CHEMICAL ENGINEERING

I SEMESTER :

COURSE CODE	THEORY/LAB	L	T	P	C
AHE1101	English	4	0	0	4
ABM1101	Mathematics-I	4	1	0	4
ABC1101	Chemistry	4	1	0	4
ACH1101	Introduction to Chemical Engineering	4	1	0	4
ACT1102	Computer Programming through C	4	1	0	4
AHE1102	*English Language Lab.*	*0*	*0*	*3*	*2*
ACT1103	*Computer Programming Lab.*	*0*	*0*	*3*	*2*
AMT1101	*Engineering Workshop*	*0*	*0*	*3*	*2*
	Total	**20**	**4**	**9**	**26**

II SEMESTER :

COURSE CODE	THEORY/LAB	L	T	P	C
ABM1102	Mathematics-II	4	1	0	4
AME1103	Engineering Mechanics	4	1	0	4
ABP1101	Physics	4	1	0	4
ABC1102	Organic Chemistry	4	1	0	4
ABE1101	Environmental Studies	4	0	0	4
ABP1102	*Physics and Chemistry Lab*	*0*	*0*	*3*	*2*
ABC1103	*Organic Chemistry Lab*	*0*	*0*	*3*	*2*
AME1102	*Engineering Drawing*	*0*	*0*	*3*	*2*
	Total	**20**	**4**	**9**	**26**

III SEMESTER :

COURSE CODE	THEORY/LAB	L	T	P	C
ABM1105	Probability & Statistics	4	1	0	4
ACH1102	Momentum Transfer	4	1	0	4
ACH1103	Chemical Process Calculations-I	4	0	0	4
ABC1104	Physical Chemistry	4	0	0	4
ACH1104	Mechanical Unit Operations	4	0	0	4
ACH1105	Process Instrumentation	4	0	0	4
ACH1106	*Mechanical Unit Operations Lab.*	*0*	*0*	*3*	*2*
ABC1105	*Physical Chemistry Lab.*	*0*	*0*	*3*	*2*
	Total	**24**	**2**	**6**	**28**

IV SEMESTER :

COURSE CODE	THEORY/LAB	L	T	P	C
ACH1107	Heat Transfer	4	0	0	4
AHM1102	Management Science	4	0	0	4
ACH1108	Chemical Process Calculations-II	4	1	0	4
ACH1109	Materials Science For Chemical Engineers	4	0	0	4
ACH1110	Mass Transfer Operations-I	4	1	0	4
ACH1111	Chemical Engg. Thermodynamics-I	4	0	0	4
ACH1112	*Heat Transfer Lab*	*0*	*0*	*3*	*2*
ACH1113	*Momentum Transfer Lab.*	*0*	*0*	*3*	*2*
	Total	**24**	**2**	**6**	**28**

V SEMESTER :

COURSE CODE	THEORY/LAB	L	T	P	C
ACH1114	Chemical Engg. Thermodynamics - II	4	0	0	4
ACH1115	Chemical Reaction Engineering-I	4	1	0	4
ACH1116	Mass Transfer Operations-II	4	1	0	4
ACH1117	Industrial Pollution & Control	4	0	0	4
ACH1118	Design & Analysis Of Experiments	4	0	0	4
ACH1119	General Chemical Technology	4	0	0	4
ACH1120	Chemical Reaction Engg. Lab	0	0	3	2
ACH1121	Mass Transfer Lab	0	0	3	2
	Total	**24**	**2**	**6**	**28**

VI SEMESTER :

COURSE CODE	THEORY/LAB	L	T	P	C
ACH1122	Process Modeling & Simulation	4	1	0	4
ACH1123	Process Dynamics And Control	4	1	0	4
ACH1124	Chemical Reaction Engineering-II	4	0	0	4
ACH1125	Chemical Plant Design & Economics	4	0	0	4
ACH1126	Biochemical Engineering	4	0	0	4
ACH1127	Chemical Process Equipment Design-I	4	0	0	4
AHE1103	Advanced Communication Skills Lab	0	0	3	2
ACH1128	Process Dynamics & Control Lab.	0	0	3	2
	Total	**24**	**2**	**6**	**28**

VII SEMESTER :

COURSE CODE	THEORY/LAB	L	T	P	C
ACH1129	Chemical Process Equipment Design-II	4	0	0	4
ACH1130	Transport Phenomena	4	1	0	4
ACH1131	Chemical Engineering Mathematics	4	1	0	4
ACH1132	Membrane Separation Processes	4	0	0	4
	Elective-I	4	0	0	4
ACH1133	Applied Numerical Methods				
ACH1134	Corrosion Engineering				
ACH1135	Safety and Hazard Analysis				
AME1135	Non-Conventional Sources of Energy				
AEC1130	Bio-Medical Instrumentation				
	Elective-II	4	0	0	4
ACH1136	Polymer Engineering				
ACH1137	Petroleum Refining and Petrochemicals				
ACH1138	Energy Engineering				
AIT1114	Data Structures for Engineering Applications	4	1	0	4
ACS1115	Software Development Engineering				
ACH1139	Computer Aided Design of				
	Chemical Equipment Lab	0	0	3	2
ACH1140	Application Of MATLAB In Chemical Engg	0	0	3	2
ACH11MP	Industry Oriented Mini-Project	-	-	-	2
	Total	**24**	**2**	**6**	**30**

VIII SEMESTER :

COURSE CODE	THEORY/LAB	L	T	P	C
ACH1141	Optimization Of Chemical Processes	4	0	0	4
	Elective-III	4	0	0	4
ACH1142	Biological Waste Water Treatment				
ACH1143	Computational Fluid Dynamics				
ACH1144	Green Chemical Engineering				
AEC1142	Process Control and Automation				
	Elective-IV	4	0	0	4
ACH1145	Instrumentation Methods				
ACH1146	Down Stream Processing				
	In Bio processing				
ACH1147	Nano Technology				
ACH1148	Optimization Techniques				
ACH11SM	Seminar	0	0	3	2
ACH11CV	Comprehensive Viva	-	-	-	4
ACH11PW	Project Work	0	0	9	12
	Total	**12**	**0**	**12**	**30**

SYLLABI FOR I SEMESTER

ENGLISH

Course Code : AHE1101

L	T	P	C
4	0	0	4

Reading and Writing skills

OBJECTIVES :

The primary objective of the course is to help students of engineering to achieve a sound foundation in communicational skills, basic grammar and vocabulary. It also enables them to become successful communicators in academic, professional and social areas of life.

The course aims to enable the students to use English effectively for the purpose of

- Understanding class room lectures in different subjects
- Reading technical and general materials
- Effective written communication in professional contexts

OUTCOMES :

- The learners develop adequate skills in skimming, scanning, intensive and extensive reading
- The learners also develop enough vocabulary to be clearly expressive in any group - Professional or Managerial or Social
- The learners can correspond and communicate in descriptive, analytical modes with ease.

COURSE WORK :

To achieve the above objectives, instruction will be imparted through relevant ESP materials, articles from newspapers, technical journals, magazines, industry materials etc. in classes and laboratory. Students will be given individual and holistic practice in LSRW skills.

Contents :

Reading :

- Reading with a purpose; Reading for understanding; skimming, scanning etc;
- Reading and interpreting charts and diagrams
- Vocabulary, synonyms, antonyms, prefixes, suffixes, confusables, one-word substitutes etc.

Writing :

- common errors, articles, prepositions, tenses, concord, phrasal verbs, modals, conditionals etc. (Remedial Grammar)
- Practice of writing- definition, description
- Paragraph writing with coherence, cohesiveness and clarity
- Essay, report and précis writing

Reference skills **:** Use of dictionary, thesaurus, library and internet materials.

UNIT - I

1. Around the House *(Language in Use)*
2. Education on Education *(English for Engineers)*

UNIT - II

1. On Holiday *(Language in Use)*
2. Vocabulary- synonyms, antonyms, prefixes, suffixes, confusables, one-word substitutes etc.

UNIT - III

1. Imagining *(Language in Use)*
2. Tenses & Concord, Articles & Prepositions

UNIT - IV

1. New Information Technology and Poverty Eradication (English for Engineers)
2. The media (Language in Use)

UNIT - V

1. What we must Learn from the West *(English for Engineers)*
2. Paragraph writing, Note-making and Minute writing

UNIT - VI

1. Essay writing
2. Value added Life *(English for Engineers)*

UNIT - VII

1. Breaking the Law *(Language in Use)*
2. Key item *(English for Engineers)*

UNIT - VIII

1. Letter and Précis writing
2. Dialogue writing

TEXT BOOKS :

1. "Language in Use(Intermediate)", Cambridge University Press India Pvt. Ltd.- Reprint-2008.
2. "English for Engineers", Regional Institute of English, Bangalore, Foundation Books Pvt. Ltd, 2006.

REFERENCES :

1. Eric H. Glendinning & Beverly Holmstorm,"Study reading- A course in Reading Skills for Academic Purposes"-CUP, 2004.
2. Liz Hamp Lyons, Ben Heasley, "Study Writing", CUP, 2004.
3. Norman Lewis, "Word Power Made Easy", Lotus Press, 2006.
4. Michael Swan, "Practical English Usage", Oxford University Press, 3rd Edition, 2005.
5. Murphy "Murphy's English Grammar", CUP, 3rd Edition, 2004.

SUGGESTED READING : Stories of humour, adventure, mystery and autobiographies of eminent scientists.

MATHEMATICS – I

(Common to all Branches)

Course Code : ABM1101

L	T	P	C
4	1	0	4

AIM :

To impart the necessary fundamental principles that are essential to study the core courses of Engineering.

OBJECTIVE :

To motivate and inculcate the logical thinking and methodical approach to solve mathematical problems

UNIT - I

Sequences – Series – Convergence and divergence – Comparison test – Ratio test –Integral test –Alternating series, Leibniz's test

(9.1 to 9.9, 9.12).

Rolle 's theorem – Lagrange's Mean Value Theorem – Cauchy's mean value Theorem –Taylor's theorem and Maclaurin's series (all theorems without proof)

(4.3, 4.4).

UNIT - II

Differential equations of first order (linear, Bernoulli), Linear differential equations with constant coefficients, Method of Variation of parameters .

(11.9, 11.10, 13.1, 13.3-13.8(i), 13.9)

UNIT - III

Applications of Linear differential equations: orthogonal trajectories, Newton's law of cooling, Simple harmonic motion, Oscillatory electrical circuits (LC and LCR circuits).

(12.3, 12.6, 14.2, 14.5)

UNIT - IV

Laplace transform of elementary functions, properties, Transforms of derivatives and integrals – Unit step function – second shifting theorem, Periodic function.

(21.1-21.5, 21.7-21.11)

UNIT - V

Inverse transform –- Inverse transform of Derivatives and Integrals - Convolution theorem – Application of Laplace transforms to ordinary differential equations, Unit step function, Unit impulse function.

(21.12-21.15, 21.17, 21.18)

UNIT - VI

Partial differentiation: Total derivative, change of variables, Jacobians, Taylor's theorem for functions of two variables, maxima and minima of functions of two variables.

(5.5 – 5.9, 5.11)

UNIT - VII

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

(17.1 to 17.3, 17.5, 17.6)

UNIT - VIII

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.

(18.1 to 18.7)

Text Book :

Dr.B.S.Grewal "Higher Engineering Mathematics", 40th Edition, Khanna Publishers

References :

1. Kreyszig E, "Advanced Engineering Mathematics", 8th Edn, John Wiley, Singapore (2001).
2. Greenberg M D, "Advanced Engineering Mathematics", 2nd Edn, Pearson Education, Singapore, Indian Print (2003).

CHEMISTRY

Course Code : ABC1101

L	T	P	C
4	1	0	4

AIM :

The aim of the course is to provide basic chemistry background required for under graduate students of engineering.

OBJECTIVE :

The Objective of the course is to provide an over view of chemical properties of materials which the engineers are likely to use during their professional careers.

UNIT - I

ELECTROMOTIVE FORCE

Electrode potential, Nernest equation, EMF of electro chemical cell, calculation of cell potential, concentration cell, determination of P^H of solution.

BATTERIES - primary cell-Dry or Lachanche cell, alkaline battery; secondary cells (storage batteries or accumulators) – Lead-acid Accumulator, Nickel-cadmium battery.and lithium ion battery.

Fuel cells - hydrogen, oxygen fuel cell, phosphoric acid fuel cell, solid oxide fuel cells.

UNIT - II

CORROSION AND ITS CONTROL

Introduction-Dry or chemical corrosion, Wet or Electrochemical corrosion-Hydrogen evolution type, oxygen absorption type, Galvanic corrosion and concentration cell corrosion, pitting ,waterline, and stress corrosion; passivity; Galvanic series; factors influencing corrosion. Corrosion control-proper designing, cathodic protection, modifying the environment and using

inhibitors. Protective coatings- anodic and cathodic coatings; Hot dipping-Galvanizing and Tinning, Metal cladding; Electroplating; Electro less plating; cementation or diffusion coatings.

UNIT - III
CHEMICAL KINETICS

Arrhenius theory-effect of temperature on reaction rates –concept of activated complex; collision theory of reaction rates; Lindeman's theory of unimolecular reactions, steady state approximation; Transition state theory.

UNIT - IV
BONDING IN COORDINATION COMPOUNDS

Valence bond theory- limitations, crystal field theory, ligand field theory-octahedral and tetrahedral complexes. Spectral properties of d^1 ions & magnetic properties of low spin and high spin complexes.Molecular orbital theory as applied to octahedral complexes not involving pi-bonding.

UNIT - V
PRINCIPLES AND MECHANISMS OF ORGANIC REACTIONS

Bond fission – homolysis and heterolysis-examples. Types of reagents-electrophilic and nucleophilic reagents -examples. Concept of aromaticity, Huckel's (4n+2) rule. Introduction to mechanistic aspect of electrophilic aromatic substitution- nitration, sulphonation. Friedel-Crafts alkylation and acylation.

UNIT - VI
POLYMER SCIENCE AND TECHNOLOGY

Nomenclature; Types of polymerization, Mechanism of addition and condensation polymerization, Effect of polymer structure on properties. Plastics- Thermo and thermosetting plastics, constituents of a plastic. Preparation, properties and uses of polythene, PVC, Teflon, nylons-6,6, bakelite and silicones.

RUBBER - Natural rubber-structure-vulcanization, compounding of rubber; synthetic rubbers-Buna-Sand Buna-N.

UNIT - VII

SEMI CONDUCTING MATERIALS

Band theory of solids, Types-Intrinsic, extrinsic,(n-type, p-type,) non-elemental semi conducting materials- stoichiometric semi conducting compounds, defect semiconductors, controlled valency semiconductors. Preparation of semiconductors- Zone refining, Czochralski crystal pulling technique, Doping technique.

UNIT - VIII

CHEMISTRY OF ENGINEERING MATERIALS

Cement - classification; Portland cement- raw materials, manufacture of Portland cement, chemical constitution of Portland cement, setting and hardening of Portland cement.

REFRACTORIES - Classification and properties of refractories

FUELS - classification; calorific value and its determination using Bomb and Junker's gas calorimeter, theoretical calculation of calorific value-Proximate and ultimate analysis of coal; Refining of petroleum-, catalytic cracking; catalytic reforming, knocking, octane rating, improvement in anti knock characteristics, unleaded petrol; diesel engine fuels, cetane value

LUBRICANTS - Friction- mechanism of lubrication-Fluid film lubrication; thin or boundary lubrication and extreme pressure lubrication, classification-Lubricating oils, greases and solid lubricants.

TEXT BOOKS :

1. Jain& Jain, "A text book of Engineering Chemistry", Dhanapat Roy publishing company, 15th Edition, 2006.
2. Shiva Shankar, "Engineering Chemistry", Tata Mc Graw Hill, 2008.

REFERENCES :

1. Engineering Chemistry –Sashi Chawala, Dhanpath Rai Publications, 3rd Edition, 2010.
2. C. Parameswara Murthy, C.V. Agarwal and Andhra Naidu, "A Text Book of Engineering Chemistry", B.S. Publications, 1st Edition, 2006.

3. J.D. Lee, "Concise inorganic Chemistry", Black Well Science Publications, 5th Edition, 2005.

4. Arun Bahl & B.S.Bahl, "Advanced Organic Chemistry", S.Chand Publications, 2010.

5. Gurudeep Raj, "Physical chemistry", Goel Publications, 3rd Edition, 2007.

6. S.S. Dara, "Text book of Engineering Chemistry", S. Chand Publications, 11th Edition, 2006.

INTRODUCTION TO CHEMICAL ENGINEERING

Course Code : ACH1101

L	T	P	C
4	1	0	4

AIM :

To introduce the student to the fundamental principles of Chemical Engineering.

OBJECTIVES :

The student should be able to learn the basics of

a) Unit Operations
b) Materials Energy Balance
c) Fluid Mechanics
d) Heat Transfer
e) Mass Transfer

UNIT - I

Introduction, units and dimensions, unit processes, unit operations, Basic laws of heat mass and energy.

UNIT - II

Energy, 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.

UNIT - IV

Reciprocating, rotary, and centrifugal pumps.

UNIT - V

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.

UNIT - VI

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 - VII

Mass transfer: Diffusion, mass transfer operation, absorption, Vapour-Liquid Equilibrium, Relative Volatility, Distillation with Reflux, Liquid- Liquid Extraction, Distribution Coefficient, Triangular graphs, Selection of Solvent.

UNIT - VIII

Equipment of Gas-Liquid Operations, Selection of Equipment for gas-liquid operations.

TEXT BOOK :

1. S. K. Ghosal, S. K. Sanyal and S. Dutta, "Introduction to Chemical Engineering", Tata McGraw Hill Publications, 1993.

REFERENCE :

1. W.L. McCabe and J.C. Smith and Peter Harriott, "Unit Operations in Chemical Engineering", Mc Graw Hill 5th Edn. 1993.

COMPUTER PROGRAMMING THROUGH C

Course Code : ACT1102

L	T	P	C
4	1	0	4

AIM :

To give the basic idea about programming.

OBJECTIVE :

To make the students capable of programming in high level computer languages as well as applications.

UNIT - I

Algorithm, Flow chart, Program development steps, Basic structures of C Language, C tokens, Data types and sizes, Declaration of variables, Assigning values, Arithmetic, Relational and Logical operators, Increment and decrement operators, Conditional operator, Bitwise operators, Type conversions, Expressions, evaluation, Input output statements, blocks.

UNIT - II

If and switch statements, while, do while and for statements. C programs covering all the above aspects.

UNIT - III

One dimensional and two dimensional arrays, Initialization, String variables declaration, reading, writing, basics of functions, parameter passing, String handling functions.

UNIT - IV

User defined functions, recursive functions, variables and storage classes, scope rules, block structure, header files, C preprocessor, Example C Programs.

UNIT - V

Pointers and arrays: Pointers and addresses, Pointers and arrays, Pointers and function arguments, address arithmetic, character pointers and functions

UNIT - VI

Pointers to pointers, multi-dimensional arrays, initialization of pointer arrays, command line arguments, pointers to functions, function pointers.

UNIT - VII

Structure definition, initializing, assigning values, passing of structures as arguments, arrays of structures, pointers to structures, self reference to structures, unions, type-defs, bit fields, C program examples.

UNIT - VIII

Console and file-I/O: Standard I/O, Formatted I/O, Opening and closing of files, I/O operations on files, command line arguments.

TEXT BOOKS :

1. Herbert Schild, "Complete Reference Using C", 4th Edition, Tata McGraw Hill, 2009.
2. Yashawanth Kanethkar, "Let us C", 9th Edition, BPB Publishers, 2009.

REFERENCES :

1. B.A.Fouruzan and R.F.Gilberg, "Computer Science, A structured Programming Approach using C", 3rd Edition, Thomson Publishers, 2008.
2. B.W.Kerninghan and Dennis M. Ritche, "C Programming Language", 2nd Edition, Pearson Education, 2009.
3. Stephen G.Kochan, "Programming in C" 3rd Edition, Pearson Education, 2005.
4. N. B. Venkateswarlu, E. V. Prasad, "C & Data structures", 1st Edition, S. Chand Publications, 2002.

ENGLISH LANGUAGE LAB

Course Code: AHE1102

L	T	P	C
0	0	3	2

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 :

- To make students recognise the sounds of English through Audio-Visual Aids and Computer Software.
- To help them overcome their inhibitions and self- consciousness while speaking in English and to build their confidence. *The focus shall be on fluency rather than accuracy.*
- To enable them to speak English correctly with focus on stress and intonation.

