ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

CHOICE BASED CREDIT SYSTEM

B.TECH. PETROLEUM ENGINEERING AND TECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

I. To inculcate in students, a professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to solve problems encountered in petrochemical sector
II. To make the students conversant with oils and their properties, principles of chemical analysis and preparation of chemicals
III. To acquaint the students with the standards for the analysis of petroleum products
IV. To give them an opportunity to gain knowledge on various reaction mechanisms
V. To help the students understand the theory, instrumentation and applications of analytical equipments used in industries for testing the quality of petroleum, intermediates and products
VI. To make them learn basic rock and fluid properties relevant to petroleum reservoirs
VII. To teach the students to solve chemical engineering problems using C and MATLAB and other computational tools
VIII. To given an introduction to the students on control systems along with instrumentation

PROGRAMME OUTCOMES (POs):

On successful completion of the programme,

I. Graduates will be able to demonstrate their knowledge professionally and shoulder ethical responsibilities
II. Graduates will be capable to design experiments, analyze and interpret data
III. Graduates will be able to meet the world's ever-increasing demand for hydrocarbon fuel, thermal energy, and waste and pollution management
IV. Graduates will gain a knowledge of the basic principles involved in different chemical synthesis and will be able to apply them in chemical industries
V. Graduates will have the capacity to choose a proper measuring instrument for a parameter to be measured
VI. Graduates will have a knowledge of different analytical techniques and shall apply them to analyze chemical and petrochemical products
VII. Graduates will understand the characteristics of source and reservoir rocks
VIII. Graduates will become familiar with environmentally sound exploration, evaluation and recovery of oil, gas and other fluids in the earth
IX. Graduates will have the ability to solve chemical engineering problems.
X. Understand the pre requisites of control strategies and the mechanism of advance control systems

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

Programme Educational Objectives	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
I	✓	✓	✓	✓						
II		✓		✓						
III				✓	✓	✓				
IV		✓		✓						
V					✓	✓				
VI							✓	✓		
VII									✓	
VIII										✓

Attested

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

ANNA UNIVERSITY : : CHENNAI 600 025
UNIVERSITY DEPARTMENTS
B. TECH. PETROLEUM ENGINEERING AND TECHNOLOGY
R – 2015
CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI I - VIII SEMESTERS

SEMESTER I

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS7151	Foundational English	HS	4	4	0	0	4
2.	MA7151	Mathematics I	BS	4	4	0	0	4
3.	PH7151	Engineering Physics	BS	3	3	0	0	3
4.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE7151	Computing Techniques	ES	3	3	0	0	3
PRACTICALS								
6.	BS7161	Basic Sciences Laboratory	BS	4	0	0	4	2
7.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
			TOTAL	**25**	**17**	**0**	**8**	**21**

SEMESTER II

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS7251	Technical English	HS	4	4	0	0	4
2.	MA7251	Mathematics – II	BS	4	4	0	0	4
3.	PH7257	Physics of Materials	BS	3	3	0	0	3
4.	CY7255	Chemistry for Technologists	BS	3	3	0	0	3
5.	GE7152	Engineering Graphics	ES	5	3	2	0	4
6.	CY7256	Organic Chemistry	BS	3	3	0	0	3
PRACTICALS								
7.	CH7261	Chemical Analysis Laboratory	BS	4	0	0	4	2
8.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
			TOTAL	**30**	**20**	**2**	**8**	**25**

Attested

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

SEMESTER III

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AS7301	Fluids and Solid Operations	PC	4	4	0	0	4
2.	AS7302	Petroleum Chemistry	PC	3	3	0	0	3
3.	AS7303	Spectroscopic Techniques for Petroleum Engineers	PC	3	3	0	0	3
4.	EE7254	Principles of Electrical and Electronics Engineering	ES	3	3	0	0	3
5.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
6.	MA7357	Probability and Statistics	BS	4	4	0	0	4
PRACTICALS								
7.	EE7312	Electrical Engineering Laboratory for Technologists	ES	4	0	0	4	2
8.	AS7313	Fluid Mechanics and Mechanical Operations Laboratory	ES	4	0	0	4	2
			TOTAL	**29**	**21**	**0**	**8**	**25**

SEMESTER IV

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AS7401	Chemical Engineering Thermodynamics	PC	4	4	0	0	4
2.	AS7402	Industrial Stoichiometry	ES	3	3	0	0	3
3.	AS7403	Reservoir Engineering	PC	3	3	0	0	3
4.	ME7251	Basic Mechanical Engineering	ES	3	3	0	0	3
5.		Professional Elective I	PE	3	3	0	0	3
PRACTICALS								
6.	AS7412	Organic Chemistry Laboratory for Petrochemical Engineers	BS	4	0	0	4	2
7.	ME7262	Mechanical Engineering Laboratory	ES	4	0	0	4	2
			TOTAL	**24**	**16**	**0**	**8**	**20**

Attested

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

SEMESTER V

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AS7501	Heat and Mass Transfer for Petrochemical Engineers	PC	4	4	0	0	4
2.	AS7502	Natural Gas Engineering	PC	3	3	0	0	3
3.	AS7503	Petroleum Refining I	PC	3	3	0	0	3
4.	GE7351	Engineering Ethics and Human Values	HS	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
6.		Open Elective I*	OE	3	3	0	0	3
PRACTICALS								
7.	AS7511	Petroleum Testing Laboratory	PC	4	0	0	4	2
8.	CH7561	Heat Transfer Laboratory	PC	4	0	0	4	2
			TOTAL	**27**	**19**	**0**	**8**	**23**

***Course from the curriculum of other UG Programmes**

SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AS7601	Catalytic Reaction Engineering	PC	4	4	0	0	4
2.	AS7602	Petrochemicals	PC	4	4	0	0	4
3.	AS7603	Petroleum Refining II	PC	4	4	0	0	4
4.	HS7551	Employability Skills	HS	3	3	0	0	3
5.		Professional Elective III	PE	3	3	0	0	3
6.		Open Elective II*	OE	3	3	0	0	3
PRACTICALS								
7.	AS7611	Computational Programming in Chemical Engineering Laboratory for Petrochemical Engineers	PC	4	0	0	4	2
8.	AS7612	Mass Transfer Laboratory for Petrochemical Engineers	PC	4	0	0	4	2
			TOTAL	**29**	**21**	**0**	**8**	**25**

***Course from the curriculum of other UG Programmes**

Attested

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

SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AS7701	Petroleum Equipment Design	PC	3	3	0	0	3
2.	CH7651	Process Instrumentation Dynamics and Control	PC	3	3	0	0	3
3.	GE7251	Environmental Science and Engineering	HS	3	3	0	0	3
4.		Professional Elective IV	PE	3	3	0	0	3
5.		Professional Elective V	PE	3	3	0	0	3
6.		Professional Elective VI	PE	3	3	0	0	3
7.	AS7711	Process Control Laboratory for Petrochemical Engineers	PC	4	0	0	4	2
8.	AS7712	Seminar I	EEC	3	3	0	0	3
9.	CH7661	Chemical Reaction Engineering Laboratory	PC	4	0	0	4	2
			TOTAL	**29**	**21**	**0**	**8**	**25**

SEMESTER VIII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective VII	PE	3	3	0	0	3
PRACTICALS								
3.	AS7811	Seminar II	EEC	3	3	0	0	3
2.	AS7812	Project Work	EEC	20	0	0	20	10
			TOTAL	**26**	**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS : 180

PROFESSIONAL ELECTIVES (PE)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	AS7024	Advanced Separation Techniques	PE	3	3	0	0	3
2.	AS7025	Chemical Process Modeling and Simulation	PE	3	3	0	0	3
3.	AS7026	Computational Fluid Dynamics for Petrochemical Engineers	PE	3	3	0	0	3
4.	AS7027	Crude oil transportation	PE	3	3	0	0	3
5.	AS7028	Drilling operations	PE	3	3	0	0	3

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

6.	AS7029	Engineering Economics	PE	3	3	0	0	3
7.	AS7030	Enhanced Oil Recovery	PE	3	3	0	0	3
8.	AS7031	Equilibrium staged operations	PE	3	3	0	0	3
9.	AS7032	Multicomponent Distillation	PE	3	3	0	0	3
10.	AS7033	Petroleum Geology	PE	3	3	0	0	3
11.	AS7011	Petroleum Production Engineering	PE	3	3	0	0	3
12.	AS7012	Plant Safety and Risk Analysis	PE	3	3	0	0	3
13.	AS7013	Process Engineering	PE	3	3	0	0	3
14.	AS7014	Process Optimization	PE	3	3	0	0	3
15.	AS7015	Process Plant Utilities for Petrochemical Engineers	PE	3	3	0	0	3
16.	AS7016	Product Design and Development for Petrochemical Engineers	PE	3	3	0	0	3
17.	AS7017	Refinery process design	PE	3	3	0	0	3
18.	AS7018	Safety and Environmental Health	PE	3	3	0	0	3
19.	AS7019	Science and Health in resonance	PE	3	3	0	0	3
20.	AS7020	Supply Chain Management for Petrochemical Engineers	PE	3	3	0	0	3
21.	AS7021	Technical analysis – An Analytical Insight	PE	3	3	0	0	3
22.	AS7022	Transport Phenomena for Petrochemical Engineers	PE	3	3	0	0	3
23.	AS7023	Well Completion Techniques	PE	3	3	0	0	3
24.	CH7071	Energy Technology	PE	3	3	0	0	3
25.	CY7352	Physical Chemistry	PE	3	3	0	0	3
26.	GE7071	Disaster Management	PE	3	3	0	0	3
27.	GE7074	Human Rights	PE	3	3	0	0	3
28.	MA7072	Statistics and Linear Programming	PE	4	4	0	0	4
29.	MA7354	Numerical Methods	PE	4	4	0	0	4
30.	ME7074	Design of Heat Exchangers	PE	3	3	0	0	3
31.	ME7075	Design of Pressure Vessels and Piping	PE	3	3	0	0	3
32.	MG7451	Principles of Management	PE	3	3	0	0	3
33.	GE7072	Foundation Skills in Integrated Product Development	PE	3	3	0	0	3

Attested

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

HUMANITIES AND SOCIAL SCIENCES (HS)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	HS7151	Foundational English	HS	4	4	0	0	4
2.	HS7251	Technical English	HS	4	4	0	0	4
3.	GE7351	Engineering Ethics and Human Values	HS	3	3	0	0	3
4.	HS7551	Employability Skills	HS	3	3	0	0	3
5.	GE7251	Environmental science and engineering	HS	3	3	0	0	3

BASIC SCIENCES (BS)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	MA7151	Mathematics – I	BS	4	4	0	0	4
2.	PH7151	Engineering Physics	BS	3	3	0	0	3
3.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
4.	BS7161	Basic Sciences Laboratory	BS	4	0	0	4	2
5.	MA7251	Mathematics – II	BS	4	4	0	0	4
6.	PH7257	Physics of Materials	BS	3	3	0	0	3
7.	CY7255	Chemistry for Technologists	BS	3	3	0	0	3
8.	CY7256	Organic Chemistry	BS	3	3	0	0	3
9.	CH7261	Chemical analysis Laboratory	BS	4	0	0	4	2
10.	MA7357	Probability and Statistics	BS	4	4	0	0	4
11.	AS7412	Organic Chemistry Laboratory for Petrochemical Engineers	BS	4	0	0	4	2

ENGINEERING SCIENCES (ES)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	GE7151	Computing Techniques	ES	3	3	0	0	3
2.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
3.	GE7152	Engineering Graphics	ES	4	4	0	0	4
4.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
5.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
6.	EE7254	Principles of Electrical and Electronics Engineering	ES	3	3	0	0	3

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

7.	EE7312	Electrical Engineering Laboratory For Technologists	ES	4	0	0	4	2
8.	AS7311	Fluids Mechanics and Mechanical operations Laboratory	ES	4	0	0	4	2
9.	AS7402	Industrial Stoichiometry	ES	3	3	0	0	3
10.	ME7251	Basic Mechanical Engineering	ES	3	3	0	0	3
11.	ME7262	Mechanical Engineering Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	AS7302	Petroleum Chemistry	PC	3	3	0	0	3
2.	AS7301	Fluids and Solid operations	PC	4	4	0	0	4
3.	AS7303	Spectroscopic Techniques for Petroleum engineers	PC	3	3	0	0	3
4.	AS7401	Chemical engineering thermodynamics	PC	4	4	0	0	4
5.	AS7403	Reservoir Engineering	PC	3	3	0	0	3
6.	AS7503	Petroleum Refining I	PC	3	3	0	0	3
7.	AS7502	Natural Gas Engineering	PC	3	3	0	0	3
8.	AS7501	Heat and Mass Transfer for Petrochemical Engineers	PC	4	4	0	0	4
9.	CH7561	Heat Transfer Laboratory	PC	4	0	0	4	2
10.	AS7511	Petroleum Testing Laboratory	PC	4	0	0	4	2
11.	AS7603	Petroleum Refining II	PC	4	4	0	0	4
12.	AS7602	Petrochemicals	PC	4	4	0	0	4
13.	AS7601	Catalytic Reaction engineering	PC	4	4	0	0	4
14.	AS7612	Mass Transfer Laboratory for Petrochemical Engineers	PC	4	0	0	4	2
15.	AS7611	Computational Programming in Chemical Engineering Laboratory for Petrochemical Engineers	PC	4	0	0	4	2
16.	CH7651	Process Instrumentation, Dynamics and Control	PC	3	3	0	0	3
17.	AS7701	Petroleum Equipment Design	PC	3	3	0	0	3
18.	AS7711	Process Control	PC	4	0	0	4	2

		Laboratory for Petrochemical Engineers						
19.	CH7661	Chemical Reaction Engineering Laboratory	PC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	AS7712	Seminar I	EEC	3	3	0	0	3
2.	AS7812	Project Work	EEC	0	0	0	20	10
3.	AS7811	Seminar II	EEC	3	3	0	0	3

SUMMARY

S. No.	Subject Area	Credits per Semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1	HS	4	4	-	-	3	3	3	-	**17**
2	BS	12	15	4	2	-	-	-	-	**33**
3	ES	5	6	11	8	-	-	-	-	**30**
4	PC	-	-	10	7	14	16	10	-	**57**
5	PE	-	-	-	3	3	3	9	3	**21**
6	OE	-	-	-	-	3	3	-	-	**6**
7	EEC	-	-	-	-	-	-	3	13	**16**
	Total	**21**	**25**	**25**	**20**	**23**	**25**	**25**	**16**	**180**
8	Non-Credit/ Mandatory									

Attested

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

HS7151 FOUNDATIONAL ENGLISH L T P C
4 0 0 4

COURSE DESCRIPTION:
This course aims at developing the language skills necessary for the first year students of Engineering and Technology.

