ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

B.E. SAFETY AND FIRE ENGINEERING

REGULATIONS – 2017

CHOICE BASED CREDIT SYSTEM

I TO VIII SEMESTERS OF CURRICULA AND SYLLABI

PROGRAMME EDUCATIONAL OBJECTIVES:

At the end of the program, students will be able to:

a. **Engineering knowledge:** Apply the knowledge of mathematics, basic sciences, and Safety and Fire Engineering to the solution of complex engineering problems.

b. **Problem analysis:** Identify, formulate, study research literature, and analyze complex Safety and Fire Engineering problems reaching substantiated conclusions.

c. **Design/development of solutions** Design solutions for complex engineering problems and design Safety and Fire components that meet the specified needs.

d. **Conduct investigations of complex problems:** Use Fire engineering research-based knowledge related to interpretation of data and provides valid conclusions.

e. **Modern tool usage:** Create, select, and apply modern Safety and Fire Engineering and IT tools to complex engineering activities with an understanding of the limitations.

f. **The engineer and society:** Apply reasoning acquired by the Safety and Fire Engineering knowledge to assess societal and safety issues.

g. **Environment and sustainability:** Understand the impact of engineering solutions on the environment, and demonstrate the knowledge for sustainable development.

h. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large.

k. **Project management and finance:** Understand the engineering and management principles and apply these to the multidisciplinary environments.

l. **Life-long learning:** Recognize the need for life-long learning in the broadest context of technological change.

PROGRAMME OUTCOMES:

PEO 1: Have a sound knowledge in Safety and Fire Engineering aspects to provide solutions for Potential hazards

PEO 2: Expertise in the area of Thermal, Chemical Reactions, Structural Stability, Environmental Impacts

PEO3: Practice their Professions through evaluation, communications, ethics and social responsibility

SEMESTER COURSE WISE PO MAPPING

		Course Title	a	b	c	d	e	f	g	h	i	j	k	l
YEAR I	SEM I	Communicative English						√				√		√
		Engineering Mathematics I	√	√	√	√								
		Engineering Physics	√	√	√	√	√		√					
		Engineering Chemistry	√	√	√	√	√		√					
		Problem Solving and Python Programming	√	√	√	√								
		Engineering Graphics	√	√	√	√	√		√		√		√	
		Problem Solving and Python Programming Laboratory	√	√	√	√	√		√					
		Physics and Chemistry Laboratory	√	√	√	√	√		√					
	SEM II	Technical English						√				√		√
		Engineering Mathematics II	√	√	√	√								
		Physics of Materials	√		√			√						
		Engineering Mechanics	√	√	√		√		√					
		Basic Civil and Mechanical Engineering	√	√			√						√	√
		Industrial Chemical Technology			√				√	√				
		Organic Chemistry Laboratory	√	√		√								
		Engineering Practices Laboratory			√									
YEAR II	SEM III	Probability and Statistics	√	√	√	√							√	
		Fluid Mechanics and Machinery	√	√	√	√		√						
		Principles of Safety Management			√		√	√	√	√			√	
		Machine Drawing	√	√	√		√							√
		Safety in Construction	√			√	√	√						
		Strength of Materials for Mechanical Engineers	√	√	√			√						
		Fluid Mechanics and Machinery Laboratory			√	√	√						√	
		Strength of Materials Laboratory			√	√	√	√					√	
	SEM IV	Principles of Chemical Engineering			√		√		√					
		Heat and Mass Transfer Operations	√	√			√	√	√					
		Environmental Science and Engineering				√			√					√
		Fire Engineering and Protection	√			√		√		√				
		Electrical Technology and Safety	√	√			√	√						
		Occupational Health and Hygiene				√				√			√	√
		Industrial Hygiene Lab			√		√							
		Interpersonal skills/Listening and Speaking									√	√		√
		Electrical Technology Laboratory					√	√					√	
YEAR III	SEM V	Quality Control and Reliability Engineering	√		√	√							√	
		Chemical Technology and Reaction Engineering	√	√			√	√	√					
		Design of Fire Fighting and Protection Systems	√	√	√	√		√		√				
		Manufacturing Processes	√				√	√						
		Chemical Process Safety					√	√	√					
		Unit Operation Laboratory			√	√		√	√				√	
		Manufacturing Processes Laboratory					√	√					√	
	SEM VI	Legal Aspects of Health Safety and Environment			√		√			√				√
		Process Instrumentation and Control	√	√	√		√	√						
		Hazard Control in Manufacturing				√		√						
		Plant Fire Safety			√		√	√	√					

		Industrial Safety			√		√	√	√					
		Industrial Training (Fire Safety)		√	√	√					√	√		√
		Professional Communication					√	√		√		√		√
YEAR IV	SEM VII	Hazard Analysis and Risk Assessment	√	√		√				√				
		Transportation Systems and Safety	√				√		√					
		Principles of Industrial Management						√	√	√			√	
		Safety in Petroleum and Petrochemical Industries	√			√	√	√		√				
		Design and Fabrication Project			√		√	√			√			√
		Fire Engineering Laboratory	√	√		√	√	√	√					
	VIII	Disaster Management			√			√					√	
		Project Work	√	√	√			√	√		√	√		√

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I TO VIII SEMESTERS OF CURRICULA AND SYLLABI

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	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

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	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.	GE8292	Engineering Mechanics	ES	5	3	2	0	4
5.	BE8252	Basic Civil and 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	**31**	**21**	**2**	**8**	**26**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA8391	Probability and Statistics	BS	4	4	0	0	4
2.	CE8394	Fluid Mechanics and Machinery	ES	4	4	0	0	4
3.	SF8301	Principles of Safety Management	PC	3	3	0	0	3
4.	MS8301	Machine Drawing	PC	6	2	0	4	4
5.	SF8302	Safety in Construction	PC	3	3	0	0	3
6.	CE8395	Strength of Materials for Mechanical Engineers	ES	3	3	0	0	3
PRACTICALS								
7.	CE8462	Fluid Mechanics and Machinery Laboratory	ES	4	0	0	4	2
8.	CE8481	Strength of Materials Laboratory	ES	4	0	0	4	2
			TOTAL	**31**	**19**	**0**	**12**	**25**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH8201	Principles of Chemical Engineering	PC	3	3	0	0	3
2.	SF8401	Heat and Mass Transfer Operations	PC	4	4	0	0	4
3.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3
4.	SF8402	Fire Engineering and Protection	PC	3	3	0	0	3
5.	SF8403	Electrical Technology and Safety	PC	3	3	0	0	3
6.	SF8404	Occupational Health and Hygiene	ES	3	3	0	0	3
PRACTICALS								
7.	SF8411	Industrial Hygiene Laboratory	ES	4	0	0	4	2
8.	HS8381	Interpersonal skills/Listening and Speaking	EEC	2	0	0	2	1
9.	SF8412	Electrical Technology Laboratory	PC	4	0	0	4	2
			TOTAL	**29**	**19**	**0**	**10**	**24**

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ME8098	Quality Control and Reliability Engineering	PC	3	3	0	0	3
2.	SF8501	Chemical Technology and Reaction Engineering	ES	3	3	0	0	3
3.	SF8502	Design of Fire Fighting and Protection Systems	PC	3	3	0	0	3
4.	SF8503	Manufacturing Processes	PC	3	3	0	0	3
5.	SF8504	Chemical Process Safety	PC	3	3	0	0	3
6.		Open Elective - I	OE	3	3	0	0	3
PRACTICALS								
7.	SF8511	Unit Operation Laboratory	ES	4	0	0	4	2
8.	SF8512	Manufacturing Processes Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	SF8601	Legal Aspects of Health Safety and Environment	PC	3	3	0	0	3
2.	SF8602	Process Instrumentation and Control	PC	5	3	2	0	4
3.	SF8603	Hazard Control in Manufacturing	PC	3	3	0	0	3
4.	SF8604	Plant Fire Safety	PC	3	3	0	0	3
5.	SF8605	Industrial Safety	PC	3	3	0	0	3
6.		Professional Elective I	PE	3	3	0	0	3
PRACTICALS								
7.	SF8611	Industrial Training (Fire Safety)	EEC	2	0	0	4	2
8.	HS8581	Professional Communication	EEC	2	0	0	2	1
			TOTAL	**24**	**18**	**2**	**6**	**22**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	SF8701	Hazard Analysis and Risk Assessment	PC	3	3	0	0	3
2.	SF8702	Transportation Systems and Safety	PC	3	3	0	0	3
3.	SF8703	Principles of Industrial Management	HS	3	3	0	0	3
4.	SF8704	Safety in Petroleum and Petrochemical Industries	PC	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
6.		Open Elective - II	OE	3	3	0	0	3
PRACTICALS								
7.	ME8682	Design and Fabrication Project	EEC	4	0	0	4	2
8.	SF8711	Fire Engineering Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	GE8071	Disaster Management	PC	3	3	0	0	3
2.		Professional Elective III	PE	3	3	0	0	3
3.		Professional Elective IV	PE	3	3	0	0	3
PRACTICALS								
4.	SF8811	Project Work	EEC	20	0	0	20	10
			TOTAL	**29**	**9**	**0**	**20**	**19**

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE: 185

HUMANITIES AND SOCIAL SCIENCES (HS)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3
2.	SF8703	Principles of Industrial Management	HS	3	3	0	0	3

BASIC SCIENCES (BS)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA8391	Probability and Statistics	BS	4	4	0	0	4

ENGINEERING SCIENCES (ES)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	CE8394	Fluid Mechanics and Machinery	ES	4	4	0	0	4
2	CE8395	Strength of Materials for Mechanical Engineers	ES	3	3	0	0	3
3	CE8462	Fluid Mechanics and Machinery Laboratory	ES	4	0	0	4	2
4	CE8481	Strength of Materials Laboratory	ES	4	0	0	4	2
5	SF8404	Occupational Health and Hygiene	ES	3	3	0	0	3
6	SF8411	Industrial Hygiene Lab	ES	4	0	0	4	2
7	SF8501	Chemical Technology and Reaction Engineering	ES	3	3	0	0	3
8	SF8511	Unit Operation Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	SF8301	Principles of Safety Management	PC	3	3	0	0	3
2	MS8301	Machine Drawing	PC	6	2	0	4	4
3	SF8302	Safety in Construction	PC	3	3	0	0	3
4	CH8201	Principles of Chemical Engineering	PC	3	3	0	0	3
5	SF8401	Heat and Mass Transfer Operations	PC	4	4	0	0	4
6	SF8402	Fire Engineering and Protection	PC	3	3	0	0	3
7	SF8412	Electrical Technology Laboratory	PC	4	0	0	4	2
8	ME8098	Quality Control and Reliability Engineering	PC	3	3	0	0	3
9	SF8502	Design of Fire Fighting and Protection Systems	PC	3	3	0	0	3
10	SF8503	Manufacturing Processes	PC	3	3	0	0	3
11	SF8504	Chemical Process Safety	PC	3	3	0	0	3
12	SF8512	Manufacturing Processes Laboratory	PC	4	0	0	4	2
13	SF8601	Legal Aspects of Health Safety and Environment	PC	3	3	0	0	3
14	SF8602	Process Instrumentation and Control	PC	5	3	2	0	4

