B.Tech. (CHEMICAL ENGINEERING) PROGRAMME
Regulations and Syllabi
(Effective from 2008)

1. Eligibility:

(1) Candidates who passed the following Examination or any other equivalent Examination thereto and who appeared for the entrance test conducted by the University or approved institutions wherever prescribed are eligible for admission to Four Year B.Tech. (Chemical Engineering) Programme.

Higher Secondary Examination with Mathematics, Physics and Chemistry conducted by the Government of Tamil Nadu or its equivalent in the relevant subjects.

(2) Candidates who passed Three Year Diploma in Technical Education in the concerned subject conducted by the Government of Tamil Nadu are eligible for admission to Second Year of Four Year B.Tech. (Chemical Engineering) Programme.

2. Duration: Four Years comprising 8 Semesters. Each semester has a minimum 90 working days with a minimum of 5 hours a day.

3. Medium: English is the medium of instruction and examination.

4. Weightage for Continuous and End Assessment: The weightage for Continuous Assessment (CA) and End Assessment (EA) be 25:75 unless the ratio is specifically mentioned in the scheme of Examinations.

5. Credit System: Credit system be followed with 18 credits for each semester and each credit is equivalent to 25 hours of effective study provided in the Time Table.

6. Scheme of Examinations

I Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
108EHT01	Technical English – I	1	25	75	100
108MAT02	Mathematics – I	3	25	75	100
108PHT03	Engineering Physics – I	3	25	75	100
108CYT04	Engineering Chemistry – I	3	25	75	100
108EGT05	Engineering Graphics – I	3	25	75	100
108FCT06	Fundamentals of Computing – I	3	25	75	100
Practical					
108CLP01	Computer Practices Laboratory – I	1	25	75	100
108ELP02	Engineering Practices Laboratory – I	1	25	75	100
	Total	**18**	**200**	**600**	**800**

II Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
208EHT01	Technical English – II	2	25	75	100
208MAT02	Mathematics – II	3	25	75	100
208PHT03	Engineering Physics – II	2	25	75	100
208CYT04	Engineering Chemistry – II	2	25	75	100
208EMT05	Engineering Mechanics	3	25	75	100
208EET06	Basic Electrical & Electronics Engineering	3	25	75	100
Practical					
208CLP01	Computer Practices Laboratory – II	1	25	75	100
208PCP02	Physics & Chemistry Laboratory – II	1	25	75	100
208DMP03	Computer Aided Drafting and Modelling Laboratory	1	25	75	100
	Total	**18**	**225**	**675**	**900**

III Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
308CHT01	Transforms and Partial Differential Equations	3	25	75	100
308CHT02	Electrical Drives and Controls	3	25	75	100
308CHT03	Organic Chemistry	2	25	75	100
308CHT04	Mechanics of Solids	2	25	75	100
308CHT05	Fluid Mechanics	2	25	75	100
308CHT06	Environmental Science and Engineering	3	25	75	100
Practical					
308CHP01	Organic Chemistry Lab.	1	25	75	100
308CHP02	Basic Electrical Electronics Engineering Lab	1	25	75	100
308CHP03	Fluid Mechanics Lab	1	25	75	100
	Total	**18**	**225**	**675**	**900**

IV Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
408CHT01	Probability and Statistics	3	25	75	100
408CHT02	Physical Chemistry	3	25	75	100
408CHT03	Instrumental Methods of Analysis	2	25	75	100
408CHT04	Chemical Process Industries I	2	25	75	100
408CHT05	Chemical Process Calculations	2	25	75	100
408CHT06	Mechanical Operation	3	25	75	100
Practical					
408CHP01	Chemical Analysis Lab	1	25	75	100
408CHP02	Physical Chemistry Lab	1	25	75	100
408CHP03	Mechanical Operations Lab	1	25	75	100
	Total	**18**	**225**	**675**	**900**

V SEMESTER

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
508CHT01	Numerical Methods	2	25	75	100
508CHT02	Materials Technology	2	25	75	100
508CHT03	Chemical Process Industries II	3	25	75	100
508CHT04	Chemical Engineering Thermodynamics I	3	25	75	100
508CHT05	Heat Transfer	3	25	75	100
508CHT06	Mass Transfer-I	3	25	75	100
Practical					
508CHP01	Technical Analysis Lab	1	25	75	100
508CHP02	Heat Transfer Lab	1	25	75	100
	Total	**18**	**200**	**600**	**800**

VI Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
608CHT01	Chemical Engineering Thermodynamics II	3	25	75	100
608CHT02	Mass Transfer-II	3	25	75	100
608CHT03	Chemical Reaction Engineering I	3	25	75	100
608CHT04	Process Instrumentation & Control	2	25	75	100
608CHT05	Process Plant Utilities	2	25	75	100
608CHT06	Energy Engineering	2	25	75	100
Practical					
608CHP01	Process Equipment design I	1	25	75	100
608CHP02	Mass transfer Lab	1	25	75	100
608CHP03	Process Control Lab	1	25	75	100
	Total	**18**	**225**	**675**	**900**

VII Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
708CHT01	Chemical Reaction Engineering II	3	25	75	100
708CHT02	Transport Phenomena	3	25	75	100
708CHT03	Bio chemical Engineering	3	25	75	100
708CHT04	Process Economics	3	25	75	100
708CHT05	Chemical process Plant safety	2	25	75	100
708CHT06	Food Technology (Elective – I)	2	25	75	100
Practical					
708CHP01	Process Equipment design II	1	25	75	100
708CHP02	Chemical Reaction Engg Lab	1	25	75	100
	Total	**18**	**200**	**600**	**800**

VIII Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
808CHT01	Total quality management	3	25	75	100
808CHT03	Fertilizer Technology (Elective – II)	3	25	75	100
808CHT08	Petroleum Technology (Elective – III)	3	25	75	100
Practical					
808CHP01	Project work	9	25	65	100
	Viva voce			10	
	Total	**18**	**100**	**300**	**400**

LIST OF ELECTIVE COURSES

Code No.	Course Title
Elective – I	
708CHT06	Food Technology
708CHT07	Enzyme Engineering
708CHT08	Fluidization Engineering
708CHT09	Process Optimization
708CHT10	Professional Ethics in Engineering
708CHT11	Air Pollution and Control
708CHT12	Basic Industrial Biotechnology
708CHT13	Fuels Technology and Combustion
708CHT14	Chemical Product Design
Elective – II	
808CHT02	Drugs and Pharmaceuticals
808CHT03	Fertilizer Technology
808CHT04	Modern Separation Processes
808CHT05	Waste Water Treatment
808CHT06	Industrial Management
808CHT07	Fermentation Engineering
Elective – III	
808CHT08	Petroleum Technology
808CHT09	Pulp and Paper Technology
808CHT10	Polymer Technology
808CHT11	Process Modeling and Simulation
808CHT12	Computer Applications in Chemical Engineering
808CHT13	Fundamentals of Nanoscience
808CHT14	Computational Fluid Dynamics
808CHT15	Introduction to Semiconductor Manufacturing Processes

7. Passing Requirements: The minimum pass mark (raw score) be 50% in End Assessment (EA) and 50% in Continuous Assessment (CA) and End Assessment (EA) put together. No minimum mark (raw score) in Continuous Assessment (CA) be prescribed unless it its specifically mentioned in the scheme of Examination.

8. Grading System: Grading System on a 10 Point Scale be followed with 1 mark = 0.1 Grade point to successful candidates as given below.

CONVERSION TABLE

(1 mark = 0.1 Grade Point on a 10 Point Scale)

Range of Marks	Grade Point	Letter Grade	Classification
90 to 100	9.0 to 10.0	O	First Class
80 to 89	8.0 to 8.9	A	First Class
70 to 79	7.0 to 7.9	B	First Class
60 to 69	6.0 to 6.9	C	First Class
50 to 59	5.0 to 5.9	D	Second Class
0 to 49	0 to 4.9	**F**	**Reappearance**

Procedure for Calculation

Cumulative Grade Point Average (CGPA) = $\frac{\text{Sum of Weighted Grade Points}}{\text{Total Credits}}$

= $\frac{\sum (CA+EA)\, C}{\sum C}$

Where Weighted Grade Points in each Course = Grade Points (CA+EA) multiplied by Credits

= (CA+EA)C

Weighted Cumulative Percentage of Marks(WCPM) = CGPAx10

C- Credit, CA-Continuous Assessment, EA- End Assessment

9. Pattern of the Question Paper: The question paper for End Assessment will be set for three hours and for the maximum of 100 marks with following divisions and details.

Part A: 10 questions (with equal distribution to all units in the syllabus). Each question carries 2 marks.

Part B: 5 question with either or type (with equal distribution to all units in the syllabus). Each question carries 16 marks.

The total marks scored by the candidates will be reduced to the maximum prescribed in the Regulations.

Registrar

10. Syllabus

108EHT01 - TECHNICAL ENGLISH – I

AIM:
To encourage students to actively involve in participative learning of English and to help them acquire Communication Skills.

OBJECTIVES:
- To help students develop listening skills for academic and professional purposes.
- To help students acquire the ability to speak effectively in English in real-life situations.
- To inculcate reading habit and to develop effective reading skills.
- To help students improve their active and passive vocabulary.
- To familiarize students with different rhetorical functions of scientific English.
- To enable students write letters and reports effectively in formal and business situations.

UNIT I
General Vocabulary - changing words from one form to another - Adjectives, comparative adjectives – Adverbs - Active and passive voice – Tenses - simple present, present continuous - Adverb forms – Nouns – compound nouns - Skimming and scanning - Listening and transfer of information – bar chart, flowchart - Paragraph writing, description – Discussing as a group and making an oral report on the points discussed, conversation techniques - convincing others.

Suggested activities:
1. Matching words & meanings - Using words in context – Making sentences.
2. Changing sentences from active to passive voice & vice versa.
3. Skimming, cloze exercises, exercises transferring information from text to graphic form – bar charts, flow charts.
4. Writing descriptions using descriptive words & phrases, and technical vocabulary.
5. Role play, conversation exercises, discussions, oral reporting exercises
   Any other related relevant classroom activity

UNIT II
Vocabulary – prefixes & suffixes – simple past tense - Spelling and punctuation – 'wh' Question forms - Scanning, inference - Listening & note-taking - Paragraph writing - comparison and contrast - Creative thinking and speaking.

Suggested Activities:
1. a. Vocabulary actiivities using prefixes and suffixes.
   b. Exercises using questions – asking & answering questions.
2. Scanning the text for specific information
3. Listening guided note-taking - Writing paragraphs using notes, giving suitable headings
   and subheadings for paragraphs. Using expressions of comparison and contrast.
4. Discussion activities and exploring creative ideas.
   Any other related relevant classroom activity

UNIT III

Tenses - simple past, simple future and past perfect - Reading in Context -Listening & note-taking – single line – Definitions – sequencing of sentences – instruction - Persuasive speaking.

Suggested activities:

1. a. Providing appropriate context for the use of tenses
2. Listening and note-taking
3. (a) Writing sentence definitions, instructions
   (b) Identifying the discourse links and sequencing jumbled sentences / writing instructions.
4. Speaking exercises, discussions, role play exercises using explaining, convincing and persuasive strategies

   Any other related relevant classroom activity

UNIT IV

Modal verbs and Probability – Concord subject verb agreement – Correction of errors - Cause and effect expressions – Extended Definition - Speaking about the future plans.

Suggested activities:

1. a. Making sentences using modal verbs to express probability
   b. Gap filling using relevant grammatical form of words.
2. 2. Writing extended definitions
3. Speaking - role play activities, discussions, extempore speaking exercises speculating about the future.

   Any other related relevant classroom activity

UNIT V

'If' conditionals – Gerunds - Intensive reading - Speaking – Presentation of problems & solutions - Itinerary – planning for an industrial visit - Formal Letter writing – Letter to the editor, invititation letter, accepting, declining letter and permission letter.

Suggested activities:

1. a) Sentence completion exercises using 'If' conditionals.
   b) Gap filling exercises using gerunds and present participle forms
2. Reading comprehension exercises.
3. Role play, discussion, debating and speaking activities for stating, discussing
   a. problems and suggesting solutions.
4. Planning a tour, Writing a travel itinerary. Writing letters to officials and to the
   a. editor in formal/official contexts.

   Any other related relevant classroom activity

TEXT BOOK:

1. Department of Humanities & Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 & 2), Chennai: Orient Longman Pvt. Ltd., 2006. Themes 1 – 4 (Resources, Energy, Computer, Transport)

REFERENCES:

1. Meenakshi Raman and Sangeeta Sharma, 'Technical Communication English skills for Engineers', Oxford University Press, 2008.
2. Andrea, J. Rutherford, 'Basic Communication Skills for Technology', Second Edition, Pearson Education, 2007.

Extensive Reading:

1. A.P.J.Abdul Kalam with Arun Tiwari, 'Wings of Fire' An Autobiography, University Press (India) Pvt. Ltd.,1999, 30th Impression 2007.

NOTE:

The book given under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

108MAT02 - MATHEMATICS – I

UNIT I MATRICES

Characteristic equation – Eigen values and eigen vectors of a real matrix – Properties – Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT II THREE DIMENSIONAL ANALYTICAL GEOMETRY

Equation of a sphere – Plane section of a sphere – Tangent Plane – Equation of a cone – Right circular cone – Equation of a cylinder – Right circular cylinder.

UNIT III DIFFERENTIAL CALCULUS

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes – Evolute as envelope of normals.

UNIT IV FUNCTIONS OF SEVERAL VARIABLES

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Differentiation of implicit functions – Jacobians – Taylor's expansion – Maxima and Minima – Method of Lagrangian multipliers.

UNIT V MULTIPLE INTEGRALS

Double integration – Cartesian and polar coordinates – Change of order of integration – Change of variables between Cartesian and polar coordinates – Triple integration in Cartesian co-ordinates – Area as double integral – Volume as triple integral

TEXT BOOK:

1. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", Third edition, Laxmi Publications(p) Ltd.,(2008).
2. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, Delhi, (2007).

REFERENCES:

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2007).
2. Glyn James, "Advanced Engineering Mathematics", 7th Edition, Pearson Education, (2007).
3. Jain R.K and Iyengar S.R.K," Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Pvt. Ltd., (2007).

108PHT03 - ENGINEERING PHYSICS – I

UNIT I ULTRASONICS

Introduction – Production – magnetostriction effect - magnetostriction generator- piezoelectric effect - piezoelectric generator- Detection of ultrasonic waves properties – Cavitations - Velocity measurement – acoustic grating - Industrial applications – drilling, welding, soldering and cleaning – SONAR - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C –scan displays, Medical applications - Sonograms

UNIT II LASERS

Introduction – Principle of Spontaneous emission and stimulated emission. Population inversion, pumping. Einsteins A and B coeffcients - derivation. Types of lasers – He-Ne, CO_2, Nd-YAG, Semiconductor lasers (homojunction & heterojunction) Qualitative Industrial Applications - Lasers in welding, heat treatment, cutting – Medical applications - Holography (construction & reconstruction).

UNIT III FIBER OPTICS & APPLICATIONS

Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – Double crucible technique of fibre drawing - Splicing, Loss in optical fibre – attenuation, dispersion, bending - Fibre optical communication system (Block diagram) - Light sources - Detectors - Fibre optic sensors – temperature & displacement - Endoscope.

UNIT IV QUANTUM PHYSICS

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton effect. Theory and experimental verification – Matter waves – Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

UNIT V CRYSTAL PHYSICS

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – NaCl, ZnS, diamond and graphite structures – Polymorphism and allotropy - Crystal defects – point, line and surface defects- Burger vector.

TEXT BOOKS:

1. R. K. Gaur and S.C. Gupta, 'Engineering Physics' Dhanpat Rai Publications, New Delhi(2003)
2. M.N. Avadhanulu and PG Kshirsagar, 'A Text book of Engineering Physics', S.Chand and company, Ltd., New Delhi, 2005.

REFERENCES:

1. Serway and Jewett, 'Physics for Scientists and Engineers with Modern Physics', 6th Edition, Thomson Brooks/Cole, Indian reprint (2007)
2. Rajendran, V and Marikani A, 'Engineering Physics' Tata McGraw Hill Publications Ltd, III Edition, New Delhi, (2004).
3. Palanisamy, P.K., 'Engineering Physics' Scitech publications, Chennai, (2007).
4. Jayakumar. S, 'Engineering Physics', R.K. Publishers, Coimbatore, (2003).
5. Chitra Shadrach and Sivakumar Vadivelu, 'Engineering Physics', Pearson Education, New Delhi, (2007).

108CYT04 - ENGINEERING CHEMISTRY – I

AIM

To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

OBJECTIVES

- The student should be conversant with the principles water characterization and treatment of potable and industrial purposes.
- Principles of polymer chemistry and engineering applications of polymers
- Industrial applications of surface chemistry
- Conventional and non-conventional energy sources and energy storage devices and Chemistry of engineering materials

UNIT I WATER TECHNOLOGY

Characteristics – alkalinity – types of alkalinity and determination – hardness – types and estimation by EDTA method (problems); Domestic water treatment – disinfection methods (Chlorination, ozonation. UV treatment) – Boiler feed water – requirements – disadvantages of using hard water in boilers – internal conditioning (phosphate, calgon and carbonate conditioning methods) – external conditioning – demineralization process – desalination and reverse osmosis.

UNIT II POLYMERS AND COMPOSITES

Polymers-definition – polymerization – types – addition and condensation polymerization – free radical polymerization mechanism – Plastics, classification – preparation, properties and uses of PVC, Teflon, polycarbonate, polyurethane, nylon-6,6, PET- Rubber -vulcanization of rubber, synthetic rubbers – buty1 rubber, SBR, Composites – definition, types polymer matrix composites – FRP only.

UNIT III SURFACE CHEMISTRY

Adsorption – types – adsorption of gases on solids – adsorption isotherms – Frendlich and Langmuir isotherms – adsorption of solutes from solution – role of adsorbents in catalysis, ion-exchange adsorption and pollution abatement.

UNIT IV NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES Nuclear energy – fission and fusion reactions and light water nuclear reactor for power generation (block diagram only) – breeder reactor – solar energy conversion – solar cells – wind energy – fuel cells – hydrogen – oxygen fuel cell – batteries – alkaline batteries – lead–acid, nickel–cadmium and lithium batteries.

UNIT V ENGINEERING MATERIALS

Refractories – classification – acidic, basic and neutral refractories – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) – manufacture of alumina, magnesite and zirconia bricks, Abrasives – natural and synthetic abrasives – quartz, corundum, emery, garnet, diamond, silicon carbide and boron carbide. Lubricants – mechanism of lubrication, liquid lubricants, - properties – viscosity index, flash and fire points, cloud and pour points, oilyness) – solid lubricants – graphite and molybdenum sulphide. Nanomaterials – introduction to nanochemistry – carbon nanotubes and their applications

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S. Dara "A text book of engineering chemistry" S.Chand & Co.Ltd., New Delhi (2006).

REFERENCES:

1. B.K.Sharma "Engineering chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

108EGT05 - ENGINEERING GRAPHICS

AIM
To develop graphic skills in students.

OBJECTIVES
To develop in students graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

Concepts and conventions (Not for Examination)
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HAND SKETCHING

Curves used in engineering practices:
Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves.

Free hand sketching:
Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES
Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT III PROJECTION OF SOLIDS
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES
Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS
Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

Perspective projection of prisms, pyramids and cylinders by visual ray method.

TEXT BOOKS:

1. N.D. Bhatt, "Engineering Drawing" Charotar Publishing House, 46th Edition, (2003).

REFERENCES:

1. K. V. Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2006).
2. M.S. Kumar, "Engineering Graphics", D.D. Publications, (2007).
3. K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited (2008).
4. M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education (2005).
5. K. R. Gopalakrishnana, "Engineering Drawing" (Vol.I&II), Subhas Publications (1998).
6. Dhananjay A.Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill Publishing Company Limited (2008).
7. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, (2008).