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/Speaking personally
5. 'Just A Minute' Sessions (JAM).
6. Describing things / Narration
7. Information Transfer
8. Debate
9. Telephoning Skills.
10. Giving Directions.

SUGGESTED SOFTWARE :

- Cambridge Advanced Learners' English Dictionary with CD.
- The Rosetta Stone English Library
- Clarity Pronunciation Power
- Mastering English in Vocabulary, Grammar, Spellings, Composition
- Dorling Kindersley series of Grammar, Punctuation, Composition etc.
- Language in Use, Foundation Books Pvt Ltd with CD.
- Learning to Speak English - 4 CDs
- Microsoft Encarta with CD
- Murphy's English Grammar, Cambridge with CD

REFERENCES :

1. Spoken English (CIEFL) in 3 volumes with 6 cassettes, OUP.
2. Daniel Jones, "English Pronouncing Dictionary", Current Edition with CD.
3. R. K. Bansal and J. B. Harrison, "Spoken English", Orient Longman 2006.
4. J. Sethi, Kamlesh Sadanand & D.V. Jindal, "A Practical course in English Pronunciation, (with two Audio cassettes)", Prentice-Hall of India Pvt. Ltd., New Delhi.
5. T.Balasubramanian (Macmillan), "A text book of English Phonetics for Indian Students", 18th Reprint, 2005.
6. English Skills for Technical Students, WBSCTE with British Council, OL

COMPUTER PROGRAMMING LAB

Course Code : ACT1103

L	T	P	C
0	0	3	2

AIM :

To give basic knowledge with practical orientation of programming language.

OBJECTIVE :

To train the students to write programmes in C language for different applications.

LIST OF PROGRAMMES :

1. To write C programs for the following
   a) 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 to generate the first n terms of the Fibonacci sequence.

2
   a) To write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user
   b) To write a C program to calculate the following sum:
   Sum=$1+x^2/2!+x^4/4!$ ———————— upto given 'n' terms.
   c) To write a c program to find the roots of a quadratic equation.

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

4. The total distance traveled 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 a C program to find the distance traveled at regular intervals of time given 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'.

5. Using switch-case statement, write a C program that takes two operands and one operator from the user, performs the operation and then prints the answer. (consider operators +, -, *, and %).

6. Write a C program to find the largest and smallest number in a list of integers.

7. Write a C program that uses functions to perform the following
   a. Addition of Two Matrices
   b. Multiplication of Two Matrices

8. Write a C program that uses functions to perform the following operations
   a. To insert a sub-string in to given main string from a given position
   b. To delete n characters from a given position in given string.

9. Write a C program to determine if the given string is a palindrome or not.

10.
   a) Write a C program that displays the position or index in the string S where the string T begins, or -1 if S does not contain T.
   b) Write a C program to count the lines, words and characters in a given text.

11. To write a C program
   a) to generate Pascal's triangle
   b) to construct a pyramid of numbers

12. To write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression $1+x+x^2+x^3+\ldots x^n$
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 nest pair of numbers of without computing the sum. Are any values of x also illegal? If so, test for them too..

13. To write a C program
    a) to find the 2's compliments of a binary number.
    b) to convert a Roman numeral to its decimal equivalent

14. To write a C program that uses functions to perform the following operations
    a. Reading a complex number
    b. Writing a complex number
    c. Addition of 2 complex numbers
    d. Multiplication of 2 complex numbers
    (Note: represent complex number using a structure)

15. To write a C program
    a) to copy the contents from one file to another.
    b) to reverse the first n characters in a file.

    (Note: the file name and n are specified on the command line)

    c) to fine the no. of characters, no. of words, no. of lines in a given file.

16. To implement the algorithms for the below given iterative methods using C to find one root of the equation f(x)=x sinx + cosx=0

    a) Bisection b) False Position c) Newton-Raphson
    d) Successive approximation

17. To write C programs to implement the Lagrange interpolation
18. To implement the Newton- Gregory forward interpolation using C language.
19. To implement in C the linear regression algorithm.
20. To implement in C the polynomial regression algorithm.

TEXT BOOKS :

1. P. Dey & M. Ghosh, "Programming in C", Oxford Univ. Press
2. E. Balaguruswamy, "C and Data Structures", TMH publications
3. P. Padmanabham, "C Programming and Data Structures", 3rd Edition, BS publications.
4. M.K. Jain, S.R.K. Iyengar & R.K. Jain, "Numerical Methods for Scientific and Engineering Computation", New Age International Publishers.
5. Aitkinson & Han, "Elementary Numerical Analysis", Wiely India, 3rd Edition 2006.

ENGINEERING WORKSHOP

Course Code : AMT1101

L	T	P	C
0	0	3	2

AIM :

To provide hands on experience on basic Engineering and IT related skills.

OBJECTIVES :

* To train the student in the basics of computer components, maintenance, software(s) installation and office tools.
* To demonstrate and train the students in basic professional trades.

Compulsory Exercises :

- Identification of the peripherals of a computer, components in a CPU and its functions - Block diagram of the CPU along with the configuration of each peripheral. Disassembly and assembly of a personal computer.
- Installation of MS windows on the personal computer.
- One lamp controlled by a one-way switch and (b) Two-way switching for stair-case lamp

Any Nine Exercises From The Following :

- **Carpentry**: Making a Cross-half lap joint using wooden pieces
- **Carpentry**: Making a Mortise and Tenon joint using wooden pieces
- **Fitting**: Preparation of a V-fit between mild steel flat pieces
- **Fitting**: Preparation of a Square-fit between mild steel flat pieces
- **Foundry**: Preparation of a sand mould using a single piece pattern
- **Foundry**: Preparation of a sand mould using a split piece pattern

- **Tin-Smithy**: Preparation of a sheet metal pipe-joint using tin-smithy tools
- **Tin-Smithy**: Preparation of a sheet metal funnel using tin-smithy tools
- **Welding**: Making a Lap joint through arc welding
- **Lathe Machine**: Demonstration of turning related activities on Lathe machine
- **Black smithy**: Demonstration of Black smithy trade
- **Plumbing**: Demonstration of Plumbing trade
- **Installation of Linux** on the computer wherein the windows was installed. The system should be configured as dual boot with both windows and Linux.
- **Hardware Troubleshooting :** Identification of the problem of a PC which does not boot (due to improper assembly or defective peripherals) and fixing it to get the computer back to working condition.
- **Software Troubleshooting :** Identification of the problem of a malfunctioning CPU (due to some system software problems) and fixing it to get the computer back to working condition.
- **Connectivity Boot Camp : C**onnectivity to the Local Area Network and accessibility to the Internet. TCP / IP setting.
- **Web Browsers, Surfing the Web : C**ustomization the web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.
- **Using LaTeX and / word : C**reation of project certificate. Exposure to features like:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both LaTeX and / Word.
- **Creating project abstract :** Features to be covered are: Formatting Styles, Inserting table, Bullets and Numbering,

Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

- **Creating a Newsletter** : Features to be covered are : Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes and Paragraphs
- **Creating a Feedback form** - Features to be covered are: Forms, Text Fields, Inserting objects, Mail Merge in Word.
- **Excel Orientation : Introduction of** Excel as a Spreadsheet tool, Using Excel –Accessing, overview of toolbars, saving excel files, Using help and resources
- **Creating a Scheduler -** Features to be covered are: Gridlines, Format Cells, Summation, auto fill, Formatting Text
- **Calculating GPA** - Features to be covered:- Cell Referencing, Formulae in excel – average, standard deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP
- **Performance Analysis** - Features to be covered:- Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting
- **Power point presentation**
- Exposure to basic power point utilities and tools (PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in both LaTeX and Power point, Hyperlinks, inserting Images, Clip Art, Audio, Video, Objects, Tables, Charts) .to create basic power point presentation.

SYLLABI FOR II SEMESTER

MATHEMATICS – II

(Common to all Branches)

Course Code : ABM1102

L	T	P	C
4	1	0	4

AIM :

To impart the necessary fundamental principles that are essential to study the core courses of Engineering

OBJECTIVE :

To motivate and inculcate the logical thinking and methodical approach to solve mathematical problems

UNIT - I

Matrices: Rank – Normal form - Echelon form – Consistency – Solution of system of simultaneous linear homogeneous and non-homogeneous equations.(Gauss Jordan)

(2.8, 2.11)

UNIT - II

Eigen values, Eigen vectors – properties – Cayley-Hamilton Theorem (only statement) - Inverse and powers of a matrix by Cayley-Hamilton theorem – Diagonalisation of matrix. (2.14-2.17)

UNIT - III

Quadratic forms - Linear Transformation - Orthogonal Transformation. Reduction of quadratic form to canonical form, Nature of the quadratic form.

(2.12, 2.18 , 2.19).

UNIT - IV

Double and triple integrals, Change of order, change of variables

(7.1 – 7.3 , 7.5, 7.7).

UNIT - V

Vector Differentiation**:** Differentiation of vectors, Scalar and Vector point functions. Gradient of a scalar field and directional derivatives- Divergence and curl of a Vector field and it's physical interpretation.

(8.1, 8.4 – 8.8)

UNIT - VI

Vector Integration - Line integral – -Circulation-work done - surface and volume integrals Vector integral theorems: Green's theorem- Stoke's and Gauss's Divergence Theorem (Without proof). Verification of Green's - Stoke's and Gauss's Theorems. (8.10 – 8.17)

UNIT - VII

Fourier series: Euler's formulae, Conditions for Fourier expansion, Change of interval, even and odd functions, half range series.

(10.1 – 10.7)

UNIT - VIII

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

(22.1 – 22.4)

TEXT BOOK :

1. Dr.B.S.Grewal "Higher Engineering Mathematics", 40th Edition, Khanna Publishers

REFERENCES :

1. Kreyszig E, "Advanced Engineering Mathematics", 8th Edn. John Wiley, Singapore (2001)
2. Greenberg M D, "Advanced Engineering Mathematics", 2nd Edn, Pearson Education, Singapore, Indian Print (2003).

ENGINEERING MECHANICS

Course Code : AME1103

L	T	P	C
4	1	0	4

AIM & OBJECTIVES :

1. To develop logical thinking approach to engineering problems.
2. Calculation and estimation of fourses developed in various engineering structures.

UNIT - I

SYSTEMS OF FORCES : Introduction – parallelogram law – Forces and components - Resultant of coplanar concurrent forces - component forces in space - vector notation – moment of force – principle of moments – couples. Resultant of planar force systems and spatial concurrent force system.

UNIT - II

EQUILIBRIUM OF FORCE SYSTEMS : Equilibrium – free body diagrams – Equations of equilibrium – equilibrium of planar systems – graphical methods and analytical methods for equilibrium of planar systems – equilibrium of spatial concurrent force systems.

UNIT - III

FRICTION: Introduction – Theory of friction – Angle of friction – Laws of friction - static friction – Kinetic friction-friction in bodies moving up or down on an inclined plane-screw friction and screw jack.

UNIT - IV

CENTROIDS AND CENTERS OF GRAVITY : Centre of gravity – centroids of area and lines – determination of centroids by integration – centroids of composite figures – theorems of Pappus.

UNIT - V

AREA MOMENT OF INERTIA : Moment of inertia – polar moment of Inertia – Radius of gyration - Transfer theorem for moment of Inertia – Moment of inertia of composite areas – product of inertia – Transfer formula for product of Inertia.

MASS MOMENT OF INERTIA : Moment of inertia of masses – Radius of gyration – Transfer formula for mass moment of inertia – Mass moment of Inertia by Integration.

UNIT - VI

KINEMATICS : Rectilinear motion-curvilinear motion - Rectangular components of curvilinear motion - Normal and Tangential components of acceleration, Radial and transverse components - Kinematics of rigid bodies - angular motion – fixed axis rotation – Definition and analysis of plane motion.

UNIT - VII

KINETICS: Kinetics of rigid bodies – equation of planes motion – fixed axis rotation – rolling bodies (simple examples) - general plane motion (Simple examples).

UNIT - VIII

WORK ENERGY METHODS : Work energy equations for translation – applications to particle motion – connected systems – fixed axis rotation (Simple cases)

TEXT BOOKS :

1. I.B. Prasad, "Applied Mechanics", Khanna Publishers, 19th Edition, 2009.
2. Ferdinand L. Singer, "Engineering Mechanics", Harper Collins Publishers India, 3rd Edition, 2008.

REFERENCES :

1. Irving. H. Shames, "Engineering Mechanics", PHI Publishers, 4th Edition, 2008.
2. Timoshenko & Young , "Engineering Mechanics", MGH Publishers, 4th Edition, 2010.
3. A.K. Tayal, "Engineering Mechanics", Umesh Publishers, 13th Edition, 2008.
4. K.L. Kumar, "Engineering Mechanics", TMH Publishers, 3rd Edition, 2009.

PHYSICS

Course Code : ABP1101

L	T	P	C
4	1	0	4

AIM :

To give prerequisites in understanding the advanced Physics leading to applications in engineering field.

OBJECTIVE :

To impart the students the concept and principles in Engineering to enable them to comprehend and take up the experimental work independently.

UNIT - I

VIBRATIONS & ACOUSTICS OF BUILDINGS :

i) Overview of vibrations with emphasis on damped and forced oscillations- resonance, coupled oscillators - two coupled pendulums and normal mode solutions.

(Engineering Physics - Gaur & Gupta Chap - 33, and Unified Physics, Vol-1, S L Gupta & Sanjeev Gupta, Chap-11 (coupled oscillators)

ii) Reverberation and Reverberation time – Sabine's formula for reverberation time – measurement of absorption coefficient of material- Basic requirements of acoustically good hall -Factors affecting the architectural acoustics and their remedies.

(Engineering Physics - Gaur & Gupta Chap - 14)

UNIT – II

PHYSICAL OPTICS : Interference: Superposition of waves, Young's double slit experiment, Interference in thin films by reflection, Newton's rings experiment with necessary theory.

DIFFRACTION: Fresnel and Fraunhoffer diffraction, Diffraction at single slit and diffraction grating, determination of wavelengths of various spectral lines, resolving power of grating.

POLARIZATION: Types of Polarizations, Brewster's law, Double refraction, Nicol Prism, Polaroid's.

(Engineering Physics - Gaur & Gupta Chap - 26, 27, 28 & 29)

UNIT – III

CRYSTAL PHYSICS & SUPERCONDUCTIVITY :

i) Crystal Physics : Space lattice, basis and crystal structure, Unit cell, primitive cell, Seven crystal systems, Bravais lattices- SC, BCC, FCC crystal structures- crystal planes and Directions- Miller indices, Derivation of inter planar spacing.

(Applied Physics for Engineers - P K Palanisamy Chap - 2)

ii) Superconductivity: superconducting phenomenon, Meissner effect, Type I & Type II Super conductors, BCS theory, DC and AC Josephson effects, SQUIDS, High Temperature Super conductors- Applications.

(Applied Physics for Engineers - P K Palanisamy Chap - 9)

UNIT – IV

QUANTUM MECHANICS : Dual nature of matter, DeBroglie wave length, Time independent Schrödinger wave equation, Physical significance of wave function, particle in a potential well, rigid and non rigid walls, Tunneling effect

(Applied Physics for Engineers - P K Palanisamy Chap - 3)

UNIT – V

FREE ELECTRON THEORY : Introduction, Quantum free electron theory, Fermi-Dirac distribution and its dependence on temperature, Fermi energy, Electron scattering and resistance, motion of an electron in periodic potential, Kronig-Penney model (qualitative treatment), effective mass; classification of solids.

(Applied Physics for Engineers - P K Palanisamy Chap - 4 & 5)

UNIT – VI

DIELECTRICS : Basic definitions, relation between **P,D** and **E** vectors, Polarization mechanisms, expression for electronic polarizability, Internal fields in solids, Claussius-Mosotti equation, frequency and temperature

dependence of electronic polarization, Dielectric strength, Dielectric loss, Loss tangent and Dielectric breakdown, Applications.
(Applied Physics for Engineers - P K Palanisamy Chap - 6)

UNIT – VII

LASERS AND FIBER OPTICS :

i) Introduction, Characteristics of lasers, Induced absorption, spontaneous and stimulated emission of radiation, Population Inversion, Einstein's coefficients, Low and high power Lasers, Ruby laser, He-Ne laser, CO_2 and semiconductor laser, Applications of lasers.

(Applied Physics for Engineers - P K Palanisamy Chap - 10)

ii) Basic principle of propagation of light in optical fibers, Numerical aperture, acceptance angle, Derivation of Numerical aperture, Classification of optical fibers on the basis of refractive index profile, Fiber optic communication system, Applications.

(Applied Physics for Engineers - P K Palanisamy Chap - 2)

UNIT – VIII

FUNCTIONAL MATERIALS :

i) Bio materials, SMART materials, metallic glasses, metal matrix composites, Electrets – piezo and ferro electric matrerials.

(Engineering Physics by V Rajendran, Chap - 21, 24, 25, materials Science - M Armugam - Metal Matrix composites and Electrets, SMART Materials chap -11)

ii) Nanophase materials: Introduction to nano materials, types of nano materials, Fabrication Techniques: ball milling, nano lithography, CVD, carbon nano tubes (CNT's), Applications.

(Engineering Physics M R Sirnivasn, Chap - 15)

TEXT BOOKS :

1. R.K. Gaur and S.L.Gupta, "Engineering Physics", 8th Edition, Dhanpaat Rai, 2003.
2. P.K. Palanisamy, "Applied Physics", 2nd Edition, Scitech Publishers, 2010.

3. M.R. Srinivasan, "Engineering Physics", 1st Edition, New Age Publishers, 2009.
4. V. Rajendran, "Engineering Physics", TMH, 2009.

REFERENCES :

1. C.Kittel, "Introduction to Solid State Physics", 7th Edition, John Wiley, 2007.
2. M Ross, Lowrence, Shepard, J Wulff, "Structure and properties of Materials, (Volume-4, Electronic properties)", Wiley East Publishers, 2004.
3. Avadhanulu & Kshirasagar, "Engineering Physics", 9th Edition, S. Chand Publishers, 2008.
4. S.O. Pillai, "Solid State Physics", New Age Publishers, 2004.
5. Sulabh. K. Kulkarni, "Nano Technology - Principles and Practices", 2006.
6. V.Raghavan, "Material Science", 5th Edition, PHI, 2007.
7. R.L.Singhal, "Solid State Physics", 6th Edition, Kedarnadh, Ramnadh Publishers, 2003.
8. A. Beiser, "Perspectives in Modern Physics", 5th Edition, McGraw Hill Publishers, 2006.
9. A.J. Dekker, "Electrical Engineering Materials", 1st Edition, Mac Millan, 2007.
10. M. Armugam, "Material Science",3rd Edition, Anuradha Publishers, 2009.
11. S.L. Gupta, & Sanjeev Gupta, "Unified Physics", Vol - 1, 16th Edition, Jaiprakash Nath & Co., 2007.

ORGANIC CHEMISTRY

Course Code : ABC1102

L	T	P	C
4	0	0	4

Aim : The aim of the course is to provide necessary organic chemistry back ground for under graduate students of Chemical engineering.

Objective : To provide an understanding of the principles, mechanisms and properties of organic reaction which chemical engineers may encounter in their subsequent professional carreer.

UNIT - I

ELECTRON DISPLACEMENT EFFECTS

Permanent effects – Inductive and Resonance effect, applications of Inductive and Resonance effects. Temporary effects – Inductomeric and Electromeric effects; Hyper conjugation and it's applications.

UNIT - II

BIOORGANIC CHEMISTRY

CARBOHYDRATES - Classification, structrual Elucidation of glucose and fructose.

Conversions of Aldohexose to ketohexose and aldopentose to aldohexose.

NATURAL PRODUCTS - Vitamins- structural elucidation vitamine B_{12}

UNIT - III

NUCLOPHILIC SUBSTITUTION REACTIONS

Nuclophilic substitution reactions of unimolecular and bimolecular reactions-examples. Mechanism of SN^1 and SN^2 reactions. Concept of Walden inversion and steric hindrance

REARRANGEMENTS

Pinacol-Pinacalone rearrangement

Beckmann rearrangement
Fries rearrangement

UNIT - IV

REACTION MECHANISM AND APPLICATIONS OF THE FOLLOWING

Aldol condensation
Perkins's reaction,
Claisen condensation
Rimer-Timmer reaction

UNIT - V

DYES: classification based on chemical structure and method of application. Witt's theory of color and chemical constitution. Synthesis and uses of the following dyes- Cong red, Bismark brown, Malachite green, Rosaniline and Fluorescein.