15	SF8603	Hazard Control in Manufacturing	PC	3	3	0	0	3
16	SF8604	Plant Fire Safety	PC	3	3	0	0	3
17	SF8605	Industrial Safety	PC	3	3	0	0	3
18	SF8701	Hazard Analysis and Risk Assessment	PC	3	3	0	0	3
19	SF8702	Transportation Systems and Safety	PC	3	3	0	0	3
20	SF8704	Safety in Petroleum and Petrochemical Industries	PC	3	3	0	0	3
21	SF8711	Fire Engineering Laboratory	PC	4	0	0	4	2
22	GE8071	Disaster Management	PC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	HS8381	Interpersonal Skills/Listening and Speaking	EEC	2	0	0	2	1
2	SF8611	Industrial Training (Fire Safety)	EEC	2	0	0	2	1
3	HS8581	Professional Communication	EEC	2	0	0	2	1
4	ME8682	Design and Fabrication Project	EEC	4	0	0	4	2
5	SF8811	Project Work	EEC	20	0	0	20	10

PROFESSIONAL ELECTIVES

SEMESTER VI, ELECTIVE – I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	SF8001	Life Safety in Building Fire	PE	3	3	0	0	3
2.	SF8002	Food and Bio-safety	PE	3	3	0	0	3
3.	ME8792	Power Plant Engineering	PE	3	3	0	0	3
4.	GE8075	Intellectual Property Rights	PE	3	3	0	0	3
5.	SF8003	Artificial Intelligent and Expert Systems	PE	3	3	0	0	3
6.	GE8073	Fundamentals of Nanoscience	PE	3	3	0	0	3

SEMESTER VII, ELECTIVES– II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	SF8004	Automobile Engineering and Safety	PE	3	3	0	0	3
2.	SF8005	Explosives Technology and Safety	PE	3	3	0	0	3
3.	GE8077	Total Quality Management	PE	3	3	0	0	3
4.	GE8074	Human Rights	PE	3	3	0	0	3
5.	SF8006	Fire and Smoke Dynamics	PE	3	3	0	0	3

SEMESTER VIII, ELECTIVES – III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MG8491	Operations Research	PE	3	3	0	0	3
2.	GE8076	Professional Ethics in Engineering	PE	3	3	0	0	3
3.	SF8007	Fire Risk Calculations	PE	3	3	0	0	3
4.	SF8008	Fire and Arson Investigation	PE	3	3	0	0	3
5.	GE8072	Foundation Skills in Integrated Product Development	PE	3	3	0	0	3

SEMESTER VIII, ELECTIVES – IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	SF8009	Human Factors Engineering	PE	3	3	0	0	3
2.	SF8010	Engineering Economics	PE	3	3	0	0	3
3.	SF8011	Advanced Safety Engineering and Management	PE	3	3	0	0	3
4.	SF8012	Environmental Protection and Waste Management	PE	3	3	0	0	3
5.	SF8013	Fire Dynamics	PE	3	3	0	0	3
6.	IE8691	Facility Layout and Materials Handling	PE	3	3	0	0	3

SUMMARY

S.No	Subject Area	Credits per Semester								Credits Total	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1	HS	4	4	-	3	-	-	3	-	14	7.5
2	BS	12	9	4		-	-	-	-	25	13.4
3	ES	9	10	11	5	5	-	-	-	40	21.5
4	PC	-	3	10	15	14	16	11	3	72	38.91
5	PE	-	-	-	-	-	3	3	6	12	6.4
6	OE	-	-	-	-	3	-	3	-	6	3.2
7	EEC	-	-	-	1	-	3	2	10	16	8.6
	Total	**25**	**26**	**25**	**24**	**22**	**22**	**22**	**19**	**185**	

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 Course book for Undergraduate 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 Means,L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007

3 Redston, Chris &Gillies Cunningham Face2Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005

4 Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011

5 Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013

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

OBJECTIVE

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 modeling 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. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.

5. Charles Dierbach, “Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, “Practical Programming: An Introduction to Computer Science using Python 3”, Second edition, Pragmatic Programmers, LLC, 2013.

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. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
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.
4. 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
		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.

OUTCOME:

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

TOTAL: 30 PERIODS

TEXT BOOK:

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- newspapers- 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 charts, graphs- Vocabulary Development-vocabulary used 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 Black swan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

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

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

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values 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:

- Eigen values 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

3 0 0 3

OBJECTIVE:

- 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.

GE8292 ENGINEERING MECHANICS L T P C
3 2 0 4

OBJECTIVES:

- 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.

BE8252 BASIC CIVIL AND MECHANICAL ENGINEERING L T P C
4 0 0 4

OBJECTIVES:

- To impart basic knowledge on Civil and Mechanical Engineering.
- To familiarize the materials and measurements used in Civil Engineering.
- To provide the exposure on the fundamental elements of civil engineering structures.
- To enable the students to distinguish the components and working principle of power plant units, IC engines, and R & AC system.

A – OVER VIEW

UNIT I SCOPE OF CIVIL AND MECHANICAL ENGINEERING 10

Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering

Overview of Mechanical Engineering - Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.

B – CIVIL ENGINEERING

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS 10

Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples.

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel - timber - modern materials

UNIT III BUILDING COMPONENTS AND STRUCTURES 15

Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations.

Civil Engineering Structures: Brickmasonry – stonemasonry – beams – columns – lintels – roofing – flooring – plastering – floor area, carpet area and floor space index - Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way.

C – MECHANICAL ENGINEERING

UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 15

Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants –- working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 10

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

TOTAL: 60 PERIODS

OUTCOMES:

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

- appreciate the Civil and Mechanical Engineering components of Projects.
- explain the usage of construction material and proper selection of construction materials.
- measure distances and area by surveying
- identify the components used in power plant cycle.
- demonstrate working principles of petrol and diesel engine.
- elaborate the components of refrigeration and Air conditioning cycle.

TEXT BOOK:

1. Shanmugam Gand Palanichamy MS, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill PublishingCo.,New Delhi,1996.

REFERENCES:

1. Ramamrutham S.,“Basic Civil Engineering”, Dhanpat Rai Publishing Co.(P) Ltd.1999.
2. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
3. Seetharaman S.,“BasicCivil Engineering”,AnuradhaAgencies,2005.
4. Venugopal K. and Prahu Raja V., “Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam,2000.
5. ShanthaKumar SRJ.,“Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai, 2000.

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/ benzylalcohol

TOTAL: 60 PERIODS

List of Equipment for a Batch of 30 students

S. No.	Description of Equipment	Quantity
Essential		
1.	Bunsen burners	30 Nos.
2.	LPG Cylinder in each row of the Laboratory	1 No.
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	30 Nos.

10.	Sharp Knives to cut sodium	6 Nos.
11.	Balance I. Rough balance II. Four digit Balance	 2 Nos. 1 No.
Desirable		
	Melting Point apparatus	4 Nos.

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

OBJECTIVES:

- 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 this 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 Unni Krishnapillai, 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.

CE8394 FLUID MECHANICS AND MACHINERY L T P C
4 0 0 4

OBJECTIVES:
- The properties of fluids and concept of control volume are studied
- The applications of the conservation laws to flow through pipes are studied.
- To understand the importance of dimensional analysis
- To understand the importance of various types of flow in pumps.
- To understand the importance of various types of flow in turbines.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 12

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.

UNIT II FLOW THROUGH CIRCULAR CONDUITS 12

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli-Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor-Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

UNIT III DIMENSIONAL ANALYSIS 12

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

UNIT IV PUMPS 12

Impact of jets - Euler's equation - Theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps– working principle - work done by the impeller - performance curves - Reciprocating pump- working principle – Rotary pumps –classification.

UNIT V TURBINES 12

Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines – governing of turbines.

TOTAL: 60 PERIODS

OUTCOMES:

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

- Apply mathematical knowledge to predict the properties and characteristics of a fluid.
- Can analyse and calculate major and minor losses associated with pipe flow in piping networks.
- Can mathematically predict the nature of physical quantities
- Can critically analyse the performance of pumps
- Can critically analyse the performance of turbines.

TEXT BOOK:

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2013.

REFERENCES:

1. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016
3. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, “Fluid Mechanics and Machinery”, 2011.
4. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010

SF8301 PRINCIPLES OF SAFETY MANAGEMENT L T P C
3 0 0 3

OBJECTIVES

- To Understanding of the principles of safety management.
- To enable the students to learn about various functions and activities in organization.
- To enable students to conduct safety audit and write audit reports effectively in auditing situations.
- To have knowledge about sources of information for safety promotion and training.
- To familiarize students with evaluation of safety performance.

UNIT I INTRODUCTION AND NEEDS OF SAFETY 9

Introduction- Safety- Goals of safety engineering. Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation.

UNIT II SAFETY ORGANIZATION INTRODUCTION 9

Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Safety Officer-responsibilities, authority. Safety committee- needs, types, advantages.
Accident prevention Methods- Engineering, Education and Enforcement

UNIT III SAFETY EDUCATION AND TRAINING 9

.Safety Education & Training-Importance, Various training methods, Effectiveness of training, Behaviour oriented training. Communication- purpose, barrier to communication. Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5s of housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

UNIT IV SAFETY PERFORMANCE MONITORING 9

Personal protection in the work environment, Types of PPEs, Personal protective equipment- respiratory and non respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Cost of accidents - Computation of Costs- Utility of Cost data. Plant safety inspection, types, inspection procedure. Safety sampling techniques. Job safety analysis (JSA), Safety surveys, and Safety audits. Safety Inventory Technique.

UNIT V ACCIDENT INVESTIGATION AND REPORTING 9

Accident investigation- Why? When? Where? Who? and How? Basics- Man- Environment and Systems. Process of Investigation -Tools-Data Collection- Handling witnesses- Case study. Accident analysis -Analytical Techniques-System Safety-Change Analysis- MORT-Multi Events Sequencing-TOR.

TOTAL: 45 PERIODS

OUTCOMES

On completion of this course the student will be able :

- To understand the functions and activities of safety engineering department.
- To carry out a safety audit and prepare a report for the audit.
- To prepare an accident investigation report.
- To estimate the accident cost using supervisors report and data.
- To identify various agencies, support institutions and government organizations involved in safety training and promotion

TEXT BOOKS

1. Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York,.,1969 4th Edition
2. Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay, 1997.

REFERENCES:

1. Krishnan, N.V. (1997). Safety management in Industry. Jaico Publishing House, New Delhi.
2. John V. Grimaldi and Rollin H.Simonds. (1989) Safety management, All India Traveller Book Seller, Delhi.
3. Ronald P. Blake. (1973). Industrial safety. Prentice Hall, New Delhi.
4. Alan Waring. (1996). Safety management system. Chapman & Hall, England.
5. Akhil Kumar Das,”Principles of Fire Safety Management” Eastern Economy Edition,2020

MS8301 MACHINE DRAWING L T P C
2 0 4 4

OBJECTIVES:

- Use of drawing tools to show the assembly view of the component and mark suitable units, fir tolerance data.
- Practicing free hand sketches and assembly drawings.
- Creating bill of materials and practicing various calculations.

