ANNA UNIVERSITY : : CHENNAI 600 025

UNIVERSITY DEPARTMENTS

R - 2012

B.TECH. PETROLEUM ENGINEERING AND TECHNOLOGY

I TO VIII SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
HS8151	Technical English – I	3	1	0	4
MA8151	Mathematics – I	3	1	0	4
PH8151	Engineering Physics	3	0	0	3
CY8151	Engineering Chemistry	3	0	0	3
GE8151	Computing Techniques	3	0	0	3
GE8152	Engineering Graphics	2	0	3	4
PRACTICALS					
PH8161	Physics Laboratory	0	0	2	1
CY8161	Chemistry Laboratory	0	0	2	1
GE8161	Computer Practices Laboratory	0	0	3	2
GE8162	Engineering Practices Laboratory	0	0	3	2
	TOTAL	**17**	**2**	**13**	**27**

SEMESTER II

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
HS8251	Technical English – II	3	1	0	4
MA8251	Mathematics – II	3	1	0	4
PH8255	Physics of Materials	3	0	0	3
CY8253	Chemistry of Technologists	3	0	0	3
GE8251	Engineering Mechanics	3	1	0	4
CH8201	Principles of Chemical Engineering	3	0	0	3
EE8252	Principles of Electrical and Electronics Engineering	3	0	0	3
PRACTICALS					
CY8261	Applied Chemistry Laboratory	0	0	2	1
CH8261	UNIX Programming Laboratory	0	0	4	2
	TOTAL	**21**	**3**	**6**	**27**

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SEMESTER III

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MA8356	Probability and Statistics	3	1	0	4
CY8301	Organic Chemistry	3	0	0	3
AS8304	Petroleum Engineering	4	0	0	4
AS8305	Fluid Mechanics for Petrochemical Engineers	3	1	0	4
CH8302	Process Calculations	3	0	0	3
ME8351	Basic Mechanical Engineering	3	0	0	3
PRACTICALS					
CH8311	Electrical Engineering Laboratory For Technologists	0	0	4	2
CH8312	Organic Chemistry Laboratory	0	0	4	2
ME8361	Mechanical Engineering Laboratory	0	0	3	2
	TOTAL	**19**	**2**	**11**	**27**

SEMESTER IV

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MA 8353	Numerical Methods	3	1	0	4
CY8451	Physical Chemistry	3	0	0	3
AS8401	Chemical Engineering Thermodynamics	3	1	0	4
CH8402	Heat Transfer	3	0	0	3
AS8402	Spectroscopic Techniques	3	0	0	3
AS8403	Natural Gas Engineering	3	0	0	3
PRACTICALS					
CH8411	Fluid Mechanics Laboratory	0	0	4	2
CH8412	Technical Analysis Laboratory	0	0	4	2
	TOTAL	**18**	**2**	**8**	**24**

SEMESTER V

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
GE8351	Environmental Science And Engineering	3	0	0	3
AS8501	Petroleum Refining I	3	0	0	3
CH8502	Chemical Reaction Engineering I	3	1	0	4
CH8651	Process Instrumentation, Dynamics and Control	3	0	0	3
CH8504	Mass Transfer – I	3	0	0	3
	Elective I	3	0	0	3
PRACTICAS					
HS8561	Employability Skills	0	0	2	1
CH8511	Heat Transfer Laboratory	0	0	3	2
AS8511	Petroleum Testing Laboratory - I	0	0	4	2
	TOTAL	**18**	**1**	**9**	**24**

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SEMESTER VI

CODE NO	COURSE TITLE	L	T	P	C
AS8601	Equilibrium Staged Operations	3	1	0	4
AS8602	Chemical Reaction Engineering II	3	0	0	3
AS8603	Petroleum Refining II	3	0	0	3
CH8603	Plant Safety And Risk Analysis	3	0	0	3
AS8604	Petrochemicals	4	0	0	4
	Elective II	3	0	0	3
PRACTICAS					
AS8611	Process Control Laboratory	0	0	4	2
AS8612	Petroleum Testing Laboratory - II	0	0	4	2
CH8612	Computational Chemical Engineering Laboratory	0	0	4	2
	TOTAL	**19**	**1**	**12**	**26**

SEMESTER VII

CODE NO	COURSE TITLE	L	T	P	C
CH8751	Transport Phenomena	3	1	0	4
CH8701	Chemical Process Design	3	0	0	3
CH8702	Process Economics	3	0	0	3
AS8701	Petroleum Equipment Design	3	1	0	4
AS8702	Petroleum Refining III	3	0	0	3
	Elective III	3	0	0	3
PRACTICALS					
CH8711	Mass Transfer Laboratory	0	0	4	2
CH8611	Chemical Reaction Engineering Laboratory	0	0	3	2
	TOTAL	**18**	**2**	**7**	**24**

SEMESTER VIII

CODE NO	COURSE TITLE	L	T	P	C
	Elective IV	3	0	0	3
	Elective V	3	0	0	3
PRACTICALS					
AS8811	Project Work	0	0	12	6
	TOTAL	**6**	**0**	**12**	**12**

TOTAL NO OF CREDITS : 191

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LIST OF ELECTIVES FOR PETROLEUM ENGINEERING AND TECHNOLOGY

CODE NO	COURSE TITLE	L	T	P	C
MA8001	Statistics and Linear Programming	3	1	0	4
AS8010	Petroleum Chemistry	3	0	0	3
AS8011	Drilling and Well Engineering	3	0	0	3
AS8012	Reservoir Engineering	3	0	0	3
AS8013	Enhanced Oil Recovery	3	0	0	3
AS8014	Production Engineering	3	0	0	3
AS8015	Multicomponent Distillation	3	0	0	3
CH8003	Energy Technology	3	0	0	3
CH8005	Modern Separation Techniques	3	0	0	3
CH8006	Optimization of Chemical Process	3	0	0	3
CH8009	Process Modeling and Simulation	3	0	0	3
CH8010	Process Plant Utilities	3	0	0	3
CH8011	Supply Chain Management	3	0	0	3
GE8751	Engineering Ethics and Human Values	3	0	0	3
ME8004	Design of Heat Exchangers	3	0	0	3
MF8077	Product Design and Development	3	0	0	3
ME8072	Computational Fluid Dynamics	3	0	0	3
ME8005	Design of Pressure Vessels and Piping	3	0	0	3
GE8072	Disaster Management	3	0	0	3
GE8073	Human Rights	3	0	0	3

HS8151	TECHNICAL ENGLISH I (For all branches of B.E / B.Tech programmes) (Semester I)	L T P C 3 1 0 4

OBJECTIVE

To impart basic communication skills and develop the habit of reading

OUTCOME

- To enable all students of engineering and technology develop their basic communication skills in English.
- To give special emphasis to the development of speaking skills amongst the students of engineering and technology students.
- To ensure that students use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading for pleasure.

UNIT I

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Speaking about one's place, important festivals etc. – Introducing oneself, one's family / friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials - Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II

Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking & answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Lab descriptions (general/specific description of laboratory experiments) - Definitions - Recommendations; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association; E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

UNIT III

Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause & effect / compare & contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV

Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations & acronyms; E-

materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

UNIT V

Listening - Listening to different accents, Listening to Speeches / Presentations, Listening to broadcast & telecast from Radio & TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar & Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents, - Interpreting posters

TOTAL : 60 PERIODS

TEXT BOOKS

1. Mindscapes: English for Technologists and Engineers, Department of English, Anna University, Chennai, 2012 .
2. S.P. Dhanavel, English and Communication Skills for Students of Science and Engineering. Orient Black Swan, Chennai, 2011.

REFERENCE BOOKS

1. Pickett, Nell Ann, Ann A.Laster and Katherine E.Staples. Technical English: Writing, Reading and Speaking. New York: Longman, 2001.
2. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
3. Morgan, David and Nicholas Regan. Take-Off: Technical English for Engineering. Reading: Garnet Publishing Limited, 2008.
4. Thorn, Michael and Alan Badrick. An Introduction to Technical English. Harlow: Prentice Hall Europe, 1993.
5. Rizvi, M.Ashraf. Effective Technical Communication. New Delhi: Tata McGraw-Hill PublishingCompany, 2007.

EXTENSIVE READERS

1. Murthy, Sudha. Wise & Otherwise. New Delhi: Penguin Books India, 2006.
2. Gates, Bill and Collins Hemingway. Business @ the Speed of Thought: Succeeding in the Digital Economy. New York: Warner Business Books, 2000.

Website Resources

1. www.uefap.com
2. www.eslcafe.com
3. www.listen-to-english.com
4. www.owl.english.purdue.edu
5. www.chompchomp.com

MA8151 MATHEMATICS – I L T P C

(Common to all branches of B.E. / B.Tech. Programmes) 3 1 0 4

(I Semester)

OBJECTIVE

To impart the fundamental knowledge about matrices, infinite series, partial derivatives, improper and multiple integrals

OUTCOME

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.

- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES 9+3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II INFINITE SERIES 9+3

Sequences – Convergence of series – General properties – Series of positive terms – Tests of convergence (Comparison test, Integral test, Comparison of ratios and D'Alembert's ratio test) – Alternating series – Series of positive and negative terms – Absolute and conditional convergence – Power Series – Convergence of exponential, logarithmic and Binomial Series.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+3

Limits and Continuity – Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables –Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Errors and approximations – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV IMPROPER INTEGRALS 9+3

Improper integrals of the first and second kind and their convergence – Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions – Properties – Evaluation of integrals using Beta and Gamma functions – Error functions.

UNIT V MULTIPLE INTEGRALS 9+3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of Solids – Change of variables in double and triple integrals – Area of a curved surface.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.

REFERENCES

1. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
2. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

Attested

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PH8151 **ENGINEERING PHYSICS** **L T P C**

(Common to all Branches of B.E./B.Tech. Programmes) **3 0 0 3**

OBJECTIVE

To introduce the basic physics concepts relevant to different branches of Engineering and Technology.

OUTCOME

On completion of the course the students are expected to have a thorough knowledge on the basic physic concepts relevant to different branches of Engineering and Technology.

UNIT I PROPERTIES OF MATTER 9

Elasticity - Poisson's ratio and relationship between moduli (qualitative) - Stress-strain diagram - factors affecting elasticity - bending of beams - cantilever - bending moment - theory and experiment of Young's modulus determination - Uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

UNIT II ACOUSTICS AND ULTRASONICS 9

Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - rate of growth and decay of sound intensity - derivation of Sabine's formula - absorption coefficient and its determination - factors affecting acoustics of buildings : focussing, interference, echo, Echelon effect, resonance - noise and their remedies. Ultrasonics - production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating - industrial applications - NDT - Ultrasonic method: scan modes and practice.

UNIT III THERMAL PHYSICS 9

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity - conductions in solids - Forbe's and Lees' disc methods - Rectilinear flow of heat through a rod - flow of heat through a compound materials - radical flow of heat through a spherical shell - thermal insulation of buildings – Laws of blackbody radiation: Kirchoffs law, Stephens law, Wiens law, Raleigh-Jean law and Planks law (derivation). Laws of thermodynamics - Otto and diesel engines and their efficiency - entropy - entropy of Carnot's cycle - reverse Carnot's cycle - refrigerator.

UNIT IV APPLIED OPTICS 9

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its application - Lasers - Einstein's coefficients - CO_2, Nd:YAG and semiconductor lasers - homo junction and hetro junction - construction and working - applications - Optical fibres - classification (index & mode based) - principle and propagation of light in optical fibres - acceptance angle and numerical aperture - fibre optic communication system - active and passive sensors.

UNIT V SOLID STATE PHYSICS 9

Nature of bonding - growth of single crystals (qualitative) - crystal systems - crystal planes and directions - expressions for interplanar distance - coordination number and packing factor for simple structures: SC, BCC, FCC and HCP - structure and significance of NaCl, ZnS, diamond and graphite - crystal imperfections: point defects, dislocations and stacking faults - unit cell, Bravais space lattices - miller indices.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gaur R.K., and Gupta, S.L., Engineering Physics, Dhanpat Raj Publications, 2003.
2. Palanisamy, P.K., Engineering Physics, Scitech Publications (P) Ltd, 2006.
3. Arumugam, M., Engineering Physics, Anuradha Publications, 2000.

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REFERENCE BOOKS

1. Sankar, B.N., Pillai.S.O., Engineering Physics, New Age International (P) Ltd., 2007.
2. Rajendran.V Engineering Physics, Tata McGraw-Hill, 2009.

CY8151	ENGINEERING CHEMISTRY	L	T	P	C
	(Common to all branches of Engineering and Technology)	3	0	0	3

OBJECTIVE

To introduce the basic chemistry concepts relevant to different branches of Engineering and Technology.

OUTCOME

On completion of the course the students are expected to have a thorough knowledge on thermodynamics, polymers, catalysis, spectroscopy and nanochemistry.

UNIT I CHEMICAL THERMODYNAMICS 9

Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation – variation of chemical potential with temperature and pressure.

UNIT II POLYMER CHEMISTRY 9

Introduction: Classification of polymers – Natural and Synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerisation. Types and mechanism of polymerisation: Addition (Free Radical, cationic, anionic and living); condensation and copolymerisation. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerisation: Bulk, emulsion, solution and suspension.

UNIT III KINETICS AND CATALYSIS 9

Introduction – reaction velocity, factors affecting reaction velocity, rate constant, order of reaction, molecularity, pseudo molecular reactions, zero, first, second and third order reactions, reactions of fractional orders, determination of order of reactions. Catalysis: Auto catalysis - Enzyme Catalysis: Michaelis-Menton equation; factors affecting enzyme catalysis. Heterogeneous Catalysis: Types of adsorption isotherms: Langmuir–Hinselwood and Rideal–Eley Mechanism.

UNIT IV PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Photoprocesses - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitisation. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. Width and intensities of spectral lines. Spectrophotometric estimation of iron. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram) and applications.

UNIT V NANOCHEMISTRY 9

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: Nanocluster, nanorod, nanotube and nanowire. Synthesis: Precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour

deposition, laser ablation; Properties and Applications. Risk discussion and Future perspectives.

TOTAL : 45 PERIODS

TEXT BOOKS

1. P. Kannan and A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2009.
2. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India, 2011

REFERENCE BOOKS

1. P.W. Atkins and de Paula Julio, "Physical Chemistry", Oxford University Press, 8th Ed., (Indian Student Edition) (2009).
2. K. K. Rohatgi-Mukherjee, "Fundamental of Photochemistry" New Age International (P) Ltd., New Delhi, 1986.
3. G.A. Ozin and A.C. Arsenault, "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.
4. V.R.Gowariker, N.V.Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International P (Ltd.,), Chennai, 2006

GE8151 COMPUTING TECHNIQUES L T P C
3 0 0 3

OBJECTIVE

To introduce the basic knowledge about computers and fundamentals of C programming.

OUTCOME

On completion of the course the students are expected to have a thorough knowledge on computers and C programming.

UNIT I INTRODUCTION 8

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

UNIT II C PROGRAMMING BASICS 10

Problem formulation – Problem Solving - Introduction to ' C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS 9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V STRUCTURES AND UNIONS 9

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL : 45 PERIODS

TEXTBOOKS

1. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Yashavant P. Kanetkar. " Let Us C", BPB Publications, 2011.

REFERENCES

1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
2. Byron S Gottfried, " Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007

GE8152 ENGINEERING GRAPHICS L T P C
2 0 3 4

OBJECTIVE

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

OUTCOME

On completion of the course the students are expected to have a thorough knowledge on design of various engineering products and technical drawings.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 1

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 14

Basic Geometrical constructions, Curves used in engineering practices

Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, **Scales:** Construction of Diagonal and Vernier scales.

Visualization concepts and Free Hand sketching : Visualization principles – Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 14

Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 14

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 14

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 15

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) 3

Introduction to drafting packages and demonstration of their use.

TOTAL: 75 PERIODS

TEXT BOOKS

1. N.D.Bhatt and V.M.Panchal, "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010

REFERENCES

1. K.R.Gopalakrishna., "Engineering Drawing" (Vol I&II combined) Subhas Stores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,'' Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production", Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International (P) Limited ,2008.
5. K. V.Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
6. 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. The examination will be conducted in appropriate sessions on the same day

PH8161 **PHYSICS LABORATORY** **L T P C**
(common to all branches of B.E./B.Tech. Programmes) **0 0 2 1**

OBJECTIVE
To make the students understand and get hands-on in the basic concepts of practical Physics.

OUTCOME
Familiarizes the basic concept in experiments and provide strong platform to apply hands-on experience gained here for experimenting higher level concepts.

1. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of disc
2. Non – uniform bending – Determination of young's modulus
3. Lee's disc – Determination of thermal conductivity of a bad conductor
4. Potentiometer – Determination of thermo e.m.f. of thermocouple
5. Air wedge – Determination of thickness of a thin sheet of paper
6. i. Optical fibre – Determination of Numerical Aperture and acceptance angle
   ii. Compact disc – Determination of width of the groove using laser
7. Acoustic grating – Determination of velocity of ultrasonic waves in liquids
8. Post office box – Determination of Band gap of a semiconductor
9. Spectrometer – Determination of wavelength using grating
10. Viscosity of liquids – Determination of co-efficient of viscosity of a liquid by Poiseuille's flow

TOTAL : 30 PERIODS

CY8161 **CHEMISTRY LABORATORY** **L T P C**
(Common to all branches of Engineering and Technology) **0 0 2 1**

OBJECTIVE
To provide hands-on experience in using PH meter, potentiometry, titration methods and estimating the strength of given solutions.

OUTCOME
Ability to perform all kinds of titrations and estimate the unknown chemical samples.

