ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS 2017
B. E. PETROCHEMICAL ENGINEERING
CHOICE BASED CREDIT SYSTEM

1. Programme Educational Objectives (PEOs)

Graduates of B. E. Petrochemical Engineering will

I. Exhibit a professional and ethical attitude, effective communication skills, teamwork, multidisciplinary approach, and an ability to solve the problems encountered in petrochemical sector.
II. Gain knowledge in basic sciences, mathematics and computational platforms.
III. Have a knowledge and competency in refinery process industries complemented by the appropriate skills and attributes.
IV. Understand the theory and applications of analytical equipments used in industries for testing the quality of petroleum, intermediates and products.
V. Address to meet the world's ever-increasing demand for hydrocarbon fuel, thermal energy, and waste management.

2. 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 able be to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
III. Graduates will be able to identify, formulate, and solve engineering problems related to petrochemical industry.
IV. Graduates will be capable to design experiments, analyze and interpret data.
V. Graduates will be able to meet the world's ever-increasing demand for hydrocarbon fuel, thermal energy, and waste management.
VI. Graduates will be able to communicate effectively and work in interdisciplinary groups.
VII. Graduates will have a knowledge to analyze chemical and petrochemical products.
VIII. Graduates will understand the characteristics of source and reservoir Engineering.
IX. Graduates will gain expertise with environmentally sound exploration, evaluation and recovery of oil, gas and other fluids in the earth.
X. Graduates will Understand the pre requisites of control strategies and the mechanism of advance control systems.

3. PEOs / POs Mapping

Programme Educational Objectives	Programme Outcomes									
	I	II	III	IV	V	VI	VII	VIII	IX	X
I	✓	✓	✓			✓				✓
II			✓	✓			✓			
III	✓		✓	✓	✓		✓	✓	✓	✓
IV		✓	✓				✓			
V		✓					✓	✓	✓	

4. Semester Course Wise PEOs Mapping

YEAR	SEM	Course Title	I	II	III	IV	V	VI	VII	VIII	IX	X
YEAR I	SEM I	Communicative English	√								√	
		Engineering Mathematics I		√								√
		Engineering Physics				√						
		Engineering Chemistry				√	√					
		Problem Solving and Python Programming	√	√								√
		Engineering Graphics	√									
		Physics and Chemistry Laboratory				√	√					
		Problem Solving and Python Programming Laboratory	√	√								√
	SEM II	Technical English	√								√	
		Engineering Mathematics II		√				√				√
		Physics of Materials				√						
		Organic Chemistry				√	√					
		Basic Mechanical Engineering	√		√		√					
		Industrial Chemical Technology			√				√	√		
		Organic Chemistry Laboratory			√	√		√				
		Engineering Practices Laboratory	√		√		√					
YEAR II	SEM III	Probability and Statistics		√				√				√
		Engineering Mechanics			√				√	√		
		Fluid Mechanics			√	√		√				
		Materials Technology	√		√	√		√				
		Process calculations			√	√		√				
		Principles of Electrical and Electronics Engineering			√	√						√
		Electrical Engineering Laboratory			√	√						√
		Mechanical Engineering			√	√		√				

		Laboratory										
	SEMIV	Chemical Engineering Thermodynamics			√	√		√				
		Petroleum Exploration and Exploitation Techniques			√				√	√		
		Chemistry for Technologists				√	√					
		Natural Gas Engineering	√		√		√					
		Mechanical Operations	√		√		√					
		Petroleum Primary Processing Technology				√	√					
		Fluids and Solid Operations Laboratory	√		√		√					
		Chemical Analysis Laboratory				√	√					
YEAR III	SEM V	Heat Transfer			√	√		√				
		Mass Transfer I			√	√		√				
		Chemical Reaction Engineering			√	√		√				
		Professional Communication	√								√	
		Heat Transfer Laboratory			√	√		√				
		Petrochemical Analysis Laboratory			√				√	√		
	SEM VI	Petroleum Secondary Processing Technology			√				√	√		
		Mass Transfer II			√	√		√				
		Catalytic Reaction Engineering			√	√		√				
		Professional Ethics In Engineering	√		√		√					
		Process Instrumentation, Dynamics and Control			√	√						√
		Mass Transfer Laboratory			√	√		√				
		Petroleum Testing Laboratory			√				√	√		
YEAR IV	SEM VII	Process Equipment Design and Drawing			√				√	√		
		Environmental Science And Engineering	√		√		√					
		Reaction Engineering and Process Control Laboratory			√	√		√				
		Internship	√								√	
	SEM VIII	Project	√	√						√		
		Pipeline and Welding Technology	√	√			√	√		√		
		Seminar	√	√						√		

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B. E. PETROCHEMICAL ENGINEERING
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS (FULL TIME) CURRICULA AND SYLLABI

SEMESTER I

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS8151	Communicative English	HS	4	4	0	0	4
2.	MA8151	Engineering Mathematics–I	BS	4	4	0	0	4
3.	PH8151	Engineering Physics	BS	3	3	0	0	3
4.	CY8151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
6.	GE8152	Engineering Graphics	ES	6	2	0	4	4
PRACTICALS								
7.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
			TOTAL	**31**	**19**	**0**	**12**	**25**

SEMESTER II

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS8251	Technical English	HS	4	4	0	0	4
2.	MA8251	Engineering Mathematics–II	BS	4	4	0	0	4
3.	PH8254	Physics of Materials	BS	3	3	0	0	3
4.	CY8291	Organic Chemistry	BS	3	3	0	0	3
5.	BE8256	Basic Mechanical Engineering	ES	4	4	0	0	4
6.	PM8251	Industrial Chemical Technology	PC	3	3	0	0	3
PRACTICALS								
7.	CY8281	Organic Chemistry Laboratory	BS	4	0	0	4	2
8.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
			TOTAL	**29**	**21**	**0**	**8**	**25**

SEMESTER III

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA8391	Probability and Statistics	BS	4	4	0	0	4
2.	GE8292	Engineering Mechanics	ES	5	3	2	0	4
3.	PM8351	Fluid Mechanics	PC	5	3	2	0	4
4.	PM8391	Materials Technology	ES	3	3	0	0	3
5.	CH8351	Process Calculations	PC	5	3	2	0	4
6.	EE8352	Principles of Electrical and Electronics Engineering	ES	3	3	0	0	3
PRACTICALS								
7.	EE8361	Electrical Engineering Laboratory	ES	4	0	0	4	2
8.	ME8362	Mechanical Engineering Laboratory	ES	4	0	0	4	2
			TOTAL	**33**	**19**	**6**	**8**	**26**

SEMESTER IV

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	PE8491	Chemical Engineering Thermodynamics	PC	3	3	0	0	3
2.	PM8451	Petroleum Exploration and Exploitation Techniques	PC	3	3	0	0	3
3.	CY8292	Chemistry for Technologists	BS	3	3	0	0	3
4.	PE8092	Natural Gas Engineering	PC	3	3	0	0	3
5.	CH8451	Mechanical Operations	PC	3	3	0	0	3
6.	PM8452	Petroleum Primary Processing Technology	PC	3	3	0	0	3
PRACTICALS								
7.	PE8461	Fluids and Solid Operations Laboratory	ES	4	0	0	4	2
8.	CH8281	Chemical Analysis Laboratory	BS	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER V

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH8591	Heat Transfer	PC	5	3	2	0	4
2.	CH8551	Mass Transfer I	PC	3	3	0	0	3
3.	PE8091	Chemical Reaction Engineering	PC	3	3	0	0	3
4.		Professional Elective I	PE	3	3	0	0	3
5.		Open Elective I*	OE	3	3	0	0	3
PRACTICALS								
6.	CH8561	Heat Transfer Laboratory	PC	4	0	0	4	2
7.	PM8561	Petrochemical Analysis Laboratory	PC	4	0	0	4	2
8.	HS8581	Professional Communication	EEC	2	0	0	2	1
			TOTAL	**27**	**15**	**2**	**10**	**21**

* - Course from the curriculum of the other UG Programmes

SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	PM8651	Petroleum Secondary Processing Technology	PC	3	3	0	0	3
2.	CH8651	Mass Transfer II	PC	5	3	2	0	4
3.	PE8072	Catalytic Reaction Engineering	PC	3	3	0	0	3
4.	GE8076	Professional Ethics in Engineering	HS	3	3	0	0	3
5.	CH8653	Process Instrumentation, Dynamics and Control	PC	3	3	0	0	3
6.		Professional Elective II	PE	3	3	0	0	3
PRACTICALS								
7.	CH8781	Mass Transfer Laboratory	PC	4	0	0	4	2
8.	PE8661	Petroleum Testing Laboratory	PC	4	0	0	4	2
			TOTAL	**28**	**18**	**2**	**8**	**23**

SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	PM8751	Process Equipment Design and Drawing	PC	5	3	0	2	4
2.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3
3.		Professional Elective III	PE	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.		Open Elective II*	OE	3	3	0	0	3
PRACTICALS								
7.	PM8761	Reaction Engineering and Process Control Laboratory	PC	4	0	0	4	2
8.	PM8711	Internship	EEC	0	0	0	0	2
			TOTAL	**24**	**18**	**0**	**6**	**23**

* - Course from the curriculum of the other UG Programmes

SEMESTER VIII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective VI	PE	3	3	0	0	3
2.	PM8801	Pipeline and Welding Technology	PC	3	3	0	0	3
PRACTICALS								
3.	PM8811	Project Work	EEC	20	0	0	20	10
4.	PM8812	Seminar	EEC	4	0	0	4	2
			TOTAL	**30**	**6**	**0**	**24**	**18**

TOTAL CREDITS: 183

PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE I, SEMESTER V

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	PM8078	Petrochemical Unit Processes	PE	3	3	0	0	3
2.	PM8075	Instrumentation and Instrumental Analysis	PE	3	3	0	0	3
3.	CH8094	Polymer Technology	PE	3	3	0	0	3
4.	PM8076	Non-Conventional hydrocarbon sources	PE	3	3	0	0	3
5.	GE8071	Disaster Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE II, SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	PM8073	Design of Pressure Vessels and Piping	PE	3	3	0	0	3
2.	PM8074	Drilling and Well Engineering	PE	3	3	0	0	3
3.	PM8080	Production Engineering	PE	3	3	0	0	3
4.	PE8071	Advanced Separation Techniques	PE	3	3	0	0	3
5.	GE8075	Intellectual Property Rights	PE	3	3	0	0	3
6.	CH8791	Transport Phenomena	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE III, SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	PM8082	Water Treatment and Management	PE	3	3	0	0	3
2.	CH8072	Fluidization Engineering	PE	3	3	0	0	3
3.	PM8071	Chemical Process Design	PE	3	3	0	0	3
4.	PE8073	Enhanced Oil Recovery	PE	3	3	0	0	3
5.	GE8074	Human Rights	PE	3	3	0	0	3
6.	CH8077	Process Modeling and Simulation	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE IV, SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	PM8079	Petroleum Process Equipment Auxiliaries	PE	3	3	0	0	3
2.	PE8074	Multicomponent Distillation	PE	3	3	0	0	3
3.	PE8075	Petroleum Corrosion Technology	PE	3	3	0	0	3
4.	PM8081	Refinery Process Design	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE V, SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	PE8079	Storage Transportation of Crude Oil and Natural gas	PE	3	3	0	0	3
2.	PE8078	Reservoir Characterization and Modeling	PE	3	3	0	0	3
3.	PM8077	Petrochemical Derivatives	PE	3	3	0	0	3
4.	GE8077	Total Quality Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE VI, SEMESTER VIII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	PE8076	Petroleum Economics	PE	3	3	0	0	3
2.	PM8072	Design of Heat Exchangers	PE	3	3	0	0	3
3.	PE8093	Plant Safety and Risk Analysis	PE	3	3	0	0	3
4.	PC8071	Safety in Chemical Industries	PE	3	3	0	0	3
5.	GE8073	Fundamentals of Nano Science	PE	3	3	0	0	3

SUBJECT AREAWISE DETAILS

HUMANITIES AND SOCIAL SCIENCES (HS)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	HS8151	Communicative English	HS	4	4	0	0	4
2.	HS8251	Technical English	HS	4	4	0	0	4
3.	GE8076	Professional Ethics in Engineering	HS	3	3	0	0	3
4.	GE8291	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.	MA8151	Engineering Mathematics I	BS	4	4	0	0	4
2.	PH8151	Engineering Physics	BS	3	3	0	0	3
3.	CY8151	Engineering Chemistry	BS	3	3	0	0	3
4.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
5.	MA8251	Engineering Mathematics II	BS	4	4	0	0	4
6.	PH8254	Physics of Materials	BS	3	3	0	0	3
7.	CY8291	Organic Chemistry	BS	3	3	0	0	3
8.	CY8281	Organic Chemistry Laboratory	BS	2	0	0	4	2
9.	MA8391	Probability and Statistics	BS	4	4	0	0	4
10.	CY8292	Chemistry for Technologists	BS	3	3	0	0	3
11.	CH8281	Chemical Analysis Laboratory	BS	4	0	0	4	2

ENGINEERING SCIENCES (ES)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
2.	GE8152	Engineering Graphics	ES	6	2	0	4	4
3.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
4.	BE8256	Basic Mechanical Engineering	ES	4	4	0	0	4
5.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
6.	GE8292	Engineering Mechanics	ES	5	3	2	0	4
7.	PM8391	Materials Technology	ES	3	3	0	0	3
8.	EE8352	Principles of Electrical and Electronics Engineering	ES	3	3	0	0	3
9.	EE8361	Electrical Engineering Laboratory	ES	4	0	0	4	2
10.	ME8362	Mechanical Engineering Laboratory	ES	4	0	0	4	2
11.	PE8461	Fluids and Solid operations 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.	PM8251	Industrial Chemical Technology	PC	3	3	0	0	3
2.	PM8351	Fluid Mechanics	PC	5	3	2	0	4
3.	CH8351	Process Calculations	PC	5	3	2	0	4
4.	PE8491	Chemical Engineering Thermodynamics	PC	3	3	0	0	3
5.	PM8451	Petroleum Exploration and Exploitation Techniques	PC	3	3	0	0	3
6.	PE8092	Natural Gas Engineering	PC	3	3	0	0	3
7.	CH8451	Mechanical Operations	PC	3	3	0	0	3
8.	PM8452	Petroleum Primary Processing Technology	PC	3	3	0	0	3
9.	CH8591	Heat Transfer	PC	5	3	2	0	4
10.	CH8551	Mass Transfer I	PC	3	3	0	0	3
11.	PE8091	Chemical Reaction Engineering	PC	3	3	0	0	3
12.	CH8561	Heat Transfer Laboratory	PC	4	0	0	4	2
13.	PM8561	Petrochemical Analysis Laboratory	PC	4	0	0	4	2
14.	PM8651	Petroleum Secondary Processing Technology	PC	3	3	0	0	3
15.	CH8651	Mass Transfer II	PC	5	3	2	0	4
16.	PE8072	Catalytic Reaction Engineering	PC	3	3	0	0	3
17.	CH8781	Mass Transfer Laboratory	PC	4	0	0	4	2
18.	PE8661	Petroleum Testing Laboratory	PC	4	0	0	4	2
19.	CH8653	Process Instrumentation, Dynamics and control	PC	3	3	0	0	3
20.	PM8751	Process Equipment Design and Drawing	PC	5	3	0	2	4
21.	PM8761	Reaction Engineering and Process Control Laboratory	PC	4	0	0	4	2
22.	PM8801	Pipeline and welding Technology	PC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	HS8581	Professional Communication	EEC	2	0	0	2	1
2.	PM8711	Internship	EEC	0	0	0	0	2
3.	PM8811	Project Work	EEC	20	0	0	20	10
4.	PM8812	Seminar	EEC	4	0	0	4	2

SUMMARY

S. No.	Subject Area	Credits per Semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1.	HUMANITIES AND SOCIAL SCIENCES (HS)	4	4	0	0	0	3	3	0	14
2.	BASIC SCIENCE (BS)	12	12	4	5	0	0	0	0	33
3.	ENGINEERING SCIENCE (ES)	9	6	14	2	0	0	0	0	31
4.	PROFESSIONAL COURE (PC)	0	3	8	15	14	17	6	3	66
5.	EMPLOYABILITY ENHANCEMENT COURSES (EEC)	0	0	0	0	1	0	2	12	15
6.	PROFESSIONAL ELECTIVES (PE)	0	0	0	0	3	3	9	3	18
7.	OPEN ELECTIVES (OE)	0	0	0	0	3	0	3	0	6
	TOTAL	**25**	**25**	**26**	**22**	**21**	**23**	**23**	**18**	**183**

HS8151 **COMMUNICATIVE ENGLISH** **L T P C**
4 0 0 4

OBJECTIVES:

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 12

Reading- short comprehension passages, practice in skimming-scanning and predicting- **Writing**- completing sentences - developing hints. **Listening**- short texts- short formal and informal conversations. **Speaking-** introducing oneself - exchanging personal information- **Language development**- Wh- Questions- asking and answering-yes or no questions- parts of speech. **Vocabulary development-**- prefixes- suffixes- articles.- count/ uncount nouns.