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. Whenever the total number of candidates in a college exceeds 150, the University Examination in that college will be conducted in two sessions (FN and AN on the same day) for 50 percent of student (approx) at a time.

108FCT06 - FUNDAMENTALS OF COMPUTING AND PROGRAMMING

AIM :

To provide an awareness to Computing and Programming

OBJECTIVES :

- To enable the student to learn the major components of a computer system
- To know the correct and efficient ways of solving problems
- To learn to use office automation tools
- To learn to program in C

UNIT I INTRODUCTION TO COMPUTERS

Introduction – Characteristics of Computers – Evolution of Computers - Computer Generations – Classification of Computers – Basic Computer organization – Number Systems

UNIT II COMPUTER SOFTWARE

Computer Software –Types of Software – Software Development Steps – Internet Evolution - Basic Internet Terminology – Getting connected to Internet Applications.

UNIT III PROBLEM SOLVING AND OFFICE APPLICATION SOFTWARE

Planning the Computer Program – Purpose – Algorithm – Flow Charts – Pseudocode - Application Software Packages- Introduction to Office Packages (not detailed commands for examination).

UNIT IV INTRODUCTION TO C

Overview of C – Constants, Variables and Data Types – Operators and Expressions – Managing Input and Output operators – Decision Making - Branching and Looping.

UNIT V FUNCTIONS AND POINTERS

Handling of Character Strings – User-defined Functions – Definitions – Declarations - Call by reference – Call by value – Structures and Unions – Pointers – Arrays – The Preprocessor – Developing a C Program : Some Guidelines

TEXT BOOKS:

1. Ashok.N.Kamthane," Computer Programming", Pearson Education (India) (2008).
2. Behrouz A.Forouzan and Richard.F.Gilberg, "A Structured Programming Approach Using C", II Edition, Brooks-Cole Thomson Learning Publications, (2007).

REFERENCES:

1. Pradip Dey, Manas Ghoush, "Programming in C", Oxford University Press. (2007).
2. Byron Gottfried, "Programming with C", 2nd Edition, (Indian Adapted Edition), TMH publications, (2006).
3. Stephen G.Kochan, "Programming in C", Third Edition, Pearson Education India, (2005).
4. Brian W.Kernighan and Dennis M.Ritchie, "The C Programming Language", Pearson Education Inc., (2005).
5. E.Balagurusamy, "Computing fundamentals and C Programming", Tata McGraw-Hill Publishing Company Limited, (2008).
6. S.Thamarai Selvi and R.Murugan, "C for All", Anuradha Publishers, (2008).

108CLP01 - COMPUTER PRACTICE LABORATORY – I

LIST OF EXERCISES

a) Word Processing

1. Document creation, Text manipulation with Scientific notations.
2. Table creation, Table formatting and Conversion.
3. Mail merge and Letter preparation.
4. Drawing - flow Chart

b) Spread Sheet

5. Chart - Line, XY, Bar and Pie.
6. Formula - formula editor.
7. Spread sheet - inclusion of object, Picture and graphics, protecting the document and sheet.
8. Sorting and Import / Export features.

Simple C Programming

9. Data types, Expression Evaluation, Condition Statements.
10. Arrays
11. Structures and Unions
12. Functions

* For programming exercises Flow chart and pseudocode are essential

HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS

Hardware

☐LAN System with 33 nodes (OR) Standalone PCs – 33 Nos.
☐Printers – 3 Nos.

Software

☐OS – Windows / UNIX Clone
☐Application Package – Office suite
☐Compiler – C

108ELP02 - ENGINEERING PRACTICES LABORATORY

OBJECTIVES

To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE

Welding:

(a) Preparation of arc welding of butt joints, lap joints and tee joints.
(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making – Trays, funnels, etc.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending.

Example –

Exercise – Production of hexagonal headed bolt.

(b) Foundry operations like mould preparation for gear and step cone pulley.

(c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

REFERENCES:

1. K.Jeyachandran, S.Natarajan & S, Balasubramanian, "A Primer on Engineering
   Practices Laboratory", Anuradha Publications, (2007).
2. T.Jeyapoovan, M.Saravanapandian & S.Pranitha, "Engineering Practices Lab Manual",
   Vikas Puplishing House Pvt.Ltd, (2006)
3. H.S. Bawa, "Workshop Practice", Tata McGraw – Hill Publishing Company Limited,
   (2007).
4. A. Rajendra Prasad & P.M.M.S. Sarma, "Workshop Practice", Sree Sai Publication,
   (2002).
5. P.Kannaiah & K.L.Narayana, "Manual on Workshop Practice", Scitech Publications,
   (1999).

SEMESTER EXAMINATION PATTERN

The Laboratory examination is to be conducted for Group A & Group B, allotting 90 minutes for each group, with a break of 15 minutes. Both the examinations are to be taken together in sequence, either in the FN session or in the AN session. The maximum marks for Group A and Group B lab examinations will be 50 each, totaling 100 for the Lab course. The candidates shall answer either I or II under Group A and either III or IV under Group B, based on lots.

Engineering Practices Laboratory

List of equipment and components (For a Batch of 30 Students)

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets.
2. Carpentry vice (fitted to work bench)	15 Nos.
3. Standard woodworking tools	15 Sets.
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools:	
(a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

ELECTRICAL

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp	1 each
4. Megger (250V/500V)	1 No.
5. Power Tools: (a) Range Finder	2 Nos
(b) Digital Live-wire detector	2 Nos

ELECTRONICS

1. Soldering guns	10 Nos.
2. Assorted electronic components for making circuits	50 Nos.
3. Small PCBs	10 Nos.
4. Multimeters	10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply	

PHYSICS LABORATORY – I

LIST OF EXPERIMENTS

1. (a) Particle size determination using Diode Laser
   (b) Determination of Laser parameters – Wavelength, and angle of divergence.
   (c) Determination of acceptance angle in an optical fiber.
2. Determination of thickness of a thin wire – Air wedge method
3. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
4. Determination of wavelength of mercury spectrum – spectrometer grating.
5. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of Hysteresis loss in a ferromagnetic material

- **A minimum of FIVE experiments shall be offered.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**
- **The lab examinations will be held only in the second semester.**

CHEMISTRY LABORATORY – I

LIST OF EXPERIMENTS

1. Estimation of hardness of Water by EDTA
2. Estimation of Copper in brass by EDTA
3. Determination of DO in water (Winkler's method)
4. Estimation of Chloride in Water sample (Argentometric)
5. Estimation of alkalinity of Water sample
6. Determination of molecular weight and degree of polymerization using viscometry.

- **A minimum of FIVE experiments shall be offered.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**
- **The lab examinations will be held only in the second semester.**

208EHT01 - TECHNICAL ENGLISH II

AIM:
To encourage students to actively involve in participative learning of English and to help them acquire Communication Skills.

OBJECTIVES:
1. To help students develop listening skills for academic and professional purposes.
2. To help students acquire the ability to speak effectively in English in real-life situations.
3. To inculcate reading habit and to develop effective reading skills.
4. To help students improve their active and passive vocabulary.
5. To familiarize students with different rhetorical functions of scientific English.
6. To enable students write letters and reports effectively in formal and business situations.

UNIT I
Technical Vocabulary - meanings in context, sequencing words, Articles-Prepositions, intensive reading& predicting content, Reading and interpretation, extended definitions, Process description

Suggested activities:
1. Exercises on word formation using the prefix 'self' - Gap filling with preposition.
2. Exercises - Using sequence words.
3. Reading comprehension exercise with questions based on inference – Reading headings
4. and predicting the content – Reading advertisements and interpretation.
5. Writing extended definitions – Writing descriptions of processes – Writing paragraphs based on discussions – Writing paragraphs describing the future.

UNIT II
Phrases / Structures indicating use / purpose – Adverbs-Skimming – Non-verbal communication - Listening – correlating verbal and non-verbal communication - Speaking in group discussions – Formal Letter writing – Writing analytical paragraphs.

Suggested activities:
1. Reading comprehension exercises with questions on overall content – Discussions analyzing stylistic features (creative and factual description) - Reading comprehension exercises with texts including graphic communication - Exercises in interpreting non-verbal communication.
2. Listening comprehension exercises to categorise data in tables.
3. Writing formal letters, quotations, clarification, complaint – Letter seeking permission for Industrial visits– Writing analytical paragraphs on different debatable issues.

UNIT III
Cause and effect expressions – Different grammatical forms of the same word - Speaking – stress and intonation, Group Discussions - Reading – Critical reading -

Listening, - Writing – using connectives, report writing – types, structure, data collection, content, form, recommendations .

Suggested activities:

1. Exercises combining sentences using cause and effect expressions – Gap filling exercises using the appropriate tense forms – Making sentences using different grammatical forms of the same word. (Eg: object –verb / object – noun)
2. Speaking exercises involving the use of stress and intonation – Group discussions– analysis of problems and offering solutions.
3. Reading comprehension exercises with critical questions, Multiple choice question.
4. Sequencing of jumbled sentences using connectives – Writing different types of reports like industrial accident report and survey report – Writing recommendations.

UNIT IV

Numerical adjectives – Oral instructions – Descriptive writing – Argumentative paragraphs – Letter of application - content, format (CV / Bio-data) - Instructions, imperative forms - Checklists, Yes/No question form – E-mail communication.

Suggested Activities:

1. Rewriting exercises using numerical adjectives.
2. Reading comprehension exercises with analytical questions on content – Evaluation of content.
3. Listening comprehension – entering information in tabular form, intensive listening exercise and completing the steps of a process.
4. Speaking - Role play – group discussions – Activities giving oral instructions.
5. Writing descriptions, expanding hints – Writing argumentative paragraphs – Writing formal letters – Writing letter of application with CV/Bio-data – Writing general and safety instructions – Preparing checklists – Writing e-mail messages.

UNIT V

Speaking - Discussion of Problems and solutions - Creative and critical thinking – Writing an essay, Writing a proposal.

Suggested Activities:

1. Case Studies on problems and solutions
2. Brain storming and discussion
3. Writing Critical essays
4. Writing short proposals of 2 pages for starting a project, solving problems, etc.
5. Writing advertisements.

TEXT BOOK:

1. Chapters 5 – 8. Department of Humanities & Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 & 2), Chennai: Orient Longman Pvt. Ltd., 2006. Themes 5 – 8 (Technology, Communication, Environment, Industry)

REFERENCES:

1. P. K. Dutt, G. Rajeevan and C.L.N Prakash, 'A Course in Communication Skills',
   Cambridge University Press, India 2007.
2. Krishna Mohan and Meera Banerjee, 'Developing Communication Skills', Macmillan
   India Ltd., (Reprinted 1994 – 2007).
3. Edgar Thorpe, Showick Thorpe, 'Objective English', Second Edition, Pearson
   Education, 2007.

Extensive Reading:

1. Robin Sharma**, '**The Monk Who Sold His Ferrari', Jaico Publishing House, 2007

Note:
The book listed under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

208MAT02 - MATHEMATICS – II

UNIT I ORDINARY DIFFERENTIAL EQUATIONS

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT II VECTOR CALCULUS

Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelpipeds.

UNIT III ANALYTIC FUNCTIONS

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping : w= z+c, cz, 1/z, and bilinear transformation.

UNIT IV COMPLEX INTEGRATION

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor and Laurent expansions – Singular points – Residues – Residue theorem – Application of residue theorem to evaluate real integrals – Unit circle and semi-circular contour(excluding poles on boundaries).

UNIT V LAPLACE TRANSFORM

Laplace transform – Conditions for existence – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function and impulse functions – Transform of periodic functions.

Definition of Inverse Laplace transform as contour integral – Convolution theorem (excluding proof) – Initial and Final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

TEXT BOOK:

1. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", 3rd Edition, Laxmi Publications (p) Ltd., (2008).
2. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, Delhi, (2007).

REFERENCES:

1. Ramana B.V, "Higher Engineering Mathematics",Tata McGraw Hill Publishing Company, New Delhi, (2007).
2. Glyn James, "Advanced Engineering Mathematics", 3rd Edition, Pearson Education, (2007).
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 7th Edition, Wiley India, (2007).
4. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Pvt. Ltd., (2007).

208PHT03 - ENGINEERING PHYSICS – II

UNIT I CONDUCTING MATERIALS

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

UNIT II SEMICONDUCTING MATERIALS

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration – compound semiconductors – Hall effect –Determination of Hall coefficient – Applications.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS

Origin of magnetic moment – Bohr magneton – Dia and para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti – ferromagnetic materials – Ferrites – applications – magnetic recording and readout – storage of magnetic data – tapes, floppy and magnetic disc drives.

Superconductivity : properties - Types of super conductors – BCS theory of superconductivity(Qualitative) - High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV DIELECTRIC MATERIALS

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

UNIT V MODERN ENGINEERING MATERIALS

Metallic glasses: preparation, properties and applications.

Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA

Nanomaterials: synthesis –plasma arcing – chemical vapour deposition – sol-gels – electrodeposition – ball milling - properties of nanoparticles and applications.

Carbon nanotubes: fabrication – arc method – pulsed laser deposition – chemical vapour deposition - structure – properties and applications.

TEXT BOOKS:

1. Charles Kittel ' Introduction to Solid State Physics', John Wiley & sons, 7th edition, Singapore (2007)
2. Charles P. Poole and Frank J.Ownen, 'Introduction to Nanotechnology', Wiley India(2007) (for Unit V)

REFERENCES:

1. Rajendran, V, and Marikani A, 'Materials science'Tata McGraw Hill publications, (2004)
   New delhi.
2. Jayakumar, S. 'Materials science', R.K. Publishers, Coimbatore, (2008).
3. Palanisamy P.K, 'Materials science', Scitech publications(India) Pvt. LTd., Chennai,
   second Edition(2007)
4. M. Arumugam, 'Materials Science' Anuradha publications, Kumbakonam, (2006).

208CYT04 - ENGINEERING CHEMISTRY – II

AIM

To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

OBJECTIVES

- The student should be conversant with the principles electrochemistry, electrochemical cells, emf and applications of emf measurements.
- Principles of corrosion control
- Chemistry of Fuels and combustion
- Industrial importance of Phase rule and alloys
- Analytical techniques and their importance.

UNIT I ELECTROCHEMISTRY

Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – Single electrode potential – Nernst equation (problem) – reference electrodes – Standard Hydrogen electrode -Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – electrochemical series – significance – potentiometer titrations (redox - Fe^{2+} vs dichromate and precipitation – Ag^{+} vs CI^{-} titrations) and conduct metric titrations (acid-base – HCI vs, NaOH) titrations,

UNIT II CORROSION AND CORROSION CONTROL

Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – factors influencing corrosion – corrosion control – sacrificial anode and impressed cathodic current methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Au) and electroless (Ni) plating.

UNIT III FUELS AND COMBUSTION

Calorific value – classification – Coal – proximate and ultimate analysis metallurgical coke – manufacture by Otto-Hoffmann method – Petroleum processing and fractions – cracking – catalytic cracking and methods-knocking – octane number and cetane number – synthetic petrol – Fischer Tropsch and Bergius processes – Gaseous fuels-water gas, producer gas, CNG and LPG, Flue gas analysis – Orsat apparatus – theoretical air for combustion.

UNIT IV PHASE RULE AND ALLOYS

Statement and explanation of terms involved – one component system – water system – condensed phase rule – construction of phase diagram by thermal analysis – simple eutectic systems (lead-silver system only) – alloys – importance, ferrous alloys – nichrome and stainless steel – heat treatment of steel, non-ferrous alloys – brass and bronze.

UNIT V ANALYTICAL TECHNIQUES

Beer-Lambert's law (problem) – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (problem) (block diagram only) – estimation of iron by colorimetry – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2006).

REFERENCES:

1. B.Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
2. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).

208EMT05 - ENGINEERING MECHANICS

OBJECTIVE

At the end of this course the student should be able to understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions. Further, he should understand the principle of work and energy. He should be able to comprehend the effect of friction on equilibrium. He should be able to understand the laws of motion, the kinematics of motion and the interrelationship. He should also be able to write the dynamic equilibrium equation. All these should be achieved both conceptually and through solved examples.

UNIT I BASICS & STATICS OF PARTICLES

Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force.

UNIT II EQUILIBRIUM OF RIGID BODIES

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

UNIT III PROPERTIES OF SURFACES AND SOLIDS

Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, - Angle section, Hollow section by using standard formula – second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Derivation of mass moment of inertia for rectangular section, prism, sphere from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS

Frictional force – Laws of Coloumb friction – simple contact friction – Rolling resistance – Belt friction.

Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

TEXT BOOK:

1. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2
   Dynamics, McGraw-Hill International Edition, (1997).

REFERENCES:

1. Rajasekaran, S, Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., (2000).
2. Hibbeller, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2000).
3. Palanichamy, M.S., Nagam, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw-Hill, (2001).
4. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd., (2003).
5. Ashok Gupta, "Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Pvt., Ltd., (2002).

208CCT05 - CIRCUIT THEORY
(Common to EEE, EIE and ICE Branches)

UNIT I BASIC CIRCUITS ANALYSIS

Ohm's Law – Kirchoffs laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for D.C and A.C. circuits.

UNIT II NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS:

Network reduction: voltage and current division, source transformation – star delta conversion.

Thevenins and Novton & Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.

UNIT III RESONANCE AND COUPLED CIRCUITS

Series and paralled resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

UNIT IV TRANSIENT RESPONSE FOR DC CIRCUITS

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input.

UNIT V ANALYSING THREE PHASE CIRCUITS

Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

TEXT BOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis",Tata McGraw Hill publishers, 6th edition, New Delhi, (2002).
2. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis",Tata McGraw Hill, (2007).

REFERENCES:

1. Paranjothi SR, "Electric Circuits Analysis," New Age International Ltd., New Delhi, (1996).
2. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, Tata McGraw-Hill, New Delhi (2001).
3. Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, (1999).
4. Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, (2003)

208EDT05 - ELECTRIC CIRCUITS AND ELECTRON DEVICES
(For ECE, CSE, IT and Biomedical Engg. Branches)

UNIT I CIRCUIT ANALYSIS TECHNIQUES

Kirchoff's current and voltage laws – series and parallel connection of independent sources – R, L and C – Network Theorems – Thevenin, Superposition, Norton, Maximum power transfer and duality – Star-delta conversion.

UNIT II TRANSIENT RESONANCE IN RLC CIRCUITS

Basic RL, RC and RLC circuits and their responses to pulse and sinusoidal inputs – frequency response – Parallel and series resonances – Q factor – single tuned and double tuned circuits.

UNIT III SEMICONDUCTOR DIODES

Review of intrinsic & extrinsic semiconductors – Theory of PN junction diode – Energy band structure – current equation – space charge and diffusion capacitances – effect of temperature and breakdown mechanism – Zener diode and its characteristics.

UNIT IV TRANSISTORS

Principle of operation of PNP and NPN transistors – study of CE, CB and CC configurations and comparison of their characteristics – Breakdown in transistors – operation and comparison of N-Channel and P-Channel JFET – drain current equation – MOSFET – Enhancement and depletion types – structure and operation – comparison of BJT with MOSFET – thermal effect on MOSFET.

UNIT V SPECIAL SEMICONDUCTOR DEVICES
(Qualitative Treatment only)

Tunnel diodes – PIN diode, varactor diode – SCR characteristics and two transistor equivalent model – UJT – Diac and Triac – Laser, CCD, Photodiode, Phototransistor, Photoconductive and Photovoltaic cells – LED, LCD.