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer

(1,10- phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of poly vinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics – ester hydrolysis.
13. Corrosion experiment – weight loss method.
14. Determination of CMC.
15. Phase change in a solid.

TOTAL : 30 PERIODS

REFERENCE BOOKS

1. A text of quantitative inorganic analysis, A. L. Vogel , ELBS London. 1995.
2. Experiments in physical chemistry, D.P. Shoemarker and C.W. Gardad, McGraw Hill, London, 2001.
3. American Public Health Association.

GE8161 COMPUTER PRACTICES LABORATORY L T P C
0 0 3 2

OBJECTIVE

• To enable the student to learn and use the major components of a computer system
• To make the students write programs and solve problems
• To learn to use office automation tools

OUTCOME

At the end of the lab session student will be able to use MS office and generate data, solve simple problems with C-Programming Language.

LIST OF EXPERIMENTS:

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

GE8162 ENGINEERING PRACTICES LABORATORY L T P C
(Common to all Branches of B.E. / B.Tech. Programmes) **0 0 3 2**

OBJECTIVE

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

OUTCOME:

- ability to fabricate carpentry components and pipe connections including plumbing
- works.

- ability to use welding equipments to join the structures.
- ability to fabricate electrical and electronics circuits

GROUP – A (CIVIL & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICE 12

Plumbing

Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.

Laying pipe connection to the suction side of a pump – inlet.

Laying pipe connection to the delivery side of a pump – out let.

Practice in mixed pipe connections: Metal, plastic and flexible pipes used in household appliances.

Wood Work

Sawing, planning and making common joints: T-Joint, Mortise and Tennon joint, Dovetail joint.

Study

Study of joints in door panels, wooden furniture

Study of common industrial trusses using models.

2. ELECTRICAL ENGINEERING PRACTICE 9

Basic household wiring using switches, fuse, indicator – lamp etc.,

Preparation of wiring diagrams

Stair case light wiring

Tube – light wiring

Study of iron-box, fan with regulator, emergency lamp

GROUP – B (MECHANICAL AND ELECTRONICS) 15

3. MECHANICAL ENGINEERING PRACTICE

Welding

Arc welding of butt joints, lap joints, tee joints

Gas welding Practice.

Basic Machining

Simple turning, drilling and tapping operations.

Machine assembly Practice.

Study and assembling the following:

Centrifugal pump, mixies and air conditioners.

Demonstration on

(a) Smithy operations like the production of hexagonal bolt.

(b) Foundry operation like mould preparation for grooved pulley.

4. ELECTRONIC ENGINEERING PRACTICE **9**

Soldering simple electronic circuits and checking continuity.

Assembling electronic components on a small PCB and testing.

Study of Telephone, FM radio, low-voltage power supplies.

TOTAL: 45 PERIODS

HS8251 **TECHNICAL ENGLISH II**

(For all branches of B.E / B.Tech programmes) **LT P C**

3 1 0 4

OBJECTIVE

- To make the students acquire listening and speaking skills meant for both formal and informal contexts
- To help them develop their reading skills by exposing them to different types of reading strategies
- To equip them with writing skills needed for academic as well as workplace situations
- To make them acquire language skills at their own pace by using e-materials and language lab component

OUTCOME

On completion of the course the students are expected to acquire various linguisdics skills required for academic and work place situations.

UNIT I **9+3**

Listening - Listening to informal conversations and participating**; Speaking -** Opening a conversation (greetings, comments on something, weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); **Reading -** Developing analytical skills, Deductive and inductive reasoning - Extensive reading**; Writing -** Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; **Grammar -** Regular & irregular verbs - Active and passive voice**; Vocabulary -** Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); **E-materials -** Interactive exercise on Grammar and vocabulary – blogging; **Language Lab -** Listening to different types of conversation and answering questions.

UNIT II **9+3**

Listening - Listening to situation based dialogues**; Speaking -** Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); **Reading -** Reading a short story or an article from newspaper, Critical reading, Comprehension skills**; Writing -** Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his success, thanking one's friend / relatives); **Grammar -** modal verbs, Purpose expressions**; Vocabulary -** Phrasal verbs and their meanings, Using phrasal verbs in sentences**; E-materials -** Interactive exercise on Grammar and vocabulary, Extensive reading activity (reading stories / novels from links), Posting reviews in blogs - **Language Lab -** Dialogues (Fill up exercises), Recording students' dialogues.

UNIT III **9+3**

Listening - Listening to the conversation - Understanding the structure of conversations**; Speaking -** Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret etc.); **Reading -** Speed reading – reading passages with the time limit - Skimming**; Writing -** Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading the articles from the journals - Format for the journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; **Grammar -** Conditional clauses - Cause and effect expressions; **Vocabulary -** Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); **E-materials -** Interactive exercise on Grammar & vocabulary - Speed Reading practice exercises; **Language Lab -** Intonation practice using EFLU materials – Attending a meeting and writing minutes.

UNIT IV **9+3**

Listening - Listening to a telephone conversation, Viewing a model interview (face-to-face, telephonic and video conferencing) and observing the practices**; Speaking -** Role play practice in telephone skills - listening and responding, -asking questions, -note taking –

passing on messages, Role play and mock interview for grasping the interview skills; **Reading -** Reading the job advertisements and the profile of the company concerned – scanning**; Writing -** Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate**; Grammar -** Numerical expressions - Connectives (discourse markers); **Vocabulary -** Idioms and their meanings – using idioms in sentences**; E-materials -** Interactive exercises on Grammar & Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; **Language Lab -** Telephonic interview – recording the responses - e-résumé writing.

UNIT V **9+3**

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener**; Speaking -** Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique**; Reading -** Note making skills – making notes from books, or any form of written materials - Intensive reading **Writing -** Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); **Grammar -** Use of clauses**; Vocabulary –** Collocation**; E-materials -** Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises - Pictures for discussion; **Language Lab -** Different models of group discussion

TOTAL : 60 PERIODS

TEXT BOOKS

1. Mindscapes: English for Technologists and Engineers, Department of English, Anna University, Chennai, 2012 .
2. S.P. Dhanavel, English and Communication Skills for Students of Science and Engineering. Orient Black Swan, Chennai, 2011.

REFERENCE BOOKS

1. Laws, Anne. **Presentations.** Hyderabad: Orient BlackSwan, 2000.
2. Lewis, Hedwig. **Body Language: A Guide for Professionals.** New Delhi: Sage Publications, 1998.
3. Naterop, Jean B. and Rod Revell. **Telephoning in English.** Cambridge: Cambridge University Press, 1987.
4. Rutherford, Andrea J. **Basic Communication Skills for Technology**. New Delhi: Pearson Education, 2001.
5. Ur, Penny. **Teaching Listening Comprehension**. Cambridge: Cambridge University Press, 1984.

Extensive Readers

1. Abdul Kalam, A P J. **Ignited Minds: Unleashing the Power within India.** New Delhi: Penguin Books India, 2002.
2. Parameswaran, Uma. **C.V.Raman: A Biography.** New Delhi: Penguin Books India, 2011.

Web Resources

1. www.esl-lab.com
2. www.englishgrammar.org
3. www.englishclub.com
4. www.mindtools.com
5. www.esl.about.com

Attested

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MA8251 MATHEMATICS II

(Common to all branches of B.E. / B.Tech. Programmes in II Semester)

L	T	P	C
3	1	0	4

OBJECTIVE

To impart the fundamental knowledge about differential equations, vector calculus, analytic functions, complex integration and Laplace transforms.

OUTCOME

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I DIFFERENTIAL EQUATIONS 9+3

Method of variation of parameters – Method of undetermined coefficients – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT II VECTOR CALCULUS 9+3

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral and volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTION 9+3

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c$, az, $\frac{1}{z}$, z^2 - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 9+3

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT V LAPLACE TRANSFORMS 9+3

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.

REFERENCES

1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education,New Delhi, 2007.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics",Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH8255 **PHYSICS OF MATERIALS** **L T P C**

(Common to Chemical, Ceramic, Food, Leather, Industrial Biotechnology and Pharmaceutical) **3 0 0 3**

OBJECTIVE

To introduce the physics of various materials relevant to different branches of technology.

OUTCOME

On completion of the course the students are expected to have a thorough knowledge on the various materials and their physical properties.

UNIT I PREPARATION AND PROCESSING OF MATERIALS 9

Phases - Phase rule – binary systems – tie line rule – lever rule – phase diagram – invariant reactions – diffusion Fick's law - Nucleation – homogeneous and heterogeneous nucleation – Free energy of formation of a critical nucleus – crystal growth – Czochralski, Bridgman, Solution methods - Thin films – preparation: PVD method - Sol-gel method – heat treatment and hardening processes..

UNIT II PROPERTIES OF CONDUCTING AND SUPERCONDUCTING MATERIALS 9

Classical free electron theory of metals –Fermi function - Schrödinger wave equation - Time independent and time dependent equations. Physical significance of wave function, particle in a box (in one dimension) – electrons in a metal - Density of energy states – effect of temperature on Fermi energy – carrier concentration in metals - Superconducting Phenomena, Properties of superconductors – Meissner effect and Isotope effect. Type I and Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS.

UNIT III ELECTRONIC MATERIALS 9

Elemental and compound semiconductors - Origin of band gap in solids (qualitative) - Concept of effective mass of electron and hole – carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Compound semiconductors – Hall effect – Determination of Hall coefficient – LED and Solar cells.

UNIT IV INSULATING AND MAGNETIC MATERIALS 9

Dielectric, paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance materials. Magnetic bubbles.

UNIT V CERAMIC AND NEW MATERIALS 9

Introduction to Ceramics and its applications - Ceramic Fibres - Fibre reinforced Plastics – Fibre reinforced Metal – Metallic glasses – Shape memory alloys – Copper base alloys – Nickel – Titanium alloys – Relaxor- Ferroelectric materials – Electro and magneto rheological fluids - Sensors and Actuators – polymer semiconductos – photoconducting polymers – liquid crystals - Bio-sensors - Scintillation detectors (Position sensitive) –Bio materials – hydroxyapatite – PMMA – Silicone.

TOTAL : 45 PERIODS

REFERENCES

1. Raghavan. V. Materials Science and Engineering, Prentice Hall of India, 2002.
2. Kumar.J, Moorthy Babu. S and Vasudevan. S., Engineering Physics, Vijay Nicole Imprints, 2006
3. Palanisamy.. P.K., Materials Science, Scitech., 2003.
4. Calister, W.D., Materials Science and Engineering an Introduction, John Wiley, 2003
5. Raghavan, V., Physical Metallurgy, Prentice Hall of India, 2002.

CY8253 CHEMISTRY FOR TECHNOLOGISTS L T P C
3 0 0 3

OBJECTIVE

To introduce the chemistry involved in various technology.

OUTCOME

On completion of the course the students are expected to have a thorough knowledge on the chemistry of water, interfaces, oils, fats, chemicals and colorants.

UNIT I WATER 9

Water quality parameters- determination of hardness (EDTA method), TDS, BOD, COD and iron and their significance. Softening – Zeolite and demineralization processes. Boiler troubles and remedies – removal of oils and silica, internal conditioning. Desalination by electro-dialysis and reverse osmosis. Water quality parameters and standards for textile wet processing.

UNIT II CHEMISTRY OF INTERFACES 9

Interface region-curved interfaces-thermodynamics of surfaces - Surface film on liquids-Adsorption of gases on Solids-adsorption isotherms. Applications of adsorption studies-detergency, wetting, foaming , defoaming, spreading, water repellency.

UNIT III OILS, FATS, SOAPS & LUBRICANTS 9

Chemical constitution, Chemical analysis of oils and fats – acid, saponification and iodine values, Definitions, determinations and significance.Definition, mechanism of lubrication, preparation of petrolubes, desirable characteristics – viscosity, viscosity index, carbon residue, oxidation stability, flash and fire points, cloud and pour points, aniline point. Semisolid lubricant – greases, preparation of sodium, lithium, calcium and axle greases and uses, consistency test and drop point test. Solid lubricants – graphite and molybdenum disulphide

UNIT IV CHEMICALS AND AUXILIARIES 9

Surfactant Chemistry, bleaching powder, sodium hypochlorite, hydrogen peroxide, chlorine dioxide, preparation, estimation of available chlorine in hypochlorite bleach liquor. determination of strength of hydrogen peroxide.

UNIT V COLORANTS 9

Theory of color and constitution: chromophore and auxochrome,classification of dyes based on application. Chemistry and synthesis of , azo dye.

TOTAL : 45 PERIODS

REFERENCES

1. Dhara S. S., "A Text Book of Engineering Chemistry", S. Chand & Co. Ltd., New Delhi, 2002
2. Jain. P.C. and Monica Jain, "Engineering Chemistry", Dhanpet Rai & Sons, New Delhi, 2001
3. Puri B. R., Sharma L. R. and Madhan S. Pathania, "Principles of Physical Chemistry", Shoban Lal Nagin Chand & Co., Jalandar, 2000
4. Shore J., "Colourants and Auxiliaries: Volume I Colorants", Wood head Publishing Ltd., 2002, ISBN 0 901956 77 5
5. Shore J., "Colourants and Auxiliaries: Volume II Auxiliaries", Wood head Publishing Ltd., 2002, ISBN 0 901956 78 3
6. Trotman E. R., "Dyeing and Chemical Technology of Textile Fibres", B.I Publishing Pvt. Ltd., New Delhi, 1994
7. Shenai V. A., "Chemistry of Dyes and Principles of Dyeing", Sevak Publications, Mumbai, 1995

GE8251 ENGINEERING MECHANICS L T P C
3 1 0 4

OBJECTIVE

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering

OUTCOME

On completion of the course the students are expected to study the effect of force and motion in various design functions of engineering

UNIT I BASICS AND STATICS OF PARTICLES 9 + 3

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces — Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES 9 + 3

Free body diagram – Types of supports –Action and reaction forces –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 – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9 + 3

Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

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UNIT IV DYNAMICS OF PARTICLES 9 + 3

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

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 9 + 3

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004)
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCES

1. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education (2010).
2. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education (2006)
3. J.L.Meriam and L.G.Kraige, " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2,Third Edition, John Wiley & Sons,(1993)
4. Rajasekaran, S and Sankarasubramanian, G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., (2005).

CH8201 PRINCIPLES OF CHEMICAL ENGINEERING L T P C
3 0 0 3

AIM

To introduce and provide an overview of chemical engineering

OBJECTIVE

To learn the history of Chemical Engineering, components of Chemical Engineering, concepts of Unit Operations and Unit Processes and modern view of Chemical Engineering accompanied with plant visits.

OUTCOME

To gain knowledge in various unit operations in chemical and petroleum industry. To get acquainted with the principles used in design of multiphase reactors.

UNIT I 5

Chemistry, Chemical Engineering and Chemical Technology; Chemical process industries: History and their role in Society; Role of Chemical Engineer; History and Personalities of Chemical Engineering; Greatest achievements of Chemical Engineering.

UNIT II 12

Components of Chemical Engineering: Role of Mathematics, Physics, Chemistry and Biology; Thermodynamics, Transport Phenomena, Chemical Kinetics and Process dynamics, design and control.

UNIT III 12

Concept of Unit Processes and Unit Operations; Description of different Unit Processes and Unit Operations; Designing of equipments; Flowsheet representation of process plants, Evolution of an Industry – Sulphuric acid and Soda ash manufacture. Demonstration of simple chemical engineering experiments; Plant visit to a chemical industry

UNIT IV **12**

Role of Computer in Chemical Engineering; Chemical Engineering Software; Visit to Process Simulation Lab; Relation between Chemical Engineering and other engineering disciplines; Traditional vs. modern Chemical Engineering; Versatility of Chemical Engineering : Role of Chemical Engineers in the area of Food, Medical, Energy, Environmental, Biochemical, Electronics etc. Plant visit to an allied industry.

UNIT V **4**

Paradigm shifts in Chemical Engineering; Range of scales in Chemical Engineering; Opportunities for Chemical Engineers; Future of Chemical Engineering.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", 6th Edition, Tata McGraw Hill, 1997.
2. Dryden, C.E., "Outlines of Chemicals Technology", Edited and Revised by Gopala Rao, M. and M.Sittig, 2nd Edition, Affiliated East-West press, 1993.
3. Randolph Norris Shreve, George T. Austin, "Shreve'e Chemical Process Industries", 5th edition, McGraw Hill, 1984

REFERENCES

1. McCabe, W.L., Smith, J. C. and Harriot, P. "Unit operations in Chemical Engineering", McGraw Hill, 7th Edition, 2001
2. Finlayson, B. A., Introduction to Chemical Engineering Computing, John Wiley & Sons, New Jersey, 2006.

EE8252 PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING **L T P C**
3 0 0 3

OBJECTIVE

- To introduce the fundamental concept of electrical and electronics engineering such as electronic components, circuits, logic gates and digital circuits etc.

OUTCOMES

- Familiarize with different electronic components and its devices.
- Acquaint the knowledge of various circuits and amplifiers.
- Understand the concepts of logic gates and digital circuits.
- Impart knowledge in measurements and instruments.
- Able to understand various parameters of microprocessors and its applications.

UNIT I ELECTRICAL CIRCUITS **9**

Basic principles involved in power generation, transmission and use – Ohms Law Kirchoff's Law – steady state solution of DC circuits – Theorem: Thevinin's, Norton's and Superposition Theorems.

UNIT II AC CIRCUITS **9**

Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three-phase balanced circuits, housing wiring, industrial wiring, materials of wiring.

UNIT III ELECTRICAL MACHINES **9**

Principles of operation and characteristics of DC machines. Transformers (single and three-phase) – synchronous machines – three-phase and single-phase induction motors – (op. Principles).