OBJECTIVES:
- To develop the four language skills – Listening, Speaking, Reading and Writing.
- To improve the students' communicative competence in English.
- To teach students the various aspects of English language usage.

CONTENTS

UNIT I GREETING AND INTRODUCING ONESELF 12
Listening- Types of listening – Listening to short talks, conversations; **Speaking** – Speaking about one's place, important festivals etc. – Introducing oneself, one's family/ friend;**Reading** – Skimming a passage– Scanning for specific information;**Writing**- Guided writing - Free writing on any given topic (My favourite place/ Hobbies/ School life, writing about one's leisure time activities, hometown, etc.); **Grammar** – Tenses (present and present continuous) -Question types - Regular and irregular verbs; **Vocabulary** – Synonyms and Antonyms.

UNIT II GIVING INSTRUCTIONS AND DIRECTIONS 12
Listening – Listening and responding to instructions; **Speaking** – Telephone etiquette - Giving oral instructions/ Describing a process – Asking and answering questions; **Reading** – Reading and finding key information in a given text - Critical reading - **Writing –**Process description(non-technical)- **Grammar** – Tense (simple past& past continuous) - Use of imperatives – Subject – verb agreement – Active and passive voice; - **Vocabulary** – Compound words – Word formation – Word expansion (root words).

UNIT III READING AND UNDERSTANDING VISUAL MATERIAL 12
Listening- Listening to lectures/ talks and completing a task; **Speaking** –Role play/ Simulation – Group interaction; **Reading** – Reading and interpreting visual material;**Writing**- Jumbled sentences – Discourse markers and Cohesive devices – Essay writing (cause & effect/ narrative);**Grammar** – Tenses (perfect), Conditional clauses –Modal verbs; **Vocabulary** –Cause and effect words; Phrasal verbs in context.

UNIT IV CRITICAL READING AND WRITING 12
Listening- Watching videos/ documentaries and responding to questions based on them; **Speaking**Informal and formal conversation;**Reading** –Critical reading (prediction & inference);**Writing**–Essay writing (compare & contrast/ analytical) – Interpretation of visual materials;**Grammar** – Tenses (future time reference);**Vocabulary** – One word substitutes (with meanings) – Use of abbreviations & acronyms – Idioms in sentences.

UNIT V LETTER WRITING AND SENDING E-MAILS 12
Listening- Listening to programmes/broadcast/ telecast/ podcast;**Speaking** – Giving impromptu talks, Making presentations on given topics- Discussion on the presentation;**Reading** – Extensive reading;**Writing**- Poster making – Letter writing (Formal and E-mail) ;**Grammar** – Direct and Indirect speech – Combining sentences using connectives;**Vocabulary** –Collocation;

TEACHING METHODS:
Interactive sessions for the speaking module.
Use of audio – visual aids for the various listening activities.
Contextual Grammar Teaching.

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

EVALUATION PATTERN:
Internals – 50%
End Semester – 50%

TOTAL:60 PERIODS

LEARNING OUTCOMES:
- Students will improve their reading and writing skills
- Students will become fluent and proficient in communicative English
- Students will be able to improve their interpersonal communication

TEXTBOOK:
1. Richards, Jack.C with Jonathan Hull and Susan Proctor **New Interchange : English for International Communication. (level2, Student's Book)** Cambridge University Press,New Delhi: 2010.

REFERENCES:
1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge,2011.
2. Morgan, David and Nicholas Regan. **Take-Off: Technical English for Engineering**. London: Garnet Publishing Limited, 2008.
3. Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. **Speaking Effectively : Developing Speaking Skillsfor Business English.** Cambridge University Press, Cambridge: Reprint 2011.

MA7151	MATHEMATICS – I	L	T	P	C
		4	0	0	4

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

COURSE OBJECTIVES
- The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals. Students will use these tools to solve application problems in a variety of settings ranging from physics and biology to business and economics.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I DIFFERENTIAL CALCULUS 12

Representation of functions - New functions from old functions - Limit of a function - Limits at infinity - Continuity - Derivatives - Differentiation rules - Polar coordinate system - Differentiation in polar coordinates - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES 12

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 III INTEGRAL CALCULUS 12

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT IV MULTIPLE INTEGRALS 12

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.

UNIT V DIFFERENTIAL EQUATIONS 12

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.

TOTAL : 60 PERIODS

COURSE OUTCOMES

- Understanding of the ideas of limits and continuity and an ability to calculate with them and apply them.
- Improved facility in algebraic manipulation.
- Fluency in differentiation.
- Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
- Understanding the ideas of differential equations and facility in solving simple standard examples.

TEXT BOOKS

1. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, New Delhi, 2008.
2. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
4. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCE BOOKS

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
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. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

Attested

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

PH7151 **ENGINEERING PHYSICS** **L T P C**

(Common to all branches of B.E / B.Tech programmes) **3 0 0 3**

OBJECTIVE:

- To introduce the concept and different ways to determine moduli of elasticity and applications.
- To instill the concept of sound, reverberation, noise cancellation, and ultrasonic generation, detection and applications
- To inculcate an idea of thermal properties of materials, heat flow through materials and quantum physics
- To promote the basic understanding of interferometers, principles and applications of lasers, optical fibers and sensors
- To establish a sound grasp of knowledge on the basics, significance and growth of single crystals

UNIT I PROPERTIES OF MATTER 9

Elasticity – Poisson's ratio and relationship between moduli (qualitative) - stress-strain diagram for ductile and brittle materials, uses - factors affecting elastic modulus and tensile strength - bending of beams - cantilever - bending moment - Young's modulus determination - theory and experiment - 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 - calculation of reverberation time for different types of buildings – sound absorbing materials - 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 – ultrasonic interferometer - industrial applications – Non-destructive testing - ultrasonic method: scan modes and practice.

UNIT III THERMAL AND MODERN PHYSICS 9

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity- heat conductions in solids – flow of heat through compound media - Forbe's and Lee's disc method: theory and experiment- Black body radiation – Planck's theory (derivation) – Compton effect – wave model of radiation and matter – Schrödinger's wave equation – time dependent and independent equations – Physical significance of wave function – particle in a one dimensional box.

UNIT IV APPLIED OPTICS 9

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its applications - Lasers – principle and applications – Einstein's coefficients – CO_2 and Nd:YAG laser - 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 CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – Single crystals: unit cell, crystal systems, Bravais lattices, ditections and planes in a crystal, Miller indices - interplanar distance for a cubic crystal - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - structure and significance of NaCl, CsCl, ZnS and graphite - crystal

imperfections: point defects, line defects – Burger vectors, dislocations and stacking faults – Growth of single crystals: Bridgman and Czochralski methods.

TOTAL: 45 PERIODS

OUTCOME:

- The students will understand different moduli of elasticity, their determination and applications.
- The students will gain knowledge on the properties of sound, noise cancellation, and production, detection and applications of ultrasonics
- The students will acquire sound knowledge on thermal expansion and thermal conductivity of materials. Further they will gain an idea of quantum physics.
- The students will gain knowledge on interferometers, lasers and fiber optics
- The students will secure knowledge on the basics of crystal structures and their significance. Further they gain basic ideas of growing single crystals.

TEXTBOOKS:

1. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai Publications (2013)
2. Palanisamy P.K., "Engineering Physics", Scitech Publications (P) Ltd. (2006).
2. Arumugam M., "Engineering Physics", Anuradha Publications (2000)

REFERENCES:

1. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co. (2010).
2. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, (2007).
3. Markert J.T.,Ohanian, H. and Ohanian, M. "Physics for Engineers and Scientists". W.W.Norton & Co. (2007).

CY7151 ENGINEERING CHEMISTRY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To develop an understanding about fundamentals of polymer chemistry.
- Brief elucidation on surface chemistry and catalysis.
- To develop sound knowledge photochemistry and spectroscopy.
- To impart basic knowledge on chemical thermodynamics.
- To understand the basic concepts of nano chemistry.

UNIT I POLYMER CHEMISTRY 9

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

UNIT II SURFACE CHEMISTRYAND CATALYSIS 9

Adsorption-Types of adsorption-adsorption of gases on solids- adsorption from solutions-Types of isotherms–Frendlich adsorption isotherm,Langmuir adsorption isotherm.Industrial applications of adsorption. Catalysis: Characteristics and types of catalysts-homogeneous and heterogeneous, auto catalysis. Enzyme catalysis -factors affecting enzyme catalysis, Michaelis-Menton equation.Industrial applications of catalysts.

Attested

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

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry-Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law. Photo processes-internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo-sensitization. Spectroscopy: Electromagnetic spectrum-absorption of radiation-electronic, vibrational and rotational transitions. Width and intensities of spectral lines.Spectrophotometric estimation of iron.UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

UNIT IV CHEMICAL THERMODYNAMICS 9

Second law: Entropy-entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Free energy and work function: Helmholtzand 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 V NANOCHEMISTRY 9

Basics-distinction between molecules, nanoparticles and bulk materials; size-dependent properties.Preparation of nanoparticles – sol-gel and solvothermal.Preparation of carbon nanotube by chemical vapour deposition and laser ablation.Preparation of nanowires by VLS growth, electrochemical deposition and electro spinning.Properties and uses of nanoparticles, nanoclusters, nanorods, nanotubes and nanowires.

TOTAL : 45 PERIODS

COURSE OUTCOMES

- Will be familiar with polymer chemistry, surface chemistry and catalysis.
- Will know the photochemistry, spectroscopy and chemical thermodynamics.
- Will know the fundamentals of nano chemistry.

TEXT BOOKS

1. Jain P. C. & Monica Jain., "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd, New Delhi, 2014.
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2014

REFERENCE BOOKS

1. Pahari A., Chauhan B., "Engineering Chemistry", Firewall Media, New Delhi, 2012.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. AshimaSrivastava. Janhavi N N, Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2010.
4. Vairam S., Kalyani P., Suba Ramesh., "Engineering Chemistry", Wiley India Pvt Ltd., New Delhi., 2011.

GE7151	COMPUTING TECHNIQUES	L	T	P	C
	(Common to all branches of Engineering and Technology)	**3**	**0**	**0**	**3**

OBJECTIVES:

- To learn programming using a structured programming language.
- To provide C programming exposure.
- To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

UNIT I INTRODUCTION 9

Introduction to Computers – Computer Software – Computer Networks and Internet - Need for logical thinking – Problem formulation and development of simple programs - Pseudo code - Flow Chart and Algorithms.

UNIT II C PROGRAMMING BASICS 9

Introduction to C programming – Fundamentals – Structure of a C program – Compilation and linking processes - Constants, Variables – Data Types – Expressions - Operators –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 - Strings- String operations – String Arrays - simple programs- sorting- searching – matrix operations.

UNIT IV POINTERS 9

Macros - Storage classes –Basic concepts of Pointers– Pointer arithmetic - Example Problems - Basic file operations

UNIT V FUNCTIONS AND USER DEFINED DATA TYPES 9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion –Enumerators – Structures - Unions

TOTAL : 45 PERIODS

OUTCOMES

At the end of the course, the student should be able to:

- Write C program for simple applications
- Formulate algorithm for simple problems
- Analyze different data types and arrays
- Perform simple search and sort**.**
- Use programming language to solve problems.

TEXTBOOKS:

1. Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013
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”, Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, “How to Solve it by Computer”, Pearson Education, Fourth Reprint, 2007

BS7161 BASIC SCIENCES LABORATORY L T P C

(Common to all branches of B.E. / B.Tech Programmes) **0 0 4 2**

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVE:

- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.

- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves, band gap determination and viscosity of liquids.

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. Uniform bending – Determination of young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using gating.
13. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille's flow

TOTAL: 30 PERIODS

OUTCOME:

Upon completion of the course, the students will be able

- To determine various moduli of elasticity and also various thermal and optical properties of materials.
- To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY:

(Minimum of 8 experiments to be conducted)

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

TEXT BOOKS

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH} edition, 2014)
2. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).

Attested

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

GE7161 COMPUTER PRACTICES LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To understand the basic programming constructs and articulate how they are used to develop a program with a desired runtime execution flow.
- To articulate where computer programs fit in the provision of computer-based solutions to real world problems.
- To learn to use user defined data structures.

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
10. Program using structures and unions.