UNIT I INTRODUCTION 6+12

Introduction to machine drawing. Importance of sectional views. Computer-aided drafting CONVENTIONS: Code of practice for engineering drawing-conventional representation of details- drilled and tapped holes, countersunk and counter bored holes, internal and external threads, undercuts, grooves, chamfers, fillet radii and keyways. Conventions to represent standard components-bolts, nuts, washers, screws, cotters, pins, circlips, bearings, gears, springs and flanges.

UNIT II ASSEMBLY CONCEPTS 6+12

Methods and concepts of assemblies-assembly requirements, Bill of materials. Methods of assembly-bolts, nuts, studs, screws and pins. Methods of arresting motion of a member in an assembly. Assembly and dismantling exercise of a typical assembly with emphasis on assembly sequence and appropriate fits.

UNIT III FITS AND TOLERANCES 6+12

Limits, fits and tolerances-need, types, representation of tolerances on drawing, calculation of minimum and maximum clearances and allowances. Geometric tolerance-uses, types of form and position tolerances, symbols, method of indicating geometric tolerances on part drawings. Surface finish symbols-methods of indicating the surface roughness. Blue print reading exercises.

UNIT IV ASSEMBLY DRAWING PRACTICE 6+12

Making free hand sketches of typical subassemblies-flange coupling, stuffing box, journal bearings, rolling element bearings, keyed joints, cotter joints, C clamp.

UNIT V ASSEMBLY USING SOLID MODELING 6+12

Modeling and assembly using software-extracting views and sections. Drawing of assemblies- plummer block, machine vice, stop valve, screw jack, tail stock, cylindrical gear box, simple drill jig. Creation of bill of materials, calculation of mass and section properties, interference check between solids.

TOTAL (L:45+P:15): 90 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the drawing tools to show the assembly view of the component and mark suitable units, fit tolerance data.
- Able to draw free hand sketches and assembly drawing.
- Able to create bill of materials.

TEXT BOOKS:

1. CAD/CAM Manual, PSG College of Technology. Coimbatore, 2002.
2. Gopalakrishna K R, "Machine Drawing", Seventeenth Edition, Subhas Stores, Bangalore, 2003.

REFERENCES:

1. ASME Y 14.5M-1994, “Dimensioning and Tolerancing”, ASME, New York, 1995.
2. Faculty of Mechanical Engineering, PSG College of Technology," Design Data Book", M/s.DPV Printers, Coimbatore,1993.
3. SP:46-2003 – “Engineering Drawing Practice for Schools and Colleges", Bureau of Indian Standards, New Delhi, 2003.
4. Varghese P I and John K C, "Machine Drawing", Jovast Publishers, Thrissur, 2007.

SF8302 SAFETY IN CONSTRUCTION L T P C
3 0 0 3

OBJECTIVES:

- To know causes of accidents related to construction activities and human factors associated with these accident
- To understand the construction regulations and quality assurance in construction
- To have the knowledge in hazards of construction and their prevention methods
- To know the working principles of various construction machinery
- To gain knowledge in health hazards and safety in demolition work Course

UNIT I INTRODUCTION 9

Introduction to construction industry and safety issues in construction - Human factors in construction safety management - Roles of various groups and stake-holders in ensuring safety in construction industry - Framing of contract conditions on safety and related matters - Relevance of ergonomics in construction safety.

UNIT II SAFETY IN CONSTRUCTION OPERATIONS 9

Safety in various construction operations - Excavation and filling - Under- water works - Under-pinning & Shoring - Ladders & Scaffolds - Tunnelling - Blasting - Dismantling - Confined space - Temporary Structures. noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Effects of air pollution in Industry, air pollution episodes; Emission factors inventory and predictive equations. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety.

UNIT III CONSTRUCTION MACHINERY 9

Safety in material handling and equipment's - Safety in storage & stacking of construction materials. Safety in the use of construction equipment/vehicles - excavators, graders and dozers - cranes - hoists & lifts - other lifting gears˜ wire ropes - chain-pulley blocks - mixers - conveyors - pneumatic and hydraulic tools in construction. Safety in temporary power supply and fire safety at construction site.

UNIT IV CONSTRUCTION ACT AND CODE OF PRACTICES 9

Contract Labour (R&A) Act and Central Rules: Definitions, Registration of Establishments, Licensing of Contractors, Welfare and Health provisions in the Act and the Rules, Penalties, Rules regarding wages.

Building & Other Construction Work (RE & CS) Act, 1996 and Central Rules, 1998: Applicability, Administration, Registration, Welfare Board & Welfare Fund, Training of Building workers, General Safety, Health & Welfare provisions. Code of Practices - -Preventive measures against Hazards at workplaces Part 1 & 2

UNIT V SAFETY IN DEMOLITION WORK 9

Safety in demolition work, manual, mechanical, using explosive - keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition - Indian standard - trusses, girders and beams – first aid – fire hazards and preventing methods –Case studies in construction sites against the fire accidents.

TOTAL: 45 PERIODS

OUTCOMES

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

- Visualize the safety issues at different stages of construction activity.
- Understand the safety requirements in various construction operations and develop guidelines to ensure safety at construction site.
- Understand the safety requirements in material handling and Equipments and develop guidelines to ensure safety at construction site.
- Learn the legal provisions with respect to the health and welfare of workers at construction site.
- List out construction regulations and Indian standards for construction and demolition work.

TEXT BOOKS

1. Hudson, R.,"Construction hazard and Safety Hand book, Butter Worth's, 1985.
2. Raymond Elliot Levitt, Nancy Morse Samelson, "Construction Safety Management, McGraw-Hill, London,1987.

REFERENCES:

1. Jnathea D.Sime, "Safety in the Build Environment", London, 1988.
2. Davies, V. J., and Tomasin, K. (1996). Construction safety handbook. Thomas Telford Publishing, London.
3. Ratay, R. T. (1996). Handbook of temporary structures in construction (2nd edn.). McGraw-Hill, London.
4. Fulman, J.B., Construction Safety, Security & Loss Prevention, John Wiley and Sons, 1979
5. Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and Central Rules.

CE8395	STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains –Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT III TORSION 9

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT IV DEFLECTION OF BEAMS 9

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure –Deformation in spherical shells – Lame's theorem.

TOTAL: 45 PERIODS

OUTCOMES

Students will be able to

- Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
- Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
- Apply basic equation of simple torsion in designing of shafts and helical spring
- Calculate the slope and deflection in beams using different methods.
- Analyze and design thin and thick shells for the applied internal and external pressures.

TEXT BOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009

REFERENCES:

1. Egor. P.Popov “Engineering Mechanics of Solids” Prentice Hall of India, New Delhi, 2002
2. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing ‘co. Ltd., New Delhi, 2005.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013
4. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.

CE8462 FLUID MECHANICS AND MACHINERY LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices.
- Also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump/ submergible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to use the measurement equipments for flow measurement
- Ability to do performance trust on different fluid machinery

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. NO.	NAME OF THE EQUIPMENT	Qty.
1	Orifice meter setup	1
2	Venturi meter setup	1
3	Rotameter setup	1
4	Pipe Flow analysis setup	1
5	Centrifugal pump/submergible pump setup	1
6	Reciprocating pump setup	1
7	Gear pump setup	1
8	Pelton wheel setup	1
9	Francis turbine setup	1
10	Kaplan turbine setup	1

CE8481 STRENGTH OF MATERIALS LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To expose the students to the testing of different materials under the action of various forces and determination of their characteristics experimentally.

LIST OF EXPERIMENTS

1. Tension test on steel rod
2. Compression test on wood
3. Double shear test on metal
4. Torsion test on mild steel rod
5. Impact test on metal specimen (Izod and Charpy)
6. Hardness test on metals (Rockwell and Brinell Hardness Tests)
7. Deflection test on metal beam
8. Compression test on helical spring
9. Deflection test on carriage spring

TOTAL: 60 PERIODS

OUTCOME:

- The students will have the required knowledge in the area of testing of materials and components of structural elements experimentally.

REFERENCES:

1. Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.
2. IS1786-2008 (Fourth Revision, Reaffirmed 2013), 'High strength deformed bars and wires for concrete reinforcement – Specification', 2008.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	Description of Equipment	Quantity
1.	UTM of minimum 400 kN capacity	1
2.	Torsion testing machine	1
3.	Izod impact testing machine	1
4.	Hardness testing machine Rockwell Vicker's (any 2) Brinnel	1 each
5.	Beam deflection test apparatus	1
6.	Extensometer	1
7.	Compressometer	1
8.	Dial gauges	Few
9	Le Chatelier's apparatus	2
10	Vicat's apparatus	2
11	Mortar cube moulds	10

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

OBJECTIVES

- To understand the overall view of the chemical engineering subjects

UNIT I **5**

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

UNIT II **12**

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

UNIT III **12**

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

UNIT IV **12**

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

UNIT V **4**

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

TOTAL: 45 PERIODS

OUTCOMES

- On completion of the course, students will attain knowledge in fluid behavior and solid properties,
- Understand the concept of chemical engineering principles

TEXT BOOKS

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

REFERENCES

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

SF8401 HEAT AND MASS TRANSFER OPERATIONS L T P C
4 0 0 4

OBJECTIVES:

- To learn the different modes of heat transfer and the concept of mass transfer operations employed in chemical industry.
- To impart the knowledge of mass transfer operations and equipment.
- To understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries.
- To learn the thermal analysis and sizing of heat
- To understand the concepts of heat transfer through extended surfaces

UNIT I CONDUCTION AND CONVECTION **12**

Importance of heat transfer - Modes of heat transfer - Mean temperature different. Concept of heat conduction - Fourier's law of heat conduction - one dimensional steady state Heat conduction equation for that plate, hollow cylinder, hollow sphere.

Concept of heat transfer by convection - Natural and forced convection- Application of dimensional analysis for convection - Equations for forced convection under laminar, transition and turbulent conditions - Equations for natural convection

UNIT II RADIATION AND HEAT EXCHANGERS 12

Heat Exchangers: Types and classification, fouling factors, overall heat transfer coefficient, LMTD calculation for parallel flow, counter flow and cross flow heat exchangers, effectiveness – NTU method.

Radiation: Concept of thermal radiations - Black body concept - Laws of radiation -concept of grey body - radiation between surfaces.

Evaporation: Types of evaporation - single effect and multiple effect evaporation - Design calculation for single and multiple effect evaporation.

UNIT III MASS TRANSFER AND ABSORPTION 12

Mass Transfer - Fick's law, equimolar diffusion, diffusion of vapors through a stagnant medium, applications. Applications of mass transfer calculations to gas dissolution in molten metals

Absorption - Equilibrium and operating line concept in absorption calculations; types of contactors, design of packed and plate type absorbers; Operating characteristics of stage wise and deferential contactors, concepts of NTU, HTU and overall volumetric mass transfer coefficients.