UNIT IV ELECTRONIC DEVICES & CIRCUITS 9

Types of Materials –Silicon & Germanium- N type and P type materials – PN Junction – Forward and Reverse Bias –Semiconductor Diodes –Rectification – Bipolar Junction Transistor – Characteristics – transistor as an Amplifier –Introduction to operational Amplifier –Inverting Amplifier –Non Inverting Amplifier –DAC – ADC .

UNIT V MEASUREMENTS & INSTRUMENTATION 9

Introduction to transducers: pressure, temperature, position, electrical measurements - Classification of instruments – moving coil and moving iron ,Ammeter and Voltmeter – multimeters – dynamometer type Wattmeter – three-phase power measurements – energy meter – megger – instrument transformer (CT and PT)

TOTAL : 45 PERIODS

REFERENCES

1. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2007
2. John Bird, “Electrical Circuit Theory and Technology”, Elsevier, First Indian Edition, 2006
3. Allan S Moris, “Measurement and Instrumentation Principles”, Elseveir, First Indian Edition, 2006
4. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall of India, 2006
5. Thereja .B.L., “Fundamentals of Electrical Engineering and Electronics”, S. Chand & Co. Ltd., 2008
6. Sanjeev Sharma, “Basics of Electrical Engineering”, S.K International Publishers, New Delhi, 2007
7. V.K Mehta and Rohit Mehta, “Principle of Electrical Engineering”, S. Chand & Company, 2008

CY8261 APPLIED CHEMISTRY LAB L T P C
0 0 2 1

OBJECTIVE

- To make the student acquire practical skills in the wet chemical and instrumental methods for quantitative estimation of hardness, alkalinity, metal ion content, corrosion in metals and cement analysis.

OUTCOMES:

- Able to solve problems related to engineering chemistry
- Familiarization with equipment like viscometers, flash point apparatus etc
- Familiarization of methods for determining COD, chlorine content, acidity etc
- Familiarisation of a few simple synthetic techniques for soap, dyes, defoamers etc

LIST OF EXPERIMENTS

1. Preparation of solutions with various normality and molarity.
2. Determination of Redwood / Saybolt numbers, kinematic viscosity and viscosity index of lubricating oils
3. Determination of flash point, fire point, cloud and pour point of oils
4. Determination of acid value, saponification number and iodine value of oils
5. Determination of total, temporary, permanent, calcium and magnesium hardness of water samples
6. Determination of chloride, sulphate ,and COD of water samples
7. Determination of purity of washing soda and strength of a commercial acid
8. Estimation of available chlorine in hypochlorite solution
9. Estimation of strength of hydrogen peroxide
10. Synthesis of a dye, preparation of soap and a defoamer

TOTAL : 45 PERIODS

Attested

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CH8261 **UNIX PROGRAMMING LAB** **L T P C**
0 0 4 2

OBJECTIVES

The aim is to introduce working in UNIX environment.

OUTCOMES

- To introduce the basic commands in UNIX.
- To teach UNIX shell programming.
- To introduce programming in C with UNIX system calls.

1. Basic Unix commands
   - i) Directory Related Commands
   - ii) File Related Commands.
   - iii) File Compression Related Commands
   - iv) Network Communication Commands
   - v) Commands for sending messages between the users
   - vi) Miscellaneous Commands
2. Editors for file operations.
   - i) Vi Editor
   - ii) Gedit
   - iii) Kwrite
3. Filters and Pipes
   - i) Concatenating Files
   - ii) Display beginning and End of Files
   - iii) Cut and Paste
   - iv) Sorting
   - v) Translating Characters
   - vi) Count Characters, words, Lines
   - vii) Comparing Files
4. Grep Operations – Grep, Fast Grep, Extended Grep
5. Sed Operations – Sed Scripts,Addresses,Commands
6. Awk
7. Input Redirection and Out Redirection Commands
8. Simple shell programming.
9. Shell programming using complex control structures
   - i) if - fi
   - ii) if-else-fi
   - iii) if-elif
   - iv) case-esac
   - v) while- do- done
   - vi) For-do-done
10. Shell Programming using Arrays & Functions .
11. C Programs using file system related system calls.
12. C Programs using process related system calls.
13. Programs for inter process communication using pipes, FIFOs.
14. Programs using signals.
15. Programs using shared memory.

TOTAL : 60 PERIODS

TEXT BOOK

1. Brain W. Kernighan and Rob Pike, “The programming Environment”, PHI, 2002.

REFERENCE

1. Neil Matthew,Richard Stones, “”Linux Programming”,3rd Edition,2004.

Attested

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MA8356 PROBABILITY AND STATISTICS L T P C
3 1 0 4

OBJECTIVES

- To make the students acquire a sound knowledge in statistical techniques that model engineering problems.
- The Students will have a fundamental knowledge of the concepts of probability.

OUTCOMES`

- To make students acquire a sound knowledge in statistical techniques
- To make students acquire fundamental knowledge about probability concepts
- To make students understand concepts like random variables
- To make students understand concepts like design of experiments
- To make students understand concepts like SQC

UNIT I RANDOM VARIABLES 9+3

Discrete and Continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions - Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 9+3

Joint distributions – Marginal and Conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTS OF SIGNIFICANCE 9+3

Sampling distributions - Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – $\chi 2$-test for goodness of fit – Independence of attributes – Non-parametric tests: Test for Randomness and Rank-sum test (Wilcoxon test).

UNIT IV DESIGN OF EXPERIMENTS 9+3

Completely randomized design – Randomized block design – Latin square design - 2^2 - factorial design - Taguchi's robust parameter design.

UNIT V STATISTICAL QUALITY CONTROL 9+3

Control charts for measurements ($\overline{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Milton, J. S. and Arnold, J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, New Delhi, 4th Edition, 3rd Reprint, 2008.
2. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2011.

REFERENCES

1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, New Delhi, 7th Edition, 2008.
2. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, New Delhi, 3rd Edition, 2004.
4. Spiegel, M.R., Schiller, J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill, New Delhi, 2004.

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CY8301 ORGANIC CHEMISTRY L T P C
3 0 0 3

AIM

To study the type of components in which organic reactions take place and also to know the preparation of the essential organic compounds.

OBJECTIVES

At the end of the course students will be in a position to have knowledge on various reaction mechanism, preparation of organic compounds and their properties. This will be a precursor for the study on Chemical Reaction Engineering.

OUTCOME

To gain basic principles involved in different chemical syntheses and apply them in chemical and petrochemical industries

UNIT I CARBOHYDRATES 9

Introduction – various definitions and classifications of carbohydrates – Preparation, Physical & Chemical propertie, Structure and Uses of Monosaccharides (Glucose & Fructose)
Interconversions – Aldo pentose to aldo hexose–Aldo hexose to aldo pentose- aldose to isomeric Ketose – Ketose to isomeric Aldose – Aldose to epimer

UNIT II HETEROCYCLIC COMPOUNDS 9

Preparation, Physical & Chemical properties and Uses of Pyrrole, Furan, Furfural, TetrahydroFuran, Thiophene, Indole, Pyridine, Quinoline and Isoquinoline.

UNIT III DYE CHEMISTRY 9

Witt's theory and modern theory of colors – Synthesis of Methyl red, Methyl orange, Congo red, Malachite green, para-rosaniline, phenolphthalein, fluorescence, Eosin dyes.

UNIT IV SYNTHETIC ORGANIC CHEMISTRY 9

Preparation and Synthetic utilities of Grignard reagent, Ethyl aceto acetate and Malonic ester.

UNIT V PHARMACEUTICAL CHEMISTRY 9

Synthesis of Antimalarial drugs – isopentaquine and chloroquine Synthesis of Antibacterial drugs – Sulphaniliamide and Sulphapyridine.

TOTAL : 45 PERIODS

TEXT BOOKS

1. R.T. Morrison and R.N. Boyd "Organic Chemistry" VI Edition Prentice Hall Inc (1996) USA.
2. K.S. Tiwari, N.K. Vishnoi and S.N. Malhotra "A text book of Organic Chemistry" Second Edition, Vikas Publishing House Pvt. Ltd. (1998) New Delhi.

REFERENCE BOOKS

1. Chemistry in Engineering and Technology, Vol.2, TMH Publishing Co Ltd., New Delhi, 1994.
2. I L Finar "Organic Chemistry" ELBS (1994).

Attested

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Centre For Academic Courses
Anna University, Chennai-600 025.

AS8304 PETROLEUM ENGINEERING L T P C
4 0 0 4

AIM
To get familiarized with basic subsurface and surface production operations and equipment used.

OBJECTIVES
To understand typical problems during completion and production of a well and learn possible remedial measures to improve wellbore productivity.

OUTCOME
To Know surface facility equipment and facilities for production and separation of hydrocarbons.
Knowledge of different types of bottom hole production tools and their utility.
Understanding of multiphase flows and their equations for production operations.

UNIT I INTRODUCTION 12
Refinery products – Refinery Feeds – Crude distillation – Coking and thermal process.

UNIT II CATALYTIC CRACKING 12
Catalytic Cracking - Catalytical hydro cracking – Hydroprocessing and Reused processing hydro treating.

UNIT III CATALYTICAL 12
Reforming and isomerization alkylation and polymerization – Product blending – Supporting processes.

UNIT IV LUBRICIATING 12
Lubriciating oil blending stocks petrochemical feedstocks.

UNIT V COST EVALUATION 12
Cost Evaluation – Economic evaluation of petroleum reused and refineries.

TOTAL : 60 PERIODS

TEXT BOOKS
1. Petroleum Refining : Technology and economics CRC Press V Edition 2007 J.CH Garry , Hardward G.E and M.J.Kaiser.
2. Modern Petroleum Technology Upstream Vol I A.G. Lucas Hurley Edition 2002.
3. Modern Petroleum Technology Downstream Vol II A.Lucas Hurley VI Edition 2002.

AS8305 FLUID MECHANICS FOR PETROCHEMICAL ENGINEERS L T P C
3 1 0 4

AIM
To have a general idea about the Mechanism of fluid, fluid flow, flow measuring devices through basic concepts and fluid dynamics in Porous Media.

OBJECTIVES
The subject will help the students to have knowledge on the fluid properties, their characteristics while static and during flow through ducts, pipes and porous medium. Knowledge on several machineries used to transport the fluid and their performance are assessed.

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OUTCOME
To impart to the student knowledge on fluid properties, fluid statics, dynamic characteristics for through pipes and porous medium, flow measurement and fluid machineries.

UNIT I **12**
The concept of fluid, the fluid as a continuum physical and thermodynamic properties – basic laws – Newtorian and non-newtorian fluids – flow patterns – Velocity field – streamlines and stream tubes – vorticity and irrotationality.
The principle of dimensional hormogeneity – dimensional analysis, the Pi-theorems. Similitude – use of dimensional analysis for scale up studies.

UNIT II **12**
Pressure and Pressure gradient – equilibrium of fluid element – hydrostatic pressure distributions – application to manometry – mass, energy and momentum balances – continuity equation, equation of motion, Navier – stokes equation and Bernoullis theorem.

UNIT III **12**
Reynold's number regimes, flow through pipes – head loss, friction factor, minor losses in pipe systems and multiple pipe systems – boundary layer concepts, drag forces on solid particles in fluids – flow through fixed and fluidized beds.

UNIT IV **12**
Constant and variable head meters – pipes, fittings and valves, classification of pumps – performance, curves – compressors and its efficiency. Introduction to compressible flow, comparison of adiabatic and isothermal flow of gases.

UNIT V **12**
Fluid dynamics in Porous Media – Hydrostatic pressure and geothermal gradients. Porosity – permeability relationships and rock microstructure. Diffusivity equation steady state, pseudo-steady state and transfer flow Radial flow and well models. Skin, partial penetration and well productivity index. Horizontal wells. Gas flow and Kbinkenberg effect.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Neol de Nevers, "Fluid Mechanics for Chemical Engineers." II Edition, Mc.Graw Hill (1991).
2. James O.Wilkes and Stacy G.Bikes, "Fluid Mechanics for Chemical Engineers" Prentice Hall PTR (International Series in Chemical Engineering) – (1999).
3. Mc.Cabe W.L.Smith, J.C and Harriot..P "Unit operations in Chemical Engineering", Mc.Graw Hill, V Edition, 2001.

REFERENCES

1. White F.M., "Fluid Mechanics", IV Edition, Mc.Graw – Hill Inc. 1999.
2. Darby, R. "Chemical Engineering Fluid Mechanics" Marcel Decker, 1998.

CH8302 **PROCESS CALCULATIONS** **L T P C**
3 0 0 3

AIM
The aim of this course is to give fundamental knowledge on material and energy balances and steady state simulation.

OBJECTIVES
To teach concept of degree of freedom and its application to solution of mass and energy balance equations for single and network of units and introduce to process simulators.

OUTCOME
To apply the optimization techniques in planning and allocation of available resources.

To use statistical methods and regression analysis in analyzing and interpreting experimental data.

UNIT I **6**

Units, dimensions and conversion; Process variables and properties; Stoichiometric Equations, Degrees of freedom.

UNIT II **11**

Introduction to material balances. Material balance problems for single units; Stoichimetry and Chemical reaction equations; materials balances for processes involving reactions bypass, purging, recycle operations.

UNIT III **11**

Ideal gases, Real gases, Single component two phase systems, Multiple component phase systems, Phase rule, Phase equilbria, Combustion processes.

UNIT IV **11**

Energy balances, Conservation of Energy processes without reaction, Heat capacity, Energy balances with chemical reaction, Efficiency applications.

UNIT V **6**

Application of energy balances. Unsteady state material and energy balances. Solving material and energy balances using process simulators.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", EEE Sixth Edition, Prentice Hall Inc., 2003
2. Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes",3rd Edn., John Wiley & Sons, New York, 2000.
3. Bhatt, B.L., Vora, S.M., "Stoichiometry ", 4th Edition,Tata McGraw-Hill (2004)

REFERENCE

1. Hougen O A, Watson K M and Ragatz R A, "Chemical process principles" Part I, CBS publishers (1973).

ME8351 BASIC MECHANICAL ENGINEERING **L T P C**
3 0 0 3

OBJECTIVE

To impart knowledge on thermodynamics and thermal engineering power generating units such as engines and theory of machines

OUTCOMES

Students learn thermodynamics and thermal engineering to understand the principles behind the operation of thermal equipments like IC engines and turbines etc., Students should be able to appreciate the theory behind operation of machinery and be able to design simple mechanisms

UNIT I LAWS OF THERMODYNAMICS **10**

Basic concepts and hints; Zeroth law; First Law of Thermodynamics - Statement and application; Steady flow energy equation-problems- Second law of Thermodynamics – Kelvin - Plank statement and Clausius statement- problems; Limitations; Heat Engine, Refrigerator and Heat Pump, Available energy, Third law of Thermodynamics - Statement.

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UNIT II HEATING AND EXPANSION OF GASES 6

Expressions for work done, Internal energy and heat transfer for Constant Pressure, Constant Volume, Isothermal, Adiabatic and Polytropic processes-Derivations and problems; Free expansion and Throttling process.

UNIT III AIR STANDARD CYCLES 6

Carnot cycle; Stirlings cycle; Joule cycle; Otto cycle; Diesel cycle; Dual combustion Cycle-Derivations and problems.

UNIT IV I.C. ENGINES, STEAM AND ITS PROPERTIES AND STEAM TURBINES 12

Engine nomenclature and classification; SI Engine; CI Engine; Four Stroke cycle, Two stroke cycle; Performance of I.C.Engine; Brake thermal efficiency; Indicated Thermal Efficiency, Specific fuel consumption.

Steam - Properties of steam; Dryness fraction; latent heat; Total heat of wet steam; Dry steam; Superheated steam. Use of steam tables; volume of wet steam, volume of superheated steam; External work of evaporation; Internal energy; Entropy of vapour, Expansion of vapour, Rankine cycle.

Steam turbines – Impulse and Reaction types - Principles of operation.

UNIT V SIMPLE MECHANISM, FLY WHEEL, DRIVES AND BALANCING 11

Definition of Kinematic Links, Pairs and Kinematic Chains;

Flywheel-Turning moment Diagram; Fluctuation of Energy.

Belt and rope drives; Velocity ratio; slip; Creep; Ratio of tensions; Length of belt; Power Transmitted; gear trains-types.

Balancing of rotating masses in same plane; Balancing of masses rotating in different planes.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Nag, P.K., " Engineering Thermodynamics ", II Edition, Tata McGraw Hill Publishing Co., Ltd., 1995.
2. Rajput, R .K, “Thermal Engineering”, Laxmi publications (P) Ltd, 2001.
3. Khurmi R.S., and Gupta J.K, “Theory of Machines”, Eurasia Publishing House (P) Ltd., 2004.

REFERENCES

1. Smith, " Chemical Thermodynamics ", Reinhold Publishing Co., 1977.
2. Bhaskaran, K.A., and Venkatesh, A., " Engineering Thermodynamics " Tata McGraw Hill, 1973.
3. Pandya A. and Shah, " Theory of Machines ", Charatakar Publishers, 1975.
4. Khurmi R.S., and Gupta J.K, “Thermal Engineering”, S.Chand & Company (P) Ltd.,2001.
5. Kothandaraman and Dhomkundwar,”: A course in Thermal Engineering (SI Units)”, Dhanpat Rai and Sons, Delhi (2001)

CH8311 ELECTRICAL ENGINEERING LABORATORY FOR TECHNOLOGISTS L T P C 0 0 4 2

OBJECTIVES

To provide the practical knowledge and control methods of electrical machines

OUTCOMES

To impart practical knowledge on

I. Characteristics of different machines
II. Method of speed control of machines
III. Measurement of various electrical parameters.