UNIT - VI

ACTIVE METHYLENE COMPOUNDS : Preparation of Malonic and Acetoacetic ester, isomerism and synthetic applications of malonic and acetoacetic ester with reference to mono and dicarboxylic acids (n-butyric, succinic and adipic acids), α, β- unsaturated acid (crotonic acid), dialkyl substituted acid (isobutyric acid), amino acid (glycine) and ketones (ethylmethylketone). Ketonic and acidic hydrolysis.

UNIT - VII

HETEROCYCLIC COMPOUNDS - Nomenclature, preparation, structure, properties and uses of Furan, Pyrrole, Thiophene, Pyridine, Quinoline, Isoquinoline.

UNIT - VIII

STEREO ISOMERISM :

CONFIGURATIONAL ISOMERISM : Optical isomerism, Conditions for an optically active compound-elements of symmetry, Optical activity of Lactic acid and Tartaric acid. Relative and Absolute configuration-Sequence rules, Geometrical isomerism-E & Z system of nomenclature.

CONFORMATIONAL ISOMERISM : Conformations of ethane, n-butane and 1,2-dihaloethane.Bayer's strain theory-limitations, Sachey and Mohr theory, conformations of cyclohexane

TEXTBOOKS :

1. Arun Bahl & B.S. Bahl, "Advanced Organic Chemistry", S. Chand Publications, 2010.
2. R.T. Morrison and R.L. Boyd, "Text book of Organic Chemistry", Prentice-Hall of India, 6th Edition, 2006.

REFERENCES :

1. Reaction Mechanism- Peter Skyes, Long Men Scientific & Technical Publishers, 6th Edition, 2008.
2. O.P.Agrawal, "Reactions and Reagents", Krishna Prakasan Publications, 42nd Edition, 2006.
3. Gaurikar, N.V. Viswanathan, "Polymer Science", New Age International, 8th Edition, 2006.
4. O.P.Agrawal, "Synthetic Organic Chemistry", Goel Publications, 7th Edition, 1985.
5. C.N.Pillai , "Organic Chemistry", University press, Orient Black Swan, 2010.
6. B.Mehata& M.Mehata, "Organic Chemistry", PHI Learning Pvt. Ltd., 2005.

ENVIRONMENTAL STUDIES

Course Code : ABE1101

L	T	P	C
4	0	0	4

AIM :

To create awareness on environmental hazards.

OBJECTIVE :

The student shall acquire knowledge regarding utilization of natural resources, and the imbalance in ecosystems, environmental pollution caused by various practices and safe guards to be taken.

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 megadiversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, manwildlife conflicts. - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Exsitu 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, 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 ecosystems-pond, river, hill slopes, etc.

TEXT BOOKS :

1 Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", University Press, Reprint 2005.

2 R. Rajagopalan, "Environmental Studies", Oxford University Press, 2nd Edn. 2011..

REFERENCE :

1. M. Anji Reddy, B "Textbook of Environmental Sciences and Technology"

PHYSICS AND CHEMISTRY LAB

Course Code : ABP1102

L	T	P	C
0	0	3	2

Aim :

To give prerequisites in understanding the advanced Physics & Chemistry leading to applications in engineering field.

Objectives :

Training the students to understand the principles, concepts helpful in doing laboratory classes individually. To mould them to solve any technical problem in general.

LIST OF PHYSICS EXPERIMENTS

Any **SIX** of the following experiments are to be performed during the semester

01. Determination of rigidity modulus of the material of a given wire– Torsional pendulum
02. Verification of laws of vibration of stretched string - Sonometer
03. Determination of radius of curvature of a given convex lens - Newton's rings
04. Determination of wavelength of spectral lines of a mercury spectrum - Diffraction grating
05. Study of frequency response of LCR series and parallel resonant circuits
06. Study of variation of magnetic field along a circular current carrying conductor – Stewart & Gee apparatus
07. Determination of Hall coefficient and carrier concentration - Hall effect

08. Study of I-V characteristics of a solar cell
09. Optical Fibers – Determination of numerical aperture and losses in fibers
10. Measurement of dielectric constant of material by Waveguide method

LIST OF CHEMISTRY EXPERIMENTS

Any **SIX** of the following experiments are to be performed during the semester.

1. Preparation of standard potassium dichromate and determination of ferrous iron.
2. Determination of hardness of water by EDTA method.
3. Determination of dissolved oxygen in water.
4. Determination of chlorides in water.
5. Determination of iron-II by potentiometric method.
6. Determination of viscosity of lubricant by viscometer.
7. Determination of flash and fire points of oils.
8. Determination of percentage residue of carbon in oils.
9. Determination of calorific value of solid fuels.
10. Colorometric determination of iron in cement.

REFERENCES :

1. J.Mendham Et.al., "Vogel's text book of quantitative chemical analysis", 6th edn. Pearson Education.
2. Dr. K. B. Chandrasekhar, "Chemistry practical lab manual",
3. K.Sudha Rani, "Laboratory Manual on Engineering Chemistry"

ORGANIC CHEMISTRY LAB

Course Code : ABC1103

L	T	P	C
0	0	3	2

Aim : The aim of the Course is to develop the basic experimental skills

Objective : Objective is to make the student familiar with certain chemical techniques which may be useful in the later professional carrier.

1. QUALITATIVE ANALYSIS OF SIMPLE ORGANIC COMPOUNDS BY FOLLOWING SYSTEMATIC PROCEDURE.

Analysis includes state, B.P&M.P, solubility, flame, unsaturation, sodium fusion extract for the identification of heteroelement, functional groups-carboxylic acids, phenols carbohydrate aldehydes, ketones, amides, esters, amines and nitro groups. Conformation of functional group by the preparation of derivative.

2. PREPARATION OF ORGANIC COMPOUNDS.

a) Aspirin

b) Acetanilide

c) Nitrobenzene

d) Urea –formaldehyde

BOOKS RECOMMENDED :

1. Vogel's Text book of Practical Organic Chemistry by PWG.Smith & B.S.Furniss

ENGINEERING DRAWING

Course Code : AME1102

L	T	P	C
0	0	3	2

AIM & OBJECTIVES :

1. To make the student familiar to the drawing practices and convention
2. To familiarize the student about various engineering curves used in industry
3. To enable the student draft simple engineering components.

LIST OF EXERCISES

1 Introduction to Engineering drawing & basics of Geometrical construction

2 Construction of parabola, ellipse, hyperbola

3 Construction of Involutes and Cycloidal curves

4 Projections of points and lines inclined to one plane

5 Projections of lines inclined to both the planes

6 Projections of planes in simple positions, planes inclined to one plane

7 Projections of planes inclined to both the planes

8 Demonstration & Practice: Computer aided drafting of lines, planes and dimensioning

9 Projections of solids in simple positions

10 Projections of solids inclined to both the planes

11 Isometric projections

12 Demonstration & Practice: Computer aided drafting of solids and dimensioning.

TEXT BOOKS :

1. N.D. Bhatt, V.M. Panchal, "Engineering Drawing", Charotar Publication House, 49th Edition, 2008.

2. R.B. Choudary "Engineering graphics with Auto CAD", Anuradha Publishes

3. Trymbaka Murthy, "Computer Aided Engineering Drawing", I.K. International, 3rd Edn. I.K. International, 2007

SYLLABI FOR III SEMESTER

PROBABILITY AND STATISTICS

Course Code: ABM1105

L	T	P	C
4	1	0	4

AIM :

To acquire basic knowledge in concepts of probability and statistics.

OBJECTIVE :

The student shall be able to apply the methods of probability distributions, perform Statistical analysis and draw inference in various engineering problems.

UNIT-I

PROBABILITY: Probability, The axioms of probability, some elementary theorems - Conditional probability –Baye's theorem. (3.3-3.7)

UNIT-II

DISCRETE RANDOM VARIABLES: Random variables , mean and variance, Chebyshev's theorem, Binomial distribution, Poisson distribution (4.1,4.2, 4.4-4.7)

UNIT-III

CONTINUOUS RANDOM VARIABLES: Continuous Random Variable, normal distribution, Normal approximation to Binomial distribution, Uniform distribution (5.1-5.3, 5.5)

UNIT-IV

SAMPLING DISTRIBUTION OF MEANS: Population and sample, Sampling distributions of mean, Point estimation, Interval estimation (6.1-6.3, 7.1, 7.2)

UNIT-V

INFERENCES CONCERNING MEAN: Null hypothesis and tests of hypothesis, Inference concerning one mean and two means (7.3-7.5 ,7.8)

UNIT-VI

INFERENCES CONCERNING VARIANCES: Sampling distribution of the variance, the estimation of Variance, Hypothesis concerning one and two variances (6.4, 8.1-8.3)

UNIT-VII

INFERENCES CONCERNING PROPORTIONS: Estimation of Proportions, Hypothesis concerning one proportion, several proportions (9.1-9.3)

UNIT-VIII

CORRELATION REGRESSION: The method of least squares , Curvilinear regression, multiple regression, correlation(excluding causation)

(11.1,11.3, 11.4,11.6)

TEXT BOOK:

Miller Freund's, "Probability and Statistics for Engineers" Richard A Johnson, CB Gupta, Pearson education , Seventh Edition 2005.

REFERENCES:

1. S.C Gupta and V.K. Kapoor "Fundamentals of Mathematical Statistics", 19th Revised Edition, Sultan Chand & Sons Educational Publishers
2. Dr. B.S. Grewal, " Higher Engineering Mathematics", 40th Edition, Khanna Publishers.

MOMENTUM TRANSFER

Course Code: ACH1102

L	T	P	C
4	1	0	4

AIM:

This subject introduces the student in applying the fundamental principles of fluid mechanics in transportation and pumping liquids.

OBJECTIVE:

To make the students analyse the system of units and impart him with the knowledge of applying basic quantitative laws and equation of fluid flow. It also enables him to handle important engineering tasks of moving fluids through process equipment and measuring & controlling fluids in flow.

UNIT –I

Unit operations and unit processes, unit systems, dimensional 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, pressure drop due to changes in velocity or direction, Forces on bends, Multiple pipe systems: Pipes in series and parallel, reservoir junctions.

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 bed 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. Measurement of fluid flow in open channel flows using weirs.

Text Books:

1. W.L.McCabe, J.C.Smith & Peter Harriot, "Unit Operations of Chemical Engineering", McGraw-Hill, 6th edn, 2001
2. Noel de Nevers, "Fluid Mechanics for Chemical Engineers", McGraw Hill, 3rd Edn. 2004.

References:

1. Geankoplis, C.J, "Transport processes and unit operations", PHI, 3rd Edn. 2002.
2. Chattopadhya P., "Unit Operations of Chemical Engineering Vol-1", Khanna publishers, 2003.
3. Foust A.S, Wenzel, L.A, Clump C.W, Maus, L & Anderson L.B. "P rinciples of Unit Operations", John Wiley, 2nd Edn., 1999
4. Coulson and Richardson, "Chemical Engineering-Vol-I", Pergamon Press.

CHEMICAL PROCESS CALCULATIONS-I

Course Code: ACH1103

L	T	P	C
4	0	0	4

AIM:

To give quantitative training in the practical applications of the principles of Material and energy balance to the solution of industrial problems

OBJECTIVES:

i) To develop systematic problem solving skills

ii) To learn what material balance are, how to formulate , apply and solve them

iii) To learn how to deal with the complex process problems

UNIT-I

STOICHIOMETRIC RELATION: basis of calculations, methods of expressing compositions of mixtures and solutions, density and specific gravity, Baume' and API gravity scales.

UNIT-II

BEHAVIOR OF IDEAL GASES: Kinetic theory of gases, application of ideal gas law, gaseous mixtures, gases in chemical reactions.

UNIT-III

VAPOR PRESSURE: Liquefaction and liquid state, vaporization, boiling point, effect of temperature on vapor pressure, Antoine equation, vapor pressure plots.

UNIT-IV

Vapor pressure of immiscible liquids and ideal solutions, Raoult's law. Non volatile solutes.

UNIT-V

HUMIDITY AND SATURATION: Relative and percentage saturation, dew point, wet bulb and dry bulb temperatures.

UNIT-VI

Use of humidity charts for engineering calculations.

UNIT-VII

Estimation of Physical and Transport Properties using group contribution methods, Estimation of normal Boiling Point, Latent heat, Specific Heat, Diffusivity, Viscosity Thermal Conductivity and Critical Properties.

UNIT-VIII

MATERIAL BALANCES: Tie substance, Yield, conversion, processes involving chemical reactions.

TEXT BOOKS:

1. Hougen O A, Watson K.M. and Ragatz R.A., "Chemical Process Principles, Part -I, Material and Energy Balance", John Wiley and Sons, New York, 2nd Edn., 1963.
2. Poling B.E,Prausnitz J. M., O'Connell J.P, "The Properties of Gases, Liquids and Solids" Mc Graw Hill, Newyork 5th Edn. 2001.

REFERENCES:

1. Himmelblau D.H. , "Basic Principles and Calculation in Chemical Engineering Vol-1", PHI India 5th Edn., 2001.
2. Bhatt B.I. and Vora S.M, "Stoichiometry, Tata McGraw Hill New Delhi, 3rd Edn, 1996.

PHYSICAL CHEMISTRY

Course Code: ABC1104

L	T	P	C
4	0	0	4

AIM:

To provide necessary physical chemistry background to chemical engineering students.

OBJECTIVE:

To make the student capable to tackle chemical engineering problems in their career.

UNIT -I

THERMODYNAMICS–I : Thermodynamics terms and Basic concepts- Thermodynamic processes- Reversible and irreversible process- pressure-volume work- Internal energy- First Law of thermodynamics – Enthalpy- Molar Heat Capacities – Adiabatic and isothermal expansion of an ideal gas .

UNIT -II

THERMODYNAMICS-II : Spontaneous process- Entropy- Second Law of thermodynamics- Carnot Cycle- Derivation of entropy from Carnot cycle – Physical significance of entropy- Free energy- Gibbs Helmholtzs Equations- Clasious- Clapeyron Equation- Vant Hoffs isochores.- Third law of thermodynamics:

UNIT -III

DISTRIBUTION LAW : Statement. - Nernst Distribution law- Explanation and limitations of law- Modification of Distribution law when association or dissociation of the solute occurs – Determination of Equilibrium constant from Distribution coefficient- Extraction of a solute from solution with an immiscible solvent- Applications of Distribution law

UNIT -IV

PHASE RULE: Definitions and explanation of terms- Thermodynamics derivation of Phase rule- one component system: water system-and sulphur system- Two component systems – Liquid-liquid systems- completely miscible, partially miscible and immissible sytstems –Distillation of zeotropic mixtures, Azeotropic mixtures, solid-liquid systems- Eutectic systems- Lead-silver systems.

UNIT -V

ELECTRO CHEMISTRY: Specific and equivalent conductance-measurement- effect of dilution on specific and equivalent conductance-relative speeds of ions- Transport number and its determination- Hittorfs method and moving boundary method- Kohlrauschs law and its applications.

UNIT -VI

CHEMICAL KINETICS: Basic Terms –Methods of determining order of reaction- Theories of reaction rates: Arrheneous , Collision and Absolute reaction rate theories- Simultaneous reactions: Consecutive reactions, parallel reactions, Reversible or opposing reactions- Chain reactions: Hydrogen and bromine

UNIT -VII

CATALYSIS: Definition-Types- Homogeneous and heterogeneous catalysis- Characteristics of catalytic reactions- promoters- catalytic poisoning- Autocatalysis- Negative catalysis- Activation energy and catalysis- Theories of Catalysis – Acid-base catalysis- Longmuir's adsorption isotherm

UNIT -VIII

COLLOIDAL STATE: Definition of colloids- Classification of colloids-Solids in liquids (Sols): kinetic, optical and electrical properties- stability of colloids: protective action, Hardy-Schultz Law- Gold Number- Liquids in liquids (emulsions): types of emulsions, preparation, Emulsifier- Liquid in Solids (gel): Classification, preparation and properties- General applications of colloids

TEXT BOOKS :

1. Arun Bahl, BS Bahl & Tuli, "Physical Chemistry", S. Chand Publications, 26th Edition.
2. Puri, Sharma and Pathania, "Physical Chemistry", Vishal Publications, 44th Edition.

REFERENCES :

1. Glasston & Lewis, "Physical Chemistry", 2nd Edition, Mc Millan Publications.
2. Gurudeep Raj, "Advanced Physical Chemistry", Goel Publishing House (Meerat), 33rd Edition.
3 Atkins, "Physical Chemistry", Oxford University Press, 8th Edition.
4. Walter J. Moore, "Physical Chemistry", PHI Publications, 4th Edition.
5. Castalin, "Physical Chemistry", Narosa Publications, 2004

MECHANICAL UNIT OPERATIONS

Course Code: ACH1104

L	T	P	C
4	0	0	4

AIM:

To study the behaviour of solid particles as per the requirement of chemical engineering.

OBJECTIVES:

To have good understanding on

a) Properties,mixing and transportation of solids

b) Laws and equipment of size reduction

c) Separation processes like screening, filtration and crystallization

d) Mixing of solids with liquids

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

MECHANICAL SEPERATIONS : 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. McCabe W.L and Smith J.C. and Harriott P., "Unit Operations in Chemical Engineering", Mc Graw Hill 5th Edn. 1993.

REFERENCES:

1. Perry J.H., "Chemical Engineers Hand Book", Mc Graw Hill, 7th Edn.
2. Banchero J.T. & Badger W.L., "Introduction to Chemical Engineering", TMH,1997.

PROCESS INSTRUMENTATION

Course Code : ACH1105

L	T	P	C
4	0	0	4

AIM:

To understand the instrumentation requirements of Chemical Process Industry.

OBJECTIVE:

Control the different process variables such as temperature, pressure, flow rate, etc and improve efficiency of the process thereby enhance the economics of plant.

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. Donald P.Eckman, "Industrial instrumentation", CBS Publishers Distributers, New Delhi, Reprint 2004.

REFERENCES:

1. Patra Nabis, "Principles of industrial instrumentation", TMH.
2. Considine G.D, "Process Instruments and Controls Hand Book", Mc Graw Hill, Newyork, 3rd Edition, 1985.
3. Hand book Instrumentation, Considine, McGraMeasurement and Control", CRC press, New York, 3rd Edition, 1997.

MECHANICAL UNIT OPERATION LAB

Course Code: ACH1106

L	T	P	C
0	0	3	2

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

PHYSICAL CHEMISTRY LAB

Course Code: ABC1105

L	T	P	C
0	0	3	2

1. Distribution of iodine between Carbon Tetrachloride. Chloroform and Water
2. Distribution of benzoic acid between benzene and water.
3. Study of inversion of sucrose by polarimetry.
4. Study of hydrolysis of an ester.
5. Determination of order of reaction between persulphate and iodide.
6. Conductiometric titration of strong acid versus strong base.
7. Conductiometric titration of weak acid versus strong base.
8. PH metric titration of strong acid versus strong Base
9. Determination of CST of Phenol- Water system
10. Determination eutectic temperature of binary systems. (UREA-Benzoic Acid)
11. Potentiometric determination of solubility of a sparingly soluble salt (AgCl)
12. Colorometric determination of Manganese in Steel

SYLLABI FOR IV SEMESTER

HEAT TRANSFER

Course Code: ACH1107

L	T	P	C
4	0	0	4

AIM:

To study the basics and applications of conduction, convection and radiation heat transfer in the areas pertaining to chemical engineering.

OBJECTIVES:

To have good understanding on

a) Fourier's law of conduction, conduction equation

b) Heat transfer in laminar and turbulent flow, heat transfer with and without phase change, heat transfer in forced and natural convection

c) Radiation

d) Heat exchangers

e) Evaporators

UNIT - I

Heat transfer by conduction in Solids - Fourier's law, thermal conductivity, steady state conduction in plane wall, cylinder and sphere; resistances in series and parallel, unsteady state heat conduction, heat conduction equation with and without internal heat generation, semi-infinite solid, finite solid, Critical insulation thickness.

UNIT- II

Principles of heat flow in fluids - Typical heat exchange equipment, range, approach, temperature versus length curves, countercurrent and parallel current flows, energy balances, Overall heat transfer coefficient, LMTD, resistance form of overall coefficient, fouling factors, effective coefficients for unsteady-state heat transfer.

UNIT- III

Heat Transfer to Fluids without Phase change - Thermal boundary layer, heat transfer by forced convection in laminar and turbulent flows, viscosity correction factor, analogies between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes, brief discussion about heat transfer to fluids in laminar flow with constant heat flux and constant wall temperature.

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

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.

UNIT - VII

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

UNIT- VIII

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, Compact Heat Exchangers, Plate type Heat Exchangers, Heat transfer in packed beds, heat exchanger (effectiveness)NTU method, LMTD method, Rating, Sizing.