TEXT BOOKS:

1. Joseph A. Edminister, Mahmood, Nahri, "Electric Circuits" – Shaum series,Tata McGraw Hill, (2001)
2. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits",Tata McGraw Hill, 2nd Edition, (2008).
3. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, (2008).

REFERENCES:

1. Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7th Education, (2006).
2. William H. Hayt, J.V. Jack, E. Kemmebly and steven M. Durbin, "Engineering Circuit Analysis",Tata McGraw Hill, 6th Edition, 2002.
3. J. Millman & Halkins, Satyebranta Jit, "Electronic Devices & Circuits",Tata McGraw Hill, 2nd Edition, 2008.

208EET06 - BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
(Common to branches under Civil, Mechanical and Technology faculty)

UNIT I ELECTRICAL CIRCUITS & MEASURMENTS

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II ELECTRICAL MECHANICS

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation.

Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts)

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations.

Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TEXT BOOKS:

1. V.N. Mittle "Basic Electrical Engineering",Tata McGraw Hill Edition, New Delhi, 1990.
2. R.S. Sedha, "Applied Electronics" S. Chand & Co., 2006.

REFERENCES:

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering",Tata McGraw Hill, Second Edition, (2006).
2. Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press (2005).
3. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, (1994).
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, (2002).
5. Premkumar N, "Basic Electrical Engineering", Anuradha Publishers, (2003)

208CMT06 - BASIC CIVIL & MECHANICAL ENGINEERING
(Common to branches under Electrical and I & C Faculty)

A – CIVIL ENGINEERING

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS

Surveying: Objects – types – classification – principles – measurements of distances – angles – leveling – determination of areas – illustrative examples.

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel sections.

UNIT II BUILDING COMPONENTS AND STRUCTURES

Foundations: Types, Bearing capacity – Requirement of good foundations.

Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

B – MECHANICAL ENGINEERING

UNIT III POWER PLANT ENGINEERING

Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants – Merits and Demerits – Pumps and turbines – working principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.

UNIT IV I C ENGINES

Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.

REFERENCES:

1. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering",Tata McGraw Hill Publishing Co., New Delhi, (1996).
2. Ramamrutham. S, "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd. (1999).
3. Seetharaman S. "Basic Civil Engineering", Anuradha Agencies, (2005).
4. Venugopal K and Prahu Raja V, "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, (2000).
5. Shantha Kumar S R J., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, (2000).

208CLP01 - COMPUTER PRACTICE LABORATORY – II

LIST OF EXPERIMENTS

1. UNIX COMMANDS

Study of Unix OS - Basic Shell Commands - Unix Editor

2. SHELL PROGRAMMING

Simple Shell program - Conditional Statements - Testing and Loops

3. C PROGRAMMING ON UNIX

Dynamic Storage Allocation-Pointers-Functions-File Handling

HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Hardware

☐1 UNIX Clone Server
☐33 Nodes (thin client or PCs)
☐Printer – 3 Nos.

Software

☐OS – UNIX Clone (33 user license or License free Linux)
☐Compiler - C

208PCP02 - PHYSICS LABORATORY – II

LIST OF EXPERIMENTS

1. Determination of Young's modulus of the material – non uniform bending.
2. Determination of Band Gap of a semiconductor material.
3. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.
4. Determination of viscosity of liquid – Poiseuille's method.
5. Spectrometer dispersive power of a prism.
6. Determination of Young's modulus of the material – uniform bending.
7. Torsional pendulum – Determination of rigidity modulus.

- **A minimum of FIVE experiments shall be offered.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**
- **The lab examinations will be held only in the second semester.**

CHEMISTRY LABORATORY – II

LIST OF EXPERIMENTS

1. Conduct metric titration (Simple acid base)
2. Conduct metric titration (Mixture of weak and strong acids)
3. Conduct metric titration using $BaCl_2$ vs Na_2SO_4
4. Potentiometric Titration (Fe^{2+} / $KMnO_4$ or $K_2Cr_2O_7$)
5. PH titration (acid & base)
6. Determination of water of crystallization of a crystalline salt (Copper sulphate)
7. Estimation of Ferric iron by spectrophotometry.

- **A minimum of FIVE experiments shall be offered.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**
- **The lab examinations will be held only in the second semester.**

208DMP03 COMPUTER AIDED DRAFTING AND MODELING LABORATORY

List of Exercises using software capable of Drafting and Modeling

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

List of Equipments for a batch of 30 students:

1. Pentium IV computer or better hardware, with suitable graphics facility
   - 30 No.
2. Licensed software for Drafting and Modeling.
   - 30 Licenses
3. Laser Printer or Plotter to print / plot drawings
   - 2 No.

208ELP03 - ELECTRICAL CIRCUIT LABORATORY
(Common to EEE, EIE and ICE)

LIST OF EXPERIMENTS

1. Verification of ohm's laws and kirchoff's laws.
2. Verification of Thevemin's and Norton's Theorem
3. Verification of superposition Theorem
4. Verification of maximum power transfer theorem.
5. Verification of reciprocity theorem
6. Measurement of self inductance of a coil
7. Verification of mesh and nodal analysis.
8. Transient response of RL and RC circuits for DC input.
9. Frequency response of series and parallel resonance circuits.
10. Frequency response of single tuned coupled circuits.

208CDP03 CIRCUITS AND DEVICES LABORATORY

1. Verification of KVL and KCL
2. Verification of Thevenin and Norton Theorems.
3. Verification of superposition Theorem.
4. Verification of Maximum power transfer and reciprocity theorems.
5. Frequency response of series and parallel resonance circuits.
6. Characteristics of PN and Zener diode
7. Characteristics of CE configuration
8. Characteristics of CB configuration
9. Characteristics of UJT and SCR
10. Characteristics of JFET and MOSFET
11. Characteristics of Diac and Triac.
12. Characteristics of Photodiode and Phototransistor.

SEMESTER III

308ITT01 - TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to all branches)

OBJECTIVES

The course objective is to develop the skills of the students in the areas of Transforms and Partial Differtial Equations. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. The course will also serve as a prerequisite for post graduate and specialized studies and research.

1. FOURIER SERIES

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identify – Harmonic Analysis.

2. FOURIER TRANSFORMS

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

3. PARTIAL DIFFERENTIAL EQUATIONS

Formation of partial differential equations – Lagrange's linear equation – Solutions of standard types of first order partial differential equations - Linear partial differential equations of second and higher order with constant coefficients.

4. APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in cartesian coordinates.

5. Z -TRANSFORMS AND DIFFERENCE EQUATIONS

Z-transforms - Elementary properties – Inverse Z-transform – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

TEXT BOOKS

1. Grewal, B.S, *'Higher Engineering Mathematics'* 40th Edition, Khanna publishers, Delhi, (2007)

REFERENCES

1. Bali.N.P and Manish Goyal *'A Textbook of Engineering Mathematics'*, Seventh Edition, Laxmi Publications(P) Ltd. (2007)
2. Ramana.B.V. *'Higher Engineering Mathematics'* Tata Mc-GrawHill Publishing Company limited, New Delhi (2007).
3. Glyn James, *'Advanced Modern Engineering Mathematics'*, Third edition-Pearson Education (2007).
4. Erwin Kreyszig *'Advanced Engineering Mathematics',* Eighth edition-Wiley India (2007).

308CHT02 - ELECTRICAL DRIVES AND CONTROLS
(Common to Mechanical, Production &Technology Faculty)

OBJECTIVE

- To understand the basic concepts of different types of electrical machines and their performance.
- To study the different methods of starting D.C motors and induction motors.
- To study the conventional and solid-state drives.

1. INTRODUCTION

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

2. DRIVE MOTOR CHARACTERISTICS

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

3. STARTING METHODS

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

4. CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications.

5. CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

TEXT BOOKS

1. VEDAM SUBRAHMANIAM, "Electric Drives (concepts and applications)", Tata McGraw-Hill, 2001
2. NAGRATH.I.J. & KOTHARI.D.P, "Electrical Machines", Tata McGraw-Hill,1998

REFERENCES

1. PILLAI.S.K "A first course on Electric drives", Wiley Eastern Limited, 1998
2. M.D.SINGH, K.B.KHANCHANDANI, "Power Electronics", Tata McGraw-Hill, 1998
3. H.Partab, "Art and Science and Utilisation of electrical energy", Dhanpat Rai and Sons, 1994.

308CHT03 - ORGANIC CHEMISTRY

AIM

To study the type of components in which organic reaction are taking place and also to know the preparation of the essential organic compounds.

OBJECTIVES

At the end of the course students are in a position to have knowledge on various reaction, Mechanism, preparation of organic compounds classification of the compounds. This will be a pre cursor for the study on Chemical Reaction Engineering.

UNIT I UNIT PROCESS

Definitions – reagents- mechanism – catalyst – illustrations of the following unit process – nitration – halogenation – oxidation & reduction – esterification.

UNIT II ORGANIC REACTIONS MECHANISM AND ESTIMATION

Electrophilic reaction - Friedel craft reaction, Riemer Timenn Reaction; Nucleophilic reactions - Aldol condensation, Benzion condensation; Free radical reaction - Halogenation of Alkane, Addition HBR on Alkene in presence of peroxide

UNIT III

Alylic halogination using N-Bromo succinamide (NBS); Thermal halogination of Alkane (CH_3-CH=CH); condensation and polymerization reaction – oxidation and reduction reactions; estimation of some organic compounds – phenol – aniline – acetone - glucose

UNIT IV SYNTHETIC CHEMISTRY

synthesis of different types of compounds like alcohol, aldehyde, acid, amine and synthesis of dicarboylic acids and unsaturated acids. Synthesis of azodyes –methyl orange and congo dye. Synthesis of triphenyl methane dyes – alizarin-melachite green

UNIT V AMINO ACIDS AND PROTEINS

Amino acids and proteins- classification - synthesis of amino acids - reactions of carboxyl group and amino group - peptide linkage - end group analysis - colour reaction of proteins- denaturation.

TEXT BOOK

1. Tiwari K.S. Vishnoi N.K. and Marhotra S.N., A text book of Organic Chemistry, II Edition , Vikas Publishing House Pvt.Ltd., (1998), New Delhi.

REFERENCE BOOK

1. P. H. Groggins Unit processes in organic synthesis. (Third Edition). McGraw-Hill, New York, 1947.

308CHT04 - MECHANICS OF SOLIDS
(Common to Textile Technology & Chemical Engg.)

AIM

To given them knowledge on structural, Mechanical properties of Beams, columns.

OBJECTIVES

The students will be able to design the support column, beams, pipelines, storage tanks and reaction columns and tanks after undergoing this course. This is precursor for the study on process equipment design and drawing.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS

Rigid bodies and deformable solids – forces on solids and supports – equilibrium and stability – strength and stiffness – tension, compression and shear stresses – Hooke's law and simple problems – compound bars – thermal stresses – elastic constants and poission's ratio – welded joints – design.

UNIT II TRANSVERSE LOADING ON BEAMS

Beams – support conditions – types of Beams – transverse loading on beams – shear force and bending moment in beams – analysis of cantilevers, simply – supported beams and over hanging beams – relationships between loading, S.F. and B.M. In beams and their applications – S.F.& B.M. diagrams.

UNIT III DEFLECTIONS OF BEAMS

Double integration method – Macaulay's method – Area – moment theorems for computation of slopes and deflections in beams – conjugate beam method

UNIT IV STRESSES IN BEAMS

Theory of simple bending – assumptions and derivation of bending equation (M/I = F/Y = E/R) – analysis of stresses in beams – loads carrying capacity of beams – proportioning beam sections – leaf springs – flitched beams – shear stress distribution in beams – determination of shear stress in flanged beams.

UNIT V TORSION

Torsion of circular shafts – derivation of torsion equation (T/J = C/R = G0/L) – stress and deformation in circular and hollow shafts – stresses and deformation in circular and hollow shafts – stepped shafts – shafts fixed at both ends – stresses in helical springs – deflection of springs – spring constant

UNIT VI COLUMNS

Axially loaded short columns – columns of unsymmetrical sections – Euler's theory of long columns – critical loads for prismatic columns with different end conditions – effect of eccentricity.

TEXT BOOKS

1. Junarkar, S.B., Mechanics of Structure Vol. 1, 21st Edition, Character Publishing House, Anand, Indian, (1995)
2. William A.Nash, Theory and Problems of Strength of Materials, Schaum's Outline Series. McGraw Hill International Editions, Third Edition, 1994.

REFERENCES

1. Elangovan, A., Thinma Visai Iyal (Mechanics of Solids in Tamil), Anna University, Madras, 1995.

308CHT05 - FLUID MECHANICS

AIM

To have a general idea about the Mechanism of fluid, fluid flow and flow measuring devises thro' basic concepts.

OBJECTIVES

The subject will help the students to have a knowledge on the fluid properties, their characteristics while abstatic, during flow thro' ducts, pipes and other channels. Knowledge on several machineries used to transport the fluid and their performance are assessed.

UNIT I INTRODUCTION

Nature of fluids - laws of dimensional homogeneity – Physical properties of fluids – Types of fluids-Newtonian and Non Newtonian fluids- viscosity and other secondary properties – Compressible and incompressible fluids-hydrostatic pressure distributions- laws of buoyancy Pressure measurements manometers

UNIT II KINEMATICS OF FLUID FLOW

Velocity potential, concept of boundary layer, form drag, skin drag-Drag coefficient-Continuity, momentum and mechanical energy equations; Laminar and turbulent flow through closed conduits, velocity profiles and friction factor for smooth and rough pipes

UNIT III DIMENSIONAL ANALYSIS AND MEASUREMENT OF FLUID FLOW

The principle of dimensional homogeneity - the Pi-theorem - relationship between dimensional analysis and similitude - use of dimensional analysis for scale up studies-Orifice meter, Venturimeter, Pitot tube, Rota meter, Weirs and notches-Principles and applications of Doppler effect in flow measurement

UNIT IV VISCOUS FLOW IN DUCTS AND BOUNDARY LAYER FLOW

Reynolds's number regimes, internal versus external viscous flow, flow in circular pipe - head loss, minor losses in pipe systems and multiple-pipe systems - functions and pressure drag - flow through packed and fluidized beds.

UNIT V FLOW MEASUREMENT AND TUBRO MACHINERY

Fluid moving machinery performance - selection and specification; Air lift and diaphragm pump – positive displacement pump – reciprocating and rotary pumps – centrifugal pump; pump characteristics. Fans, blowers and compressors – steam jet ejector.

TEXT BOOKS

1. McCabe, W.L, Smith J.C and Harriot .P., "Unit Operations in Chemical Engineering", Mc-Graw-Hill, Sixth Edition, 2000.
2. Noel de Nevers, "Fluid Mechanics for Chemical Engineers", Second Edition, McGraw-Hill, 1991.

REFERENCES

1. Coulson J.M. and Richardson J.E.., Chemical Engineering, Vol. 1 (3rd Edition) Pergamon Press.
2. Shames, I.H., "Mechanics of Fluids", Third Edition, McGraw-Hill Inc., 1992.
3. White, F.M., "Fluid Mechanics", 4th Edition, McGraw-Hill Inc., 1999.
4. Daughenty, R.L., Franzini, J.B and Finnemore, E.J., "Fluid Mechanics with Engineering Applications", SI metric Edn., McGraw-Hill Book Company, 1989.
5. Darby, R. Chemical Engineering Fluid Mechanics, Marcel Dokker, 1998.
6. Vennarol, J.K., Street, R.L. Elementary Fluid Mechanics. 6th Edition John Wiley & Sons. 1982.

308CHT06 - ENVIRONMENTAL SCIENCE AND ENGINEERING
(Common to EEE, EIE, ICE, Biotech, Chemical, Fashion, Plastic, Polymer & Textile)

OBJECTIVES

- To create an awareness on the various environmental pollution aspects and issues.
- To give a comprehensive insight into natural resources, ecosystem and biodiversity.
- To educate the ways and means to protect the environment from various types of pollution.
- To impart some fundamental knowledge on human welfare measures.

1. INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

Definition, scope and importance – need for public awareness – forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their ground water, floods, drought, conflicts over water, dams-benefits and problems – mineral resources: use effects on forests and tribal people – water resources: use and over-utilization of surface 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.

Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

2. ECOSYSTEMS AND BIODIVERSITY

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 (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – introduction to biodiversity – definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Field study of common plants, insects, birds

Field study of simple ecosystems – pond, river, hill slopes, etc.

3. ENVIRONMENTAL POLLUTION

Definition – causes, 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.

Field study of local polluted site – urban / rural / industrial / agricultural

4. 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 production 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.

5. 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.

TEXT BOOKS

1. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", Pearson Education Pvt., Ltd., Second Edition, ISBN 81-297-0277-0, 2004.
2. Miller T.G. Jr., "Environmental Science", Wadsworth Publishing Co.

REFERENCES

1. Bharucha Erach, "The Biodiversity of India", Mapin Publishing Pvt. Ltd., Ahmedabad India.
2. Townsend C., Harper J and Michael Begon, "Essentials of Ecology", Blackwell Science.
3. Trivedi R.K. and P.K. Goel, "Introduction to Air Pollution", Techno-Science Publications.
4. Trivedi R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
5. Cunningham, W.P.Cooper, T.H.Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
6. Wager K.D. "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.

308CHP01 - ORGANIC CHEMISTRY LABORATORY

OBJECTIVE

To learn basic principles involved in analysis and synthesis of different organic derivatives.

1. 1. Analysis of nature of organic compounds – To identify aliphatic / aromatic, saturated / unsaturated compounds.
2. Identification and Characterization of various functional groups by their characteristic reactions:
   a). alcohol,
   b) aldehyde,
   c) ketone,
   d) carboxylic acid,
   e) phenol,
   f) ester,
   g) primary, secondary and tertiary amines
   h) amide
   i) nitro compounds.
3. Analysis of an unknown organic compound and preparation of suitable solid derivatives.
4. Analysis of Proteins.
5. Methodology of filtrations and recrystallization.
6. Introduction to organic Synthetic procedures:
   - Acetylation – Preparation of acetanilide from aniline.
   - Hydrolysis – Preparation of salycilic acid from methyl salyciliate.
   - Substitution – Conversion of acetone to iodoform.
   - Nitration – Preparation of m-dinitrobenze from nitrobenzene.
   - Oxidation – Preparation of benzoic acid from benzaldehyde / benzylalcohol.

REFERENCE BOOKS:

1. Vogels's Text Book of Practical Organic Chemistry, Fifth Edition, Longman Singapore Publishers Pte. Ltd., Singapore (1989).
2. Organic Chemistry Lab Manual, Chemistry Division, Chemical Engineering Departemnt, A.C. Tech, Anna University (2007).

308CHP02 - BASIC ELECTRICAL & ELECTRONICS ENGINEERING LABORATORY

AIM

The laboratory course aims to provide a basic understanding of operation and characteristics of Electrical machines and Electronic devices

OBJECTIVE

Gain knowledge on characteristics of Electrical machines and Electronic Devices

List of Experiments:

1. Open circuit and load test on shunt generators
2. Load test of D.C. shunt motor
3. Load test or single phase induction motor
4. Equivalent circuit of a transformer
5. Swinturn's test
6. Load test or 3- phase squirrel cage induction motor
7. Load test or 3 –phase slip ring induction motor
8. Diode characteristics
9. Transistor amplifier
10. SCR application
11. Frequency Response Analysis
12. Characteristics of Transducers

List of Equipments

1. Shunt Generators
2. Shunt DC motors
3. Single phase Induction motor
4. Single phase transformer
5. Three phase Squirrel Cage induction Motors
6. Diodes and Amplifiers
7. Oscilloscope
8. Transducers

308CHP03 - FLUID MECHANICS LAB

AIM

To determine experimentally the flow characteristics of fluids and also to determine the efficiency of the flow measuring devices and fluid transport machineries.