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1. Study of Starters
2. Power Measurements in Three-Phase Circuits
3. Speed Control of DC Motor
4. Load Test on DC Shunt Motor
5. OCC & Load Test on DC Shunt Generator
6. Load Test on DC series motor.
7. OC and SC Test on Single- Phase Transformer
8. Load Test on Single-Phase Transformer
9. Load Test on Single-Phase Induction Motor
10. Load Test on Three-Phase Induction Motor
11. Load Characteristics of Alternator.

TOTAL : 60 PERIODS

CH8312 ORGANIC CHEMISTRY LABORATORY L T P C
0 0 4 2

AIM
To learn qualitative analysis of organic compounds.

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

OUTCOME
To gain knowledge in preparation methods of various chemicals and purifying them using different techniques.

1. Quantitative analysis of organic compounds – Identification of 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) imide i) nitro compounds.
3. Analysis of an unknown organic compound and preparation of suitable solid derivatives.
4. Analysis of carbohydrates.

5. Analysis of proteins.

6. Methodology of filtration and recrystallization.

7. Introduction to organic synthetic procedures:

i. Acetylation – Preparation of acetanilide from aniline.

ii. Hydrolysis – Preparation of salycilic acid from methyl salyciliate.

iii. Substitution – Conversion of acetone to iodoform.

iv. Nitration – Preparation of m-dinitrobenzene from nitrobenzene.

v. Oxidation – Preparation of benzoic acid from benzaldehyde/ benzyl alcohol

TOTAL : 60 PERIODS

REFERENCE MANUAL
1. Organic Chemistry Lab Manual, Chemistry Division, Chemical Engineering Department, A. C. Tech, Anna University (2007).

ME8361 MECHANICAL ENGINEERING LABORATORY L T P C
0 0 3 2

OBJECTIVES
To impart practical knowledge in operating IC engines and conduct experiments. To understand test procedures in testing material for engineering applications

OUTCOMES
- Students will be able to understand Power-generating units such as engines and operate IC engines and conduct tests. They will be able to appreciate the theory behind the functioning of engines. Material properties, their behavior under different kinds of loading and testing can be visualized.

LIST OF EXPERIMENTS *

1. Port timing diagram
2. Valve timing diagram
3. Study of 2,4 stroke I C Engines
4. Load test on 4-stroke petrol engine
5. Performance test on 4-stroke single cylinder diesel engine
6. Performance test on 4-stroke twin cylinder diesel engine
7. Heat balance test on diesel engines
8. Tension test
9. Compression test
10. Deflection test
11. Hardness test (Rockwell and Brinell)
12. Spring test
13. Torsion test
14. Impact test

TOTAL : 45 PERIODS

* Minimum 10 experiments shall be offered

MA8353 NUMERICAL METHODS L T P C
3 1 0 4

OBJECTIVE:
This course aims at providing the necessary basic concepts of a few numerical methods and give procedures for solving numerically different kinds of problems occurring in Engineering and Technology.

OUTCOME:
It helps the students to have a clear perception of the power of numerical techniques, ideas and would be able to demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton-Raphson method- Solution of linear system of equations - Gauss Elimination method – Pivoting - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method and by Jacobi's method.

UNIT II INTERPOLATION AND APPROXIMATION 9+3
Interpolation with unequal intervals - Lagrange interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae – Least square method - Linear curve fitting.

UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION 9+3

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9+3

Single step-methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations - Multi-step methods - Milne's and Adams-Bashforth predictor-corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9+3

Finite difference methods for solving two-point linear boundary value problems. Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank-Nicholson) methods - One dimensional wave equation by explicit method.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal, B.S. and Grewal,J.S., "Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, 9th Edition, 2007.
2. Sankara Rao, K. "Numerical methods for Scientists and Engineers', Prentice Hall of India Private Ltd., New Delhi, 3rd Edition,2007.

REFERENCES

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education Asia, New Delhi, 1st Edition, 2007.
2. Gerald, C.F. and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education Asia, New Delhi, 6th Edition, 2006.
3. Laurene V. Fausett, "Applied Numerical Analysis using MATLAB", Pearson Education, New Delhi, 1st print, 2nd Edition, 2009

CY8451 PHYSICAL CHEMISTRY L T P C
3 0 0 3

AIM

To know the basic concepts of physical chemistry and its applications.

OBJECTIVES

To acquire knowledge in the field of electrochemistry, solubility behaviour, chemical reaction kinetics, photochemical reactions and colloidal chemistry towards different applications.

OUTCOME

To apply the knowledge in kinetics and electrochemistry to different chemical and petrochemical processes.

UNIT I ELECTROCHEMISTRY 9

Electrical Resistance – Specific Resistance – Electrical conductance – Specific conductance – Equivalent conductance – Cell constant- Determination of cell constant – variation of conductance with dilution – Kohlrausch's law –Single electrode potential – Galvanic cell – Cu – Zn cell - EMF and its measurement – Reference electrode – Standard Hydrogen Electrode – Calornel electrode – Nernst equation - Electrochemical series – Applications of EMF Measurements: Fuel cells – Hydrogen -Oxygen fuel cell .

UNIT II CHEMICAL KINETICS 9

Rate of a reaction-Order of a reaction – Examples and rate equations for Zero order, First order, Second order and Third order reactions –Molecularity of a reaction – Unimolecular and Bimolecular reactions – Half life period– Kinetics of parallel and opposing reactions – Activation energy – Arrhenius equation –Collision theory of reaction rates – Theory of absolute reaction rates – Michalis Menton kinetics of enzyme catalyzed reactions.

UNIT III PHOTOCHEMISTRY 9

Laws of Photochemistry, Beer–Lambert's law- Grothus & Drapper's law- Stark Einstein's law- Quantum efficiency– Reason for difference in quantum efficiency –Method of determination of quantum yield. Photochemical reactions, Actinometry – Uranyl oxalate method only – Kinetics and mechanism of Hydrogen – Bromine reaction, Hydrogen – Chlorine reaction – Photosensitization- Photo inhibitor- Chemiluminescence.

UNIT IV COLLOIDS 9

Introduction to colloids – properties of colloids – coagulation of solutions – Origin of charge on colloidal particles – Determination of size of colloidal particles – Donnan Membrane equilibrium – Emulsions – Gels – Applications of colloids – Nanoparticles (Au, Ag, Pt) – Preparation – Characterization – Properties – Application in catalysis and drug delivery systems.

UNIT V THE DISTRIBUTION LAW 9

Distribution co-efficient - Distribution Law –– Conditions for the validity of the Distribution law – I_2–CCl_4–H_2O System – Nature of interaction of the solute with one of the solvents – Dissociation- Association – Applications of Distribution law – Process of Extraction.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kund and Jain, Physical Chemistry, S.Chand and Company, New Delhi (1996).
2. Puri B.H. Sharma L.R. and M.S.Prathama, "Principles of Physical Chemisry", S.Chand and Company, New Delhi (2001).
3. B.S.Bahl, Arun Bahl and G.D.Tuli, "Essentials of Physical Chemistry", S.Chand and Company, New Delhi (2005).

REFERENCES

1. Gordon M. Barrow, Physical Chemistry, Sixth Edition, Tata McGraw Hill (1998).
2. Peter Atkins & Julio de Paula, Atkins' Physical Chemistry, 7th Edition, Oxford university press.(2002).

AS8401 CHEMICAL ENGINEERING THERMODYNAMICS L T P C
3 1 0 4

AIM

To study the basic concepts involved in thermodynamics.

OBJECTIVES

To be able to calculate heat and work effects associated with a process.

OUTCOME

To learn to predict and correlate important thermodynamic properties.
To gain insight into phase equilibria and chemical equilibria.

UNIT I BASIC CONCEPTS 6

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 FIRST LAW OF THERMODYNAMICS 6

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.

UNIT III SECOND LAW OF THERMODYNAMICS 12

Statements of the second law of thermodynamics, available and unavailable energies, The entropy function, applications of the second law.

UNIT IV THERMODYNAMIC FORMULATIONS 12

Measurable quantities, basic energy relations, maxwell relations, thermodynamic formulations to calculate enthalpy, internal energy and entropy as fuction 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 THERMODYNAMIC PROPERTIES OF REAL GASES 12

The PVT behaviour of fluids, laws of corresponding states and equation of states approaches to the PVT relationships of non ideal gas problems, compressiblity factors, generalised equations of state, property estimation via generalised eqaution of state , fugacity and fugacity coefficients of real gases.

UNIT VI COMPRESSION OF FLUIDS 12

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.

TOTAL : 60 PERIODS

TEXT BOOK

1. Smith, J.M., Van Ness, H.C., " Introduction to Chemical Engineering Thermodynamics ", Kogakushai 1976.

REFERENCES

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

CH8402 HEAT TRANSFER L T P C
3 0 0 3

AIM

To understand the principles and applications heat transfer

OBJECTIVES

To learn heat transfer by conduction, convection and radiation and heat transfer equipments like evaporator and heat exchanger

OUTCOME

To learn the fundamental concepts of heat transfer principles and to apply those concepts to real engineering problems.

To be familiar with equations describing heat transfer through gases, liquids, and solids.

UNIT I 9

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer - Fourier's law of heat conduction - one dimensional steady state heat conduction equation for

flat plate, hollow cylinder, - Heat conduction through a series of resistances - Thermal conductivity measurement; effect of temperature on thermal conductivity; Heat transfer in extended surfaces.

UNIT II **9**

Concepts of heat transfer by convection - Natural and forced convection, analogies between transfer of momentum and heat - Reynold's analogy, Prandtl and Coulburn analogy. Dimensional analysis in heat transfer, heat transfer coefficient for flow through a pipe, flow past flat plate, flow through packed beds.

UNIT III **9**

Heat transfer to fluids with phase change - heat transfer from condensing vapours, drop wise and film wise condensation, Nusselt equation for vertical and horizontal tubes, condensation of superheated vapours, Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling.

UNIT IV **9**

Theory of evaporation - single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation. Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzman law, Plank's law, radiation between surfaces.

UNIT V **9**

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

TOTAL : 45 PERIODS

TEXT BOOKS

1. Holman, J. P., 'Heat Transfer ', 8th Edn., McGraw Hill, 1997.
2. Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill, 1984
3. Kern, D.Q., "Process Heat Transfer ", McGraw-Hill, 1999.

REFERENCES

1. Cabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 6th Edn., McGraw-Hill, 2001.
2. Coulson, J.M. and Richardson, J.F., "Chemical Engineering " Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998.

AS8402 **SPECTROSCOPIC TECHNIQUES** **L T P C**
3 0 0 3

AIM

To know the principle and importance of various analytical instruments used for the characterization of various materials.

OBJECTIVES

To have thorough understanding of theory, instrumentation and applications of analytical equipments used in industries for testing quality of raw materials, intermediates and finished products.

To know the importance of analytical instrumentation during the purification, compounding and formulating the finished product.

OUTCOME

To get knowledge in different analytical techniques and apply them to analyze the chemical and petroleum products explored.

UNIT I INTRODUCTION TO SPECTROSCOPIC METHODS OF ANALYSIS 9

Electromagnetic radiation - Various ranges, Dual 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.

UNIT II UV AND VISIBLE SPECTROSCOPY 9

Jablonski diagrams, Various electronic transitions in organic and inorganic compounds effected by UV and Visible radiations, Various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and Visible radiations, Choice of solvents, cut off wavelengths for solvents, Effects of auxochromes and effects of conjugation on the absorption maxima, Different shifts of absorption peaks(Bathochromic, hypsochromic, hypochromic, hyperchromic), Instrumentation for UV and Visible spectrophotometer (source, optical parts and detectors), Woodward -Fieser rules for the calculation of absorption maxima (Lamda max) for dienes and carbonyl compounds, Qualitative Spectroscopy- Lamda max and epsilon max rules, Applications of UV and Visible spectroscopy.

UNIT III QUANTITATIVE SPECTROSCOPY 9

Beer-Lambert's law, Limitations, Deviations (Real, Chemical, Instrumental), Estimation of inorganic ions such as Fe, Ni and estimation of Nitrite using Beer-Lambert's Law. Multicomponent analysis (no overlap, single way overlap and two way overlap), Photometric titration (Experimental set-up and various types of titrations and their corresponding curves).

UNIT IV IR SPECTROSCOPY 9

Theory of IR spectroscopy, various stretching and vibration modes for diatomic and triatomic molecules (both linear and nonlinear), various ranges of IR (Near, Mid, Finger print and Far) and their usefulness, Instrumentation (Only the sources and detectors used in different regions), sample preparation techniques. Qualitative analysis of alkanes, alkenes and carbonyl compounds.

UNIT V RAMAN & MOLECULAR LUMINESCENCE SPECTROSCOPY 9

Principle, Instrumentation, Applications of Raman & Luminescence spectroscopy.

TOTAL : 45 PERIODS

REFERENCES

1. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Instrumental Analysis, CENGAGE Learning, India Edition, 2007.
2. Willard H.H, Merritt L.L, Dean J.A and Settle F.A, Instrumental method of analysis, 7th edition, CBS publishers, 1986.
3. Sharma, B.K., Instrumental Methods of Analysis, Goel publishing House, 1995.
4. William Kemp, Organic Spectroscopy, 3rd Edition, Palgrave publishers, 2007.

AS8403 NATURAL GAS ENGINEERING L T P C
3 0 0 3

AIM

The main of learning this subject is that student will be able to understand the basics of Natural Gas engineering techniques.

OBJECTIVES

The objective of studying this subject is that student will be understanding the basic concept and applications of Natural Gas Engineering.

OUTCOME

To understand markets, capacities, sources and technologies issues involved in natural

gas production, processing and transport.
To get acquainted with technologies used in consumption of natural gas.

UNIT I **9**

Natural gas technology and earth science: Branches of petroleum Industry. Sources of Information for natural gas engineering and its applications. Geology and earth sciences: Earth sciences-Historical geology, Sedimentation process, Petroleum reservoirs, Origin of petroleum. Earth temperatures & pressure, Earth temperatures, Earth pressure. Petroleum : Natural gas, LP gas, Condensate, & Crude oil.

UNIT II **9**

Properties of Natural Gases: typical compositions. Equations of state: general cubic equations, specific high accuracy equations. Use of equation of state to find residual energy properties, gas measurement gas hydrates, condensate stabilization, acid gas treating, gas dehydrations, compressors, process control deliverability test, gathering and transmission, and natural gas liquefaction.

UNIT III **9**

Gas Compression: Positive displacement and centrifugal compressors; fans. Calculation of poser requirements. Compressible Flow in Pipes: Fundamental equations of flow: continuity, momentum, elegy equations.

UNIT IV **9**

Isothermal flow in pipes: the Weymouth equation. Static and flowing bottom-hole pressures in wells. Fundamentals of Gas flow in porous media: Steady state flow equations. Definition of pseudo-pressure function. Gas flow in cylindrical reservoirs: general equation for radial flow of gases in symmetrical homogeneous reservoirs.

UNIT V **9**

Non-dimensional forms of the equation; derivation of coefficients relation dimensionless to real variables. Infinite reservoir solution: Pseudo-steady-state solution. Gas Well Deliverability Tests: Flow-after-flow tests: prediction of IPR curve and AOF for the well. Isochronal tests. Draw down tests: need for data at two flow rates.

TOTAL : 45 PERIODS

TEXT BOOK

1. Katz D.L.et al., Natural Gas Engineering (Production & storage), McGraw-Hill, Singapore.

REFERENCE

1. Standard Handbook of Petroleum and Natural Gas Engineering. 2nd Edition. William C Lyons, Gary C Plisga. Gulf Professional Publishing.

CH8411 FLUID MECHANICS LABORATORY **L T P C**
0 0 4 2

AIM

To understand the concepts of fluid mechanics through experiments.

OBJECTIVES

To learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.

OUTCOME

To get acquainted with fundamentals of fluidization engineering, different regimes, classification of particles.
To understand movement of bubbles mixing in bed.

To get qualitative appreciation of mathematical models of Fluidized Bed

LIST OF EXPERIMENTS

1. Viscosity measurement of non Newtonian fluids
2. Calibration of constant and variable head meters
3. Calibration of weirs and notches
4. Open drum orifice and draining time
5. Flow through straight pipe
6. Flow through annular pipe
7. Flow through helical coil and spiral coil
8. Losses in pipe fittings and valves
9. Characteristic curves of pumps
10. Pressure drop studies in packed column
11. Hydrodynamics of fluidized bed
12. Drag coefficient of solid particle

EQUIPMENT REQUIRED

1. Viscometer
2. Venturi meter
3. Orifice meter
4. Rotameter
5. Weir
6. Open drum with orifice
7. Pipes and fittings
8. Helical and spiral coils
9. Centrifugal pump
10. Packed column
11. Fluidized bed

TOTAL : 60 PERIODS

CH8412 TECHNICAL ANALYSIS LAB L T P C
0 0 4 2

AIM

To know quantitative estimation of important chemicals.

OBJECTIVE

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

OUTCOME

To know the principles involved in different industrially important chemicals

I Soap Analysis

a. Estimation of total fatty acid

b. Estimation of percentage alkali content

II. Oil Analysis

a. Estimation of free acid

b. Determination of Saponification value

c. Determination of iodine value

III. Cement Analysis

a. Estimation of Silica content

b. Estimation of mixed oxide content

c. Estimation of calcium oxide content

d. Estimation of calcium oxide by rapid method

IV. Coal Analysis

a. Estimation of Sulphur present in coal

b. Ultimate analysis of coal

c. Proximate analysis of coal

V. Analysis of Bleaching Powder

a. Estimation of available chlorine

VI. Analysis of Glycerol

a. Estimation of purity of glycerol

VII. Analysis of fuels

a. Flash point b. Fire point c. Cloud point d. Pour point e. Aniline point.