TOTAL: 60 PERIODS

OUTCOMES

At the end of the course, the student should be able to:

- Write and compile programs using C programs.
- Write program with the concept of Structured Programming
- Identify suitable data structure for solving a problem
- Demonstrate the use of conditional statement.

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS

30 Systems with C compiler

HS7251 TECHNICAL ENGLISH

L	T	P	C
4	0	0	4

OBJECTIVES

- To enable students acquire proficiency in technical communication.
- To enhance their reading and writing skills in a technical context.
- To teach various language learning strategies needed in aprofessional environment.

CONTENTS

UNIT I ANALYTICAL READING **12**

Listening- Listening to informal and formal conversations; **Speaking** – Conversation Skills(opening, turn taking, closing)-explaining how something works-describing technical functions and applications;**Reading** –Analytical reading, Deductive and inductive reasoning; **Writing**- vision statement–structuring paragraphs.

UNIT II SUMMARISING **12**

Listening- Listening to lectures/ talks on Science & Technology;**Speaking** –Summarizing/ Oral Reporting, **Reading** – Reading Scientific and Technical articles; **Writing**- Extended definition – Lab Reports – Summary writing.

Attested

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

UNIT III DESCRIBING VISUAL MATERIAL 12

Listening- Listening to a panel discussion; **Speaking** – Speaking at formal situations; **Reading** –Reading journal articles - Speed reading;**Writing**-data commentary-describing visual material-writing problem-process- solution-the structure of problem-solution texts- writing critiques

UNIT IV WRITING/ E-MAILING THE JOB APPLICATION 12

Listening- Listening to/ Viewing model interviews; **Speaking** –Speaking at different types of interviews – Role play practice (mock interview); **Reading** – Reading job advertisements and profile of the company concerned;**Writing**- job application – cover letter –Résumé preparation.

UNIT V REPORT WRITING 12

Listening- Viewing a model group discussion;**Speaking** –Participating in a discussion - Presentation;**Reading** – Case study - analyse -evaluate – arrive at a solution;**Writing**– Recommendations- Types of reports (feasibility report)- designing and reporting surveys- – Report format.- writing discursive essays.

TEACHING METHODS:

Practice writing
Conduct model and mock interview and group discussion.
Use of audio – visual aids to facilitate understanding of various forms of technical communication.
Interactive sessions.

EVALUATION PATTERN:

Internals – 50%
End Semester – 50%

TOTAL:60 PERIODS

LEARNING OUTCOMES

- Students will learn the structure and organization of various forms of technical communication.
- Students will be able to listen and respond to technical content.
- Students will be able to use different forms of communication in their respective fields.

TEXTBOOK:

1. Craig,Thaine**. Cambridge Academic English: An integrated skills course for EAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012

REFERENCES:

1. Laws, Anne. **Presentations.** Hyderabad: Orient Blackswan, 2011.
2. Ibbotson, Mark. **Cambridge English for Engieering**. Cambridge University Press, Cambridge,New Delhi: 2008
3. Naterop, Jean B. and Rod Revell. **Telephoning in English**. Cambridge: Cambridge University Press, 2004.
4. Rutherford, Andrea J. **Basic Communication Skills for Technology**. New Delhi: Pearson Education, 2001.
5. Bailey, Stephen. **Academic Writing A practical Guide for Students**. Routledge, London: 2004.
6. Hewings, Martin**. Cambridge Academic English: An integrated skills course for EAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012.

Attested

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

MA7251 **MATHEMATICS – II** **L T P C**
4 0 0 4

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

COURSE OBJECTIVES

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- 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 MATRICES **12**

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 VECTOR CALCULUS **12**

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

UNIT III ANALYTIC FUNCTION **12**

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 **12**

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 **12**

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

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

- Evaluate real and complex integrals using the Cauchy integral formula and the residue theorem
- Appreciate how complex methods can be used to prove some important theoretical results.
- Evaluate line, surface and volume integrals in simple coordinate systems

- Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities
- Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

TEXT BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCE BOOKS

1. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
4. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
5. Peter V. O'Neil , "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH7257	PHYSICS OF MATERIALS	L T P C
	(Common to Chemical, Ceramic, Food, Leather, Textile, Apparel, Industrial Biotechnology, Pharmaceutical and PET)	3 0 0 3

OBJECTIVE:

- To make the students to understand the basics of phase diagrams and various materials preparation techniques
- To equip the students to have a knowledge on different types of electron theory, basics of quantum mechanics and about superconductors
- To introduce the physics of semiconducting materials and applications of semiconductors in device fabrication
- To familiarize the students with the theory and applications of magnetic and dielectric materials
- To provide the students a sound platform towards learning about advanced materials and their applications.

UNIT I PREPARATION OF MATERIALS 9

Phases - phase rule – binary systems – tie line rule – lever rule – phase diagram – invariant reactions - nucleation – homogeneous and heterogeneous nucleation – free energy of formation of a critical nucleus – Thin films – preparation: PVD, CVD method – Nanomaterials Preparation: wet chemical, solvothermal, sol-gel method.

UNIT II ELECTRICAL AND SUPERCONDUCTING MATERIALS 9

Classical free electron theory - expression for electrical conductivity – thermal conductivity, - Wiedemann-Franz law - Quantum free electron theory – applications of Schrodinger wave equation: particle in a finite potential well – particle in a three-dimensional box- degenerate states – Fermi-Dirac statistics – density of energy states – electron in periodic potential – electron effective mass – concept of hole. Superconducting phenomena, properties of superconductors – Meissner effect and isotope effect. Type I and Type II superconductors, High T_c superconductors – Magnetic levitation and SQUIDS.

UNIT III SEMICONDUCTING MATERIALS 9

Elemental Semiconductors - Compound semiconductors - Origin of band gap in solids (qualitative) - carrier concentration in metals - 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 – Hall effect – determination of Hall coefficient – LED - Solar cells.

UNIT IV DIELECTRIC 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 - Ferroelectric materials - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance materials.

UNIT V NEW MATERIALS AND APPLICATIONS 9

Ceramics – types and applications – Composites: classification, role of matrix and reinforcement – processing of fibre reinforced plastics and fibre reinforced metals – Metallic glasses – Shape memory alloys – Copper, Nickel and Titanium based alloys – grapheme and its properties – Relaxor ferroelectrics - Bio materials – hydroxyapatite – PMMA – Silicone - Sensors: Chemical Sensors - Bio-sensors – Polymer semiconductors – Photoconducting polymers.

TOTAL: 45 PERIODS

OUTCOME:

On completion of the course, the students will be able to

- acquire knowledge of phase diagram, and thin film and nanomaterial preparation techniques
- familiarize with conducting materials, basic quantum mechanics, and properties and applications of superconductors.
- gain knowledge on semiconducting materials based on energy level diagrams, its types, temperature effect. Also, fabrication methods for semiconductor devices will be understood.
- realize with theories and applications of dielectric and ferromagnetic materials
- familiarize with ceramics, composites, metallic glasses, shape memory alloys, biomaterials and their important applications.

.

REFERENCES:

1. Callister W. D. and Rethwisch, D. G., “Materials Science and Engineering”, 9th Edition, Wiley (2014).
2. Raghavan V., “Materials Science and Engineering”, Prentice Hall of India (2004).
3. Askeland D.R. and Wright, W.J., “Essentials of Materials Science and Engineering”, 3rd Edition, Cengage Learning (2014).
4. Pillai, S.O., “Solid State Physics”, New Age International, 7th Edition (2015).
5. Viswanathan, B., “Nanomaterials”, Narosa Book Distributors Pvt Ltd. (2011).

CY7255	CHEMISTRY FOR TECHNOLOGISTS	L	T	P	C
		3	0	0	3

OBJECTIVE

- The students should be conversant with
- boiler feed water requirements, water treatment techniques,
- Applications of oil and its properties, principles of different chemical analysis.
- Different kinds of preparations of important chemicals.

OUTCOME

- Will be familiar with boiler feed water requirements, water treatment techniques.
- Will know the oil and its properties, principles of different chemical analysis.
- Will know the preparations of important chemicals.

UNIT I WATER TECHNOLOGY 9

Water quality parameters- hardness -definition - units of hardness - determination of hardness (EDTA method).Alkalinity - definition - determination of alkalinity.TDS, BOD, COD and iron and their significance. Softening – zeolite and demineralization processes. Boiler troubles (scale, sludge, boiler corrosion, caustic embrittlement and carry over) and remedies – removal of oils and silica, internal conditioning.Desalination by electro-dialysis and reverse osmosis.

UNIT II OILS, FATS, SOAPS & LUBRICANTS 9

Chemical constitution, chemical analysis of oils and fats – free acid, saponification and iodine values, definitions, determinations and significance.Soaps and detergents - cleaning action of soap. Lubricants - definition, characteristics, types and properties – viscosity, viscosity index, carbon residue, oxidation stability, flash and fire points, cloud and pour points, aniline point. Solid lubricants – graphite and molybdenum disulphide.

UNIT III CHEMICAL ANALYSIS – AN ANALYTICAL INSIGHT 9

Gravimetric analysis – principles – method – applications.redox titrations – principle – method – applications. Thin layer chromatography – principles – techniques – applications. Principles underlying the estimations of nitrogen in nitrogeneous fertilizers, phenol and aniline.

UNIT IV DYE CHEMISTRY 9

Witt's theory and modern theory of colors – synthesis of methyl red, methyl orange, congo red, malachite green, p-rosaniline, phenolphthalein, fluorescence, eosin dyes.

UNIT V CHEMICALS AND AUXILIARIES 9

Preparations of bleaching powder, sodium hypochlorite, hydrogen peroxide, chlorine dioxide – estimation of available chlorine in hypochlorite – determination of strength of hydrogen peroxide.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Jain & Jain, "Engineering Chemistry", 16th Edition, 2014,DhanpatRai Publishing Company, New Delhi.
2. Sharma B.K, "Industrial Chemistry", 16th Edition, 2014, GOEL Publishing House, Meerut.

REFERENCE BOOKS

1. Dara SS, Umare SS, "A Textbook of Engineering Chemistry", S. Chand & Company Ltd., New Delhi, 2010.
2. Puri BR, Sharma LR, Pathania S, "Principles of Physical Chemistry", 42nd Edition, 2008, Vishal Publishing Co., Jalandhar.
3. Morrison RT, Boyd RN, Bhattacharjee SK, "Organic Chemistry", 7th Edition, Pearson India, 2011.

GE7152 ENGINEERING GRAPHICS L T P C
3 2 0 4

OBJECTIVES

• 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.

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 ANDFREE HANDSKETCHING **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. 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

14

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES

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 both the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **14**

Sectioning of 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.

15

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS

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.

L=45+T=30, TOTAL: 75 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

- Perform free hand sketching of basic geometrical shapes and multiple views of objects.
- Draw orthographic projections of lines, Planes and Solids
- Obtain development of surfaces.
- Prepare isometric and perspective views of simple solids.

TEXT BOOK:

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) SubhasStores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,,'' Fundamentals of Engineering Drawingwith 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.Natarajan, "A text book of Engineering Graphics", 28th Edition, Dhanalakshmi Publishers, Chennai, 2015.
6. BasantAgarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. N.S Parthasarathy and Vela Murali, " Engineering Drawing", Oxford University Press, 2015

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out ofdrawing 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.

CY7256 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.

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, Tetrahydro Furan, Thiophene, Indole, Pyridine, Quinoline and Isoquinoline.

Attested

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

UNIT III PREPARATION OF SYNTHETIC INTERMEDIATES 9

Preparations of Benzil from benzyl aldehydes - Furyl from furfural, Vanniline from catechol, Gramine from indole, N-actetyl-5- bromo indoline from indole, Salol from phenol, Alanine from propionic acid, Heteroauxin from indole - Uses, Preparation of Chlorampenicol - Uses

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 Malonyl urea, Phenacetin, Isoniazid, Para amino benzoic acid (PABA), Tryptophan Isopentaquine, chloroquine, 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).

CH7261	CHEMICAL ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

(Minimum of 8 experiments to be conducted)

OBJECTIVE

- To make the student acquire practical skills in the wet chemical and instrumentalmethods for quantitative estimation of nitrite in water, cement, oil, coal and Phenol.

LIST OF EXPERIMENTS

1. Determination of Redwood / Saybolt numbers, kinematic viscosity and viscosity index of Lubricating oils
2. Determination of flash point, fire point, cloud and pour point of oils
3. Determination of acid value and iodine value of oils
4. Determination of COD of water samples
5. 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
6. Coal Analysis
    a. Estimation of sulphur present in coal
    b. Ultimate analysis of coal
    c. Proximate analysis of coal
7. Soap Analysis
    a. Estimation of total fatty acid
    b. Estimation of percentage alkali content
8. Flue gas analysis by Orsat’s apparatus
9. Estimation of phenol.
10. Determination of calorific value using bomb calorimeter
11. Determination of nitrite in water.

TOTAL: 60 PERIODS

OUTCOME

- Familiarization with equipment like viscometers, flash and fire point apparatus etc
- Familiarization of methods for determining COD
- Familiarization of a few simple synthetic techniques for soap

REFERENCE BOOKS

1. Environmental pollution analysis, S.M.Khopkar, New age international. 2011
2. Manual of environmental analysis, N.C Aery, Ane books. 2010
3. Text book of quantitative chemical analysis, J.Mendham, Pearson education 2008

GE7162	ENGINEERING PRACTICES LABORATORY	L	T	P	C
	(Common to all Branches of B.E. / B.Tech. Programmes)	0	0	4	2

COURSE OBJECTIVES

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

GROUP – A (CIVIL & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICES **15**

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.
- Laying pipe connection to the delivery side of a pump.
- Practice in connecting pipes of different materials: Metal, plastic and flexible pipes used in householdappliances.