TEXT BOOK:

1. McCabe W.L., Smith J.C. and Harriot P., "Unit Operations of Chemical Engineering", McGraw-Hill 5th Edition 1993.

REFERENCES:

1. Kern D.Q., “Process Heat Transfer”, Tata McGraw-Hill Education, 1997.
2. Rao Y.V.C., “Heat Transfer”, University Press, 2001
3. Holman J.P., “Heat Transfer”, Mc Graw Hill, 9th Edition, 2002.

MANAGEMENT SCIENCE

Course Code: AHM1102

L	T	P	C
4	0	0	4

OBJECTIVE:

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

OUTCOME:

To understand the management processes and evolve management levels for effective decision making

UNIT - I

INTRODUCTION TO MANAGEMENT: Concepts of Management and Organization – Nature, Importance and Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Mayo's Hawthorne experiments, Maslow's Theory of human needs, Douglas Mc Gregor's Theory X and Theory Y, Hertzberg's Two factor Theory of motivation, Systems approach to Management, Leadership styles

UNIT - II

DESIGNING ORGANIZATIONAL STRUCTURES: Basic concepts related to Organization, Departmentation and Decentralization, Types of mechanistic and organic structure of organization (Line Organization, Line and staff Organization, Functional Organization, Committee Organization, Matrix Organization, Virtual Organization, Cellular Organization, 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: R chart, P chart, C chart (Simple numerical problems)

UNIT - IV

MATERIALS MANAGEMENT : Objectives, Need for Inventory control, EOQ, ABC & VED Analysis, Purchase Procedure, Stores Management and Stores Records (simple numerical problems)

Just in Time System (JIT)

UNIT - V

MARKETING MANAGEMENT: Functions of Marketing, Marketing mix, marketing strategies based on product life cycle, Channels of distribution, Consumer behavior and Customer relationship management

UNIT - VI

HUMAN RESOURCES MANAGEMENT: 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, Performance Appraisal, Job Evaluation and Merit Rating Grievance handling and Welfare Administration

Introduction to Social Security Laws: Payment of Gratuity Act (1972), Employees Provident Fund & Miscellaneous Provisions Act (1958), Employees State Insurance Act (1948)

UNIT - VII

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 numerical problems)

UNIT - VIII

STRATEGIC MANAGEMENT : Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Steps in strategy formulation and implementation, value Chain Analysis, SWOT Analysis.

Corporate social responsibility, business ethics and corporate governance

TEXT BOOKS :

1. A R Aryasri, "Management Science", Tata McGraw Hill, 2nd Edition, 2007
2. O P Khanna, "Industrial Engineering and Management", Dhanpat Rai Publishers, 2nd Edition, 2007

REFERENCE BOOKS :

1. Kazmi, "Business Policy and Strategic Management", Tata McGraw Hill
2. S D Sharma, "Operations Research", Kedarnath Ramnath& Co
3. Philip Kotler & Keller, "Marketing Management", Pearson Education
4. C B Mamoria & C B Mamoria, "Personnel Management", Himalaya Publishers
5. B S Goel, "Production and Operations Management", Pragati Prakasan
6. R Srinivasan, "Strategic Management", Eastern Economy Edition
7. L M Prasad, "Principles and Practice of Management", Sultan Chand & Sons.

CHEMICAL PROCESS CALCULATIONS-II

Course Code: ACH1108

L	T	P	C
4	1	0	4

AIM:

To give quantitative training in the practical applications of the principles of Material and Energy balance to the solution of industrial problems

OBJECTIVES:

i) To develop systematic problem solving skills

ii) To learn what material balance are, how to formulate , apply and solve them

iii) To learn what energy balances are and how to apply them

iv) To learn how to deal with the complex process problems

UNIT-I

Material balance calculations involving drying.

UNIT-II

Dissolution and crystallization., theory and associated problems.

UNIT-III

Problems on processes involving recycle, bypass and purge.

UNIT-IV

THERMO PHYSICS: 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-V

THERMO CHEMISTRY: Calculation and applications of heat of reaction, combustion, formation and neutralization, Kirchhoff's equation, enthalpy concentration change.

UNIT-VI

Calculation of theoretical and actual flame temperatures.

UNIT-VII

Introduction Calorific value of fuels, Various Fuels (Qualitative Analysis), Combustion Calculations, Orsat Analysis.

UNIT-VIII

Numerical Simulation of Material Balance Equations-Simultaneous and Sequential Modular approaches: Learning how to arrange equations and solve them using both techniques.

TEXT BOOKS:

1. Hougen O A, Watson K.M. and Ragatz R.A., "Chemical Process Principles, Part -I, Material and Energy Balance" John Wiley and Sons Inc., New York, 2nd Edn.1963.
2. Poling B.E., Prausnitz J.M and O'Connell J.P., "The properties of Gases, Liquids and Solids", Mc Graw Hill, New York, 5th Edn. 2001.

REFERENCE:

1. Himmelblau D.H., "Basic Principles and Calculation in Chemical Engineering", PHI India, 5th Edn. 2001.
2. Bhatt B.I. and Vora S.M., "Stoichiometry", Tata Mc Graw Hill, New Delhi, 3rd Edn. 1996.

MATERIALS SCIENCE FOR CHEMICAL ENGINEERS

Course Code: ACH1109

L	T	P	C
4	0	0	4

AIM:

To make students learn the structure-property- processing interrelationship in engineering materials

OBJECTIVES:

i) To enable students selects suitable materials for specific applications

ii) To process the materials so as to tailor the materials properties for given application

UNIT-I

Introduction - Classification of Engineering Materials – Fundamental Blocks of Matter. A brief review on Atomic(micro) Structure and Atomic Bonding- Energy of the Atomic system. Ionization potential, Electron Affinity- Ionic radii and Equilibrium Distance, Bond Length, $\Delta H_{Crystal}$, $\Delta H_{Lattice}$, Ionic , Covalent and metallic Bonding , Secondary bonding- Property relation to Bond characteristics.

UNIT-II

Crystal Geometry And Structure Determination - Space lattice, Unit cell- Primitive cell, Double Cell, Triple Cell, Multiple Cell- Crystal and Crystalline Substance, Amorphous Material-Bravais lattices, Crystal systems and their characteristics with suitable examples. Lattice points –Lattice Co-ordinates, Miller indices for directions and planes, Miller-Bravais indices, Linear and Planer Densities, Slip Directions and slip Planes , Packing efficiencies and fractions Close Packed Structures(CPS) , C/A ratio for HCP Structures- Bragg's law of X-Ray Diffraction and determination of Cubic Crystal structure, Lattice Constant and identification of metals using powder method, problems relating to these topics.

UNIT-III

Crystal Defects and Imperfection - What is a crystal defect and how does it arise in Crystal point (Zero dimensional and one dimensional defect) Types of point Defect, configurational Entropy, Determination of defect concentration , expression for one and two –dimensional defect concentration, Significance of point defects in the determination of properties of materials- Dislocations, Line defects- Edge and Screw Dislocations, Burgers Vector, Burgers Circuit, Dislocation motion – Dislocation reactions– Role of Dislocations on the properties of materials, dislocation density- surface defects, dislocation Energy, stress required to move a dislocation, multiplication of dislocation – Frank read source and mechanism of dislocations.

UNIT-IV

Basic thermodynamic functions -Free Energy of Transformation – Criteria for transformation – Nucleation and Growth – Homogeneous and Heterogeneous nucleation and their applications. Solid Solutions- Polymorphs – Types of Solid Solutions – Temp – Time – Cooling curves for different systems – Solid – Solid phase equilibrium – Tie Line, Lever Rule and its application. Phase Rule, Phase Changes and its application to Thermal Equilibrium diagrams or Phase Diagrams of Unary System, - Binary Systems – Eutectic Eutectoid alloys – Cu-Ni, Bi-Cd, Pb-Sn, Fe-Fe_3C systems.

UNIT-V

Phase transformations in steels – Modifications in structure of Steel by Heat Treatment – Time – Temperature – Transformation Curves for Eutectoid Steel – Classification of Steels and Cast Irons – Types and their properties. Alloys of Steel and their uses in Chemical Industry.

UNIT-VI

Mechanical behavior of metals and alloys - Elastic, Plastic and anelastic behavior of materials. Viscoelastic materials, behavior of polymers and plastics. Critical Resolved Shear strength, Schmidt's Law and prediction of Tensile Strength of materials, Strengthening mechanisms – Work Hardening or Strain Hardening, Alloying – Cold and Hot working – Recovery and Recrystallization, Grain Growth, Grain Size and Yield

Strength, Age hardening of Aluminum alloys – Al-Cu system. Composite Materials and their mechanical behavior, expressions for Tensile Strength and strains in Composite Materials – Fracture of Materials Ductile, Brittle, Creep and Fatigue fractures – Simple Problems related to these topics.

UNIT-VII

Corrosion- Materials in the service of Chemical and Marine Environments – Basis for corrosion , Corrosion reactions and Mechanisms of Corrosion – Eight forms of Corrosion- Uniform Corrosion , Galvanic , Differential Aeration Corrosion , Stress corrosion Cracking, Intergranular Corrosion, Localized Corrosion and Fatigue Corrosion . Corrosion of Stainless steel- Oxidation, Tarnishing, behavior of non-ferrous materials used in Chemical Industry – Effect of environmental factors on corrosion.

UNIT-VIII

Corrosion Prevention, Pilling – Bedworth ratios Conventional methods – Estimation of Corrosion rates, different Corrosion rate expressions, Remedial measures for Galvanic, Stress Corrosion Cracking, Intergranular and Pitting Corrosion, Anodic and Cathodic protection techniques, Conventional methods on organic and Inorganic coatings, Electroplating, Alloying – Cladding- Design Procedures of chemical equipment and structure to mitigate or completely prevent corrosion in Chemical Plants.

TEXT BOOKS:

1. Raghavan V., "Materials Science and Engineering : A first Course", Prentice Hall of India Pvt. Ltd., 5th Edn. 2006.
2. Fontanna M.G., "Corrosion Engineering", Tata Mc Graw Hill, 3rd Edn. 2005.

REFERENCES:

1. Manas Chanda, "Science of Engineering Materials Vol. 1 & 2", Mc Millan Company of India Ltd., 1st Edn. 2006.
2. Vam Vlack L.E., "Elements of Materials Science", Pearson Educational India, 6th Edn. 2008.
3. Raymond A. Higgins, Pub, ELBS, "Engineering Metallurgy", Part-I, Elsevier Publisher, 6th Edn. 2006.

MASS TRANSFER OPERATIONS-I

Course Code: ACH1110

L	T	P	C
4	1	0	4

AIM:

To separate individual components from the mixture through methods necessarily involving physical changes.

OBJECTIVES:

To study various operations that brings change in composition of the constituent mixture by employing only physical methods. The operations of the study are absorption, humidification, drying, distillation, extraction, leaching, adsorption etc.

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 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 tray 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, Psychro 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. Treybal R.E, "Mass Transfer Operations", Mc Graw Hill, 3rd Edn. 1980.

REFERENCES:

1. Diffusion : Cussler E. L, "Mass Transfer in Fluid System", Cambridge University Press, 2009.
2. Geankoplis C.J, "Transport Processes and Unit Operations" PHI,3rd Edn, 2002.
3. Dutta B.K, "Principles of Mass Transfer and Separation Processes", PHI India, 2007.
4. Seader J.D, Henley E.J, "Separation Process Principles", John Wiley.

CHEMICAL ENGINEERING THERMODYNAMICS-I

Course Code: ACH1111

L	T	P	C
4	0	0	4

AIM:

The purpose of this subject is to present thermodynamics from a 'Chemical' 'Engineering' view point.

OBJECTIVES:

Chemical Engineering thermodynamics is primarily concerned with application of thermodynamics to 'phase equilibra and 'reaction equilbria' in multi component system. It plays a supervisory role in engineering and its application in design of chemical engineering equipment in process in which approach to equilibrium is nearly 100% in practice.

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

THE SECOND LAW OF THERMODYNAMICS: Statements of the second law, heat engines, thermodynamic temperature scales, thermodynamic temperature and the ideal gas scale

UNIT-V

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-VI

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-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. Smith J.M. and Van Ness H.C., "Introduction to Chemical Engineering Thermodynamics", 5th Edn, Tata McGraw Hill,1996.

REFERENCES:

1. Rao Y.V. C, "Chemical Engineering Thermodynamics", University Press Ltd., 1st Edn. 2001.
2. Narayanan K. V, "Chemical Engineering Thermodynamics", PHI, New Delhi, 1st Edn. 2005.
3. Kyle B.G. , "Chemical and Process Thermodynamics", PHI Publishers, New Delhi, 3rd Edn. 1999.

HEAT TRANSFER LAB

Course Code: ACH1112

L	T	P	C
0	0	3	2

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.

MOMENTUM TRANSFER LAB

Course Code: ACH1113

L	T	P	C
0	0	3	2

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

SYLLABI FOR V SEMESTER

CHEMICAL ENGG. THERMODYNAMICS-II

Course Code: ACH1114

L	T	P	C
4	0	0	4

AIM:

The application of the thermodynamics for the design and development of processes is essential such that they require minimum energy, space and material and the rate of production is as high as possible. Hence this course aims at estimating preliminary requirements necessary to design and rating of processing equipment.

OBJECTIVES:

To make students understand the phase equilibrium and chemical reaction equilibria, to apply various models in estimating the properties of pure substances and mixtures, to estimate VLE data and to understand the essentials of dew point, bubble point and flash calculations.

UNIT-I

HEAT EFFECTS: Sensible heat effects, Internal energy of ideal gases, Latent heats of pure substances, standard heat of reaction, standard heat of formation, standard heat of combustion, temperature dependence of heat of reaction. Heat effects of industrial reactions.

UNIT-II

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, ideal solutions, excess properties.

UNIT-III

VLE at low to moderate pressure, the nature of equilibrium, the phase

rule, VLE qualitative behaviour, dew point and bubble point calculations using Raoults law.

UNIT-IV

SOLUTION THERMODYNAMICS: APPLICATIONS: models for the excess Gibbs energy (Margules, Van Laar and Wilson models), calculating the two constants using margules, Vanlaar and Wilson models from experimental data. VLE estimations using Margules, VanLaar and Wilson equations.

Basics of UNIFAC model, NRTL model, UNIQUAC model (Qualitative treatment only), Property changes of mixing.

UNIT-V

Dew point and bubble point calculations for non-ideal solutions, flash calculations, VLE from K-value correlation.

UNIT-VI

THERMODYNAMIC PROPERTIES AND VLE FROM EQUATIONS OF STATE: Properties of fluids from the virial equations of state and Pitzer correlations, VLE from cubic equations of state.

UNIT-VII

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 (Qualitative treatment only)

UNIT-VIII

CHEMICAL REACTION EQUILIBRIA : The reaction coordinate, application of 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, and multiple reactions, Phase rule for reacting systems.

TEXT BOOK:

1. Smith J.M., Van Ness H.C. and Abbott M.M., "Introduction to chemical engineering thermodynamics" , 5th Edn., Mc Graw Hill, 1996.

REFERENCE:

1. Narayanan K.V., "A Text book of chemical engineering thermodynamics" PHI, 2001.
2. Kyle B.G., "Chemical and Process Thermodynamics", 3rd Edn., Pearson Education.

CHEMICAL REACTION ENGINEERING-I

Course Code: ACH1115

L	T	P	C
4	1	0	4

AIM:

Chemical Reactors are the heart of any chemical industry and it is important to know how they are designed.

OBJECTIVES: To understand how chemical reactors are modeled and designed.

UNIT-I

INTRODUCTION TO CHEMICAL REACTION ENGINEERING: Elementary and Non-elementary Reactions, Homogeneous and Heterogeneous Reaction, The definition of rate equation. The meaning of Arrhenius Rate law, searching for rate Mechanism.

UNIT-II

BATCH REACTOR: Design equation for isothermal case. Problems on constant and variable Volume isothermal Batch Reactor.

UNIT-III

FLOW REACTORS: Design Equations for isothermal CSTR and PFR. Problems on CSTR and PFR with and without expansion, size comparison of CSTR and PFR(Given volumes calculate conversion and given conversion calculate volumes).

UNIT-IV

FIND THE RATE EQUATIONS FROM:

- Half life Data.
- Integral and Differential analysis of C_A vs t and P vs t data.
- CSTR experimental Data at Isothermal operations non isothermal operations.

UNIT-V

Problems on reactor sequencing for CSTR in series and PFR in series and their combination. Autocatalytic reactions and Recycle Reactors (Calculation of volumes needed for different Recycle Ratios and similar problems)

UNIT-VI

MULTIPLE REACTIONS: Series Reactions in Batch, CSTR and PFR's

PARALLEL REACTIONS: Problems on Calculation of yields and selectivities in CSTR andPFR. Finding the best reactor for maximizing selectivities. Product distribution as a function of Temperature for Parallel and series reactions (Qualitatively only)

UNIT-VII

NON ISOTHERMAL REACTORS: Energy balance derivation for batch CSTR and PFR's. Calculating equilibrium conversion at different temperature.

UNIT-VIII

PROBLEMS ON ADIABATIC CSTR,PFR: Calculating steady state conversion & temperature for a non-isothermal CSTR,concept and problems on interstage cooling , optimal temperature progression for batch reactors (Qualitative only)

TEXT BOOK :

1. Levenspiel O., "Chemical Reaction Engineering", 3rd Edn., John Wiley and Sons, 2007.

REFERENCES :

1. Fogler H.S., "Elements of chemical reaction engineering", 3rd Edn., PHI., 1999.
2. Smith J.M., "Chemical Engineering Kinetics", 3rd Edn., Mc Graw Hill, 1981.

MASS TRANSFER OPERATIONS-II

Course Code: ACH1116

L	T	P	C
4	1	0	4

AIM:

To Separate individual components from the mixture through methods necessarily involving physical changes.

OBJECTIVES:

To study various operations that brings change in composition of the constituent mixture by employing only physical methods.The operations of the study are distillation, extraction, leaching, adsorption and membrane operations.

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(qualitative treatment), 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, Pressure swing distillation.

UNIT-IV

LIQUID-LIQUID OPERATIONS: fields of application, 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.

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, unsteady state operation equipment – Percolation tanks, Shank system, filter press leaching, Agitated vessels, Steady state operation equipment- agitated vessels, thickeners, CCD, Classifiers, Leaching of Vegetable seeds.

UNIT-VII

ADSORPTION: Theories of adsorption, recovery of solvent vapors, industrial adsorbents, adsorption equilibria and isotherms. Single and multi- stage operations, unsteady state adsorption, equipment for stage-wise and continuous contact.

UNIT-VIII

INTRODUCTION TO MEMBRANE PROCESS: UF, MF, NF, RO, gas permeation, Pervaporation, liquid membranes, dialysis, electrodialysis, applications, driving forces, membrane modules.

TEXT BOOK:

1. Tryebal R..E., "Mass transfer operations" 3rd Edn., McGraw Hill, 1980.

REFERENCE:

1. Cussler E. L., "Diffusion: Mass Transfer in Fluid System", Cambridge University Press, 2009.
2. Geankoplis C.J., "Transport Processes and Unit Operations", 3rd Edn., Prentice Hall, India, 2002.
3. Dutta B.K., "Principles of Mass Transfer and Separation Processes", PHI, India, 2007.
4. Seader J.D., and Henley E.J., "Separation Process", 2nd Edn., John Wiley & Sons, 2007.
5. Moulder M., "Basic Principles of Membrane Technology" 2nd Edn., Springer, 2007.

INDUSTRIAL POLLUTION AND CONTROL

Course Code: ACH1117

L	T	P	C
4	0	0	4

AIM :

To develop proper concern for our deteriorating environment.

OBJECTIVES :

To present fundamentals of environmental engineering. To provide broad background for applying these principles to the problems.

UNIT-I

Types of emissions from chemical industries and effects of environment, environment legislation, Types 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. Rao C. S., "Environmental pollution and control engineering", 2nd Edn., Wiley Eastern Limited, India, 2006.
2. Mahajan S.P., "Pollution Control in Process Industries", TMH., 1985.