VIII. Determination of the molecular weight of the polymer by viscometry.
IX. Calorimetric measurements
X. Conductivity measurement of an electrolyte solution
XI. pH measurements

TOTAL : 60 PERIODS

REFERENCE MANUAL

1. Technical Analysis Manual, Chemistry Division, Chemical Engineering Department, A.C.Tech, Anna University (2007).

GE8351 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To the study of nature and the facts about environment.

- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions

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- Development and improvement in std. of living has lead to serious environmental disasters

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - 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.

UNIT II ENVIRONMENTAL POLLUTION 8

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 – soil waste management: causes, effects and control measures of municipal solid 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.

UNIT III NATURAL RESOURCES 10

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

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

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

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 – role of non-governmental organization- 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 – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

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.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2006).

REFERENCES

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2 Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia',Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

AS8501 PETROLEUM REFINING - I L T P C
3 0 0 3

AIM

To know the knowledge of petroleum refining process.

OBJECTIVES

To understand the nature of hydrocarbon reservoirs.
To be familiar with pressure transient analysis.

OUTCOME

To understand pressure distribution in a reservoir.
To understand decline curve patterns for producing reservoirs.

UNIT I **9**

Exploration and Refining of Crude Oil : Introduction, Indian and world reserve of crude oil and its processing capacity, Market demand & supply of petroleum Fractions. Exploration, Drilling and Production of crude oil; engineering data of crude and fractions. Characterization factor, Key Fraction Number and correlaton index methods for evaluation of crude & fractions. TBP, ASTM, EFV, and their inter-convertibility, yield Curve etc.

UNIT II **9**

Desalting of crude, pipe still furnaces, preflashing operation, Atmospheric and vacuum distillation units, different types of Reflux arrangements, Calculation of tray requirement for ADU column. Test methods and specifications:Distillation, Aniline point, Reid vapour pressure, Smoke point, flash point fire point, Carbon residue, viscosity and viscosity index, refractive index, Copper & silver strip corrosion, Octane No, cetane No, sulphur content, calorific value, Total acid number, oxidation stability, cloud point, pour point etc.

UNIT III **9**

Thermal conversion Processes: Thermal cracking processes – mechanism, applications e.g. visbreaking, thermal cracking, coking operations, Catalytic Conversion Processes : Catalytic cracking processes, Different FCC operating modes, Catalytic reforming operations, Hydro cracking, Simple process calculations.

UNIT IV **9**

Thermal Polymerization, Isomerization processes, Alkylation, Catalytic Polymerization for gasoline stock preparation.

UNIT V **9**

Finishing & Treatment processes : Different Hydrotreatment (eg. Hydro desulfurization)

processes, Merox process, Doctor's sweetening, Smoke point improvement, etc. Simple process calculations Alternative fuels, Production and Specifications: Synthetic gasoline, Bio Diesel, Ethanol, Automotive LPG

TOTAL : 45 PERIODS

TEXT BOOKS

1. Petroleum Refinery Engineering – W.L. Nelson, Mc Graw Hill.
2. Modern Petroleum Refining Processes – B.K. Rao. Oxford & IBM.

REFERENCES

1. Petroleum Refining Technology – Dr. Ram Prasad, Khanna Publishers.
2. Advanced Petroleum Refining: Dr. G. N. Sarkar, Khanna Publishers.

CH8502 CHEMICAL REACTION ENGINEERING - I L T P C
3 1 0 4

AIM

To impart knowledge to design different types of chemical reactors

OBJECTIVES

Students gain knowledge on different types of chemical reactors, the design of chemical reactors under isothermal and non-isothermal conditions.

OUTCOME

To understand complications of the rate equation in case of a multiphase reaction on account of diffusional, mass transfer and heat transfer effects.
To get acquainted with the principles used in design of multiphase reactors.

UNIT I **12**

Rate equation, elementary, non-elementary reactions, theories of reaction rate and Prediction; Design equation for constant and variable volume batch reactors, analysis of experimental kinetics data, integral and differential analysis.

UNIT II **12**

Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors, combination of reactors, size comparison of reactors.

UNIT III **12**

Design of reactors for multiple reactions - consecutive, parallel and mixed reactions - factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield.

UNIT IV **12**

Non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate input and constant heat transfer coefficient, operation of batch and continuous reactors, optimum temperature progression.

UNIT V **12**

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

TOTAL : 60 PERIODS

TEXT BOOKS

1. Levenspiel O, "Chemical Reaction Engineering", Wiley Eastern Ltd., II Edition, 2000.
2. Smith, J.M, "Chemical Engineering Kinetics", McGraw Hill, III Edition, 1981.
3. Fogler.H.S., "Elements of Chemical Reaction Engineering", Prentice Hall of India Ltd., IIIrd Edition, 2000.

REFERENCE

1. Froment. G.F. & K.B.Bischoff, “Chemical Reactor Analysis and Design”, John Wiley and Sons, 1979.

CH8651 PROCESS INSTRUMENTATION, DYNAMICS AND CONTROL L T P C
3 0 0 3

AIM

To familiarize the students with concepts of process dynamics and control leading to control system design.

OBJECTIVE

To introduce dynamic response of open and closed loop systems, control loop components and stability of control systems along with instrumentation.

OUTCOME

To understand the importance of system dynamics and feedback control.
To be able to analyze open loop and closed-loop system properties.
To be able to design a control system to meet desired objectives.
To be able to perform model-based design and tuning of controllers.

UNIT I INSTRUMENTATION 6

Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity, humidity of gases.

UNIT II OPEN LOOP SYSTEMS 11

Laplace transformation, application to solve ODEs. 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; transportation lag.

UNIT III CLOSED LOOP SYSTEMS 10

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability.

UNIT IV FREQUENCY RESPONSE 9

Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controller settings

UNIT V ADVANCED CONTROL SYSTEMS 9

Introduction to advanced control systems, cascade control, feed forward control, Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control of chemical processes.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Stephanopoulos, G., “Chemical Process Control“, Prentice Hall of India, 2003.
2. Coughnowr, D., “ Process Systems Analysis and Control “, 3rd Edn., McGraw Hill, New York, 2008.

REFERENCES

1. Marlin, T. E., “ Process Control “, 2nd Edn, McGraw Hill, New York, 2000.
2. Smith, C. A. and Corripio, A. B., “Principles and Practice of Automatic Process Control”, 2nd Edn., John Wiley, New York, 1997.

CH8504 **MASS TRANSFER I** **L T P C**
3 0 0 3

AIM

To impart knowledge on fundamentals of mass transfer phenomena and rate based mass transfer operations.

OBJECTIVES

Students will learn to determine mass transfer rates under laminar and turbulent conditions and apply these concepts in the design of humidification columns, dryers and crystallisers.

OUTCOME

To be familiar with techniques used to estimate mass transfer coefficients in laminar and turbulent flows.
To get acquainted with the general approach for the design of continuous contact and stage wise operations.

UNIT I **9**

Introduction to mass transfer operations; Molecular diffusion in gases, liquids and solids; diffusivity measurement and prediction; multi-component diffusion.

UNIT II **10**

Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients. NTU and NTP concepts, Stage-wise and differential contractors.

UNIT III **9**

Humidification – Equilibrium, humidity chart, adiabatic and wet bulb temperatures; humidification operations; theory and design of cooling towers, dehumidifiers and humidifiers using enthalpy transfer unit concept.

UNIT IV **9**

Drying– Equilibrium; classification of dryers; batch drying – Mechanism and time of cross through circulation drying, continuous dryers – material and energy balance; determination of length of rotary dryer using rate concept.

UNIT V **8**

Crystallization - Equilibrium, classification of crystallizers, mass and energy balance; kinetics of crystallization – nucleation and growth; design of batch crystallizers; population balance model and design of continuous crystallizers.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Treybal, R.E., "Mass Transfer Operations", 3rd Edn, McGraw-Hill, 1981.
2. Geankoplis, C.J., “Transport Processes and Unit Operations”, 4th Edition, Prentice Hall Inc., New Jersey, 2003.

REFERENCES

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.
2. Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. I and II, 4th Edition,Asian Books Pvt. Ltd., India, 1998.
3. J.D. Seader and E.J. Henley, “Separation Process Principles”, 2nd Ed., John Wiley, 2006.

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HS8561 **EMPLOYABILITY SKILLS** **L T P C**
(Lab / Practical Course) **0 0 2 1**

(Common to all branches of Fifth or Sixth Semester
B.E / B.Tech programmes)

OBJECTIVES:

- To enhance the employability skills of learners with a special focus on presentation skills, group discussion and interview skills.
- To enable them to improve their soft skills necessary for workplace contexts.
- To equip them with effective communicative competence for a global reach.

OUTCOMES:

At the end of the course learners should be able to

- Participate in conversations both formal and informal, attend phone calls and interviews successfully.
- Read different types of texts.
- Listen to, and understand foreign accents.

1. Making presentations – introducing oneself – introducing a topic – answering questions – individual presentation practice
2. Creating effective PPTs – presenting the visuals effectively
3. Using body language with awareness – gestures, facial expressions, etc.
4. Preparing job applications - writing covering letter and résumé
5. Applying for jobs online - email etiquette
6. Participating in group discussions – understanding group dynamics - brainstorming the topic
7. Training in soft skills - persuasive skills – sociability skills - questioning and clarifying skills – mock GD
8. Writing reports – collecting, analyzing and interpreting data – drafting the report
9. Attending job interviews – answering questions confidently
10. Interview etiquette – dress code – body language – mock interview

TOTAL: 30 PERIODS

Requirements for a class of 30 students

1. A PC or a lap top with one or two speakers
2. A Collar mike and a speaker
3. An LCD projector and a screen
4. CD's and DVD's on relevant topics
5. Individual chairs for conducting group discussions

REFERENCE BOOKS

1. Dhanavel, S.P. 2010. English and Soft Skills. Hyderabad: Orient BlackSwan Ltd.
2. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.
3. D'Abreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
4. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.
5. Gulati, Sarvesh. Corporate Soft Skills. New Delhi: Rupa and Co. 2006.
6. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.

EXTENSIVE READERS

1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press, 1989.
2. Bagchi, Subroto. The Professional. New Delhi: Penguin Books India, 2009.

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WEB RESOURCES
1. www.humanresources.about.com
2. www.careerride.com

CH8511	HEAT TRANSFER LABORATORY	L T P C 0 0 3 2

AIM
To impart knowledge on heat transfer operation by practice

OBJECTIVES
Students develop a sound working knowledge on different types of heat transfer equipments.

OUTCOME
To gain knowledge in using different equipments in calculation of heat transfer in bed reactors.

LIST OF EXPERIMENTS
1. Performance studies on Cooling Tower
2. Batch drying kinetics using Tray Dryer
3. Heat transfer in Open Pan Evaporator
4. Boiling Heat Transfer
5. Heat Transfer through Packed Bed
6. Heat Transfer in a Double Pipe Heat Exchanger
7. Heat Transfer in a Bare and Finned Tube Heat Exchanger
8. Heat Transfer in a Condenser
9. Heat Transfer in Helical Coils
10. Heat Transfer in Agitated Vessels

EQUIPMENT REQUIRED
1. Cooling Tower
2. Tray Dryer
3. Open Pan Evaporator
4. Boiler
5. Packed Bed
6. Double Pipe Heat Exchanger
7. Bare and Finned Tube Heat Exchanger
8. Condenser
9. Helical Coil
10. Agitated Vessel

TOTAL : 45 PERIODS

AS8511	PETROLEUM TESTING LAB - I	L T P C 0 0 4 2

AIM
To introduce various methods of analysis by using sophisticated instruments and analytical equipments to determine various physical properties of crude, natural gas, petroleum products and petro-chemicals

OBJECTIVES
On completion of the course, the students should be conversant with the theoretical principles and experimental procedures for quantitative estimation.

OUTCOME
To get knowledge in analysis of petrochemical products qualitatively and quantitatively

LIST OF EXPERIMENTS

1. Aromatic content Determination
2. Carbon residue determination
3. Karl-Fisher Conductometer Apparatus for water estimation
4. Foaming characteristics of lube oil
5. Mercaptan as sulphur estimation
6. Copper Corrosion test of petroleum oil
7. Freezing point of Aqueous Engine coolant solution
8. Automatic Vacuum Distillation
9. Characteristics of Hydrocarbon in Petroleum products
10. Coking tendency of oil
11. Testing of Petroleum products using Saybolt

TOTAL : 60 PERIODS

LIST OF EQUIPMENTS

1. Conradson Apparatus
2. Karl –Fisher
3. Dr. Test Apparatus
4. Bomb Calorimeter
5. API Distillation Apparatus
6. Junkers Gas Calorimeter
7. Abbey Refractometer
8. Mercaptan as sulphur Estimation Apparatus

AS8601 EQUILIBRIUM STAGED OPERATIONS L T P C
3 1 0 4

AIM
To impart knowledge on the design of different staged operations using the concept of equilibrium

OBJECTIVES
The students will learn in detail the unifying theory and design of different staged operations like absorption, distillation, extraction and adsorption.

OUTCOME
Gain insight into vapour – liquid, liquid – solid phase equilibrium
Understand and explain different drive mechanisms and factor of primary recovery
Calculate reserves of oil and gas by volumetric and material balance

UNIT I ABSORPTION 12
Gas Absorption and Stripping – Equilibrium; material balance; limiting gas-liquid ratio; tray tower absorber - calculation of number of theoretical stages, tray efficiency, tower diameter; packed tower absorber – rate based approach; determination of height of packing using HTU and NTU calculations.

UNIT II DISTILLATION 9
Vapour liquid equilibria - Raoult's law, vapor-liquid equilibrium diagrams for ideal and non-ideal systems, enthalpy concentration diagrams. Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification, Number of ideal stages by Mc.Cabe - Thiele method and Ponchan - Savarit method, Total reflux, minimum reflux ratio, optimum reflux ratio. Desing of azeotropic and extractive distillation columns.

UNIT III MULTICOMPONENT DISTILLATION 12

Fundamental principles involved in the separation of multi component mixtures –equilibrium flash distillation calculations for multi component mixtures – separation of multi component mixtures at total reflux. Calculation of minimum reflux ratio. Determination of number of trays

UNIT IV LIQUID-LIQUID EXTRACTION 10

Liquid - liquid extraction - solvent characteristics-equilibrium stage wise contact calculations for batch and continuous extractors- differential contact equipment-spray, packed and mechanically agitated contactors and their design calculations-packed bed extraction with reflux. Pulsed extractors, centrifugal extractors-Supercritical extraction

UNIT V ADSORPTION & MEMBRANE SEPARATION PROCESS 14

Adsorption - Types of adsorption, nature of adsorbents, adsorption equilibria, effect of pressure and temperature on adsorption isotherms, Adsorption operations - stage wise operations, steady state moving bed and unsteady state fixed bed adsorbers, break through curves. Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultrafiltration.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Wankat, P., "Equilibrium Stage Separations", Prentice Hall, 1993.
2. Treybal, R.E., "Mass Transfer Operations ", 3rd Edn., McGraw-Hill, 1981.
3. Seader, J.D. and E.J. Henley, “Separation Process Principles”, 2nd Ed., John Wiley, 2006.

REFERENCES

1. W.L McCabe J.C.Smith, and Harriot. P., " Unit Operations of Chemical Engineering ", sixth edition McGraw-Hill. International Edition, 2001
2. C.Judson King " Separation Processes ", Tata McGraw-Hill 1974.
3. R.F.Strigle (jr), Packed Tower Design and Application, 2nd Edn Gulf Publishing company U.S.A.1994

AS8602 CHEMICAL REACTION ENGINEERING II L T P C
3 0 0 3

AIM

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.

OUTCOME

To study separat ion and treatment of produced oil and associated surface facil ities.
To understand emerging technologies in production operations

UNIT I NON-IDEAL REACTORS 9

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 nonideal reactors

UNIT II HETEROGENEOUS PROCESS AND SOLID CATALYSIS 9

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 9

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 9

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 9

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.

TOTAL : 45 PERIODS

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.

AS8603 PETROLEUM REFINING - II L T P C
3 0 0 3

AIM

To know the processes involved in refining of petroleum products

OBJECTIVES

Know surface facility equipment and facilities for production and separation of hydrocarbons.
Knowledge of different types of bottom hole production tools and their utility .
Understanding of multiphase flows and their equations for production operations .

OUTCOME

Understanding of different completion methods
Understanding of Inflow Performance Relationship
Understanding of important well problems and possible workover operations

UNIT I CRACKING 9

Need and significance, types and functions of Secondary Processing. Cracking, Thermal Cracking and Visbreaking. Different Feed Stocks, Products Yields, Qualities and Recent Development. Catalytic Cracking, Commercial Catalyst, Feedstock and Catalytic Cracking Conditions, Types and Processes- Fixed Bed Cracker, Fluid Catalytic Cracking (FCC), Flexi Cracking.

UNIT II CATALYTIC REFORMING 9

Theory, Reaction Conditions and Catalyst for Catalytic Reforming, Platforming, Houdri Forming,Rhein Forming, Power Forming, Selecto Forming. Ultra Forming and Rex Forming.Naphtha Cracking, Feedstock Selection and Effect of Steam.