WOOD WORK

- Sawing, planing and making joints like T-Joint, Mortise and Tenon joint and Dovetail joint.

STUDY

- Study of joints in door panels and wooden furniture
- Study of common industrial trusses using models.

2. **ELECTRICAL ENGINEERING PRACTICES** **15**

- Basic household wiring using Switches, Fuse, Indicator and Lamp etc.,
- Stair case light wiring
- Tube – light wiring
- Preparation of wiring diagrams for a given situation.
- Study of Iron-Box, Fan Regulator andEmergency Lamp

GROUP – B (MECHANICAL AND ELECTRONICS)

3. **MECHANICAL ENGINEERING PRACTICES** **15**

WELDING

- Arc welding of Butt Joints, Lap Joints, and Tee Joints
- Gas welding Practice.
- Basic Machining - Simple turning, drilling and tapping operations..
- Study and assembling of the following:
  a. Centrifugal pump
  b. Mixie
  c. Air Conditioner.

DEMONSTRATION ON FOUNDRY OPERATIONS.

4. **ELECTRONIC ENGINEERING PRACTICES** **15**

- Soldering simple electronic circuits and checking continuity.
- Assembling electronic components on a small PCB and Testing.
- Study of Telephone, FM radio andLow Voltage Power supplies.

TOTAL : 60 PERIODS

COURSE OUTCOMES

- Ability to fabricate carpentry components and to lay pipe connections including plumbing works.
- Ability to use welding equipments to join the structures
- Ability to do wiring for electrical connections and to fabricate electronics circuits.

MA7357 PROBABILITY AND STATISTICS L T P C
4 0 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.

UNIT I RANDOM VARIABLES 12

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 12

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 12

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 12

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

UNIT V STATISTICAL QUALITY CONTROL 12

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

OUTCOMES:

- Students will be able characterize probability models using probability mass (density) functions & cumulative distribution functions.
- The students can independently participate in the processes of analysis, planning, formulating strategies of development, decision-making, governing and management, and independent making of tactical and strategic decisions related to the statistics.

Attested

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

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.

AS7302 PETROLEUM CHEMISTRY L T P C
3 0 0 3

AIM

To take an overview of downstream petroleum industry.

OBJECTIVES

To get acquainted with the various standards for the analysis s of petroleum products

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 heteroatom's in heavy crude oil – heteroatom's concentrations, structure of heteroatom functions; Asphaltenes and structure of petroleum

UNIT III **9**

Thermal chemistry of petroleum constituents – visbreaking, coking, hydro treating, hydro cracking

UNIT IV **9**

Heavy oil up gradation processes- carbon rejection, hydrogen addition; Hydro cracking 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, 2015

REFERENCE

1. Speight, J.G., The chemistry and technology of petroleum, Marcel Dekker, New York, 2014

AS7301 **FLUIDS AND SOLID OPERATIONS** **L T P C**
4 0 0 4

AIM

To understand the principles and applications of fluid mechanics and mechanical operations.

OBJECTIVES

To impart to the student knowledge on fluid properties, fluid static and dynamic characteristics flow metering and transport, particle mechanics, techniques of solid – fluid separation

UNIT I PROPERTIES OF FLUID **9**

Newtonian fluids Classification of fluid motion Fluid statics – equilibrium of fluid element – pressure variation in a static fluid – Differential analysis of fluid motion – continuity, Euler's and Bernoulli equation

UNIT II FLOW THROUGH PIPES & BOUNDARY LAYER CONCEPTS **9**

Reynolds number regimes, Flow through pipes – pressure drop under laminar and turbulent flow conditions; boundary layer concepts; different types of flowmeters; Valves, pumps, compressors – characteristics and sizing; Agitation and Mixing;

UNIT III SIZE ANALYSIS **9**

General characteristics of solids, techniques of size analysis; Laws of size reduction, equipments for size reduction

UNIT IV FLOW THROUGH FLUIDIZED BEDS **9**

Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds. Filtration – batch and continuous, filtration equipments - selection, operation

UNIT V CLASSIFIERS **9**

Screening, gravity separation - sedimentation, thickening, elutriation, classifiers - Centrifugal separation - continuous centrifuges, cyclones and hydro cyclones, electrostatic and magnetic separators

TEXT BOOKS

1. Noel de Nevers, "Fluid Mechanics for Chemical Engineers ", Second Edition, McGraw-Hill, (1991).
2. Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", Tata McGraw Hill, 1997.

REFERENCES

1. Munson, B. R., Young, D.F., Okiishi, T.H. "Fundamentals of Fluid Mechanics", 5th Edition", John Wiley, 2006
2. McCabe W.L, Smith, J C and Harriot. P "Unit operations in Chemical Engineering", McGraw Hill, V Edition, 2001
3. Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998.

GE7153 **ENGINEERING MECHANICS** **L T P C**
4 0 0 4

OBJECTIVE :

The objective of this course is to inculcate in the student the ability to analyze any problem in a simple and logical manner and to predict the physical phenomena and thus lay the foundation for engineering applications.

UNIT I STATICS OF PARTICLES 12

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors.

Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGID BODIES 12

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point ,Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

UNIT III DISTRIBUTED FORCES 16

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus-Guldinus, Distributed Loads on Beams, Center of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies , Determination of Centroids of Volumes by Integration.

Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV FRICTION 8

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance , Ladder friction.

UNIT V DYNAMICS OF PARTICLES 12

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles.

Kinetics- Newton's Second Law of Motion -Equations of Motions , Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force , Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

L – 45 + T – 15 TOTAL: 60 PERIODS

OUTCOMES:

- Upon completion of this course, students will be able to construct meaningful mathematical models of physical problems and solve them.

TEXT BOOK

1. Beer,F.P and Johnson Jr. E.R, "Vector Mechanics for Engineers", McGraw-Hill Education (India) Pvt. Ltd. 10th Edition, 2013.

REFERENCES

1. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
2. J.L. Meriam & L.G. Karige, Engineering Mechanics: Statics (Volume I) and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
3. P. Boresi & J. Schmidt, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
4. Irving H. Shames, G. Krishna Mohana Rao, Engineering Mechanics - Statics and Dynamics, Fourth Edition – PHI / Pearson Education Asia Pvt. Ltd., 2006.

5. Vela Murali, “Engineering Mechanics”, Oxford University Press (2010)

AS7303 SPECTROSCOPIC TECHNIQUES FOR PETROLEUM ENGINEERS 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, 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),

UNIT II UV AND VISIBLE SPECTROSCOPY 9

Qualitative Spectroscopy- Lamda max and epsilon max rules, , Woodward -Fieser rules for the calculation of absorption maxima (Lamda max) for dienes and carbonyl compounds, Fieser and kuhn rules - Instrumentation for UV and Visible spectrophotometer (source, optical parts and detectors)-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 ATOMIC SPECTROSCOPY 9

Atomic absorption spectrophotometry: Principle, Instrumentation (Types of burners, Types of fuels, Hollow cathode lamp, Chopper only) and Applications, Various interferences observed in AAS (Chemical, radiation and excitation)

Flame photometry: Principle, Instrumentation, quantitative analysis (Standard addition method and internal standard method) and applications

Differences between AAS and FES.

TOTAL : 45 PERIODS

REFERENCES

1. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Instrumental Analysis, CENGAGE Learning, India, 7th Edition, 2007.
2. Willard H.H, Merritt L.L, Dean J.A and Settle F.A, Instrumental method of analysis, 7th edition,Wadsworth Publishing Company, 1988.
3. Sharma, B.K., Instrumental Methods of Analysis, Goel publishing House, 24th Edition.
4. William Kemp, Organic Spectroscopy, 3rd Edition, Palgrave publishers, 2007.
5. Gurdeep R. Chatwal, Sharma K. Anand, Instrumental methods of Chemical Analysis, Himalaya Publishers, New Delhi, 2014
6. John R Dyer, Applications of Absorption Spectroscopy of Organic Compounds, Prentice-hall of India Pvt. Ltd., 2012
7. Robert M.Silverstein, Francis X.Webstrer, David Kiemle, David L.Bryce, Spectrometric Identification of Organic Compounds, Wiley, 8th Edition

EE7254 PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To impart knowledge on

- Electric circuit laws, single and three phase circuits and wiring
- Working principles of Electrical Machines
- Various electronic devices and measuring instruments

UNIT I ELECTRICAL CIRCUITS 9

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

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.

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 –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 transformers (CT and PT)

TOTAL : 45 PERIODS

OUTCOMES:

Ability to

- Understand electric circuits and working principles of electrical machines

- Understand the concepts of various electronic devices
- Choose appropriate instruments for electrical measurement for a specific application

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. V.K Mehta and Rohit Mehta, “Principle of Electrical Engineering”, S. Chand & Company, 2008

EE7312 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.

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

AS7313 FLUID MECHANICS AND MECHANICAL OPERATIONS LABORATORY **LT P C 0 0 4 2**

OBJECTIVES

- To learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.
- Students develop a sound working knowledge on different types of crushing equipments and separation characteristics of different mechanical operation separators.

OUTCOME:

Use variable area flow meters and variable head flow meters

Analyze the flow of fluids through closed conduits, open channels and flow past immersed bodies Select pumps for the transportation of fluids based on process conditions/requirements and fluid properties.

Determine work index, average particle size through experiments by crushers, ball mill and conducting sieve analysis.

Design size separation equipments such as cyclone separator, sedimentation, Filters etc.

LIST OF EXPERIMENTS - Phase - I

1. Calibration of constant and variable head meters
2. Open drum orifice and draining time
3. Flow through straight pipe
4. Flow through annular pipe
5. Flow through helical coil and spiral coil
6. Characteristic curves of pumps
7. Pressure drop studies in packed column

EQUIPMENT REQUIRED

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

LIST OF EXPERIMENTS - Phase- II

1. Sieve analysis
2. Batch filtration studies using a Leaf filter
3. Batch filtration studies using a Plate and Frame Filter press
4. Characteristics of batch Sedimentation
5. Reduction ratio in Jaw Crusher
6. Reduction ratio in Ball mill
7. Separation characteristics of Cyclone separator
8. Reduction ratio of Roll Crusher

EQUIPMENT REQUIRED

1. Sieve shaker
2. Leaf filter
3. Plate and Frame Filter Press
4. Sedimentation Jar
5. Jaw Crusher
6. Ball Mill
7. Cyclone Separator
8. Roll Crusher
9. Elutriator
10. Drop Weight Crusher
11. Sieves.

TOTAL : 60 PERIODS

AS7401 CHEMICAL ENGINEERING THERMODYNAMICS L T P C
4 0 0 4

AIM

To study the basic concepts involved in Thermodynamics and their application

OBJECTIVE

- Students will learn heat and work effects associated with process, PVT behavior of fluids, laws of thermodynamics and their application, Phase and Reaction equilibrium.

OUTCOME

- Evaluate the thermodynamic properties of fluids.
- Analyze the feasibility of systems/devices.
- Calculate chemical reaction rate and equilibrium composition.

UNIT I ZEROTH AND FIRST LAW OF THERMODYNAMICS 12

Definitions and Concepts, Scope of Thermodynamics, Zeroth law; Temperature scales; Equations of state for ideal and real gases; First law and internal energy; First law for the non flow and flow systems; Enthalpy and heat capacity; Limitations of first law.

UNIT II SECOND LAW OF THERMODYNAMICS 12

Statements of the second law of thermodynamics; Carnot cycle and Carnot theorems; Thermodynamic temperature scale; Entropy and its calculation; Clausius Inequality; Applications of the second law.

UNIT III THERMODYNAMIC FORMULATIONS 12

Measurable quantities; Basic energy relations, Maxwell relations, Thermodynamic formulations to calculate enthalpy, internal energy and entropy as a function of pressure and temperature; Formulations involving C_p and C_v; Complex thermodynamic formulations, Thermodynamic properties of an ideal gas, entropy change in reversible and irreversible process.

UNIT IV THERMODYNAMIC PROPERTIES OF REAL GASES 12

PVT behavior of fluids; Mathematical representation for PVT behavior; Generalized compressibility factor correlation; Generalized equation of state; Partial molar properties; Chemical potential, fugacity and fugacity coefficient for pure species and species in solution; Residual properties; Properties of solutions; ideal solutions; Excess properties; Gibbs free energy models; Henry's law.

UNIT V PHASE EQUILIBRIA AND CHEMICAL EQUILIBRIA 12

Criteria for equilibrium between phases in multi component non- reacting systems; Applications of phase rule; Qualitative behavior of Vapor- liquid equilibrium in binary and multicomponent system; Chemical Reaction Equilibria – Reaction coordinate; Criteria for chemical equilibria; Equilibrium constant; Equilibrium compositions of homogeneous gas and liquid phase reactions.

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 2nd edition, John Wiley Newyork 1970.
2. Dodge, B.F., " Chemical Engineering Thermodynamics ", McGraw-Hill, Newyork 1960.
3. Sandler, S.I., " Chemical and Engineering Thermodynamics 4th edition. ", John Wiley, 2007.
4. Kyle, B.G., " Chemical and Process Thermodynamics 3rd edition. ", Prentice Hall of India Pvt.Ltd., 2003.

AS7403 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 behavior of rocks and fluids.
To understand the drive mechanism of a reservoir

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, 2010.
2. Slip Slider, H.C. “Worldwide Practical Petroleum Reservoir Engineering Method”, PennWell Publishing Company, 1983.
3. Gian.Luigichierici, “Principles of Petroleum Reservoir Engineering”, Elsevier, 2011.