OBJECTIVES: To gain practical knowledge on the measurement of Fluid Flow and their characteristics at different operating conditions.

LIST OF EXPERIMENTS*

1. Calibration of constant and variable Head meters
2. Calibration of Weirs
3. Drag reduction studies
4. Flow through straight pipe
5. Pressure drop studies in packed column
6. Pressure drop studies in Fluidized bed
7. Flow through fittings / valves
8. Open drum orifice and draining time
9. Flow through helical and spiral Coil
10. Characteristic curves of centrifugal pump
11. Characteristic curves of Gear pump
12. Characteristic curves of Reciprocating pump
13. Viscosity measurement of non Newtonian fluids
14. Flow through annular pipe of horizontal concentric pipe

LIST OF EQUIPMENTS REQUIRED

1. Orifice Meter with U tube manometer
2. Venturi meter with U tube Manometer
3. V-notch and circular Notch weirs.
4. Straight pipes with U tube Manometers
5. Packed column with U tube manometer.
6. Fluidized column with U tube manometer.
7. Flow loops for pipes, fittings and valves.
8. Open drum orifice.
9. Helical coil of different diameter.
10. Centrifugal pump with sump and pressure gauge (Vertical discharge & horizontal discharge).
11. Reciprocating pump with sump and pressure gauge (Vertical discharge & horizontal discharge).
12. Gear pump with sump and pressure gauge (Vertical discharge & horizontal discharge).
13. Horizontal double pipe (concentric pipes) with U tube Manometer

***Minimum 10 experiments shall be offered**

SEMESTER IV

408CHT01 - PROBABILITY AND STATISTICS

(Common to Biotech, Chemical, Fashion, Petroleum, Polymer, Plastic)

OBJECTIVES

- At the end of the course, the students would
- Acquire skills in handling situations involving more than one random variable and functions of random variables.
- Be introduced to the notion of sampling distributions and have acquired knowledge of statistical techniques useful in making rational decision in management problems.
- Be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.

1. RANDOM VARIABLES

Discrete and continuous random variables - Properties- Moments - Moment generating functions and their properties. Binomial, Poisson ,Geometric, Negative binomial, Uniform, Exponential, Gamma, and Weibull distributions.

2. TWO DIMENSIONAL RANDOM VARIABLES

Joint distributions - Marginal and conditional distributions – Covariance - Correlation and Regression – function of a random variable-Transformation of random variables - Central limit theorem.

3. TESTING OF HYPOTHESIS

Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions - Tests for independence of attributes and Goodness of fit.

4. DESIGN OF EXPERIMENTS

Analysis of variance – One way classification – CRD - Two – way classification – RBD - Latin square.

5. RELIABILTY AND QUALITY CONTROL

Concepts of reliability-hazard functions-Reliability of series and parallel systems-control charts for measurements (x and R charts) – control charts for attributes (p, c and np charts)

Note : Use of approved statistical table is permitted in the examination.

TEXT BOOKS

1. J. S. Milton and J.C. Arnold, " Introduction to Probability and Statistics", Tata McGraw Hill, 4th edition, 2007. (For units 1 and 2)
2. R.A. Johnson and C.B. Gupta, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th edition, (2007)

REFERENCES

1. Walpole, R. E., Myers, R. H. Myers R. S. L. and Ye. K, "Probability and Statistics for Engineers and Scientists", Seventh Edition, Pearsons Education, Delhi, 2002.
2. Navidi, W, "Statistics for Engineers and Scientists", Special Indian Edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi,2008.
3. Spiegel, M.R, Schiller, J and Alu Srinivasan, R, "Schaum's Outlines Probability and Statistics", Tata McGraw-Hill Publishing Company Ltd. New Delhi ,2007.

408CHT02 - PHYSICAL CHEMISTRY

AIM

To know the basic concepts of physical chemistry aspects of chemical compounds and their behaviour at different processing conditions.

OBJECTIVES

The students get knowledge on the reactors mechanism. Use of catalyst and also the reactions stages involved in a particular process operations.

UNIT I CHEMICAL KINETICS

Rate equations – order of reaction – I order – II order – III order – zero order – pseudo order reactions – effect of temperature on reaction rate – concept of activation energy- chain reactions – branched chain reactions – reactions in solutions – influence of ionic strength in rates of reactions.

UNIT II ELECTROCHEMISTRY

Electrolytic conductance – specific conductance – equivalent conductance – molar conductance-variation with dilution – kohlrausch's law- applications of kohlrausch's law - molar ionic conductance - conductometric titrations – ostwald dilution law – Debye – Huckel theory of mean ionic activity coefficient.

UNIT III PHASE RULE AND DISTRIBUTION LAW

Definition of terms- one component system – water – sulphur – two component system –simple eutectic system – reduced phase rule. Distribution-chemical combinations-applications-applications of distribution law-Raoults law-Henry's law-ideal and non-ideal solutions-vapour pressure & boiling point

UNIT IV SURFACE CHEMISTRY

ADSORPTION: Definition – types – isotherms – theories of adsorption – BET method – applications.

CATALYSIS: Homogeneous catalysis – acid –base – enzyme catalysis autocatalysis mechanism and kinetics – Michaelis-Menten equation - Heterogeneous catalysis – kinetics – effect of temperature on surface reactions

UNIT V MACRO MOLECULES

COLLOIDS: Classification – preparations – coagulation – flocculation – determination of size of particles- surfactants – emulsions – emulsifiers –gels – applications.

POLYMERS: Classification – polymerization reactions – molar masses of reactions – determination of molar masses- kinetic study.

TEXT BOOKS

1. Puri B.H and Sharma L.R. Principles of Physical Chemistry, S. Nagin Chand and Company, Delhi (1994)
2. P.L.Soni , O.P. Dharmarha & U.N. Dash, Textbook of Physical Chemistry , Sultan Chand & Sons.

REFERENCES:

1. Kund and Jain, Physical Chemistry, S.Chand and Company, Delhi (1996)
2. Kuriakose, J.C. and Rajaram J, Chemistry in Engineering and Technology Vol. I, Tata McGraw-Hills.1984.

408CHT03 - INSTRUMENTAL METHODS OF ANALYSIS

AIM

To impart knowledge on various analytical instruments and methods for accurate chemical analysis.

OBJECTIVES

Several chemical reaction have to be analysed for composition of raw materials, materials in progress and also the final products. Several sophisticated instruments on the basic principles involving operation and interpretation of data thro' the instruments are obtained by the students.

Unit 1 : FUNDAMENTALS OF SPECTRAL ANALYSIS

ELECTROMAGNETIC RADIATION: Regions and properties, Various energy levels, Interaction of photons with matter, absorbance, & transmittance and their relationship**,** Permitted energy levels for the electrons of an atom and simple molecules, classification of instrumental methods based on physical properties.;VISIBLE SPECTROSCOPY AND COLORIMETRY: Beer-Lambert's Law, Limitations, Deviations (Real, Chemical and Instrumental deviations) Nesslerimetry, Duboscq colorimetry, Estimation of inorganic ions such as Fe, Ni and Nitrite using Beer-Lambert's Law. UV-VISIBLE AND IR SPECTROSCOPY: Instrumentation (Source, Optical parts and Detectors) - Various electronic transitions in organic and inorganic compounds effected by UV, Visible and infra red radiations. Woodward-Fischer rules for the calculation of absorption maxima (dienes and carbonyl compounds). Effects of auxochromes and effects of conjugation on the absorption maxima, Multicomponent analysis - Photometric titration

Unit 2 : ELECTROMETRIC METHODS

Conductometric Titrations: Instrumentation-Types-Advantages-Application; Potentiometric Titrations: Instrumentation-Types-Advantages-Application; Measurement of pH: Instrumentation-Applications; Ion selective electrodes: Electrode setup-Applications.; Amperometric titrations: Principle-instrumentation-Application

Unit 3: X-RAY DIFFRACTION & THERMAL ANALYSIS METHODS

XRD: Introduction, Mosley's law, Different emission and diffraction methods, various X-ray detectors.

Thermogravimetic Analysis (TGA): Instrumentation, factors affecting the shapes of thermograms, applications, thermograms of some important compounds ($CuSO_4$, $5H_2O$, $CaC_2O_42H_2O$ etc).

Differential thermal analysis (DTA) & Differential Scanning Calorimetry (DSC): Principle, Instrumentation and applications of DSC and DTA, differences between DSC and DTA.

.

Unit 4: IMPORTANT SPECTROSCOPIC METHODS OF ANALYSIS

Atomic Absorption Spectroscopy (AAS): Principle, Instrumentation, Interference and Applications.

Flame Photometry and Inductively coupled Plasma Atomic Emission spectroscopy(ICP-AES):

Principle, Instrumentation and Applications. Polarimetry: Principle, Instrumentation and Applications.

Refractometry: Principle, Instrumentation and Applications. Nephlometry/Turbidimetry: Principle, Instrumentation and Applications.

Unit 5 : CHROMATOGRAPHIC METHODS

Chromatographic methods - Types (column, Thin layer, paper, Gas, High performance liquid Chromatographic methods) – principle- separation technique - separation of organic compounds by column and thin layer, Amino acids and mixture of Cu, Co & Ni by Paper, estimation of organic compounds by GC and HPLC.

TEXTS PRESCRIBED :

1. Skoog D.A. and West D.M., " Fundamentals of Analytical Chemistry ", Saunders-college Publishing, 1982.
2. Willard, H.H., Merritt. I.I., Dean J.a., and Settle, F.A., " Instrumental methods of analysis ", Sixth edition, CBS publishers, 1986.

REFERENCES :

1. A.I.Vogel., "Qualitative Inorganic analysis ", V.Edition, Prentice-Hall of India (P) Ltd., New Delhi, 1991.
2. S harma, B.K., " Instrumental Methods of Analysis ", Goel publishing House, 1995.
3. 3. Parikh V.M., " Absorption spectroscopy of organic molecules ", Addison - Wesley Publishing Company, 1974.

408CHT04 - CHEMICAL PROCESS INDUSTRIES I

AIM

To integrate various courses such as chemistry, unit operations, mechanical operation, stoichiometry etc., and to give the young chemical engineers some comprehension on various fields of production into which he will enter or with which he will be affiliated during the course of study or after completion of the study.

OBJECTIVES

To gain knowledge on various aspects of production engineering and understand the practical methods of production in a chemical factory.

UNIT I INTRODUCTION AND CHLORO- ALKALI INDUSTRIES

The role of a chemical engineers in process industries, Introduction to common devices used in manufacturing processes, block diagrams, flow charts and standard symbols used for devices, industrial safety and pollution, outline of plant and equipment design. Manufacture of Soda ash and sodium bicarbonate, chlorine and caustic soda; bleaching powder and related bleaching agents, Sodium chloride, By-products of common salt industry. .

UNIT II SULPHUR AND SULPHURIC ACID INDUSTRIES

Mining and manufacture of sulphur, recovery of sulphur from polluting gases, sulphur trioxide and sulphuric acid, hydrochloric acid, sodium sulphate, sodium thiosulphate.

UNIT III SILICATE INDUSTRIES

Types and manufacture of Portland cement, Manufacture of glasses and special glasses, Ceramics and refractories

UNIT IV NITROGEN AND PHOSPORUS INDUSTRIES

Synthetic ammonia, Nitric acid, Urea, Phosphate rock beneficiation and phosphoric acid

UNIT V FERTILIZER INDUSTRIES

Growth elements, functions, ammonium sulphate, ammonium nitrate, ammonium phosphate, potassium chloride, potassium sulphate, single, triple super phosphate introduction to pesticides, herbicides and bio-fertilizers.

TEXT BOOKS

1. Austin, G.T.,Shreve's Chemical Process Industries, Fifth Edition, McGraw-Hill International Book Co, Singapore, 1984
2. Dryden, C.E., Outlines of Chemicals Technology, Edited and Revised by Gopala Rao, M. and M.Sittig, Second Edition, Affiliated East-West press, 1993.

REFERENCES

1. Shukla and G.N. Pandey "Text book on Chemical Technology", Vikas publishing company 1997
2. Kirk and othmer ,"Encyclopedia of Chemical Technology", III Edition.

408CHT05 - CHEMICAL PROCESS CALCULATIONS

AIM

Every chemical reaction involves consumption of Materials and energy. The reactions are to be balanced with correct quantity of materials and energy to achieve good percentage of conversion for products. The aim of this course is to give fundamental knowledge on such material and energy balances.

OBJECTIVES

To make them understand different types of laws of chemistry of materials and also prepare the students to accurately calculate the Stoichiometric relations between the materials involved in a physical and chemical reaction.

UNIT I UNITS AND DIMENSIONS

Basic and derived units, use of model units in calculations, Methods of expression, compositions of mixture and solutions.

UNIT II GAS CALCULATIONS

Ideal and real gas laws - Gas constant - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

UNIT III MATERIAL BALANCE

Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallisation, drying etc., - Material balance with chemical reaction - Limiting and excess reactants - recycle - bypass and purging - Unsteady state material balances.

UNIT IV HUMIDITY AND SATURATION

Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

UNIT V FUELS AND COMBUSTION

Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from orsat technique, problems on sulphur and sulphur burning compounds.

UNIT VI THERMO PHYSICS

Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.

UNIT VII THERMOCHEMISTRY

Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems with and without chemical reaction. - Unsteady state energy balances.

TEXT BOOKS

1. Bhatt, B.L., Vora, S.M., "Stoichiometry", Tata McGraw-Hill, 1976.
2. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", EEE Sixth Edition, Prentice Hall Inc., 2003 (with CD containing programmes and problems).

REFERENCES

1. Process Calculation for Chemical Engineering, Second Revised Edition, Chemical Engineering Education Development Centre, I.I.T., Madras, 1981.
2. Process Calculations, Venkataramani, V and Anantharaman, N, Prentice Hall of India Pvt. Ltd., 2003.

408CHT06 - MECHANICAL OPERATIONS

AIM

To impart knowledge in separating solids from solids, solids from liquids, reduction of size, and mixing of solid, solid, liquid – liquid components

OBJECTIVES

The students will be in a position to understand that the industrial processes contain a coordinated series of separation operations and they will be in a position to decide the best process needed for a particular process industry.

UNIT I PARTICLE CHARACTERISTICS AND SIZE ANALYSIS

General characteristics of solids, their behaviour under different external forces, agglomeration, techniques for size analysis.

UNIT II SIZE REDUCTION

Laws of size reduction, classification of equipment, methods of size reduction, disintegration, preparation of colloids.

UNIT III MECHANICAL SEPARATIONS

Screening and Screening equipment, effectiveness of screens, gravity settling, sedimentation, thickening, centrifugal separation, impingement methods, industrial dust removing equipment with special reference to electrostatic and magnetic separators, heavy media separations, floatation.

UNIT IV FILTRATION

Theory of filtration, Batch and continuous filters, centrifuges, membrane and ultra filtration.

UNIT V MIXING AND AGITATION

Equipment for blending and kneading, dispersion, power for agitation, correlations.

UNIT VI STORAGE AND CONVEYING OF SOLIDS

Conveyors, Elevators, Pneumatic conveying, Different methods for storage of solids.

TEXT BOOKS

1. McCabe, W.L, Smith J.C and Harriot, P., "Unit Operations in Chemical Engineering", McGraw-Hill, Fourth Edition, 1984.
2. Coulson, J.M., Richardson, J.F., "Chemical Engineering", Volume 2, Third Edition, Pergamon Press, 1977.

408CHP01 - CHEMICAL ANALYSIS LAB

OBJECTIVE

To learn basic principles involved in estimation and characterization of industrially important materials.

I. Soap Analysis

- Estimation of total fatty acid.
- Estimation of percentage alkali content.

II. Oil Analysis

- Estimation of free acid
- Determination of Saponification value
- Determination of iodine value

III. Cement Analysis

- Estimation of Silica content
- Estimation of mixed oxide content
- Estimation calcium oxide content
- Estimation of calcium oxide by rapid method

IV. Coal Analysis

- Estimation of Sulphur present in coal
- Ultimate analysis of coal
- Proximate analysis of coal

V. Analysis of Bleaching Power

- Estimation of Available Chlorine

VI. Analysis of Glycerol

- Estimation of purity of glycerol

VII. Analysis of fuels

- Flash point
- Fire point
- Cloud point
- Pour point
- Aniline point

REFERENCES

1. Technical Analysis Manual, Chemistry Division, Chemical Engineering Department, A.C. Tech. Anna University (2007).
2. Hand book of Chemical Analysis by Griffin.

408CHP02 - PHYSICAL CHEMISTRY LAB

AIM

To determine experimentally various properties of the chemical compounds and to determine and estimate kinetics values, and other properties of chemicals.

OBJECTIVES : To improve the practical knowledge on the properties and characteristics of solvents and mixtures.

LIST OF EXPERIMENTS

1. Determination of molecular weight of a polymer by viscosity method.
2. Determination of partition co-efficient of iodine between two immiscible solvents
3. Determination of partition co-efficient of benzoic acid between two immiscible solvents
4. Determination of Ka of the weak acid
5. Conductometric experiments- Verification of Oswald's Dilution Law
6. Titration of Strong Acid Vs Strong Base
7. Titration of mixture of Strong Acid Weak Acid Vs Strong Base
8. Titration of Weak Acid Vs Weak Base
9. Determination of Rate Constant (K)
10. Determination of Activation Energy (ΔE)
11. Estimation of Ferrous ion concentration by Potentiometric Titration
12. Determination of standard electrode potential (Zn, Cu, Ag)
13. Adsorption studies
14. To study the adsorption of Acetic acid on charcoal and construct the isotherm.
15. Determination of pH metric titration of Strong Acid Vs Strong Base
16. Enzyme catalytic reaction by varying pH.
17. Application of Phase Rule to Phenol-Water system
18. To study the inversion of cane sugar by polarimeter.
    - Polarimeter-Inversion of cane sugar
    - Refractometer

REFERENCE BOOK :

1. Physical Chemistry experiments by Alexander Findley, McGraw-Hill IV Edition, (1976).

LIST OF EQUIPMENTS

1. Micro Calorimeter
2. Beckman Thermometers. Glasswares,
3. Thermometers 0 to 110 – 0°. Bottle Shakers .pH meters
4. Pressure Glass bottles. Standard Cells. Multimeters
5. Viscometers-Ostwald Cannan Ubbelholde. Voltage Stabiliser
6. Stalalmometer
7. Surface Tension Meter .Tape Heaters
8. Mantle Heaters
9. DC Power Supply. Thermostat. Cyrostats

408CHP03 - MECHANICAL OPERATIONS LAB

AIM

To impart practical knowledge and have on experience on various separation techniques.

LIST OF EXPERIMENTS

1. Study of crushing strength of solid materials using jaw crusher
2. Study of crushing strength of solid materials using crushing rolls
3. Study of crushing strength of solid materials using ball mill
4. Taylor sieves
5. Layer sieves
6. Study of characterization of filtration using to Filter Press.
7. Study of characterization of solid materials using leaf Filter.
8. Study of separation of fine particles using cyclone separator.
9. Study of separation of fine particles using sedimentation
10. Study of separation of fine particles using Elutriator.
11. Study of separation of solid particles using drum Filter.
12. Study of separation of fine particles using screens and determination of effectiveness of factor.

LIST OF EQUIPMENTS

1. Jaw crusher
2. Crushing rolls
3. Ball mill
4. Taylor sieving
5. Layer sieving
6. Filter press
7. Leaf filter
8. Cyclone separator
9. 2 liter and one liter Glass Jars, Stop Clock.
10. Elutriator
11. Rotary Drum filter
12. Screens of various mesh sizes.