UNIT II GENERAL READING AND FREE WRITING 12

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- **Writing** – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –**Listening**- telephonic conversations. **Speaking –** sharing information of a personal kind—greeting – taking leave- **Language development** – prepositions, conjunctions **Vocabulary development-** guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12

Reading- short texts and longer passages (close reading) **Writing-** understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences **Listening** – listening to longer texts and filling up the table- product description- narratives from different sources. **Speaking**- asking about routine actions and expressing opinions. **Language development**- degrees of comparison- pronouns- direct vs indirect questions- **Vocabulary development –** single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 12

Reading- comprehension-reading longer texts- reading different types of texts- magazines **Writing**- letter writing, informal or personal letters-e-mails-conventions of personal email- **Listening**- listening to dialogues or conversations and completing exercises based on them. **Speaking-** speaking about oneself- speaking about one's friend- **Language development-** Tenses- simple present-simple past- present continuous and past continuous- **Vocabulary development**- synonyms-antonyms- phrasal verbs

UNIT V EXTENDED WRITING 12

Reading- longer texts- close reading –**Writing**- brainstorming -writing short essays **–** developing an outline- identifying main and subordinate ideas- dialogue writing-**Listening** – listening to talks- conversations- **Speaking –** participating in conversations- short group conversations-**Language development**-modal verbs- present/ past perfect tense - **Vocabulary development**-collocations- fixed and semi-fixed expressions

TOTAL : 60 PERIODS

OUTCOMES:

At the end of the course, learners will be able to:

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1. Board of Editors. **Using English** A Coursebook for Undergarduate Engineers and Technologists**.** Orient BlackSwan Limited, Hyderabad: 2015**.**
2. Richards, C. Jack. **Interchange Students' Book-2** New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge,2011.
2. Comfort, Jeremy, et al. **Speaking Effectively : Developing Speaking Skillsfor BusinessEnglish.** Cambridge University Press, Cambridge: Reprint 2011.
3. Dutt P. Kiranmai and RajeevanGeeta. **Basic Communication Skills,** Foundation Books: 2013.
4. Means,L. Thomas and Elaine Langlois. **English & Communication For Colleges.** CengageLearning ,USA: 2007.
5. Redston, Chris &Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005.

MA8151 ENGINEERING MATHEMATICS – I L T P C
4 0 0 4

OBJECTIVES :

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I DIFFERENTIAL CALCULUS 12

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES 12

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – 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**

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

TOTAL : 60 PERIODS

OUTCOMES :

After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units I & III - Sections 1.1, 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES :

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.

PH8151	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I PROPERTIES OF MATTER 9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT II WAVES AND FIBER OPTICS 9

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers - fibre optic sensors: pressure and displacement.

UNIT III THERMAL PHYSICS 9

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) - scanning tunnelling microscope.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course,

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.

CY8151 ENGINEERING CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

UNIT I WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – desalination of brackish water - Reverse Osmosis.

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement.

Catalysis: Catalyst – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

UNIT III ALLOYS AND PHASE RULE 9

Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) -

carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H_2-O_2 fuel cell.

TOTAL: 45 PERIODS

OUTCOMES:

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, “A Textbook of Engineering Chemistry”, S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India PVT, LTD, New Delhi, 2013.

REFERENCES:

1. Friedrich Emich, “Engineering Chemistry”, Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, “Engineering Chemistry”, Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, 2015.

GE8151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C

3 0 0 3

OBJECTIVES:

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a

card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

OUTCOMES:

Upon completion of the course, students will be able to

- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES:

1. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
2. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013

3. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.
4. Paul Gries, Jennifer Campbell and Jason Montojo, “Practical Programming: An Introduction to Computer Science using Python 3”, Second edition, Pragmatic Programmers, LLC, 2013.
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
6. Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

GE8152 ENGINEERING GRAPHICS L T P C
2 0 4 4

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To 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 AND FREEHAND SKETCHING 7+12

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- Freehand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

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

UNIT III PROJECTION OF SOLIDS 5+12

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+12

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

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

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 - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

TOTAL: 90 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- familiarize with the fundamentals and standards of Engineering graphics
- perform freehand sketching of basic geometrical constructions and multiple views of objects.
- project orthographic projections of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- visualize and to project isometric and perspective sections of simple solids.

TEXT BOOK:

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy And Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

Publication of Bureau of Indian Standards:

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

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size. The examination will be conducted in appropriate sessions on the same day

GE8161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY **L T P C 0 0 4 2**

OBJECTIVES:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

LIST OF PROGRAMS

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

OUTCOMES:

Upon completion of the course, students will be able to

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

TOTAL :60 PERIODS

BS8161 PHYSICS AND CHEMISTRY LABORATORY **L T P C**

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

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum

2. Determination of Young's modulus by non-uniform bending method

3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.

5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating

7. Determination of band gap of a semiconductor

8. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:

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

- apply principles of elasticity, optics and thermal properties for engineering applications.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometery.

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 polyvinyl 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.
16. Conductometric titration of strong acid vs strong base.

OUTCOMES:

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

TOTAL: 30 PERIODS

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH} edition, 2014)

HS8251 TECHNICAL ENGLISH L T P C
4 0 0 4

OBJECTIVES:

The Course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations , participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

UNIT I INTRODUCTION TECHNICAL ENGLISH 12

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** –Asking for and giving directions- **Reading** – reading short technical texts from journals- newsapapers- **Writing**- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-**Vocabulary Development**- technical vocabulary **Language Development** –subject verb agreement - compound words.

UNIT II READING AND STUDY SKILLS 12

Listening- Listening to longer technical talks and completing exercises based on them-**Speaking** – describing a process-**Reading** – reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing**- interpreting cgarts, graphs- **Vocabulary Development-** vocabularyused in formal letters/emails and reports **Language Development-** impersonal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING AND GRAMMAR 12

Listening- Listening to classroom lectures/ talkls on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing**-Describing a process, use of sequence words- **Vocabulary Development-** sequence words- Misspelled words. **Language Development-** embedded sentences

UNIT IV REPORT WRITING 12

Listening- Listening to documentaries and making notes. **Speaking** – mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing**- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays--**Vocabulary Development**- finding suitable synonyms-paraphrasing-. **Language Development-** clauses- if conditionals.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 12

Listening- TED/Ink talks; **Speaking** –participating in a group discussion -**Reading**– reading and understanding technical articles **Writing**– Writing reports- minutes of a meeting- accident and survey-**Vocabulary Development- verbal analogies Language Development-** reported speech
.

TOTAL :60 PERIODS

OUTCOMES: At the end of the course learners will be able to:

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

TEXT BOOKS:

1. Board of editors. **Fluency in English A Course book for Engineering and Technology.** Orient Blackswan, Hyderabad: 2016.
2. Sudharshana.N.P and Saveetha. C. **English for Technical Communication**. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana**, Project Work,** Oxford University Press**,** Oxford: 2014.
2. Grussendorf, Marion, **English for Presentations,** Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. **Engineering English**. Orient Blackswan: Hyderabad,2015.
4. Means, L. Thomas and Elaine Langlois, **English & Communication For Colleges.** Cengage Learning, USA: 2007
5. Raman, Meenakshi and Sharma, Sangeetha- **Technical Communication Principles and Practice.**Oxford University Press: New Delhi,2014.

Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.

MA8251 ENGINEERING MATHEMATICS – II L T P C
4 0 0 4

OBJECTIVES :

- This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

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 - Vector identities – 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 FUNCTIONS 12

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

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 second order ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS

OUTCOMES :

After successfully completing the course, the student will have a good understanding of the following topics and their applications:

- Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES :

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

PH8254	PHYSICS OF MATERIALS	L	T	P	C
	(Common to courses offered in Faculty of Technology except Fashion Technology)	3	0	0	3

OBJECTIVES:

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

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 CONDUCTING MATERIALS 9

Classical free electron theory - expression for electrical conductivity – thermal conductivity, - Wiedemann-Franz law – electrons in metals: particle in a three-dimensional box- degenerate states – Fermi-Dirac statistics – density of energy states – electron in periodic potential (concept only) – 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 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, magnetoresistance materials.

UNIT V NEW MATERIALS AND APPLICATIONS 9

Metallic glasses – Shape memory alloys: Copper, Nickel and Titanium based alloys – graphene and its properties - Ceramics: types and applications – Composites: classification, role of matrix and reinforcement – processing of fibre reinforced plastics and fibre reinforced metals – Biomaterials: hydroxyapatite – PMMA – Silicone - Sensors: Chemical Sensors - Bio-sensors – conducting, semiconducting and photoresponsive polymers.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the students will able to

- gain knowledge on phase diagrams and various material processing methods,
- acquire knowledge on basics of conducting materials, superconductors and their applications
- get knowledge on the functioning of semiconducting materials and their applications in

LED and solar cells,

- understand the functioning of various dielectric and magnetic materials ,
- have the necessary understanding on various advanced materials.

TEXT BOOKS:

1. Balasubramaniam, R. "Callister's Materials Science and Engineering". Wiley India Pvt. Ltd. 2014.
2. Kasap, S.O. "Principles of Electronic Materials and Devices". McGraw-Hill Education, 2007.
3. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.

REFERENCES

1. Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010
2. Raghavan, V. "Materials Science and Engineering : A First course". PHI Learning, 2015.
3. Smith, W.F., Hashemi, J. & Prakash. R. "Materials Science and Engineering". Tata Mcgraw Hill Education Pvt. Ltd., 2014.

CY8291 ORGANIC CHEMISTRY L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to learn the type of components in which organic reactions take place and also to know the preparation of the essential organic compounds.

UNIT I ORGANIC REACTION MECHANISM 9

Electrophilic reactions-Friedel crafts reaction, Riemer Tiemenn reaction, Beckmann rearrangements; nucleophilic reactions- aldol condensation, perkin reaction, benzoin condensation; free radical reaction-halogenation of alkane, addition of HBr on alkene in presence of peroxide; allylic halogenation - using N-Bromo Succinamide (NBS), thermal halogenation of alkene $CH_3 – CH = CH_2$.

UNIT II CARBOHYDRATES 9

Introduction – mono and disaccharides – important reactions – polysaccarides – starch and cellulose – derivatives of cellulose – carboxy methyl cellulose and gun cotton – structural aspects of cellulose

UNIT III POLYNUCLEAR AROMATICS AND HETEROCYCLES 9

Classification of polynuclear aromatics. naphthalene preparation, properties and uses. Classification of heterocyclic compounds. Furan, thiophene, pyrrole, pyridine, quinoline, isoquinoline - preparation, properties and uses.

UNIT IV AMINO ACIDS AND PROTEINS 9

Classification, preparation (Strecker, Skraup, Gabriel phthalimide) and properties of Amino acids. Composition and classification of proteins. Structure of proteins – tests for proteins – general properties and relations of proteins – hydrolysis of proteins.

UNIT V DRUGS & DYES 9

Classification and properties of drugs. Penicillin sulpha drugs, mode of action, synthesis of sulphanilamide, chloroquine and chloroamphenicol.

Colour and constitution, chromogen and chromophore. Classification of dyes based on structure and mode of dyeing. Synthesis of dyes. Malachite green, methyl orange, congo red, phenolphthalein.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of the course students will have knowledge on various reaction mechanism, preparation of organic compounds and their properties.

TEXTBOOKS:

1. B.S.Bhal and Arun Bhal, "A Text Book of Organic Chemistry", 17th Ed., S Chand & Co. New Delhi, 2005.
2. R.T. Morrison and R.N. Boyd "Organic Chemistry", 7th Ed., Prentice Hall Inc. USA, 2010.

REFERENCES:

1. Jonathan Clayden, Nick Greeves, Staurt Warren and Peter Wothers, "Organic Chemistry", Oxford University Press, 2nd Ed., New Delhi, 2013.
2. K.S. Tiwari, N.K. Vishnoi, S.N. Mehrotra, "A Text Book of Organic Chemistry", Vikas Publishing House, 2nd Ed., New Delhi, 2006.

BE8256 BASIC MECHANICAL ENGINEERING L T P C

4 0 0 4

OBJECTIVE

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

UNIT I LAWS OF THERMODYNAMICS 12

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 12

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 12

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 TEAM 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 BALNCING 12

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 : 60 PERIODS

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

TEXT BOOKS

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

PM8251 INDUSTRIAL CHEMICAL TECHNOLOGY L T P C

3 0 0 3

OBJECTIVE:

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

UNIT I SULFUR, SULFURIC ACID AND CEMENT 9

Sulfur, Raw materials Sources, Mining and production of Sulfur – Sulfuric acid, Methods of production of Sulfuric acid – Contact process – Chamber process. Cement – properties of Cement – Methods of production – Overall factors for Cement industry.

UNIT II FERTILIZER INDUSTRY, FUEL AND INDUSTRIAL GASES 9

Major Components of Fertilizer industries – Nitrogen industries, ammonia, nitric acid, urea – Phosphorus industries - Phosphorus, Phosphoric acid, Super Phosphate – Potassium chloride, Potassium Sulphate – Fuel Gases – Producer gas, Water gas, Coke oven gas, Natural gas, Liquefied natural gas – Industrial gases – Carbon dioxide, hydrogen, nitrogen and oxygen. .

UNIT III PULP, PAPER, SUGAR AND STARCH INDUSTRIES 9

Pulp – Methods of production – Comparison of pulping processes. Paper – types of paper products, Raw materials, Methods of production. Sugar – Methods of production – by products of the Sugar industry – Starch – Methods of production, Starch derivations. .

UNIT IV PETROLEUM AND PETRO CHEMICAL INDUSTRIES 9

Petroleum – Chemical Composition, Classification of crude petroleum, Petroleum Refinery products – Petroleum Conversion processes – Pyrolysis and Cracking, Reforming Polymerization, isomerization and Alkylation – petrochemicals – methanol, chloro methanol, Acetylene and ethylene, Isopropanol, Acrylonitrile, Buta diane – Chemicals from Aromatics - Benzene, Toluene and Xylene.

U**NIT V RUBBERS, POLYMERS AND SYNTHETIC FIBRE 9**

Natural and Synthetic rubber, SBR – Silicone rubber – polymer – physical – chemical structure of polymers, Thermosetting and Thermoplastic materials - Polymer manufacturing processes – polyethylene, polystyrene – Resins phenolic and epoxy resins – Synthetic Fibers – Viscose rayon, Polyamides and polyesters.

TOTAL : 45 PERIODS

OUTCOME:

- Student can classify the chemical process industry into industrial categories of base, intermediate end-products and specialty chemicals manufacturers.

TEXT BOOKS:

1. Dryden, C.E, Outlines of Chemical technology, II Ed., Affiliate East West press, 2003.
2. Moulin, J.A., M. Makkee, and Diepen, A.V., Chemical Process Technology, Wiley, 2001.