UNIT IV DISTILLATION 12

Distillation - relative volatility, simple distillation, steam distillation, distillation with reflux, principle of azeotropic and extractive distillation. McCabe Thiele method of calculation of number of theoretical stages, total, minimum and optimum reflux.

UNIT V DRYING 12

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. Case studies: Combined modes of heat transfer in (a) induction heating and (b) plasma spraying

TOTAL: 60 PERIODS

OUTCOMES:

On completion of this course the student will be able to:

- Identify the different modes of heat transfer and carry out the conduction calculations in various geometries.
- Calculate the design requirements of heat transfer in co-current and counter-current heat exchanger operations.
- Identify the best possible separation method with the given parameters
- Select the most suitable equipment for absorption, distillation, liquid- liquid extraction and solid-liquid extraction.
- Develop an understanding of various Physico-chemical separation techniques

TEXT BOOKS

1. Suryanarayana A., "Mass Transfer Operations", New Age International, New Delhi, 2002.
2. Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education.

REFERENCES:

1. Binay K.Dutta. (2001) Heat Transfer principles and applications, Prentice Hall of India, New delhi.
2. Robert E. Treybal. (2012). Mass transfer operations. (third edition). McGraw Hill Education, New York.
3. McCabe, W.L., J.C. Smith, J.C. and Peter Harriott. (2004). Unit operations of chemical engineering. (seventh edition). McGraw-Hill Education, New York.
4. Badger, W.L. and Banchero, J.T. (1997). Introduction to chemical engineering. Tata McGraw Hill Education, New Delhi.
5. Christe J. Geankoplis. (1993). Transport process and unit operations, Prentice Hall India Pvt Ltd, New Delhi.

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

TEXTBOOKS:

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.

SF8402 FIRE ENGINEERING AND PROTECTION L T P C
3 0 0 3

OBJECTIVES

- To understand the basic theory of fire chemistry, the development of fire and its characteristics, and about different types of fire.
- To study about the product of combustion and their characteristics.
- To study about the use, operation and maintenance requirements of equipment, vehicles and accessories used in fire services.
- To understand the fundamentals of fire hydraulics and fire ground operations.
- To focuses on fire detection, suppression and mitigation and fire safety engineering which focuses on human behavior and maintaining a tenable environment for evacuation from a fire.

UNIT I PROPERTIES OF COMBUSTION 9

Introduction- temperature, heat, specific heat, flash point, fire point, ignition, combustion; Ignition- pilot ignition, spontaneous ignition, ignition sources; Types of combustion-rapid, spontaneous, explosion;. Development of fire- incipient, smoldering, flame and heat stages; Diffusion flames-zones of combustion, smoldering combustion, characteristics of diffusion flame; Premixed flames-burning velocity, limits of flammability, explosion and expansion ratios, deflagration and detonation, characteristics of premixed flame; Explosion- physical explosion, chemical explosion; Special kinds of combustion- Flash fire, Pool fire, Deep seated fire, Spillover, Boil over, Dust explosion, BLEVE, UVCE; Classification of fire based on material.

UNIT II BEHAVIOUR OF BUILDING ELEMENTS UNDER ACTION OF FIRE 9

Product of combustion-flame, heat, smoke, fire gases; Flame and its characteristics, spread of flames in solids and liquids, linear and three dimensional fire propagation; spread of fire in rooms and buildings; Effect of heat exposure to human body, body burns. Smoke - constituents of smoke, quantity and rate of production of smoke, quality of smoke, smoke density, visibility in smoke, smoke movement in buildings, modelling of smoke movement; Smoke control in buildings- natural and mechanical ventilation, pressurization; Design principles of smoke control using pressurization technique; Principles of smoke vent design. Toxicity of smoke- effect of harmful agents preventing escape and causing injury or death - CO, CO2, HCN, SO2, NH3, Nitrogen oxide.

UNIT III OPERATION HANDLING AND MAINTENANCE OF FIRE SERVICE EQUIPMENTS AND ACCESSORIES 9

Use, operation and maintenance of fire service equipments and accessories- Suction and delivery Hose, Hose reel, Hose fittings- coupling, adapters, branches, branch holders, radial branches, collecting heads, stand pipe, monitors, hydrants; Introduction to fire fighting vehicles and appliances- Pumps, primers, crash tenders, rescue tenders, hose laying tenders, control vans, hydraulic platforms; Ladders- extension ladders, hook ladder, turntable ladders, snorkel; Uses and maintenance of small gear and miscellaneous equipments used during fire fighting; Lamps and lighting sets; Ropes and Lines- Types-wire and rope lines used in fire service. Use and testing of lines, knots, Bends and hitches; General rope work.

UNIT IV HYDRAULIC SYSTEM 9

Fire stream-path, range; nozzles-types, calculation of discharge capacity, nozzle reaction; Hydraulic and energy grade lines, pressure loss or gain because of elevation, back pressure; friction losses in pipes, fire hoses and fixtures, parallel and series connections; Flow in pipes and fire hoses, branching lines; water relay techniques; Estimation of fire protection water requirements, pump capacity and other parameters relating to fire hydraulics.

Fire ground operations - preplanning, action on arrival and control, methods of rescue, methods of entry. Personnel safety. Control procedure and use of other safety equipment. Ventilation and salvage operations.

UNIT V FIRE SUPPRESSION & PROTECTION 9

Introduction, Definitions, Water as an extinguishing agent, Basic Components of a Fire Protection system, Fire water supply systems-Types, Design philosophy acc.to OISD, Foam, DCP & other gaseous extinguishing agents; Classification of fire protection systems-Active & Passive: Active FPS-Definitions, classifications- Water Based (Vs) Non water based & Fixed (Vs) Portable/Mobile, Types:- Fire Extinguishers, Fire hydrants, Sprinklers, standpipe systems, Fire detectors, water spray systems - definitions, types, operation, applications & limitations, selection, installation & maintenance as per relevant national and international standards(IS, OISD, NFPA etc)

TOTAL: 45 PERIODS

OUTCOMES

- On successful completion of the course, the student will be able to Understand the theory of fire chemistry; learn about different kinds of combustion and their characteristics
- Learn about the products of combustion-flame, heat, smoke, fire gases- and their characteristics.
- Acquire the knowledge about the use and operation of fire service equipment, machineries and accessories.
- Calculate the water requirement and the pump capacity for fire fighting and understand the basic fire ground operations.
- Learn different types of fire protection systems/ installations in oil and gasindustry.

TEXT BOOKS:

1. Gupta, R.S., “Hand Book of Fire Technology” Orient Longman, Bombay 1977.
2. William E Clark (1991). Fire fighting principles & practices (2nd edn). Fire Engineering Books Videos.

REFERENCES:
1. HMSO,"Manual of fireman ship-part 1 to 13". London,1991.
2. Jain V.K. "Fire safety in buildings" (2nd edn.). New Age International (P) Ltd., New Delhi.2010.
3. Barendra Mohan Sen,"Fire protection and prevention the essential handbook", UBS publishers and Dist., New Delhi,2013.
4. "Fire Prevention and fire fighting", Loss prevention Association, India.
5. N F P A. Fire Protection Hand Book.20th Edition, 2008

SF8403 ELECTRICAL TECHNOLOGY AND SAFETY L T P C
3 0 0 3

OBJECTIVES:
- To provide an overview of basic electrical engineering concepts
- To expose the students to the principles of operation of d.c and a.c machines and safety systems in various electrical installations
- To brief the legislative requirements for electrical safety- national/international laws/codes of practices/ standards and/or regulations.
- To understand & brief the hazards associated with electricity at work place
- To study the electrical safety rules, regulations and quality management by the power factor improvement.

UNIT I ELEMENTARY IDEAS OF DC MACHINES, TRANSFORMERS AND RELAYS 9

Construction and Principle of operation of D.C machines - e.m.f equation of a generator - use of interpoles - characteristics of shunt, series and compound generators - starting and speed control - losses and efficiency. Construction and Principle of operation of single phase transformers - e.m.f equation - phase diagrams - equivalent circuit - regulation - losses and efficiency. Protective relays - Requirement of relay - types of protection – classification - distance relay, differential relay, state relays.

UNIT II SYNCHRONOUS, INDUCTION MOTOR, AND THEIR ELECTRICAL CIRCUIT BREAKERS 9

Synchronous machines - types - e.m.f equation - winding factors - armature reaction and leakage resistance. Synchronous motor - methods of starting - applications. Induction Motors - Construction and principle of operation - equivalent circuit - Torque - slip characteristics - method of starting - applications. Circuit breakers - function of switch gear - arc phenomenon - initialization of an arc - arc interruption - recovery voltage and restriking voltage - MCB and ELCB. Faults in power systems - causes - types.

UNIT III ELECTRICAL GROUNDING, EARTHLING AND INSULATION 9

Fuses - types - selection - advantages and disadvantages. Grounding - neutral grounding - solid grounding - resistance grounding - arc suppression coil grounding. Equipment grounding for safety - grounding substation - grounding of line structure. Earthing Effect of electric and magnetic fields - Human safety aspects - effect of current and voltage on human beings - typical V-I characteristics of skin - Electric shocks and their prevention. Insulation - classes of insulation - FRLS insulation - continuity test.

UNIT IV SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE 9

Safety during installation of plant and equipment. Safe sequences in installation - risk during installation. Safety during testing and commissioning. Test on relays - protection and interlock systems for safety. Hazardous zones - classification of hazardous zones. Intrinsically safe and explosion proof electrical apparatus. Selection of equipments in hazardous area. Electrical fires - hazards of static electricity. Safe procedures for electrical maintenance - Statutory requirements. Safety provisions in Indian Electricity Act & Rules.

UNIT V ELECTRICITY AND FIRE SAFETY 9

Total quality control and management – Importance of high load factor – Disadvantages of low power factor – Causes of low P.F. – power factor improvement – equipments – Importance of P.F. improvement.

Personal Protective equipments (PPE's) used in connection with safe use of electricity like Hand Gloves, Rubber Shoes, Waist belt, , earthing rod, Goggles etc., Safe working clearances for different voltage levels, fire extinguishers used for different applications, knowledge of Static electricity, Lightning protection, Electrical Safety Audit, elementary knowledge of first aid.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course the student will be able to:

- Know the constructional and operational features of d.c machines and single phase transformers.
- Understand the types and applications of synchronous machines, induction motors and circuit breakers.
- Understand the working principle of fuses, and grounding and earthling mechanisms
- Identify the safety precautions to be taken during installation of plant and equipment and understand the significance of hazardous zone classification and hazards of static electricity.
- Learn the human safety aspects over electric and magnetic fields

TEXT BOOKS

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. Pradeep Chaturvedi, "Energy Management Policy, Planning and Utilization", Concept Publishing Company, 1997.

REFERENCES:

1. Cotton, H. (2005). Electrical technology. (Seventh edition). CBS Publishers and Distributors, New Delhi
2. Kothari, D.P. and Nagrath, I.J. (2009). Basic electrical engineering. (Third edition). Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. National Safety Council. (1982). Accident prevention manual for industrial operations. Chicago.
4. Fordham-Cooper, W. (1998). Electrical safety engineering. Elsevier bv Amsterdam.
5. Rao, S. and Saluja, H.L. (2012). Electrical safety, fire Engineering and safety Management, Khanna Publishers, Delhi.

