber ii) shellac iii) rosin iv) cellulose v) proteins.

Unit-III
Mechanism and kinetics of : Addition or chain polymerization
a) free radical addition polymerisation
b) Ionic addition polymerizations
c) Coordination polymerization.
d) Coordination or step growth or condensation polymerization.

Unit-IV
Methods of polymeisation: mass or Bulk polymerization process, solution polymeisation process, suspension polymeisation process and emulsion polymerisation method comparison of merits and demerits of these methods.Properties of polymers: crystalline and amorphous status, melting and glass transition temperatures and their determination, effect of polymer structure on mechanical, physical, chemical and thermal properties.

Unit-V
Degradation of polymers, Role of the following additives in the polymers: i) Fillers and reinforcing fillers ii) Plasticizers iii) Lubricants iv)Antioxidants and UV stabilizers v) Blowing agents vi)Coupling agents vii)Flame retardents viii) Inhibitors

Unit-VI
Brief description of manufacture, properties and uses of : i) Polyethylene (HDPE&LDPE), ii) Poly propylene iii) Polyvinylchloride iv) Polystyrene v) Polytetra fluoroethylene vi) Polymethyl mehacrylate
vii) Polyvinylacetate & Polyvinylalcohol.

Unit-VII
Brief description of manufacture, properties and uses of : i) Polyesters(Polyethylene terephalate polycarbonate and unsaturated polyesters) ii) Nylon(Nylon 66) iii) Phenol- Formaldehyde resins iv) Epoxy resins v) Polyurethane vi) Silicones

Unit-VIII
Compounding of polymer resins, brief description of : i) Compression and transfer moulding ii) Injection moulding iii) Extrusion iv) Blow moulding v) Calendaring vi) Laminating and pultrusion

TEXT BOOKS:
1. Plastic materials, J.A. Brydson, Newnes-Butterwarths (London) 1989.
2. Text book of polymer science, Bill meyer, F.W.Jr. (3rd ed.) John Wiely&sons 1984

REFERENCES:
1. Introduction to plastics, J.H. Brison and C.C. Gosselin, Newnes, London 1968.
2. Polymeric Materials, C.C.Winding and G.D.Hiatt Mc Graw Hill Book Co. 1961
3. Polymer Science by Gowarikar

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PETROLEUM AND PETRO CHEMICAL TECHNOLOGY
(ELECTIVE - I)

UNIT I
Origin, formation and composition of petroleum: Origin and formation of petroleum, Reserves and deposits of world, Indian Petroleum Industry.

Unit-II:
Petroleum processing data: Evaluation of petroleum, thermal properties of petroleum fractions, important products, properties and test methods.

Unit-III:
Fractionation of petroleum: Dehydration and desalting of crudes, heating of crudepipe still heaters, distillation of petroleum, blending of gasoline.

Unit-IV:
Treatment techniques: fraction-impurities, treatment of gasoline, treatment of kerosene, treatment of lubes.

Unit-V:
Thermal and catalytic processes: Cracking, catalytic cracking, catalytic reforming, Naphtha cracking, coking, Hydrogenation processes, Alkylations processes, Isomerization process.

Unit-VI:
Petrochemical Industry – Feed stocks

Unit-VII:
Chemicals from methane: Introduction, production of Methanol, Formaldehyde, Ethylene glycol, PTFE, Methylamines.

Unit-VIII:
Chemicals from Ethane-Ethylene-Acetylene: Oxidation of ethane, production of Ethylene, Manufacture of Vinyl Chloride monomer, vinyl Acetate manufacture, Ethanol from Ethylene, Acetylene manufacture, Acetaldehyde from Acetylene.

TEXT BOOKS:
1. Petroleum refining Engineering ; WL Nelson Mc Graw Hill company IV addition.
2. Modern Petroleum Refining Processes, 4th ed.,, B.K.bhaskara Rao, Oxford & IBH Publishing,2002.

REFERENCES:
1. The Petroleum chemicals industry by R.F.Goldstine, e & fn London, 1967
2. Chemical technology of petroleum by W.S.Gruese and D.R. Stevens, Mcgraw‘ Hill, 1980
3. Fundamentals of petroleum chemical technology by P Below.
4 Petro Chemicals Volume 1 and 2 ; A Chauvel and Lefevrev ; Gulf Publishing company 1989

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FLUIDIZATION ENGINEERING
(Elective-I)

Unit-I:
Introduction: The phenomenon of fluidization; liquid like behaviour of a fluidized bed; Comparison with other contacting methods; Advantages and disadvantages of fluidized beds.

Unit-II:
Industrial applications of fluidized beds: Coal gasification; gasoline from other petroleum fractions; Gasoline from natural and synthesis gases; Heat exchange; Coating of metal objects with plastics; Drying of solids; Synthesis of phthalic anhydride; Acrylonitrile; Polymerization of olefins; FCCU; Fluidized combustion of coal; incineration of solid waste; Activation of carbon; gasification of waste; bio-fluidization.