REFERENCES:

1. Austin, G.T., Shreve's "Chemical Process Industries", 5th ed., McGraw-Hill, 1998.
2. Srikumar Koyikkal,"Chemical Process Technology and Simulation",PHI Learning Ltd (2013).

CY8281 ORGANIC CHEMISTRY LABORATORY L T P C

0 0 4 2

OBJECTIVE:

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

LIST OF EXPERIMENTS

1. Quantitative analysis of organic compounds – Identification of aliphatic/aromatic, saturated/unsaturated compounds.
2. Identification and characterization of various functional groups by their characteristic reactions:
   a) alcohol, b) aldehyde, c) ketone, d) carboxylic acid, e) phenol, f) ester,
   g) primary, secondary and tertiary amines and h) nitro compounds.
3. Analysis of an unknown organic compound and preparation of suitable solid derivatives (Benzoic acid from Benzaldhehyde, hydrolysis of ester and meta- dinitrobenzene from nitrobenzene) .
4. Analysis of carbohydrates.
5. Analysis of proteins.
6. Methodology of filtration and recrystallization.

7. Introduction to organic synthetic procedures:
   i. Acetylation – Preparation of acetanilide from aniline.
   ii. Hydrolysis – Preparation of salycilic acid from methyl salyciliate.
   iii. Substitution – Conversion of acetone to iodoform.
   iv. Nitration – Preparation of m-dinitrobenzene from nitrobenzene.
   v. Oxidation – Preparation of benzoic acid from benzaldehyde/ benzyl alcohol

TOTAL: 60 PERIODS

List of Equipment for a Batch of 30 students

S. No.	Description of Equipment	Quantity
Essential		
1.	Bunsen burners	30
2.	LPG Cylinder in each row of the Laboratory	
3.	Hot Air Oven	2 Nos
4.	Hot Plate	6 Nos
5.	Water Bath	6 Nos
6.	Deep freezer	1 No.
7.	Magnetic Stirrers	6 Nos.
8.	Mechanical Stirrers	6 Nos.
9.	Refluxion Set up	
10.	Sharp Knives to cut sodium	6 Nos.
11.	Balance	
Desirable		
	Melting Point apparatus	

OUTCOME:

- The student is able to identify what distinguishes a strong and weak nucleophile and recall the rules of reactions. The student shows their mastery of nomenclature since ethyl bromide is not drawn out. The student analyzes a list of compounds and determines their reactivity.

REFERENCES:

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

GE8261 ENGINEERING PRACTICES LABORATORY L T P C
0 0 4 2

OBJECTIVES:

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

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 13

Buildings:

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

Plumbing Works:

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

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

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

II MECHANICAL ENGINEERING PRACTICE 18

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:

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

Sheet Metal Work:

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

Machine assembly practice:

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

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.

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

IV ELECTRONICS ENGINEERING PRACTICE 16

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

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundary and
- fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

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

MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.

4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

ELECTRICAL

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

ELECTRONICS

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

MA8391 PROBABILITY AND STATISTICS L T P C

4 0 0 4

OBJECTIVE:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

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 TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 12

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT V STATISTICAL QUALITY CONTROL 12

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

TOTAL: 60 PERIODS

OUTCOMES:

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

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 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 Edition, 2004.
5. 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.

GE8292 ENGINEERING MECHANICS L T P C

3 2 0 4

OBJECTIVE:

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

UNIT I STATICS OF PARTICLES 9+6

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces -

additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES 9+6

Free body diagram – Types of supports –Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9+6

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

UNIT IV DYNAMICS OF PARTICLES 9+6

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

UNIT V FRICTION AND RIGID BODY DYNAMICS 9+6

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

TOTAL: 45+30=75 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- illustrate the vectorial and scalar representation of forces and moments
- analyse the rigid body in equilibrium
- evaluate the properties of surfaces and solids
- calculate dynamic forces exerted in rigid body
- determine the friction and the effects by the laws of friction

TEXT BOOKS:

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

REFERENCES:

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.

3. Irving H. Shames and Krishna Mohana Rao. G., “Engineering Mechanics – Statics and Dynamics”, 4th Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., “Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2”, Third Edition, John Wiley & Sons,1993.
5. Rajasekaran S and Sankarasubramanian G., “Engineering Mechanics Statics and Dynamics”, 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

PM8351 FLUID MECHANICS L T P C
3 2 0 4

OBJECTIVES:

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

UNIT I **15**

Methods of analysis and description - fluid as a continuum – Velocity and stress field - Newtonian and non-Newtonian fluids – Classification of fluid motion

UNIT II **15**

Fluid statics – basic equation - equilibrium of fluid element – pressure variation in a static fluid - application to manometry – Differential analysis of fluid motion – continuity, equation of motions, Bernoulli equation and Navier- Stokes equation.

UNIT III **15**

The principle of dimensional homogeneity – dimensional analysis, Rayleigh method and the Pi-theorem - non-dimensional action of the basic equations - similitude - relationship between dimensional analysis and similitude - use of dimensional analysis for scale up studies

UNIT IV **15**

Reynolds number regimes, internal flow - flow through pipes – pressure drop under laminar and turbulent flow conditions – major and minor losses; Line sizing; External flows - boundary layer concepts, boundary layer thickness under laminar and turbulent flow conditions- Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds.

UNIT V **15**

Flow measurement - Constant and variable head meters; Velocity measurement techniques; Types, characteristics and sizing of valves; Classification, performance characteristics and sizing of pumps, compressors and fans

TOTAL:75 PERIODS

OUTCOMES:

On completion of this course, the students would have knowledge on

- Fluid properties and their characteristics while static and during flow through ducts, pipes and porous medium.
- Several machineries used to transport the fluid and their performance.

TEXT BOOKS:

1. Noel de Nevers, “Fluid Mechanics for Chemical Engineers “, Second Edition, McGraw-Hill, (1991).
2. Munson, B. R., Young, D.F., Okiishi, T.H. “Fundamentals of Fluid Mechanics”, 5th Edition“, John Wiley, 2006.

3. McCabe W.L, Smith, J C and Harriot. P “Unit operations in Chemical Engineering”, McGraw Hill, VII Edition, 2005

REFERENCES:

1. White, F.M., “Fluid Mechanics “, IV Edition, McGraw-Hill Inc., 1999.
2. James O Wilkes and Stacy G Bike, “Fluid Mechanics for Chemical Engineers’ Prentice Hall PTR (International series in Chemical Engineering) (1999)

PM8391 MATERIALS TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To provide students with a strong foundation in materials science with emphasis on the fundamental scientific and engineering principles which underlie the knowledge and implementation of material structure, processing, properties, and performance of all classes of materials used in engineering systems.

UNIT I STRUCTURE OF MATERIALS 9

Introduction-classification of materials, selection of materials, properties of materials, x-ray crystallography, Bragg's law, x-ray diffraction, electron diffraction, neutron diffraction, structure of NaCl and diamond, Crystal defects - point, line, surface and volume defects, alloy formation, solid solution types, solidification of castings, structural examination using microscopy**.**

UNIT II METALLURGICAL PROPERTIES OF MATERIALS 9

Phase diagrams - isomorphous, eutectic, eutectoid and peritectic system. Diffusion - Fick 's laws. Mechanical properties - tension test, hardness test - brinnel, vickers, rockwell, micro hardness test - shore scleroscope. Impact test, fracture - grifiths' theory, fracture toughness, embrittlement phenomena. Fatigue and creep. Strengthening mechanisms

UNIT III TYPES OF MATERIALS 9

Classification of steel, Fe-C phase diagram, heat treatment, TTT curves, ausforming, marforming, annealing types, normalizing, tempering, hardening, effect of alloying elements, tool steels, stainless steel, cast iron - malleable and ductile types and properties. Copper and its alloys - brass, bronze, copper – nickel. Aluminium and its alloys, hardening treatment. Al cladding nickel and its alloys, titanium and its alloys, cermets, welding electric and magnetic materials, nano particles and nano structures.

UNIT IV PHYSICAL CHARACTERISTICS OF MATERIALS 9

Metals, semiconductors, insulators, electron theory, band theory, types of magnetism, domain structures, anisotrophy of materials, and application. Soft and hard magnets. Conductivity of materials, zone refining, crystal growth techniques.

UNIT V NON-METALLIC MATERIALS 9

Ceramic materials - oxides, silicates. Refractories. Glasses, enamels, abrasives, cement and concrete materials. Polymers – classification, reaction, types, mechanisms, deformation of polymers, mechanical, thermal, electrical and chemical behavior. Rubber, silicones, fluoro carbons, composites -FRP, particulates, and laminates.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course, the students will be able to understand various material and its properties and manufacturing methods.

TEXT BOOKS:

1. V.Raghavan, "Materials Science and Engineering: A first course", V Edition, Prentice Hall of India , 2004.
2. Van Vlack L.H , "Elements of Materials Science and Engineering" (Addision Wesley series in metallurgy and materials engineering), VI Edition, Prentice Hall, 6th Edition, 1989.

REFERENCES:

1. WF.Hosford, "Material Science", Cambridge Univ. Press, New York, 2006.
2. C.Srinivasan, " Science of Engineering Materials", John Wiley, New York, 1987.

CH8351 PROCESS CALCULATIONS L T P C
3 2 0 4

OBJECTIVE:

- To acquire knowledge on laws of chemistry and its application to solution of mass and energy balance equations for single and network of units and introduce to process simulators.

UNIT I **15**

Base and derived Units - Composition of Mixture and solutions - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

UNIT II **15**

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

UNIT III **15**

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

UNITIV **15**

Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction -Energy balance for systems with and without chemical reaction - Unsteady state energy balances

UNIT V **15**

Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculation of excess air from orsat technique, problems on sulphur and sulphur burning compounds - Application of Process simulators in energy and material balance problems.

TOTAL: 75 PERIODS

OUTCOMES:

- 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.

TEXT BOOKS:

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

REFERENCE:

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

EE8352 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 AND 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 AND 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

EE8361 ELECTRICAL ENGINEERING LABORATORY L T P C

0 0 4 2

OBJECTIVE:

- To validate the principles studied in theory by performing experiments in the laboratory

LIST OF EXPERIMENTS

1. Load test on DC Shunt & DC Series motor
2. O.C.C & Load characteristics of DC Shunt and DC Series generator
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on single phase transformer
5. O.C & S.C Test on a single phase transformer
6. Regulation of an alternator by EMF & MMF methods.
7. V curves and inverted V curves of synchronous Motor
8. Load test on three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Study of DC & AC Starters

TOTAL: 60 PERIODS

OUTCOME:

- Ability to perform speed characteristic of different electrical machine

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1	DC Shunt motor	2
2	DC Series motor	1
3	DC shunt motor-DC Shunt Generator set	1
4	DC Shunt motor-DC Series Generator set	1
5	Single phase transformer	2
6	Three phase alternator	2
7	Three phase synchronous motor	1
8	Three phase Squirrel cage Induction motor	1
9	Three phase Slip ring Induction motor	1

ME8362 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

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.

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.

S. No.	NAME OF THE EQUIPMENT	Qty.
1.	I.C Engine – 2 stroke and 4 stroke model	1 set
2.	4-stroke Diesel Engine with mechanical loading.	1 No.
3.	Torsion cylinder Diesel Engine	1 No.
4.	Universal Tensile Testing machine with double 1 shear attachment –	1
5.	Torsion Testing Machine (60 NM Capacity)	1
6.	Impact Testing Machine (300 J Capacity)	1
7.	Brinell Hardness Testing Machine	1
8.	Rockwell Hardness Testing Machine	1
9.	Spring Testing Machine for tensile and compressive loads (2500 N)	1

PE8491 CHEMICAL ENGINEERING THERMODYNAMICS L T P C
3 0 0 3

OBJECTIVE:

- Students will learn PVT behaviour of fluids, laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.

UNIT I **9**

Scope of thermodynamics, basic concepts and definitions, Equilibrium state and phase rule, Energy, Work, Temperature and Zeroth Law of Thermodynamics, reversible and irreversible process, Ideal gas- Equation of State involving ideal and real gas, Law of corresponding states, Compressibility chart, First Law of Thermodynamics and its consequences.

UNIT II **9**

Joule's experiment, internal energy, enthalpy, Application of first Law of Thermodynamics for Flow and non flow processes. Limitations of the first Law , statements of second Law of Thermodynamics and its Applications ,Heat Engine, Heat Pump/Refrigerator, Carnot cycle and Carnot theorem, Thermodynamic Temperature scale, Entropy , Clausius inequality, Third law of thermodynamics.

UNIT III **9**

Refrigeration and liquefaction process, Thermodynamic Potentials, thermodynamic correlation, Maxwell relations, criteria for Equilibria and stability. Clapeyron equation

UNIT IV **9**

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

UNIT V **9**

Activity coefficient-composition models, thermodynamic consistency of phase equilibria, ChemicalReaction equilibria, Extent of reaction, equilibrium constant and standard free energy change

TOTAL: 45 PERIODS

OUTCOME:

- The course will help the students to know about engineering thermodynamics and understand the practical implications of thermodynamic law in engineering design.

TEXT BOOKS:

1. Sonntag, Borgnakke, Van Wylen, Fundamentals of Thermodynamics, 7th Edition, Wiley India, New Delhi, 2009.
2. Narayanan, K.V. A Textbook of Chemical Engineering Thermodynamics Prentice Hall India, 2004
3. Smith, van Ness and Abbott, "Chemical Engineering Thermodynamics", 7th Edition, McGraw Hill, New York, 2005

REFERENCES:

1. S. I. Sandler, Chemical, Biochemical and Engineering Thermodynamics, Wiley New York, 2006
2. Y V C Rao, "Chemical Engineering Thermodynamics", Universities Press, Hyderabad 2005.
3. Pradeep ahuja," Chemical Engineering Thermodynamics", PHI Learning Ltd (2009).
4. GopinathHalder," Introduction to Chemical Engineering Thermodynamics", PHI Learning Ltd (2009).

PM8451 PETROLEUM EXPLORATION AND EXPLOITATION TECHNIQUES **L T P C 3 0 0 3**

OBJECTIVE:

- To make the students understand the stages of oil and gas formation, exploration and production

UNIT I ORIGIN AND OCCURRENCE OF PETROLEUM AND SEDIMENTRARY ENVIRONMENT **9**

Origin of oil – Rock cycle - Important factors that control petroleum occurrence – Source, cap and reservoir rocks - Oil bearing rocks - Migration and accumulation - Continental environment – Transitional environment – Marine environment.

UNIT II EXPLORATION METHODS, WELL PROGNOSIS AND ECONOMIC ANALYSIS **9**

Geological exploration methods – Geophysical exploration methods – Geochemical methods - Prognostication – Classification of drilling locations – Economic analysis – Well programme – Geotechnical order.

UNIT III GEOLOGICAL STRUCTURE AND GEOLOGGING **9**

Various traps and faults – Core Collection Techniques – Sample logging, Drilling time logging, Mud/Gas/Oil logging – Formation Evaluation Techniques using wire line well logging include – Spontaneous pontential logging, Natural Gamma Ray Logging, Caliber Logging, Formation Density Logging, Neutron Porosity logging, Sonic velocity Logging, Electrical Resistance Logging, etc..

UNIT IV DRILLING FLUIDS AND WORK COMPLETION **9**

Drilling Technology - Drilling Fluids: Function, composition, and classification – Packer fluid – Casing packs – Cementing – Various well completion methods – Various stimulation methods.

UNIT V OFF – SHORE TECHNOLOGY **9**

Seismic technology – Sniffer survey – Drilling technology – Off-shore rigs – Primary, secondary and enhanced oil recovery techniques and methods – Major well complication and Remedies.

TOTAL: 45 PERIODS

OUTCOME:

- Identify the origin and favorable geological conditions for the formation and accumulation of petroleum and natural gas.
- Understand the modern oil finding techniques and its feasibility for oil production.
- Formulate drilling fluid for well drilling and well completion methods
- Analyse the various oil recovery and stimulation methods to optimize oil production.