*** Minimum experiments shall be offered.**

FIFTH SEMESTER
508CHT01 - NUMERICAL METHODS

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS
Solution of equation –Fixed point iteration: x=g(x) method - Newton's method – Solution of linear system by Gaussian elimination and Gauss-Jordon method– Iterative method - Gauss-Seidel method - Inverse of a matrix by Gauss Jordon method – Eigen value of a matrix by power method and by Jacobi method for symmetric matrix.

UNIT II INTERPOLATION AND APPROXIMATION
Lagrangian Polynomials – Divided differences – Interpolating with a cubic spline – Newton's forward and backward difference formulas.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION
Differentiation using interpolation formulae –Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two and Three point Gaussian quadrature formulae – Double integrals using trapezoidal and Simpsons's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS
Single step methods: Taylor series method – Euler method for first order equation – Fourth order Runge – Kutta method for solving first and second order equations – Multistep methods: Milne's and Adam's predictor and corrector methods.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS
Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

TEXT BOOKS:

1. Veerarajan, T and Ramachandran, T. 'Numerical methods with programming in 'C' Second Editiion, Tata McGraw-Hill Publishing.Co.Ltd. (2007).
2. Sankara Rao K, 'Numerical Methods for Scientisits and Engineers' – 3rd edition Printice Hall of India Private Ltd, New Delhi, (2007).

REFERENCES:

1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, New Delhi, 2007.
2. Gerald, C. F. and Wheatley, P.O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, New Delhi, 2006.
3. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2004

508CHT02 - MATERIALS TECHNOLOGY

AIM

To impart knowledge in material properties and manufacturing methods.

OBJECTIVES

- Students will be able to understand various material and its properties and manufacturing methods.

UNIT I INTRODUCTION

Selection criteria and processes: General criteria of selection of materials in process industries. Properties: Mechanical, Thermal, Chemical, Electrical, Magnetic and Technological properties. Processing of metals and alloys-Casting-hot and cold rolling forging- extrusion-deep drawing.

UNIT II FERROUS AND NON-FERROUS METALS

Pure iron, cast iron, mild steel, stainless steels, special alloy steels- iron and iron carbide phase diagram-heat treatment of plain-carbon steels. Manufacturing methods of Lead, Tin and Magnesium. Properties and applications in process industries.

UNIT III POLYMERS, COMPOSITES, CERAMICS AND INORGANIC MATERIALS

(i) Industrial polymerization methods, crystallinity and stereo isomers-Thermosetting and Thermo plastics.
(ii) FRP-Fiber Reinforced Plastics (FRP), different types of manufacturing methods; asphalt and asphalt mixtures; wood.
(iii) Ceramic crystal and silicate structures-processing of ceramics- cements-glasses enamels - properties.
(iv) Cement and its properties-manufacturing of cement, special cements, cement concrete, RCC- Pre stressed concrete.

UNIT IV ADVANCED MATERIALS

Single crystals-production-properties-applications-memory metals - Intelligent materials some important metallic and non-metallic single crystals.

UNIT V CORROSION AND PREVENTION

Definition of corrosion-Basic theories and mechanism of corrosion-Types of corrosion Anti-Corrosion methods-Organic paints and coatings metal, ceramic coatings.

TEXT BOOKS

1. Budinsky K G and Budinsky K M " Engineering materials- Properties and Selection" Prentice Hall of India (2002).
2. Khanna O P, "Material Science and metallurgy" Dhnapat Rai Publications (1995).

REFERENCE

1. Henry R Clauster, "Industrial and Engineering materials" McGraw Hill Book Co. (1975).

508CHT03 - CHEMICAL PROCESS INDUSTRIES II

AIM

To integrate various courses such as chemistry, unit operations, mechanical operation, stoichiometry etc., and to give the young chemical engineers some comprehension on various fields of production into which he will enter or with which he will be affiliated during the course of study or after completion of the study.

OBJECTIVES

- To gain Knowledge on various aspects of production engineering and understand the practical methods of production in a chemical factory.

UNIT I PULP AND PAPER INDUSTRIES AND SUGAR AND STARCH INDUSTRIES

Wood and Wood extracts – Wood Chemicals - Cellulose derivatives, Manufacture of pulp – different processes of pulping – Manufacture of paper – Manufacture of Boards Raw and refined sugar, by products of sugar industries, Starch and starch derivatives.

UNIT II OILS, FATS, SOAPS AND DETERGENT INDUSTRIES

Vegetable oils and animal fats, their nature, analysis and extraction methods, hydrogenation of oils, fatty acids and alcohols, waxes, soaps, synthetic detergents.

UNIT III PETROLEUM AND PETROCHEMICAL INDUSTRIES

Petroleum refining, physical and chemical conversion products, lubricating oils, petrochemical precursors, methane, olefines, acetylenes and aromatics and products obtained from them by various unit processes.

UNIT IV RUBBER AND POLYMERS

Monomers – Thermosetting and Thermoplastic materials – General properties and Applications of Resins – Polymerization processes – different types - Natural rubber; Synthetic rubber such as SBR, NBR, CR - Fundamental methods of processing of synthetic Rubbers.

UNIT V SYNTHETIC FIBRE AND FILM INDUSTRIES

Natural and synthetic fibres – properties of - Poly amides – manufacture of Nylon 6. Polyesters Fibres – manufacturer of – Cellulosic Fibres – Viscose Rayon production manufacture of films - cellulose Acetate, PVC, Polyesters - polyethylene

TEXTBOOK

1. "Shreve's Chemical Process Industries Handbook", Fifth Edition, McGraw-Hill 1998.
2. Dryden, C.E., "Outlines of Chemical Technology", Edited and Revised by Gopala Rao. M. and M.Sittig, Second edition, Affiliated East-West press, 1993.

REFERENCES

1. "Kent and Riegel's Hand Book of Industrial Chemistry and Biotechnology", Springer , XI Edition, 2007.

508CHT04 - CHEMICAL ENGINEERING THERMODYNAMICS I

AIM

To present thermodynamic principles from a chemical engineering viewpoint.

OBJECTIVES

- The Students will be well versed with the behavior of fluids under PVT conditions and also apply them for practical purpose. Main advantage will be to deal with power production and refrigeration processes. The study further provides a comprehensive exposition to theory and application of solution thermodynamics.

UNIT I BASIC CONCEPTS

The terminologies of thermodynamics, the variables and quantities of thermodynamics, categorization of systems and processes. Energy classifications, point and path properties, energy in transition, heat and work, reversible and irreversible processes, phase rule.

UNIT II LAWS OF THERMODYNAMICS

The first law and internal energy, statements of first law for the non flow and flow systems, enthalpy and heat capacity limitations of the first law. Statements of the second law of thermodynamics, available and unavailable energies, and the entropy function, applications of the second law.

UNIT III THERMODYNAMIC PROPERTIES OF REAL GASES

The PVT behavior of fluids, laws of corresponding states and equation of states approaches to the PVT relationships of non ideal gas, problems; compressibility factors, generalized equations of state, property estimation via generalized equation of state; fugacity and fugacity coefficients of real gases.

UNIT IV THERMODYNAMIC FORMULATIONS

Measurable quantities, basic energy relations, Maxwell relations, thermodynamic formulations to calculate enthalpy, internal energy and entropy as function of pressure and temperature, other formulations involving Cp and Cv, complex thermodynamic formulations, thermodynamic properties of an ideal gas, entropy change in reversible and irreversible process.

UNIT V COMPRESSION OF FLUIDS

Thermodynamic aspects of compression process, classification of compression processes, basic equation for change of state of gases, the work expression for different situations, the effect of clearance volume, multistage compression, convergent divergent flow, Ejectors.

TEXT BOOKS

1. Smith, J.M., VanNess, H.C., & Abbot M.C, "Introduction to Chemical Engineering Thermodynamics", McGraw Hill VII Edition 2004.
2. Narayanan K.V "A Text Book of Chemical Engineering Thermodynamics" Prentice Hall of India Pvt. Ltd. 2001.

REFERENCES

1. Hougen, O.A., Watson, K.M., and Ragatz, R.A., "Chemical Process Principles Part II, Thermodynamics", John Wiley 1970.
2. Dodge, B.F., "Chemical Engineering Thermodynamics", McGraw-Hill, 1960.
3. Sandler, S.I., "Chemical and Engineering Thermodynamics 2nd edn.", Wiley, 1989.
4. Kyle, B.G., "Chemical and Process Thermodynamics 2nd edn.", Prentice Hall of India Pvt. Ltd., 1990.

508CHT05 - HEAT TRANSFER

AIM

To impart basic concepts of heat transfer thro' different media.

OBJECTIVES

- To gain knowledge in various heat transfer methodology in process engineering and to design heat transfer equipments such as furnace, boilers, heat exchangers evaporation etc.,

UNIT I HEAT TRANSFER BY CONDUCTION

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer - Mean temperature difference. Concept of heat conduction - Fourier's law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder, hollow sphere – Heat conduction through a series of resistances - Analogy between flow of heat and flow of electricity - Thermal conductivity measurement; effect of temperature on thermal conductivity; conduction through liquids.

UNIT II FILM COEFFICIENTS AND THEIR APPLICATION

Individual and overall heat transfer coefficients and the relationship between them - Conduction with heat source - Two dimensional steady state conduction - Analytical and graphical methods - Transient heat conduction.

UNIT III CONVECTION

Concept of heat transfer by convection - Natural and forced convection - Application of dimensional analysis for convection - Equations for forced convection under laminar, transition and turbulent conditions - Equations for natural convection - Heat transfer from condensing vapors, heat transfer to boiling liquids - Influence of boundary layer on heat transfer - Heat transfer to molten metals - Heat transfer in packed and fluidized beds.

UNIT IV HEAT EXCHANGERS

Parallel and counter flow heat exchangers - Log mean temperature difference – Single pass and multipass heat exchangers; plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; number of transfer unit - Chart for different configurations - Fouling factors and Wilson's plot - Design of various types of heat exchangers - Design of furnaces - Design of condensers, - Design of tubular reactors.

UNIT V RADIATION AND EVAPORATION

Concept of thermal radiations - Black body concept - Stefan Boltzmann's law - concept of grey body – radiation between surfaces. Types of evaporation - single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation.

TEXT BOOKS

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", McGraw-Hill VII Edition 2004.
2. Binay K.Dutta "Heat Transfer Principles and Applications", Prentice Hall of India, 2001.

REFERENCES

1. Harker J Coulson, J.M., Richardson, J.F., Backhurst J "Chemical Engineering", Vol.I., Butterworth Heinman 1996.
2. Kern, D.Q., "Process Heat Transfer", McGraw-Hill - Revised adition - 1999.

508CHT06 - MASS TRANSFER I

AIM

To impart knowledge on how certain substances undergo the change in composition, change in phases and exhibit the properties according to the changed environment.

OBJECTIVES

- Students develop a sound knowledge on the types of Mass Transfer thro' a driving force in the same fashion as temperature differences as driving force for heat transfer. The students shall have an elementary knowledge on fluid flow, heat transfer and stoichiometry.

UNIT I DIFFUSION

Molecular and eddy diffusion in gases and liquids, steady state diffusion under stagnant and laminar flow conditions Diffusivity measurement and prediction, multicomponent diffusion, diffusion in solids and its applications.

UNIT II MASS TRANSFER COEFFICIENTS

Concept of mass transfer coefficients, mass transfer under laminar and turbulent flow past solids, boundary layers, mass transfer at fluids surfaces correlation of mass transfer coefficients, JD, HTU, and NTU concepts, theories of mass transfer and their applications, interphase mass transfer and over all mass transfer coefficients in binary and multicomponent systems, application to gas-liquid and liquid-liquid systems.

UNIT III HUMIDIFICATION AND AIR CONDITIONING

Basic concepts, psychrometric chart construction, Humidification and dehumidification operations, and design calculations, cooling tower principle and operation, types of equipment, design calculation.

UNIT IV DRYING

Theory and mechanism of drying, drying characteristics of materials, batch and continuous drying, calculation for continuous drying, drying equipment, design and performance of various drying equipments.

UNIT V CRYSTALLISATION

Nuclei formation and crystal growth, theory of crystallization, growth coefficients and the factors affecting these in crystallization, batch and continuous industrial crystallizers, principle of design of equipment.

TEXT BOOKS

1. R.E.Treybal, "Mass Transfer Operations", McGraw-Hill III Edition, 1980.
2. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", McGraw-Hill VII Edn., 2004.

REFERENCES

1. Harker J Coulson, J.M., Richardson, J.F., Backhurst J "Chemical Engineering", Vol.I., Butterworth Heinman 1996.
2. Foust, A.S.Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., "Principles of Unit Operations", Second Edition, Wiley, 1980.
3. Roman Zarzytci, Andrzai Chacuk, "Absorption: Fundamentals and Application",Pergamon Press, 1993.
4. Skelland, A.H.P., "Diffusional Mass Transfer", Krieger, Malabar FL (1985).

508CHP01 - TECHNICAL ANALYSIS LAB

AIM

To determine experimentally the various elements and compounds used in chemical Engineering.

OBJECTIVES

- To have a thorough understanding on the estimation and analysis of chemical compounds.

LIST OF EXPERIMENTS

1. Ore Analysis
    - Estimation of manganese in pyrolusite ore.
    - Estimation of magnesium in dolomite.
2. Analysis of alloys .
3. Analysis of fertilizer.
    - Estimation of nitrogen in urea by kjeldal method.
4. Sugar Analysis .
5. Estimation of phenol by Iodimetry / UV-Vis Spectrometer.
6. Water Analysis
    - Determination of total residual chlorine in water.
    - Determination of chemical oxygen demand.
    - Determination of dissolved oxygen.
7. Polymer analysis .
8. Conductometric Titration.
9. Potentiometry.
    - Estimation of iron.
    - Determination of standard – electrode potential of Zn , Fe , Copper.
10. Estimation of sodium and potassium by flame photometry.
11. Gravimetric analysis
    - Estimation of barium in barium sulphate.
    - Estimation of nickel as DMG.
12. pH metry (acid – basic titration) – not basic.
    - Minimum 10 experiments shall be offered

INSTRUMENTS REQUIRED

1. UV/Vis Spectrophotometer
2. Colorimeter
3. pH meter
4. Flame photometer
5. Conductivity meter
6. Glass electrodes
7. Kjeldal's apparatus
8. Potentiometer

508CHP02 - HEAT TRANSFER LABORATORY

AIM

To determine experimentally the heat transfer coefficient of different fluid in different equipments.

OBJECTIVES

- To have a wide knowledge on the conductive, convective and radiative type of heat transfer under different operative conditions and also the selection of instruments to measure the heat.

LIST OF EXPERIMENTS

1. Laminar Flow
2. Condenser (Vertical)
3. Condenser (Horizontal)
4. Convective Heat Transfer
5. Transient Heat Conduction
6. Agitated vessel
7. Natural Convection
8. Jacketed Kettle
9. Sreafan Boltzman experiment – Radiation.
10. Open Pan Evaporator
11. Characteristics of Temperature Measuring Device

*** Minimum 10 experiments shall be offered**

LIST OF EQUIPMENT

1. Data Loger
2. Heat Exchanger
3. Condenser
4. Stirrers
5. Jacketed Kettle
6. Pan Evaporator
7. Mini Boiler
8. Controllers for Temperature
9. Temperature Measuring Devices

VI SEMESTER
608CHT01 - CHEMICAL ENGINEERING THERMODYNAMICS II

AIM

To present thermodynamic principles from a chemical engineering viewpoint.

OBJECTIVES

The Students will be well versed with the behavior of fluids under PVT conditions and also apply them for practical purpose. Main advantage will be to deal with power production and refrigeration processes. The study further provides a comprehensive exposition to theory and application of solution thermodynamics.

UNIT I PROPERTIES OF SOLUTIONS

Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, property changes of mixing for ideal solutions, excess properties of mixtures.

UNIT II PHASE EQUILIBRIA

Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity, application of phase rule, vapour-liquid equilibrium, phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azeotrope composition, liquid-liquid equilibrium, ternary liquid-liquid equilibrium, VLE for system of limited miscibility.

UNIT III CORRELATION AND PREDICTION OF PHASE EQUILIBRIA

Activity coefficient-composition models, vapour liquid equilibria involving high pressures and multi-component systems, thermodynamic consistency of phase equilibria, application of the correlation and prediction of phase equilibria in systems of engineering interest particularly to distillation and liquid extraction processes.

UNIT IV CHEMICAL REACTION EQUILIBRIA

Heat effects accompanying chemical reactions, standard free energy change and reaction equilibrium constant, evaluation of reaction equilibrium constant, prediction of free energy data, equilibria in chemical reactors, calculation of equilibrium compositions for homogeneous chemical reactors, thermodynamic analysis of simultaneous reactions.

UNIT V REFRIGERATION

Principles of refrigeration, choice of refrigerant, methods of producing refrigeration, liquefaction process, co-efficient of performance, evaluation of the performance of vapour compression and gas refrigeration cycles.

TEXT BOOKS

1. Smith, J.M., VanNess, H.C., & Abbot M.C, "Introduction to Chemical Engineering Thermodynamics", McGraw Hill VII Edition 2004.
2. Narayanan K.V "A Text Book of Chemical Engineering Thermodynamics" Prentice Hall of India Pvt. Ltd. 2001.

REFERENCES

1. Hougen, O.A., Watson, K.M., and Ragatz, R.A., "Chemical Process Principles Part II", Thermodynamics, John Wiley, 1970.
2. Dodge, B.F., "Chemical Engineering Thermodynamics", McGraw-Hill, 1960.
3. Sandler, S.I., "Chemical and Engineering Thermodynamics", 2nd Edition, Wiley, 1989.

608CHT02 - MASS TRANSFER II

AIM

To impart knowledge on how certain substances undergo the change in composition, change in phases and exhibit the properties according to the changed environment.

OBJECTIVES

Students develop a sound knowledge on the types of Mass Transfer thro' a driving force in the same fashion as temperature differences as driving force for heat transfer. The students shall have an elementary knowledge on fluid flow, heat transfer and stoichiometry.

UNIT I ABSORPTION

Equilibrium solubility of gases in liquids; types of contactors, design of packed and plate type absorbers; Operating characteristics of stage wise and differential contactors, concepts of NTU, HTU and overall volumetric mass transfer coefficients; counter current multistage operations multicomponent absorption; non-ideal liquid solutions mechanism and model of absorption with chemical reaction; non-isothermal operations, thermal effects in absorption process.

UNIT II DISTILLATION

Vapour-liquid equilibria, Ideal solutions-Raoult's law and deviations, methods of distillation; fractionation of binary and multicomponent system; continuous rectification-binary systems, design calculations by McCabe-Thiele and ponchon-Savarit, methods; continuous contact distillation tower (packed tower) design; multicomponent system, extractive and azeotropic; distillation low pressure distillation; steam distillation.

UNIT III LIQUID-LIQUID EXTRACTION

Liquid equilibrium; equilibrium stage wise contact calculations for batch and continuous extractors, fractional extraction, differential contact extraction equipment - spray, packed and mechanically agitated contactors and their design calculations; counter current extractor, pulsed extractors, centrifugal extractors.

UNIT IV SOLID-LIQUID EXTRACTION (LEACHING)

Solid-liquid equilibria; leaching equipment- steady state and unsteady state operations; calculation of number of stages, stage efficiency, rate of leaching.

UNIT V ADSORPTION AND OTHER ION EXCHANGE SEPARATION PROCESSES

Theories of adsorption of gases and liquids; heat of adsorption, stage wise operations, Freundlich equation, industrial adsorbents, adsorption equipment for batch and continuous operation; design calculation of ion-exchange resins; principle of ion-exchange; industrial equipment.