SF8404 OCCUPATIONAL HEALTH AND HYGIENE L T P C
3 0 0 3

OBJECTIVES:

- To teach the significance of occupational health and hygiene.
- To learn the fundamental principles of first aid.
- To Gain an historical, economic, and organizational perspective of occupational health and first aid.
- To identify the components needed to provide a safe and healthful work environment
- To acquired knowledge and skills needed to identify workplace problems and advance safe work

UNIT I OCCUPATIONAL HAZARD AND CONTROL PRINCIPLES 9

Concept and spectrum of health- functional units and activities of occupational health services- occupational and work related disease- Levels of prevention of diseases - notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax - Lead-Nickel, chromium and manganese toxicity- gas poisoning (such as CO, ammonia, coal and dust), their effects and prevention - Industrial toxicology - local and systemic and chronic effects, temporary and cumulative effects - threshold limit values, calculation of TLVs - carcinogens, mutagens, teratogens. Instruments for Radiation detection and measurement. Early recognition of radiation hazard. Personal monitoring devices, Medical support. Hazards associated with the following radiations and preventive measures- Laser, infra-red, ultra violet and ELF.

UNIT II PHYSICAL HAZARD MEASUREMENT, EVALUATION AND CONTROL 9

Recognition, evaluation and control of physical hazards. Vibration - description and measurement of vibration. Vibration control methods. Effects of whole body vibration on human body and control measures. Noise- noise measurement, evaluation, noise control methods -hearing loss - causes - Biological effects of noise exposure.Thermal stress - heat disorders and health effects such as heat exhaustion, hear cramp etc. WBGT index, acclimatization. Ventilation systems - purpose of ventilation-general principles ventilation requirements. Physiological and comfort level. Natural ventilation - Dilution ventilation - Mechanical ventilation - Local exhaust ventilation - Ventilation measuring instruments. Fundamentals of hood and duct designs. Standards on ventilation. Purpose of lighting. Advantages of good illumination. Lighting and the work. Sources and kinds of artificial lighting principles of good illumination. Design of lighting installation. Maintenance. Lighting and colour. Standards on lighting and illuminations.

UNIT III PRINCIPLES OF FIRST AID 9

First Aid principles-Role of the first aider-sequence of action on arrival at scene. Vital signs-breathing -pulse. Introduction to the body-basic anatomical terms-body cavities-head- cranium - thorax- abdomen and pelvis. Biomechanics - Structure and functions of musculoskeletal systems, tendons, ligaments, facia, bone, muscles, joints and basic mechanisms.Fainting-recognition-management-aftercare. Diabetes - hypoglycaemia – hyper glycaemia- management. Seizures (epileptic fits, convulsions) features- management, stroke. Head injuries-fractures of the base-vault and sides of skull.

UNIT IV FIRST-AID PRACTICE IN INDUSTRY 9

The circulatory system-heat attack-chest compression- CPR. Shock -causes - signs and symptoms - management of shock. Eye-eye injuries-foreign body in eye-eye trauma-corrosive chemical in eye-arc eye. Wounds-bleeding-classification-types of wounds-case of wounds- bleeding from special sites. Fractures- classification of fractures-principles of immobilisation- sprains and dislocation. Broad and narrow fold bandages-hand bandages-slings. The skin. Burns-rule of nines-pure thermal burns. Electric burns. Chemical burns. Radiation burns. Cold burns. Poisoning. Physical fitness. Lifting -casualty handling. Use of stretchers.

UNIT V OCCUPATIONAL AND PSYCHOLOGICAL HAZARDS 9

Elements of Industrial Psychology-Mental Health in Industries- Organisational Behaviour, Motivational Theory , Job SatisfactionValue system, Habits, Drug Abuse-Alcoholism in Industry, Communications, Organising Health education and Training Programme for employees, Psychological Hazards - Workplace Stress- General Adaptation SyndromeEustress –Distress-Diseases/Disorders related to Work stress- Psychosomatic disorders. Managing Work-stress in industry- Individual responsibilities - Employers Responsibilities. Psychological Counseling of employees- Employees Assistance Programme, Behaviour based Safety,.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the concept and spectrum of health – functional units and activities of occupational health service.
- Identify physical chemical and biological hazards in the work environment and its control measures.
- Demonstrate the principles of first aid.
- Understand anatomy and functions of different human systems.
- Identify the decisions required to maintain protection of the environment, home and workplace as well as personal health and safety.

TEXT BOOKS:

1. Goetsch D.L., (1999), Occupational Safety and Health for Technologists, Engineers and Managers, Prentice Hall.
2. Slote. L, Handbook of Occupational Safety and Health, John Willey and Sons, New York

REFERENCES:

1. Jeanne Mager Stellman (ed). Encyclopedia of occupational health and safety. (four volumes). (fourth edition). International Labour Office, Geneva.
2. The industrial environment - its evaluation and control. DHHS (NIOSH) publication number 74-117, 1973.
3. Clayton, C.D. and Clayton, F. (1981). Patty´s industrial hygiene and toxicology. Wiley Inderscience, New York.
4. Sue Reed, Dino Pisaniello, Geza Benke, Kerrie Burton, “Principles of Occupational Health and Hygiene” – An Introduction,Taylor and Francis group,2nd Edition,2013

SF8411 INDUSTRIAL HYGIENE LABORATORY L T P C

0 0 4 2

OBJECTIVES

To learn the techniques of assessing the quality of the work environment

LIST OF EXPERIMENTS:

1. Study of Personal Protective equipment
2. Study of occupational diseases with photographic models.
3. Demonstration of Air sampling equipment.
4. Sampling and estimation of dusts using high volume sampler
5. Sampling and estimation of dust using personal sampler
6. Measurement of Noise
7. Measurement of illumination
8. Vision testing
9. Lung functions testing.
10. Measurement of thermal stress.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of this course the student will be able to

- Evaluate the different pollutants in the atmosphere using air sampling equipment
- Evaluate heat stress in industries
- Measure different physical hazards such as noise, illumination etc.

HS8381 INTERPERSONAL SKILLS/LISTENING AND SPEAKING L T P C
0 0 2 1

OBJECTIVES: The Course will enable learners to:

- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- improve general and academic listening skills
- Make effective presentations.

UNIT I

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

UNIT II

Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

UNIT III

Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail

UNIT IV

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.

UNIT V

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

TOTAL :30PERIODS

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

- Listen and respond appropriately.
- Participate in group discussions
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal

TEXT BOOKS:

1. Brooks,Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Richards,C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

REFERENCES

1. Bhatnagar, Nitin and MamtaBhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.

SF8412 ELECTRICAL TECHNOLOGY LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To impart knowledge on electric circuits, DC motors, single phase transformers, AC motors, protective relays and circuit breakers.

LIST OF EXPERIMENTS

1. Verification of Kirchoff´s Laws
2. Verification of Superposition Theorem
3. Study of B.H. Curve on C.R.O
4. Measurement of power in an A.C. circuit by 3 ammeter and 3 voltmeter method
5. Load test on a DC series motor
6. Speed characteristics of DC shunt motor
7. Regulation of a Transformer
8. Load characteristics of a 3 phase induction motor
9. Study of protective relays and circuit breakers.
10. Study of insulation testing and ground testing.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of this course the student will be able to:

- Understand the laws governing electric circuits
- Study the load and speed characteristics of d.c motors
- Do load test on single phase transformer
- Study the load and speed characteristics of a.c motors
- Understand the functions of protective relays and circuit breakers.

ME8098	QUALITY CONTROL AND RELIABILITY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of SQC
- To understand process control and acceptance sampling procedure and their application.
- To learn the concept of reliability.

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 9

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation – Theory of control chart- uses of control chart –X chart, R chart and chart - process capability – process capability studies and simple problems. Six sigma concepts

UNIT II PROCESS CONTROL FOR ATTRIBUTES 9

Control chart for attributes –control chart for non conformings– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT III ACCEPTANCE SAMPLING 9

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT IV LIFE TESTING – RELIABILITY 9

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNIT V QUALITY AND RELIABILITY 9

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development–Product life cycles.

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

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 Summarize the concept of Quality and Process control for variables

CO2 Apply the process control for attributes

CO3 Explain the concept of sampling and to solve problems

CO4 Explain the concept of Life testing

CO5 Explain the concept Reliability and techniques involved

TEXT BOOKS:

1. Douglas.C. Montgomery, "Introduction to Statistical quality control", 7th edition, John Wiley 2012.
2. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 2008.

REFERENCES:

1. Besterfield D.H., "Quality Control", Prentice Hall, 2013.
2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 2012
3. Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991
4. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 2017
5. Gupta. R.C, "Statistical Quality control", Khanna Publishers, 2001.

SF8501 CHEMICAL TECHNOLOGY AND REACTION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To learn the manufacturing methods for various heavy chemicals and fertilisers and organic chemicals and to expose the students to the basics of reaction kinetics.
- To learn organic chemical elements like sugar, synthetic rubber, reactors and its behaviors etc..,
- To learn advance reaction technology and its function and application etc..,
- Concepts of catalysts, catalytic kinetic rate expressions, pore diffusion, and effectiveness factor
- Concepts of one-dimensional and two-dimensional pseudo homogeneous models

UNIT I SIMPLE INORGANIC SUBSTANCES 9

Inorganic chemical technology: Chlor-alkali industries-soda ash-caustic soda-chlorine-hydrochloric acid. Manufacture of bricks-Steps only, Characteristics of good sand-Functions of sand, Chemical composition of cement, Method of manufacture of cement – Dry process(Flow chart only), Preparation of cement mortar, Plain concrete and reinforced concrete, Brick Masonry – Bonds in brick masonry – (English bond only)

UNIT II SIMPLE ORGANIC SUBSTANCES 9

Organic chemical technology: Manufacturing processes for pulp and paper, sugar, industrial alcohol by fermentation-absolute alcohol, beers, wines, oils and fats, soaps and detergents, agrochemicals.

UNIT III MECHANISM OF REACTION 9

Classification of reactions, variables affecting rate of reaction, definition of reaction rate. Kinetics of homogeneous reactions - concentration dependent term of a rate equation, temperature dependent term of a rate equation, theories of reaction - collision theory, transition theory, Arrhenius equation.

UNIT IV PERFORMANCE OF REACTOR 9

Ideal reactors- Design for homogeneous systems, batch, stirred tank and tubular Flow reactor, design of reactors for multiple reactions, combination reactor system, size comparison of reactors. Elementary ideas of non-ideal reactor performance, residence time distribution curves E, F and C...