AS7402 INDUSTRIAL STOICHIOMETRY L T P C
3 0 0 3

OBJECTIVES

To acquire a 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

Understand the fundamentals of units and stoichiometric equations. Write material balance for different chemical process. Understand the fundamentals of ideal gas behavior and phase equilbria. Write energy balance for different chemical process.

UNIT I **9**

Units, dimensions and conversion; Chemical & Petrochemical Process variables and properties; Stoichiometric Equations, Degrees of freedom

UNIT II **9**

Introduction to material balances. Material balance problems for single units; Stoichiometry and Petrochemical & Chemical reaction equations; material balance for processes involving reaction bypass, purging, recycle operations.

UNIT III **9**

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

UNIT IV **9**

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

UNIT V **9**

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)

REFERENCES

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

ME7251 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

OUTCOME

- Students should 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.

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)

ME7262 MECHANICAL ENGINEERING LABORATORY L T P C

0 0 4 2

OBJECTIVE

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

OUTCOME

- 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 : 60 PERIODS

* Minimum 10 experiments shall be offered.

AS7412 ORGANIC CHEMISTRY LABORATORY FOR PETROCHEMICAL ENGINEERS **LT P C 0 0 4 2**

OBJECTIVES

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

OUTCOME:

Conduct simple experiments to identify the functional groups
Prepare derivatives for aldehydes, ketones, sugars, amine and phenol
To separate organic mixtures
To carry out recrystallization

LIST OF EXPERIMENTS

1. Identification and characterization of various functional groups by their characteristic reactions: a) alcohol, b) aldehyde, c) ketone, d) carboxylic acid, e) phenol f) primary, secondary and tertiary amines
2. preparation of solid derivatives : a) 2,4 tri nitro phenyl hydrazone for aldehydes and ketones, b) Osazone for sugras, c) acetyl and benzoyl derivatives for amine and phenol d) diazotization of aromatic amine
3. Preparation of Methyl red and Fluorescein
4. Separation of organic mixtures: a) aldehyde and acid, b) amine and phenol
5. Recrytallization of benzoic acid and acetanilide
6. Preparation of simple pharmaceuticals a) acetanilide, b) methyl salicylate, c) aspirin
7. Detection of peroxide in ether and its removal

TOTAL : 60 PERIODS

REFERENCE

1. Practical organic chemistry, S.P. Bhutani, Ane books. 2009
2. Practical chemistry, V K Ahluwalia, University press. 2011
3. Text book of practical organic chemistry. Brain S Furniss, Pearson education 2011
4. Practical Organic Chemistry by Dey and Raman
5. Laboratory Manual of Organic Synthesis by M.N.Khramkina MIR publishers Moscow, First published in 1980, revised editions once in every five year. Last revised edition 2010.

6. Practical Chemistry by Balwant Rai Satija, Allied Publishers Pvt Ltd 1988.

AS7503 **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.

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 correlation 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 Hydro treatment (e.g. 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, 2007.
2. Modern Petroleum Refining Processes – B.K. Rao. Oxford & IBM., 2007.

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

AS7502 **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.

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.

AS7501 HEAT AND MASS TRANSFER FOR PETROCHEMICAL ENGINEERS L T P C
4 0 0 4

AIM

To learn heat transfer by different modes of heat transfer and to develop skills of the students in the area of Mass Transfer operation

OBJECTIVES

Students gain knowledge in various heat transfer and mass transfer operations in process engineering and also to design heat transfer and mass transfer equipments

UNIT I **12**

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; Radiation heat transfer - Black body radiation, Emissivity, Stefan - Boltzman law, Plank's law, radiation between surfaces.

UNIT II **12**

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. Heat transfer to boiling liquids - mechanism of boiling, nucleate boiling and film boiling.

UNIT III **12**

Theory of evaporation - single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation. 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

UNIT IV **12**

Introduction to mass transfer operations; Molecular diffusion in gases, liquids and solids; diffusivity measurement and prediction; multi-component diffusion. theories of mass transfer, , relationship between individual and overall mass transfer coefficients. Stage-wise and differential contractors. Gas Absorption and Stripping – Equilibrium; material balance; limiting gas-liquid ratio; tray tower absorber - calculation of number of theoretical stages,

UNIT V **12**

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, Introduction to multi-component distillation, azeotropic and extractive distillation. Liquid - liquid extraction - solvent characteristics-equilibrium stage wise contact calculations for batch and continuous extractors

TOTAL : 60 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.
4. Seader, J.D. and E.J. Henley, "Separation Process Principles", 2nd Ed., John Wiley,2006.

REFERENCES

1. McCabe, 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.

GE7351 ENGINEERING ETHICS AND HUMAN VALUES L T P C
3 0 0 3

OBJECTIVES

- To emphasise into awareness on Engineering Ethics and Human Values.
- To understand social responsibility of an engineer.
- To appreciate ethical dilemma while discharging duties in professional life.

UNIT I HUMAN VALUES 3

Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – Self-Confidence – Discrimination- Character.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' - variety of moral issued - 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 –Professional Ideals and Virtues - uses of ethical theories. Valuing Time – Co-operation – Commitment –

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics – Importance of Industrial Standards - a balanced outlook on law – anticorruption- occupational crime -the challenger case study.

UNIT IV ENGINEER'S RIGHTS AND RESPONSIBILITIESON 12

Collegiality and loyalty – Respect for authority – Collective Bargaining – Confidentiality- Conflict of interest – Occupational Crime – Professional Rights – IPR- Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the Three Mile Island, Bhopal Gas plant and chernobyl as case studies.

UNIT V GLOBAL ISSUES 12

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

OUTCOMES

- Students will have the ability to perform with professionalism , understand their rights , legal ,ethical issues and their responsibilities as it pertains to engineering profession with engaging in life-long learning with knowledge of contemporary issues.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 2005.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000 (Indian
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, 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, “Fundamentals of Ethics for Scientists and Engineers”, Oxford Press , 2000
5. R.Subramanian , “Professional Ethics “,Oxford University Press ,Reprint ,2015.

CH7561 HEAT TRANSFER LABORATORY L T P C
0 0 4 2

OBJECTIVES

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

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

*Minimum 10 experiments shall be offered

TOTAL : 60 PERIODS

OUTCOMES

Determine Heat transfer co-efficient and evaluate performance of different types of equipments including cooling towers, tray dryers, pan evaporator, packed bed, heat exchangers, condensers, helical coils and agitated vessels

AS7511 PETROLEUM TESTING LABORATORY L T P C
0 0 4 2

AIM:

To introduce various methods of analysis by using instruments and analytical equipment to determine various physical properties of petroleum and petroleum products

OBJECTIVES:

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

LIST OF EXPERIMENT

1. Determination of flash point.
2. Carbon residue determination of petroleum products.
3. Distillation of crude oil
4. Determination of viscosity capillary viscometer.
5. Density of crude oil by hydrometer.
6. Pour point of crude oil and petroleum products.
7. Determination of calorific value of fuels.
8. Determination of refractive index of the petroleum products.
9. Determination of salacity of oil field waters
10. Characterization of formation waters
11. Water content in crude oil
12. Moisture content in crude oil and products
13. BS&W in crude oil

TOTAL : 60 PERIODS

LIST OF EQUIPMENT

1. Flash point apparatus.
2. Centrifuge
3. Dean and Stark Apparatus
4. API standard distillation apparatus
5. Capillary Viscometer
6. Gas Chromatograph
7. Bomb calorimeter
8. Refractometer
9. Junker gas calorimeter
10. Glass wares, balance, hot plate and heating mantle
11. Pour Point Apparatus
12. Karl Fisher Apparatus

AS7603 PETROLEUM REFINING – II L T P C
4 0 0 4

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.

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, Plat forming, 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 Aluminum 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 Up gradation of Heavy Crudes. Specialty Products: Industrial Grease- Manufacture of Calcium Grease, Liquid Paraffin and Petroleum Jelly's.

TOTAL : 60 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.

AS7602 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 multi objective optimization problem with and without constraints based on process requirements.

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.
5. Petrochemical Hand book Hydrocarbon Processing 1989.

AS7601 CATALYTIC REACTION ENGINEERING L T P C
4 0 0 4

AIM

To impart knowledge to design different types of chemical reactors

OBJECTIVES

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

UNIT I CHEMICAL KINETICS AND IDEAL REACTORS **12**

Rate equation, elementary, non-elementary reactions, theories of reaction rate and Prediction; Design equation for constant and variable volume batch reactors, Design of continuous reactors - stirred tank and tubular flow reactor

UNIT II DESIGN FOR MULTIPLE REACTIONS **12**

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

UNIT III TEMPERATURE AND PRESSURE EFFECTS **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 IV BASICS OF NON-IDEAL FLOW **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

UNIT V HETEROGENEOUS NON CATALYTIC REACTIONS **12**

Fluid solid non catalytic reactions . rate controlling steps; time for complete conversion for single and mixed sizes, fluidized and static reactors. Kinetics of fluid –fluid reactions, Absorption combined with chemical reactions; mass transfer coefficients and kinetic constants; application of film, penetration and surface renewal theories; Hatta number and enhancement factor for first order reaction, tower reactor design.

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., IVth Edition, 2005.

REFERENCE

1. Froment. G.F. & K.B.Bischoff, “Chemical Reactor Analysis and Design”, II Edition, Wiley New York, 1990.

HS7551 EMPLOYABILITY SKILLS L T P C
3 0 0 3

COURSE DESCRIPTION

This course aims to help the students acquire the employability skills necessary for the workplace situations. It also attempts to meet the expectations of the employers by giving special attention to language skills, presentation skills, group discussion skills and soft skills. This will be achieved through expert guidance and teaching activities focusing on employability skills.

COURSE OBJECTIVES

- To enhance the employability skills of students with a special focus on presentation skills, group discussion skills and interview skills
- To help them improve their reading skills, writing skills, and soft skills necessary for the workplace situations
- To make them employable graduates

CONTENTS

UNIT I READING AND WRITING SKILLS 9

Reading: skimming & scanning strategies – note making skills – interpreting visual material (charts & tables) – critical reading – fast reading necessary for reading letters & files - preparing job applications - writing covering letter and résumé - applying for jobs online - email etiquette – writing official letters (placing an order, letters to consumers, etc.) writing reports – collecting, analyzing and interpreting data

UNIT II SOFT SKILLS 9

Hard skills & soft skills – soft skills: self-management skills & people skills - training in soft skills - persuasive skills – sociability skills –interpersonal skills – team building skills – leadership skills – problem solving skills – adaptability - stress management – motivation techniques – life skills -

UNIT III PRESENTATION SKILLS 9

Preparing slides with animation related to the topic – organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentation

UNIT IV GROUP DISCUSSION SKILLS 9

Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies (expressing opinions, accepting or refusing others opinions, turn taking) – activities to improve GD skills – viewing recorded GD - mock GD

UNIT V INTERVIEW SKILLS 9

Interview etiquette – dress code – body language – mock interview -–attending job interviews – answering questions confidently – technical interview – telephone/Skype interview - practice in different types of questions – one to one interview &panel interview – FAQs related to job interview- Emotional and cultural intelligence.

LEARNING OUTCOMES

- Students will be able to make presentations and participate in group discussions with high level of self-confidence.
- Students will be able to perform well in the interviews
- They will have adequate reading and writing skills needed for workplace situations

TOTAL : 45 PERIODS

REFERENCES:

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

EXTENSIVE READING

1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press, 2013.
2. Bagchi, Subroto. The Professional. New Delhi: Penguin Books India, 2009.

WEB RESOURCES

1. www.humanresources.about.com
2. www.careerride.com
3. https://bemycareercoach.com/softskills

AS7612 MASS TRANSFER LABORATORY FOR PETROCHEMICAL ENGINEERS 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. Estimation of mass/heat transfer coefficient for cooling tower.
10. Demonstration Gas – liq Absorption

EQUIPMENTS REQUIRED

1. Simple distillation setup
2. Steam distillation setup

3. Packed column Liquid-liquid extractor
4. Liquid – Liquid Extractor
5. Vacuum Dryer
6. Tray dryer
7. Rotary dryer
8. Rotating Disc Contactor
9. Cooling Tower
10. Absorption Column

Minimum 10 experiments shall be offered.

TOTAL : 60 PERIODS

AS7611 COMPUTATIONAL PROGRAMMING IN CHEMICAL ENGINEERING LABORATORY FOR PETROCHEMICAL ENGINEERS **L T P C**
0 0 4 2

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

OUTCOME:
Able to solve chemical engineering problems using C and MATLAB programming and Microsoft Excel software.
Analyse and estimate the physical properties of data bank and non data bank components; calculate bubble and dew points and generate T-xy and P-xy diagram by simulating flash drum using ASPEN PLUS Process Simulator.

Programming in C
C programs will be written to solve problems from core courses of chemical and petrochemical 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.

TOTAL : 60 PERIODS

CH7651 PROCESS INSTRUMENTATION DYNAMICS AND CONTROL **L T P C**
3 0 0 3

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

UNIT I INSTRUMENTATION 9

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 9

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 9

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

OUTCOME:

Understand the prerequisites of control strategies and design different process control systems
Evaluate the suitable controllers for different chemical process.
Analyse and tune the control systems unto stability
Understand the mechanism of advance control systems

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.

AS7701 PETROLEUM EQUIPMENT DESIGN L T P C
3 0 0 3

AIM

To give practice to students to design in detail different process equipments used in petroleum industry.