Membrane separation process; solid and liquid membranes; concept of osmosis; reverse osmosis; electrodialysis; chromatography, their applications; foam separation process; Thermal and sweep diffusion process.

TEXT BOOKS

1. R.E.Treybal, "Mass Transfer Operations", McGraw-Hill, III Edition 1980.
2. W.L McCabe J.C.Smith, and Harriot. P., "Unit Operations of Chemical Engineering", VI edition McGraw-Hill, International Edition, 2001.

REFERENCES

1. 1 . C.Judson King "Separation Processes", McGraw-Hill II Edition 1980.
2. A.H.P.Skelland, "Diffusional Mass Transfer", Krieger, Malapur, FL (1985).
3. Roman Zarfyki and Andrzej Chacuk, "Absorption Fundamentals and Applications", Pergamon Press, 1993.
4. P.Wankat "Separation Process Engineering ", Prentice Hall, II Edition 2006.
5. R.F.Strigle (jr), Packed Tower Design and Application, 2nd Edn. Gulf Publishing Company U.S.A. 1994.

608CHT03 - CHEMICAL REACTION ENGINEERING I

AIM

To present reaction kinetic principles and different type of reactors to achieve the required reaction.

OBJECTIVES

To gain knowledge on the selection of right type of reactor for the required reaction.

UNIT I REACTION KINETICS

Law of mass action, rate equation, molecularity of reaction, elementary, non-elementary reactions and their mechanisms, kinetic models for non-elementary reactions, theories of reaction rate and temperature dependency, evaluation of rate equation, integral and differential analysis for constant variable volume system, integral method of analysis of rate data, fitting of data complex reaction mechanism.

UNIT II IDEAL REACTORS

Design for ideal reactor, batch, stirred tank and tubular flow reactor, steady state mixed flow reactor, design of reactors for multiple reactions, combination reactor system and size comparison of reactors.

UNIT III CHOICE OF REACTORS

Quantitative treatment for batch reactor, Factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield problems, consecutive, parallel and mixed reactions, recycle, product distribution.

UNIT IV HEAT EFFECTS IN REACTORS

Heat of reactions from thermodynamics, Isothermal and non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate heat input and constant heat transfer coefficient, operation, batch and continuous reactors, optimum temperature progression, Reaction Stability.

UNIT V REACTOR STABILITY AND REACTION EQUILIBRIA

Chemical equilibrium, evaluation of reaction equilibrium constant, effect of temperature on equilibrium, stable operating conditions in reactors, application to system involving gaseous components, computation of equilibrium composition.

TEXT BOOKS

1. Levenspiel.O, "Chemical Reaction Engineering", John Wiley, III Ediition, 1998.
2. Smith.J.M., "Chemical Engineering Kinetics", McGraw-Hill Third Edition, 1981.
3. Fogler .S "Fundamental Chemical Reaction Engg", Prentice Hall of India.

608CHTO4 - PROCESS INSTRUMENTATION AND CONTROL

UNIT I

Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application. Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics, transfer function for chemical reactors and dynamics.

Unit-II

Control systems Controllers and final control elements, Block diagram of a chemical rector control system.Closed loop transfer functions, Transient response of simple control systems Stability, Root locus

Unit-III

Transient response from root locus, Application of root locus to control systems Introduction to frequency response, Control systems design by frequency response.Advanced control strategies, Cascade control, Feed forward control, ratio control, Smith predictor, dead time compensation, internal model control.

UNIT IV

Controller mechanism, introduction to advanced control systems, cascade control, feed forward control, control of distillation towers and heat exchangers, introduction to microprocessors and computer control of chemical processes.

UNIT V

Principles of measurements and classification of process control instruments, measurements of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity and consistency, p^H, concentration, electrical and thermal conductivity, humidity of gases, composition by physical and chemical properties and spectroscopy

TEXT BOOK

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

REFERENCE

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

608CHT05 - PROCESS PLANT UTILITIES

Unit- I INTRODUCTION
Identification of Common Plant Utility, Importance of Utility in Industry

Unit-II WATER
Row Water Storage And Treatment , Treatment Of Water, Soft Water And Dm Water, Cooling Water System, Fire Water System

Unit-III STEAM
Properties of Steam, Steam Generation of Boiler, Types of Boiler and Their Operation, Steam Generation by Utilizing Process Waste Heat Using Thermic Fluid, Re-Generators And Re-Evaporators, Distribution of Steam in Plant, Efficient Use of Steam

Unit-IV AIR
Compressed Air from Blower and Compressor, Air Drying System for Instrument Air and Plant Air, Humidification and De- Humidification of Air

Unit- V REFRIGERATION
Principal of Refrigeration, Refrigeration System like Compression Refrigeration, Absorption Refrigeration, And Chilled Water System, Types of Refrigerants

Unit-VI Vacuum System
Selection Of Vacuum System, Operation Of Various Process Equipment Under Vacuum Distillation, Reactor,Evaporators; **Flaring and Venting.** Introduction, Type of Vent Flares

TEXT BOOKS

1. Jack Broughton; Process utility systems; Institution of Chem. Engineers U.K.
2. Reid, Prausnitz poling; The properties of gases & liquids, IV ed. McGraw Hill international ed.
3. S.C.Arora & S.Domkumdwar; A course in refrigeration and air conditioning; Dhanpat Rai & Co.(P) ltd.

608CHT06 - ENERGY ENGINEERING

Unit-I Energy Resources - A Global View

Energy Sources – Coal Oil, Natural Gas – Nuclear Energy – Hydro Electricity – Other Fossil Fuels– Geothermal – Supply And Demand – Depletion of Resources – Need For Conservation – Uncertainties – National and International Issues.

Unit II Energy and Environment

Energy – Various Forms – Energy Storage – Structural Properties of Environment – Bio-Geochemical Cycles – Society and Environment Population and Technology.

Unit III Management of Energy Conservation In Chemical Industries

Chemical Industries – Classification – Conservation in Unit Operation Such as Separation – Cooling Tower – Drying – Conservation Applied to Refineries, Petrochemical, Fertilizers, Cement,Pulp And Paper, Food Industries – Chloroalkali Industries – Conservation Using Optimization Techniques.

Unit IV Energy Alternatives

Sources Of Continuous Power – Wind And Water – Geothermal – Tidal And Solar Power – Mhd,Fuel Cells – Hydrogen As Fuel.

Unit V Economic Balance in Energy Consumption

Cost Analysis – Capacity – Production Rate – System Rate – System Cost Analysis – Corporate Models – Production Analysis And Production Using Fuel Inventories – Input-Output Analysis – Economics – Tariffs.

TEXT BOOKS

1. Jerrold H. Krentz, "Energy Conservation and Utilisation", Allyn and Bacur Inc., 1976.
2. Gemand M. Gramlay, "Energy", Macmillon Publishing Co., 1975.

REFERENCES

1. Rused, C.K., "Elements of Energy Conservation", McGraw-Hill Book Co., 1985.
2. Judson King, "Separation Processes", McGraw-Hill Book Co., 1985.

608CHP01 - PROCESS EQUIPMENT DESIGN– I

AIM

To integrate the various courses such as Chemistry, Engineering mechanism, Engineering Graphics, unit operation, Mechanics of solids Materials Technology for a comprehension approach to the design of the process equipments.

UNIT-I

Design and drawing considerations of bolt, nut and screws, welded and riveted joints, flanged joints, nozzles and reinforcements. Pipe fittings.

UNIT II

Design and drawing considerations of vessel supports such as bracket, saddle, skirt, etc. Storage Tanks for solids, liquids and gases.

UNIT III

General design and drawing consideration of vessels subjected to internal pressure, and external pressure. High pressure vessels.

UNIT IV

Fundamental principles, equations, general design and drawing considerations of cyclone separators centrifuges, thickeners and filtration equipments.

UNIT V

General design and drawing considerations of crystallizers, agitated vessel, jacketed and coil heated vessels.

TEXT BOOKS

1. R.S. Khurmi, "Textbook of Machine design". S. Chand & Company , XXV Edition , 2005.
2. M.V. Joshi and V.V. Mahajan, "Design of Process Equipment Design", McMillan India III Edition 1994.

REFERENCES

1. S.D. Dawande, "Process Design of Equipments", Central Techno Publications, Nagpur, 2000.
2. Indian Standard Specifications IS-803, 1962; IS-4072, 1967; IS-2825, 1969. Indian Standards Institution, New Delhi.
3. R.H. Perry, "Chemical Engineers' Handbook", McGraw-Hill.
4. W.L. McCabe, J.C. Smith and P. Harriot, "Unit Operation of Chemical Engineering", McGraw-Hill, 2001.
5. Robert Treybal, "Mass Transfer Operations", McGraw-Hill.
6. J.M. Coulson and J.Richardson, "Chemical Engineering", Vol. 6, Asian Books Printers Ltd.

608CHP02 - MASS TRANSFER LAB

AIM

To determine experimentally certain physical properties of fluids and solids

OBJECTIVES

- To gain knowledge on the determination of important data for the design and operation of the process equipments.

LIST OF EXPERIMENTS

1. Simple distillation.
2. Steam distillation.
3. Packed column distillation.
4. Bubble cap distillation.
5. Diffusivity measurements.
6. Liquid-liquid extraction.
7. Vacuum Dryer.
8. Tray dryer.
9. Rotary dryer.
10. Surface Evaporation.
11. Adsorption.
12. Leaching.

608CHP03 - PROCESS CONTROL LAB

AIM

To determine experimentally the methods of controlling the processes including measurements using process simulation techniques.

OBJECTIVES

- To gain knowledge on the development and use of right type of control dynamics for process control under different operative conditions.

LIST OF EXPERIMENTS

1. ON-OFF control of thermal process
2. Simulation of Proportional Controller
3. Flow control loop and Flow Transmitter
4. Level Control loop and Level Transmitter
5. Pressure control loop and Pressure Transmitter
6. Control valve characteristics
7. Verifying the inherent characteristics of control valve
8. Flow co-efficient of control valve
9. Range ability of control valve
10. Verifying the response of Non-Interacting level System
11. Verifying the response of Interacting level System
12. Effect of PI controller on flow control System
13. The effect of a P controller on level process for set point and load changes
14. Effect of P, PI, PID Controller on Pressure Control Loop
15. Optimum controller setting using Zigler's Nichols Methods
16. Optimum Controller Tuning on Level Process Station

VII SEMESTER
708CHT01 - CHEMICAL REACTION ENGINEERING - II

AIM

To introduce various types of Reactions and Reactors that are commonly used in Chemical Engineering operations.

OBJECTIVES

Get ability in deciding and designing the type of Reactors that are necessary for a particular type of reaction in an Industry. They also learn mechanism and control of several types of reactions.

UNIT I NON-IDEAL REACTORS

The residence time distribution as a factor performance; residence time functions and relationship between them in reactor; basic models for non-ideal flow; conversion in non-ideal reactors.

UNIT II HETEROGENEOUS PROCESS AND SOLID CATALYSIS

Rate equations for heterogeneous reactions nature of catalysis, adsorption isothermal and rates of adsorption, desorption and surface reaction analysis of rate equation and rate controlling steps, surface area and pore-volume distribution, catalyst preparation.

UNIT III GAS-SOLID CATALYTIC REACTORS

Diffusion within catalyst particle effective thermal conductivity mass and heat transfer within catalyst pellets; effective factors, Thiele Modulus, fixed bed reactors.

UNIT IV GAS-SOLID NON-CATALYTIC REACTORS

Models for explaining the kinetics; volume and surface models; controlling resistances and rate controlling steps; time for complete conversion for single and mixed sizes, fluidized and static reactors.

UNIT V GAS-LIQUID REACTIONS

Absorption combined with chemical reactions; mass transfer coefficients and kinetic constants; application of film penetration and surface renewal theories; Hatta number and enhancement factor for first order reaction, tower reactor design.

TEXT BOOKS

1. Fogler. H.S., "Elements of Chemical reaction engineering III edition, Prentice Hall of India Pvt. Ltd., 1998 (Indians Reprint 2003)
2. Levenspiel, O; "Chemical Reaction Engineering", III Edition, John Wiley, 1998.

REFERENCE

1. Smith J.M., "Chemical Engineering Kinetics", 3rd edition, McGraw-Hill, New York, 1981.

708CHT02 - TRANSPORT PHENOMENA

AIM

To have an in depth study on fluid transport

OBJECTIVES

Different types of Fluids, their flow characteristics and different mathematical models are analysed and applied to actual situations. This subject helps the students to understand the mechanism of fluids in motion under different conditions.

UNIT I TRANSPORT PHENOMENA BY MOLECULAR MOTION

Importance of transport phenomena; analogous nature of transfer process; basic concepts, conservation laws; continuous concept, field, reference frames, substantial derivative and boundary conditions; methods of analysis; differential, integral and experimental methods.

Phenomenological laws of transport properties Newtonian and non Newtonian fluids; rheological models; theories of transport properties of gases and liquids; effect of pressure and temperature.

UNIT-II ONE DIMENSIONAL TRANSPORT IN LAMINAR FLOW(SHELL BALANCE)

General method of shell balance approach to transfer problems; Choosing the shape of the shell; most common boundary conditions; momentum flux and velocity distribution for flow of Newtonian and non-Newtonian fluids in pipes for flow of Newtonian fluids in planes, slits and annulus heat flux and temperature distribution for heat sources such as electrical, nuclear viscous and chemical; forced and free convection; mass flux and concentration profile for diffusion in stagnant gas, systems involving reaction and forced convection.

UNIT III EQUATIONS OF CHANGE AND THEIR APPLICATIONS

Conservation laws and equations of change; Development of equations of continuity motion and energy in single multicomponents systems in rectangular co-ordinates and the forms in curvilinear co-ordinates; simplified forms of equations for special cases, solutions of momentum mass and heat transfer problems discussed under shell balance by applications of equation of change, scale factors; applications in scale-up

UNIT IV TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW

Turbulents phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow overflat surface.

UNIT V ANALOGIES BETWEEN TRANSPORT PROCESSES

Importance of analogy; development and applications of analogies between momentum and mass transfer; Reynolds, Prandtl, Von Karman and Colbum analogies.

TEXT BOOKS

1. R.B. Bird, W.E. Stewart and E.W. Lightfoot, "Transport Phenomena", John Wiley, II Edition 2006.
2. Robert, S Brodkey, Harry C. Hershey, "Transport Phenomena A Unified Approach ", Brodkey Publishing 2003.

REFERENCES

1. L.S.Sissom, and D.R.Pitts, "Elements of Transport Phenomena", McGraw-Hill, New York, 1972.
2. R.W.Fahien, "Elementary Transport Phenomena", McGraw-Hill, New York, 1983.
3. J.R. Welty, R.W. Wilson, and C.W.Wicks, Rorer G.E, Wilson R.W. "Fundamentals of Momentum Heat and Mass Transfer", V Edn. John Wiley, New York, 2007.

708CHT03 - BIOCHEMICAL ENGINEERING

AIM

To impart knowledge on the role of micro organism in different types of Bio-chemical reaction.

OBJECTIVES

To design Bio-chemical reactors with proper knowledge on Enzyme Engineering.

UNIT I INTRODUCTION TO BIOCHEMICAL ENGINEERING

An overview of industrial biochemical processes with typical examples, comparing chemical and biochemical processes, development and scope of biochemical engineering as a discipline.

Industrially important microbial strains; their classification; structure; cellular genetics; typical examples of microbial synthesis of biologicals.

UNIT II ENZYMES AND ENZYME KINETICS

Enzyme used in industry medicine and food, Their classification with typical examples of industrially important enzymes; mechanism of enzymatic reactions; michaelis-menten kinetics; enzymes inhibition; factors affecting the reaction rates; industrial production purification and immobilization; enzyme reactors with typical examples.

UNIT III MICROBIAL KINETICS

Typical growth characteristics of microbial cells; factors affecting growth; Monod model; modeling of batch and continuous cell growth; immobilized whole cells and their characteristics; free cell and immobilized cell reactors; typical industrial examples; transport in cells.

UNIT IV TRANSPORT IN MICROBIAL SYSTEMS

Newtonian and Non-Newtonian behaviour of broths; agitation and mixing; power consumption; gas/liquid transport in cells; transfer resistances; mass transfer coefficients and their role in scaleup of equipments; enhancement of o_2 transfer; heat transfer correlation; sterilization cycles and typical examples of heat addition and during biological production.

UNIT V BIOREACTORS

Batch and continuous types; immobilized whole cell and enzyme reactors; high performance bioreactors; sterile and non-sterile operations; reactors in series with and without recycle; design of reactors and scaleup with typical examples.

TEXT BOOKS

1. Bailey J.E., Ollis, D.F. Biochemical Engineering Fundamentals, McGraw-Hill, International Edition, 2nd Edition, New York, 1986.
2. Rajiv Dutta Fundamentals of Biochemical Engineering Springer I Edition 2008

REFERENCES

1. Web, F.C., Biochemical Engineering, Van Nostrand, 1964.
2. Atkinsono, B., Biochemical Reactors, Pion Ltd., 1974

708CHT04 - PROCESS ECONOMICS

AIM

To introduce process economics and industrial management principles to chemical engineers.

OBJECTIVES

The objective of this course is to teach principles of cost estimation, feasibility analysis, management, organization and quality control that will enable the students to perform as efficient managers.

UNIT I PRINCIPLES OF MANAGEMENT AND ORGANISATION

Planning, organization, staffing, coordination, directing, controlling, communicating, organization as a process and a structure; types of organizations.

Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning; routing; scheduling; dispatching; costs and costs control, inventory and inventory control.

UNIT II INVESTMENT COSTS AND COST ESTIMATION

Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, invested capital and profitability.

UNIT III PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT

Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

UNIT IV ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE

Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.

UNIT V ECONOMIC BALANCE

Essentials of economic balance – Economic balance approach, economic balance for insulation, evaporation, heat transfer.

TEXT BOOKS

1. Peters, M. S. and Timmerhaus, C. D. RE West , "Plant Design and Economics for Chemical Engineers", III Edn, McGraw Hill, 2003. Holand, F.A., Watson, F.A. and Wilkinson, J.K., "Introduction to process Economics", 2nd Edn, John Wiley, 1983.
2. Narang, G.B.S. and Kumar, V., "Production and Costing", Khanna Publishers, New Delhi,

REFERENCES

1. Allen, L.A., "Management and Organization", McGraw Hill.
2. Perry, R. H. and Green, D., "Chemical Engineer's Handbook ", 7th Edition, McGraw Hill.

708CHT05 - CHEMICAL PROCESS PLANT SAFETY

AIM

To get awareness on the important of total plant safety in a Chemical Industry

OBJECTIVES

Become a skill and person in hazopard hazarel analysis and able to find out the root cause of an accident. Gain knowledge in devising safety policy and procedures to be adopted to implement total safety in a plant

UNIT I INTRODUCTION TO SAFETY PROGRAMMES

Safety in industries; need for development; importance safety consciousness in Indian chemical industry; social environmental setup; tolerance limit of the society; psychological attitude towards safety programmes.

Elements of safety programme; effective realization; economic and social benefits; effective communication training at various levels of production and operation.

UNIT II INDUSTRIAL SAFETY

Chemical process industries; potential hazards; chemical and physical job safety analysis; high pressure; high temperature operation; dangerous and toxic chemicals; highly radioactive materials; safe handling and operation of materials and machineries; planning and layout.

UNIT III SAFETY PERFORMANCE

Appraisal; effective steps to implement safety procedures; periodic inspection and study of plant layout and constant maintenance; periodic advice and checking to follow safety procedures; proper selection and replacement of handling equipments; personal protective equipments.

UNIT IV ACCIDENTS

Industrial accidents – accident costs – identification of accident spots; remedial measures; identification and analysis of causes of injury to men and machines – accident prevention – accident proneness – vocational guidance, fault free analysis. Fire prevention and fire protection.