UNIT III ALKYLATION AND ISOMERIZATION 9

Feed Stocks and Reactions for Alkylation Process- Cascade Sulphuric Acid Alkylation, Hydrofluoric Acid Alkylation. Isomerization Process- Isomerization with Platinum Catalyst and Aluminium Chloride Process.

UNIT IV COKING 9

Methods of Petroleum Coke Production – Koppers, Thermal Cracking, Delayed Coking, Fluid Coking and Contact Coking. Hydro Cracking- principles, reactions in Hydro Cracking, Catalyst, Hydro Cracking Reaction Conditions, Iso Max Processes and Hydro Desulphurization Processes.

UNIT V ASPHALT TECHNOLOGY 9

Source of Asphalt (Bitumen), Chemical Structure of Asphalt, Action of Heat on Asphalt, Types of Asphalts. Air Blowing of Bitumen and Upgradarion of Heavy Crudes. Specialty Products:Industrial Grease- Manufacture of Calcium Grease, Liquid Paraffin and Petroleum Jellys.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jones, D.S.J. and Pujadó, P.R., Handbook of petroleum processing, Springer, The Netherlands, 2006
2. Nelson, W. L “Petroleum Refinery Engineering”, McGraw Hill Publishing Company Limited, 1985.
3. Watkins, R. N “Petroleum Refinery Distillations”, 2nd Edition, Gulf Publishing Company, Texas, 1981.

REFERENCES

1. Parkash, S., Refining processes handbook, Gulf Professional Publishing, 2003
2. Hobson, G. D “Modern Petroleum Refining Technology”, 4th Edition, Institute of Petroleum,U. K. 1973.

CH8603 PLANT SAFETY AND RISK ANALYSIS L T P C
3 0 0 3

AIM

To get awareness on the importance of plant safety and risk analysis

OBJECTIVES

Students learn about implementation of safety procedures, risk analysis and assessment, hazard identification.

OUTCOME

To familiarize with issues related to occupational health and industrial hygiene
To get acquainted with risk assessment, process safety auditing and management Systems.

UNIT I 9

Need for safety in industries; Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling

UNIT II 9

Implementation of safety procedures – periodic inspection and replacement; Accidents - identification and prevention; promotion of industrial safety

UNIT III 9

Over all risk analysis--emergency planning-on site & off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment - rapid

and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.

UNIT IV **9**

Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras-Vizag-Bopal analysis

UNIT V **9**

Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prantice Hall, NJ, 1990.
2. Fawatt, H.H. and Wood, W.S., "Safety and Accident Prevention in Chemical Operation", Wiley Interscience, 1965.
3. Marcel, V.C., Major Chemical Hazard- Ellis Harwood Ltd., Chi Chester, UK, 1987.
4. Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press, 2004

REFERENCES

1. Handley, W., "Industrial Safety Hand Book ", 2nd Edn., McGraw-Hill Book Company, 1969.
2. Heinrich, H.W. Dan Peterson, P.E. and Rood, N., " Industrial Accident Prevention", McGraw-Hill Book Co., 1980.
3. Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall, London, 1994

AS8604 **PETROCHEMICALS** **L T P C**
4 0 0 4

AIM

To know about various processes involved in petroleum products.

OBJECTIVES

To develop understanding of the principles, techniques, standard tools of process optimization.

To formulate multiobjective optimization problem with and without constraints based on process requirements.

OUTCOME

To gain exposure to application of processing techniques in case of various petrochemical products.

UNIT I **12**

Overview of petrochemical industrial Growth in India, Economics, Feedstock Selection for Petrochemicals

UNIT II **12**

Steam reforming, Hydrogen, Synthesis gas, cracking of gaseous and liquid for stocks, Olefins, Diolifins, Acetylene and Aromatics and their separation.

UNIT III **12**

Alkylation, Oxidation, Dehydrogenation, Nitration, Chlorination, Sulphonation and Isomerization

UNIT IV **12**

Chemicals from synthesis gas, Olefins, Diolefins, Acetylene and Aromatics.

UNIT V **12**

Modes and techniques, Production of Polyethylene, PVC, Polypropylene, SAN, ABS, SBR, Polyacrylonitrile, Polycarbonates, Polyurethane, Nylon, PET.

TOTAL : 60 PERIODS

REFERENCES

1. Brownstein A.M. Trends in Petrochemical Technology, Petroleum Publishing Company, 1976.
2. Sitting M., Aromatics Hydrocarbons, Manufacture and Technology, Noyes Data Corporation, 1976.
3. Stevens P.M. Polymer Chemistry, Addison Wesley Publishing Company, 1975.
4. Hatch F. and Sami Mater, "From Hydrocarbon to Petrochemicals", Gulf Publishing Company, Texas 1998.Petrochemical Hand book Hydrocarbon Processing 1988, 1989.

AS8611 PROCESS CONTROL LABORATORY **L T P C**
0 0 4 2

AIM

Know about different petro products process.

OBJECTIVES

Study of processes of operation and different orders of a system.

OUTCOME

Gaining knowledge in operating different valves in the process reactors.

LIST OF EXPERIMENTS

1. Response of first order system
2. Response of second order system
3. Response of Non-Interacting level System
4. Response of Interacting level System
5. Open loop study on a level system
6. Open loop study on a flow system
7. Open loop study on a thermal system
8. Closed loop study on a level system
9. Closed loop study on a flow system
10. Closed loop study on a thermal system
11. Tuning of a level system
12. Tuning of a flow system
13. Tuning of a thermal system
14. Flow co-efficient of control valves
15. Characteristics of different types of control valves

Minimum 10 experiments shall be offered

TOTAL : 60 PERIODS

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

AS8612 **PETROLEUM TESTING LAB II** **L T P C**
0 0 4 2

AIM
To impart practical knowledge on different petroleum testing methods

OBJECTIVES
Students learn petroleum testing, determination of aniline point, softening point, carbon residue,foaming characteristics, sulphur content etc.

OUTCOME
To know complete details about the petrochemical products using different characterization techniques.

LIST OF EXPERIMENTS

1. Petroleum testing using Distillation Apparatus
2. Moisture estimation using Dean and Stark Apparatus
3. Determination of Aniline Point
4. Determination of Softening Point
5. Determination of Conradson Carbon Residue
6. Determination of Binder Content using Bitumen Apparatus.
7. Determination of foaming Characteristics
8. Determination of Congealing Point of Wax.
9. Determination of H2S and Sulphur Content
10. Determination of Aromatic Content Determination

TOTAL : 60 PERIODS

CH8612 **COMPUTATIONAL CHEMICAL ENGINEERING LABORATORY** **L T P C**
0 0 4 2

AIM
To give practice to students to solve chemical engineering problems through programming and using computational tools.

OBJECTIVE
Students will solve chemical engineering problems from core courses using C and MATLAB programming and also using computational tools like Excel and Aspen.

OUTCOME
To make student aware of different equipment and machineries used in petroleum industry.

PROGRAMMING IN C
C programs will be written to solve problems from core courses of chemical engineering.

MICROSOFT EXCEL SOFTWARE
The computational, plotting and programming abilities in Excel will be used to solve different chemical engineering problems.

PROGRAMMING IN MATLAB
Chemical engineering problems will be solved using the powerful computational and graphical capability of MATLAB.

ASPEN SOFTWARE

Individual process equipments and flowsheets will be simulated using Aspen Plus and property analysis and estimation will be done using Aspen Properties.

EVALUATION

This lab course will have two or three online assessment tests and an online end semester examination in the Process Simulation Laboratory and assignments in all the above four units.

REFERENCES

1. Finlayson, B. A., Introduction to Chemical Engineering Computing, John Wiley & Sons, New Jersey, 2006.

TOTAL: 60 PERIODS

CH8751 TRANSPORT PHENOMENA L T P C
3 1 0 4

AIM

To give an overview of mass, momentum and energy transport, present the fundamental equations and illustrate how to use them to solve problems.

OBJECTIVE

To describe mass, momentum and energy transport at molecular, microscopic and macroscopic level, to determine velocity, temperature and concentration profiles.

OUTCOME

Understand the similarity between heat, mass and momentum transport and their analogy.
Develop the ability to formulate and solve mathematical models for physical situations.
Understand the science of turbulence, its prediction through various models and their utility.
Mathematical formulation of heat transfer problem and it numerical solution.

UNIT I MOMENTUM TRANSPORT 12

Viscosity, temperature effect on viscosity of gases and liquids, Newton's law, mechanism of momentum transport, shell balance method, pressure and velocity distributions in falling film, circular tube, annulus, slit.

UNIT II EQUATIONS OF CHANGE AND TURBULENT FLOW 12

Equation of continuity, motion, mechanical energy, use of equations of change to solve flow problems, dimensional analysis of equations of change, comparison of laminar and turbulent flows, time-smoothed equation of change, empirical expressions.

UNIT III ENERGY TRANSPORT 12

Thermal conductivity, temperature and pressure effect on thermal conductivity of gases and liquids, Fourier's law, mechanism of energy transport, shell energy balance, temperature distribution in solids and laminar flow, with electrical, nuclear, viscous, chemical heat source, heat conduction through composite walls, cylinders, spheres, fins, slits.

UNIT IV EQUATIONS OF CHANGE FOR NONISOTHERMAL SYSTEM AND TEMPERATURE DISTRIBUTION IN TURBULENT FLOWS 12

Energy equations, special forms, use of equations of change, dimensional analysis of equations of change, time-smoothed equations of change, empirical expressions, temperature distribution for turbulent flow in tubes, jets.

UNIT V MASS TRANSPORT, EQUATIONS OF CHANGE FOR MULTICOMPONENT SYSTEMS AND CONCENTRATION DISTRIBUTION IN TURBULENT FLOWS 12

Diffusivity, temperature and pressure effect, Fick's law, mechanism of mass transport, theory of diffusion in gases and liquids, shell mass balances, concentration distribution in solids and

in laminar flow : stagnant gas film, heterogeneous and homogeneous chemical reaction systems, falling film, porous catalyst. The equation of continuity, summary of equations of change and fluxes, use of equations of change, dimensional analysis, time smoothed equations of change, empirical expressions for turbulent mass flux.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Bird, R. B., Stewart, W. E. and Lighfoot, E. W., "Transport Phenomena", 2nd Edn., John Wiley, 2002
2. Brodkey, R. S., and Hershey, H. C., "Transport Phenomena", McGraw-Hill, 1988.

REFERENCES

1. Welty, J. R., Wilson, R. W., and Wicks, C. W., "Fundamentals of Momentum Heat and Mass Transfer ", 3rd Edn. John Wiley, New York, 1984.
2. Slattery, J. S., "Advanced Transport Phenomena", Cambridge University Press, London, 1999.

CH8701 CHEMICAL PROCESS DESIGN L T P C
3 0 0 3

AIM

To understand the fundamental concepts of equipment and machinery design.
To make student aware of different equipment and machineries used in petroleum industry.

OBJECTIVES

An ability to understand the design of chain, gear system and brakes for draw works, bearing system for drilling bits.
An ability to understand selection of Pumps and valves in mud circulation system, compressor types and design.
An ability to understand design of pressure vessels, and types of separators.

OUTCOME

An ability to understand fundamentals of heat exchanger design, and types of heat exchangers.
An ability to understand design of crude oil storage tanks.

UNIT I **9**

Process Design and Development: General Design Considerations; The Hierarchy of Chemical Process Design; The Nature of Process Synthesis and Analysis;

UNIT II **9**

Choice of reactor based on reactor performance, reactor conditions and reactor configuration. Reactor networks in process flow sheets:

UNIT III **9**

Choice of separation of heterogeneous and homogeneous mixtures - Attainable region Separation systems in process flowsheets: multicomponent distillation for ideal and non-ideal systems, distillation column sequences,

UNIT IV **9**

Heat exchange networks synthesis and utilities: Energy targets, Integration in distillation columns

UNIT V **9**

Introduction to optimization approaches to optimal design, role of simulations in process design, Design under uncertainty and failure tolerance, Engineering around variations, Introduction to process integration

TOTAL : 45 PERIODS

TEXT BOOKS

1. Smith, R., Chemical Process Design, McGraw Hill, New York, 1995.
2. Douglas, J., Conceptual Design of Chemical Processes, McGraw Hill, 1989.

REFERENCES

1. Rudd, D.F. and Watson, C.C., Strategy of Process Engineering, John Wiley, 1969.
2. Sinnot, R.K., an Introduction to Chemical Engineering Design, Pergamon Press, Oxford, 1989.
3. Seider, W.D. and J.D. Seader, Product and Process Design Principles: Synthesis, Analysis and Evaluation, 2nd ed., John Wiley, 2004.

CH8702 PROCESS ECONOMICS L T P C
3 0 0 3

AIM

To emphasize the importance of time value of money in petroleum projects.

OBJECTIVES

To understand the economic and decision analysis parameters in Petroleum E and P Business.
To understand the background of functioning of petroleum industry as an economic entity.

OUTCOME

To understand petroleum fiscal system within the context of India.

UNIT I INTRODUCTION 5

The themes of economics – scarcity and efficiency – three fundamental economic problems – society's capability – Production possibility fronties (PPF) – Productive efficiency Vs economic efficiency – economic growth & stability – Micro economies and Macro economies – the role of markets and government – Positive Vs negative externalities.

UNIT II CONSUMER AND PRODUCER BEHAVIOUR 10

Market – Demand and Supply – Determinants – Market equilibrium – elasticity of demand and supply – consumer behaviour – consumer equilibrium – Approaches to consumer behaviour – Production – Short-run and long-run Production Function – Returns to scale – economies Vs diseconomies of scale – Analysis of cost – Short-run and long-run cost function – Relation between Production and cost function.

UNIT III PRODUCT AND FACTOR MARKET 10

Product market – perfect and imperfect market – different market structures – Firm's equilibrium and supply – Market efficiency – Economic costs of imperfect competition – factor market – Land, Labour and capital – Demand and supply – determination of factor price – Interaction of product and factor market – General equilibrium and efficiency of competitive markets.

UNIT IV PERFORMANCE OF AN ECONOMY – MACRO ECONOMICS 10

Macro-economic aggregates – circular flow of macroeconomic activity – National income determination – Aggregate demand and supply – Macroeconomic equilibrium – Components of aggregate demand and national income – multiplier effect – Demand side management – Fiscal policy in theory.

UNIT V AGGREGATE SUPPLY AND THE ROLE OF MONEY 10

Short-run and Long-run supply curve – Unemployment and its impact – Okun's law –

Inflation and the impact – reasons for inflation – Demand Vs Supply factors –Inflation Vs Unemployement tradeoff – Phillips curve –short- run and long-run –Supply side Policy and management- Money market- Demand and supply of money – money-market equilibrium and national income – the role of monetary policy.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Paul A. Samuelson and William D. Nordhaus, Economics, 18th edition, Tata McGraw Hill, 2005.
2. William Boyes and Michael Melvin, Textbook of economics, Biztantra, 2005.
3. N. Gregory Mankiw, Principles of Economics, 3rd edition, Thomson learning, New Delhi, 2007.
4. Richard Lipsey and Alee Charystal, Economics, 11th edition, Oxford University Press, New Delhi,2008.
5. Karl E. Case and Ray C. fair, Principles of Economics, 6th edition, Pearson Education Asia, New Delhi, 2002.

AS8701 PETROLEUM EQUIPMENT DESIGN L T P C
3 1 0 4

AIM

To understand the concept of designing Equipments for Petroleum Exploration

OBJECTIVES

To study and analyze the suitable equipment for particular reservoir conditions.

OUTCOME

To study different forces and stresses to be considered in the design process and to understand drawing related national and international standards and practices followed.

UNIT I **12**

Casing program, casing and tubing design, principles of cementing, completion added skin, well perforating, hydraulic fracturing. DRILL BIT DESIGN.ROLLER CONE BITS.PDC DRILL BITS.NOMENCLATURE AND IADC CODES for drill bits. BHA (Bottom hole assembly).ESP(Electrical submersible pumps). SRP(Sucker rod pumping) unit design.

UNIT II **12**

Design of Surface Facilities -Design of production and processing equipment, including deparation problems, treating, and transmission systems.

UNIT III **12**

Capstone design Student teams apply knowledge in the areas of geology, reservoir engineering, production, drilling and well completions to practical design problems based on real field data with all of the associated shortcomings and uncertainties. Use of commercial software.

UNIT IV **12**

Oil desalting-horizontal and spherical electrical dehydrators- Natural Gas Dehydration-Hortonsphere- Natural Gas Sweetening. Crude & Condensate Stabilization-design of stabilizer- Oil and Gas Treatment. Treating Equipment.

UNIT V **12**

Refinery Equipment Design-atmospheric distillation column Design and construction of on/ offshore pipelines, Fields Problems in pipeline, Hydrates, scaling & wax etc and their mitigation

TOTAL : 60 PERIODS

TEXT BOOKS

1. Petroleum Exploration Hand Book by Moody, G.B.
2. Wellsite Geological Techniques for petroleum Exploration by Sahay.B et al

REFERENCES

1. Standard Hand Book of Petroleum & Natural Gas Engineering" – 2nd Edition 2005-William C.Lyons & Gary J.Plisga-Gulf professional publishing comp (Elsevier).

AS8702 **PETROLEUM REFINING - III** **L T P C**
3 0 0 3

AIM

To impart detailed knowledge on petroleum refining operations, this course being the last part in a three parts series

OBJECTIVES

Students learn about the petroleum additives, support systems, safety measures, environmental, quality and economic aspects.

OUTCOME

Know the composition of crude oil and its products, along with its properties and characterization methods
Get conversant the basic separation and conversion processes used in refining crude oil
Apply chemical engineering principles to the analysis of safe and efficient refinery operations.