Unit-III:
Fluidization and mapping of regimes: Minimum fluidization velocity; Pressure drop vs. velocity diagram; effect of temperature and pressure on fluidization; Geldart classification of particles; terminal velocity of particles; turbulent fluidization; pneumatic transport of solids; fast fluidization; solid circulation systems; Voidage diagram; Mapping of regimes of fluidization.

Unit-IV:
Bubbles in dense bed: Single rising bubbles; Davidson model for gas flow at bubbles; Evaluation of models for gas flow at bubbles.

Unit-V:
Bubbling Fluidized beds: Experimental findings; Estimation of bed porosities; Physical models: simple two phase model; K-L model.

Unit-VI:
High velocity Fluidization: Turbulent fluidized bed; Fast fluidization pressure drop in turbulent and fast fluidization.
Solids Movement, Mixing, Segregation and staging: Vertical movement of solids; Horizontal movement of solids; Staging of fluidized beds.

Unit-VII:
Gas Dispersion and Gas interchange in Bubbling Beds: Dispersion of gas in beds; Gas interchange between bubble and emulsion; Estimation of gas interchange coefficients.
Unit-VIII:
Particle to Gas Mass Transfer: Experimental interpolation of mass transfer coefficients; Heat transfer; Experimental heat transfer from the bubbling bed model.

TEXT BOOKS
1. Fluidization Engineering by Kunil, Diazo and Octave Levenspiel
2. Fluidization by Max Leva.

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MEMBRANE TECHNOLOGY
(Elective-II)

UNIT-I
Introduction: Separation process, Introduction to membrane processes, definition of a membrane, classifications membrane processes.

UNIT-II
Preparation of Syntheic membranes: Types of Membrane materials, preparation of Syntheic membranes, phase inversion membranes, preparation technique for immersion precipitation, preparation technique for composite membranes.

UNIT-III
Characterization of membranes; Introduction, membrane characterization, characterization of porous membranes, characterization of non-porous membranes.

UNIT-IV
Transport in membranes: introduction, driving forces, non equilibrium thermodynamics, transport through porous, non-porous, and ion exchange membranes.

UNIT-V
Membrane Processes: Introduction, osmosis, pressure driven membrane processes: Introduction, microfiltration, membranes for microfiltration, industrial applications, ultrafiltration: membranes for ultrafiltration, industrial applications, reverse Osmosis and nanofiltration: membranes for reverse osmosis and nanofiltration, industrial applications, Electrically Driven processes: Introduction, electrodialysis, Process parameters, membranes for electrodialysis, applications, Membrane electrolysis, Bioploar membranes, Fuel Cells

UNIT-VI
Concentration driven membrane processes: gas separation: gas separation in porous and non porous membranes, membranes for gas separation, applications, pervaporation, membranes for pervaporation, applications, dialysis: membranes for dialysis, applications, liquid membranes: aspects, liquid membrane development, choice of the organic solvent and carrier, applications, introduction to membrane reactors,

UNIT-VII
Polarization phenomenon and fouling: Introduction to concentration polarization, turbulence promoters, pressure drop, gel layer model, osmotic pressure model, boundary layer resistance model, concentration polarization in diffusive membrane separations and electro dialysis, membrane fouling, methods to reduce fouling, compaction.

UNIT-VIII
Module and process design: Introduction, plate and frame module, spiral wound module, tubular module, capillary module, hollow fiber module, comparison of module configurations.

Text Books:

1. M.H.V.Mulder, Membrane Separations, Springer Publications, 2007
2. R.Philip C.Wanket, Rate- Controlled Separations, Springer, 1994.

References:

1. S.P.Nunes, K.V.Peinemann, Membrane Technology in the chemical industry, Wiley-VCH
2. Rautanbach and R. Albrecht, Membrane Process, John Wiley & sons.
3. J.G.Crespo, K.W.Bodekes, Membrane Processes in separation and Purification, Kluwer Academic Publications.
4. Transport processes and Unit Operations by C.J. Geankoplis.

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INDUSTRIAL BIOTECHNOLOGY
(Elective-II)

Unit-I
Fundamentals of biochemical engineering sciences ; Biotechnology – ancient and modern.

Unit-II
Exploitation of microbes – Large scale process, commercial exploitation, microgravity biotechnology (space biotechnology);

Unit-III
Animal biotechnology – application of animal cell culture, monoclonal antibodies, transgenic animal and gene therapy;

Unit-IV
Plant biotechnology – plant cell, tissue and organ culture processes – engineering perspectives;

Unit-V
Large scale separation processes- ATPS, gradient elution and affinity interaction;

Unit-VI
Technoeconomics of biotechnology industries;

Unit-VII
Legal, social and ethical aspects of biotechnology;

Unit-VIII
Biotechnology and the third world.