UNIT V SELECTION OF REACTORS 9

Size comparison of Single reactors, multiple reactor system, Reactions in Parallel and Series, Yield and Selectivity.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course the student will be able to:

- Analyse and improve the manufacturing methods for heavy chemicals and fertilizers
- Analyse and improve the manufacturing methods for organic chemicals and polymers.
- Behaviors of reaction elements
- Analyse the batch reactor systems
- Perform design calculations of CSTR and PFR

TEXT BOOKS:

1. Tapio Salmi and Jyri-pekka Mikkola,"Chemical Reaction Engineering and Technology",CRC press 2011 by Taylor & Francis Group, LLC, International Standard Book Number-13: 978-1-4398-9485-9
2. Davis, Mark E. and Davis, Robert J,".Fundamentals of chemical reaction engineering" ,McGraw-Hill, Chemical Engineering series. McGraw-Hill Higher Education , New York, NY. ISBN 007245007X,2003

REFERENCES:

1. Gopal Rao, M. and Sittig, M (Eds)."Dryden´s outlines of chemical technology for the 21st century". (third edition). Affiliated East West Press, New Delhi,2010.
2. Missen, R.W.; Mims, C.A.; Saville, B.A. 1999. Introduction to chemical reaction engineering and kinetics. John Wiley & Sons, Inc., New York.
3. Levenspiel, O. (2010). Chemical reaction engineering. (third edition).Wiley India Pvt. Ltd., New Delhi.
4. Dr.Anil kumar Misra,"Building Materials and Construction",S.Chand Publication, ,2017.
5. S.K.Duggal,"Building Materials",3rd Edition,New Age International (pvt) Limited Publishers,2000.

SF8502 DESIGN OF FIRE FIGHTING AND PROTECTION SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the principle of different automatic fire detection systems and their application.
- To learn about the principle of fire extinguishment and the performance of extinguishing agent.
- To learn about the different types of first aid and portable fire protection system; their operation and maintenance requirements.
- To learn about the details and design principle of fixed fire fighting systems with different extinguishers like water, CO2, DCP and foam.
- To learn about different types of fire alarm system.

UNIT I INTRODUCTION OF FIRE PROTECTION SYSTEMS 9

Fire detection- Need and importance of automatic fire detection system, principle of detection, classification of detectors; Heat detectors - fixed temperature, rate of rise , thermistor rate of rise and rate compensated type detectors; Smoke detectors- optical and ionization type, photo electric light scattering and light obstruction type detectors; Flame detectors - infra red and ultra violet detectors; Flammable gas detection- Pellistor and laser detectors; Testing of fire detection devices as per relevant Indian standards specifications; Comparison of detectors; Performance characteristics of detectors; Lag time associated with fire detection.

UNIT II FIRE FIGHTING EQUIPMENTS 9

Hose And Hose Fitting – Detail study of hoses-coupling, branches-branch holders, Monitors-Nozzles-Stand pipes-Collecting Head-Suction hose fitting breaching. Adapters and Ramps. Portable Fire Extinguishers – Construction features - Specifications and Application-Extinguishers using water,Foam,co2 dry power and dry water. Foam and Foam making Equipment – Types of Foam, Properties and characteristics of good foam-practical consideration, care and maintenance.

UNIT III FIRE CONTROL SYSTEM 9

Automatic water sprinkler system- requirement and source of water supply, automatic pumps; Automatic sprinkler heads-Quartzoid type, fusible link type, modern types; mounting and protection of sprinkler heads; Sprinkler pipe works-standard and staggered lay out, hangers; Control valves for wet and dry installations; deluge valve. Drenchers; High velocity and medium velocity spray system; Principles of water sprinkler system design as per relevant standards (ISI).

UNIT IV FIRE DETECTION AND ALARM SYSTEM 9

Fire detection sensors - Fire alarm system- classification of alarm system as per NBC; Manually operated system; Automatic alarm system-Addressable and non-addressable system; Features of Local system, Auxiliary system, Remote station system, Central station system and Proprietary system.

UNIT V PERSONNEL PROTECTIVE EQUIPMENTS 9

Complete Head to Toe Protection Equipments – Types, Construction and reliability of Head protection-Helmets,Face protection – Face shields, Body Protection – Aprons, Leg Protection – Shoes and Fall protection – Safety belts

TOTAL: 45 PERIODS

OUTCOMES

On completion of this course the student will be able to

- Understand the working principle of different types of fire detectors and will be able to select suitable fire detectors appropriate to the given situation.
- Understand the concept of fire extinguishment and able to choose the proper type of first aid and portable fire protection system appropriate to the given situation.
- Interpret the appropriate standards for the design, installation, inspection, testing and maintenance of fixed sprinkler systems as per Indian standard specifications.
- Interpret the appropriate standards for the design, installation, inspection, testing and maintenance of fixed CO2, DCP and foam systems as per Indian standard specifications.
- Understand about the different types of fire alarm systems and about their requirements as per Indian standard specifications.

TEXT BOOKS:

1. Barendra Mohan Sen,"Fire protection and prevention the essential handbook", UBS publishers and Dist., New Delhi,2013.
2. William E Clark (1991). "Firefighting principles & practices" (2nd edn.) Fire Engineering Books & Videos,1991.

REFERENCES:

1. Ron Hirst (1989). Underdowns practical fire precautions, Gower publishing company Ltd., England.
2. Handbook of Fire and Explosion Protection Engineering Principles for Oil, Gas, Chemical, and Related Facilities, Fourth Edition DENNIS P. NOLAN Saudi Aramco, Milwaukie, OR, United States, gulf professional publishing.
3. Introduction to Fire Safety Management The handbook for students on NEBOSH and other fire safety courses Andrew Furness CFIOSH, GIFireE, Dip2OSH, MIIRSM, MRSH Martin Muckett MA, MBA, CMIOSH, MIFireE, Dip2OSH., Elsevier Ltd.
4. Daniel E.della-Giustina,Ph.d."Fire and safety management hand book", third edition, CRS press international standard book number 13:978-1-4822-2123-7.
5. N F P A. Fire protection hand book Relevant IS codes

SF8503 MANUFACTURING PROCESSES L T P C
3 0 0 3

OBJECTIVES:

- To learn about the various engineering materials, their properties and properties modification methods ; various manufacturing processes and corresponding equipment and machineries used in engineering industries.

UNIT I INTRODUCTION ABOUT MATERIALS AND ITS PROCESS 9

Engineering Materials: - Classification, Properties - mechanical, thermal, chemical and technological. Iron and Steel-Processes and Classifications. Non-ferrous metals, processes, properties and use. Heat treatment of steels-purpose and methods. Processes-annealing, normalizing, hardening, tempering.

UNIT II METAL JOINING PROCESS 9

Welding:-Introduction, weldability, Types of welding, Gas welding, Arc welding - submerged arc, TIG, MIG. Resistance welding, solid state welding, Electron beam welding, Laser beam welding. Oxygen cutting. Heat affected zones, Weld defects, Inspection of welded joints.

UNIT III CASTING PROCESS 9

Metal Casting: - Pattern- pattern materials, types of patterns, pattern allowance, Molding sands-properties and classification. Core and core sands. Molding process. Special casting methods- die casting, centrifugal casting, investment casting, slush casting. Casting defects and inspection.

UNIT IV METAL FORMING AND ADVANCED MACHINING TECHNIQUE 9

Metal Forming: - Mechanical working of metals. Hot working, cold working. Methods and process of rolling, forging, and extrusion.

Machining: - Metal cutting, Orthogonal and Oblique cutting, Cutting tool materials. Classification of machine tools - lathe, shaper, milling machine, drilling machine and grinding machine. Advanced machining methods- ECM, EDM, USM and AJM.

UNIT V CONVENTIONAL MACHINING PROCESS AND ADDITIVE MANUFACTURING 9

Single and multi-point cutting, orthogonal cutting. Various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool materials, cutting fluids, Coating, Turning, Drilling, Milling and finishing processes. Introduction to CNC machining Additive manufacturing: Rapid prototyping and rapid tooling Joining/Fastening processes: Physics of welding, brazing and soldering, design considerations in welding, Solid and liquid state joining processes, Adhesive bonding.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course the student will be able to have

- Knowledge of various engineering materials, properties and properties modification methods.
- Knowledge of various welding processes and the equipment´s; Gas cutting, NDT of weldments
- Knowledge of various metal casting methods and equipment and NDT of castings
- Knowledge of various metal forming methods and equip; various metal cutting methods and machines.

TEXT BOOKS:

1. V.K. Jain (2005), Advanced Machining Processes, Allied Publishers Private Limited, India.
2. Pandey P. C., Modern Machining Processes, TMH Publication

REFERENCES:
1. Sharma P.C. (2007). A Text Book of Production Technology. S. Chand & Co, New Delhi.
2. P.C. Pandey and H. S. Shan (1996), Modern Machining Processes, TMH Publishing Limited, New Delhi.
3. Benedict G.F., Non Traditional Manufacturing Processes, Marcel Dekker.
4. Jain P L, Principles Foundry Technology, Tata McGraw Hill,New Delhi
5. S. Kalpakjian and S. Schemid (2001), Manufacturing, Engineering and Technology, Addison Wesley.

SF8504 CHEMICAL PROCESS SAFETY L T P C
3 0 0 3

OBJECTIVES

- To teach the principles of safety applicable to the design, and operation of chemical process plants.

UNIT I SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES 9

Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories.

UNIT II CHEMICAL REACTION HAZARDS 9

Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening,

UNIT III SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS 9

Design principles -Process design development -types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares- new concepts in safety design and operation- Pressure vessel testing standards- Inspection techniques for boilers and reaction vessels.

UNIT IV SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS 9

Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards -standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures- condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

UNIT V SAFETY AND ANALYSIS 9

Safety vs reliability- quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course the student will be able to:

- Differentiate between inherent safety and engineered safety and recognize the importance of safety in the design of chemical process plants..
- Develop thorough knowledge about safety in the operation of chemical plants.
- Apply the principles of safety in the storage and handling of gases
- Identify the conditions that lead to reaction hazards and adopt measures to prevent them.

TEXT BOOK

1 David A Crowl & Joseph F Louvar,"Chemical Process safety", Pearson publication, 3rd Edition,2014

2 Maurice Jones .A,"Fire Protection Systems,2nd edition, Jones & Bartlett Publishers,2015

REFERENCES:

1. Ralph King and Ron Hirst,"King´s safety in the process industries", Arnold, London, 1998.
2. Industrial Environment and its Evolution and Control, NIOSH Publication, 1973.
3. National Safety Council," Accident prevention manual for industrial operations". Chicago, 1982.
4. Lewis, Richard. J., Sr,"Sax´s dangerous properties of materials". (Ninth edition). Van Nostrand Reinhold, New York, 1996.
5. Roy E Sanders, "Chemical Process Safety",3rd Edition, Gulf professional publishing, 2006

SF8511 UNIT OPERATION LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To understand the practical aspects of the various unit operations employed in chemical industry.

LIST OF EXPERIMENTS

1. Sieve Analysis - To analyse a given sample using a set of standard sieves and thus to determine the specific surface area, the volume surface mean diameter and the mass mean diameter by differential analysis and cumulative analysis.
2. Verification of the laws of crushing in a Ball mill and calculation of critical speed.
3. Study of the working of Plate and frame filter press.
4. Free settling - To find out the drag coefficient of a falling sphere in a Fluid and verification of Stoke´s law.
5. Sedimentation - To study batch sedimentation of slurry and to determine the area of the continuous thickener.
6. Heat transfer from steam to air - Determination of overall heat transfer coefficient.
7. Verification of material balance equation and Rayleigh´s equation for simple distillation.
8. Steam distillation.
9. Leaching - leaching a mixture of salt and sand.
10. Study of the kinetics of chemical reaction in a batch reactor.
11. Adsorption isotherms.
12. Frequency response of first and second order systems.