TEXT BOOKS:

1. Bhagwan Sahay “Petroleum Exploration and Exploitation Practices” Allied Publishers Ltd., Chennai, 1994.
2. Richard Dawe, “Modern Petroleum Technology”, Vol.I, Upstream, 6th Edition, John and Wiley Sons Ltd, 2000.

REFERENCES:

1. Howard B. Bradley, “Petroleum Engineering Handbook”, Society of Petroleum Engineers, 1987.

2. Norman J. Hyne., “Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production”, 2nd Edition, Pennwell Books, 2001.
3. Shay B., “Wellsite Geological Techniques for Petroleum Exploration” Allied Publishers Ltd., 1991.

CY8292 CHEMISTRY FOR TECHNOLOGISTS L T P C
3 0 0 3

UNIT I UNIT PROCESSES 9

Nitration, Sulphonation, Halogenation, Esterification, Amination, Saponification and Hydrogenation – Role of the above unit processes in such industries as petroleum, drugs, pharmaceuticals and organic synthesis.

UNIT II REACTION MECHANISMS 9

Free radical, substitutions, electrophilic, addition, aromatic electrophilic substitutions, nucleophilic additions, condensation reactions, nucleophilic substitutions in aliphatic and aromatic compounds, cyclo-additions, rearrangements-Beckmann and Fries rearrangement reactions.

UNIT III OILS, FATS, SOAPS & LUBRICANTS 9

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

UNIT IV CHEMICALS AND AUXILIARIES 9

Preparation, properties and uses of bleaching powder, sodium hypochlorite, hydrogen peroxide, chlorine dioxide. Estimation of available chlorine in hypochlorite bleach liquor. Determination of strength of hydrogen peroxide.

UNIT V COLORANTS 9

Theory of color and constitution: chromophore and auxochrome, classification of dyes based on application. Chemistry and synthesis of azo dye (Methyl red, Methyl orange and Congo red)

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dhara S. S., “A Text Book of Engineering Chemistry”, 12th Ed., S. Chand & Co. Ltd., New Delhi, 2016.
2. Jain. P.C. and Monica Jain, “Engineering Chemistry”, Dhanpet Rai & Sons, New Delhi, 2012.
3. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, 2015.

REFERENCES:

1. W.L. McCabe, J.C. Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill Education, 2005.
2. B.K. Sharma, “Industrial chemistry”, Krishna Prakashan Media (P) Ltd, Meerut, 2011.
3. Shore J., “Colourants and Auxiliaries: Volume II Auxiliaries”, Wood head Publishing Ltd., 2002.

4. Shenai V. A., “Chemistry of Dyes and Principles of Dyeing”, Sevak Publications, Mumbai, 1995.
5. Trotman E. R., “Dyeing and Chemical Technology of Textile Fibres”, B.I Publishing Pvt. Ltd., New Delhi, 1994.

PE8092 NATURAL GAS ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- Enable the students to learn 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

OUTCOME:

- Students will be able to understand the Natural gas processing, Gas Compression, Gas Gathering and Transport Installation, Operation and trouble shooting of natural gas pipelines.

TEXT BOOK:

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

REFERENCE:

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

CH8451 MECHANICAL OPERATIONS L T P C
3 0 0 3

OBJECTIVE:

- To impact knowledge in the field of particle size reduction and also deals with the detail construction and working of equipment's used for mechanical operations.

UNIT I PARTICLE CHARACTERIZATION AND MEASUREMENT 9

General characteristics of solids, different techniques of size analysis- Static - Image analysis and Dynamic analysis - Light scattering techniques, shape factor, surface area determination, estimation of particle size. Advanced particle size analysis techniques. Screening methods and equipment, screen efficiency, ideal and actual screens.

UNIT II PARTICLE SIZE REDUCTION AND SIZE ENLARGEMENT 9

Laws of size reduction, energy relationships in size reduction, methods of size reduction, classification of equipments, crushers, grinders, disintegrators for coarse, intermediate and fine grinding, power requirement, work index; Advanced size reduction techniques - Nano particle fabrication - Top down approach - Bottom-up approach. Size enlargement - Importance of size enlargement, principle of granulation, briquetting, pelletisation, and flocculation. Fundamentals of particle generation.

UNIT III PARTICLE SEPARATION (GAS-SOLID AND LIQUID-SOLID SYSTEM) 9

Gravity settling, sedimentation, thickening, elutriation, double cone classifier, rake classifier, bowl classifier. Centrifugal separation - continuous centrifuges, super centrifuges, design of basket centrifuges; industrial dust removing equipment, cyclones and hydro cyclones, electrostatic and magnetic separators, heavy media separations, floatation, jigging

UNIT IV FILTRATION AND FILTRATION EQUIPMENTS 9

Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipments - selection, operation and design of filters and optimum cycle of operation, filter aids.

UNIT V MIXING AND PARTICLE HANDLING 9

Mixing and agitation - Mixing of liquids (with or without solids), mixing of powders, selection of suitable mixers, power requirement for mixing. Storage and Conveying of solids - Bunkers, silos, bins and hoppers, transportation of solids in bulk, Powder hazards, conveyer selection, different types of conveyers and their performance characteristics.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course, the students will be able to understand the overview of equipment used to perform various mechanical operations and problems associated during the implementation and applications.

TEXT BOOKS:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.

2. Badger W.L. and Banchero J.T., “Introduction to Chemical Engineering”, Tata McGraw Hill, 1997.
3. Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., “Principles of Unit Operations”, 2nd Edn., John Wiley & Sons, 1994.
4. Hiroaki Masuda , KoHigashitani and Hideto Yoshida, Powder Technology Handbook, 3rd Edition.

REFERENCES:

1. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. II, 4th Edn., Asian Books Pvt. Ltd., India, 1998.
2. Christie J. Geankoplis, Transport processes and unit operations.
3. Sunggyu Lee, Kimberly H. Henthorn, Particle Technology and Applications.
4. Martin Rhodes, Introduction to Particle Technology, Second Edition.
5. Richard R. Klimpel, Introduction to the Principles of Size Reduction of Particles by Mechanical Means, NSF Engineering Research Center for Particle Science & Technology. University of Florida, 1997.

PM8452 PETROLEUM PRIMARY PROCESSING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To make the students to learn the primary refining operation of crude oil and testing of petroleum products and its treatment techniques.

UNIT I GENERAL 9

Origin – Exploration and production of petroleum – Types of crudes, crude composition – Characteristics and classification – Crude oil properties – Indigenous and imported crudes – Crude availability Vs demands.

UNIT II TESTING OF PETROLEUM PRODUCTS 9

IS 1448: Standard – Testing of crude oil and its commercial Products - Specifications and their Significance. Bharath stage III, IV Norms for fuels. Euro Stage IV, V, VI norms for fuels.

UNIT III CRUDE PROCESSING 9

Pretreatment of crude for Refining – Dehydration and desalting – Atmospheric distillation, Vacuum distillation of residue products – Types of trays, flow pattern in the trays – Reflux types and its significance.

UNIT IV LUBE DISTILLATE TREATMENT TECHNIQUES 9

Treatment techniques for vacuum distillates with different processes like solvent extraction – Deasphalting, dewaxing, hydrofining, catalytic dewaxing and clay contact process – Production of lubricating oils.

UNIT V BITUMEN PROCESSING and FINAL TREATMENT TECHNIQUES 9

Asphalt manufacture, Air blowing technology, Bitumen Types and their properties, Acid gas removal and sulphur removal techniques.

TOTAL: 45 PERIODS

OUTCOMES:

- Acquire knowledge on types of crude and their primary refining operations.
- Perform various tests to check the quality of crude oil and its products.
- Understand the manufacturing techniques involved in lubricating oil and bitumen.

- Understand the final treatment techniques required for the finished products.

TEXT BOOKS:

1. Ram Prasad, “Petroleum Refining Technology”, Khanna Publishers.
2. Bhaskara Rao, B.K., “Modern Petroleum Refining Processes”, 3rd edition, Oxford and IBH Publishing Company Pvt. Ltd.

REFERENCES:

1. James H. Gary and Glenn E. Handwerk., “Petroleum Refining Technology and Economics”, 4th Edition, Marcel Dekker Inc., 2001.
2. Nelson, W.L., “Petroleum Refinery Engineering”, McGraw Hill Publishing Company Limited, 1985.
3. Hobson, G.D., “Modern Petroleum Refining Technology “, 5th Edition, John Wiley Publishers, 1984

PE8461 FLUIDS AND SOLID OPERATIONS LABORATORY L T 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.

LIST OF EXPERIMENTS - Phase – I(minimum 5 Experiments to be conducted)

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(minimum 5 Experiments to be conducted)

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
9. Drop weight crusher
10. Drag on Sphere
11. Effectiveness of screen

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

OUTCOMES:

- 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.

CH8281	**CHEMICAL ANALYSIS LABORATORY**	**L T P C**
	(Minimum of 8 experiments to be conducted)	**0 0 4 2**

OBJECTIVE:

- To make the student acquire practical skills in the wet chemical and \ instrumental methods 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.

S. No.	Description of Equipment	Quantity required
1	Silica Crucible	20
2	Heating Mantle	3
3	Muffle Furnace	1
4	Hot air oven	1
5	Desiccator	5
6	Vacuum Pump	1
7	Condenser	10
8	Reflux Condenser	10
9	Pensky martens closed cup apparatus	1
10	Cleveland Open cup apparatus	1
11	Cloud point apparatus	1
12	Saybolt Viscometer	1
13	Redwood Viscometer	1
14	Bomb Calorimeter	1
15	COD reflux	1
16	Orsat apparatus	1
17	UV-Vis Spectrophotometer	1

TOTAL: 60 PERIODS

OUTCOMES:

- 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

REFERENCES:

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

CH8591 HEAT TRANSFER L T P C
3 2 0 4

OBJECTIVE:

- To enable the students to learn heat transfer by conduction, convection and radiation and heat transfer equipments like evaporator and heat exchanger

UNIT I **15**

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer -

Fourier's law of heat conduction - one dimensional steady state heat conduction equation for flat plate, hollow cylinder, - Heat conduction through a series of resistances - Thermal conductivity measurement; effect of temperature on thermal conductivity; Heat transfer in extended surfaces.

UNIT II **15**

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

UNIT III **15**

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

UNIT IV **15**

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

UNIT V **15**

Log mean temperature difference - Single pass and multipass heat exchangers; plate heat exchangers; use of correction factor charts; heat exchangers effectiveness; number of transfer unit - Chart for different configurations - Fouling factors

TOTAL: 75 PERIODS

OUTCOMES:

At the end of this course,

- The students would have knowledge in various heat transfer methodology in process engineering.
- To design heat transfer equipments such as furnace, boilers, heat exchangers evaporation

TEXT BOOKS:

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

REFERENCES:

1. 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.

CH8551 **MASS TRANSFER I** **L T P C**
3 0 0 3

OBJECTIVE:

- Students will learn to determine mass transfer rates under laminar and turbulent conditions.

UNIT I **9**

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

UNIT II **10**

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

UNIT III **9**

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

UNIT IV **9**

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

UNIT V **8**

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

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course,

- Students would have knowledge in diffusion and its application in laminar and turbulent conditions.
- Students would apply the mass transfer concepts in the design of humidification columns, dryers and crystallizers.

TEXT BOOKS:

1. Treybal, R.E., “Mass Transfer Operations”, 3rd Edn, McGraw-Hill, 1981.
2. Geankoplis, C.J., “Transport Processes and Unit Operations”, 4th Edition, Prentice Hall Inc., New Jersey, 2003.
3. McCabe, W.L., Smith, J.C., and Harriot, P., “Unit Operations in Chemical Engineering”, 7th Edn., McGraw-Hill, 2005.

REFERENCES:

1. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. I and II, 4th Edition, Asian Books Pvt. Ltd., India, 1998.
2. J.D. Seader and E.J. Henley, “Separation Process Principles”, 2nd Ed., John Wiley, 2006.
3. Binay K. Dutta, ”Principles of Mass Transfer and Separation Processes”, PHI Learning Ltd, 2013.

PE8091 **CHEMICAL REACTION ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVE:

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

UNIT I **9**

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

UNIT II **9**

Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors, Equal sized CSTRs in series and parallel, Equal sized PFRs in series and parallel,size comparison of reactors.

UNIT III **9**

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

UNIT IV **9**

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

UNIT V **9**

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

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course, the students would gain knowledge on the selection of reactor for the required reaction.

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., 3rd Edition, 2000.

REFERENCE:

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

CH8561 **HEAT TRANSFER LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:

- To enable the students to develop a sound working knowledge on different types of heat transfer equipments.

LIST OF EXPERIMENTS

1. Heat Transfer in a Double Pipe Heat Exchanger
2. Heat transfer in Shell and Tube Heat Exchanger
3. Heat Transfer in a Bare and Finned Tube Heat Exchanger
4. Heat transfer in composite wall
5. Heat transfer by Forced / Natural Convection
6. Heat Transfer by Radiation - Determination of Stefan Boltzmann constant
7. Heat Transfer by Radiation - Emissivity measurement
8. Heat transfer in Open Pan Evaporator
9. Heat transfer by Single effect evaporation / Multiple effect evaporation
10. Boiling Heat Transfer
11. Heat Transfer through Packed Bed
12. Heat Transfer in a Horizontal Condenser / Vertical Condenser

13. Heat Transfer in Helical Coils
14. Heat Transfer in Agitated Vessels

TOTAL: 60 PERIODS

Minimum 10 experiments to be offered

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1.	Double Pipe Heat Exchanger	1 No.
2.	Shell and Tube heat exchanger	1 No.
3.	Bare and Finned Tube Heat Exchanger	1 No.
4.	Composite wall set up	1 No.
5.	Natural convection set up or Forced convection set up	1 No.
6.	Stefan Boltzmann Apparatus	1 No.
7.	Emissivity measurement set up	1 No.
8.	Open Pan Evaporator	1 No.
9.	Single effect evaporator or Multiple effect evaporator	1 No.
10.	Boiler	Compulsory equipment
11.	Packed Bed	1 No.
12.	Vertical Condenser or Horizontal Condenser	1 No.
13.	Helical Coil	1 No.
14.	Agitated Vessel	1 No.
15.	Jacketed vessel	1 No.

Any 10 equipment excluding boiler

OUTCOME:

- Student would be able to calculate heat transfer by conduction, different types of convection using classical models for these phenomena.

PM8561 PETROCHEMICAL ANALYSIS LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To learn basic principles involved in analysis of petrochemical products.

LIST OF EXPERIMENTS

1. Sulphur content determination
2. Flue gas Analysis – Orsat Apparatus
3. Aromatic Content determination
4. Determination of Lead, Acid and Salt content
5. Analysis of petrochemicals using UV spectrophotometer
6. Analysis of petrochemicals using NMR with MS
7. Analysis of petrochemicals using Gas chromatography
8. Biodegradation of petrochemicals
9. Bioremediation of petrochemicals
10. Refractive index of petrochemicals
11. Determination of moisture content – KF Titrator
12. Total acidity determination
13. Dynamic viscosity measurement

14. Calorific value of fuels

TOTAL:60 PERIODS

OUTCOMES:

- Carry out experiments as a team to acquire knowledge about physical and chemical characterization of petrochemical products and apply their knowledge in industries.
- Perform the advanced qualitative and quantitative laboratory tasks, including the operation of advanced analytical instrumentation.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1. Bomb calorimeter
2. ORSAT apparatus
3. UV- Visible spectrophotometer.
4. Gas Chromatography
5. Sulphur content determination instrument
6. NMR
7. Dynamic Viscometer
8. KF-Titrator
9. Refractometer
10. Laminar flow chamber
11. COD Incubator
12. BOD Incubator and shaker
13. Bacteriological chamber
14. Atomic absorption Spectrophotometer

HS8581	PROFESSIONAL COMMUNICATION	L T P C
		0 0 2 1

OBJECTIVES:

The couse aims to:

- Enhance the Employability and Career Skills of students
  - Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully

UNIT I

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations

UNIT III

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- activities to improve GD skills

UNIT IV

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews

UNIT V

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

TOTLA: 30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:

- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

Recommended Software

1. Globearena
2. Win English

REFERENCES:

1. Butterfield, Jeff **Soft Skills for Everyone.** Cengage Learning: New Delhi, 2015
2. **Interact** English Lab Manual for Undergraduate Students,. OrientBalckSwan: Hyderabad, 2016.
3. E. Suresh Kumar et al. **Communication for Professional Success.** Orient Blackswan: Hyderabad, 2015
4. Raman, Meenakshi and Sangeeta Sharma. **Professional Communication**. Oxford University Press: Oxford, 2014
5. S. Hariharanetal. **Soft Skills**. MJP Publishers: Chennai, 2010.