REFERENCES:

1. Rao M.N. and A.K.Datta, "Waste water treatment ", 2nd Edn, Oxford and IBH publisher, New Delhi,2005.

DESIGN AND ANALYSIS OF EXPERIMENTS

Course Code: ACH1118

L	T	P	C
4	0	0	4

AIM:

To study the effects of variations in the input variables on the response

OBJECTIVES:

a) To make a plan of experimentation

b) To analyze the response for various levels of input variables by ANOVA

c) To fit the best model for the given experimental data

UNIT-I

Strategy of Experimentation, Some Typical Applications of Experimental Design, Basic Principles, Guidelines for Designing Experiments, A Brief History of Statistical Design

Summary: Using Statistical Techniques in Experimentation

UNIT-II

Sampling and Sampling Distributions, Inferences about the Differences in Means-Randomized Designs, Inferences about the Differences in Means-Paired Comparison Designs, Inferences about the Variances of Normal Distributions.

UNIT-III

The Analysis of Variance, Analysis of the Fixed Effects Model.

UNIT-IV

Statistical Analysis of the RCBD.

UNIT-V

Introduction to Factorial Designs, Basic Definitions and Principles, The

Advantage of Factorials, The Two-Factor Factorial Design, The General Factorial Design.

UNIT-VI

The 2^k Factorial Design, Introduction, The 2^2 Design, The 2^3 Design, The General 2^k Design, A single replicate of the 2^k design, The addition of center points to the 2^k design.

UNIT-VII

Fitting Regression Models, Introduction, Linear Regression Models, Estimation of the Parameters in Linear Regression Models, Hypothesis testing in multiple regression, Confidence intervals in multiple regression.

UNIT-VIII

Introduction to Response Surface Methodology, the Method of Steepest Ascent, Experimental Designs for Fitting Response Surfaces- Designs for Fitting the First-Order Model, Designs for Fitting the Second-Order Model, Evolutionary Operation.

TEXT BOOKS:

1. Montgomery D.C., "Design and Analysis of Experiments", 5th Edn., John Wiley and sons, New York, 2006.
2. Montgomery D.C., "Introduction to Statistical Quality Control", 4th Edn., John Wiley and sons, New York, 2001.

GENERAL CHEMICAL TECHNOLOGY

Course Code: ACH1119

L	T	P	C
4	0	0	4

AIM:

To give an overall view of the Chemical process industry to the student.

OBJECTIVES:

This course gives the methods of manufacturing various chemicals in the chemical process industry .

UNIT-I

Manufacturing of 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 like –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. Austin G.T., "Shreve's Chemical Process Industries", 5th Edn., McGraw-Hill, 1985.
2. Dryden C.E., "Outlines of Chemical Technology", 3rd Edn, East - West press Pvt. Ltd, New Delhi, 2000.

CHEMICAL REACTION ENGINEERING LAB

Course Code: ACH1120

L	T	P	C
0	0	3	2

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 – Solid- Liquid Reactors setup
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

MASS TRANSFER LAB.

Course Code: ACH1121

L	T	P	C
0	0	3	2

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

SYLLABI FOR VI SEMESTER

PROCESS MODELLING AND SIMULATION

Course Code: ACH1122

L	T	P	C
4	1	0	4

AIM:

To develop mathematical models for Chemical Engineering systems and simulate them.

OBJECTIVES:

1) Develop mathematical model using fundamental laws.
2) Simulate the equations using MATLAB/ C language.
3) Validate the simulation results with the experimental data.

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 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

TEXT BOOKS:

1. Luyben W. L., "Process Modeling Simulation and Control for Chemical Engineers", 2nd Edn., McGraw Hill, 1989.
2. Gupta S.K., "Numerical Methods For Engineers", New Age International Pub,1998.

REFERENCE:

1. Grewal B. S., "Engineering Mathematics", Khanna Pub., 2007.
2. Balu K.and Padmanabhan K., "Modeling and Analysis of Chemical Engineering Processes", IK International private limited, 2007.

PROCESS DYNAMICS AND CONTROL

Course Code: ACH1123

L	T	P	C
4	1	0	4

AIM:

To understand the dynamics of first order and second order systems.

OBJECTIVES:

To analyze the open loop performance and design a control system for a better closed loop behaviour.

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 reactor control system.

UNIT-IV

Closed loop transfer functions, Transient response of simple control systems.

UNIT-V

Stability: Theory and Problems, Introduction to Root Locus (Qualitative treatment only).

UNIT-VI

Introduction to Frequency responses, control systems, design by frequency response for 1^{st} order, 2^{nd} order systems having dead time.

UNIT-VII

Advanced Control Strategies: Cascade control, Feed forward control, Ratio control (Qualitative Treatment only).

UNIT-VIII

CONTROLLER TUNING: Z-N Settings, C-C settings, control valves.

TEXT BOOK:

1. Coughanowr D.R., "Process Systems Analysis and Control", 2nd Edn., Mc Graw Hill, 1991.

REFERENCE :

1. Stephanopolous G., "Chemical Process Control", PHI, 1998.

CHEMICAL REACTION ENGINEERING-II

Course Code: ACH1124

L	T	P	C
4	0	0	4

AIM:

Chemical Reactors are the heart of any chemical industry and it is important to know how they are designed.

OBJECTIVES:

To understand how chemical reactors are modeled and designed.

UNIT-I

The importance of Residence Time Distribution studies. The concept of E and F curves. Diagnosing Reactor ills like stagnant zones and bypassing in a vessels (Qualitative only)

UNIT-II

Compartment Models for modeling of Non-Ideal Flow Reacting vessels. Problems on calculating volumes and bypassing flow rates in a CSTR and PFR and their combination given the F curve or E curve.

Dispersion Model and Tanks in series model for modeling Non-Ideal reacting vessels, problems to calculate N and D based on these models

UNIT-III

THE EFFECT OF NON-IDEALITY ON CONVERSION: Problems on calculating conversion based on dispersion Model, Tanks in series and Segregated Flow Model.

UNIT-IV

Catalysis: the rate controlling step in Catalysis. Synthesizing a rate law given the rate controlling step.

UNIT-V

Effectiveness factor definition and calculation for rectangular and spherical

catalyst particles. Finding the weight of catalyst needed in the design of Packed Bed Reactor for mixed flow and plug flow of fluid.

UNIT-VI

Deactivating catalyst, factors influencing catalyst decay, the role of pore diffusion on catalyst activity rate and performance equation for deactivating catalyst. Rate equation for batch solids and fluids in batch, mixed flow with constant and variable flow of fluid and PFR.

UNIT-VII

Fluid- Solid, Non-Catalytic Reactions: Progressive conversion model and shrinking core model.

- ✤ Shrinking core model for spherical particles of unchanging size.
- ✤ Rate of Reaction for shrinking spherical particles.
- ✤ Determination of Rate controlling step.

UNIT-VIII

DESIGN OF FLUID- SOLID REACTORS: Problems on

- ✤ Mixture of particles of different but unchanging sizes: plug flow of solids and uniform gas composition.
- ✤ Mixed flow of particles of a single unchanging size, uniform gas composition.
- ✤ Mixed flow of the size mixture of particles of unchanging size, uniform gas composition.

TEXT BOOK :

1. Levenspiel O., "Chemical Reaction Engineering" 3rd Edn., Wiley Eastern Ltd., 2007.

REFERENCES:

1. Fogler H.S., "Elements of Chemical Reaction Engineering", 3rd Edn., PHI, 1999.
2. Smith J.M., "Chemical Engineering Kinetics", 3rd Edn., McGraw Hill, 1981.

CHEMICAL PLANT DESIGN AND ECONOMICS

Course Code: ACH1125

L	T	P	C
4	0	0	4

AIM:

To make Chemical Engineering graduate well versed with economic and engineering principles in the design of chemical plants.

OBJECTIVE:

To impart knowledge of process design, cost estimation, taxes, insurance, depreciation, profitability, optimum design, accounting to develop Chemical Engg. graduates into successful Chemical Engineers.

UNIT-I

Introduction, Process Design Development.

UNIT-II

General design considerations, Cost and asset accounting.

UNIT-III

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-IV

Organizations for presenting capital investments, estimates by compartmentalization, estimation of total product cost direct, production costs, fixed charges, plant overhead costs, financing.

UNIT-V

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

UNIT-VI

Taxes and insurances, type of taxes: federal income taxes, insurance-types of insurance, self insurance. Depreciation : types of depreciation, service 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. Peters M.S. and Timmerhaus K.D., "Plant Design and Economics for Chemical Engineering", Mc Graw Hill, 4th Edn., 1991.

REFERENCE:

1. Schweyer H.E., "Process Engineering Economics", McGraw Hill,1955.

BIOCHEMICAL ENGINEERING

Course Code: ACH1126

L	T	P	C
4	0	0	4

AIM:

Biochemical Engineering is integrated knowledge of governing biological properties and principles of chemical engineering methodology.

OBJECTIVES:

Our challenge in learning Biochemical Engineering is to understand and analyze the processes of biotechnology. This mainly deals with the design and construction of unit processes that involve biological organisms or molecules.

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

Introduction to metabolic pathways: metabolic reaction coupling, oxidation

and reduction, EMP pathway, TCA cycle, biosynthesis, transport across cell membranes, end products of metabolism, stoichiometry of cell growth and product formation.

UNIT-V

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-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.

UNIT-VII

Fermentation technology: medium formulation, design and operation of a typical aseptic, aerobic fermentation process, Selection, scale up of bioreactors (qualitative analysis only). Overview of reactor types, some considerations on aeration, Agitation and heat transfer, scale up, scale down.

UNIT-VIII

Downstream 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 BOOKS:

1. Bailey J.E. and Ollis D.F., "Biochemical Engineering Fundamentals", 2nd Edn., McGraw Hill, 1986.
2. Shuler M.L. and Kargi F., "Bioprocess Engineering", 2nd Edn., PHI, 2002.

CHEMICAL PROCESS EQUIPMENT DESIGN-I

Course Code: ACH1127

L	T	P	C
4	0	0	4

AIM:

To introduce the student to the fundamental elements of design

OBJECTIVES:

1) To enable the student to develop flow sheets of chemical processes
2) To select & design heat transfer equipment suitable for the Particular processes.

UNIT-I

Introduction to design, development of flow diagram from process description, Material and Energy balance, sizing of equipment.

UNIT-II

Materials of construction, selection procedure, corrosion prevention, selection of surface coatings.

UNIT-III

Stresses due to static loads, thermal stresses, stresses caused by bending and wind loads. Thin and thick wall cylinders under internal and external pressure. Thin and thick walled spherical shells under internal and external pressure, prediction of failure of vessels by maximum normal stress theory and maximum strain theory.

UNIT-IV

Design of thin walled vessels and pressures vessels, nozzles, Jackets, flanges and vessels closure.

UNIT-V

Fabrication and inspection methods of storage tank, pressure vessels and heat exchangers.

UNIT-VI

Design of double pipe heat exchangers, LMTD, temperature cross.

UNIT-VII

Shell and tube heat exchangers(1-2,2-4), optimum design and heat recovery.

UNIT- VIII

Design of single and multiple effect evaporators with and without boiling point elevation.

TEXT BOOK:

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

REFERENCES:

1. Joshi M.V., "Process Equipment Design" 3rd Edn., MCMillan India, 1996.
2. Brownell L.E., "Process Equipment Design-Vessel Design", Wiley Eastern Ltd., 1986.
3. Bhattacharya B.C "Introduction to Chemical Equipment Design-Mechanical Aspects", CBS Publishers, 1991.
4. Kern Q., "Process Heat Transfer", McGraw Hill book Co. Inc., 1982.
5. Treybal R.E., "Mass Transfer Operations" MGH Book Co.Inc, 1982.
6. Perry, "Chemical Engineering Hand Book", 7th Ed. McGraw Hill, 1997.

ADVANCED COMMUNICATION SKILLS LAB

CODE: AHE1103

L	T	P	C
0	0	3	2

INTRODUCTION

The introduction of English Language Lab is considered essential at III/ IV B.Tech 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. This is an integrated theory and lab course to enable students use 'good' English and perform the following:

- Gathering ideas and information: organizing ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research/technical reports
- Making oral presentations.
- Writing formal letters and essays.
- Transferring information from non-verbal to verbal texts and vice versa.
- Taking part in social and professional communication.

OBJECTIVES:

The Lab focuses on using computer-aided multimedia instruction for language development to meet the following targets:

- To improve the students' accuracy and fluency in English through a well-developed vocabulary, and enable them listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.

- To enable them communicate their ideas relevantly and coherently in writing.

TEXT BOOK: LANGUAGE IN USE (Upper-Intermediate) ***by Adrian Doff and Christopher Jones, Cambridge University Publications.***

UNIT-I

- Reading and Listening comprehension – reading for facts, guessing meanings from context, scanning, skimming, inference, critical reading
- (Lesson 2: Communicating)

UNIT-II

- Vocabulary building, Creativity & Innovation, Using Advertisements and Music, Case studies
- Decision-Making, Time Management, Positive Thinking
- (Lesson 4: Sports and Games, Lesson 8: In The Market-Place)

UNIT-III

- Cross-Cultural Communication- Problems of Language, Lack of Language equivalency/difficulties in using English.
- Non-Verbal Communication across different Cultures.
- (Lesson 13: Right and Wrong)

UNIT-IV

- Literary reviews- reviewing the choicest genres like science fiction, autobiographies, travelogues, modern poetry etc.

UNIT-V

- Group Discussion – dynamics of group discussion , Lateral thinking, Brainstorming and Negotiation skills

(Lesson 10: Life, the universe and everything & Lesson 16: World Affairs)

UNIT-VI

- Resume writing – structure and presentation, planning, defining the career objective.

- Interview Skills – concept and process, pre-interview planning, opening strategies, answering-strategies, interview through tele and video-conferencing.

UNIT-VII

- Writing essays for competitive examinations
- Media writing-writing headlines, analyzing newspaper articles
- Analytical writing

UNIT-VIII

- Technical Report writing – Types of formats and styles, subject matter – organization, clarity, coherence and style, planning, data-collection, tools, analysis.- Progress and Project Reports.

RECOMMENDED BOOKS:

COMMUNICATIONS SKILLS

1. M. Ashraf Rizvi, "Effective Technical Communication", Tata McGraw-Hill Publishing Company Ltd., 2005.
2. Bhanu Ranjan, "An Approach to Communication Skills", DhanpatRai & Co., 2010.
3. Raymond V. Lesikar, Marie E. Flatley, "Basic Business Communication: Skills for Empowering The Internet Generation", 11th Edition, Tata McGraw-Hill. 2006.
4. Stephen Bailey, "Academic Writing- A Practical guide for students", Routledge Falmer, London & New York, 2004.
5. Dr A. Ramakrishna Rao, Dr G.Natanam & Prof S.A. Sankaranarayanan, "English Language Communication : A Reader cum Lab Manual", Anuradha Publications, Chennai, 2006.
6. Dr. Shalini Verma, "Body Language- Your Success Mantra", S. Chand, 2006.
7. Barron's, "DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice", New Age International (P) Ltd., Publishers, New Delh, Books on TOEFL/GRE/GMAT/CAT, 2011.
8. "IELTS series with CDs", CUP, 2010.

9. Daniel G. Riordan & Steven E. Pauley, "Technical Report Writing Today", Biztantra Publishers, 2005.
10. Andrea J. Rutherford, "Basic Communication Skills for Technology", 2nd Edition, Pearson Education, 2007.
11. Sunita Mishra & C. Muralikrishna, "Communication Skills for Engineers", Pearson Education, 2007.
12. Jolene Gear & Robert Gear, "Cambridge Preparation for the TOEFL" Test, 2010.
13. Meenakshi Raman & Sangeeta Sharma, "Technical Communication", OUP, 2010.
14. Nick Ceremilla & Elizabeth Lee, "Cambridge English for the Media", CUP, 2010

GENERAL READING

1. A Reader's Digest Selection, "Classic Short Stories" (India Today group), 2004.
2. Saros Cowasjee, "More Stories from the Raj and After", HarperCollins Publishers India, 1986.
3. Girish Karnad, "Hayavadana", OUP 1976.
4. A.P.J. Abdul Kalam "Wings of Fire", Universities Press, 1999.
5. Bernard Shaw, "Apple Cart/Arms and the Man", Orient Longman, 2010.
6. Khalil Gibran, "The Prophet" - Rajapal & Sons, 2008.

PROCESS DYNAMICS AND CONTROL LAB

Course Code: ACH1128

L	T	P	C
0	0	3	2

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

SYLLABI FOR VII SEMESTER

CHEMICAL PROCESS EQUIPMENT DESIGN-II

Course Code: ACH1129

L	T	P	C
4	0	0	4

AIM :

To provide students with useful design methods and techniques required in different unit operations of chemical industry

OBJECTIVE:

This course introduces the student to the design of some chemical Engg. Equipment.

UNIT-I

Tray type of absorbers: criteria for selection, types of distributors, calculation of number of plates, and pressure drop.

UNIT –II

Packed bed type of absorbers: Types of packing, Height of transfer unit, Number of Transfer units, overall column height, Pressure drop calculations.

UNIT-III

McCabe-Thiele method, for binary distillation , Fensky-Underwood-Gillilands method calculation of minimum reflux, minimum plates and real number of plates.

UNIT-IV

Criteria for selection of distillation column, selection of key components, selection of operating pressure.

UNIT-V

Determination of distillation column diameter, selection of liquid flow pattern, total pressure drop in column, design of downcomer, Tray efficiency and height equivalent of theoretical plate, Tray efficiency, calculation of flooding velocity and weping velocity

UNIT-VI

Types of extractors (mixer-settler, un-agitated columns, agitated columns, centrifugal extractor), selection of extractors, selection of solvents, process design of extractors, supercritical extraction

UNIT-VII

Types of reactors, process design of batch reactor and continuous flow reactors, selection of reactor

UNIT-VIII

Process design of piping, process design of pumps blowers and extractors, flow meters, process design of orifice meters and rotameters.

TEXT BOOKS:

1. Coulson J.M and Richardson J.F, "Chemical Engineering", Vol. 6, 4th Edn, Pergamon Press, 2005.
2. Thakore S.B. and Bhat, B.I, "Introduction to Process Engineering and Design", Tata McGraw-Hill Publishing Co., New Delhi, 2007.
3. Seader J.D., and Henley E.J, "Separation Process Principles", 2nd Edn, John Wiley, New York, 2006.

TRANSPORT PHENOMENA

Course Code: ACH1130

L	T	P	C
4	1	0	4

AIM :

To give a balanced overview on the field of Transport phenomena, present fundamental equation s and illustrate how to solve them.

OBJECTIVES:

As transport phenomena includes three closely related topics like Momentum, Mass and energy transport, this subject will enable the student to apply these concepts in various chemical process engineering aspects and help them be better designers

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. Bird R.B., Stewart W.C., Lightfoot F.N., "Transport Phenomena", 2nd Edn, John Wiley and Sons,U.S.A, 1960.

REFERENCES:

1. Theodore, L. "Transport Phenomena for Engineers", International text book company,U.S.A.,1971.
2. Geankoplis, C.J. "Transport Processes and Unit Operations", 3rd Edn, PHI, New Delhi, 1997.
3. Welty J.R, Wicks C.E, Wilson R.E, "Fundamental of Momentum, Heat and Mass Transfer", 4th Edn, John Wiley, 2009.

CHEMICAL ENGINEERING MATHEMATICS

Course Code: ACH1131

L	T	P	C
4	1	0	4

AIM :

The aim of this course is to introduce the student the concept of mathematical modeling.

OBJECTIVES:

This course teaches the student the various analytical techniques to solve the Mathematical models.

UNIT-I

FORMULATION OF PHYSIOCHEMICAL PROBLEMS:

Introduction, Illustration of the Formulation Process (Cooling of Fluids), Combining Rate and Equilibrium Concepts (Packed Bed Adsorber), Boundary Conditions and Sign Conventions, Summary of the Model Building Process, Model Hierarchy and its Importance in Analysis.

UNIT-II

SOLUTION TECHNIQUES FOR MODELS YIELDING ORDINARY DIFFERENTIAL EQUATIONS (ODE) :

Geometric Basis and Functionality, Classification of ODE, First Order Equations, Exact Solutions, Equations Composed of Homogeneous Functions, Bernoulli's Equation, Riccati's Equation, Linear Coefficients, First Order Equations of Second Degree,

UNIT-III

Solution Methods for Second Order Nonlinear Equations, Derivative Substitution Method, Homogeneous Function Method, Linear Equations of Higher Order, Second Order Unforced Equations: Complementary Solutions, Particular Solution Methods for Forced Equations, Summary of Particular Solution Methods, Coupled Simultaneous ODE, Summary of Solution Methods of ODE.

UNIT-IV

SERIES SOLUTION METHODS AND SPECIAL FUNCTIONS:

Introduction to Series Methods, Properties of Infinite Series, Method of Frobenius, Indicial Equation and Recurrence Relation, Summary of the Frobenius Method, Special Functions, Bessel's Equation, Modified Bessel's Equation, Generalized Bessel Equation, Properties of Bessel Functions, Differential, Integral and Recurrence Relations.