TOTAL: 60 PERIODS

OUTCOMES:

On completion of this course the student will be able to:

- Determine the surface characteristics of solid particles
- Determine the energy requirements for size reduction equipment
- Calculate the area required for a continuous thickener
- Compare the efficiency of different types of distillation

SF8512 MANUFACTURING PROCESSES LABORATORY L T P C
0 0 4 2

OBJECTIVES

- To understand and appreciate the importance of basic principles of Production Engineering.
- To understand the application of those principles in practice.
- To understand the design and manufacture of simple patterns.
- To understand the Arc welding, gas welding and resistance welding equipment for the fabrication of welded joints.
- To understand the concept of blow and injection moulding processes.

LIST OF EXPERIMENTS

I. Metal Casting Lab:

1. Pattern Design and making – for one casting drawing.
2. Sand properties testing – Exercise -for strengths, and permeability – 1
3. Moulding Melting and Casting – 1 Exercise

II. Welding Lab:

1. ARC Welding Lap & Butt Joint – 2 Exercises
2. Spot Welding – 1 Exercise
3. TIG Welding – 1 Exercise
4. Plasma welding and Brazing – 2 Exercises (Water Plasma Device)

III. Mechanical Press Working:

1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending and other operations

IV. Processing of Plastics

1. Injection Moulding
2. Blow Moulding

OUTCOMES

1. Recommend appropriate part manufacturing processes when provided a set of functional requirements and product development constraints.
2. Recommend cost-effective material options based upon net part shape, expected loading, operating environment, cost constraints, and life expectancy.
3. Fabricate basic parts and assemblies using powered and non-powered machine shop equipment in conjunction with mechanical documentation.
4. Ascertain product and process quality levels through the use of precision measurement tools and statistical quality control charts.
5. Mitigate production problems using risk management and root cause analysis tools.

TOTAL: 60 PERIODS

SF8601 LEGAL ASPECTS OF HEALTH SAFETY AND ENVIRONMENT L T P C
3 0 0 3

OBJECTIVES:

- To be aware of and to gain insight into the laws relating to industries, docks and harbors, labor welfare and environment protection. On successful completion of this course the students will be able to prepare legal compliance registers appropriate to their industries or organizations.
- An ability to select and apply the knowledge, techniques and modern tools of the discipline to fields broadly-defined as fire protection, health, environment and safety engineering and technology.
- Demonstrate a mastery of Health safety and environment knowledge and safety management skills, to reach higher levels in their profession.
- Effectively communicate on Health safety and environment, facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering environment.
- To provide a structured management approach to control safety risks in operations. Effective safety management must take into account the organization's specific structures and processes related to safety of operations

UNIT I FACTORIES ACT 9

Factories Act- Definitions, Preliminary, Inspecting staff, Health, Safety, Provisions relating to hazardous processes, Welfare, Working hours of adults, Employment of young persons, Special provisions. Dock Workers (Safety, Health and Welfare) Act - Definitions, Powers of inspectors, Power of Govt. to direct inquiry, Obligation of dock workers. Duties of Safety Officers, Reporting of accidents, Emergency Action Plan, Safety Committee.

UNIT II DOCK WORKERS (SAFETY, HEALTH AND WELFARE) ACT 9

Employees' Compensation Act: Definitions, Employer´s liability for compensation, Calculation of amount of compensation. ESI Act and Rules: Applicability, Definitions and Benefits. Public Liability Insurance Act and Rules- Definitions, Calculation of amount of relief, Environmental Relief Fund, Advisory Committee, Powers of District Collector, Extent of Liability, Contribution to Relief Fund.

UNIT III EXPLOSIVES ACT 9

Explosives Act: Definitions, Categories of Explosives, General Safety Provisions, and Use of Explosives, Grant of license, Notice of Accidents, Inquiry into ordinary and more serious accidents, Extension of definition to other explosive substances. Explosives Rules, SMPV Rules and Gas Cylinder Rules (in brief). Petroleum Act with important rules - definitions, safety in the import, transport, storage, license, exemption, notice of accidents.

UNIT IV WORKMEN'S COMPENSATION ACT 9

Water Act and Air Act: Definitions, powers and functions of Boards, prevention and control of pollution, consent administration. Environment (Protection) Act and Rules-Definitions, powers of central government, power of giving directions, authorities. MSIHC Rules- Definitions, Duties of Authorities, Notification of major accidents, safety Reports, safety audit, on- site & out-site emergency plans, safety information to public.

UNIT V POWER TO MAKE RULES 9

Powers and Functions of Central, State and Joint Boards, Provisions regarding prevention and control of water pollution, Penalties, Central & State Water Laboratories, Power to make rules, Power of supersession and overriding effect. Rules on Consent for Establishment

Note: Case laws may be referred if necessary, but those are beyond the scope of this course.

TOTAL: 45 PERIODS

OUTCOMES:

- Gain knowledge and to apply the knowledge on provisions relating to Hazardous process.
- Gain knowledge on laws relevant and concerning towards welfare, working hours and health and safety of workers engaged in industries.
- Learn various laws relevant for inquiry into certain accidents, Advisory Committee, Inquiry in Public, and Reporting of accidents, Emergency Action Plan, Safety Committee, Occupational Health services for dockworkers, various safety and health regulations in brief.
- Understand and learn about the legal aspects granting of license for storage, transportation and usage of explosive substance as applicable as per Petroleum Act and Explosive Act.
- Understand the legal obligations regarding any injury by gaining knowledge of Workmen's Compensation Act. ESI Act & Rules. Public Liability Act & Rules.
- Learn concept, powers and functions of Central, State and Joint Boards, provisions regarding prevention and control of Water & Air pollution, Penalties, Central & State Laboratories, Power of supersession and overriding effect and the rules on Consent for Establishment of an industries and their applicable no objection certificate.

TEXT BOOKS:

1 K.T.Narayanan, "Safety, Health and Environment Handbook Hardcover",1st Edition,McGraw Hill Education (India) private limited,2017
2 Gayle wood side and Dianna Koeurek,"Environmental Safety and Health Engineering", John Wiley & Sons,1997

REFERENCES:

1. Environmental Management Handbook for Hydrocarbon Processing Indus; James B. Well Factories Act, 1948.
2. Ganguly & Changeriya,"Health Safety and Environment
3. Explosives Act and related Rules & The Gas Cylinder Rules, 2004, Professional Book publishers
4. Petroleum Act and Rules & The Petroleum Act, 1934 © Universal Law publishing
5. Environmental Acts & relevant Rules as above.

SF8602 PROCESS INSTRUMENTATION AND CONTROL L T P C
3 2 0 4

OBJECTIVES:

- The aim of the course is to impart the principles of measurement used in industries and research, classification of instruments, analysis of process parameters and design of control systems for open loop and closed loop systems and their application in chemical industries.
- To provide a structured management approach to control safety risks in operations. Effective safety management must take into account the organization's specific structures and processes related to safety of operations.
- Demonstrate a mastery of Health safety and environment knowledge and safety management skills, to reach higher levels in their profession.
- Effectively communicate on Health safety and environment, facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering environment.
- Demonstrate professional expertise to the industrial and societal needs at national and global level subject to legal requirements

UNIT I FUNCTIONS OF INSTRUMENTS AND MEASUREMENT SYSTEM 15

Elements of measurement - Fundamental standards, Quality of measurement, Meaning of measurement, Errors in measuring instruments, Precision and accuracy, Calibration principle, Static and dynamic characteristics of measuring instruments. Measurement of temperature - Bimetallic and pressure thermometers, Thermocouples, Resistance thermometers, Pyrometer, Calibration. Pressure and vacuum measurement - Manometers, Measuring element, Absolute pressure measurement, Static accuracy of pressure gauges.

UNIT II MEASUREMENT OF PRESSURE 15

Flow measurement - Orifice installation, Pitot tube, Area Flow meters, Open channel meters. Level measurement - Direct method, Measurement of level in open and pressure vessels. Measurement of pH and humidity. Recording Instruments, Indicating and signaling instruments, Signal transmission, and codes.

UNIT III ELEMENTS OF GENERALIZED PROCESS CONTROL 15

Open loop and close loop systems - Transfer function modeling -block diagram representation of mechanical, thermal and liquid level systems. Transient response analysis - Time response of first and second order system for impulse and step inputs - Effect of damping factors on transient response - Characteristics of proportional, integral, derivative, PI, PD and PID controllers. Frequency response method of analysis - polar plot - Bode Plot.

UNIT IV PROCESS CONTROL 15

Introduction to stability - Definition via impulse response function - Routh- Hurwitz stability criterion - SyQuest stability criterion. Control system components-error detectors modulators and demodulators - Hydraulic controllers - Pneumatic controllers - PLC.

UNIT V ADVANCED CONTROL SYSTEMS 15

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

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course the student will be able to

- Acquire knowledge about the measurement principles and techniques of measuring temperature and pressure.
- Identify suitable methods for the measurement of Flow, level, pH and humidity.
- Understand the open loop and closed loop control system
- Analyze the stability of a control system
- Knowledge of various hazards associated with hot working of metals and methods of Control.

TEXT BOOK:

1. Patranabis, D."Principles of Industrial Instrumentation". (Second edition). Tata McGraw-Hill Publishing Company Ltd, New Delhi,1996.
2. Coughanowr, C.R. and Koppel, L.M."Process System Analysis and Control". McGraw Hill, New York.1998.

REFERENCES:

1. Eckman, D. P. "Industrial instrumentation". Wiley Eastern Ltd, New Delhi.1990.
2. George Stephanopolous, "Chemical process control: An introduction to theory and practice". Prentice Hall of India Pvt. Ltd,1990.
3. Irwin B Crandall, "Theory of Vibrating Systems and Sound", D. Vannostrand Company, New Jercy, 1974.
4. I.K. Sawhney, S. K. Chaudhary & Sunil Kumar," Instrumentation and Process Control,2018
5. K Krishnaswamy," Industrial Instrumentation Vol. I, New Age International, 2003

SF8603 HAZARD CONTROL IN MANUFACTURING L T P C
3 0 0 3

OBJECTIVES:

- To learn about the various hazards associated with the manufacturing processes employed in engineering industries and methods used to safeguard the operators and others
- To understand the concepts of global scenario of Health & safety.
- To analyses the gaps between reference standards & pertinent conditions of safety in India.
- Students should be able to analyses and solve basic agronomical issues.
- To be efficient in the operation of industrial hygiene equipment.
- To understand the effects of various gases & treatments.

UNIT I INTRODUCTION TO MANUFACTURING PROCESSES 9

Introduction - Classification of Engineering Industry - Manufacturing Processes Hot Working - Foundry operations-furnace and equipment, health hazard, safe methods of operation. Forging operations, heat radiation, maintenance of machines, shop equipment and hand tools - safe work practice. Operations in hot and cold rolling mills.