OBJECTIVE

Students learn to do in detail process and mechanical design and engineering drawing of different equipments generally used in petroleum industry

UNIT I HEAT TRANSFER OPERATIONS 9

Fired heaters, Heat Exchangers, Condensers, Evaporators, Reboilers,

UNIT II DESIGN OF PHASE SEPARATION EQUIPMENT 9

Design of physical separation equipments such as cyclones, centrifuges, thickeners,filtration equipment

UNIT III MASS TRANSFER OPERATIONS 9

Absorption column, Distillation Column, Extraction Column ,Cooling tower, Dryer, Crystallizer

UNIT IV REACTORS AND STORAGE VESSELS 9

Packed bed Reactors, FCC units, Pressure Vessel, Storage Vessel

UNIT V MATERIALS OF CONSTRUCTION AND PLANT LAYOUT 9

Design of Plant Layout, Pipe Lines and Pipe Layouts, Design Schematics and Presentation, Materials of Construction and Selection of process

TOTAL : 45 PERIODS

REFERENCES

1. Baranan, C.R., "Rules of Thumb for Chemical Engineers", 3rd Edition, Gulf Professional Publishing Co, Texas, 2002.
2. R. K. Sinnott, "Coulson & Richardson's Chemical Engineering Design ", Vol. 6, IV Edition Butterworth Heinermann, Oxford, 2005.
3. Dawande, S. D., "Process Design of Equiments", IV Edition, Central Techno Publications, Nagpure, 2005.
4. Green D. W., "Perry's Chemical Engineer's Handbook", VIII Edition McGraw Hill, 2007.

GE7251 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

To the study of nature and the facts about environment.

- To find and implement 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.

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

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 environment at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in standard of living has lead to serious environmental disasters.

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.

AS7711 PROCESS CONTROL LABORATORY FOR PETROCHEMICAL ENGINEERS

L T P C
0 0 4 2

OBJECTIVES

Students will gain the hands on training about the control systems

OUTCOME:

Understand the prerequisites of control strategies and design different process control systems
Evaluate the suitable controllers for different chemical & Petrochemical process.
Analyse and tune the control systems unto stability

LIST OF EXPERIMENTS

1. Open loop study on a level system
2. Open loop study on a flow system
3. Open loop study on a thermal system
4. Closed loop study on a level system
5. Closed loop study on a flow system
6. Closed loop study on a thermal system
7. Response of first order system
8. Response of second order system
9. Response of Non-Interacting level System
10. Response of Interacting level 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

CH7661 CHEMICAL REACTION ENGINEERING LABORATORY L T P C
0 0 4 2

OBJECTIVES

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

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 : 60 PERIODS

OUTCOMES

Understand rate equation for different types of reactors.

Design experiments in kinetics to determine conversion and effect of temperature on rate constant.

Assess the performance of Plug flow Mixed flow and Packed bed by studying the residence time distribution.

MA 7354 NUMERICAL METHODS L T P C
4 0 0 4

OBJECTIVES:

- To provide the mathematical foundations of numerical techniques for solving linear system, eigenvalue problems, interpolation, numerical differentiation and integration and the errors associated with them;
- To demonstrate the utility of numerical techniques of ordinary and partial differential equations in solving engineering problems where analytical solutions are not readily available.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

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 12

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 12

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 12

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 12

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

OUTCOMES:

- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
- Apply numerical methods to obtain approximate solutions to mathematical problems.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyse and evaluate the accuracy of common numerical methods.

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" PHI
3. Learning Pvt Ltd. New Delhi, 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.
4. S. R. K. Iyengar, R. K. Jain, Mahinder Kumar Jain, "Numerical Methods for Scientific and Engineering Computation", 6th Edition, New Age International Publishers, New Delhi, 2012.

Attested

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

AS7017 REFINERY PROCESS DESIGN L T P C
3 0 0 3

AIM

To get acquainted with process design of distillation columns involving multicomponent and complex mixtures. To learn methodologies practiced in rating and designing heat transfer equipment used in refining and process industry.

OBJECTIVE

Students learn process design aspects related to distillation column, Fired Heaters, pumps and compressors

UNIT I MULTICOMPONENT DISTILLATION 9

Dew point and bubble point for multi component mixtures. Design of multi component distillation column, Number of variables, Selection of key components, Selection of column pressure, Feed condition, Plate-to-plate calculations, Empirical short cut methods, Introduction to rigorous solution procedures.

UNIT II PETROLEUM REFINERY DISTILLATION 9

TBP, EFV, ASTM distillation curves and their relevance, Material balance and flash zone calculations for petroleum refinery distillation columns, Pump around and pump back calculations, Overall energy requirements, Estimation of number of equilibrium stages, Design using Packie charts and Watkins method, Introduction to rigorous solution procedure based on pseudo components.

UNIT III COLUMN DESIGN 9

Process design of distillation towers. Flooding charts. Trays and packings. Vacuum devices.Pressure drops. Height,diameter,supports.Piping requirements. Aspects of mechanical design. A typical P&ID for a distillation column. .

UNIT IV FIRED HEATERS 9

Heat load calculations for furnace heaters used in crude refining, Basic constructional features, Different furnace types, Review of factors to be considered in the design of fired heaters, Introduction to manual cal'culations methods.

UNIT V PUMPS AND COMPRESSORS 9

Types of pumps and compressors. Selection criteria. Power rating calculations based on process duty.Use of operating curves of centrifugal pump. NPSHR and NPSHA. Pump Cavitation. Surge problem in compressors.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Van Winkle M., “Distillation”, McGraw Hill, 1967.
2. Watkins, “Petroleum Refinery Distillation”, McGraw Hill, 1993
3. Sinnott R. K., “Coulson and Richardson’s Chemical engineering”, Vol. 6, III Edition, Butter Worth-Heinemann, 1999.
4. Kern D. Q., “Process Heat Transfer”, McGraw Hill, 1965.
5. Cao Eduardo,”Heat Transfer in Process Engineering”, McGraw Hill,2010

AS7029 ENGINEERING 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 Engineering and Petroleum Business.

To understand the background of functioning of petroleum industry as an economic entity.

UNIT I INTRODUCTION 9

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 9

Market – Demand and Supply – Determinants – Market equilibrium – elasticity of demand and supply – consumer behavior – consumer equilibrium – Approaches to consumer behavior – 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 9

Product market – perfect and imperfect market – different market structures – Firm's equilibrium and supply – Market efficiency – Economic costs of imperfect competition – factor market – Land, Labor 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 9

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 9

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. Unemployment 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.

OUTCOME

Understanding of petroleum fiscal system within the context of India.

TEXT BOOKS

1. Paul A. Samuelson and William D. Nordhaus, ''Economics'' 19th edition, Tata McGraw Hill, 2010.

REFERENCES

1. William Boyes and Michael Melvin, ''Textbook of Economics'', 9th edition. Cengage Learning 2009
2. N. Gregory Mankiw, ''Principles of Economics'', edition, 6th edition. South-Western, 2011
3. Richard Lipsey and Alee Charystal, ''Economics'', 12thedition, Oxford University Press, New Delhi, 2011.

4. Karl E. Case and Ray C. fair, ''Principles of Economics'', 10th edition, Pearson Education Asia, New Delhi, 2012.

MA7072 STATISTICS AND LINEAR PROGRAMMING L T P C
4 0 0 4

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

UNIT I TESTING OF HYPOTHESIS 12
Sampling distributions - Tests for single mean , proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi-Square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 12
Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT III STATISTICAL QUALITY CONTROL 12
Control charts for measurements (and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

UNIT IV LINEAR PROGRAMMING 12
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 12
Dual simplex method – Formation and using simplex method – Integer programming – Cutting plane algorithm.

TOTAL : 60 PERIODS

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

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

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

AS7028 **DRILLING OPERATIONS** **L T P C**
3 0 0 3

AIM
Students will understand the Drilling Process and Drilling Equipments**.**

OBJECTIVES
Students will understand the concepts and techniques used in well drilling. They will learn the design requirements of well planning and construction.

UNIT I **9**
Drilling operations – Location to Rig. Release Well Bore Diagram, Crews – Operator – Drilling, contractor – Third Party Services – Rig Types – Land Types – Marine types

UNIT II **9**
Components- Overall Drilling Rig, Drilling Sub systems – Power – Hoisting Line – speeds and Loads Power – Loading Components – Drill Pipe, Heavy Weight Drill Pipe (HWDP), Drill String Loads Uniaxial.

UNIT III **9**
Directional Drilling, Well Planning, Two Dimensional, Horizontal, Tools, Techniques, MWD, surveying – Radius of Curvature, Long's Method – Errors, Muds, Mud Use, Property measurements, Types, - Pneumatic (Air, Gas, Mist, Foam), Water based, Oil based, solids Control, Definitions, Equipment, Problems, Contaminations Effect.

UNIT IV **9**
Hydraulics, Classifications of Fluids, Rheological Models – Rotary Drilling Hydraulics – Jet Hydraulic Optimizing and Maximizing – Circulations Rate Selection – Drill Bit – Jet Sizing – Equivalent Circulations Density, Hole Cleaning. Theory – Vertical and Deviated Holes, Annular Velocities – Carrying Capacity – Pills and Slugs.

UNIT V **9**
Origin of Overpressure, Kick Signs, shut –in Procedures, Kill sheets, Kill Procedures, Driller's Methods – Engineer's Method (Wait and Weight)

TOTAL : 45 PERIODS

TEXT BOOKS

1. Rabia.H. 'Oil Well Drilling Engineering, Principles And Practices' Graham And Trotman Ltd. 1985.
2. Standard Handbook of Petroluem and Natural Gas Engineering, 2nd Edition, William C Lyons, Gary C Pilisga, Gulf Professional Publishing

AS7023 **WELL COMPLETION TECHNIQUES** **L T P C**
3 0 0 3

AIM
To provide insights into the Well Operation during the hydrocarbon Explorations**.**

OBJECTIVES
Student will be able to understand the basics and operations of Well Completion techniques.

UNIT I **9**
Well design: Prediction of formation pore pressure and stress gradients. Determination of safety mud weight bounds for different in-situ stress conditions. Design and planning well trajectory. Surveying tools and methods**.**

UNIT II **9**

Design of drill string including bottom hole (BHA) assembly. Drilling methods and equipment for directional, horizontal and multilateral wells. Selection of casing shoes, material properties and design of casing program**.**

UNIT III **9**

Well Completion and Stimulations: Well completion design, types of completion, completion selection and design criteria. Interval selection and productivity considerations: effects of producing mechanisms. Inflow performance and multiple tubing performance analyses using commercial software.

UNIT IV **9**

Well stimulation and workover planning. Tubing-packer movement and forces. Tubing design: graphical tubing design and simplified tensional strength design. Selection of down hole equipment, tubing accessories and wellhead equipment.

UNIT V **9**

Basics of perforation, selection of equipment and procedure for perforation oil and gas wells. Technology of sand control: gravel packing. Fundamentals of well stimulation technologies: acidization and hydraulic fracturing.

TOTAL: 45 PERIODS

TEXT BOOKS

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

REFERENCE

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

AS7012 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.

UNIT I NEED FOR SAFETY IN INDUSTRIES **9**

Importance & objectives of safety- Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling

UNIT II PLANT SAFETY AND SAFETY REGULATION **9**

Implementation of safety procedures – periodic inspection and replacement; Accidents - identification and prevention; Criteria for setting & layout of chemical plant, Factories Act and Safety Regulations.

UNIT III PLANT HAZARDS & RISK ANALYSIS **9**

Fire hazards- Chemical hazards, Toxic hazards, Explosion hazards, Electrical hazards, Mechanical hazards, Radiation hazards, Noise hazards-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.

Attested

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

UNIT IV SAFETY AUDIT 9

Objective of safety audit- 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 RISK ANALYSIS TECHNIQUES 9

Hazard & Operability (HAZOP) studies- Hazard Analysis (HAZAN)-Fault Tree Analysis Consequence Analysis.

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

AS7030 ENHANCED OIL RECOVERY L T P C
3 0 0 3

AIM

To understand the nature of reservoirs 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.

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 9

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

UNIT IV ENHANCED OIL RECOVERY OPERATIONS-2 9

Gas injection, in-situ combustion technology, microbial method

UNIT V PROBLEMS IN ENHANCED OIL RECOVERY 9

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 Pollen, H.K. “Fundamentals of enhanced oil recovery”, Penn Well Books, 1980.

AS7011 PETROLEUM 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 computer assisted approach, Gulf Professional Publishing, Burlington,

AS7019 SCIENCE AND HEALTH IN RESONANCE L T P C
3 0 0 3

AIM

To sensitize and create an awakening among the course participants on adhering to principles of healthy living and instilling the style modifications.

OBJECTIVE

To cause behavioral changes in the learning clientele and creating the necessary psycho sociological ramiflications, motivating the participants to adopt a healthy life style.

UNIT I IMPORTANCE OF MICRONUTRIENTS AND ADHERING TO LOW GLYCEMIC INDEX FOODS 9

Millets and fibre rich foods –Their high nutritive value –Dangers of consumption of refined foods –Iron protein combination –Micronutrients –Their importance in upkeep of good health – Overcoming their deficiency –Foods rich in micronutrients – Glycemic index –Its importance – Comparative glycemic index of various foods.

UNIT II IMMUNIZATION SCHEDULING – NEED FOR ADHERENCE 9

Protein calorie malnutrition –Importance of intake of folic acid supplements to prevent genital abnormalities –Necessity to avoid early marriage –Need for various immunizations their dosage schedules-Need to immunize adolescent and girl children to prevent cervical cancer.