UNIT V HEALTH HAZARDS AND LEGAL ASPECTS

Health hazards – occupational – industrial health hazards – health standards, and rules – safe working environments – parliamentary legislations – factories act – labour welfare act – ESI Act – Workmen Compensation Act.

Role of Government, safety organizations, management and trade unions in promoting industrial safety.

TEXT BOOKS

1. Ridley Safety at Work, VII Edition, Butterworth Heinman 2007.
2. William Handley, Industrial Safety Hand Book McGraw-Hill Book Company 2nd Edition, 1977.
3. Fawatt, H.H. and Wood, W.S.Safety and Accident Prevention in Chemical Operation, Interscience, 1965

REFERENCES

1. Heinrich, H.W. Dan Peterson, P.E. and Nester Rood. Industrial Accident Prevention, McGraw-Hill Book Co., 1980
2. Blake, R.P., Industrial Safety, Prentice Hall Inc., New Jersy – 3rd Edn. 1963.

708CHP01 - PROCESS EQUIPMENT DESIGN II

(All Tables/Chemical Engineers' Handbook/Data Books/Graph Sheets are permitted during the Examination.)

AIM

To gain practical knowledge on the shape and drawing of the process equipments

OBJECTIVES

To become a design engineers on process equipments design and drawing consideration of the following:-

UNIT I

Fundamental principles, equations, general design and drawing considerations of cooling towers, evaporators and driers.

UNIT II

Heat exchangers, condensers and reboilers.

UNIT III

Distillation columns- sieve tray, and bubble cap tray columns and packed column.

UNIT IV

Equipments for absorption and adsorption of gases.

UNIT V

Equipments for liquid-liquid extraction and solid-liquid extraction.

TEXT BOOKS

1. M.V.Joshi and V.V. Mahajan, "Process Equipment Design", MacMillan India Ltd.
2. S.D.Dawande, "Process Design of Equipments", Central Techno Publications, Nagpur, 2000.

REFERENCES

1. Indian Standard Specifications IS-803, 1962; IS-4072, 1967; IS-2825, 1969. Indian Standards Institution, New Delhi.
2. R.H. Perry, "Chemical Engineers' Handbook", McGraw-Hill.
3. W.L.McCabe, J.C.Smith and Harriet, "Unit Operation of Chemical Engineering", McGraw-Hill.
4. Robert Treybal, "Mass Transfer Operations", McGraw-Hill.
5. J.M. Coulson and J.Richardson, "Chemical Engineering", vol. 6, Asian Books Printers Ltd.

708CHP02 - CHEMICAL REACTION ENGINEERING LAB

AIM

To determine experimentally the kinetics and rate constants of reactions in different types of reactors.

OBJECTIVES

To gain knowledge in the design of reactors.

LIST OF EXPERIMENTS*

1. Kinetic studies in a batch reactor
2. Kinetics in a plug flow reactor
3. Kinetics in a PFR followed by a CSTR
4. RTD in a PFR
5. RTD in a packed bed
6. RTD in CSTRs in series

VIII SEMESTER
808CHT01 - TOTAL QUALITY MANAGEMENT

UNIT-I INTRODUCTION

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II TQM PRINCIPLES

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT V QUALITY SYSTEMS

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

TEXT BOOK

1. Dale H.Besterfiled, et at., "Total Quality Management", Pearson Education Asia, 3rd Edition, Indian Reprint (2006).

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S., "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006.
4. Janakiraman, B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

ELECTIVE-I
708CHT06 - FOOD TECHNOLOGY

AIM

To create awareness on the need for processing and preservatives of Foods.

OBJECTIVE

To design processing equipments for Food Industries.

UNIT I AN OVERVIEW

General aspects of food industry; world food needs and Indian situation.

UNIT II FOOD CONSTITUENTS, QUALITY AND DERIVATIVE FACTORS

Constituents of food; quality and nutritive aspects; food additives; standards; deteriorative factors and their control.

UNIT III GENERAL ENGINEERING ASPECTS AND PROCESSING METHODS

Preliminary processing methods; conversion and preservation operations.

UNIT IV FOOD PRESERVATION METHODS

Preservation by heat and cold; dehydration; concentration; drying irradiation; microwave heating; sterilization and pasteurization; fermentation and pickling; packing methods.

UNIT V PRODUCTION AND UTILISATION OF FOOD PRODUCTS

Cereal grains; pulses; vegetables; fruits; spices; fats and oils; bakery; confectionery and chocolate products; soft and alcoholic beverages; dairy products; meat; poultry and fish products.

TEXT BOOKS

1. Heid J.L. Joslyn M.A., Fundamentals of Food Processing Operation, The AVI publishing Co., West port 1967.
2. Potter N.N., Food Science, The AVI publishing Co., Westport, 1963.

REFERENCES

1. Heldman D.R., Food Process Engineering, The AVI publishing co., 1975.
2. Charm S.E., The Fundamentals of Foods Engineering, The AVI Publishing Co., Westport, 1963.

708CHT07 - ENZYME ENGINEERING

UNIT-I

Types of Microorganism: Structure and function of microbial cells. Fundamentals of microbial growth, batch and continuous culture. Isolation and purification of enzymes from cells. Cell and Enzyme Immobilization.

UNIT II

Fermentation – Types of mechanisms, Continuous fermentation – aeration and agitation, kinetics of fermentation – Processes

UNIT III

Introduction of Bioreactor design: Continuously stirred aerated tank bioreactors. Mixing power correlation. Determination of volumetric mass transfer rate of oxygen from air bubbles and effect of mechanical mixing and aeration on oxygen transfer rate, heat transfer and power.

UNIT IV

Enzyme and Enzyme Kinetics

Introduction to Biochemistry, Function and applications. Nature and function of enzyme. Coenzyme / Cofactor. Classification of enzymes. Assay methods and units. Examples of applications of enzymes in industry, analytical technique medicine and Pharmaceuticals.

UNIT V

Industrial Bioreactors Utilizing Isolated enzymes and biosensors development and applications. Designs of reactor, Batch and continue type; analysis for immobilized enzyme reactors. Sterile and non sterile operations; reactors in series with and without recycle.

TEXT BOOKS

1. Technological Applications of Bio-catalysts, BIOTOL series, Butter worth, 1995.
2. Cornish. A -Bowden, Analysis of Enzyme Kinetic Data, Oxford University Press, 1996.

REFERENCES

1. Wiseman. A and Blakeborough N and Dunnill P, Enzymic and nonenzymic catalysis, Ex. Vol.5 Ellis and Harwood, U.K. (1981).
2. Wiseman A (Ed.), Topics in enzyme and fermentation Bio-technology, Ellis and Harwood, U.K. Vol-5.

708CHT08 - FLUIDIZATION ENGINEERING

UNIT-I

Pressure drop velocity relationship in packed beds. Correlations of kezenycarman, leva and Ergun. Fluidization phenomena – properties of fluidized beds. Development of fluidized condition from fixed bed.

UNIT II

Limiting conditions of stability of a fixed bed-minimum fluidizing condition, correlations for minimum fluidizing velocity.

UNIT III

Liquid solid gas solid fluidization – sludging and channeling correlation for bed expansion in liquid-solid-and gas solid fluidization.

UNIT IV

Factors affecting rate of elutriation of fines fluidized bed. Continuous air classification. Pneumatic transportation of solids in vertical and horizontal lines. Prediction of pressure drop. Minimum chocking velocity and minimum saltation velocity.

UNIT V

Single stage and multi stage continuous fluidization its flow of solids by gravity and collection of fine using cyclones.

TEXT BOOK

1. Fluidization Engineering, O.Levenspiel and D.Kunii, John Wiley, II Edition 1991

REFERENCES

1. Gar-Liquid-Solid Fluidization Engineering, Liang-Shih Fan, Butter Worths, 1989.
2. Fluidization idealized and Bubbleless with Applications, Monsoon Kwauk, Science Press, 1992.

708CHT09 - PROCESS OPTIMISATION

UNIT-I OPTIMISATION

Introduction; formulation of objective functions; fitting models to data; classification of functions; necessary and sufficient conditions for optimum; unimodal, multimodal functions; analytical methods Lagrange multiplier methods. convex and concave functions, necessary and sufficient conditions for stationary points.

UNIT II NUMERICAL METHODS

Unimodal functions; Newton's quasi Newton, secant methods; region elimination methods, polynomial approximation; quadratic and cubic interpolation techniques for optimum. Multimodal functions; direct methods; random, grid. Hooke's Nelder and Mead methods; Powell's technique; indirect methods; gradient and conjugate gradient methods; secant methods.

UNIT III MULTIVARIABLE OPTIMIZATION

Unconstrained Multivariable Optimization Algorithms: Optimality criteria, Unidirectional search, direct search methods: Evolutionary optimization method, simplex search method, Powell's conjugate direction method. Gradient-based methods: Cauchy's (steepest descent) method, Newton's method.

UNIT IV LINEAR AND NON-LINEAR PROGRAMMING

Review on basic concepts of LP formulations; Simplex methods; Integer, quadratic, geometric and dynamic programming.

UNIT V APPLICATIONS

Heat transfer and energy conservation; separation processes; fluid flow systems; reactor design and operation; large scale systems.

TEXT BOOKS

1. Edgar, T.F., Himmelblau, D.M., " Optimisation of Chemical Processes ", McGraw-Hill Book Co., New York, 1985.
2. Reklaitis, G.V., Ravindran, A., Ragsdell, K.M. " Engineering Optimisation ", John Wiley, New York, 1980.

REFERENCES

1. Biles, W.E., Swain, J.J.; "Optimisation and Industrial Experimentation ", Inter Science, New York, 1980.
2. Seinfeld, J.H.; Lapidus, L; "Process Modelling, Estimation and Identification ", Prentice Hall, Englewood Cliffs, New Jersey, 1974.
3. SS Rao, Engineering Optimization, John Wiley and Sons, IV Edition, 2009

708CHT10 - PROFESSIONAL ETHICS IN ENGINEERING

UNIT-I ENGINEERING ETHICS

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal

UNIT IV RESPONSIBILITIES AND RIGHTS

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination

UNIT V GLOBAL ISSUES

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2005.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, 2000.

REFERENCES

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, 2004.
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)

708CHT11 - AIR POLLUTION AND CONTROL

UNIT-I INTRODUCTION

Air Pollution Regulatory Framework Histroy – Air Pollution Regulatory Framework - Regulatory System – Laws and Regulations – Clean air Act – Provisions for Recent Developments.

UNIT II AIR POLLUTION GASES

Measurement fundamentals – chemicals and physical properties – Phase Equelbonem consecoation laws – Incinerators – Design and Performance – Operation and Maintainance - Absorbers – Design operation and improving performances Absorbers.

UNIT III PARTICULATE AIR POLLUTION

Particle Collection mechanisms – Fluid particle Dynamics – Particle size Distribution – Efficency – Gravity Setling chambers Cyclones – Electrostatic precepators Bannouses

UNIT IV HYBRID SYSTEM

Heat electrostatic precepitation – Genizing Heat Scrubbers – Dry Scrubbers – Electrostatically Augmented Fabric Fillration

UNIT V AIR POLLUTION CONTROL EQUIPMENT

Introduction – Installation – Cost Model.

TEXT BOOK

1. Air Pollution Control Equipment Louis Theodore, Burley Intuscence 2008.
2. Air Pollution Control CD Cooper and FC.Alley Wairland Press III Edition 2002.
3. Air Pollution Control Engg, Noel de nevey – Mcgrew Hill.

708CHT12 - BASIC INDUSTRIAL BIOTECHNOLOGY

UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESS

A historical overview of industrial fermentation process – traditional and modern biotechnology. A brief survey of organisms, processes, products relating to modern biotechnology. Process flow sheeting – block diagrams, pictorial representation.

UNIT II PRODUCTION OF PRIMARY METABOLITES

A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc.,); amino acids (glutamic acid, phenyalanine, aspartic acid etc.,) and alcohols (ethanol, butanol etc.,)

UNIT III PRODUCTION OF SECONDARY METABOLITES

Study of production processes for various classes of secondary metabolites: antibiotics: beta-lactams (penicillin, cephalosporin etc.), aminoglycosides (streptomycin etc.,) macrolides (erythromycin), vitamins and steroids.

UNIT IV PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS

Production of industrial enzymes such as proteases, amylases, lipases, cellulases etc., Production of biopesticides, biofertilisers, biopreservatives (Nisin), cheese, biopolymers (xanthan gum, PHB etc.,), single cell protein.

UNIT V PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS

Production of recombinant proteins having therapeutic and diagnostic applications, production of vaccines. Production of monoclonal antibodies. Products of plant and animal cell culture

Text Book

1. Casida Jr, L.E., "Industrial Microbiology", New Age International (P) Ltd.
2. Presscott, Dunn, "Industrial Microbiology", Agrobios (India).

Reference Book

1. Wulf Cruger and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", Panima Publishing Corporation.
2. Murrey Moo & Young, "Comprehensive Biotechnology", Pergamon.

708CHT13 - FUELS TECHNOLOGY AND COMBUSTION

UNIT-I

Energy crisis – Present position in India and the world. Origin and Chemical composition, Classification of fuels, Storage and general use of Industrial fuels. Comparison of various types of fuels, Calorific value of a fuel, LCV and HCV, meaning and definition.Determination of HCV and LCVfor solid fuels, Bomb calorimeter, Gas calorimeter.

UNIT-II

Solid fuels: Wood and charcoal, Coals and their characteristics, combustion and availability of coals in India, Coal washing and blending. High and low temperature coal carbonization.

UNIT-III

Manufacture of coke and recovery of by products. Pulverized coal and its conduction. Liquid fuels: Petroleum, its origin and occurrence. Distillation, products of distillation, their characteristics and uses.

UNIT-IV

Combustion, Chemistry of combustion, combustion calculations pertaining to different fuels and furnaces used in ceramic industries. Theoretical air / fuel ratio, Excess air, Flue gas analysis calculations.

UNIT-V

Gaseous Fuels: Classification, merits and demerits of the gaseous fuels. N_2 gas, LPG, coal gas, Oil gas, Produces gas, Water gas, Semi-water gas etc., their chemical composition, Manufacture and uses in detail.

UNIT-VI

Nuclear fuels, their scope and classification, Types of nuclear fuels, method of generation of nuclear energy from the sources, etc., Nuclear reactor – classification and types Accessories and their study in detail. Nuclear fuel roads, Moderators,Heavy water

TEXT AND REFERENCE BOOKS

1. Efficient use of fuels – HMSO Publication, London.
2. Fuels Technology – Himus
3. Energy – Resources, demand and Conservation with special reference to India – Kashkari.
4. Combustion Engineering and Fuels Technology – Shaha (Oxford & IBM).
5. Principles of Energy conversion – Gulp Jr. A.W. (McGraw Hill).
6. Energy resources and supply – McMullan, Morgan Murray (John Wiley).

For more details, visit http://www.vtu.ac.in/

708CHT14 - CHEMICAL PRODUCT DESIGN

UNIT-I

Introduction to chemical product design, Customer Needs- Interviewing Customers, Interpreting Customer Needs,Consumer Products- Consumer Assessments, Consumer versus Instrumental Assessments Converting ,Needs to Specifications, Revising Product Specifications

UNIT-II

Human Sources of Ideas- Sources of Ideas, Collecting the Ideas, Problem Solving Styles, Chemical Sources of Ideas- Natural Product Screening, Random Molecular Assembly, Combinatorial Chemistry, Sorting the Ideas, Screening the Ideas- Strategies for Idea Screening, Improving the Idea Screening Process

UNIT-III

Selection Using Thermodynamics-Ingredient Substitutions, Substitutions in Consumer Products, Ingredient Improvements, Selection Using Kinetics- Chemical Kinetics, Heat and Mass Transfer Coefficients, Less Objective Criteria, Risk in Product Selection- Risk Assessment, Risk Management

UNIT-IV

Intellectual Property- Patents and Trade Secrets, Supplying Missing Information- Reaction Path Strategies, Final Specifications- Product Structure, Central Product Attributes, Chemical Triggers, Microstructured Products- Thermodynamics, Colloid Stability, Rheology and Mixing, Device Manufacture- Thermodynamics, Enzyme Kinetics.

UNIT-V

First Steps Toward Production- Extending Laboratory Results, Reaction Engineering, Separations- Heuristics for Separations, The Most Useful Separations, Specialty Scale- Up- Reactor Scale-Up, Separation Scale-Up, Process Economics- A Hierarchy of Process Design, Economic Potential, Capital Requirements, Economics for Products

Text Books:

1. E.L.Cussler, G.D.Moggridge, "Chemical Product Design" Cambridge University Press.
2. G. and Beitz, W. (1996). *Engineering Design, a Systematic Approach*, 2nd ed. Springer, New York, ISBN 354019917
3. Ulrich, K. T. and Eppinger, S. D. (2000). *Product Design and Development*, 2nd ed. McGraw- Hill, New York, ISBN 0071169938

ELECTIVE-II
808CHT02 - DRUGS AND PHARMACEUTICAL TECHNOLOGY

UNIT-I DRUG METABOLISM AND PHARMACO KINETICS

Development of drugs and pharmaceutical industry; organic therapeutic agent's uses and economics.

Drug metabolism; physico chemical principles; Radio Activity; Pharma Kinetics-action of drugs on human bodies.

UNIT II UNIT PROCESSES AND THEIR APPLICATIONS

Chemical conversion processes; alkylation; carboxylation; condensation and cyclisation; dehydration, esterification, halogenation, oxidation, sulfonation; complex chemical conversions fermentation.

UNIT III MANUFACTURING METHODS

Compressed tablets; wet granulation; dry granulation or slugging; direct compression, tablet presses formulation; coating pills; capsules sustained action dosage forms; parential solutions, oral liquids; injections; ointments; standard of hygiene and manufacturing practice.

UNIT IV PHARMACEUTICAL PRODUCTS

Vitamins; cold remedies; laxatives; analgesics; nonsteroidal contraceptives; external antiseptics; antacids and others.

UNIT V MICROBIOLOGICAL AND ANIMAL PRODUCTS AND PACKING AND QUALITY CONTROL

Antibiotics; biologicals; hormones; vitamins; preservation, Packing; packing techniques; quality control.

TEXT BOOKS

1. Rawlines, E.A.; "Bentleys Text book of Pharmaceutics", III Edition, Bailliere Tindall, London, 1977.
2. Yalkonsky, S.H.; Swarbick. J.; "Drug and Pharamaceutical Sciences", Vol. I, II, III, IV, V, VI and VII, Marcel Dekkar Inc., New York, 1975.

REFERENCE

1. "Remingtons Pharmaceutical Sciences", Mack Publishing Co., 1975.

808CHT03 - FERTILIZER TECHNOLOGY

UNIT- INITROGENOUS FERTILISERS

Methods of production of nitrogenous fertilizer-ammonium sulphate, nitrate, urea and calcium ammonium nitrate; ammonium chloride and their methods of production, characteristics and specifications, storage and handling.

UNIT II PHOSPHATIC FERTILISERS

Raw materials; phosphate rock, sulphur; pyrites etc., processes for the production of sulphuric and phosphoric acids; phosphates fertilizers - ground rock phosphate; bone meal-single superphosphate, triple superphosphate, triple superphosphate, thermal phosphates and their methods of production, characteristics and specifications.

UNIT III POTASSIC FERTILISERS

Methods of production of potassium chloride, potassium schoenite, their characteristics and specifications.

UNIT IV COMPLEX AND NPK FERTILISERS

Methods of production of ammonium phosphate, sulphate diammonium phosphate, nitrophosphates, urea, ammonium phosphate, mono-ammonium phosphate and various grades of NPK fertilizers produced in the country.