TEXT BOOK :
1. Text book of Biotechnology ; HK Das, Wiely Dremtechs Publications
2. Concepts in Biotechnology by Balasubramayam, 2nd ed., University Press,2004.

REFERENCES :
1. Molecular biotechnology; Glick and Pasternack,
2. Fundamentals of biochemical engineering ; Baily Ollis
3. Introduction to Biotechnology ; Ray V.Herran, Thomsam publications-2005

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Unix and Shell Programming
(ELECTIVE - II)

Unit I:-
Introduction to Unix:- Architecture of Unix, Features of Unix , Unix Commands – PATH, man, echo, printf, script, passwd, uname, who, date, stty, pwd, cd, mkdir, rmdir, ls, cp, mv, rm, cat, more, wc, lp, od, tar, gzip.

Unit II:-
Unix Utilities:- Introduction to unix file system, vi editor, file handling utilities, security by file permissions, process utilities, disk utilities, networking commands, unlink, du, df, mount, umount, find, unmask, ulimit, ps, w, finger, arp, ftp, telnet, rlogin.

Text processing utilities and backup utilities , detailed commands to be covered are tail, head , sort, nl, uniq, grep, egrep,fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, cpio

Unit III:-

Introduction to Shells:-
Unix Session, Standard Streams, Redirection, Pipes, Tee Command, Command Execution, Command-Line Editing, Quotes, Command Substitution, Job Control, Aliases, Variables, Predefined Variables, Options, Shell/Environment Customization.
Filters:-
Filters and Pipes, Concatenating files, Display Beginning and End of files, Cut and Paste, Sorting, Translating Characters, Files with Duplicate Lines, Count characters, Words or Lines, Comparing Files.

Unit IV:-
grep:-
Operation, grep Family, Searching for File Content.
sed:-
Scripts, Operation, Addresses, commands, Applications, grep and sed.

Unit V:-
awk:-
Execution, Fields and Records, Scripts, Operations, Patterns, Actions, Associative Arrays, String Functions, String Functions, Mathematical Functions, User – Defined Functions, Using System commands in awk, Applications, awk and grep, sed and awk.

Unit VI-

Interactive Korn Shell:-
Korn Shell Features, Two Special Files, Variables, Output, Input, Exit Status of a Command, eval Command, Environmental Variables, Options, Startup Scripts, Command History, Command Execution Process.

Korn Shell Programming:-
Basic Script concepts, Expressions, Decisions: Making Selections, Repetition, special Parameters and Variables, changing Positional Parameters, Argument Validation, Debugging Scripts, Script Examples.

Unit VII-

Interactive C Shell:-
C shell features, Two Special Files, Variables, Output, Input, Exit Status of a Command, eval Command, Environmental Variables, On-Off Variables, Startup and Shutdown Scripts, Command History, Command Execution Scripts.

C Shell Programming:-
Basic Script concepts, Expressions, Decisions: Making Selections, Repetition, special Parameters and Variables, changing Positional Parameters, Argument Validation, Debugging Scripts, Script Examples.

Unit VIII-

File Management:-
File Structures, System Calls for File Management – create, open, close, read, write, lseek, link, symlink, unlink, stat, fstat, lstat, chmod, chown, Directory API – opendir, readdir, closedir, mkdir, rmdir, umask.

TEXT BOOKS :

1. Unix and shell Programming Behrouz A. Forouzan, Richard F. Gilberg.
2. Unix the ultimate guide, Sumitabha Das, TMH. 2nd Edition.

REFERENCES :

1. Unix programming environment, Kernighan and Pike, PHI. / Pearson Education
2. Unix for programmers and users, 3rd edition, Graham Glass, King Ables, Pearson Education.

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IV Year B.Tech. Ch.E. I Sem	**T**	**P**	**C**
	4+1*	**0**	**4**

CHEMICAL ENGINEERING MATHEMATICS
(ELECTIVE - II)

UNIT I

Mathematical formulation of the Physical Problems : (i) Application of the law of conservation of mass-Salt accumulation in a stirred tank- starting an equilibrium still-solvent extraction in two stages-Diffusion with chemical reaction. (ii) Application of the law of conservation of energy-Radial heat transfer through a cylindrical conductor-Heating a closed Kettle-Flow of heat from a fin.

UNIT II

Analytical (explicit) solution of Ordinary differential equation encountered in chemical engineering problems.

(i) First order differential equations-Method of separation of variables- Equations solved by Integration factors-certain examples involving Mass and Energy balances and Reaction Kinetics.

(ii) Second order differential equations-Non-linear equations-linear equations- Simultaneous Diffusion and Chemical reaction in a Tubular reactor- Continuous hydroloysis of Tallow in a spray column.

UNIT III

(i) Formulation of partial differential equations-Unsteady state heat conduction in one dimension-Mass transfer with axial symmetry-Continuity equations.

(ii). Boundary conditions-function specified-Derivative specified and Mixed conditions.