UNIT III LIFE SAVING CHILD SURVIVAL STRATEGIES 9

Drastically cutting down mortality and morbidity –Causative factors of dehydration –Warning symptoms –Need to administer life saving Oral Rehydration Salt solution (ORS) –Methodology of preparing ORS solution –Importance of zinc as an additive.

UNIT IV STRATEGIES FOR INCREASING HDL AND LOWERING LDL CHOLESTEROL 9

Healthy fats –Need to avoid saturated and trans fats –Optimum value of HDL and LDL cholesterols –Need to lower triglycerides –Ways of reducing bad LDL cholesterol –Role of Thyroid Simulating Hormone (TSH) –Importance of mental health –Positive and optimistic outlook on life –Pronic breathing as a stress relief mechanism.

UNIT V ORGANIC FARMING – BIOPESTICIDES PRODUCTION – WEALTH FROM WASTE 9

Eco friendly organic vegetables and fruits –Biopesticides –Neem based –Use of BIOBLOOM in conversion of waste into Bio manure –Healthy equilibrium between work and rest –Maintaining good postures to avoid back and neck pain syndrome – Principles of ERGONOMICS –Gender sensitization –Respecting each others domain and contribution.

TOTAL : 45 PERIODS

REFERENCE

1. Kedar N.Prasad, Micronutrients in Health and Disease, CRC Press, 1st Edition, 2010

AS7021 TECHNICAL ANALYSIS – AN ANALYTICAL INSIGHT L T P C
3 0 0 3

AIM

The elective will enable the students to have a good grasp over the principles and generalizations of Technical analysis.

OBJECTIVE

The study of the elective will enhance the cognitive domain of the Learners and motivate them to extrapolate the principles of analysis to their analytical skills and to make an indelible

evergreen impression in their minds about the logical, sequential, stepwise approach to analysis.

UNIT I TYPES OF ANALYSIS – UNDERLYING PRINCIPLES 9

Purity of simple sugars – Glycemic Index and its importance – Principles underlying Bertrand's estimation of percentage purity of glucose – Estimation of percentage purity of aniline – Underlying principles

UNIT II COAL AND FERTILZER ANALYSIS – BASIC PRINCIPLES 9

Correlation between thermal energy and fixed carbon – Estimation of Sulphur in coal – Fluidized bed technology to reduce sulphur – Estimation of Nitrogen in soil and nitrogenous fertilizers – Analysis of coal for grading

UNIT III CLASSIFICATION OF CEMENT – OPTIMUM PARAMETER FOR QUALITY 9

Types of analysis of cement – Standard and Rapid method – Underlying theory behind percentage estimation of SiO_2, Mixed oxides and Calcium oxides – Optimum Quality parameter and ratios for good quality cement – Gel formation – Use of additives

UNIT IV ANALYSIS OF OILS – PURITY CRITERIA – OILS AND GOOD HEALTH 9

Principles underlying estimation of acid, saponification and iodine value of an oil – Importance of increase in HDL and lowering LDL cholesterol – Optimum values for HDL and LDL cholesterol – Lowering of triglycerides – Various approaches

UNIT V DRINKING WATER STANDARDS – STRATEGIES FOR STERILIZATIONS 9

Estimation of chloride, sulphate, Total dissolved solids and dissolved oxygen in a given sample of water – Principles underlying the above fundamentals and generalizations underlying determination of chemical oxygen demand – Reduction of BOD – Various strategies, Principles underlying water purification – WHO standards of drinking water.

TOTAL : 45 PERIODS

REFERENCES

1. Commercial methods of Analysis by Foster Dee Snell and Frank M Biffen – Chemical Publishing Company, Revised edition, 1988
2. Technical Analysis lab manuals – Volume-I and II by Dr K Srinivasan and Dr P Gnanasundaram, Anna University, Chennai. Revised edition 2013.

AS7032 MULTICOMPONENT DISTILLATION L T P C
3 0 0 3

AIM

To understand the concepts of Multicomponent distillation systems.

OBJECTIVE

Students able to design multicomponent distillation unit. They learn about various types of MCD column.

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, I Edition, 1997
2. Van Winkle, “Distillation Operations”, McGraw Hill Publications, 1987.

CH7071 ENERGY TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

Students will gain knowledge about different energy sources

UNIT I ENERGY 9

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 9

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 9

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 9

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

Attested

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

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

OUTCOMES

Understand conventional Energy sources, Non- conventional Energy sources, biomass sources and develop design parameters for equipment to be used in Chemical process industries. Understand energy conservation in process industries

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

AS7024 ADVANCED 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.

UNIT I GENERAL REVIEW 9

Mechanisms: Separation factors and its dependence on process variables, classification and characterization, thermodynamic analysis and energy utilization, kinetics and mass transport. Theory and Equipment used in cross flow Filtration, cross flow Electro Filtration.

UNIT II MEMBRANE SEPARATIONS 9

Types and choice of membranes, their merits, commercial, pilot plant polarization of membrane processes and laboratory membrane permeators, dialysis, reverse osmosis, ultra filtration, Concentration and economics of membrane operations, Design controlling factors.

UNIT III SEPARATION BY SORPTION TECHNIQUES 9

Types and choice of adsorbents, chromatographic techniques, Types, Retention theory mechanism, Design controlling factors ion exchange chromatography equipment and commercial processes, recent advances and economics.

UNIT IV IONIC SEPARATIONS 9

Controlling factors, applications, Theory mechanism and - equipments for electrophoresis, dielectrophoresis and electro dialysis - commercial applications - Design considerations.

Attested

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

UNIT V THERMAL SEPARATION 9

Thermal diffusion: Basic rate law, phenomenological theories of thermal diffusion for gas and liquid mixtures, Equipments design and applications. Zone melting: Equilibrium diagrams, Controlling factors, Apparatus and applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. H.M. Schoen, "New Chemical Engineering Separation Techniques", Wiley Interscience, New York, 1972.
2. C.J. King, "Separation Processes", Tata McGraw Hill, New Delhi, 1982.
3. B. Sivasankar, "Bioseparations – Principles and Techniques", Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. "Membrane Separation processes", Kaushik Nath, PHI ,2008.

REFERENCES

1. Roussel, R. W., "Handbook of Separation Process Technology", John Wiley, New York, 1987.
2. Nakagawal, O. V., "Membrane Science and Technology"' Marcel Dekkar, 1992.
3. R.E. Lacey and S. Loeb, "Industrial Processing with Membranes," Wiley–Inter sciences, New York, 1972

AS7014 PROCESS OPTIMIZATION L T P C
3 0 0 3

AIM

To acquaint the student with the concepts and techniques of single and multivariable optimization techniques using numerical search and analytical methods

OBJECTIVE

The student will enable to optimize the problems related to design, planning and operations involved in a chemical industry

UNIT I OPTIMISATION 9

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

UNIT II NUMERICAL METHODS 9

Unimodel functions; newton's quasi newton, secant methods; region elimination methods, polynomial approximation; quadratic and cubic interpolation techniques for optimum. Multimodal functions; direct methods; random, grid. Hooke's nelder and mead methods; Powell's technique; indirect methods; gradient and conjugate gradient methods; secant methods.

UNIT III LINEAR AND NON-LINEAR PROGRAMMING APPLICATIONS 9

Review on basic concepts of LP formulations; Simplex methods; Integer, quadratic, geometric and dynamic programming. Heat transfer and energy conservation; separation processes; fluid flow systems; reactor design and operation; large scale systems.

UNIT IV MULTIVARIABLE OPTIMIZATION WITHOUT AND WITH CONSTRAINTS 9

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

UNIT V APPLICATIONS OF OPTIMIZATION 9

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. Edgar, T.F., Himmelblau, D.M., "Optimisation of Chemical Processes", McGraw-Hill II Edition 2001.
2. Reklaitis, G.V., Ravindran, A., Ragsdell, K.M. "Engineering Optimisation", John Wiley, II Edition 2006

REFERENCES

1. Biles, W.E., Swain, J.J.; "Optimisation and Industrial Experimentation", Inter Science, New York, 1980.
2. Seinfeld, J.H.; Lapidus, L; "Process Modelling, Estimation and Identification", Prentice Hall, Englewood Cliffs, New Jersey, 1974.
3. Beveridge, C.S.; Schechter, R.S.; "Optimisation: Theory and Practice", McGraw-Hill Book Co., New York, 1970

AS7025 CHEMICAL PROCESS MODELLING AND SIMULATION L T P C
3 0 0 3

OBJECTIVES

Students will develop suitable chemical process model to get process output

UNIT I INTRODUCTION 9

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 9

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 9

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

OUTCOME:

Understand the fundamentals of modelling and their applications to transport/energy equations, chemical and phase equilibria kinetics etc.,

Create the mathematical models for different unit operations equipments such as stirred tank heaters, Heat exchangers, Evaporators, Reactors, distillation columns etc.,.

Analyze the principles of steady state/unsteady state lumped systems and steady state/ unsteady state distributed systems and can select proper equation of state for estimating component properties and process flow sheeting.

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

AS7015 PROCESS PLANT UTILITIES FOR PETROCHEMICAL ENGINEERS L T P C
3 0 0 3

AIM

To understand the fundamentals and principles of main utilities required for process plants are water, steam, air & refrigerants.

OBJECTIVES

- State the principles involved during water treatment, generation of steam and its uses, refrigeration cycles.
- Describe the different equipment's used to run the process plant with different utilities

UNIT I WATER 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 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 Brines. Refrigerating Effects and Liquefaction Processes.

UNIT IV COMPRESSORS AND COOLING TOWERS 9

Classification of Compressor, Reciprocating Compressor, Single Stage and Two Stage Compressor, Velocity Diagram for Centrifugal Compressor, Slip Factor, Impeller Blade Shape. Properties of Air –Water Vapors and use of Humidity Chart. Equipment's 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

TEXT BOOKS

1. Perry R. H. Green D. W. “Perry's chemical Engineer's Handbook”, McGraw Hill, New York, 2008.

REFERENCES

1. W.Eckenfelder.Jr. “Industrial Water Pollution Control” 3rd edition, McGraw-Hill: New York, 1999.
2. P. L. Ballaney, “Thermal Engineering”,24th edition, Khanna Publisher New Delhi, 2011.
3. P. N. Ananthanarayan, “Basic Refrigeration & Air conditioning”, 4th edition, Tata McGraw Hill, New Delhi, 2013.

AS7020 SUPPLY CHAIN MANAGEMENT FOR PETROCHEMICAL ENGINEERS

L T P C
3 0 0 3

OBJECTIVES

Students will gain knowledge about practices followed in supply chain management

OUTCOMES

Understand the logistics Smanagement and supply chain network design Apply latest technology used in supply chain management.

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

ME7074 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.

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

OUTCOME
To study heat exchange in different systems.

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. Hessel greaves,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

AS7016 PRODUCT DESIGN AND DEVELOPMENT FOR PETROCHEMICAL ENGINEERS **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.

UNIT I 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

OUTCOME

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

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.

AS7026 COMPUTATIONAL FLUID DYNAMICS FOR PETROCHEMICAL ENGINEERS **L T P C 3 0 0 3**

AIM

The course gives an introduction into modeling using Computational Fluid Dynamics (CFD), which has become a indispensible tool for many engineers.

OBJECTIVE

Be able to demonstrate competence in setting up computational fluid dynamics models for some industrially important applications. This technical competence in building and conducting CFD simulations is a skill which enhances employability.

UNIT I CONSERVATION LAWS AND TURBULENCE MODELS 9

Governing equations of fluid flow and heat transfer –mass conservation, momentum and energy equation, differential and integral forms, conservation and non-conservation form. Characteristics of turbulent flows, time averaged Navier Strokes equations, turbulence models-one and two equation, Reynolds stress, LES and DNS

UNIT II FINITE DIFFERNCE APPROXIMATION 9

Mathematical behaviour of PDE, finite difference operators, basic aspects of discretization by FDM, explicit and implicit methods, error and stability analysis

UNIT III FINITE VOLUME METHOD 9

Diffusion problems – explicit and implicit time integration; Convection-diffusion problems – properties of discretisation schemes, central, upwind, hybrid, QUICK schemes; Solution of discretised equations.

UNIT IV FLOW FIELD COMPUTATION 9

Pressure velocity coupling, staggered grid, SIMPLE algorithm, PISO algorithm for steady and unsteady flows

UNIT V FINITE VOLUME METHOD FOR UNSTEADY FLOWS AND IMPLEMENTATION OF BOUNDARY CONDITIONS 9

One-dimensional unsteady heat conduction, Discretisation of transient convection-diffusion equation, Solution procedures for unsteady flow calculations, Implementation of Inlet, outlet and wall boundary conditions, constant pressure boundary condition. .

TOTAL : 45 PERIODS

TEXT BOOKS

1. Anderson, J. D., “Computational Fluid Dynamics: The Basics with Applications”, McGraw-Hill, 1995.
2. Fletcher, C. A. J., “Computational Techniques for Fluid Dynamics, Vol. 1: Fundamental and General Techniques, 2nd Edition., 2013
3. Versteeg, H.K. and Malalasekera, W., “An Introduction to Computational Fluid Dynamics: The Finite Volume Method”, Pearson Education Ltd., 2007.
4. Chung T.J Computational Fluid Dynamics Cambridge University Press 2003.
5. Muralidhar, K., and Sundararajan, T., “Computational Fluid Flow and Heat Transfer”, NarosaPublishing House, New Delhi, 2001.

REFERENCE

1. Vivek V. Ranade, Computational flow modeling for chemical reactor engineering Academic Press, San Diego, 2002.

GE7071 **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

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

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.