UNIT I **9**

Octane Improver – TEL, MTBE, Viscosity Index Improver, Pour Point Depressor, Anti Oxidants and others.

UNIT II **9**

Support systems – control systems, offsite systems, safety systems

UNIT III **9**

Components of Fire, Classification of Fires and Fire Extinguishment, Fire Hazards and Control,Causes of Refinery Fires and Explosion Hazards, Safety in Handling and Storage, Emergency Preparation.

UNIT IV **9**

Environmental control and engineering – aqueous wastes, emission to the atmosphere, noise pollution

UNIT V **9**

Quality control of products, Refinery operation planning, process evaluation and economics

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jones, D.S.J. and Pujadó, P.R., Handbook of petroleum processing, Springer, The Netherlands, 2006
2. Nelson, W. L "Petroleum Refinery Engineering", McGraw Hill Publishing Company Limited,1985.
3. Watkins, R. N "Petroleum Refinery Distillations", 2nd Edition, Gulf Publishing Company, Texas, 1981.

REFERENCES

1. Parkash, S., Refining processes handbook, Gulf Professional Publishing, 2003
2. Hobson, G. D "Modern Petroleum Refining Technology", 4th Edition, Institute of Petroleum,U. K. 1973.

CH8711 MASS TRANSFER LABORATORY L T P C
0 0 4 2

AIM

To impart knowledge on mass transfer by practice

OBJECTIVES

Students develop a sound working knowledge on different types of mass transfer equipments.

OUTCOME

Acquiring knowledge in separation of petroleum products using various distillation techniques

LIST OF EXPERIMENTS

1. Separation of binary mixture using simple distillation
2. Separation of binary mixture using Steam distillation
3. Separation of binary mixture using Packed column distillation
4. Measurement of diffusivity
5. Liquid-liquid extraction
6. Drying characteristics of Vacuum Dryer
7. Drying characteristics of Tray dryer
8. Drying characteristics of Rotary dryer
9. Water purification using ion exchange columns
10. Mass transfer characteristics of Rotating disc contactor
11. Estimation of mass/heat transfer coefficient for cooling tower
12. Demonstration of Gas – Liquid absorption

EQUIPMENTS REQUIRED

1. Simple distillation setup
2. Steam distillation setup
3. Packed column
4. Liquid-liquid extractor
5. Vacuum Dryer
6. Tray dryer
7. Rotary dryer
8. Ion exchange column
9. Rotating disc contactor
10. Cooling tower
11. Absorption column

Minimum 10 experiments shall be offered.

TOTAL : 60 PERIODS

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Centre For Academic Courses
Anna University, Chennai-600 025.

CH8611 CHEMICAL REACTION ENGINEERING LABORATORY L T P C
0 0 3 2

AIM
To impart knowledge on reaction engineering by practice.

OBJECTIVES
Students develop a sound working knowledge on different types of reactors.

OUTCOME
Studying kinetics of different reactions involved in petroleum industries.

LIST OF EXPERIMENTS
1. Kinetic studies in a Batch reactor
2. Kinetic studies in a Plug flow reactor
3. Kinetic studies in a CSTR
4. Kinetic studies in a Packed bed reactor
5. Kinetic studies in a PFR followed by a CSTR
6. RTD studies in a PFR
7. RTD studies in a Packed bed reactor
8. RTD studies in a CSTR
9. Studies on micellar catalysis
10. Study of temperature dependence of rate constant using CSTR.
11. Kinetic studies in Sono chemical reactor
12. Batch reactive distillation
13. Kinetics of photochemical reaction
14. Demonstration of heterogeneous catalytic reaction
15. Demonstration of gas-liquid reaction

EQUIPMENT REQUIRED
1. BATCH REACTOR
2. Plug flow reactor
3. CSTR
4. Sono-chemical reactor
5. Photochemical reactor
6. Packed bed reactor

***Minimum 10 experiments shall be offered.**

TOTAL : 45 PERIODS

MA8001 STATISTICS AND LINEAR PROGRAMMING L T P C
3 1 0 4

AIM
This course aims at providing the required skill to apply the statistical and Linear Programming tools for engineering problems.

OBJECTIVES
The students will have a fundamental knowledge of the concepts of statistical inference
Have the knowledge of applying Linear programming tools in management problems.

OUTCOME
To learn various numerical techniques to solve engineering problems.
To get acquainted with operations research tools and statistical techniques required in Petrochemical engineering practice.

UNIT I TESTING OF HYPOTHESIS 9 + 3

Sampling distributions - Tests for single mean , proportion and difference of means (large and small samples) – Tests for single variance and equality of variances – χ^2-test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 9 + 3

Completely randomized design – Randomized block design – Latin square design - 2^2 - factorial design.

UNIT III STATISTICAL QUALITY CONTROL 9 + 3

Control charts for measurements ($\overline{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling

UNIT IV LINEAR PROGRAMMING 9 + 3

Formulation of LPP – Graphical methods for two variables – Simplex method – Big M method – Transportation Problem - Basic feasible solution – North West corner rule – Vogel's approximation method (Unit penalty method) – Matrix minima method (Least cost method) – Optimal solution – Non degeneracy and degeneracy problem – Assignment problem – Hungarian method – Balanced and unbalanced.

UNIT V ADVANCED LINEAR PROGRAMMING 9 + 3

Dual simplex method – Formation and using simplex method – integer programming – Cutting plane algorithm.

L: 45, T: 15, TOTAL: 60 PERIODS

TEXT BOOKS

1. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th edition, (2007).
2. Taha, H.A., "Operations Research", Pearson Education, Asia, 8th edition, (2007).

REFERENCES

1. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K.,"Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th edition, (2007).
2. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, 7th edition, (2008).
3. Winston, W.L.,"Operations Research – Applications and Algorithms",Thomson, 1st Indian Reprint, 4th edition, (2007).

AS8010 PETROLEUM CHEMISTRY L T P C
3 0 0 3

AIM

To take an overview of downstream petroleum industry.

OBJECTIVES

To get acquainted wi th the various standards for the analysi s of petroleum products

OUTCOME

To get acquainted with industrial reactors, their design and operations.

UNIT I 9

Composition of Petroleum – separation by molecular weight, type; Composition maps; Petroleum analysis and evaluation – ASTM evaluation, spectroscopic methods

UNIT II **9**

Metals and heteroatoms in heavy crude oil – hetroatoms concentrations, structure of heteroatom functions; Asphaltenes and structure of petroleum

UNIT III **9**

Thermal chemistry of petroleum constituents – visbreaking, coking, hydrotreating, hrdocracking

UNIT IV **9**

Heavy oil upgradation processes- carbon rejection, hydrogen addition; Hydrocracking reactions, catalysts, process configurations

UNIT V **9**

Instability of petroleum products – distillate and residual products; Incompatibility in refining Operations

TOTAL : 45 PERIODS

TEXT BOOK

1. Speight, J.G., Petroleum chemistry and refining Taylor and Francis, London, 1998

REFERENCE

1. Speight, J.G., The chemistry and technology of petroleum, Marcel Dekker, New York, 1998

AS8011 DRILLING AND WELL ENGINEERING L T P C
3 0 0 3

AIM

To understand oil well drilling and operations engineering.

OBJECTIVES

To get familiarized with field equipment drilling and practices nature of difficulties and actions to be taken.
To learn fundamental equations and calculations used in drilling engineering.

OUTCOME

Understand drilling rig power system, hoisting system, rotary system, and circulation system. Knowledge of well control equipment, directional drilling, importance of coring, fishing operations.

UNIT I DRILLING GEOLOGY, OIL AND GAS MIGRATION **9**

Rock Strengths and Stresses, Hydrostatic Pressure Forced by a Fluid. Rock Properties, Primary Migration, Reservoir Rock, Seal Rock and Secondary Migration. Reservoir Drives, Problems Related Fluids in the Reservoir.

UNIT II PLANNING AND DRILLING OF WELL **9**

Well Proposal, Gathering Data, Designing the Well, Drilling the Well and Testing the Well. Planning of Well, Hole and Casing Sizes and Drilling the Well. Selecting a suitable Drilling Rig, Classification of Drilling Rig, Rig Systems and Equipments.

UNIT III DRILL BITS AND DRILLING FLUIDS **9**

Roller Cone Bits, Fixed Cutter Bits and Cone Bits. Optimizing Drilling Parameters- Grading the Dull Bit and Bit Selection. Functions of Drilling Fluid, Basic Mud Classification Designing the Drilling Fluid.

UNIT IV DIRECTIONAL DRILLING, CASING, CEMENTING AND EVALUATION **9**

Controlling the Well Path of a Deviated Well, Horizontal Wells and Multi Lateral Well.

Importance of Casing in a Well, Designing the Casing String, Role of the Cement Outside the Casing, Mud Removal, Cement Design, Running and Cement Casing and other Cement Jobs. Evaluation Techniques, Physical Sampling at Surface and Downhole, Electrical Logging and Production testing.

UNIT V MANAGING DRILLING OPERATIONS, SAFETY AND ENVIRONMENTAL ISSUES 9

Personnel involved in Drilling Operation, Decision Making at the Well site and in the Office, Estimating the Well Cost. Safety Meetings, New Comers on the Rig, Training and Certification, Permit to Work Systems, Safety Alerts, Safety Equipments, Minimizing Spills and Environmental Impact Studies.

TOTAL : 45 PERIODS

REFERENCES

1. Devereux, S., "Drilling Technology", PennWell Publishing Company, 1999.
2. Azar, J.J. and G. Rabello Samuel, "Drilling Engineering", PennWell Corporation, 1937.
3. Devereux, S., "Practical Well Planning and Drilling", PennWell Corporation, 1998.

AS8012 RESERVOIR ENGINEERING L T P C
3 0 0 3

AIM

To understand a reservoir and know its properties.

OBJECITVES

To learn about basic rock and fluid properties relevant to petroleum reservoir.
To understand the causes of variation in the behaviour of rocks and fluids.
To understand the drive mechanism of a reservoir

OUTCOME

Understand the rock properties and reasons for variation
Understand and explain the properties of fluid
Understand the phenomenon of presence of multiphase flow system in porous media and equations for the calculation of parameters

UNIT I RESERVOIR FLUID BEHAVIOR AND PROPERTIES 9

Classification of Reservoir and Reservoir Fluids. Properties of Natural Gases. Direct Calculation of Compressibility Factors. Methods of Calculating Viscosity of Natural Gases, Properties of Crude Oil Systems. Methods of Calculating Viscosity of the Dead Oil. Properties of Reservoir Water.

UNIT II ANALYSIS OF RESERVOIR FLUID AND ROCK PROPERTIES 9

Composition of Reservoir Fluid, Separation Test, Laboratory Analysis of Gas Condensate System, Porosity and Capillary Pressure. Rock Compressibility, Reservoir Heterogeneity. Dynamic Pseudo-Relative Permeabilities, Two Phase and Three Phase Relative Permeability.

UNIT III FUNDAMENTALS OF RESERVOIR FLUID FLOW 9

Reservoir Geometry, Fluid Flow Equations, Steady State and Unsteady State Flow, Constant Terminal Pressure Solution. Horizontal and Vertical Oil Well and Gas Well Performance.

UNIT IV RECOVERY MECHANISM AND MATERIAL BALANCE 9

Primary Recovery Mechanism, Material Balance Equation, Performance prediction Methods and Relating Reservoir Performance to Time. Volumetric Method and the Material Balance Equations as a Straight Line in Gas Reservoir.

UNIT V WATER FLOODING AND VAPOR LIQUID PHASE EQUILIBRIUM 9

Factors to consider in Water Flooding, Optimum Time to Water Flooding, Selection of Flooding Patterns, Overall Recovery Efficiency, Displacement Efficiency, Vertical Sweep Efficiency. Equilibrium Ratio, Flash Calculations, Equilibrium Ratios for Real Solution. Application of the Equilibrium Ratio in Reservoir Engineering.

TOTAL : 45 PERIODS

REFERENCES

1. Ahmed, T, "Reservoir Engineering Handbook", 3rd Edition, Elsevier, 2006.
2. Slip Slider, H.C. "World wide Practical Petroleum Reservoir Engineering Method", PennWell Publishing Company, 1983.
3. Gianluigichierici, "Principles of Petroleum Reservoir Engineering", Elsevier, 1994.

AS8013 ENHANCED OIL RECOVERY L T P C
3 0 0 3

AIM

To understand the nature of reservoi rs and strategy for increasing reservoir efficiency.

OBJECTIVES

To be able to design an oil recovery technique.
To be able to predict the future performance of a reservoir.

OUTCOME

To understand working principle of reservoir systems.

UNIT I FUNDAMENTALS OF ENHANCED OIL RECOVERY 9

Pore Geometry, Microscopic Aspects of Displacement. Residual Oil Magnitude and Mobilization. Buoyancy Forces and Prevention of Trapping, Wettability, Residual Oil and Oil Recovery. Macroscopic Aspect of Displacement.

UNIT II WATER FLOODING 9

Properties, sampling and analysis of Oil Field Water; Injection waters; Water flooding – Sweep Efficiency, Predictive Techniques, Improved Water Flood Processes, Performance of some Important Water Floods.

UNIT III ENHANCED OIL RECOVERY OPERATIONS-1 10

Flooding – miscible, CO2, polymer, alkaline, surfactants, steam;

UNIT IV ENHANCED OIL RECOVERY OPERATIONS-2 10

Gas injection, in-situ combustion technology, microbial method

UNIT V PROBLEMS IN ENHANCED OIL RECOVERY 7

Precipitation and Deposition of Asphaltenes and Paraffins, Scaling Problems, Formation of Damage Due to Migration of Fines, Environmental factors.

TOTAL : 45 PERIODS

REFERENCES

1. Donaldson, E.C. and G. V. Chilingarian, T. F. Yen, "Enhanced oil Recovery – I & II",
2. Fundamentals and Analysis, Elsevier Science Publishers, New York, 1985.
3. Lake, L.W., "Enhanced oil recovery", Prentice Hall, 1989.
4. Schumacher, M.M., "Enhanced oil recovery: Secondary and tertiary methods", Noyes Data Corp., 1978.
5. Van Poollen, H.K. "Fundamentals of enhanced oil recovery", PennWell Books, 1980.

AS8014 PRODUCTION ENGINEERING L T P C
3 0 0 3

AIM
To develop a logical built up of the various facets of the oil and gas production technology.

OBJECTIVES
An ability to understand and apply operational and maintenance of has lift wells along with surface facilities
An ability to understand and apply other methods of artificial lift systems with awareness of their advantages and disadvantages

OUTCOME
An ability to understand and apply need of stimulation techniques and their types for enhancement in production

UNIT I **9**
Petroleum production system, properties of oil and natural gas, reservoir deliverability

UNIT II **9**
Wellbore performance, choke performance, well deliverability, forecast of well production, production decline analysis

UNIT III **9**
Equipment design and selection – well tubing, separation and transportation systems

UNIT IV **9**
Artificial lift methods - sucker rod pumping, gas lift, artificial lift methods

UNIT V **9**
Production enhancement – well problem identification, matrix acidizing, hydraulic fracturing, production optimization

TOTAL : 45 PERIODS

REFERENCE
1. Guo, B, Lyons, W.C. and Ghalambor, A., Petroleum production engineering: a computerassisted approach, Gulf Professional Publishing, Burlington,

AS8015 MULTICOMPONENT DISTILLATION L T P C
3 0 0 3

AIM
To understand distillation in multicomponent system.

OBJECTIVES
To understand a petroleum reservoir system.

OUTCOME
To understand the basic principles and operations in upstream petroleum industry

UNIT I THERMODYNAMIC PRINCIPLES **9**
Fundamental Thermodynamic principles involved in the calculation of vapor – liquid equilibria and enthalpies of multi component mixtures – Use of multiple equation of state for the calculation of K values – Estimation of the fugacity coefficients for the vapor phase of polar gas mixtures – calculation of liquid – phase activity coefficients.

UNIT II THERMODYNAMIC PROPERTY EVALUATION **9**
Fundamental principles involved in the separation of multi component mixtures – Determination of bubble-point and Dew Point Temperatures for multi component mixtures –

equilibrium flash distillation calculations for multi component mixtures – separation of multi component mixtures at total reflux.

UNIT III MINIMUM REFLUX RATIO FOR MCD SYSTEM 9

General considerations in the design of columns – Column sequencing – Heuristics for column sequencing – Key components – Distributed components – Non-Distributed components – Adjacent keys. Definition of minimum reflux ratio – calculation of Rm for multi component distillation – Underwood method – Colburn method.

UNIT IV VARIOUS METHODS OF MCD COLUMN DESIGN 9

Theta method of convergence – Kb method and the constant composition method – Application of the Theta method to complex columns and to system of columns – Lewis Matheson method – Stage and reflux requirements – Short cut methods and Simplified graphical procedures.

UNIT V VARIOUS TYPES OF MCD COLUMNS 9

Design of sieve, bubble cap, valve trays and structured packing columns for multi component distillation – computation of plate efficiencies.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Holland, C.D., “Fundamentals of Multi Component Distillation”, McGraw Hill Book Company,1981
2. Van Winkle, “Distillation Operations”, McGraw Hill Publications, 1987.

CH8003 ENERGY TECHNOLOGY L T P C
3 0 0 3

AIM

To understand characterization of source and reservoir rocks.

OBJECTIVES

To understand methodology to produce these reserves.
To understand environmental consequences of producing these reserves.

OUTCOME

To understand characterization of source and reservoir rocks.

UNIT I ENERGY 8

Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives.

UNIT II CONVENTIONAL ENERGY 8

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY 10

Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY 10

Biomass origin - Resources – Biomass estimation. Thermochemical conversion – Biological conversion, Chemical conversion – Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification.