UNIT IV

(i) Iterative solution of algebraic equations.

(a) Jacobi's method (b) Gauss-Siedal Method.

(b) Successive order-relaxation (S.O.R) method.

Unit V

(i) The difference operator-Properties of the diffrerence operator-Difference tables and other difference operators.

(ii) Linear finite difference equations-the complimentary solution of the particular solution-Simultaneous linear differential equations.

UNIT VI

Non-linear finite difference equations-analytical solution. Solution of the following type of problems by finite difference method.

(a) Calculation of the number of plates required for an absorption column.

(b) Calculation of the number of theoretical plates required for distillation column.

(c) Number of steps required for a counter-current extraction and leaching operations.

UNIT VII

Application of Statistical Methods.

(i) Propagation of errors of experimental data.

(ii) Parameter estimation of alge braic equations encountered in Heat and Mass Transfer, Kinetics and Thermodynamics by

(a) The method of averages.

(b) Linear least squares and

(c) Weight linear least squares methods.

UNIT VIII

Design of experiments, Fractional factorial methods.

TEXT BOOK :

1. "Mathematical methods in chemical engineering" by Jenson, V.J. and G.V.Jeffereys, Academic Press. London and New York, 1977

REFERENCE :

1. "Applied Mathematics in Chemical Engineering" by H.S.Mickley, Thoms, K.,Sherwood and C.E.Reed, 2nd ed., Tata McGraw-Hill, Publications, 1975.

2. Applied Mathematical Methods for Chemical Engineers, Norman W. Loney, 2nd edition CRC press, 2007

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PROCESS DYNAMICS AND CONTROL LAB

1. Calibration and determination of time lag of various first and second order instruments
   Major equipment - First order instrument like Mercury-in-Glass thermometer and Overall second order instrument like Mercury-in-Glass thermometer in a thermal well

2. Experiments with single and two capacity systems with and without interaction.
   Major equipment- Single tank system, Two-tank systems (Interacting and Non-Interacting)

3. Level control trainer
   Major equipment - Level control trainer set up with computer

4. Temperature control trainer
   Major equipment - Temperature control trainer with computer

5. Cascade control
   Major equipment - Cascade control apparatus with computer

6. Experiments on proportional, reset, rate mode of control etc.
   Major equipment – PID control apparatus

7. Control valve characteristics
   Major equipment – Control valve set up

8. Estimation of damping coefficient for U-tube manometer
   Major equipment - U-tube manometer

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SIMULATION LAB

The following experiments have to be conducted using C/C++/Simulink using MATLAB

1. Gravity Flow tank.

2. Three CSTR's in series – open loop

3. Three CSTR's in series – Closed loop

4. Non isothermal CSTR

5. Binary Distillation column

6. Batch Reactor isothermal; Batch reactor non isothermal – closed loop

7. Isothermal batch reactor – open loop

8. Heat Exchanger

9. Interacting System- two tank liquid level

10. Non interacting system-two tank liquid level

11. Plug flow reactor

12. Bubble point calculations

13. Dew point calculations

Major requirements are Personnel Computer and MATLAB Software

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INDUSTRIAL POLLUTION CONTROL ENGINEERING

Unit-I
Types of emissions from chemical industries and effects of environment, environment legislation, Type of pollution, sources of wastewater, Effluent guidelines and standards,

Unit-II
Characterization of effluent streams, oxygen demands and their determination (BOD, COD, and TOC), Oxygen sag curve, BOD curve mathematical, controlling of BOD curve, self purification of running streams, sources and characteristics of pollutants in fertilizer, paper and pulp industry, petroleum and petroleum industry.

Unit-III:
General methods of control and removal of sulfur dioxide, oxides of nitrogen and organic vapors from gaseous effluent, treatment of liquid and gaseous effluent in fertilizer industry.

Unit-IV
Air pollution sampling and measurement: Types of pollutant and sampling and measurement, ambient air sampling: collection of gaseous air pollutants, collection of particulate air pollutants. Stack sampling:
sampling system, particulate sampling, and gaseous sampling. Analysis of air pollutants: Sulphur dioxide, nitrogen oxides, carbon monoxide, oxidants and Ozones, hydrocarbons, particulate matter.

Unit-V
Air pollution control methods and equipments: Source collection methods: raw material changes, process changes, and equipment modification. Cleaning of gaseous equipments particulate emission control: collection efficiency, control equipment like gravitational settling chambers, Cyclone separators, fabric filters, ESP and their constructional details and design aspects. Scrubbers: wet scrubbers, spray towers, centrifugal scrubbers, packed beds and plate columns, venturi scrubbers, their design aspects. Control of gaseous emissions: absorption by liquids, absorption equipments, adsorption by solids, equipment and the design aspects.

Unit-VI
Introduction to waste water treatment, biological treatment of wastewater, bacterial and bacterial growth curve, aerobic processes, suspended growth processes, activated aerated lagoons and stabilization ponds,
Attached growth processes, trickling filters, rotary drum filters, anaerobic processes.