PM8651 PETROLEUM SECONDARY PROCESSING TECHNOLOGY L T P C

3 0 0 3

OBJECTIVE:

- Students will learn the refining operations like cracking, reforming, alklylation, isomerization and coking

UNIT I THERMAL CRACKING AND COKING 9

Need and significance, types and functions of Secondary Processing. Cracking, Thermal Cracking and Visbreaking. Different Feed Stocks, Products Yields, Qualities and Recent Development. Hydro Cracking- principles, reactions in Hydro Cracking, Catalyst, Hydro Cracking Reaction Conditions, Iso Max Processes and Hydro Desulphurization Processes. Methods of Petroleum Coke Production – Koppers, Thermal Cracking, Delayed Coking, Fluid Coking and Contact Coking.

UNIT II CATALYTIC CRAKING AND HYDRO CRACKING 9

Catalytic Cracking, Commercial Catalyst, Feedstock and Catalytic Cracking Conditions, Types and Processes- Fixed Bed Cracker, Fluid Catalytic Cracking (FCC), Flexi Cracking.

UNIT III CATALYTIC REFORMING 9

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

UNIT IV ALKYLATION AND ISOMERIZATION 9

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

UNIT V SPECIALTY PRODUCTS 9

Specialty Products: Industrial Grease- Manufacture of Calcium Grease, Liquid Paraffin and Petroleum Jellys. Polymer Gasoline: Feed Stock and Reactions of Polymer Gasoline

TOTAL: 45 PERIODS

OUTCOMES:

- Demonstrate knowledge on various secondary processing technologies available for improving the quality of the petroleum products.
- Understand different flow sheets, catalyst and reactor technologies to perform secondary processes.
- Select appropriate technologies to meet the specified needs of the industries with appropriate consideration for safety, environmental and society
- Understand and application of specialty products obtained from crude oil

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.

CH8651 MASS TRANSFER II L T P C

3 2 0 4

OBJECTIVE:

- To provide introduction to physical and thermodynamic principles of mass transfer with an emphasis on how these principles affect the design of equipment and result in specific requirements for quality and capacity.

UNIT I ABSORPTION 12

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

UNIT II DISTILLATION 18

Vapour liquid equilibria - Raoult’s law, vapor-liquid equilibrium diagrams for ideal and non-ideal systems, enthalpy concentration diagrams. Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification, Number of ideal stages by Mc.Cabe - Thiele method and Ponchan - Savarit method, Total reflux, minimum reflux ratio, optimum reflux ratio. Introduction to multi-component distillation, azeotropic and extractive distillation

UNIT III LIQUID-LIQUID EXTRACTION 15

Liquid - liquid extraction - solvent characteristics-equilibrium stage wise contact calculations for batch and continuous extractors- differential contact equipment-spray, packed and mechanically

agitated contactors and their design calculations-packed bed extraction with reflux. Pulsed extractors, centrifugal extractors-Supercritical extraction

UNIT IV LEACHING 12

Solid-liquid equilibria- leaching equipment for batch and continuous operations- calculation of number of stages - Leaching - Leaching by percolation through stationary solid beds, moving bed leaching, counter current multiple contact (shank's system), equipments for leaching operation, multi stage continuous cross current and counter current leaching, stage calculations, stage efficiency.

UNIT V ADSORPTION AND ION EXCHANGE & MEMBRANE SEPARATION PROCESS 18

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. Principle of Ion exchange, techniques and applications. Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultrafiltration.

TOTAL:75 PERIODS

OUTCOME:

After completion of the curse, students will be able to

- Design absorber and stripper, distillation column.
- Design extraction, leaching equipments and adsorber.

TEXT BOOKS:

1. Wankat, P., "Equilibrium Stage Separations", Prentice Hall, 1993.
2. Treybal, R.E., "Mass Transfer Operations ", 3rd Edn., McGraw-Hill, 1981.
3. Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall Inc., New Jersey, 2003.

REFERENCES:

1. Seader, J.D. and E.J. Henley, "Separation Process Principles", 2nd Ed., John Wiley,2006.
2. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill, 2005.
3. King, C. J., "Separation Processes ", 2nd Edn., Tata McGraw-Hill 1980.

PE8072 CATALYTIC REACTION ENGINEERING L T P C

3 0 0 3

OBJECTIVE:

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

UNIT I CATALYST AND ITS CHARACTERIZATION 9

General definition of catalysts, Solid catalysts, Components of catalyst, Industrial catalysts, Preparation of solid catalysts, Precipitation and co-precipitation methods, Sol gel method, Supported catalysts,Impregnation and ion exchange method, Catalyst drying calcination and formulations, Catalyst Characterization techniques, Structural analysis, Chemisorption technique, Thermal analysis, Spectroscopic techniques, Microscopic technique.

UNIT II KINETICS OF HETEROGENEOUS CATALYTIC REACTIONS 9

Reaction mechanism and rate equations, Power law model, Langmuir-Hinshelwood –Hougen-Watson (LHHW) model, EleyRideal model, Rate controlling Step, Estimation of model

parameters, Reactor types- Fixed bed reactor, Fluidised bed reactor, Berty Reactor, Multiphase Reactors- Slurry Reactor, Trickle bed reactor, Bioreactors, Catalysts tests.

UNIT III TRANSPORT PROCESSES WITH REACTIONS CATALYZED BY SOLIDS 9

Effect of external transport on catalytic reaction rate, Effect of external mass transfer resistance on order of reaction, Effect of external transport on selectivity, Effect of internal mass transport on catalytic reaction rate, Bulk diffusion , Knudsen diffusion, Surface diffusion,Effectiveness factor at isothermal conditions, Significance of intrapellet diffusion, Effect of intrapellet mass transfer on activation energy

UNIT IV CATALYST DEACTIVATION 9

Types of Catalyst Deactivation. Kinetics of Catalyst Poisoning. Kinetics of Catalyst Deactivation by Coke Formation.

UNIT V INDUSTRIAL CATALYTIC PROCESSES 9

Steam reforming, Catalytic cracking, Three Lumped kinetic model for catalytic cracking of gas oil Hydrocracking, Hydrogenation and Dehydrogenation Catalytic Reactions

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course, the students would gain knowledge on the selection of catalyst and multiphase reactor for the heterogeneous reaction.

TEXT BOOKS:

1. Chemical Reactor Analysis and Design, Gilbert F. Froment and Kenneth B. Bischoff, John Wiley & Sons, 2nd Edition, 1990.
2. Elements of Chemical Reaction Engineering, H. Scott Fogler, Prentice Hall International Series, 3rd Edition, 2000.

REFERENCES:

1. Chemical Reaction Engineering, Octave Levenspiel, John Wiley & Sons, 3rd Edition, 1999.
2. Fundamentals of Chemical Reaction Engineering, Mark E. Davis and Robert J.Davis, McGrawHill, 2003.
3. An Introduction to Chemical Engineering Kinetics & Reactor Design, Charles G. Hill, Jr., JohnWiley& Sons, 1977.

GE8076 PROFESSIONAL ETHICS IN ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas –

Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 8

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

TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
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 University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

Web sources:

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

CH8653 PROCESS INSTRUMENTATION, DYNAMICS AND CONTROL L T P C
3 0 0 3

OBJECTIVE:

- To introduce open and closed loop systems and its responses, 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 and its application in process control. First order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag.

UNIT III CLOSED LOOP SYSTEMS 10

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

UNIT IV FREQUENCY RESPONSE 9

Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controllers Z-N tuning rules, C-C tuning rules.

UNIT V ADVANCED CONTROL SCHEMES 8

Feedback control of systems with dead time and inverse response. Control systems with multiple loops. Advanced Control Schemes a) Feed forward b) ratio control. control of distillation towers and heat exchangers,

TOTAL: 45 PERIODS

OUTCOME:

- Students will understand and discuss the importance of process control in process operation and the role of process control engineers They also understand and design the modern hardware and instrumentation needed to implement process control.

TEXT BOOKS:

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

REFERENCES:

1. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp , Process dynamics and control *I* -2nd ed. John Wiley & Sons, Inc.
2. Marlin, T. E., " Process Control ", 2nd Edn, McGraw Hill, New York, 2000.
3. Smith, C. A. and Corripio, A. B., "Principles and Practice of Automatic Process Control", 2nd Edn., John Wiley, New York, 1997.
4. Jason L. Speyer, Walter H. Chung, "Stochastic Processes, Estimation, and Control", PHI Ltd (2013).

CH8781 **MASS TRANSFER LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:

- To train the students to develop sound working knowledge on different types of mass transfer equipments.

LIST OF EXPERIMENTS

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

*Minimum 10 experiments shall be offered.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

1.	Simple distillation setup	1 No.
2.	Steam distillation setup	1 No.
3.	Packed column	1 No.
4.	Liquid-liquid extractor	1 No.
5.	Vacuum Dryer	1 No.
6.	Tray dryer	1 No.
7.	Rotary dryer	1 No.
8.	Ion exchange column	1 No.
9.	Rotating disc contactor	1 No.
10.	Cooling tower	1 No.
11.	Absorption column	1 No.
12.	Surface evaporation set up	1 No.
13.	Adsorption column set up / Adsorption studies using conical flask	1 No.
14.	Leaching column set up / Leaching studies using conical flask	1 No.

Any 10 equipment

OUTCOME:

- Students would be able to determine important data for the design and operation of the process equipments like distillation, extraction, diffusivity and drying principles which are having wide applications in various industries

PE8661 **PETROLEUM TESTING LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:

- To make the student to be conversant with the theoretical principles and experimental procedures for quantitative estimation of petroleum products.

LIST OF EXPERIMENTS

1. Fluid viscosity determination
2. Carbon residue determination
3. Karl-Fisher Conductometer Apparatus for water estimation
4. Fluid density
5. Aniline point
6. Corrosion testing of petroleum oils and copper
7. Freezing point of Aqueous Engine coolant solution
8. Automatic Distillation
9. Fire point- Flash point
10. Gas Colorific value determination
11. liquid or solid Colorific value determination
12. Smoke point determination
13. Cloud and pour point determination
14. Softening point determination
15. Ductility of bitumen
16. Penetration index determination

TOTAL:60 PERIODS

OUTCOMES:

- Perform the various physical and chemical properties of the petroleum products in a safe manner.
- Differentiate various petroleum products by performing the specific tests.
- Perform the advanced qualitative and quantitative laboratory tasks, including the operation of advanced analytical instrumentation.

LIST OF EQUIPMENT

1. Redwood / Saybolt / Engler viscometer
2. Conradson Apparatus
3. Muffle furnace
4. Hydrometer
5. Aniline point apparatus
6. Copper corrosion Apparatus
7. Freezing / Cloud / Pour point apparatus
8. Junkers Gas Calorimeter / Bomb Calorimeter
9. Cleveland / PenskyMartien open and closed cup Flash and fire point Apparatus
10. API Distillation Apparatus
11. Abbey Refractometer
12. Dean and Stark apparatus
13. Karl –Fisher Apparatus
14. Softening point apparatus
15. Ductilometer
16. Penetrometer

PM8751 PROCESS EQUIPMENT DESIGN AND DRAWING L T P C
3 0 2 4

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

OBJECTIVES:

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

UNIT I THERMODYNAMIC PROPERTIES EVALUATION FOR DESIGN 12

Physical properties evaluation, Thermodynamic properties of gases and binary mixtures– Methods of calculations –Vapour-liquid equilibrium data for ideal and non-ideal mixtures. Bubble points and dew points, flash distillation calculation.

UNIT II HEAT EXCHANGER DESIGN 15

Design of double pipe heat exchangers, Heat exchanger types and its selection – shell and tube heat exchangers and Condensers – Effectiveness – NTU method of heat exchanger analysis. Design of cooling towers.

UNIT III EVAPORATOR DESIGN 15

Steam – Uses of steam – Outstanding qualities of steam – BPE – Duhring's rule – Principle of multiple effect evaporation – Temperature driving force – Evaporators types and its selection – Design of single and multiple effect evaporators. Design of batch and continuous Dryers.

UNIT IV COLUMN DESIGN 18

Design of distillation columns, Absorption columns, Extraction column, and Adsorption columns.

UNIT V PUMPS, FANS AND COMPRESSORS 15

Pumps, fans and compressors – Types and its applications – Selection criteria - Characteristics – NPSHR and NPSHA – Power rating calculations based on process duty - Performance analysis of pumps, fans and compressors - Pump Cavitation. Surge problem in compressors.

TOTAL:75 PERIODS

OUTCOMES:

- Apply the skill in thermal design of heat transfer equipment like shell and tube, Double pipe heat Exchangers and evaporators, and assessing thermal efficiency of the above equipment in practice.
- Demonstrate the skills in basic design and drawing of different dryers, cooling towers and adsorption columns.
- Apply the concepts involved in phase separation and design of distillation, Extraction and absorption columns.

TEXT BOOKS:

1. Ernest E. Ludwig., "Applied Process Design for Chemical and Petrochemical Plants", Vol.I, II and III, Gulf Professional Publishing, 2002.
2. Dawande, S. D., "Process Design of Equiments", 4th Edition, Central Techno Publications, Nagpure, 2005.

REFERENCES:

1. Coulson, M. and Richardson, J.F., "Chemical Engineering", Vol.6, 3rd Edition, Pergamon Press, 1987.

2. Robert H. Perry and Don W. Green, “Perry’s Chemical Engineer’s Hand Book”, 7th Edition, McGraw Hill – International, 1997. 3. Van Winkle, “Distillation Operations”, McGraw Hill Publications, 1987.
3. D. Q. Kern, “Process Heat Transfer", Tata McGraw Hill Publishing Co., New Delhi, 1990.
4. Baranan, C.R., “Rules of Thumb for Chemical Engineers”, Gulf Publishing Co,Texas, 1996.

GE8291 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

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

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 – solid 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 environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS:

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

REFERENCES:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.

PM8761 REACTION ENGINEERING AND PROCESS CONTROL LABORATORY **L T P C 0 0 4 2**

REACTION ENGINEERING:

OBJECTIVE:

- 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 5 experiments shall be offered.

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.

PROCESS CONTROL:

OBJECTIVE:

- Students will gain the hands on training about the control systems

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 5 experiments shall be offered.

TOTAL: 60 PERIODS

OUTCOMES:

- 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

PM8711 INTERNSHIP L T P C
0 0 0 2

Students shall undergo training in R&D institutions / Academics / Industries for a minimum period of 15 days. At the end of internship students must submit a report for internal evaluation.

PM8801 PIPELINE AND WELDING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on piping engineering and welding technology

UNIT I FUNDAMENTALS OF PIPING ENGINEERING 9

Definitions, Piping Components their introduction, applications. Piping MOC, Budget Codes and Standards, Fabrication and Installations of piping. Pipe sizing based on velocity and pressure drop consideration cost, least annual cost approach,

UNIT II PLOT PLAN 9

Development of plot plan for different types of fluid storage, equipment layout, process piping layout, utility piping layout. Stress analysis -Different types of stresses and its impact on piping, methods of calculation, dynamic analysis, flexibility analysis.Different types of support based on requirement and its calculation.

UNIT I II GAS, ARC AND RESISTANCE WELDING PROCESSES: 9

Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electroslag welding processes - advantages, limitations and applications.,Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications.