UNIT V ENERGY CONSERVATION 9

Energy conservation - Act; Energy management importance, duties and responsibilities; Energy audit – Types methodology, reports, instruments. Benchmalcing and energy performance, material and energy balance, thermal energy management.

TOTAL : 45 PERIODS

TEXTBOOKS

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.
4. Energy Management, Paul W.O'Callaghan McGraw – Hill, 1993

REFERENCES

1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.
4. Handbook of Energy Audit by 7th edition Albert Thumann, P.E., C.E.M & William J Younger C.E.M, Faiment Press 2008

CH8005 MODERN SEPARATION TECHNIQUES L T P C
3 0 0 3

AIM

To identify the multiple factors influencing the choice of separation techniques.

OBJECTIVES

To be able to qualitatively and quantitatively address the fundamental aspects of specialty separation processes.

OUTCOME

To separate the petroleum products using sophisticated separation techniques.

UNIT I BASICS OF SEPARATIO PROCESS 9

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 Electro Filtration, Surface based solid – liquid separations involving a second liquid.

UNIT II MEMBRANE SEPARATIONS 9

Types and choice of Membranes, Plate and Frame, tubular, spiral wound and hollow fiber Membrane Reactors and their relative merits, commercial, Pilot Plant and Laboratory Membrane permeators involving Dialysis, Reverse Osmosis, Nanofiltration, Ultra filtration and Micro filtration, Ceramic- Hybrid process and Biological Membranes.

UNIT III SEPARATION BY ADSORPTION 9

Types and choice of Adsorbents, Adsorption Techniques, Dehumidification Techniques, Affinity Chromatography and Immuno Chromatography, Recent Trends in Adsorption.

UNIT IV INORGANIC SEPARATIONS 9

Controlling factors, Applications, Types of Equipment employed for Electrophoresis, Dielectrophoresis, Ion Exchange Chromatography and Eletrodialysis, EDR, Bipolar Membranes.

UNIT V OTHER TECHNIQUES 9

Separation involving Lyophilisation, Pervaporation and Permeation Techniques for solids, liquids and gases, zone melting, Adductive Crystallization, other Separation Processes, Supercritical fluid Extraction, Oil spill Management, Industrial Effluent Treatment by Modern Techniques.

TOTAL : 45 PERIODS

REFERENCES

1. King, C. J., “Separation Processes”, Tata McGraw Hill, 1982.
2. Roussel, R. W., “Handbook of Separation Process Technology”, John Wiley, New York, 1987.
3. Nakagawal, O. V., “Membrane Science and Technology”’ Marcel Dekkar, 1992.

CH8006 OPTIMIZATION OF CHEMICAL PROCESS L T P C
3 0 0 3

AIM

To learn basic concepts of production enhancement methods.

OBJECTIVES

To understand use of any production enhancement software.
To understand optimization of field management.

OUTCOME

Selecting methods to optimize a production system and maximize the recoverable reserves from a field.

UNIT I INTRODUCTION 5

Introduction to optimization; applications of optimization in chemical engineering; classification of optimization problems.

UNIT II SINGLE VARIABLE OPTIMIZATION 9

Necessary and sufficient conditions for optimum; region elimination methods; interpolation methods; direct root methods.

UNIT III MULTIVARIABLE OPTIMIZATION WITHOUT AND WITH CONSTRAINTS 9

Necessary and sufficient conditions for optimum; direct search methods; indirect search methods.

UNIT IV OTHER OPTIMIZATION METHODS 9

Introduction to geometric, dynamic and integer programming and genetic algorithms.

UNIT V APPLICATIONS OF OPTIMIZATION 13

Formulation of objective functions; fitting models to data; applications in fluid mechanics, heat transfer, mass transfer, reaction engineering, equipment design, resource allocation and inventory control.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Rao, S. S., Engineering Optimization - Theory and Practice, Third Edition, John Wiley & Sons, New York, 1996.
2. Edgar, T.F., Himmelblau, D.M., "Optimisation of Chemical Processes ", McGraw-Hill Book Co., New York, 2003.
3. Reklaitis, G.V., Ravindran, A., Ragsdell, K.M. "Engineering Optimisation ", John Wiley, New York, 1980.

CH8009 PROCESS MODELLING AND SIMULATION L T P C
3 0 0 3

AIM
To understand physical and empirical modeling techniques.

OBJECTIVES
To get introduced to modeling and simulation of steady state and dynamic behavior of chemical processes.

OUTCOME
To gain hands-on experience with commercial simulators.

UNIT I INTRODUCTION 3
Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT II STEADY STATE LUMPED SYSTEMS 9
Degree of freedom analysis, single and network of process units, systems yielding linear and non-linear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.

UNIT III UNSTEADY STATE LUMPED SYSTEMS 9
Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.

UNIT IV STEADY STATE DISTRIBUTED SYSTEM 7
Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT V UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES 13
Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor, hierarchy in model development, classification and solution of partial differential equations. Empirical modeling, parameter estimation, population balance and stochastic modeling**.**

TOTAL : 45 PERIODS

TEXT BOOKS
1. Ramirez, W.; " Computational Methods in Process Simulation ", 2nd Edn., Butterworths Publishers, New York, 2000.
2. Luyben, W.L., " Process Modelling Simulation and Control ",2nd Edn, McGraw-Hill Book Co., 1990

REFERENCES
1. Felder, R. M. and Rousseau, R. W., " Elementary Principles of Chemical Processes ", John Wiley, 2000.
2. Franks, R. G. E., " Mathematical Modelling in Chemical Engineering ", John Wiley, 1967.

Attested

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CH8010 PROCESS PLANT UTILITIES L T P C
3 0 0 3

AIM
To understand the fundamentals and principles of Process Control and Field Instrumentation.

OBJECTIVES
Apply the principles of instrumentation and control for efficient production and transportation of crude oil.

OUTCOME
Choose the proper measuring instrument for a parameter to be measured according to the operating conditions.

UNIT I IMPORTANT OF UTILITIES 9
Hard and Soft water, Requisites of Industrial Water and its uses. Methods of water Treatment such as Chemical Softening and Demineralization, Resins used for Water Softening and Reverse Osmosis. Effects of impure Boiler Feed Water.

UNIT II STEAM AND STEAM GENERATION 9
Properties of Steam, problems based on Steam, Types of Steam Generator such as Solid Fuel Fired Boiler, Waste Gas Fired Boiler and Fluidized Bed Boiler. Scaling and Trouble Shooting. Steam Traps and Accessories.

UNIT III REFRIGERATION 9
Refrigeration Cycles, Methods of Refrigeration used in Industry and Different Types of Refrigerants such as Monochlorodifluro Methane, Chlorofluro Carbons and Brins. Refrigerating Effects and Liquefaction Processes.

UNIT IV COMPRESSED AIR 9
Classification of Compressor, Reciprocating Compressor, Single Stage and Two Stage Compressor, Velocity Diagram for Centrifugal Compressor, Silp Factor, Impeller Blade Shape. Properties of Air –Water Vapors and use of Humidity Chart. Equipments used for Humidification, Dehumidification and Cooling Towers.

UNIT V FUEL AND WASTE DISPOSAL 9
Types of Fuel used in Chemical Process Industries for Power Generation such as Natural Gas, Liquid Petroleum Fuels, Coal and Coke. Internal Combustion Engine, Petrol and Diesel Engine. Waste Disposal.

TOTAL : 45 PERIODS

REFERENCES

1. Eckenfelder, W. W, Jr. “Industrial Water Pollution Control” McGraw-Hill: New York, 1966.
2. P. L. Ballaney, “Thermal Engineering”, Khanna Publisher New Delhi, 1986.
3. Perry R. H. Green D. W. “Perry's chemical Engineer's Handbook”, McGraw Hill, New York, 2007.
4. P. N. Ananthanarayan, “Basic Refrigeration & Air conditioning”, Tata McGraw Hill, New Delhi, 2007.

CH8011 SUPPLY CHAIN MANAGEMENT L T P C
3 0 0 3

AIM
To understand economic considerations involved in process plant design.

OBJECTIVES
Master the basic techniques of economic evaluation, including accounting techniques, taxes, investment, interest and insurance.

OUTCOME
To get introduced to various aspects and stages of process plant design such as process design, pilot plants, plant design and project engineering.

UNIT I INTRODUCTION 6
Definition of Logistics and SCM: Evolution, Scope, Importance& Decision Phases – Drivers of SC Performance and Obstacles.

UNIT II LOGISTICS MANAGEMENT 10
Factors – Modes of Transportation - Design options for Transportation Networks-Routing and Scheduling – Inbound and outbound logistics- Reverse Logistics – 3PL- Integrated Logistics Concepts- Integrated Logistics Model – Activities - Measuring logistics cost and performance – Warehouse Management - Case Analysis

UNIT III SUPPLY CHAIN NETWORK DESIGN 10
Distribution in Supply Chain – Factors in Distribution network design –Design options-Network Design in Supply Chain – Framework for network Decisions - Managing cycle inventory and safety.

UNIT IV SOURCING, AND PRICING IN SUPPLY CHAIN 9
Supplier selection and Contracts - Design collaboration - Procurement process. Revenue management in supply chain

UNIT V COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN 10
Supply chain coordination - Bullwhip effect – Effect of lack of co-ordination and obstacles – IT and SCM - supply chain IT frame work. E Business & SCM. Metrics for SC performance – Case Analysis

TOTAL : 45 PERIODS

REFERENCES

1. Supply Chain Management, Strategy, Planning, and operation – Sunil Chopra and Peter Meindl- PHI, Second edition, 2007
2. Logistics, David J.Bloomberg, Stephen Lemay and Joe B.Hanna, PHI 2002
3. Logistics and Supply Chain Management –Strategies for Reducing Cost and Improving Service. Martin Christopher, Pearson Education Asia, Second Edition
4. Modeling the supply chain, Jeremy F.Shapiro, Thomson Duxbury, 2002
5. Handbook of Supply chain management, James B.Ayers, St.Lucle Press, 2000

GE8751 ENGINEERING ETHICS AND HUMAN VALUES L T P C
3 0 0 3

AIM
Students to gain knowledge in decision making and solve problems.

OBJECTIVES
To familiarize students with contemporary ethical and professional conduct issues.

OUTCOME
To provide students with guidelines for evaluating and resolving ethical dilemmas and decision-making in Professional career.

UNIT I HUMAN VALUES 10
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

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

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – The Three Mile Island and Chernobyl Case Studies

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 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Sample Code of Conduct

TOTAL : 45 PERIODS

TEXTBOOK

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.

REFERENCES

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Thompson Wadsworth, A Division of Thomson Learning Inc., United States, 2000
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001

WEB SOURCES:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

ME8004 DESIGN OF HEAT EXCHANGERS LT P C
3 0 0 3

AIM

To learn heat flow in condensers, cooling towers.

OBJECTIVES

To learn the thermal and stress analysis on various parts of the heat exchangers.
To analyze the sizing and rating of the heat exchangers for various applications.

OUTCOME

To study heat exchange in different systems.

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UNIT I INTRODUCTION 9

Types of heat exchangers, shell and tube heat exchangers – regenerators and recuperators - Temperature distribution and its implications - Parts description, Classification as per Tubular Exchanger Manufacturers Association (TEMA)

UNIT II PROCESS DESIGN OF HEAT EXCHANGERS 9

Heat transfer correlations, Overall heat transfer coefficient, analysis of heat exchangers – LMTD and effectiveness method. Sizing of finned tube heat exchangers, U tube heat exchangers, Design of shell and tube heat exchangers, fouling factors, pressure drop calculations.

UNIT III STRESS ANALYSIS 9

Stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses - types of failures, buckling of tubes, flow induced vibration.

UNIT IV COMPACT AND PLATE HEAT EXCHANGER 9

Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.

UNIT V CONDENSERS AND COOLING TOWERS 9

Design of surface and evaporative condensers – cooling tower – performance characteristics.

TOTAL : 45 PERIODS

TEXT BOOKS

1. SadikKakac and Hongtan Liu, Heat Exchangers Selection, Rating and Thermal Design, CRC Press, 2002.
2. Shah,R. K., Dušan P. Sekulić, Fundamentals of heat exchanger design, John Wiley & Sons,2003.

REFERENCES

1. Robert W. Serth, Process heat transfer principles and applications, Academic press, Elesevier, 2007.
2. Sarit Kumar Das, Process heat transfer, Alpha Science International, 2005
3. John E. Hesselgreaves,Compact heat exchangers: selection, design, and operation, Elsevier science Ltd, 2001.
4. T. Kuppan, Heat exchanger design hand book, New York : Marcel Dekker, 2000.
5. Eric M. Smith, Advances in thermal design of heat exchangers: a numerical approach: direct-sizing, step-wise rating, and transients, John Wiley & Sons, 1999.
6. Arthur. P Frass, Heat Exchanger Design, John Wiley & Sons, 1989

MF8077 PRODUCT DESIGN AND DEVELOPMENT L T P C
3 0 0 3

AIM

To understand the fundamental concepts of equipment and product design.

OBJECTIVE

To teach the students basic concepts of Product Design and Process Development. Expose the students to the importance, various stages, concepts, management and prototyping of Product Design and Process Development.

OUTCOME

An ability to understand the concepts of manufacturing and product developement.

UNIT INTRODUCTION 9

Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer - behavior analysis. Understanding

customer-promoting customer understanding-involve customer in development and managing requirements - Organization process management and improvement.

UNIT II CONCEPT GENERATION, SELECTION AND TESTING 9

Plan and establish product specifications. Task - Structured approaches - clarification - search externally and internally-Explore systematically - reflect on the solutions and processes - concept selection - methodology - benefits. Implications - Product change - variety – component standardization - product performance – manufacturability.

UNIT III PRODUCT ARCHITECTURE 9

Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems -architecture of the chunks - creating detailed interface specifications-Portfolio Architecture.

UNIT IV INDUSTRIAL DESIGN 9

Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically - Need for industrial design-impact – design process - investigation of customer needs - conceptualization - refinement - management of the industrial design process.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 9

Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping - Planning for prototypes - Economic Analysis.

TOTAL : 45 PERIODS

TEXT BOOK

1. Ulrich K.T. and Eppinger S.D., “Product Design and Development” McGraw - Hill International Editions,1999.

REFERENCES

1. Belz A., 36-Hour Course: “Product Development” McGraw-Hill, 2010.
2. Rosenthal S., “Effective Product Design and Development”, Business One Orwin,Homewood, 1992, ISBN 1-55623-603-4.
3. Pugh S., “Total Design – Integrated Methods for successful Product Engineering”, Addison Wesley Publishing, 1991, ISBN 0-202-41639-5.

ME8072 COMPUTATIONAL FLUID DYNAMICS L T P C
3 0 0 3

AIM

To have knowledge in computational techniques.

OBJECTIVES

To introduce Governing Equations of viscous fluid flows
To introduce numerical modeling and its role in the field of fluid flow and heat transfer
To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.

OUTCOME

To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 8

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic

Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three - dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 10

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT IV FLOW FIELD ANALYSIS 9

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

UNIT V TURBULENCE MODELS AND MESH GENERATION 9

Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Versteeg, H.K., and Malalasekera, W., An Introduction to Computational Fluid Dynamics:The finite volume Method, Pearson Education Ltd. Second Edition – 2007.
2. Ghoshdastidar, P.S., Computer Simulation of flow and heat transfer, Tata McGraw Hill Publishing Company Ltd., 1998.

REFERENCES

1. Patankar, S.V. Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation, 2004.
2. Chung, T.J. Computational Fluid Dynamics, Cambridge University, Press, 2002.
3. Ghoshdastidar P.S., Heat Transfer, Oxford University Press, 2005
4. Muralidhar, K., and Sundararajan, T., Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi, 1995.
5. ProdipNiyogi, Chakrabarty, S.K., Laha, M.K. Introduction to Computational Fluid Dynamics, Pearson Education, 2005.
6. Introduction to Computational Fluid Dynamics Anil W. Date Cambridge University Press, 2005.

ME8005 DESIGN OF PRESSURE VESSELS AND PIPING L T P C
3 0 0 3

AIM

To understand physical environment and field operations in deepwater.

OBJECTIVES

To understand deepwater piping environment, equipment and drilling operations.

OUTCOME

To understand deepwater piping operations and transportation of produced Fluids.

UNIT I INTRODUCTION 3

Methods for determining stresses – Terminology and Ligament Efficiency – Applications.

UNIT II STRESSES IN PRESSURE VESSELS 15

Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses Discontinuity stresses in pressure vessels.

UNIT III DESIGN OF VESSELS 15

Design of Tall cylindrical self supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design.

UNIT IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS 8

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT V PIPING 4

Introduction – Flow diagram – piping layout and piping stress Analysis.

TOTAL : 45 PERIODS

TEXT BOOK

1. John F. Harvey, Theory and Design of Pressure Vessels, CBS Publishers and Distributors, 1987.

REFERENCES

1. Henry H. Bedner, “Pressure Vessels, Design Hand Book, CBS publishers and Distributors, 1987.
2. Stanley, M. Wales, “Chemical process equipment, selection and Design. Buterworths series in Chemical Engineering, 1988.
3. William. J., Bees, “Approximate Methods in the Design and Analysis of Pressure Vessels and Piping”, Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Sam Kannapan, “Introduction to Pipe Stress Analysis”. John Wiley and Sons, 1985.

GE8072 DISASTER MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context,
- Disaster damage assessment and management.

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of-community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level-State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

Attested

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GE8073 **HUMAN RIGHTS** **L T P C**
3 0 0 3

OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOME :

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

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