Unit-VII:
Methods of primary treatments: screening, sedimentation, flotation, neutralization, and methods of tertiary treatment. A brief study of carbon absorption, ion exchange, reverse osmosis, ultra filtration, chlorination, ozonation, treatment and disposal.

Unit-VIII
Hazardous waste management: Nuclear wastes: health and environment effects, sources and disposal methods. chemical wastes: health and environmental effects, treatment and disposal: treatment and disposal by industry, off site treatment and disposal, treatment practices in various countries. Biomedical wastes: types of wastes and their control.

TEXT BOOKS:

1. Environmental pollution and control engineering, Rao C. S. – Wiley Eastern Limited, India, 1993.
2. Pollution control in process industries by S.P. Mahajan TMH.,1985.

REFERENCES:

1. Waste water treatment by M.Narayana Rao and A.K.Datta,Oxford and IHB publ. New Delhi.
2. Air pollution control by P.Prathap mouli and N.Venkata subbayya. Divya Jyothi Prakashan, Jodhpur.
3. “Industrial Pollution Control and Engineering.” Swamy AVN, Galgotia publications, 2005. KAKINADA

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INDUSTRIAL SAFETY AND HAZARD MANAGEMENT
(Elective III)

Unit I:
Introduction:
Safety program, Engineering ethics, Accident and loss statistics, Acceptable risk, Public perception.

Unit II:
Toxicology:
How toxicants enter biological organisms, How toxicants are eliminated from biological organisms.

Unit III:
Industrial Hygiene:
Government regulations, Identification, Evaluation, Control.

Unit IV:
Fires and Explosions:
The fire triangle, Distinction between fire and explosions; Definitions, Flammability characteristics of liquids and vapors, MOC and inerting, ignition energy, Auto ignition, Auto oxidation, Adiabatic compression, Explosions.

Unit V:
Designs to prevent fires and explosions:
Inerting, Explosion proof equipment and instruments, Ventilations, Sprinkler systems.

Unit VI:
Introduction to Reliefs:
Relief concepts, Definitions, Location of reliefs, Relief types, Data for sizing reliefs, Relief systems.

Unit VII:
Relief Sizing:
Conventional spring operated relief's in liquids, Conventional spring operated relief's in vapor or gas service, Rupture disc relief's in liquid, vapour or gas service.

Unit VIII:
Hazards Identification:
Process hazards checklists, Hazard surveys, Hazop safety reviews.

TEXT BOOK:
1 D.A.Crowl & J.F.Louvar – Chemical Process Safety (Fundamentals with applications), Prentice Hall (1990).
2. Industrial Hygiene and Chemical safety

REFERENCES:
1. H.H.Fawcett and W.S.Wood –Safety and Accident Prevention in Chemical Operations, 2nd edition, John Wiley and sons, New York 1982
2. Coulson and Richardson's – Chemical engineering – R.K.Sinnot, Vol.6, Butterworth-Heinmann Limited 1996.

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DESIGN AND ANALYSIS OF EXPERIMENTS
(ELECTIVE - III)

Unit I :
Introduction to the role of experimental design; basic statistical concepts; sampling and sampling distribution;

Unit II :
Testing of hypotheses about differences in means- randomized designs and paired comparison designs; testing of hypotheses about variances

Unit III :
Analysis of variance (ANOVA) –one-way classification ANOVA; analysis of fixed effects model; comparison of individual treatment means; the random effects model; the randomized complete block design

Unit IV
Factorial design of experiments; two-factor factorial design-fixed effects and random effects model;

Unit V :
General factorial design; analysis of 2^k and 3^k factorial designs

Unit VI :
Conforming in the 2^k factorial design in 2p block; confounding in the 3^k factorial design in 3p block;

Unit VII:
Fractional replication of the 2^k factorial design and the 3^k factorial design

Unit VIII:
Regression analysis- Simple and multiple linear regression and hypothesis testing; response surface methodology-the method of steepness ascent : response surface designs for first-order and second-order models. Evolutionary operation(EVOP)

TEXT BOOK:. “Design and analysis of experiments” by D.C. Montgomery, 2nd edition John Wiley and sons, NewYork (1984).

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TECHNOLOGY OF PHARMACEUTICALS AND FINE CHEMICALS
(ELECTIVE - III)

Unit I:
A brief outline of grades of chemicals, sources of impurities in chemicals, principles (without going into details of individual chemicals) of limit test for arsenic, lead, iron, chloride and sulfate in Pharmaceuticals.

Unit II:
Outlines of Preparation, properties, uses and testing of the following Pharmaceuticals - sulfacetamide, paracetamol, , riboflavin, nicotinamide,

Unit III:
Outlines of Preparation, properties, uses and testing of the following fine chemicals - Methyl orange, fluorescence, procaine hydrochloride, paramino salicylic acid, isonicatinic acid hydrazide.