UNIT IV SOLID STATE WELDING AND OTHER WELDING PROCESSES: 9

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forgewelding, Roll welding and Hot pressure welding processes - advantages, limitations and applications. Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stirwelding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

UNIT V DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS 9

Various weld joint designs – Weldability of Aluminium, Copper, and Stainless steels. Destructive andnon destructive testing of weldments.

TOTAL:45 PERIODS

OUTCOMES:

- Students gain knowledge on fundamentals of piping engineering, pipe hydraulics, piping supports . Upon completion of this course, the students can able to compare different types of Welding process for effective Welding of Structural components.

TEXT BOOKS

1. Piping Handbook, 6 th edition, M.L. Nayyar, P.E., Mc Graw-Hill, Inc
2. Piping Design Handbook edited by Johan J McKetta, CRC Press, 1992.
3. Luyben, W. L.," Process Modeling Simulation and Control for Chemical Engineers, McGraw Hill, 1990.
4. 4.Parmer R.S., “Welding Engineering and Technology”, 1st edition, Khanna Publishers, New
5. Delhi, 2008.
6. Parmer R.S., “Welding Processes and Technology”, Khanna Publishers, New Delhi, 1992.

PM8811 PROJECT WORK L T P C

0 0 20 10

OBJECTIVE:

- The objective of the project is to make use of the knowledge gained by the student at various stages of the degree course.

Each student is required to submit a report on the project assigned to him by the department. The report should be based on the information available in the literature or data obtained in the laboratory/industry.

Students, in addition to the home problem will be permitted to undertake industrial/ consultancy project work, outside the department, in industries/Research labs for which proportional weightage will be given in the final assessment.

PM8812 SEMINAR L T P C

0 0 4 2

The Objective of the comprehension test is to assess the overall level of proficiency and the scholastic attainment of the student in the various subjects studied during the degree course.

PM8078 PETROCHEMICAL UNIT PROCESSES L T P C
3 0 0 3

OBJECTIVE:

- To design and conduct experiments and analyze and interpret data related to petrochemical Unit processes

UNIT I FEED STOCK AND SOURCE OF PETROCHEMICALS 9

Overview of Petrochemical Industry – The key growth area of India, Economics – Feed stock selections for Petrochemicals – Steam cracking of Gas and Naphtha to produce Olefins, Diolefins and Production of Acetylene.

UNIT II SYNTHESIS GAS PRODUCTION 9

Steam reforming of Natural gas – Naphtha and Heavy distillate to produce Hydrogen and Synthesis gas – Production of Methanol – Oxo process.

UNIT III PRIMARY UNIT PROCESSES 9

Fundamental and Technological principled involved in Alkylation – Oxidation – Nitration and Hydrolysis.

UNIT IV SECONDARY UNIT PROCESSES 9

Fundamental and Technological principled involved in Sulphonation, Sulfation and Isomerisation.

UNIT V TERTIARY UNIT PROCESSES 9

Fundamental and Technological principles involved in Halogenation and Esterification

TOTAL: 45 PERIODS

OUTCOME:

- Students would be able to understand the principles of various unit processes in the petrochemical industry.

TEXT BOOKS:

1. Bhaskara Rao, B.K., “A Text on Petrochemicals”, Khanna Publishers, 2000.
2. Sukumar Maiti, “Introduction to Petrochemicals”, 2nd Edition, Oxford and IBH Publishers, 2002.

REFERENCES:

1. Margaret Wells, “Handbook of Petrochemicals and Processes”, 2nd Edition, Ash Gate Publishing Limited, 2002.
2. Sami Matar, and Lewis F. Hatch., “Chemistry of Petrochemical Processes”, 2nd Edition, Gulf Publishing Company, 2000.
3. Dryden, C.E., “Outlines of Chemical Technology”, 2nd Edition, Affiliated East-West Press, 1993.

PM8075 INSTRUMENTATION AND INSTRUMENTAL ANALYSIS L T P C
3 0 0 3

OBJECTIVE:

- To understand the working principles of different instruments, and its applications.

UNIT I INTRODUCTION TO INSTRUMENTS, CHARACTERISTICS AND SIGNAL CONDITIONING 9

Introduction to Instruments and Their representation: Introduction, Elements, Classification, Standards, Calibration procedures Static and Dynamic Characteristics of Instruments,

Specification of static characteristics, Selection of instruments, Forcing functions, Formulation of First order and second order system equations, Dynamic response Principals of Analog signal conditioning, converters, guidelines for analog signal conditioning design , Principles of digital signal conditioning, computer interface, DACs, ADCs, DAS hardware, DAS software, characteristics of digital data

UNIT II TEMPERATURE, PRESSURE, LEVEL MEASUREMENTS 9

Temperature measurement: Temperature scales, Non electrical methods, Electrical methods, Radiation methods

Pressure measurement: Moderate pressure measurement, High pressure measurement, vacuum measurement

Level measurement: measurement techniques for Liquids and slurries, advance measurement techniques

UNIT III FLOW MEASUREMENTS AND STUDY OF VALVES 9

Flow measurement: Introduction, Review of Venturimeter, orifice meters, rotameters, Pitot tube, working of turbine, vortex shedding, electromagnetic flow meters

Introduction to Advanced flow measurement techniques: Hot Wire anemometer, Laser Doppler anemometer, Ultrasound, Particle image Velocimetry

Study of Valves: Types of Valves, Actuators, Positioners, Valve characteristics, Controllability and Rangeability, Cavitation, Flashing, choking, Valve Sizing for incompressible fluids, compressible fluids, Two phase flows

UNIT IV INTRODUCTION TO QUALITY CONTROL AND ANALYTICAL TECHNIQUES 9

Need for Chemical analysis in Petroleum industry. Crude Assay. Standard Test Methods. Introduction to principles of Analytical techniques: Spectroscopic Techniques, Chromatographic techniques, Crystallography, electrochemical analysis, thermal analysis, electrophoresis, calorimetery, Hybrid techniques

Miscellaneous measurements and analysis: density, viscosity, Refractormeter, pH and redoxpotential measurements. Thermal conductivity gas analyzers. Oxygen determination. Orsat analysis

UNIT V WORKING AND INTERPRETATION OF INSTRUMENTAL ANALYTICAL METHODS: I 9

Spectroscopic techniques: Atomic Absorption, X-ray, inductively coupled argon plasma(ICAP), ultraviolet – visible (UV-VIS), fluorescence, infrared (IR), Raman spectroscopy, mass spectrometry (MS),nuclear magnetic resonance (NMR)

Chromatographic Techniques: gas chromatography (GC), high pressure liquid chromatography, gel permeation chromatography (GPC) , thin layer chromatography (TLC), super critical fluid chromatography (SFC)

Classification of spectroscopic and chromatographic techniques for Analysis of fuels

Working and Interpretation of Instrumental analytical methods: II

Lubricant Analysis: constituents of lubricants, characterization of lubricants by analytical techniques, importance of elemental analysis in lubricants

TOTAL: 45 PERIODS

OUTCOME:

- Students gain an knowledge about the Qualitative and quantitative instrument analysis of different materials.

TEXT BOOKS:

1. Eckman, D. P.; Industrial Instrumentation; Wiley Eastern, 1991.
2. Johnson, C.; Process Control Instrumentation Technology; 4th ed., Prentice-Hall International.
3. Liptak, B. G., Venczel, K.; Instrument Engineer's Handbook, Process Measurement; Hilton Book Company

REFERENCES:

1. Nakra, B. C.; Chaudhary K. K.; Instrumentation Measurement and Analysis; Tata McGraw Hill, New Delhi, 1998.
2. Patranabis, D.; Principles of Industrial Instrumentation; Tata McGraw Hill, New Delhi, 1996.
3. Silverstein, Bassler, Morrill; Spectrometric Identification of Organic Compounds; John Wiley Publication, 1991.
4. Gary J.H. and Handework G.E., "Petroleum Refining Technology and Economics", Marcel Dekker, Inc., 1984. Instrumental Methods of Analysis. D.A. Skoog, F. James Holler, Stanky, R.Crouch . Cengage Learning – 2007.
5. Sharma, B.K. "Instrumental Methods of Chemical Analysis: Analytical Chemistry" Goel Publishing House, 1972.

CH8094 POLYMER TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to compute molecular weight averages from the molecular weight distribution, Condensation polymerization and transition in polymers.

UNIT I INTRODUCTION 6

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

UNIT II ADDITION POLYMERIZATION 12

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

UNIT III CONDENSATION POLYMERIZATION 9

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

UNIT IV MOLECULAR WEIGHTS OF POLYMERS 9

Difference in molecular weights between simple molecules and polymers – number average and weight average molecular weights – Degree of polymerization and molecular weight – molecular weight distribution – Polydispersity – molecular weight determination. Different methods – Gel

Permeation Chromatography – Osmometry, Light Scattering.

UNIT V TRANSITIONS IN POLYMERS 9

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

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course, the student would be able to demonstrate knowledge and understanding on the principles related to the synthesis and characterization of polymers.

TEXT BOOKS:

1. Billmeyer.F.W.,Jr, Text Book of Polymer Science, Ed. Wiley-Interscience, 1984.
2. Seymour. R.B., and Carraher.C.E., Jr., Polymer Chemistry, 2nd Ed., Marcel Dekker, 1988.
3. Gowariker.V.T., Viswanathan.N.V., and Sreedar.J., Polymer Science, Wiley Eastern Ltd., 1988.

REFERENCES:

1. Joel,R.F; Polymer Science and Technology, Eastern Economy Edition, 1999.
2. Rodriguez, F., Cohen.C., Oberic.K and Arches, L.A., Principles of Polymer Systems, 5th edition, Taylor an

PM8076 NON - CONVENTIONAL HYDROCARBON SOURCES L T P C
3 0 0 3

OBJECTIVES:

- To understand the geographic distribution of unconventional hydrocarbon resources
- To understand characterization of source and reservoir rocks
- To understand methodology to produce these reserves
- To understand environmental consequences of producing these reserves
- Demonstrate awareness related to environmental issues involved in the development
- of non-conventional hydrocarbon resources.

UNIT I NON-CONVENTIONAL OIL 9

Continuous Accumulation System

Introduction, geology of Heavy oil, extra heavy oil, Tar Sand and bituminous, oil shales, their origin and occurrence worldwide, resources, reservoir characteristics, new production technologies.

UNIT II SHALE GAS/ OIL RESERVOIR 9

Introduction to shale gas & basin centered gas, tight reservoirs. Shale gas geology, important occurrences in India, petrophysical properties, Development of shale gas, design of hydro fracturing job, horizontal wells, production profiles.

UNIT III COAL BED METHANE 9

Formation and properties of coal bed methane. Thermodynamics of coal bed methane. Exploration and Evaluation of CBM. Hydro-fracturing of coal seam. Production installation and surface facilities. Well operations and production equipment.

UNIT IV GAS HYDRATES 9

Introduction & present status of gas hydrates. Formation and properties of gas hydrates, Thermodynamics of gas hydrates. Recovery methods. Prevention& control of gas hydrates, Gas hydrates accumulation in porous medium. Gasextraction from gas hydrates.

UNIT V COAL AND GAS CONVERSION TO OIL 9

Introduction, classification and principles, pyrolysis, theoretical aspect of processes involved inconversion. Technological development of direct conversion and indirect processes and sustainability of conversions.

TOTAL:45 PERIODS

OUTCOMES:

At the end of the course, the student will be able to

- Recognise and apply the concept of continuous accumulation system.
- Apply the concepts related to exploration and development of Shale Gas Reservoirs.
- Apply the concepts related to exploration and development of Coal Bed Methane.
- Understand and apply the concepts related to formation of gas hydrates.
- Understand and apply different conversion processes for the production of Hydrocarbons.

REFERENCES:

1. Carrol John, 2003, Natural Gas Hydrates: A guide for engineers, Gulf Publications.
2. Farooqi Ali, S M, Jones S A and Meldau R F, Practical Heavy Oil Recovery, SPE, 1997.
3. James T. Bartis, Frank Camm, David S. Ortiz, Producing Liquid Fuels from Coal, Prospects and Policy Issues. NETL, DOE, USA, 2008.
4. Warner, H.R., 2009, Emerging and Peripheral Technologies, Society of Petroleum Engineers, Handbook, Volume VI.
5. Pramod Thakur, Steve Schatzel and KashyAminian, (Editors), 2014, Coal Bed Methane: From Prospects to Pipeline, Elsevier,
6. Rafiqul Islam, M, 2014, Unconventional Gas Reservoirs: Evaluation, Appraisal, and Development, Gulf Professional Publishing.

GE8071 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.

TEXT BOOKS:

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.

PM8073 DESIGN OF PRESSURE VESSELS AND PIPING L T P C
3 0 0 3

OBJECTIVES:

- The main objective is to present the industrial related problems, procedures and design.
- Principles for pressure vessels and enhance the understanding of design procedure of pressure vessel and Design of piping layout.

UNIT I DESIGN OF PIPE FITTINGS AND JOINTS 9

Stress-strain relationships of elastic materials subjected to tensile, compressive and shear forces; Membrane stresses in shells of revolutions; Theories of failures. Design and schematic of simple bolts and screws. Design and drawing of shafts and couplings.

UNIT II DESIGN OF PRESSURE VESSELS 9

Unfired pressure vessel: Pressure vessel codes; Design of cylindrical and spherical shells under internal and external pressures; Selection and design of flat plate, tori spherical, ellipsoidal, and conical closures; Shell design of tall vertical vessels; Compensations of openings. Vessel supports: Design of skirt, lug, and saddle supports.

UNIT III DESIGN OF STORAGE TANK 9

Liquid storage tanks: Storage tank codes; Classification; Design of shell, bottom plates, self-supported, and column supported roofs; Wind girder; Nozzles and other accessories.

UNIT IV FABRICATION AND MATERIALS 9

Fabrication of equipment: Major fabrication steps; Vessel lining; Materials used in fabrication of Chemical Equipments. Selection of process equipment's.

UNIT V DESIGN OF PIPING NETWORK 9

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

TOTAL: 45 PERIODS

OUTCOME:

- Students would develop skill to design and install process equipment's used widely in achemical industry.

TEXT BOOKS:

1. R.S. Khurmi, "Textbook of Machine design". S. Chand & Company , XXV Edition, 2005.
2. M.V. Joshi and V.V. Mahajan, "Design of Process Equipment Design", McMillan India III Edition 1994.
3. Bhattacharyya, B.C., "Introduction to chemical Equipment Design: Mechanical aspects", CBS Publishers & Distributors, New Delhi.

REFERENCES:

1. S.D. Dawande, "Process Design of Equipments", Central Techno Publications, Nagpur, 2000.
2. Indian Standard Specifications IS-803, 1962; IS-4072, 1967; IS-2825, 1969. Indian Standards Institution, New Delhi.
3. R.H. Perry, "Chemical Engineers' Handbook", McGraw-Hill.
4. Ludwig, E.E., Applied Process Design for Chemical and Petrochemical Plants", Volume I, II, and III, Gulf Publishing Co.
5. J.M. Coulson and J.Richardson, "Chemical Engineering", Vol. 6, Asian Books Printers Ltd.

PM8074 **DRILLING AND WELL ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVE:

- Students would expertise in the key areas of a good design, drilling and operation management.

UNIT I DRILLING GEOLOGY, OIL AND GAS MIGRATION 9

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

UNIT II PLANNING AND DRILLING OF WELL 9

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

UNIT III DRILL BITS AND DRILLING FLUIDS 9

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

UNIT IV DIRECTIONAL DRILLING, CASING, CEMENTING AND EVALUATION 9

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

UNIT V MANAGING DRILLING OPERATIONS, SAFETY AND ENVIRONMENTAL ISSUES 9

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

TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of this course, the students would be involved from good design to testing completion and abandonment.

REFERENCES:

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

PM8080 **PRODUCTION ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVE:

- To provide knowledge of production operations in the oil and gas wells such as artificial lifts and subsurface equipments.