UNIT V MISCELLANEOUS FERTILISERS

Mixed fertilizers and granulated mixtures; biofertilisers, nutrients, secondary nutrients and micro nutrients; fluid fertilizers, controlled release fertilizers, controlled release fertilizers.

TEXT BOOKS

1. "Handbook of fertilizer technology", Association of India, New Delhi, 1977.
2. Menno, M.G.; "Fertilizer Industry - An Introductory Survey", Higginbothams Pvt. Ltd.,1973.

REFERENCES

1. Sauchelli, V.; "The Chemistry and Technology of Fertilizers", ACS MONOGRAPH No. 148, Reinhold Publishing Cor. New York, 1980.
2. Fertiliser Manual, "United Nations Industrial Development Organisation", United Nations, New York, 1967.
3. Slack, A.V.; Chemistry and Technology of Fertilisers, Interscience, New York, 1966.

808CHT04 - MODERN SEPARATION TECHNIQUES

UNIT-I INTRODUCTION

Review of conventional processes, Recent advances in separation techniques based on size, surface properties, ionic properties and other special characteristics of substances, Process concept, Theory and equipment used in cross flow filtration, cross flow electrofiltration, dual functional filter, Surface based solid – liquid separations involving a second liquid, Sirofloc filter.

UNIT II MEMBRANE SEPARATIONS

Types and choice of membranes, Plate and frame, tubular, spiral wound and hollow fibre membrane reactors and their relative merits, Commercial, pilot plant and laboratory membrane permeators involving dialysis, reverse osmosis, Nanofiltration, ultrafiltration, Microfiltration and Donnan dialysis, Economics of membrane operations, Ceramic membranes

UNIT III SEPARATIONS BY ADSORPTION TECHNIQUES

Mechanism, Types and choice of adsorbents, Normal adsorption techniques, Affinity chromatography and immuno Chromatography, Types of equipment and commercial process, Recent advances and process economics.

UNIT IV IONIC SEPARATIONS

Controlling factors, Applications, Types of equipment employed for electrophoresis, Dielectrophoresis, ion exchange chromatography and electrodialysis, Commercial processes.

UNIT V OTHER TECHNIQUES

Separations involving Lyophilization, Pervaporation and permeation techniques for solids, liquids and gases, Industrial viability and examples, zone melting, Addluctive crystallization, Other separation processes, Supercritical fluid extraction, Oil spill Management, Industrial effluent treatment by modern techniques.

TEXT BOOKS

1. Lacey, R.E. and S.Looeb – Industrial Processing with Membranes Wiley – Inter Science, N.Y.1972.
2. King, C.J. Separation Processes, Tata McGraw–Hill Publishing Co. Ltd., 1982.

REFERENCES

1. Schoew, H.M. – New Chemical Engineering Separation Techniques, Interscience Publishers, 1972.
2. Ronald W. Roussel – Handbook of Separation Process Technology, John Wiley, New York, 1987.
3. Kestory, R.E. – Synthetic polymeric membranes, Wiley. Interscience, N.Y. 1985.
4. Osadar, Varid Nakagawal – Membrane Science and Technology, Marcel Dekkar (1992).

808CHT05 - WASTE WATER TREATMENT

UNIT-I WASTE WATER TREATMENT

Terminology – Regulatios – Health and Environment Concerns in waste water management – Constituents in waste water inorganic – Organic and metallic constituents.

UNIT II PROCESS ANALYSIS AND SELECTION

Components of waste water flows – Analysis of Data – Reactors used in waste water treatment – Mass Balance Analysis – Modeling of ideal and non ideal flow in Reactors – Process Selection.

UNIT III CHEMICAL UNIT PROCESSES

Role of unit processes in waste water treatment chemical coagulation – Chemical precipitation for improved plant performance chemical oxidation – Neutralization – Chemical Storage.

UNIT IV BIOLOGICAL TREATMENT

Overview of biological Treatment – Microbial metabolism – Bacterial growth and energatus – Aerobic biological oxidation – Anaerobic fermentation and oxidation – Trickling filters – Rotating biological contractors – Combined aerobic processes – Activated sludge film packing.

UNIT V ADVANCED WASTE WATER TREATMENT

Technologies used in advanced treatment – Classification of technologies Removal of Colloids and suspended particles – Depth Filtration – Surface Filtration – Membrane Filtration Absorption – Ion Exchange – Advanced oxidation process.

TEXT BOOK

1. Waste water Engineering Treatment and Reuse: Mc Graw Hill, G. Tchobanoglous, FI Biston, 2002.
2. Industrial Waste Water Managemnet Treatment and Disposal by Waste Water Mc Graw Hill III Edition 2008.

808CHT06 - INDUSTRIAL MANAGEMENT

UNIT-I

Principles of Management – functions of management, structure of industrial organization; Human relations and performance in organization, Workers' participation in management.

UNIT II

Professional Ethics;Motivation – methods of improving motivation; Need for leadership and Functions of a leader. Human Resource Development Staff development and career development. Wage Payment (4 hrs) – classification, types of labour laws, types of taxes

UNIT III

Accidents and Safety – effects of accidents and safety procedures; Environmental Management - various management techniques for control of environmental pollution; pollution control acts Materials Management inventory control model, ABC Analysis, Economic ordering quantity, materials handling

UNIT IV

Financial Management - Profit and Loss Account, Balance Sheet, Interpretation of Statements, Ratio Analysis, Project financing, Project appraisal, return on investments.

UNIT V

Marketing and Sales - Marketing, Sales, Market conditions, Break even analysis, Budgets, Pricing Policies.

TEXT BOOKS

1. Khanna, O.P.,Industrial Engineering and Management by Dhanpat Rai Publications, Delhi.
2. Sharma, V.K., and Harkut, O.P. Industrial Management
3. Kotler, P., Marketing Management , Prentice Hall of India, New Delhi
4. Kotler, P., Principles of Management by, TEE Publication.

REFERENCES

1. Duncan, J.C, The Principles of Industrial Management Bibliobazaar LLC 2008
2. Smith, J.R., The Elements of Industrial Management Bibliobazaar LLC 2009

808CHT07 - FERMENTATION ENGINEERING

UNIT- I INTRODUCTION TO FERMENTATION PROCESSES

Microbial biomass – Microbial Engymes – Microbial metabolites – Recombinant products – Transformation Process – Microbial growth binetus – Isolation and preservation and improvement of industrially important micro organism.

UNIT II INSTRUMENTATION AND CONTROL.

Measurement of process variables – Temperature and its control – Flow measurement and control – Gases and Liquids – Pressure measurement and control – Cenline analysis – Control System – Combination of Control Systems – Computer application in termentation technology.

UNIT III RECOVERY AND PURIFICATION OF FERMENTATION PRODUCTS

Removal of Microbial cells – Foam Separation – Precipitation Filtration – Different Filtration process – Centifugation – Different centrifuge cell description – Different methods – Solvent recovery – Superfluid extraction – Chromatography – Membrane processes – Drying – Crystallization – Whole growth processing.

UNIT IV EFFLUENT TREATMENT

Strength of fermentation effluent – Treatment and disposal – Treatment Processes – Physical, chemical and biological – Aerobic process – Anareobic treatment.

UNIT V FERMENTATION ECONOMICS

Introduction – Isolation of micro organisms of industrial interest – Strain improvement – Market potential – Plant and equipment – Media – Air sterilization – Heating and cooling – Recovery costs.

REFERENCES

1. Principles of fermentation Technology P.Stanbury Buttuworth Hanman – 1999.
2. Fermentation and Biochemical Engineering Handbook – C.C Haber. William Andrew II Edition 2007.
3. Bioprocess Engineering Hydersen B.K Nancy A.dela K.L.Nelsen Wiley Interscience,1994.

ELECTIVE-III
808CHT08 - PETROLEUM TECHNOLOGY

UNIT I INTRODUCTION
Classification of crude oil, atmospheric distillation, vacuum distillation of residue – products and distillation practice

UNIT II CRACKING AND REFORMING
Light end products of distillation, hydro cracking , thermal cracking , fluid catalytic cracking unit , visbreaking, catalytic reforming of naptha and its products

UNIT III PRIMARY FINISHING TREATMENTS
Processes for kerosene,diesel and hydrodesulphurization, treatment techniques for removal of objectionable odours, storage stability,extraction of aromatics,olefins and recovery operations

UNIT IV SECONDARY FINISHING PROCESSES
Treatment of gasoline production, alkylation –sulphuric acid process and hydrofluoric acid process,isomerisation process , polymer gasoline

UNIT V HEAVY ENDS TREATMENT
Production of lube oil stock, wax and asphalt

TEXT/REFERENCE BOOKS:

1. Nelson W.L.,Petroleum Refinery Engineering, 4th Edition McGraw Hill 1958
2. Bhaskara Rao B K "Modern Petroleum Refining Processes" 2nd Edition Oxford and IBH Publishing Company , New Delhi 1990.
3. Ramprasad Petroleum Refining Technology 1st Edition Kanna Publishers New Delhi 2000

808CHT09 - PULP AND PAPER TECHNOLOGY

UNIT-I INTRODUCTION

Introduction Basic pulp and paper technology – Wood haves dry – Wood as a raw material.

UNIT II WOODYARD OPERATION

Woodyard operation - Mechanical pulping – Chemical pulping – Secondary fibre pulp processing.

UNIT III PAPER MACHINE

Paper Machine wet and addition paper machine dry and operation – Paper machine – wet and operation

UNIT IV PAPER AND PAPERBOARD

Paper and paperboard frames and products – Surface treatments – Finishing operation – End uses.

UNIT V PROPERTIES AND TESTING OF PULP AND PAPER

Properties and Testing of pulp and paper Process control – Quality assurance – Water and air pollution control.

REFERENCE

1. Pulp and paper chemistry and Technology Monica ER Monica, Goran Gellerstcdt Gunnar Hennksson De Gneyter 2009.

808CHT10 - POLYMER TECHNOLOGY

UNIT-I INTRODUCTION

History of Macromolecules – structure of natural products like cellulose, rubber,proteins – concepts of macro molecules – Staudinger's theory of macromolecules – difference between simple organic molecules and macromolecules.

UNIT II ADDITION POLYMERIZATION

Chemistry of Olefins and Dienes – double bonds – Chemistry of free radicals – monomers – functionality – Polymerization: Initiation – types of initiation – free radical polymerization – cationic polymerization – anionic polymerization – coordination polymerization – industrial polymerization – bulk, emulsion, suspension and solution polymerization techniques – Kinetics – Copolymerization concepts.

UNIT III CONDENSATION POLYMERIZATION

Simple condensation reactions – Extension of condensation reactions to polymer synthesis – functional group reactivity – polycondensation – kinetics of polycondensation- Carother's equation – Linear polymers by polycondensation – Interfacial polymerization – crosslinked polymers by condensation – gel point.

UNIT IV MOLECULAR WEIGHTS OF POLYMERS

Difference in molecular weights between simple molecules and polymers – number average and weight average molecular weights – Degree of polymerization and molecular weight – molecular weight distribution – Polydispersity – molecular weight determination. Different methods – Gel Permeation Chromatography – Osmometry, Light Scattering.

UNIT V TRANSITIONS IN POLYMERS

First and second order transitions – Glass transition, Tg – multiple transitions in polymers – experimental study – significance of transition temperatures – crystallinity in polymers – effect of crystallization – in polymers – factors affecting crystallization crystal nucleation and growth – relationship between Tg and Tm – Relationship between properties and crystalline structure.

REFERENCES

1. Billmeyer.F.W.,Jr, Text Book of Polymer Science, Ed. Wiley-Interscience, 1984.
2. Seymour.R.B., and Carraher.C.E., Jr., Polymer Chemistry, 2nd Ed., Marcel Dekker, 1988.
3. Gowariker.V.T., Viswanathan.N.V., and Sreedar.J., Polymer Science, Wiley Eastern Ltd., 1988.
4. Joel,R.F; Polymer Science and Technology, Eastern Economy Edition, 1999.
5. Rodriguez, F., Cohen.C., Oberic.K and Arches, L.A., Principles of Polymer Systems, 5th edition, Taylor an

808CHT11 - PROCESS MODELLING AND SIMULATIONS

UNIT-I BASIC MODELLING

Introduction to modeling; uses of mathematical models; scope of coverage; principles of formation; review on algebraic, ordinary and partial differential equations; solutions of the above equations; linearization; probabilization models; development of models by experiment and statics; regression and correlation analysis.

UNIT II MATRIX MODELS

Elementary matrix concepts; simple array models; multi-component distillation; dynamic simulation of distillation column; solution techniques for matrix differential equations; matrix formation of distributed parameter system; flow pattern in stirred tanks; design of mixers.

UNIT III LUMPED PARAMETER MODEL

Introduction to lumped parameter system; mathematical description of multiphase transfer process; non isothermal reactors etc.; Axial dispersion in packed beds; reactor design from response curves; reactor effectiveness factor; computer aided modeling of reaction networks.

UNIT IV DISTRIBUTED PARAMATER MODEL

Formation and solution of one dimensional unsteady state problem in heat transfer and mass transfer systems; multidimensional problems; application in heat and mass transfer equipments.

UNIT V OPTIMISATION AND SIMULATIONS

Introduction; application; analytical and numerical techniques for multivariable problems; techniques for constrained optimization; simulation; introduction; discrete event and continuous simulation; dynamic simulation of reactors, distillation columns, absorbers, evaporators and crystallizers; simulation in process control.

TEXT BOOKS

1. 1 .Ramirez, W.; "Computational Methods in Process Simulation", Butterworths Publishers, II Edition 1998..
2. Edgar, T.F., Himmelblau, D.M., "Optimisation of Chemical Processes", McGraw-Hill II Edition 2001.

REFERENCES

1. Luyben, W.L., "Process Modelling Simulation and Control", McGraw-Hill Book Co., 1973.
2. Myers, A.L., Seider, W.D.; "Introduction to Chemical Engineering and Computer Calculations", Prentice Hall Inc., Englewood Cliffs, New Jersey, 1976.
3. Chemical Engineering Refresher Series on "Process Dynamics", McGraw-Hill Publications, 1983.
4. Mickley, H.S.; Sherwood, T.S.; Reed C.E.; "Applied Mathematics for Chemical Engineers", Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1989.

808CHT12 - COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING

AIM

To introduce computer and its application to solve problems in Chemical Engineering operation thro required software.

OBJECTIVES

To obtain skill in creating database retrieval of data and also to solve Mathematical models thro' linear and non-linear programming.

UNIT I INTRODUCTION

Review on Programming languages, Basic, Fortran, Review on operating system commands.

UNIT II SPREAD SHEETS

Application in Density, molecular weight, mole and percentage compositions, Empirical and Molecular formula calculations, Heat of mixing, Gas laws, Vapour pressure, Chemical Kinetics calculations.

UNIT III SPREAD SHEETS (DATA ANALYSIS)

Application in data processing, Statistical analysis of data, Regression. Analysis of variance, Interpolation, Graphical representations of various Chemical Engineering problem both in laboratory exercise and core subjects such as Mechanical operation, Reaction Engineering, Distillation etc.,

UNIT IV DATABASE

Design and developments of simple databases on Chemical and Physical properties of substances. Retrieval and Database in report, query and other formats, Interfacing with other softwares. Preparation of Material and energy Balances preparation of plant layout.

UNIT V MATHEMATICAL PROGRAMMING

Linear Programming, Transportation, Assignment, Dynamic Programming in Chemical Engineering, Formulation and solution through PC based programes.

TEXT BOOKS

1. Hanna, O.T. Scandell, O.C. Computational Methods in Chemical Engineering, Prentice Hall, 1995.
2. R.K. Taxali, T.K. dBase IV made simple, Tata McGraw-Hill 1991.

REFERENCES

1. Jerry, O., Breneman, G.L. Spreadsheet Chemistry, Prentice Hall, Englewood Cliffs, 1991.
2. Myers, A.L. Seider W.D. Introduction to Chemical engineering and Computer Calculations.

808CHT13 - FUNDAMENTALS OF NANOSCIENCE

UNIT- I INTRODUCTION

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thin films-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT IV PREPARATION ENVIRONMENTS

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARECTERISATION TECHNIQUES

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

TEXT BOOKS

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale characterization of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES

1. G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia (Editor), "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

808CHT14 - COMPUTATIONAL FLUID DYNAMICS

UNIT-I

Elementary details in numerical Techniques: Number system and errors, Representation of integers,Fractions, Floating point Arithmetic, loss of significance and error propagation, condition and instability, computational methods for error estimation, Convergence of Sequences.

UNIT – II

Applied Numerical Methods: Solution of a system of simultaneous Linear Algebraic Equations, iterative schemes of Matrix Inversion, Direct Methods for Matrix inversion, Direct Methods for banded matrices.

UNIT – III

Finite Difference Applications in Heat conduction and Convention – Heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application i in convective heat transfer, closure.

UNIT – IV

Finite Differences, discretization, consistency, stability, and Fundamentals of fluid flow modeling: Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

UNIT – V

Introduction to first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modeling, conservative property, the upwind scheme.

UNIT – VI

Review of Equations Governing Fluid Flow and Heat Transfer: Introduction, conservation of mass, Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier-stokes equations.

UNIT – VII

Steady flow, dimensionless form of Momentum and Energy equations, Stokes equation, conservative body force fields, stream function - Vorticity formulation.

UNIT –VIII

Finite Volume Method: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, Upwind interpolation, Linear interpolation and Quadratic interpolation.

TEXTBOOK

1. Numerical heat transfer and fluid flow / Suhas V. Patankar- Butter-worth Publishers
2. Computational fluid dynamics - Basics with applications - John. D. Anderson / Mc Graw Hill.

REFERENCES :

1. Computational Fluid Flow and Heat Transfer/ Niyogi, Pearson Publications
2. Fundamentals of Computational Fluid Dynamics – Tapan K. Sengupta / Universities Press For more details, visit http://www.gmrit.org/resources/syllabus_me.pdf

808CHT15 - INTRODUCTION TO SEMICONDUCTOR MANUFACTURING PROCESSES

UNIT – I

Review of Chip Manufacturing Process, FEOL and BEOL Concepts. PhotoLithography: Lithography basics, Wavelength, Layout and Optical Proximity Correction (OPC), Mask Making, Phase Shift Mask.

UNIT – II

Deposition: Physical and Chemical vapor Deposition (PVD & CVD) basics, Electrochemical deposition, Electro-migration vs grain size, Implantation basics, Constant source and limited source diffusion.

UNIT – III

Material Removal: Plasma and wet etching, Aluminimum and Oxide etching, Chemical Mechanical Polishing (CMP) basics, Dishing, Erosion, Issues in Shallow Trench Isolation, Oxide Polish and Copper Polish, Dummy fill.

UNIT – IV

Process Integration: BEOL Issues, Cu vs al metallization, oxide vs low-k integration.

UNIT – V

Testing, Process Control and Yield: Scribeline Test (for process evaluation), Functional Test (for product) evaluation), Process stability and control, Yield Models, process and design modifications for yield optimization .

Text books:

1. Introduction to Microelectronic Fabrication, Vol 5 of Modular Series on Solid State Devices (2nd Edition) by Richard C Jaeger, Prentice Hall, 2001.
2. Microchip Fabrication: A Practical Guide to Semiconductor Processing (2nd Edition) by Peter Van Zant, Carol Rose (Editor) , Daniel Gonneau (Editor), Semiconductor Devices, 1990.

Reference Books;

1. ULSI Technology by CY Chang and S M Sze, McGraw Hill, 1996.
2. The Science and Engg. of Microelectronic Fabrication (2nd Edition) by S A Campbell, Ox Uni Press 2001.