Unit IV:
Manufacture with flowsheets, properties uses and testing of the following Pharmaceuticals – aspirin, penicillin, calcium gluconate,

Unit V:
Manufacture with flowsheets, properties uses and testing of the following ferric ammonium citrate, pthallic anhydride and phenol flourobenzene process and benzene sulfate process, other processes in outline only.

Unit VI:
Tablet making and coating, granulation equipments

Unit VII:
Preparation of capsules, extraction of crude drugs.

Unit VIII:
Sterilization: introduction, risk factor, methods of sterilization, heat (dry and moist), heating with bactericide, filtration, gaseous sterilization and radiation sterilization, suitable example to be discussed.

TEXT BOOKS :
1. Remington's Pharmaceutical Science, Mac publishing company, 13th ed. 1965.
2. TEXT BOOK of Pharmaceutical Chemistry by Blently and driver. Oxford University press, London, 8th ed. 1960.

REFERENCES :
1. Blently's TEXT BOOK of Pharmaceutical Chemistry by H A Rawlins, B Tindell and Box, 8th ed. OU Press, London, 1977.
2. Industrial Chemicals by Faith, Kayes and Clark, John Wiley & Sons, 3rd Ed. 1965.

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COMPUTER ORGANIZATION
(ELECTIVE - III)

UNIT-I
BASIC STRUCTURE OF COMPUTERS : Computer Types, Functional unit, Basic OPERATIONAL concepts, Bus structures, Software, Performance, multiprocessors and multi computers. Data Representation. Fixed Point Representation. Floating – Point Representation. Error Detection codes.

UNIT-II
REGISTER TRANSFER LANGUAGE AND MICROOPERATIONS : Register Transfer language. Register Transfer Bus and memory transfers, Arithmetic Mircrooperatiaons, logic micro operations, shift micro operations, Arithmetic logic shift unit. Instruction codes. Computer Registers Computer instructions – Instruction cycle.
Memory – Reference Instructions. Input – Output and Interrupt. STACK organization. Instruction formats. Addressing modes. DATA Transfer and manipulation. Program control. Reduced Instruction set computer.

UNIT-III
MICRO PROGRAMMED CONTROL : Control memory, Address sequencing, microprogram example, design of control unit Hard wired control. Microprogrammed control

UNIT-IV
COMPUTER ARITHMETIC : Addition and subtraction, multiplication Algorithms, Division Algorithms, Floating – point Arithmetic operations. Decimal Arithmetic unit Decimal Arithmetic operations.

UNIT-V
THE MEMORY SYSTEM : Basic concepts semiconductor RAM memories. Read-only memories Cachememories performance considerations, Virtual memories secondary storage. Introduction to RAID.

UNIT-VI
INPUT-OUTPUT ORGANIZATION : Peripheral Devices, Input-Output Interface, Asynchronous data transfer Modes of Transfer, Priority Interrupt Direct memory Access, Input –Output Processor (IOP) Serial communication; Introduction to peripheral component, Interconnect (PCI) bus. Introduction to standard serial communication protocols like RS232, USB, IEEE1394.
UNIT-VII
PIPELINE AND VECTOR PROCESSING : Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline Vector Processing, Array Processors.

UNIT-VIII
MULTI PROCESSORS : Characteristics or Multiprocessors, Interconnection Structures, Interprocessor Arbitration. InterProcessor Communication and Synchronization Cache Coherance. Shared Memory Multiprocessors.

TEXT BOOKS :
1. Computer Systems Architecture – M.Moris Mano, IIIrd Edition, Pearson/PHI
2. Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, Vth Edition, McGraw Hill.

REFERENCES :
1. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI
2. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition PHI/Pearson
3. Fundamentals or Computer Organization and Design, - Sivaraama Dandamudi Springer Int. Edition.
4. Computer Organization, Anjaneyulu, Himalaya Pub house.

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OPTIMIZATION OF CHEMICAL PROCESSES
(ELECTIVE - IV)

Unit-I:
Nature and organization of optimization problems: what optimization is all about, Why optimize, scope and hierarchy of optimization, examples of applications of optimization, the essential features of optimization problems, general procedure for solving optimization problems, obstacles to optimization. Classification of models, how to build a model, fitting functions to empirical data, the method of least squares, factorial experimental designs, fitting a model to data subject to constraints.

Unit-II:
Basic concepts of optimization: Continuity of functions, unimodal versus Multimodel functions. Convex and Concave functions, Convex region, Necessary and sufficient conditions for an extremum of an unconstrained function, interpretation of the objective function in terms of its quadratic approximation.

Unit-III:
optimization of unconstrained functions: one-dimensional search:
Numerical methods for optimizing a function of one variable, scanning and bracketing procedures, Newton's, Quasi-Newton's and Secant methods of uni-dimensional search, region elimination methods, polynomial approximation methods, how the one- dimensional search is applied in a multi-dimensional problem, evaluation of uni-dimensional search methods.