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.

GE7074 **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.

CY7352 PHYSICAL CHEMISTRY L T P C
3 0 0 3

AIM

- To make the students understand the principle and application of various physical chemistry concepts

OBJECTIVE

- To acquire knowledge in the fields of electrochemistry, corrosion, phase equilibria, colloids, colligative properties towards different applications

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 - Nerst equation - Electrochemical series - Applications of EMF Measurements.

UNIT II CORROSION & ITS CONTROL 9

Introduction - Dry or Wet corrosion Types - Wet or Electrochemical Corrosion - Mechanism - Galvonic corrosion - Concentration Cell Corrosion - Soil Corrosion - Pitting Corrosion - intergranular corrosion - pipeline corrosion - Water line Corrosion - Factors influencing Corrosion and Corrosion Control.

UNIT III PHASE EQUILLIBRIA 9

Phase - Components - Degrees of freedom - The Gibbs Phase rule - Derivation of the Phase rule - One Component system - The water System - The Sulphur System - Two Component system - Simple Eutectic System - Thermal analysis - cooling curves - Lead-Silver System - Desilverisation of Lead - Congruent and Incongruent Melting points.

UNIT IV COLLOIDS 9

Introduction to colloids - Classification of Colloids - Preparation of lyophobic colloidal solutions - Purification of Colloidal Solutions - Properties of Colloids - Origin of charge on colloidal particles - Determination of Size of colloidal particles - Donnan Membrane equilibrium - Emulsions - Gels - Application of Colloids in Catalysis and drug delivery systems.

UNIT V THE DISTRIBUTION LAW & COLLIGATIVE PROPERTIES 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 - Colligative properties - Vapour Pressure Lowering - Osmosis and Osmotic Pressure - The boiling Point elevation - The freezing point depression.

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. Prathma, " Principles of Physical Chemistry", S. Chand and Company, New Delhi (2005)
3. B.S.Bahl, Arun Bahl and G.D. Tuli, "Essentials of Physical Chemistry", S.Chand and Company, New Delhi (2005)

REERENCES

1. Gordon M. Barrow, Physical Chemistry, Sixth Edition, Tata McGraw Hill (1998).
2. Peters Atkins & Julio de Paula, Atkins' Physical Chemistry, 8th Edition, Oxford university press. (2006).

AS7018 SAFETY AND ENVIRONMENTAL HEALTH

L	T	P	C
3	0	0	3

AIM : To know how to monitor the safety performance in industry

OBJECTIVE

To ensure that potential hazards are identified and mitigation measures are in place to prevent accidents.

UNIT I CONCEPTS **9**

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety.

UNIT II TECHNIQUES **9**

Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNIT III ACCIDENT INVESTIGATION AND REPORTING **9**

Concept of an accident, reportable and non reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports- Class exercise with case study.

UNIT IV SAFETY PERFORMANCE MONITORING **9**

permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems.

UNIT V SAFETY EDUCATION AND TRAINING **9**

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

TOTAL : 45 PERIODS

REFERENCES

1. Accident Prevention Manual for Industrial Operations”, N.S.C.Chicago, 1982
2. Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York, 1980.
3. Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay, 1997.
4. John Ridley, “Safety at Work”, Butterworth & Co., London, 1983.
5. Blake R.B., “Industrial Safety” Prentice Hall, Inc., New Jersey, 1973.

AS7033 PETROLEUM GEOLOGY

L	T	P	C
3	0	0	3

AIM

To have a basic understanding of a broad array of tools used in the search for and production of hydrocarbon reserves. To learn the principles of mapping a subsurface reservoir and estimating the volumetrics.

OBJECTIVES

Students able to understand how geologists conduct the search for petroleum resources through the value chain or the life cycle of a petroleum resource.

UNIT I **9**

Introduction to earth science - Origin of earth. Nature and properties of minerals and rocks. Sedimentation and sedimentary environment. Stratigraphy and geological time scale. Introduction of plate tectonics.

UNIT II **9**

Sedimentalogy of Petroleum bearing sequences - Sedimentary basins. Generation and Migration of Petroleum. Physical and Chemical properties of Petroleum.

UNIT III **9**

Subsurface Environment – Formation fluids – Composition, temperature, pressure and dynamics. Traps and Seals. The Reservoir. Generation and Migration and Distribution.

UNIT IV **9**

Exploration Methods - Well drilling. Formation Evaluation. Geophysical. Borehole Seismic and 4D Seismic. Subsurface geology.

UNIT V **9**

Non conventional petroleum resources and reserve estimation.– Plastic and solid hydrocarbons. Tar sands. Oil and gas shales. Coal bed methane. Assessment of reserves.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Cox, P.A., “The Elements on Earth”, Oxford University Press, Oxford 1995
2. Wilson, M., Igneous Petrogenesis”, Unwin Hyman, London 1989.

REFERENCES

1. Boggs, S., “Principles of Sedimentology and Stratigraphy”, second edition, Merrill Publishing Co., Toronto, 1995.
2. Krumblein, W.C. and Sloss, L.L., “Stratigraphy and Sedimentation”, second edition W.H. Freeman and Co., 1963.

AS7013 PROCESS ENGINEERING **L T P C**
3 0 0 3

OBJECTIVE:

- To impart knowledge on the fundamentals of Process Engineering activities in designing the oil and gas facilities.

OUTCOME:

- To get familiarized on the roles and responsibilities of a Process Design Engineer.
- Understand the Engineering Drawings used in Design.
- To know the basics of performing various Hydraulic Calculations and sizing of Equipments.
- Aware of various Design Codes & Standards used in Project.

UNIT I INTRODUCTION TO OIL AND GAS FACILITIES **9**

Introduction to Oil and Gas Industry-Process description- Piping elements- Instruments: field instruments, control valves- Process equipments- Role of Process Engineer.

UNIT II INTRODUCTION TO PROJECT ENGINEERING 9

Elements in Project Execution, Different Phases of a Project-(Basic Engineering package-BEP, Front End Engineering Design-FEED, Proposal Engineering, EPC-EPCM Contract, LSTK), Elements of Engineering, Process Engineering Deliverables.
Introduction to Piping design engineering, Instrument Design Engineering.

UNIT III PROCESS SIMULATION AND DESIGN 9

Introduction and purpose- Softwares used for Simulation, Simulation inputs- Steady state simulation- Typical operation in simulation schemes- Heat and material balance generation, Dynamic Simulation Study and its uses. Introduction to Relief and Blow down Studies, Pipeline Flow assurance Study-Steady State and Transient, Softwares used in Flow assurance Studies, Introduction to AIV/FIV studies, CFD analysis

UNIT IV ENGINEERING DIAGRAMS 9

Block flow diagram-Process/Utility flow diagram-Symbols for P&ID development: piping elements, control system-Operation & control philosophy-Cause and Effect chart- typical PID development for Glycol Dehydration unit, Process Safety Flow diagrams, SAFE Chart. Introduction to Plot plan, General arrangement drawings.

UNIT V FACILITIES ENGINEERING 9

Process Design Basis and Design Criteria, Overview of various process equipments and its design principles: Separators, Pumps, Compressors, Heat exchangers, Absorber column, Heaters, Air coolers, Storage Tanks, Line hydraulics(Gas, Liquid and Multiphase lines)- Pump hydraulics-Control valve hydraulics, Softwares used in Equipment design (Column, Heat Exchanger etc). Introduction to various Codes and Standards followed in a PROJECT (API,TEMA,ISA etc)

TOTAL : 45 PERIODS

REFERENCES

1. Perry's Chemical Engineers' Handbook, Robert H. Perry, October 2007.
2. GPSA Engineering Data Book, Gas Processors Suppliers Association, 13th Edition 2012.
3. American Petroleum Institute (API) Standards.
4. ISA Standards
5. TEMA standards, Tubular Exchanger Manufacturers Association, Inc.

AS7027 CRUDE OIL TRANSPORTATION L T P C
3 0 0 3

AIM To understand the crude oil transportation and to learn the concepts of storage.

OBJECTIVES

Students would be able to design various terminal design. They will be familiarize with the storage systems**.**

UNIT I INTRODUCTION 9

Crude oil Trade, Selection of Port Location, Ship Building/Shipyards.

UNIT II NATURAL GAS REGASIFICATION TECHNOLOGY 9

Commercial Sourcing of Natural Gas, Different Kinds of Regasification Techniques, Regasification Process & Cold Utilization, Synchronization of Degasified gas and Pipelines, Current Status in India

UNIT III CRUDE OIL TRANSPORTATION 9

Transportation techniques of crude oil, Pipeline specification, Corrosion Prevention techniques, Pressure drop, Pumps and Booster station, Wax deposition and prevention, Chemical treatment

UNIT IV DESIGN 9

Basic Engineering Aspects of Terminal Design, Design of Liquefaction Train, Ship Building/Shipyards, Storage Facilities

UNIT V CHARACTERISTICS OF STORAGE VESSELS 9

Supply & Demand, Variation Gas Field & Aquifers, Technical Qualities and Storage, Properties of Storage Reservoir, Rocks & Fluids. Flow through Storage Reservoir; Inventory Concept, Pressure- Content Hysteresis, Inventory Verification, Gas Flow Performance, Gas Deliverability. Design & Development of Underground Storage Fields: Operation of Storage Fields. Threshold Pressure. Water Influx/Efflux Quantities. Aquifer Equilibrium Pressure. Error and Uncertainty. Gas Storage in Salt Cavity & Caverns: Thermodynamics, Temperature and Pressure Effect. Recent Developments Advanced Storage Techniques, Case Histories.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Oilfield Processing: Crude Oil (Oilfield Processing of Petroleum R. Solvay, Pennwell Books 1995.
2. Advances in Environmental Control Technology: Storage Tank Paul Cheremisinoff Gulf Professional Publishing; 1ST edition (May 9, 1996)

AS7031 EQUILIBRIUM STAGED OPERATIONS L T P C
3 0 0 3

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.

UNIT I ABSORPTION 9

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

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 9

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 9

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

Attested

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

UNIT V ADSORPTION & MEMBRANE SEPARATION PROCESS 9

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 : 45 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

AS7022 TRANSPORT PHENOMENA FOR PETROCHEMICAL ENGINEERS L T P C

3 0 0 3

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 its numerical solution.

UNIT I MOMENTUM TRANSPORT 9

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 ENERGY TRANSPORT 9

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 III TEMPERATURE DISTRIBUTION 9

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 IV CONCENTRATION DISTRIBUTION 9

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.

UNIT V ANALOGIES BETWEEN TRANSPORT PROCESSES 9

Turbulence, Reynolds equation for incompressible turbulent flow, Reynolds stresses Prandtl's mixing length theory, Eddy viscosity, the statistical theory of turbulence, Correlation coefficients, intensity and scale of turbulence. Turbulence measurement, Hot – wire anemometer. Turbulence flow in a closed conduit, Prandtl's Power law of Velocity distribution in smooth and rough pipes. Analogy between Momentum, Heat and Mass transfer. The Reynolds' Analogy for turbulent flow over a flat plate, The Prandtl's Analogy, The Von karmon Analogy, Coulburn analogy

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bird R.B., Stewart W.E. and Lightfoot E.N., Transport Phenomena, 2nd Edition, Wiley, New York, 2006,
2. Brodkey, R. S., and Hershey, H. C., " Transport Phenomena **-** A unified approach", McGraw-Hill, 1988.

REFERENCES

1. Welty, J. R., Wilson, R. W., and Wicks, C. W., "Fundamentals of Momentum Heat and Mass Transfer ", 5thedition John Wiley, New York, 2007.
2. Slattery, J. S., "Advanced Transport Phenomena", 2nd Edition, Cambridge University Press, London, 1999
3. Knudson J.G. and Katz D.L., "Fluid Dynamics and Heat Transfer ", 2nd Edition, McGraw Hill, New York, 2000

ME 7075 DESIGN OF PRESSURE VESSELS AND PIPING L T P C
3 0 0 3

OBJECTIVES:

- To apply the Mathematical knowledge gained in the design of pressure vessels and piping
- To carry out the stress analysis in pressure vessels and piping.

UNIT I INTRODUCTION 9

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

UNIT II STRESSES IN PRESSURE VESSELS 9

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 9

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 9

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 **9**

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

TOTAL:45 PERIODS

OUTCOMES:

Upon completion of this course, the students will be able to:

- Apply the mathematical fundamentals for the design of pressure vessels and pipes.
- Analyse and design pressure vessels and piping.

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.

MG7451 PRINCIPLES OF MANAGEMENT **L T P C**
3 0 0 3

AIM :

To learn the different principles and techniques of management in planning, organizing, directing and controlling.

OBJECTIVES

- To study the Evolution of Management
- To study the functions and principles of management
- To learn the application of the principles in an organization

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS **9**

Definition of Management –Science or Art – Manager Vs Entrepreneur- types of managers-managerial roles and skills – Evolution of Management –Scientific, human relations , system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING **9**

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING **9**

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING **9**

Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership

– Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

TEXT BOOKS:

1. Stephen P. Robbins and Mary Coulter, " Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert, "Management", Pearson Education, 6th Edition, 2004.

REFERENCES:

1. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.
2. Robert Kreitner and Mamata Mohapatra, " Management", Biztantra, 2008.
3. Harold Koontz and Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.
4. Tripathy PC and Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.

GE7072 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends **- Introduction to Product Development Methodologies and Management -** Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies **-** Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling -** Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design -** Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program **-** Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping -** Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance -**Maintenance and Repair – Enhancements - **Product EoL -** Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials -** Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

Attested

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