UNIT-V

INTEGRAL FUNCTIONS:

Introduction, The Error Function, Properties of Error Function, The Gamma and Beta Functions, The Gamma Function, The Beta Function, The Elliptic Integrals, The Exponential and Trigonometric Integrals.

UNIT-VI

STAGED-PROCESS MODELS: THE CALCULUS OF FINITE DIFFERENCES:

Introduction, Modeling Multiple Stages, Solutions Methods for Linear Finite Difference Equations, Complementary Solutions, Particular Solution Methods, Method of Undetermined Coefficients, Inverse operator Method, Nonlinear Equations (Riccaati Equation.

UNIT-VII

LAPLACE TRANSFORMS:

Laplace Transformations: Building Blocks, Taking the Transform, Transforms of Derivatives and Integrals, The Shifting Theorem, Transform of Distribution Functions, Practical Inversion Methods, Partial Fractions, Convolution Theorem, Applications of Laplace Transforms for Solutions of ODE.

UNIT-VIII

SOLUTION TECHNIQUES FOR MODELS PRODUCING PDEs:

Introduction, Classification and Characteristics of Linear Equations, Particular Solutions for PDEs, Boundary and Initial Conditions, Combination of Variables Method, Coated Wall Reactor, Orthogonal Functions and

Sturm-Liouville Conditions, The Sturm-Liouville Equation, Inhomogeneous Equations, Applications of Laplace Transforms for Solutions of PDEs.

TEXT BOOK :

1. Richard, G. R. and. Do, D. D. "Applied Mathematics and Modeling for Chemical Engineers", John Wiley and Sons, New York,1995.

REFERENCE :

1. Mickley, H.S.,Sherwood, T.K. and Reed, C.E, "Applied Mathematics in Chemical Engineering", 2nd Edn., Tata McGraw-Hill, New Delhi Publications, 1975.
2. Jenson, V.J. and Jeffereys, G.V "Mathematical Methods in Chemical Engineering", 2nd Edn, Academic Press New York, 1977.

MEMBRANE SEPARATION PROCESSES

Course Code: ACH1132

L	T	P	C
4	0	0	4

AIM:

This course explains the general aspects and importance of various membrane processes and the various mechanism involved in membrane based separations.(QualitativeTreatment only)

OBJECTIVES:

Membrane are finding an important role in various operation in the industry. The courses introduces to these useful operations

UNIT-I

INTRODUCTION: Separation process, membrane processes, definition of a membrane, classifications membrane processes.

UNIT-II

PREPARATION OF SYNTHETIC MEMBRANES: Types of Membrane materials, 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

MEMBRANE PROCESSES: Introduction, 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.

UNIT-V

ELECTRICALLY DRIVEN PROCESSES: Introduction,

electrodialysis, Process parameters, membranes for electrodialysis, applications, Membrane electrolysis, Bipolar membranes, Fuel Cells.

UNIT-VI

CONCENTRATION DRIVEN MEMBRANE PROCESSES: Gas separation: 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.

UNIT-VII

POLARIZATION PHENOMENON AND FOULING: Introduction to concentration polarization, turbulence promoters, pressure drop, concentration polarization in diffusive membrane separations and electro dialysis, membrane fouling, methods to reduce fouling.

UNIT-VIII

MEMBRANE MODULES: Introduction, plate and frame module, spiral wound module, tubular module, capillary module, hollow fiber module, comparison of module configurations.

TEXT BOOKS:

1. Marcel Mulder, Basic Principles of Membrane Technology, Springer Publications 2nd Edn., 2007

REFERENCES:

1. Nunes, S.P, Peinemann, K.V, "Membrane Technology in the Chemical industry", 2nd Edn, Wiley-VCH, 2006.
2. Rautanbach and Albrecht, R., "Membrane Process", John Wiley and Sons.,1989.
3. Crespo, J.G., Bodekes, K.W., "Membrane Processes in separation and Purification", Kluwer Academic Publications, Netherland,1994.
4. Geankoplis, C.J. "Transport processes and Unit Operations" 3rd Edn, PHI, New Delhi, 2002.
5. Wankat, R. C. "Rate- Controlled Separations", Springer, 1994.

APPLIED NUMERICAL METHODS

(ELECTIVE-I)

Course Code: ACH1133

L	T	P	C
4	0	0	4

AIM:

This course trains the students in learning and applying numerical techniques to solve the usual chemical engineering problems.

OBJECTIVES:

Numerical techniques are needed to solve non-linear problems and this course teaches some of these techniques.

UNIT-I

NONLINEAR ALGEBRAIC EQUATIONS: Introduction, simple fixed point method, Two variable Newton-Raphson Technique, Simultaneous Non linear equations,

UNIT-II

LEAST SQUARES REGRESSION : Linear Regression, Polynomial Regression, Non linear Regression.

UNIT-III

ODE INITIAL VALUE PROBLEMS (IVP): Introduction: Importance of IVP, Euler-Explicit and Implicit methods, R-K Methods.

UNIT-IV

ODE BOUNDARY VALUE PROBLEMS(BVP): Introduction: Importance of BVP's, shooting method technique to solve ODE BVP's.

ODE BVP'S APPLICATIONS : PFR with non linear kinetics and axial diffusion, Heat Transfer through a Fin, effectiveness factor calculation for slab and spherical geometries.

UNIT-V

ODE FINITE DIFFERENCE METHOD(FDM): Importance: Forward , Backward and Central Difference schemes, Methods for

solving problems of PFR with non linear kinetics and axial diffusion, Heat Transfer through a Fin, effectiveness factor of a slab and spherical geometries.

UNIT-VI

PARTIAL DIFFERENTIAL EQUATION (PDE) –FDM APPLICATIONS : Importance: Forward, Backward, Central differencing schemes, Implicit and Explicit schemes for Unsteady state problems, Crank-Nicholson scheme. Applications: 2 Dimensional steady state Heat Transfer, Unsteady Heat Transfer with 1 dimensional space.

UNIT-VII

ORDINARY DIFFERENTIAL EQUATIONS (ODE) - ORTHOGONAL COLLOCATION(OC) APPLICATIONS: Importance: Theory of Legendre Polynomials, Generating the Matrices for OC, solving Heat Transfer through a Fin, Effectiveness factor calculation for a slab and spherical geometry.

UNIT-VIII

PARTIAL DIFFERENTIAL EQUATION (PDE) – OC APPLICATIONS: 2 Dimensional steady state Heat Transfer, Unsteady Heat Transfer with 1 dimensional space.

TEXT BOOK:

1. Gupta, S.K. "Numerical Methods for Engineers" New Age International (P) Ltd, 1995.

REFERENCE :

1. Rice, R.G. and. Do, D.D., "Applied Mathematics and Modeling for Chemical Engineers", John Wiley and Sons, New York, 1995.

CORROSION ENGINEERING

(ELECTIVE-I)

Course Code: ACH1134

L	T	P	C
4	0	0	4

AIM:

This course introduces the student the basics of electro chemistry and corrosion Engg.

OBJECTIVES:

Corrosion is a major industrial problem and the present course introduces the student the technical aspects of Corrosion Engg., their measurement & prevention.

UNIT-I

Definitions-explanation with suitable examples Factors affecting the choice of Engineering Material-Factors affecting Corrosion resistance-Dry Corrosion , Wet Corrosion- Corrosive media or environments- acidic, basic, neutral marine-Corrosion Rate expressions-Effect of aeration, flow rate of the medium, corrosive concentration, temperature, pH on the rates of Corrosion. Direct and indirect costs due to corrosion in Industrial practice- Corrosion rates determination from weight loss measurements.

UNIT-II

Basic electrochemical relevant to corrosion-Anode, Cathode, electrolyte, conductivity, resistivity, Electrochemical theories of Corrosion- relevant reactions at the respective metal/alloy electrodes, Mixed Potential theory of Electrochemical Corrosion, Electrode potentials- reversible and irreversible - EMF series, Galvanic Series their significance in corrosion monitoring-Corrosion Potential-representation by Evans Diagrams-Polarization-Over voltage, Activation and Concentration polarization-Tafels Equation, Tafels constants in determination of Corrosion Current densities and Corrosion rates- Nernst Equation and determination of Corrosion potentials. Thermodynamic aspects of Corrosion reactions-Potential-pH phase diagram for Iron-Water system.

UNIT-III

A Corrosion Cell –its components with examples –types of corrosion cells generally encountered-concentration cells, galvanic or dissimilar metal cells, temperature differentiation cells, Differential aeration cells. Forms of Corrosion-Uniform, Pitting, crevice corrosion, Cavitation erosion, impingement attack, Parting, Corrosion fatigue- metallurgical aspects affecting corrosion reactions Area effect, Grain boundary effect.

UNIT-IV

Dezincification, Intergranular Corrosion, mechanism and remedial measures, Stress Corrosion Cracking, Caustic embrittlement, Hydrogen embrittlement mechanism and remedial measures-mechanism of differential aeration corrosion and remedial measures. Biological corrosion due to bacterial habitat, Combination of two dissimilar metal electrodes and relevant current-potential diagrams to evaluate corrosion rates-galvanic Corrosion.

UNIT-V

Combating Corrosion – Corrosion testing methods: Weight Loss methods, standard expression for corrosion rates-Huey Test, Streicher Test, Warren Test for corrosion. Linear Polarization Technique to evaluate corrosion, interpretation of corrosion data by Nelson's Method.

UNIT-VI

Corrosion Prevention Methods generally followed-Coatings, Organic (paints) and Inorganic coatings-Chemical Conversion coatings- Altering the environment, inhibitors organic and inorganic, altering or modifying the material, alloying essential design rules during fabrication and other precautions during the choice of the material for a given service environment.

UNIT-VII

Passivity, Anodic Protection and Cathodic Protection, Sacrificial anode Method –Current impressed Method- galvanizing of steel.

UNIT-VIII

Selection for a given Chemical Engineering Service Environment- Materials for Chemical Engineering Industry to resist the given chemical Environment.- Ferritic, Austenitic steels and stainless steels-Copper and its alloys-Brasses,

bronzes, Nickel and its alloys- Monel alloys-materials for a petroleum refinery industry.

TEXT BOOKS:

1. Fontana M.G, "Corrosion Engineering", 3rd Edn, Tata McGraw Hill, New York, 2005.
2. Uhlig, H.H., "Corrosion and Corrosion Control" 3rd Edn, John Wiley and Sons, New York, 1985.

SAFETY AND HAZARD ANALYSIS

(ELECTIVE-I)

Course Code: ACH1135

L	T	P	C
4	0	0	4

AIM:

To impart fundamental knowledge of safety requirements in Chemical industry.

OBJECTIVES:

These fundamentals will make students understand the safety concepts thoroughly and then apply accordingly.

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, LOC 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 Crowe, D.A.and Louvar, J.F. "Chemical Process Safety (Fundamentals with applications)", Prentice Hall ,1990.

REFERENCE:

1. Fawcet, H.H. and.Wood, W.S. "Safety and Accident Prevention in Chemical Operations", 2nd Edn, John Wiley, New York, 1982.
2. Sinnot, R.K. "Coulson and Richardson's , Chemical Engineering" Vol.6, Butterworth-Heinmann Limited 1996.

NON CONVENTIONAL SOURCES OF ENERGY

(ELECTIVE-I)

Course Code: AME1135

L	T	P	C
4	0	0	4

AIM:

To introduce and familiarize the student with the various renewable sources of energy.

OBJECTIVE:

Renewable sources of energy is an area of research and development especially for countries like India. So the student should be in a position to take up small scale projects, as entrepreneurs, since the cost of investment is minimal in some of the sources.

UNIT-I

Introduction to various renewable sources of energy.

SOLAR RADIATIONS: Extra terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, Longitude, Latitude, Declination angle, Surface azimuth angle, Hour angle, Zenith angle, Solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India.

UNIT-II

SOLAR ENERGY: Solar thermal power and its conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing . Solar thermal energy storage, Different systems, Solar pond. Applications - Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants.

SOLAR PHOTOVOLTAIC SYSTEM: Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system.

UNIT-III

WIND ENERGY: Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, performance characteristics, Betz criteria Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent developments.

UNIT-IV

BIO-MASS AND BIO-GAS: Principles of Bio-Conversion, Photosynthesis, Bio gas production, Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Biomass gasification, Energy recovery from urban waste, Power generation from liquid waste, Biomass cogeneration, Energy plantation, Fuel properties, Biomass resource development in India.

UNIT-V

OCEAN ENERGY: Principle of ocean thermal energy conversion, Wave energy conversion machines, Power plants based on ocean energy, Problems associated with ocean thermal energy conversion systems, Thermoelectric OTEC, Developments of OTEC.

TIDAL POWER: Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy, Limitations of tidal energy conversion systems.

UNIT-VI

GEOTHERMAL ENERGY: Structure of earth's interior, Geothermal sites, earthquakes & volcanoes, Geothermal resources, Hot springs,

Steam ejection, Principle of working, Types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion.

UNIT-VII

ELECTROCHEMICAL EFFECTS AND FUEL CELLS: Principle of operation of an acidic fuel cell, Reusable cells, Ideal fuel cells, Other types of fuel cells, Comparison between acidic and alkaline hydrogen-oxygen fuel cells, Efficiency and EMF of fuel cells, Operating characteristics of fuel cells, Advantages of fuel cell power plants, Future potential of fuel cells

HYDROGEN ENERGY: Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use.

UNIT-VIII

DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, Principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule-Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, Hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects.

TEXT BOOK:

1. Rai G.D, "Non-Conventional Energy Sources", 4th Edn, Khanna Publishers, 2008.

REFERENCES:

1. Kothari D.P, "Renewable Energy Resources and Emerging Tech", 1st Edn, Prentice Hall of India Pvt. Ltd, 1990.

BIOMEDICAL INSTRUMENTATION

(ELECTIVE-I)

Course Code: AEC1130

L	T	P	C
4	0	0	4

AIM:

To give a complete exposure of various recording mechanisms and physiological parameters measured for diagnostic application.

OBJECTIVES:

- To study different types of electrodes used in bio-potential recording.
- To understand the characteristics of bio-amplifiers and different types of recorders.
- To understand how to measure various biochemical and nonelectrical parameters of human system.
- To study the instrumentation concerned with measuring the blood flow
- To study the latest developments in medical imaging systems.

UNIT-I

COMPONENTS OF MEDICAL INSTRUMENTATION SYSTEMS: Bio-amplifier, Static and dynamic characteristics of medical instruments. Bio-signals and characteristics. Problems encountered with measurements from human beings, Organization of cell, Nernst equation and Goldman's Equation for membrane Resting Potential Generation, Propagation of Action Potential,

UNIT-II

BIO-POTENTIAL ELECTRODES & TRANSDUCERS: Electrode potential, Electrode equivalent circuit, Types of Electrodes-Surface Electrodes, Needle Electrodes, Micro Electrodes. Transducers for measuring the physiological parameters

UNIT-III

BIO-SIGNAL ACQUISITION: Electrical Conduction system of the heart, ECG leads, Einthoven triangle, ECG amplifier, EEG 10-20 lead system, EEG amplifier, Specifications and Interpretation of ECG,EEG,EMG, ERG, EOG

UNIT-IV

BIO-SIGNAL MEASUREMENTS: Blood flow meters- Electromagnetic blood flow meter, Ultrasonic Doppler blood flow meter. Blood pressure measurement- Ultrasonic blood pressure monitoring. Phonocardiograph- Heart sound Microphone and preamplifier, TMT Machine.

UNIT-V

PHYSIOLOGICAL ASSIST DEVICES & THERAPEUTIC EQUIPMENT: Pacemakers- External & internal, Defibrillators- External & internal, Different types of Hemodialyser and Hemodialysis machine. Heart-Lung machine – Oxygenators and Blood pumps. Audio meter, Opthalmoscope, Shortwave Diathermy, Microwave Diathermy and Ultrasound Diathermy.

UNIT-VI

OPERATION THEATRE EQUIPMENT AND MONITORING EQUIPMENT: Spiro meter, Pnemuotachography using strain-gauge, Plethysmography, Anesthesia machine, Ventilators, Surgical diathermy, Humidifiers, Neubilisers. Arrthmia Monitor, Holter monitor, Ambulatory Monitor, Fotal Monitor, Incubator.

UNIT-VII

CLINICAL LABORATORY EQUIPMENT: Colorimeter, Flame photometer, Spectrophotometer, Conductivity meter, Electrophoresis, Chromatography, Blood cell Counter, Blood gas analyzer: pH-pCO_2, pO_2, Auto-analyzer, Glucometer.

UNIT-VIII

MEDICAL IMAGING EQUIPMENT: X-ray generation, X-ray tube, X-ray machine. Computed Tomography (CT), Endoscope, Ultrasound Imaging system, Magnetic resonance Imaging (MRI), Nuclear Imaging

systems- Positron Emission Tomography (PET), Single Photon Emission Tomography (SPECT)

TEXT BOOKS:

1. Cromwell L Weibell F.J., and Pfeiffer E.A., "Biomedical Instrumentation and Measurements", 2nd Edn, PHI, 1980.
2. Webster J. G., "Medical Instrumentation, Application and Design", 3rd Edn., John Wiley, 2009.
3. Arumugam M., "Biomedical Instrumentation", Anuradha Publications, 2nd Edn., 1994.

REFERENCES:

1. R.S. Khandpur, "Hand-book of Biomedical Instrumentation", 2nd Edn., TMH, 2003.

POLYMER ENGINEERING

(ELECTIVE-II)

Course Code: ACH1136

L	T	P	C
4	0	0	4

AIM:

The course introduces the student the basics of Polymer processing & Polymer technology.

OBJECTIVES:

This course teaches the student the various polymerization techniques and the desirable properties.

UNIT-I

INTRODUCTION : Defining Polymers, Classification of Polymers and Some Fundamental Concepts, Chemical Classification of Polymers Based on Polymerization Mechanisms, Molecular-weight Distributions, Configurations and Crystallinity of Polymeric Materials, Conformation of Polymer Molecules, Polymeric Supports in Organic Synthesis.

UNIT-II

EFFECT OF CHEMICAL STRUCTURE ON POLYMER PROPERTIES : Introduction, Effect of Temperature on Polymers, Additives for Plastics, Rubbers, Cellulose Plastics, Copolymers and blends, Cross-linking Reactions, Ion-Exchange Resins.

UNIT-III

STEP-GROWTH POLYMERIZATION: Introduction, Esterification of Homologous Series and the Equal Reactivity Hypothesis.

UNIT-IV

1) Chain-Growth Polymerization: Introduction, Radical Polymerization, Ionic Polymerization, Anionic Polymerization.
2) Emulsion Polymerization: Introduction, Aqueous Emulsifier Solutions.

UNIT-V

MEASUREMENT OF MOLECULAR WEIGHT AND ITS DISTRIBUTION: Introduction, End-Group Analysis, Colligative Properties, Light Scattering, Ultracentrifugation, Intrinsic Viscosity, Gel Permeation Chromatography.

UNIT-VI

THEORY OF RUBBER ELASTICITY: Introduction, Elastic Force Between Chain Ends, Stress-Strain Behavior, The Stress Tensor (Matrix), Measures of Finite Strain, The Stress Constitutive Equation, Vulcanization of Rubber and Swelling Equilibrium.

UNIT-VII

MECHANICAL PROPERTIES: Introduction, Stress-Strain Behavior, The Glass Transition Temperature, Dynamic Mechanical Experiments, Time-Temperature Superposition, Polymer Fracture, Crazing and Shear Yielding, Fatigue Failure, Improving Mechanical Properties.

UNIT-VIII

POLYMER PROCESSING: Introduction, Extrusion, Injection Molding and Fiber Spinning.

TEXT BOOK:

1. Anil Kumar, Gupta, R.K. "Fundamentals of Polymer Engineering", 2nd Edn, Marcel Dekker, 2003.

PETROLEUM REFINING & PETROCHEMICALS

(ELECTIVE-II)

Course Code: ACH1137

L	T	P	C
4	0	0	4

AIM :

Crude refining is a major operation in the chemical industry . This course teaches the students the various aspects of refining.

OBJECTIVES:

Petroleum and petroleum refining is an important segment of energy and Petrochemical chemical products. This course adequately trains and equips the student in understand various refining problems and helps them to be abreast with basic aspects of petroleum refining and petrochemical products

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. Nelson, W.L. "Petroleum refining Engineering", 4th Edn., Mc Graw Hill, New York, 1969.
2. Rao, B.K.B. "Modern Petroleum Refining Processes", 4th Edn, Oxford and IBH Publishing, 2002.