Unit-IV:
unconstrained multivariable optimization:
Direct methods, random search, grid search, uni-variate search, simplex method, conjugate search directions, Powell's method, indirect methods- first order, gradient method, conjugate method, indirect method- second order: Newton's method forcing the Hessain matrix to be positive definite, movement in the search direction, termination, summary of Newton's method, relation between conjugate gradient methods and Quasi-Newton method.

Unit – V:
Linear programming and applications:
Basic concepts in linear programming, Degenerate LP's – graphical solution, natural occurrence of linear constraints, the simplex method of solving linear programming problems, standard LP form, obtaining a first feasible solution, the revised simplex method, sensitivity analysis, duality in linear programming, the Karmarkar algorithm, LP applications.

Unit-VI:
Optimization of Unit operations-1 recovery of waste heat, shell & tube heat exchangers, evaporator design, liquid liquid extraction process, optimal design of staged distillation column.

Unit-VII:
Optimization of Unit operations-2 Optimal pipe diameter, optimal residence time for maximum yield in an ideal isothermal batch reactor, chemostat, optimization of thermal cracker using liner programming.

Unit-VIII:
Genetic Algorithms: (Qualitative treatment) Working principles, differences between GAs and traditional methods, similarities between GAs and traditional methods, GAs for constrained optimization, other GA operators, real coded GAs, Advanced Gas

TEXT BOOK:
1. Optimization of chemical processes by T.F.Edgar and Himmelblau DM.Mc- Graw. Hill.2001.
2. Optimization for Engineering Design, Kalyan Moy Deb, PHI-2000

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OPERATIONS RESEARCH
(ELECTIVE - IV)

UNIT – I
Development – Definition– Characteristics and Phases – Types of models – operation Research models – applications.
ALLOCATION: Linear Programming Problem Formulation – Graphical solution – Simplex method – Artificial variables techniques -Two–phase method, Big-M method – Duality Principle.

UNIT – II
TRANSPORTATION PROBLEM – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.
Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem- Traveling Salesman problem.
SEQUENCING – Introduction – Flow **–**Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines.

UNIT – III
REPLACEMENT: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely, group replacement.

UNIT – IV
THEORY OF GAMES: Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – 2 X 2 games – dominance principle – m X 2 & 2 X n games –graphical method.

UNIT – V
WAITING LINES: Introduction – Single Channel – Poisson arrivals – exponential service times – with infinite population and finite population models– Multichannel – Poisson arrivals – exponential service times with infinite population single channel Poisson arrivals.

UNIT – VI
INVENTORY: Introduction – Single item – Deterministic models – Purchase inventory models with one price break and multiple price breaks – shortages are not allowed – Stochastic models – demand may be discrete variable or continuous variable – Instantaneous production. Instantaneous demand and continuous demand and no set up cost.

UNIT – VII
DYNAMIC PROGRAMMING:
Introduction – Bellman's Principle of optimality – Applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem.

UNIT – VIII
SIMULATION: Definition – Types of simulation models – phases of simulation– applications of simulation – Inventory and Queuing problems – Advantages and Disadvantages – Simulation Languages.

TEXT BOOK :
1. Operations Research / S.D.Sharma-Kedarnath.

REFERENCES :

1. Operations Research /A.M.Natarajan,P.Balasubramani,A. Tamilarasi/Pearson Education.
2. Operations Research: Methods and Problems / Maurice Saseini, Arhur Yaspan and Lawrence Friedman
3. Operations Research / R.Pannerselvam,PHI Publications.
4. Operations Research / Wagner/ PHI Publications.
5. Operation Research /J.K.Sharma/MacMilan.
6. Introduction to O.R/Hiller & Libermann (TMH).
7. O.R/Wayne L.Winston/Thomson Brooks/cole
8. Introduction to O.R /Taha/PHI

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ENERGY ENGINEERING
(Elective- IV)

Unit I:
Sources of energy, types of fuels- energy and relative forms. Calorific value- gross and net value, calculation of calorific value from fuel analysis, experimental determination energy resources present and future energy demands with reference to India.

Unit II:
Coal: origin, occurrence, reserves, petrography, classification, ranking, analysis, testing, storage, coal carbonization and byproduct recovery, liquefaction of coal, gasification of coal, burning of coal and firing mechanism, burning of pulverized coal.

Unit III:
Liquid fuels: petroleum: origin, occurrence, reserves, composition, classification, characteristics, fractionation, reforming, cracking, petroleum products, specification of petroleum products, burning of liquid fuels.

Unit IV:
Natural gas, coke oven gas, producer gas, water gas, LPG, burning of gaseous fuels, hydrogen (from water) as future fuel, fuel cells, flue gas, analysis: orsat apparatus

Unit V:
Energy auditing: short term, medium term, long term schemes, energy conversion, energy index, energy cost, representation of energy consumption, Sankey diagram, energy auditing.