UNIT I **9**

Components of the petroleum systems. Well productivity engineering. Production from under saturated oil reservoirs. Production from two-phase reservoirs. Production from gas reservoirs. Pseudo critical properties of natural gases. Gas well deliverability for non – Darcy flow.

UNIT II **9**

The near-well bore condition and damage characterization, the effect of perforation conditions on well performance. Well bore flow performance. Well deliverability. Well head surface gathering systems. Artifical lift systems. Horizontal well production. System analysis. Production Chemistry Basics (Wax, Scale, Corrosion, Emulsions).

UNIT III **9**

Surface equipment and operations. Flow control and well heads. Gathering systems; service and cleaning systems; design and testing of flow lines. Separation and separators; separator components, stage separation; design and construction of separators. Meeting – Oil and gas metering techniques.

UNIT IV **9**

Flow measurement system; liquid level controllers. Emulsion problems; oil emulsions; emulsifying agents and de-emulsifiers, choice and dosage of de-emulsifiers, heat treatment, heat treaters, desalting, oil storage and tank farms. Gauging, sampling and quality control. Underground storage – caverns etc. Water disposal, corrosion. Water injection systems. Subsurface equipment.

UNIT V **9**

Well completion techniques and equipment, drill stem test (DST) flowing well performance, vertical lift performance, optimum size tubing and chokes, production forecast for a pool. Design and analysis of artificial methods of petroleum production. Work over and sand exclusion technique.

TOTAL: 45 PERIODS

OUTCOME:

- Student will be able to understand the basics of oil and gas production engineering techniques.

TEXT BOOKS:

1. “Gas Production Engineering” – S.Kumar-Gulf publishing Co., – 1987.
2. T.E.W.Nind ”Principles of well Produciton”- 2nd Edition. Mc.Graw hill Book-Co. Ltd, Newyork 1981. ISBN 0070465762.

REFERENCE:

1. T.O.allen and A.P.Roberts. “Production operations” –SPE – Vol-I 4th edition

PE8071 ADVANCED SEPARATION TECHNIQUES **L T P C**
3 0 0 3

OBJECTIVE:

- To learn the principle and technical concept of advanced separation processes.

UNIT I BASICS OF SEPARATION PROCESS **9**

Review of Conventional Processes, Recent advances in Separation Techniques based on size, surface properties, ionic properties and other special characteristics of substances, Process concept, Theory and Equipment used in cross flow Filtration, cross flow Electro Filtration, Surface based solid – liquid separations involving a second liquid.

UNIT II MEMBRANE SEPARATIONS 9

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

UNIT III SEPARATION BY ADSORPTION 9

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

UNIT IV INORGANIC SEPARATIONS 9

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

UNITV OTHER TECHNIQUES 9

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

TOTAL: 45 PERIODS

OUTCOME:

1. Fully understand key concepts of separation processes including equilibrium stages, reflux, countercurrent contacting, limiting cases, efficiency and mass transport effects.

TEXT BOOKS:

1. Schoen, H.M., “New Chemical Engineering Separation Techniques”, Interscience Publishers,1972.
2. Treybal, R.E., “Mass Transfer Operations”, 3rd Edition, McGraw Hill Book Co., 1980.

REFERENCES:

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

GE8075 INTELLECTUAL PROPERTY RIGHTS L T P C

3 0 0 3

OBJECTIVE:

- To give an idea about IPR, registration and its enforcement.

UNIT I INTRODUCTION 9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs 10

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III AGREEMENTS AND LEGISLATIONS 10

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW 9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs 7

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL:45 PERIODS

OUTCOME:

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

TEXT BOOKS:

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, “Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002.

REFERENCES:

1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,”Intellectual Property Rights: Unleashing the Knowledge Economy”, McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

CH8791 TRANSPORT PHENOMENA L T P C
3 0 0 3

OBJECTIVE:

- To develop a fundamental knowledge of the physical principles that govern the transport of momentum, energy and mass, with emphasis on the mathematical formulation of the conservation principles.

UNIT I TRANSPORT PHENOMENA BY MOLECULAR MOTION 9

Vectors/Tensors, Newton’s law of viscosity, Newtonian & Non-Newtonian fluids, rheological models, Temperature, pressure and composition dependence of viscosity,Kinetic theory of viscosity, Fourier’s law of heat conduction, Temperature, pressure and compositiondependence of thermal conductivity, Kinetic theory of thermal conductivity, Fick’s law of diffusion,Temperature, pressure and composition dependence of diffusivity, Kinetic theory of diffusivity.

UNITII ONE DIMENSIONAL MOMENTUM TRANSPORT 9

Shell Momentum balances, boundary conditions, velocity profiles, average velocity, momentum flux at the surfaces,of Newtonian and non-Newtonian for flow of a falling film, flow through circular tube, slits, flow through an Annulus,Adjacent flow of two Immiscible fluids.EquationsofChange (Isothermal), equation of continuity, equation of motion, equation of energy (isothermal) their applications in fluid flow problems.

UNIT III ONE DIMENSIONAL HEAT TRANSPORT 9

Shell energy balances, boundary conditions, temperature profiles, average temperature, energy fluxes at surfaces for different types of heat sources such as electrical, nuclear viscous and chemical, Equations ofchange (non-isothermal), equation of motion for forced and free convection, equationof energy (non-isothermal).

UNIT IV ONE DIMENSIONAL MASS TRANSPORT 9

Shell mass balances, boundary conditions, concentration profiles, average concentration, mass flux at surfaces for Diffusion through stagnant gas film, Diffusion with homogeneous and heterogeneouschemical reaction, Diffusion in to a falling liquid film, Diffusion and chemical reaction in porous catalystand the effectiveness factor,equation of continuity for binary mixtures, equation of change to set updiffusion problems for simultaneous heat and mass transfer.

UNITV TRANSPORT IN TURBULENT AND BOUNDARY LAYER FLOW 9

Turbulence phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent flow in pipes; boundary layer theory; laminar and turbulent hydrodynamics thermal and concentration boundary layer and their thicknesses; analysis of flow over flat surface. Introduction to macroscopic balances for isothermal flow systems, non-isothermal systems and multicomponent systems.

TOTAL: 45 PERIODS

OUTCOME:

- Students would gain the knowledge of fundamental connections between the conservation laws in heat, mass, and momentum in terms of vector and tensor fluxes. The students would be able to understand the mechanism of fluids in motion under different conditions.

TEXT BOOKS:

1. R. B. Bird, W.E. Stewart, E.W. Lightfoot, Transport Phenomena, 2nd RevisedEdition, John Wiley, 2007
2. Robert, S Brodkey, Harry C. Hershey, “Transport Phenomena A Unified Approach”, Brodkey Publishing 2003.

REFERENCES:

1. C. J. Geankoplis, Transport Processes and Separation Process Principles, Prentice- Hall Inc., 4th Edition 2003.
2. C. O. Bennett, J. O. Myers, Momentum, Heat and Mass Transfer, 2nd International Student Edition Mc-Graw Hill, 1983.
3. R. Welty, R.W. Wilson, and C.W.Wicks, Rorer G.E, Wilson R.W. “Fundamentals of Momentum Heat and Mass Transfer”, 5th Edition, John Wiley, New York, 2007.

PM8082 WATER TREATMENT AND MANAGEMENT L T P C

3 0 0 3

OBJECTIVE:

- To focus on the wastewater transport system and the theory and design technique for the wastewater treatment process

UNIT I INTERNAL TREATMENT PROCESS 9

Character and properties – Water problem and solution – Water Sedimentation - Coagulation – Filtration – Disinfection – Theory, necessity, process, equipment, application, location, limitation.

UNIT II EXTERNAL TREATMENT PROCESS 9

Softening by Ion – exchange process, Demineralization – Cation exchange materials – Removal of ion, Manganese, odour, colour taste – Deaeration – Oxidation – Fluoridation– Dealkalisation – Desalination by Reverse osmosis.

UNIT III BOILER WATER AND COOLING WATER 9

Concept – Importance – Location – Commonly used desalination process – Distillation – Electrodialysis – Reverse osmosis – Freezing – Solar distillation- Purpose – Problem associated with water quality and equipment – Steam system fundamentals – Hot water closed system – Measurement and control of pH, corrosion, fouling – Microbial analysis – Ozone control – Study of microorganism – Energy efficient operations and maintenance.

UNIT IV WASTE WATER TREATMENT 9

Waste water in Industry- Home and Agriculture – Various waste water treatment processes – Optimization – Benefits and costs – Microbial and sanitation water treatment – Biofilm formation and removal – Microbial trend analysis – Pretreatment system and equipment.

UNIT V WATER MANAGEMENT IN INDIA 9

Water resources and planning – Water policy – Indian scene – Main aspects of water management – Hydrological cycle – Hydrosphere – Water transport – Water exchange – Causes and problems in irrigation, rural water, urban water – Water conservation resource management – Rain Harvesting.

TOTAL: 45 PERIODS

OUTCOME:

- The students would have learnt the physical/chemical/biological characteristics and evaluation technique for sewage. They would understand the theory, engineering application, and design technique for the wastewater treatment unit process.

TEXT BOOKS:

1. P.C.Bansil "Water Management in India", Concept Publishing company, New Delhi, First Edition, 2004.
2. G.S.Bridie and J.S.Bridie "Water Supply and Sanitary Engineering", Dhanpat Raj Publishing company (P) Ltd., New Delhi, 7th Edition, 2003.

REFERENCES:

1. Austin G.T., "Shreve's Chemical Process Industries", Fifth Edition, McGraw Hill, 1998.
2. S.C. Rangwala, "Water supply and Sanitary Engineering", Eighteenth Edition, Charotar Publishing House, 2003.
3. Pandey G.N., "Text Book of Chemical Technology", Vikas Publishing House Pvt. Ltd., New Delhi, 1992

CH8072 FLUIDIZATION ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to learn the design aspects of fluidized beds.

UNIT BASICS OF FLUIDIZATION 9

Packed bed – Velocity – Pressure drop relations – Correlations of Ergun, Kozneykarman – On set of fluidization – Properties of fluidized beds – Development of fluidization from fixed bed.

UNIT II FLUIDIZED BED TYPES 9

Minimum fluidization conditions – Expanded bed – Elutriation – Moving solids and dilute phase – spouted bed.

UNIT III DESIGN ASPECTS 9

Channeling – Bed expansion in liquid – Solid and gas – Solid fluidizations. Design aspects of fluidized bed systems.

UNIT IV HEAT AND MASS TRANSFER IN FLUIDIZED BEDS 9

Heat and mass transfer in fluidized bed systems – Industrial applications and case studies of fluidized bed systems.

UNIT V OTHER TYPES OF FLUIDIZATION 9

Single stage and multistage fluidization – Collection of fines – Use of cyclones.

TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of this course, the students will have the knowledge on fluidization phenomenon, behavior of fluidized beds and industrial applications.

TEXT BOOKS:

1. Levenspiel, "Fluidization Engineering", 2nd Edition, Butterworth – Heinmann, 1991.
2. Robert H. Perry and Don W. Green, "Perry's Chemical Engineer's Hand Book", 7th Edition, Mc Graw Hill – International, 1997.

REFERENCES:

1. Rowe and Davidson, "Fluidization", Academic Press ,1971.
2. Leva, M., "Fluidization", McGraw Hill Book Co, 1959.
3. Wen-Ching Yang., "Handbook of Fluidization and Fluid-Particle Systems", Marcel Dekker Inc, 2003.

PM8071 CHEMICAL PROCESS DESIGN L T P C

3 0 0 3

OBJECTIVE:

- This course would expose the students how to develop process alternatives, how to generate them and how to quickly screen the alternatives.

UNIT I INTRODUCTION 9

The Hierarchy of Chemical process Design- Overall process Design, approaches to design.

UNIT II CHOICE OF REACTORS AND SEPARATOR 9

Reaction path, reactor performance, practical reactors, Separation of Heterogeneous mixtures, homogeneous fluid mixtures.

UNIT III SYNTHESIS OF REACTION – SEPARATION SYSTEMS 9

Process recycle, Batch processes, process yield

UNIT IV DISTILLATION SEQUENCING 9

Using simple columns, using columns with more than two products, Distillation Sequencing Using thermal coupling.

UNIT V HEAT EXCHANGER NETWORK & UTILITIES –ENERGY TARGETS 9

Heat recovery pinch, The Problem table Algorithm, Utilities Selection, Energy targets capital& total Cost targets -Number of Heat Exchanger Units, Area Targets, Number of Shells Targets, Capital Cost Targets, Total Cost Targets.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course, the students will have learned how to solve large, open-ended under defined design problems of realistic complexity.

REFERENCES:

1. Smith, R., “Chemical Process Design”, McGraw Hill, New York, 1995.
2. Douglas, J.M., “Conceptual Design of Chemical Process”, McGraw Hill, New York,1988.

PE8073 ENHANCED OIL RECOVERY L T P C

3 0 0 3

OBJECTIVE:

- To impart knowledge on how residual oil is recovered and the problems associated with Enhanced Oil Recovery.

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, CO_2, 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 Paraffin’s, Scaling problems, Formation of damage due to migration of fines, Environmental factors.

TOTAL: 45 PERIODS

OUTCOME:

- Students would gain knowledge on residual oil recovery, operations and problems of Enhanced Oil Recovery.

REFERENCE:

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

GE8074 **HUMAN RIGHTS** **L T P C**
3 0 0 3

OBJECTIVE:

- 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.

CH8077 **PROCESS MODELING AND SIMULATION** **L T P C**
3 0 0 3

OBJECTIVE:

- To give an overview of various methods of process modeling, different computational techniques for simulation.

UNIT I INTRODUCTION **7**

Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT II STEADY STATE LUMPED SYSTEMS **9**

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

UNIT III UNSTEADY STATE LUMPED SYSTEMS 9

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

UNIT IV STEADY STATE DISTRIBUTED SYSTEM 7

Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT V UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES 13

Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor, hierarchy in model development, classification and solution of partial differential equations. Empirical modeling, parameter estimation, population balance and stochastic modeling.

TOTAL: 45 PERIODS

OUTCOME:

- Upon completing the course, the student should have understood the development of process models based on conservation principles and process data and computational techniques to solve the process models.

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 Modeling in Chemical Engineering", John Wiley, 1967.
3. Amiya K. Jana, "Process Simulation and Control Using ASPEN", 2nd Edn, PHI Learning Ltd (2012).
4. Amiya K. Jana, "Chemical Process Modeling and Computer Simulation" 2nd Edn, PHI Learning Ltd,(2012).

PM8079 PETROLEUM PROCESS EQUIPMENT AUXILIARIES L T P C

3 0 0 3

OBJECTIVE:

- To give an overview of various equipment auxiliaries involved in the petroleum processes.

UNIT I ELECTRICAL MOTORS AND STARTERS 9

Electrical motors – Induction –Synchronous – Electrical Starters.

UNIT II ROTARY EQUIPMENT 9

Pumps –Turbines – Blowers – Compressors – Fans – Concept – Working and application.

UNIT III INDUSTRIAL VALVES 9

Needle valves – Globe, gate and ball valves – Butterfly valves – Check and needle valves – Piping system.

UNIT IV INDUSTRIAL DRYERS 9

Rotary fluid bed – Spray and freeze dryers – Electro osmotic dryers – Rotary dryer – Case Studies.

UNIT V PROCESS UTILITY EQUIPMENTS 9

Vacuum devices – Filters – Cooling towers – Refrigeration systems – Flare system –Equipments for waste water treatment systems.

TOTAL: 45 PERIODS

OUTCOME:

- Student gain knowledge on the utility equipment's and other auxiliaries and its applications.

TEXT BOOKS:

1. Walas, S.M., "Chemical Process Equipment", Butterworth – Heinemann Oxford Publishing Ltd., 1999.
2. Thomas, C.E., "Process Technology – Equipment and systems", Uhai Publishing, Inc., 2002.