REFERENCES:

1. Goldstine, R.F. "The Petroleum Chemicals Iindustry" , Taylor and Francis, London, 1967.
2. Gruese, W.S.and Stevens, D.R. "Chemical Technology of Petroleum" McGraw' Hill, 1980.
3. Chauvel, A. and Lefevrev, "Petro Chemicals" Volume 1 and 2, Gulf Publishing Company 1989.

ENERGY ENGINEERING

(ELECTIVE-II)

Course Code: ACH1138

L	T	P	C
4	0	0	4

AIM:

This course introduces the student the use of energy as a source of energy.

OBJECTIVES:

Energy plays as important role in human life and this course introduces the student the various forms of energy sources.

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, sanky diagram, energy auditing.

UNIT-VI

BATTERIES:

Fundamentals:

EMF, reversible cells and irreversible cells, reversible electrodes, relationship between electrical energy and energy content of a cell, free energy changes and emf in cells, relationship between the energy changes accompanying a cell reaction and concentration of the reactants, effect of cell temperature on batteries, derivation of number of electrons involved in a cell reactions, thermodynamic calculation of the capacity of a battery, calculations of energy density of cells, heating effects in batteries, spontaneous reaction in electrochemical cells, pressure development in sealed batteries.

(i) Factors affecting battery performance :

Factors affecting battery capacity, voltage level current drain of discharge, types of

Discharge continuous, intermittent, constant current, constant load, constant power, service life, voltage regulation, changing methods, battery age & storage condition, effect of battery design.

(ii) Testing of battery components:

Evaluation of active masses, porosity - mercury porosity meter, liquid absorption method, surface area measurement - BET method (nitrogen absorption.), internal resistance of cells - D.C. methods, polarization elimination method. I.E. polarization and flash current method A.C. methods, A.C. impedance method, testing of storage batteries

Storage Batteries

Principle design construction, advantage and disadvantages.

Primary batteries - Zn-MnO2 system, carbon-zinc and carbon-zinc chlorides performance characteristics and zinc-silver oxide.

Reserve batteries: seawater activated batteries, thermal batteries, electrolyte activated batteries

Secondary batteries – lead acid, nickel cadmium, nickel metal hydride, silver oxide zinc system, lithium ion, Lithium polymer

Batteries for Defense applications:

(i)Army – Lithium based primary batteries

(ii)Air force- Silver zinc, nickel cadmium, batteries used in UAV

(iii) Navy- batteries for Torpedo, mines, Decoys, AUV, submarine etc.

Fuel cells & Super capacitor:

Introduction to super capacitors, types of super capacitors, introduction to fuel cells, types of fuel cells and technology development Testing and Evaluation of high energy & power batteries capacity test -test for retention of charge, vibration test, life test, efficiency test, leakage test for sealed cells, testing of separators, HRD at normal and low temperature

UNIT -VII

FUEL CELLS: What is a fuel cell, Types of fuel cells, fuel cells applications, main components of a PEM fuel cell.

UNIT -VIII

ENERGY CONSERVATION: conservation methods in process industries, theoretical analysis, practical limitations.

TEXT BOOKS:

1. Gupta, O.P. "Fuels, Furnaces and Refractories", Khanna Publishers, NewDelhi,1990.
2. Samir Sarkar, "Fuels and Combustion", 2nd Edn, Orient Longman, 1998.
3. Linden D and Reddy T.B., " Hand book on batteries and Fuel cells", 3rd Edn., McGraw Hill Book Co., New York, 2002.
4. Frano B., "PEM fuel cells: Theory and practice", Elsevier, 2005.

REFERENCES:

1. Rai, G.D. "Non-Conventional Energy Resources", Khanna Publsihers, New Delhi, 1993.
2. Sukhathme , S.P. "Solar Energy". , Tata Mc Graw Hill, New Delhi, 1996.
3. Murphy, W.R., Mc.Kay, G. "Energy Management", 1st Edn, Butterworth, 2000.

DATA STRUCTURES FOR ENGINEERING APPLICATIONS

(ELECTIVE- II)

Prerequisite: Computer Programming through C

Course Code: AIT1114

L	T	P	C
4	1	0	4

AIM:

To empower students to build efficient software applications with suitable data structures.

OBJECTIVE:

To make students understand the software design techniques for solving engineering applications of their discipline

UNIT-I

RECURSION AND LINEAR SEARCH : Preliminaries of algorithm, Algorithm analysis and complexity, Recursion: Definition, Design Methodology and Implementation of recursive algorithms, Linear and binary recursion, recursive algorithms for factorial function, GCD computation, Fibonacci sequence, Towers of Hanoi.

Chapters 1, 2 from Text Book 1

UNIT-II

SEARCHING TECHNIQUES : Introduction, Linear Search, Transpose Sequential, Search, Interpolation Search, Binary Search, Fibonacci Search.

Chapter 15 from Text Book 2.

UNIT-III

SORTING TECHNIQUES : Basic concepts, insertion sort, selection sort, bubble sort, quick sort, merge sort.

Chapter 12 from Text Book 1

UNIT-IV

STACKS : Basic Stack Operations, Representation of a Stack using Arrays, Stack Applications: Reversing list, Factorial Calculation, In-fix-to postfix Transformation, Evaluating Arithmetic Expressions.

Chapter 3 from Text Book 1.

UNIT-V

QUEUES : Basic Queues Operations, Representation of a Queue using array, Implementation of Queue Operations using Stack.

Chapter 4 from Text Book 1.

UNIT-VI

APPLICATIONS OF QUEUES : Applications of Queues- Enqueue, Dequeue, Circular Queues, Priority Queues.

Chapter 4 from Text Book 1.

UNIT-VII

LINKED LISTS : Introduction, single linked list, representation of a linked list in memory, Operations on a single linked list, merging two single linked lists into one list, Reversing a single linked list, Circular linked list, Double linked list.

Chapter 6 from Text Book 2.

UNIT-VIII

TREES : Basic tree concepts, Binary Trees: Properties, Representation of Binary Trees using arrays and linked lists, operations on a Binary tree , Binary Tree Traversals (recursive), Creation of binary tree from in-order and pre(post)order traversals.

Chapter 8 from Text Book 2.

TEXT BOOKS:

1. Richard F, Gilberg & Behrouz A. Forouzan, "Data Structures", 2nd Edn, Thomson, 2007.
2. GAV PAI, "Data Structures and Algorithms", 1st Edn, Tata McGraw-Hill, 2010.

REFERENCES :

1. Seymour Lipschutz, "Data Structure with C", 1st Edn, TMH, 2009.
2. Debasis, Samanta, "Classic Data Structures", 2nd Edn, PHI,2009.
3. Horowitz,Sahni, Anderson, "Fundamentals of Data Structure in C", 2nd Edn, Freed, University Press, 2009.

SOFTWARE DEVELOPMENT ENGINEERING

(ELECTIVE-II)

Course Code: ACS1115

L	T	P	C
4	0	0	4

AIM :

- To provide an understanding of the various processes software engineers may employ in developing contemporary software systems
- To examine all phases of the software development life cycle, from initial planning through implementation and maintenance.
- To develop an understanding of the tools and Techniques employed in contemporary Software engineering.

OBJECTIVES:

- To demonstrate the skills required to analyze, design for software systems.
- To demonstrate an appreciation of good practices in software engineering.
- To demonstrate the application of software quality concepts.

UNIT-I

INTRODUCTION TO SOFTWARE ENGINEERING : The evolving role of software, Changing Nature of Software, Software Myths.

A GENERIC VIEW OF PROCESS: SOFTWARE ENGINEERING – A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), process patterns, process assessment, personal and team process models.

UNIT-II

PROCESS MODELS : The waterfall model, Incremental process models, Evolutionary process Models, The Unified process, agile methodology.

SOFTWARE REQUIREMENTS: Functional and non-functional requirements, user requirements, System requirements, Interface specification, the Software Requirements document.

UNIT-III

REQUIREMENTS ENGINEERING PROCESS: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.

SYSTEM MODELS: context models, Behavioral models, Data models, object models, structured Methods.

UNIT-IV

DESIGN ENGINEERING: Design process and Design quality, Design concepts, the design model.

CREATING AN ARCHITECTURAL DESIGN: Software Architecture, Data design, Architectural styles and Patterns, Architectural Design.

UNIT-V

OBJECT ORIENTED DESIGN: Objects and Object classes, An Object Oriented design process, Design Evolution.

PERFORMING USER INTERFACE DESIGN: Golden rules, User interface analysis and design, interface Analysis, interface design steps, Design evaluation,

UNIT-VI

TESTING STRATEGIES: A strategic approach to software testing, the strategies for conventional

Software, Verification Testing and Validation Testing, Different Types of Testing, the art of Debugging.

UNIT-VII

Client Server Systems - Meaning, Architecture and Design

Web based Systems - Meaning, Architecture and Design

Data warehouse System - Meaning, Architecture and Design

Introduction to RAD Tool (3-4 lab sessions included)

UNIT-VIII

Write Software Development Specifications that include System Analysis and System design for

a) A Web Based Application System

b) A Data warehouse Application system

TEXT BOOKS:

1. Pressman R.S, "Software Engineering, A Practitioner's Approach", 7th Edn, TMH, 2008.

2. Han J and Kamber M, "Data Mining - Concepts and Techniques", 2nd Edn, Morgankaufmann Publishers, 2008.

COMPUTER AIDED DESIGN OF CHEMICAL EQUIPMENT LAB

Course Code: ACH1139

L	T	P	C
0	0	3	2

1) Design of a double pipe Heat Exchanger.
2) Design of a 1-2 shell & tube Heat Exchanger.
3) Design of a Evaporator.
4) Design of a Distillation Column
5) Process simulation of absorber, Distillation Column, LLE columns using PRO-II. Inclusion of Tray efficiencies, Side streams, Interchange Heaters & coolers.

APPLICATIONS OF MATLAB IN CHEMICAL ENGINEERING

Course Code: ACH1140

L	T	P	C
0	0	3	2

1) Basics of MATLAB: Matrices and vector manipulation, calculating inverse and eigen values and eigen vectores of a matrix.
2) Linear Regression, Non- linear Regression.
3) Non-linear Algebraic Equations: Solving CSTR: isothermal & non-isothermal case, Bioreactor model and calculating multiple steady states.
4) ODE-IVP
   - Batch reactor, PFR
5) ODE-BVP
   - Tubular Reactors with Axial diffusion, Heat transfer in a fin, effectiveness factor calculation.
6) Control systems: Defining a transfer function, calculating poles and zeros of a transfer function.
7) Step and pulse response of a given transfer function.
8) Inverse Response and its limitations in controller setting.
9) Design a feedback PID controller by simulations for a given transfer function.

SYLLABI FOR VIII SEMESTER

OPTIMIZATION OF CHEMICAL PROCESSES

Course Code: ACH1141

L	T	P	C
4	0	0	4

AIM:

To provide the overview of concepts and methods of single and multi-variable optimization.

OBJECTIVE:

To solve general and chemical engineering single and multi-variable optimization Problems.

The following syllabus is limited to Multi-variable problems with two variables only.

UNIT-I

Gradient of a single variable function, gradient vector of a multi-variable function, second derivative of a single variable function, Hessian of a multi-variable function, Eigen values of a matrix, convex functions, determination of convexity of a function by Eigen values.

UNIT-II

Optimality conditions for a single-variable and multi-variable functions, classification of stationary points for single-variable and multi-variable functions.

UNIT-III

Structure of a single-variable and multi-variable optimization problems with and without constraints (qualitative treatment), single-variable optimization methods and problems: interval halving method, golden section method and Fibanocci method.

UNIT-IV

Multi-variable optimization without constraints: Multi-variable optimization methods, such as steepest descent, Newton's method and unidirectional search method. Solving two-variable optimization problems using above methods.

UNIT-V

Multi-variable optimization with constraints: Lagrangian multiplier method, Karush-Kuhn-Tucker (KKT) conditions, penalty function method. Solving two-variable constrained optimization problems using above methods.

UNIT-VI

Linear programming, Simplex method to solve LP problems, duality principle and converting a LP to dual LP.

UNIT-VII

Chemical engineering optimization problems

Part 1: Pipe diameter, multi-stage evaporator, reflux ratio of distillation column.

UNIT-VIII

Chemical engineering optimization problems

Part 2: Thermal cracker, Alkylation reactor.

TEXT BOOKS:

1. Edgar,T.F., Himmelblau, D.M. and Lasdon L.S., "Optimization of Chemical Processes", 2nd Edn, McGraw-Hill International, 2001.
2. Kalyanmoy Deb "Optimization for Engineering Design", Prentice Hall,India, 2005.
3. Rao S.S., "Engineering Optimization-Theory and Practice", New Age International Publishers, 3rd Edn, New Delhi, 1996.

REFERENCES:

1. Arora J.S., "Introduction to Optimum Design", 2nd Edn, Elsevier Academic Press, San Diego, USA, 2004.
2. Reklaitis, G.V., Ravindran, A., and Ragsdell, K.M., "Engineering Optimization-Methods and Applications", 2nd Edn, Wiley., New York, 1983.

BIOLOGICAL WASTE WATER TREATMENT

(ELECTIVE-III)

Course Code: ACH1142

L	T	P	C
4	0	0	4

AIM :

To impart knowledge on biological methods of waste treatment.

OBJECTIVES:

To understand and help remove different chemicals from waste water generated from various chemical industrial by biological means

UNIT-I

HISTORICAL DEVELOPMENT OF WASTEWATER COLLECTION AND TREATMENT: Water Supply and Wastewater Management in Antiquity, Water Supply and Wastewater Management in the Medieval Age, First Studies in Microbiology, Wastewater Management by Direct Discharge into Soil and Bodies of Water – The First Studies ,Mineralization of Organics in Rivers, Soils or by Experiment –A Chemical or Biological Process?, Early Biological Wastewater Treatment Processes, The Cholera Epidemics – Were They Caused by Bacteria Living in the Soil or Water?, Early Experiments with the Activated Sludge Process, Taking Samples and Measuring Pollutants, Early Regulations for the Control of Wastewater Discharge.

WASTEWATER CHARACTERIZATION AND REGULATIONS: Volumetric Wastewater Production and Daily Changes, Pollutants, Survey, Dissolved Substances, Organic Substances, Inorganic Substances, Colloids, Oil-In-Water Emulsions, Solid-In-Water Colloids, Suspended Solids, Methods for Measuring Dissolved Organic Substances as Total Parameters, Biochemical Oxygen Demand, Chemical Oxygen Demand, Total and Dissolved Organic Carbon.

UNIT-II

MICROBIAL METABOLISM: Some Remarks on the Composition and Morphology of Bacteria (Eubacteria),Proteins and Nucleic Acids,

Proteins , Amino Acids , Structure of Proteins, Proteins for Special Purposes , Enzymes, Nucleic Acids, Desoxyribonucleic Acid, Ribonucleic Acid, DNA Replication, Mutations, Catabolism and Anabolism, ADP and ATP, Transport of Protons, Catabolism of Using Glucose, Aerobic Conversion by Prokaryotic Cells, Anaerobic Conversion by Prokaryotic Cells,Anabolism.

DETERMINATION OF STOICHIOMETRIC EQUATIONS FOR CATABOLISM AND ANABOLISM: Introduction ,Aerobic Degradation of Organic Substances , Degradation of Hydrocarbons Without Bacterial Decay, Mineralization of 2,4-Dinitrophenol , Degradation of Hydrocarbons with Bacterial Decay, Measurement of O_2 Consumption Rate r O_2,S and CO_2 Production.

UNIT-III

GAS/LIQUID OXYGEN TRANSFER AND STRIPPING: Transport by Diffusion, Mass Transfer Coefficients, Definition of Specific Mass Transfer Coefficients , Two Film Theory, Measurement of Specific Overall Mass Transfer Coefficients KLa ,Absorption of Oxygen During Aeration, Steady State Method , Non-steady State Method , Dynamic Method in Wastewater Mixed with Activated Sludge , Desorption of Volatile Components During Aeration, Oxygen Transfer Rate, Energy Consumption and Efficiency in Large-scale Plants, Surface Aeration, Oxygen Transfer Rate , Power Consumption and Efficiency.

UNIT-IV

AEROBIC WASTEWATER TREATMENT IN ACTIVATED SLUDGE SYSTEMS: Introduction, Kinetic and Reaction Engineering Models With and Without Oxygen Limitation, Batch Reactors, With High Initial Concentration of Bacteria, With Low Initial Concentration of Bacteria, Chemostat, Completely Mixed Activated Sludge Reactor, Preliminary Remarks ,Mean Retention Time, Recycle Ratio and Thickening Ratio as Process Parameters, Sludge Age as Parameter, Plug Flow Reactor , Completely Mixed Tank Cascades With Sludge Recycle , Flow Reactor With Axial Dispersion ,Stoichiometric and Kinetic Coefficients ,Comparison of Reactors, Retention Time Distribution in Activated Sludge Reactors, Retention Time Distribution, Completely Mixed Tank, Completely Mixed Tank Cascade, Tube Flow Reactor With Axial Dispersion, Comparison

Between Tank Cascades and Tube Flow Reactors , Technical Scale Activated Sludge Systems for Carbon Removal.

UNIT-V

AEROBIC TREATMENT WITH BIOFILM SYSTEMS: Biofilms, Biofilm Reactors for Wastewater Treatment , Trickling Filters, Submerged and Aerated Fixed Bed Reactors , Rotating Disc Reactors, Mechanisms for Oxygen Mass Transfer in Biofilm Systems , Models for Oxygen Mass Transfer Rates in Biofilm Systems, Assumptions, Mass Transfer Gas/ Liquid is Rate-limiting ,Mass Transfer Liquid/Solid is Rate-limiting , Biological Reaction is Rate-limiting, Diffusion and Reaction Inside the Biofilm ,Influence of Diffusion and Reaction Inside the Biofilm and of Mass Transfer Liquid/Solid , Influence of Mass Transfer Rates at Gas Bubble and Biofilm.

UNIT-VI

ANAEROBIC DEGRADATION OF ORGANICS: Catabolic Reactions – Cooperation of Different Groups of Bacteria, Survey, Anaerobic Bacteria , Acidogenic Bacteria, Acetogenic Bacteria, Methanogenic Bacteria, Regulation of Acetogenics by Methanogenics, Sulfate and Nitrate Reduction, Kinetics – Models and Coefficients ,Preface, Hydrolysis and Formation of Lower Fatty Acids by Acidogenic Bacteria, Transformation of Lower Fatty Acids by Acetogenic Bacteria, Transformation of Acetate and Hydrogen into Methane, Conclusions, Catabolism and Anabolism ,High-rate Processes , Introduction,Contact Processes, Upflow Anaerobic Sludge Blanket , Anaerobic Fixed Bed Reactor ,Anaerobic Rotating Disc Reactor , Anaerobic Expanded and Fluidized Bed Reactors.

UNIT-VII

BIODEGRADATION OF SPECIAL ORGANIC COMPOUNDS

Introduction, Chlorinated Compounds , Chlorinated n-Alkanes, Particularly Dichloromethane and1,2-Dichloroethane , Properties, Use, Environmental Problems and Kinetics , Treatment of Wastewater Containing DCM or DCA , Chlorobenzene , Properties, Use and Environmental Problems , Principles of Biological Degradation , Treatment of Wastewater Containing Chlorobenzenes ,Chlorophenols , Nitroaromatics ,Properties, Use,

Environmental Problems and Kinetics ,Treatment of Wastewater Containing 4-NP or 2,4-DNT , Polycyclic Aromatic Hydrocarbons and Mineral Oils, Properties, Use and Environmental Problems, Mineral Oils, Biodegradation of PAHs , PAHs Dissolved in Water, PAHs Dissolved in n-Dodecane Standard Emulsion , Azo Reactive Dyes, Properties, Use and Environmental Problems ,Production of Azo Dyes in the Chemical Industry – Biodegradability of Naphthalene Sulfonic Acids, Biodegradation of Azo Dyes ,Direct Aerobic Degradation, Anaerobic Reduction of Azo Dyes, Aerobic Degradation of Metabolites, Treatment of Wastewater Containing the Azo Dye Reactive Black.