Unit VI:
Steam Plant: Run time cycle, boiler plant, steam cost, steam distribution and utilization, combined heat and power systems, energy from biomass and biogas plants, gas purification, solar energy, wind energy, energy storage

Unit VII:
Waste heat recovery, sources of waste heat and potential application, various types of heat recovery systems, regenerators, recuperators, waste heat boilers

Unit VIII
Energy conservation: conservation methods in process industries, theoretical analysis, practical limitations.

TEXT BOOKS
1. Fuels , furnaces and refractories by O.P.Gupta.
2. Fuels and combustion by Sami Sarkar 2nd edition orient Longman (1998).

REFERENCES
1. Non-conventional energy resources by G.D.Rai
2. Solar energy by S.P.Sukhathame
3. Conventional energy technology, Fuel and chemical energy by Tata McGraw- Hill book Co.Ltd. (1987)
4. Fuel and energy by harker and Backhurst Academic press London 1981
5. Fuel science- harker and Allen Oliver and Boyd 1972
6 W.R.Murphy, G.Mc.Kay- Energy Management, 1st edition – Butterwolfer &Co.Ltd.(2001)
7. Energy management by Turner

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OPERATING SYSTEMS
(ELECTIVE – IV)

UNIT I :
Computer System and Operating System Overview: Overview of computer operating systems operating systems functions protection and security distributed systems special purpose systems operating systems structures and systems calls operating systems generation

UNIT II :
Process Management – Process concepts threads, scheduling-criteria algorithms, their evaluation, Thread scheduling, case studies UNIX, Linux, Windows

UNIT III :
Concurrency : Process synchronization, the critical- section problem, Peterson's Solution, synchronization Hardware, semaphores, classic problems of synchronization, monitors, Synchronization examples, atomic transactions. Case studies UNIX, Linux, Windows

UNIT IV :
Memory Management : Swapping, contiguous memory allocation, paging, structure of the page table , segmentation, virtual memory, demand paging, page-Replacement, algorithms, case studies UNIX, Linux, Windows

UNIT V :
Principles of deadlock – system model, deadlock characterization, deadlock prevention, detection and avoidance, recovery form deadlock,
I/O systems, Hardware, application interface, kernel I/O subsystem, Transforming I/O requests Hardware operation, STREAMS, performance.

UNIT VI :
File system Interface- the concept of a file, Access Methods, Directory structure, File system mounting, file sharing, protection.
File System implementation- File system structure, file system implementation, directory implementation, directory implementation, allocation methods, free-space management, efficiency and performance, case studies. UNIX, Linux, Windows

UNIT VII :
Mass-storage structure overview of Mass-storage structure, Disk structure, disk attachment disk scheduling, swap-space management, RAID structure, stable-storage implementation, Tertiary storage structure.

UNIT VIII :
Protection : Protection, Goals of Protection, Principles of Protection, Domain of protection Access Matrix, Implementation of Access Matrix, Access control, Revocation of Access Rights, Capability- Based systems, Language – Based Protection,
Security- The Security problem, program threats, system and network threats cryptography as a security tool, user authentication, implementing security defenses, firewalling to protect systems and networks, computer – security classifications, case studies UNIX, Linux, Windows

TEXT BOOKS :
1. Operating System Concepts- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley.
2. Operating systems- A Concept based Approach-D.M.Dhamdhere, 2nd Edition, TMH

REFERENCES :
1. Operating Systems' – Internal and Design Principles Stallings, Fifth Edition–2005, Pearson education/PHI
2. Operating System A Design Approach-Crowley, TMH.
3. Modern Operating Systems, Andrew S Tanenbaum 2nd edition Pearson/PHI.

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INDUSTRY ORIENTED MINI PROJECT

a. Observation of operating chemical plants. Noting down operating procedures, construction details, management procedures. Doing a project related to the selected industry.

b. Developing experimental setup and studying the effect of operating parameters on process performance

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SEMINAR

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PROJECT WORK

The project work may consist of any one of the following works.

a) The project work should consist of a comprehensive design project of a chemical plant in the form of a report with the following chapters.

1. Introduction
2. Physical and Chemical Properties and uses
3. Literature survey for different processes
4. Selection of the process
5. Material and Energy balances
6. Specific equipment design, (Process as well as mechanical design with drawing), including computer programs where possible, of Heat Transfer equipments or separation equipments or reactors
7. General equipment Specifications
8. Plant location and layout
9. Materials of construction
10. Health and Safety factors
11. Preliminary cost estimation
12. Bibliography

b) Modelling & Simulation of any Chemical Engineering Process

c) Any experimental work with physical interpretations

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COMPREHENSIVE VIVA

Questions should be asked from Momentum transfer, Process heat transfer, Chemical Engineering thermodynamics, Mass transfer operations, Chemical Reaction Engineering, Process dynamics & control