REFERENCES:

1. Ludwig, E.E., "Applied Process Design for Chemical and Petrochemical Plants", Vol.I and III, Gulf Professional Publishing, 2002.
2. Perry, R.H. and Green, D.W., "Perry's Chemical Engineer's Hand Book", 7th Edition, McGraw Hill – International, 1997.
3. Sahu, G.K., "Hand Book of Piping Design", New Age International Publishers, 2005

PE8074 MULTICOMPONENT DISTILLATION L T P C

3 0 0 3

OBJECTIVE:

- To understand the concepts of Multicomponent distillation systems.

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 R_m 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

OUTCOME:

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

TEXT BOOKS:

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

REFERENCES:

1. King, C.J., "Separation Process Principles", Mc Graw Publications, 1986.
2. Treybal, R.E., "Mass Ttransfer Operations", 5th Edition, Mc Graw Hill publications. 1996.
3. Mc Cabe and Smith, J.C., Harriot, "Unit Operation of Chemical Engineering", 6th Edition, McGraw Hill, 2001.

PE8075 PETROLEUM CORROSION TECHNOLOGY L T P C

3 0 0 3

OBJECTIVE:

- To understand the types of corrosion found in the petroleum industries. This course will provide the student with knowledge of the analytical methods needed to diagnose, treat, and monitor corrosion to reduce costs, protect the environment, and increase safety.

UNIT I 9

Introduction to corrosion control. Definitions - Materials involved - Basic corrosion principles - corrosion rate. Electrochemical reactions. Electrode potentials – passivity – temperature – pressure – velocity – conductivity - pH - dissolved gases. Corrosion in oil and gas production.

UNIT II 9

Forms of corrosion – uniform corrosion – Pitting - Galvanic corrosion - Intergranular and weld corrosion - Selective Leaching - Stress corrosion. Impingement - Hydrogen embrittlement – Corrosion fatigue.

UNIT III 9

Role of oxygen in oil filed corrosion- down hole and surface equipment - water flood. Removal of oxygen, analysis and criteria for control. Role of carbon dioxide (CO_2) in corrosion-Effect of temperature and pressure - Corrosion of well tubing and other equipments. Role of hydrogen sulphide (H_2S)-Corrosion in downhole, surface, storage and pipelines.

UNIT IV 9

Corrosion prevention methods - Principles of operation and applications systems. Cathodic protection – Galvanic systems - Corrosion prevention coatings- Corrosion prevention inhibitors-types of corrosion inhibitors- Inhibitor selection and injection.

UNIT V **9**

Inspection and corrosion monitoring. Oil treatment corrosion - crude oil properties - desalting-sweetening processes. Corrosion in oil storage tank corrosion- oilfield and oil treating facilities-oil/ gas pipelines -offshore platforms- subsea systems.

TOTAL: 45 PERIODS

OUTCOME:

- Students will identify and define the various types of petroleum corrosion and prevention technologies.

TEXT BOOKS:

1. "Corrosion control in Petroleum production"-TPC 5-2-nd edition H.G.Byars NACE International, 1999.
2. Chemical engineering series, coulson and Richardson, Mc Graw Hill Publications.

REFERENCE:

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

PM8081 **REFINERY PROCESS DESIGN** **L T P C**
3 0 0 3

OBJECTIVE:

- 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.

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 calculations 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

OUTCOME:

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

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, Third 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

PE8079 STORAGE TRANSPORTATION OF CRUDE OIL AND NATURAL GAS **L T P C 3 0 0 3**

OBJECTIVE:

- To understand the natural gas regasification technology, crude oil transportation and to learn the concepts of storage.

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 CHARTERTICS OF STORAGE **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

OUTCOME:

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

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)

PE8078 RESERVOIR CHARACTERIZATION AND MODELING L T P C
3 0 0 3

OBJECTIVE:

- To enable the students to follow and utilize different concepts of reservoir modeling and characteristics and theirusage.

UNIT I **9**

Overview of reservoir characterization and modeling problems. Reservoir mapping.3D modeling. Univariate, bivariate and multivariate statistics for geological data analysis**.**

UNIT II **9**

Pattern recognition techniques. Petrophysical predictions from well logs. Introduction to petroleum geostatitsics. Variograms. Kringin. Uncertainty quantification. Finite difference approximations to the diffusivity equation and the application of those approximations for reservoir simulations

UNIT III **9**

Stochastic reservoir modeling. Sequential simulation. Gaussian simulation. Indicator simulation. Integrating seismic attributes, well tests and production data. Constraining reservoir models with various sources of information. Reservoir up girding and upscaling.

UNIT IV **9**

Reservoir simulation – Investigation of petroleum reservoir characteristics and behavior, including: pore volume, fluid distribution and movement, and recovery. optimized field development and management plans.

UNIT V **9**

Workstations and Software's used in reservoir characterization and modeling. Seismic reservoir characterization - AVO Reservoir Characterization. Correlation and Petrophysical analysis. Practical use of reservoir simulation.

TOTAL: 45 PERIODS

OUTCOME:

- Students gain the knowledge of reservoir characterization, modeling and simulation methods used in oil industry.

TEXT BOOKS:

1. Petroleum Exploration Hand Book by Moody, G.B. McGraw-Hill Inc
2. Wellsite Geological Techniques for petroleum Exploration by Shay's et al.

REFERENCE:

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

PM8077 PETROCHEMICAL DERIVATIVES L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on different types of petrochemicals

UNIT I PRECURSORS 9

Alternate routes with flow diagram for production of methane, ethane, propane, ethylene, propylene, butylenes, acetylene, naphthalene. Chemicals from methane, ethane, propane, ethylene, propylene, butylenes, acetylene.

UNIT II FIRST GENERATION PETROCHEMICALS 9

Alternate routes with flow diagram for production of butadiene, related dienes, aromatics – Benzene, toluene, xylene – Chemicals from butadiene, related dienes, aromatics – Benzene, toluene, xylene.

UNIT III SECOND GENERATION PETROCHEMICALS 9

Alternate routes with flow diagram for production of ethylene glycol, VCM, acrylonitrile, phenol, caprolactum, adipicacid, hexmethylenediamine, DMT, TPA, maleic anhydride, styrene.

UNIT IV THIRD GENERATION PETROCHEMICALS 9

Polymerization – Modes and techniques – Production of polyethylene – LDPE, HDPE, polypropylene, poly butadiene rubber, SBR, polystyrene, SAN, ABS.

UNIT V FOURTH GENERATION PETROCHEMICALS 9

Polyacrylonitrile, polyvinyl chloride, polycarbonates, nylon 6, nylon 66, polyesters, formaldehyde resins, explosives, dyes.

TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of this course, the students will know the sources and production methods of petrochemicals and the methods of manufacture of different petrochemicals from additives to electronic chemicals.

TEXT BOOKS:

1. Bhaskara Rao, B.K., “A Text on Petrochemicals”, Khanna Publishers, 2000.
2. SukumarMaiti, “Introduction to Petrochemicals”, 2nd Edition, Oxford and IBH Publishers, 2002.

REFERENCES:

1. Margaret Wells, “Handbook of Petrochemicals and Processes”, 2nd Edition, Ash Gate Publishing Limited, 2002.
2. Sami Matar, and Lewis F. Hatch., “Chemistry of Petrochemical Processes”, 2nd Edition, Gulf Publishing company, 2000.
3. Dryden, C.E., “Outlines of Chemical Technology”, 2nd Edition, Affiliated East-West Press, 1993

GE8077 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran

and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II TQM PRINCIPLES 9

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

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

UNIT IV TQM TOOLS AND TECHNIQUES II 9

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

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

TOTAL: 45 PERIODS

OUTCOME:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

PE8076 PETROLEUM ECONOMICS L T P C
3 0 0 3

OBJECTIVE:

- To understand the basic quantitative theories and methodologist in oil sector.

UNIT I **9**

Supply and demand curves, the elasticity of supply and demand, public finance concepts such as consumer surplus, excise and export taxes. Forecasting techniques for the energy industry, including energy prices. Demand and supply for natural gas, cured oil and pipeline transportation, determinants of energy demand, energy markets, energy pricing, stability and performance of energy markets.

UNIT II **9**

The economics of investment, Discounted cash flow analysis, Cost Benefit Analyses, Internal Rate of Return, NPV, Profitability Index, Natural Monopoly theory, National competition Policy, Gas Market Regulation, taxation of the oil and gas industry, government policy and trade permits, Monte Carlo analysis, Net Back Pricing, Transfer Pricing and regulatory aspects.

UNIT III **9**

Application of petroleum engineering principles and economics to the evaluation of oil and gas projects, evaluation principles, time value of money concepts, investment measures, cost estimation, price and production forecasting, risk and uncertainty, project selection and capital budgeting inflation, escalation, operating costs, depreciation, cost recovery**.**

UNIT IV **9**

Petroleum exploration and production contracts. Sharing of the economic rent, portfolio management. Value creation, Corporate finance & return on capital, economic appraisal methods for oil filed development, reservoir model costs and calculations.

UNIT V **9**

Case studies: Economic study of an oil filed development project, petrochemical plant project, natural gas break even price, natural gas liquefaction cost, LGN transport cost, investment profitability study for a gas pipeline.

TOTAL: 45 PERIODS

OUTCOME:

- Students will be able to understand the concept and fundamentals of engineering economics of energy industry

TEXT BOOKS:

1. Industrial Economics – An Introductory Textbook. R.R.Barthwal, 2nd Edition, New Age International Publisher.
2. Managerial Economics – D.N.Divedi. 6th Revised Edition. Vikas Publishing House Private Ltd.
3. Standard Handbook of Petroleum and Natural Gas Engineering. 2nd Edition. William C Lyons, Gary, C Plisga. Gulf Professional Publishing.

REFERENCES:

1. Petroleum Engineering Handbook. Bradely, H.B. Society of Petroleum Engineers. Richardson. Texas.
2. The Encyclopedia Americana, International Edition Volume 9, Grolier Incorporated.

PM8072 **DESIGN OF HEAT EXCHANGERS** **L T P C**

3 0 0 3

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:

- Upon completion of this course, the students can able to apply the mathematical knowledge for thermal and stress analysis on various parts of the heat exchangers components.

TEXT BOOKS:

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

REFERENCES:

1. Robert W. Serth, “Process heat transfer principles and applications”, Academic press, Elesevier, 2007.
2. Sarit Kumar Das, “Process heat transfer”, Alpha Science International, 2005
3. John E. Hesselgreaves, “Compact heat exchangers: selection, design, and operation”, Elsevier science Ltd, 2001.
4. Kuppan. T., “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.

PE8093 PLANT SAFETY AND RISK ANALYSIS L T P C

3 0 0 3

OBJECTIVE:

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

UNIT I INDUSTRIAL SAFETY 9

Concepts of safety – Hazard classification chemical, physical, mechanical, ergonomics, biological and noise hazards – Hazards from utilities like air, water, steam.

UNIT II HAZARD IDENTIFICATION AND CONTROL 9

HAZOP, job safety analysis – Fault tree analysis – Event tree analysis – Failure modes and effect analysis and relative ranking techniques – Safety audit – Plant inspection –Past accident analysis.

UNIT III RISK MANAGEMENT 9

Overall risk analysis – Chapains model, E and FI model– Methods for determining consequences effects: Effect of fire, Effect of explosion and toxic effect – Disaster management plan – Emergency planning – Onsite and offsite emergency planning –Risk management – Gas processing complex, refinery – First aids.

UNIT IV SAFETY PROCEDURES 9

Safety in plant design and layout – Safety provisions in the factory act 1948 – Indian explosive act 1884 – ESI act 1948 – Advantages of adopting safety laws.

UNIT V SAFETY IN HANDLING AND STORAGE OF CHEMICALS 9

Safety measures in handling and storage of chemicals – Fire chemistry and its control –Personnel protection – Safety color codes of chemicals.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course, the students will be able to analyze the risk in the process industries.

TEXT BOOKS:

1. Blake, R.P., “Industrial Safety”, third edition, Prentice Hall, 2000.
2. Lees, F.P., “Loss Prevention in Process Industries”, Fourth Edition, Butterworth Heinemann, 2012.

REFERENCES:

1. Geoff Wells, “Hazard Identification and Risk Assessment”, Institute of Chemical Engineers,1996
2. John Ridley and John Channing, “Safety at Work”, 6th Edition. Butterworth Heinemann, 2003.
3. Raghavan, K.V. and Khan, A.A., “Methodologies in Hazard Identification and Risk Assessment”, Manual by CLRI, 1990.

PC8071 SAFETY IN CHEMICAL INDUSTRIES L T P C

3 0 0 3

OBJECTIVE:

- This course would expose the students to identify and assess hazard in any stage of operation, to quantify and manage them as well in chemical industries.

UNIT I SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM DESIGN 9

Design process, conceptual design and detail design, assessment, inherently safer design-chemical reactor , types, batch reactors, reaction hazard evaluation, assessment, reactor safety, operating conditions, unit operations and equipments, utilities. Pressure system, pressure vessel design, standards and codes- pipe works and valves- heat exchangers- process machinery- over pressure protection, pressure relief devices and design, fire relief, vacuum and thermal relief, special situations, disposal- flare and vent systems- failures in pressure system.

UNIT II PLANT COMMISSIONING AND INSPECTION 9

Commissioning phases and organization, pre-commissioning documents, process commissioning, commissioning problems, post commissioning documentation Plant inspection, pressure vessel, pressure piping system, nondestructive testing, pressure testing, leak testing and monitoring-plant monitoring, performance monitoring, condition, vibration, corrosion, acoustic emission-pipe line inspection.

UNIT III PLANT OPERATIONS 9

Operating discipline, operating procedure and inspection, format, emergency procedures- hand over and permit system- start up and shut down operation, refinery units- operation of fired heaters, driers, storage- operating activities and hazards- trip systems- exposure of personnel

UNIT IV PLANT MAINTENANCE, MODIFICATION AND EMERGENCY PLANNING 9

Management of maintenance, hazards- preparation for maintenance, isolation, purging, cleaning, confined spaces, permit system- maintenance equipment- hot works- tank cleaning, repair and demolition- online repairs- maintenance of protective devices- modification of plant, problems-controls of modifications. Emergency planning, disaster planning, onsite emergency- offsite emergency, APELL

UNIT V STORAGES 9

General consideration, petroleum product storages, storage tanks and vessel- storages layout-segregation, separating distance, secondary containment- venting and relief, atmospheric vent, pressure, vacuum valves, flame arrestors, fire relief- fire prevention and protection- LPG storages, pressure storages, layout, instrumentation, vapourizer, refrigerated storages- LNG storages, hydrogen storages, toxic storages, chlorine storages, ammonia storages, other chemical storages- underground storages- loading and unloading facilities- drum and cylinder storage-ware house, storage hazard assessment of LPG and LNG

TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of the course, the students understand the key issues for making petroleum production and processing, cleaner and safe.

TEXT BOOK::

1. Lees, F.P. “Loss Prevention in Process Industries” Butterworth and Company, 1996.

REFERENCES:

1. “Quantitative Risk Assessment in Chemical Process Industries” American Institute of Chemical Industries, Centre for Chemical Process safety.
2. Fawcett, H.h. and Wood, “Safety and Accident Prevention in Chemical Operations” Wiley inters, Second Edition.
3. “Accident Prevention Manual for Industrial Operations” NSC, Chicago, 1982.
4. GREEN, A.E., “High Risk Safety Technology”, John Wiley and Sons,. 1984.
5. Petroleum Act and Rules, Government of India.
6. Carbide of Calcium Rules, Government of India.

GE8073 FUNDAMENTALS OF NANOSCIENCE L T P C

3 0 0 3

OBJECTIVE:

- To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION 8

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

UNIT II GENERAL METHODS OF PREPARATION 9

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

UNIT III NANOMATERIALS 12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications-Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT IV CHARACTERIZATION TECHNIQUES 9

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

UNIT V APPLICATIONS 7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

TOTAL: 45 PERIODS

OUTCOMES:

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS:

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

REFERENCES:

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