UNIT-VIII

BIOLOGICAL NUTRIENT REMOVAL: Introduction, Biological Nitrogen Removal , The Nitrogen Cycle and the Technical Removal Process, Nitrification , Nitrifying Bacteria and Stoichiometry, Stoichiometry and Kinetics of Nitrification, Parameters Influencing Nitrification ,Denitrification , Denitrifying Bacteria and Stoichiometry, Stoichiometry and Kinetics of Denitrification ,Parameters Influencing Denitrification ,Nitrite Accumulation During Nitrification , New Microbial Processes for Nitrogen Removal ,Biological Phosphorus Removal , Enhanced Biological Phosphorus Removal Kinetic Model for Biological Phosphorus Removal , Preliminary Remarks , Anaerobic Zone , Aerobic Zone, Results of a Batch Experiment , Parameters Affecting Biological Phosphorus Removal ,Biological Nutrient Removal Processes, Nitrogen Removal Processes, Chemical and Biological Phosphorus Removal, Processes for Nitrogen and Phosphorus Removal, Different Levels of Performance , WWTP Waßmannsdorf ,Membrane Bioreactors (MBR) , Phosphorus and Nitrogen Recycle, Recycling of Phosphorus, Recycling of Nitrogen.

TEXT BOOK :

1. Weismann, U., Dombrovski, E.M., "Fundamentals of Biological Water Treatment", Wiley- VCH, Federal Republic of Germany, 2007.

COMPUTATIONAL FLUID DYNAMICS

(ELECTIVE-III)

Course Code: ACH1143

L	T	P	C
4	0	0	4

AIM:

Computational Fluid Dynamics is emerging as one of the most useful techniques to understand the nature of flow in varying flow systems. To make the student in tune to the recent development, this course would be helpful

OBJECTIVES:

This course teaches the student the introductory and numerical aspects of CFD.

UNIT-I

INTRODUCTION TO DIFFERENCING SCHEMES: Basics of Finite difference methods, finite element method and finite volume method. CFD Applications.

UNIT-II

Final Governing differential equations of CFD and boundary conditions in Cartesian, cylindrical and spherical co-ordinate systems.

UNIT-III

FINITE DIFFERENCE METHODS FOR DIFFUSION PROBLEMS(THEORY): Explicit Method and its Stability criteria, Implicit Method, Crank Nicholson method, Use of one Sided FDM to handle boundary conditions.

UNIT-IV

FINITE DIFFERENCE METHODS FOR STEADY STATE CONVECTION- DIFFUSION PROBLEMS (THEORY): Use and importance of Upwinding difference method.

UNIT-V

FINITE VOLUME METHOD FOR STEADY SATE DIFFUSION (THEORY): One dimensional and two dimensional problems.

UNIT-VI

FINITE VOLUME METHOD FOR STEADY STATE CONVECTION-DIFFUSION PROBLEMS (THEORY): One dimensional and two dimensional problems**.** Use and importance of Upwinding difference method, Hybrid method and Power Law method.

UNIT-VII

CASE STUDY-1 : Using FDM and FVM for solving steady and un-steady state one dimensional diffusive problem.

UNIT-VIII

CASE STUDY-2 : Using FDM and FVM for solving one and two dimensional convection and diffusion problem.

TEXT BOOKS:

1. Patankar S.V., "Numerical Heat Transfer and Fluid Flow", Taylor and Francis, 1980.
2. Versteeg, H.K., and Malalasekera W, "An Introduction to Computational Fluid Dynamics: The Finite Volume Method" , Longman, 1998.

REFERENCE:

1. Muralidhar.K and Sundarajan T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi 1995.

GREEN CHEMICAL ENGINEERING

(ELECTIVE-III)

Course Code: ACH1144

L	T	P	C
4	0	0	4

AIM:

The challenge for Chemists and Chemical engineers is to develop new methods for product manufacture that minimizes material and energy.

OBJECTIVES:

After reading this course the student would be able to

- The importance of green chemistry.
- Sustainable development.
- Some technologies that have minimized the material and energy usage.

UNIT-I

PRINCIPLES OF SUSTAINABLE AND GREEN CHEMISTRY

- Green Chemistry and Industry
- Waste Minimization
- Reduction of Material Use
- Reduction of Energy requirements
- Reduction of Risk and Hazard
- Concept of Sustainability
- Green Chemistry and Sustainability Parameters.

UNIT-II

LIFE CYCLE ASSESSMENT: TOOL FOR IDENTIFICATION OF MORE SUSTAINABLE PRODUCTS AND PROCESSES

- Life Cycle Methodology.
- Application of Life Cycle assessment.

UNIT-III

INDUSTRIAL PROCESSES USING SOLID ACID CATALYSTS

- Concept of Acidity and solid acid catalyst
- Industrial application of solid acid catalysts
- Recent developments in Catalytic materials and processes

UNIT-IV

MICELLE- TEMPLATED SILICA AS CATALYSTS IN GREEN CHEMISTRY

- Mesoporous materials : introduction
- Catalytic applications : Oxidation Reactions like epoxidation, metal free epoxidation, arene hydroxylation, alkane oxidation, and base catalysis(other than oxidation)

UNIT-V

POLYMER SUPPORTED REAGENTS FOR ORGANIC SYNTHESIS

- Polymeric tools for organic synthesis: Polymeric reagents, Polymeric carriers, polymeric catalysts.
- Synthesis with polymer supported reagents
- Acids Chlorides and Anhydrides
- Alcohols, Aldehydes, Ketones, Amides, amines, azodyes, carbodiamides, epoxides, esters, ethers, fluoro derivatives etc

UNIT-VI

BIO CATALYSIS:

- Chemical Production using biocatalysis: bulk chemicals, Pharmaceuticals, Flavours and fragrance, Carbohydrates, polymers
- Green Biocatalytic processes: Biocatalysis in waste treatment and hydro-desulfurization

UNIT-VII
PROCESS INTENSIFICATION IN GREEN CHEMISTRY:

- Spinning Disc reactor, Micro reactors, Intensified cross-corrugated multifunctional membrane

UNIT-VIII

Application of Sonochemistry, Microwave irradiation, electrochemistry and photochemistry in Green Chemistry

TEXT BOOKS :

1. Clark.J., and Macquarie, D.(Editors), "Handbook of Green Chemistry and Technology", Blackwell Science, Oxford, 2002.
2. Allen, D.T. and Shonnard, D.R., "Green Engineering: Environmentally Conscious Design of Chemical Processes", Prentice Hall, New Jersey, 2001.

PROCESS CONTROL AND AUTOMATION

(ELECTIVE-III)

Course Code: AEC1142

L	T	P	C
4	0	0	4

AIM:

To familiarize engineers of all disciplines with the knowledge of computers and electronics.

OBJECTIVE:

1. To make a student comprehensive Engineer.
2. To make the student understand the importance of automation and control for imrovement of quality and productivity.
3. This knowledge should make every engineer to undrstand the importance of proper specifications to be defined for making the automation successful.

UNIT-I

INTRODUCTION TO COMPUTER CONTROL : Role of computers in the control of Industrial processes (plants). Elements of Computer Controlled Process / Plant. Classification – Batch, Continuous, Supervisory and Direct Digital Controls. Architecture – Centralized, Distributed and Hierarchical Systems. Man Machine or Human Computer Interface (HCI).

UNIT-II

BUILDING BLOCKS : Process Control Requirements of Computers. Process related variables. Computer Network. Communications in Distributed control Systems. Smart Sensors and Field bus.

UNIT-III

CONTROL SYSTEM DESIGN : Control System Design – Heuristics, Structural Controllability and Relative Gain Array. Controller Design – Regulator design and other design considerations. Controller Tuning – P,

PI, PID, and Ziegler-Nicholas method. Computer aided Control System Design.

UNIT-IV

PROGRAMMABLE LOGIC CONTROLLERS (PLCS) : Introduction - principles of operation - Architecture of Programmable Logic controllers - programming the programmable controllers- software - configurations - applications.

UNIT-V

DESIGN OF FEED FORWARD CONTROLLER : Block Diagram, Feed Forward control algorithms – dynamic, static, Deadbeat

UNIT-VI

CASCADE, PREDICTIVE AND ADAPTIVE CONTROL : Cascade Control – Dynamic response, Types, Implementation. Predictive Control – Model based and Multivariable System. Adaptive Control – Adjustment, Schemes, and Techniques.

UNIT-VII

INDUSTRIAL CONTROL APPLICATIONS : Automation of thermal power plant - Automation strategy - distributed system structure - Automatic boiler controller - diagnostic function and protection - - automatic start-up system - thermal stress control - man - machine interface – software system - communication system - variable pressure control - combined plant control.

UNIT-VIII

DISTRIBUTED CONTROL SYSTEMS : Introduction - Functional requirements of distributed control system - system architecture -

Distributed control systems - configuration - Applications of distributed control systems.

TEXT BOOKS :

1. Singh S.K. " Computer Aided Process Control", PHI Learning Pvt. Ltd., 2004
2. Chidambaram M., "Computer Control of Processes ", Narosa, 2003.

REFERENCES:

1. Seborg, D.E., Edgar T.F., and Mellichamp D.A., "Process Dynamics and Control", John Wiley, 2004.
2. Curtis J. D, "Instrumentation Technology", 7th Edn, Prentice Hall India, 2002.
3. Krishna Kanth, "Computer-based Industrial Control", PHI, 1997.
4. Bennett S. "Real Time Control: An Introduction" 2nd Edn, Pearson Education India, 2003.

INSTRUMENTATION METHODS

(ELECTIVE-IV)

Course Code: ACH1145

L	T	P	C
4	0	0	4

AIM:

To make the student understand the advanced instrumentation available for chemical analysis

OBJECTIVES:

After studying this course the student would be able to choose the instrument needed for analysis.

UNIT-I

AN INTRODUCTION TO INSTRUMENTAL METHODS : Terms Associated With Chemical Analysis, Classification Of Instrumental Techniques, A Review Of The Important Considerations In Analytical Methods, Basic Functions of Instrumentation, Important Considerations in Evaluating an Instrumental Method.

MEASUREMENTS, SIGNALS AND DATA : Introduction, Signal-to-Noise Ratio, Sensitivity and Detection Methods, Source of Noise, Hardware Techniques for Signal-to-Noise Enhancement, Software Techniques for Signal-to-Noise Enhancement, Evaluation of Results, Accuracy and Instrument Calibration, Chemometrics.

UNIT-II

AN INTRODUCTION TO ABSORPTION AND EMISSION SPECTROSCOPY : The Nature of Electromagnetic Radiation, The Electromagnetic Spectrum, Atomic Energy Levels, Molecular Electronic Energy Levels, Vibrational Energy Levels, Raman Effect, Lasers, Nuclear Spin Behaviour, Electron Spin Behaviour.

UNIT-III

ULTRAVIOLET AND VISIBLE SPECTROMETRY-INSTRUMENTATION : Radiation Sources, Wave Length Selection, Cells And Sampling Devices, Detectors, Instruments for Absorption Photometry.

ULTRAVIOLET AND VISIBLE ABSORPTION METHODS : Fundamental Laws of Photometry, Spectrophotometric Accuracy, Photometric Precision, Quantitative Methodology, Differential or Expanded-Scale Spectroscopy.

UNIT-IV

FLAME EMISSION AND ATOMIC ABSORPTION SPECTROSCOPY : Introduction, Instrumentation for Flame Spectrometric Methods, Flame Emission Spectrometry, Atomic Absorption Spectrometry, Interference Associated with Flame and Furnaces, Applications, Comparision of FES and AAS.

UNIT-V

INFRARED SPECTROMETRY : Correlation of Infrared Spectra with Molecular Structure, Instrumentation, Sample Handling.

RAMAN SPECTROSCOPY : Theroy, Instrumentation, Sample Handling and Illumination, Structural Analysis, Comparision of Raman with Infrared Spectroscopy.

UNIT-VI

MASS SPECTROMETRY : Sample Flow in a Mass Spectrometer, Inlet Sample System, Ionization Methods in Mass Spectrometry, Mass Analyzers, Ion-Collection System, Vacuum System, Isotope- Ratio Spectrometry, Correlation of Mass Spectra With Molecular Structure.

UNIT-VII

CHROMATOGRAPHY: GENERAL PRINCIPLES : Classification of Chromatographic Methods, Chromatographic Behaviour of Solutes, Column Efficiency and Resolution, Column Processes and Band Broadening, Time of Analysis and Resolution, Quantitative Determinations.

GAS CHROMATOGRAPHY : Gas Chromatographs, Derivative Formation, Gas Chromatographic Columns, Liquid Phases and Column Selection, Detectors for Gas Chromatography.

HIGH PERFORMANCE LIQUID CHROMATOGRAPHY: HPLC Instrumentation, Mobile-Phase Delivery System, Sample Introduction, Separation Columns, Detectors.

UNIT-VIII

THERMAL ANALYSIS : Thermogravimetry, Evolved Gas Detection and Analysis, Methodology of Thermogravimetry, Differential Scanning Calorimetry and Differential Thermal Analysis.

X RAY DIFFRACTION : General Principles, Braggs equation, Laue photographic method, Rotating crystal method, Oscillating crystal method, Powder method, Interpretation of the Diffraction pattern, Applications of XRD.

TEXT BOOK:

1. Willard,H.H, Merritt,L.L, Dean, J.A, and Settle, F.A, "Instrumental Methods of Analysis" 7th Edn, CBS Publishers & Distributors, 1986.

REFERENCES:

1. Srivastava, A.K. and. Jain, P.C, "Instrumental Approach to Chemical Analysis", 4th Edn, S Chand and Company Ltd, New Delhi, 2012.
2. Chatwal, G. R., Anand, Sham K., "Instrumental Methods of Chemical Analysis" 5th Edn, Himalaya Publishing House, 2005.

DOWNSTREAM PROCESSING IN BIOPROCESSING

(ELECTIVE-IV)

Course Code: ACH1146

L	T	P	C
4	0	0	4

AIM:

To learn separation and purification processes in Biochemical Engineering.

OBJECTIVE:

To study different separation processes in the purification of biochemical engineering qualitatively.

UNIT-I

Introduction to bio separations, Filtration and Micro filtration: - Equipment for Conventional Filtration, Pretreatment, General Theory for Filtration, Continuous Rotary Filters, Micro filtration.

UNIT-II

Centrifugation, settling of solids, Centrifuges, Centrifugal filtration, Scale-Up of Centrifugation.

UNIT-III

Cell Disruption: - Cell membranes, Chemical Methods, Mechanical Disruption.

UNIT-IV

Extraction: - The chemistry of extraction, Batch extraction, Staged Extraction, Differential extraction, Fractional Extractions with stationary phase and Fractional Extractions with two moving phases.

UNIT-V

Adsorption: - The chemistry of adsorption, Batch adsorption, Adsorption in a continuous stirred tank, Adsorption in fixed beds.

UNIT-VI

Elution Chromatography: - Adsorbents yield and purity, Discrete stage analysis, Kinetic analysis, Precipitation with a non solvent, Precipitation with salts, Precipitation with temperature change, Large Scale precipitation.

UNIT-VI

Ultra filtration and Electrophoresis: - Basic ideas, Ultrafiltration, Electrophoresis, Electro dialysis and Isoelectric Focusing.

UNIT-VIII

Crystallization : Basic concepts, crystal Size Distribution, Batch crystallization, Recrystalization.Drying: - Basic concepts, Drying Equipment, Conduction Drying, Adiabatic Drying.

TEXT BOOK:

1. Better P.A., Cussler E.L.,Wei-Shou Hu, A, "Downstream Processing for Biotechnology" , Wiley- Interscience Publication, 1988.

NANO TECHNOLOGY

(ELECTIVE-IV)

Course Code: ACH1147	L	T	P	C
	4	0	0	4

AIM:

This course introduces the student the basic knowledge of Nano Technology.

OBJECTIVES:

After studying the course the student will be able to know

- Properties that make nano materials.
- How nano materials are produced and characterized.
- Where nano materials are used.

UNIT-I

Introduction to Nano Technology, Carbon NanoTubes (CNTs), Porous Silicon, Aerogels, Zeolites, Ordered Porous Materials Using Micelles as Templates, Self Assembled Nanomaterials, Core- Shell Particles.

UNIT-II

STRUCTURE AND BONDING: Arrangement of Atoms, Two Dimensional Crystal Structures, Three Dimensional Crystal structures, Some Examples of Three Dimensional Crystals, Planes in the Crystals, Crystallographic Directions, Reciprocal Lattice, Quasi Crystals, Bonding in Solids.

UNIT-III

SYNTHESIS OF NANOMATERIALS-I (PHYSICAL METHODS): Mechanical Methods, Methods based on Evaporation, Sputter Deposition, Chemical Vapour Deposition(CVD), Electric Arc Deposition, Ion Beam Techniques (Ion Implantation), Molecular Beam Epitaxy(MBE).

UNIT-IV

SYNTHESIS OF NANOMATERIALS-II (CHEMICAL METHODS) : Colloids and Colloids in solutions, Growth of Nanoparticles, Synthesis of Metal Nanoparticles by Colloidal Route, Synthesis of Semiconductor Nanoparticles by Colloidal Route, Langmuir-Blodgett(L-B) method, Microemulsion, Sol-Gel Methods.

UNIT-V

SYNTHESIS OF NANOMATERIALS-III (BIOLOGICAL METHODS): Synthesis Using Microorganisms, Synthesis Using Plant Extracts, Use of Proteins and Templates like DNA .

UNIT-VI

ANALYSIS TECHNIQUES : Microscopes, Electron Microscopes, Scanning Probe Microscopes (SPM), diffraction Techniques, Spectroscopies, Magnetic Measurements.

UNIT-VII

PROPERTIES OF NANOMATERIALS: Mechanical Properties, Structural Properties, Melting of Nanoparticles, Electrical Conductivity, Optical Properties, Magnetic Properties.

UNIT-VIII

APPLICATIONS : Electronics, Energy, Automobiles, Sports and Toys, Textiles, Cosmetics, Domestic Appliances, Biotechnology and Medical Fields, Space and Defense, Nanotechnology and Environment.

TEXT BOOKS:

1. Sulabha.K.Kulkarni., "Nano Technology: Principles and Practices", Capital Publishing Company, New Delhi, 2006.
2. Wilson, M., Smith, G.,Simmons, M. and Raguse, B., "Nano Technology: Basic Science and Emerging Technologies", Overseas Press, New Delhi,2008.

REFERENCE:

1. Ratner,M. and Ratner, D., "Nano Technology : A gentle Introduction to the next big idea", Pearson Education, Dorling Kindersley Publishing, 2003.

OPTIMIZATION TECHNIQUES

(ELECTIVE-IV)

Course Code: ACH1148

L	T	P	C
4	0	0	4

50 Hours of theory + 10 Hours of Lab Practice on MATLAB OPTIMIZATION Toolbox.

AIM & OBJECTIVES:

This course is concerned with formulating the optimization problems and solving them. Advanced topics on Evolutionary Optimization are also treated. MATLAB optimization Toolbox is used to solve large scale optimization problems.

UNIT-I

INTRODUCTION TO PROCESS OPTIMIZATION: Formulation of various process optimization problems and their classification, constrained and unconstrained optimization. Classification of points in the 2D space.

Basic concepts of optimization: Convex Set, Convex functions, necessary and sufficient conditions for stationary points. Calculating Gradient of a function and Hessian matrix. Identifying minima and maxima points.

UNIT-II

LINEAR PROGRAMMING: SIMPLEX algorithm, duality in Linear programming.

UNIT-III

TRANSPORTATION PROBLEM: Solution of Balanced problems using East-West Rule.

UNIT-IV

UNCONSTRAINED OPTIMIZATION: Optimality Criteria, Undirectional search, Powell's Conjugate direction method, Gradient based method: Cauchy's steepest Descent method; Newton's method.

UNIT-V

CONSTRAINED OPTIMIZATION: Kuhn-Tucker conditions, Transformation methods: Penalty function method, method of multipliers.

UNIT-VI

DISCRETE OPTIMIZATION : Enumeration techniques and Branch and Bound method to solve discrete optimization problem.

UNIT-VII

GENETIC ALGORITHMS: Working principles, differences between GAs and traditional methods. Various operations like crossover and mutation.

SIMULATED ANNEALING : Metropolis Algorithm. (Qualitative treatment of GA and SA only).

UNIT-VIII

MULTIOBJECTIVE OPTIMIZATION (MOO) : Different methods to solve MOO like Utility function method and bounded function method. Solving 2D MOO problems graphically and identifying the Pareto set.

TEXT BOOK:

1. Kalyanmoy D, "Optimization for Engineering Design", Prentice Hall of India, 2005.
2. Rao S.S, "Engineering Optimization-Theory and Practices", New Age International Publishers, New Delhi, 1996.

REFERENCES:

1. Reklaitis, G.V., Ravindran, A., and Ragdell, "Engineering Optimization-Methods and Application",John Wiley, New York, 1983.