UNIT II HAZARDS SAFETY MEASURES IN MANUFACTURING INDUSTRY 9

Machinery safeguard-Point-of-Operation, Principle of machine guarding - breakdown of machine guarding - types of guards and devices.Cold Working-Safety in Power Presses, primary & secondary operations - shearing -bending - rolling - drawing. Metal Cutting- safety in turning, boring, milling, planning and grinding. Maintenance of machine tools - health hazards and prevention.

UNIT III CONCEPTS OF FIRE SAFETY IN INSTALLATIONS 9

Welding and Cutting-Safety Precautions of Gas welding and Arc Welding, Cutting and Finishing. Gas Cylinders and Equipment´s. Heat Treatment- Furnaces and Salt baths-operations and maintenance - safety in handling and storage of salts - disposal of effluents - health precautions, exposure to hazardous fumes, source of fumes, ventilation and fume protection.

UNIT IV FUNDAMENTALS OF MATERIAL HANDLING 9

Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance. Maintenance of common elements- wire rope, chains slings, hooks, clamps.

UNIT V SAFETY IN OIL AND GAS PLANT 9

Well Completion Practices: Well- Head Assemble, Installation and Testing, Activation, Well Testing, Self-Flowing Wells, Gas Lift: Sucker Rod and Down Hole Motor Pumping of Oil, Safety Issues in Oil and Gas Production

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course the student will be able to have

- Knowledge of various hazards associated with hot working of metals and methods of control
- Knowledge of various hazards associated with cold working and cutting of metals and methods of control
- Knowledge of various hazards associated with welding and cutting of metals and methods of control
- Knowledge of various material handling methods and systems; the hazards and methods of control
- Analyze the stability of a control system in A to Z of Environmental Audit.

TEXT BOOKS :

1. SC Bhatia,"A Handbook on health, Safety and Environment", 2007
2. James T. Tweedy,"Introduction to Hazard Control Management, CRC Press,2013

REFERENCES:

1. National Safety Council."Accident prevention manual for industrial operations". Chicago,1982.
2. Ronald P. Blake."Industrial safety". Prentice Hall, New Delhi. Balchin, N.C.,2005. Health and Safety in Welding and Allied process, Jaico Publishers, New Delhi,1973.
3. E-Waste Managing the Digital Dump Yard, Edited by VishakhaMunshi, ICFAI University Press
4. J.M. Goel," Hazardous Waste Management" Perspectives in Nuclear Toxic and Hazardous Waste by Kadambari Sharma.

SF8604 PLANT FIRE SAFETY L T P C
3 0 0 3

OBJECTIVES

- To enable the students to acquire knowledge of Fire and Safety Studies
- To learn about the effect of fire on materials used for construction, the method of test for non-combustibility & fire resistance and to learn about the approximate method of calculation of fire resistance rating of structural elements
- To learn about fire area, fire stopped areas and different types of fire-resistant doors
- To learn about the method of fire protection of structural members and their repair due to fire damage.
- To develop safety professionals for both technical and management through systematic and quality-based study programmes

UNIT I INHERENT SAFETY CONCEPTS 9

Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within building and between buildings. Effect of temperature on the properties of structural materials- concrete, steel, masonry and wood; Behavior of non-structural materials on fire- plastics, glass, textile fibres and other house hold materials. Determination of combustibility by fire tube method; Brief description on non-combustibility test and classification of flame spread rate of materials as per relevant standards (BIS).

UNIT II PLANT LOCATIONS 9

Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements-standard heating condition, types of furnaces, Indian standard test method, performance criteria, drawbacks to the fire resistance test. Approximate methods for calculating the fire resistance of structural elements- Schematic diagrams, influencing factors; Principle of calculation of the fire resistance limits of structures; Approximate calculation of the required fire resistance for a building; Method of arriving at the required fire resistance of structural members as per BIS.

UNIT III WORKING CONDITIONS 9

Fire area- calculation of building fire area, subdivision of fire areas in Industrial, Residential and Public buildings; Fire separation between building- principle of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens- solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures; Fire doors- Low combustible, Non-combustible and Spark-proof doors; method of suspension of fire doors; Air-tight sealing of doors; Specification, test and performance criteria of Plate, Metal covered and Rolling type fire doors as per relevant standards (ISI).

UNIT IV FIRE SEVERITY AND REPAIR TECHNIQUES 9

Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements - Wooden, Steel and RCC.. Reparability of fire damaged structures- Assessment of fire severity, Assessment of damage to concrete, steel, masonry and timber structures, Assessment of feasibility of repair; Repair techniques- repair methods to reinforced concrete Columns, beams and slabs, Repair to steel structural members, Repair to masonry structures.

UNIT V WORKING AT HEIGHTS 9

Safe Access - Requirement for Safe Work Platforms- Stairways - Gangways and Ramps-Fall Prevention & Fall Protection - Safety Belts - Safety nets - Fall Arrestors- Working on Fragile Roofs - Work Permit Systems-Accident Case Studies.

TOTAL: 45 PERIODS

OUTCOMES

On completion of the course the student will be able to

- Understand the effect of fire on materials used for construction
- Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.
- To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.
- To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.
- Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.

TEXT BOOKS

1. Roytman, M. Y,"Principles of fire safety standards for building construction". Amerind Publishing Co. Pvt. Ltd., New Delhi,1975
2. John A. Purkiss,"Fire safety engineering design of structures" (2nd edn.), Butterworth-Heinemann, Oxford, UK,2009.

REFERENCES:

1. Smith, E.E. and Harmathy, T.Z. (Editors),"Design of buildings for fire safety". ASTM Special Publication 685, American Society for Testing and Materials, Boston, U.S.A,1979.
2. Butcher, E. G. and Parnell, A. C, "Designing of fire safety". JohnWiley and Sons Ltd., New York, U.S.A.1983.
3. Jain, V.K,"Fire safety in buildings" (2nd edn.). New Age International(P) Ltd., New Delhi,2010.
4. Hazop & Hazan,"Identifying and Assessing Process Industry Hazards", Fourth Edition ,1999
5. Frank R. Spellman, Nancy E. Whiting,"The Handbook of Safety Engineering: Principles and Applications", 2009

SF8605 **INDUSTRIAL SAFETY** **L T P C**
3 0 0 3

OBJECTIVES:

- To illustrate the importance and need of safety engineering.
- To understand the concepts of global scenario of Occupational Health & safety Management system.
- To analyses the gaps between reference standards & pertinent conditions of safety in India.
- Finding out a proper workplace/ location and making layout of plant for safe/time saving and low-cost work practice
- Modelling of best working conditions (ergonomics and environment) and material transfer techniques for engineering works

UNIT I FOUNDRY OPERATIONS SAFETY 9

FOUNDRY OPERATIONS Furnace - health hazard - safe methods of operation. Forging operations - heat radiation - maintenance of machines - final checking of tools, guards, lubrication, shop equipment and hand tools - safe work practice. Operations in hot and cold rolling mills.
Shearing -bending - rolling - drawing - turning - boring - milling - planing - grinding. Selection and care of tools - health hazards and prevention

UNIT II BUILDING FIRE SAFETY 9

Building Fire Safety Objectives of fire safe building design, Fire load, fire resistant material and fire testing – structural fire protection –structural integrity –concept of exit design -exists width calculations -fire certificates –fire safety requirements for high rise buildings –snookers.

UNIT III PERSONNEL RISK IN INDUSTRIAL OPERATIONS 9

Storages and Transportation 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 -underground storages-loading and unloading facilities-drum and cylinder storage-ware house, storage hazard assessment of LPG and LNG Hazards during transportation –pipeline transport

UNIT IV WORKSHOP PROCESS SAFETY 9

Workshop Safety Hand tools and Power tools - Safety while using Grinding stone - Welding and gas cutting safety – Identification of Dangerous points - Lubrication Safety-Safety in Cold Forming and Hot Working of Metals

UNIT V SAFETY INSPECTION AND AUDIT 9

Safety Inspections Safety Audit- Safety Survey - Plant safety inspection - Safety tour - Safety samplings - What is safety budget – Direct cost – indirect cost- Safety Equipment's & their budget preparation

TOTAL: 45 PERIODS

OUTCOMES:

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

- To demonstrate the role and Responsibility of safety officers, hazards in Petroleum industry
- To apply the statutory rules and regulations applicable in Petroleum industry mainly
- Conduct Accident Investigation process and find the root cause of Accident
- Calculate the compensation money for injured person and reporting to higher authorities
- Form a Safety policy for any organization and demonstrate its need
- To explain the various elements of Process Safety Management
- To form Emergency Management plan for any Organization
- To explain and control major risk in Material transfer from one place to another place.

TEXT BOOKS

1. Elahi naseer," Industrial safety management, kalpaz publication,2006
2. Dr. Shailednrakumar u. Kale dr. Umesh gramopadhye,"Industrial Safety Management",

REFERENCES

1. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council, UK
2. Hazop and Hazon, by Trevor A Klett, Institute of Chemical Engineering.
3. "Guidelines for Chemical Process Quantitative Risk Analysis", second edition, Centre for Chemical Process safety, AICHE, 2000
4. Guidelines for Hazard Evaluation Procedures, Third Edition,Centre for Chemical Process safety, AICHE 2008
5. An introduction to Production management techniques. (Wickens Christopher, Lee John).
6. Ronald P. Blake, Industrial Safety: Prentice Hall, New Delhi,1963

SF8611 INDUSTRIAL TRAINING (FIRE SAFETY) **L T P C**
0 0 4 2

The objective of the Industrial Training is to enable the students to get practical knowledge towards the handling of safety and fire equipmnts in a reputed industry or institution. The training involves hands on training of safety equipments in industry, case study in safety measurements / arrangements which have been used in industry/Institute and emerging techniques in fire safety. Groups of not more than four members in a group will carry out the training.

The students are required to undergo Industrial Training during the winter vacation of around 10-15 Days / 90 Hrs in a reputed industry or institution. The students who wish to undergo industrial training, the industry chosen for undergoing the training should be at least a private limited company. The students shall submit and present the progress report at the Institute at least thrice in this duration for internal assessment. The presentation will be attended by a committee. Alternately, the teacher may visit the Industry to get the feedback of the students.

The final end semester exam of the Industrial Training will be conducted by an external examiner and one internal examiner appointed by the Institute. External examiner will be from the panel of examiners submitted by the concerned institute approved by the Anna University. Assessment of Industrial Training will be based on seminar, viva-voce, report and certificate of Industrial Training or Institutional Project Work obtained by the student from the industry or Institute.

The internal marks distributions for the students who have undergone Industrial Training consist of 50 marks from the industry concern and 100 marks by the committee members consisting of faculty members of concerned department of the parent institute.

The teachers engaged for Institutional Project work shall have a workload of 2 hours per group (at least 4 students) per week.

TOTAL: 60 PERIODS

HS8581 **PROFESSIONAL COMMUNICATION** **L T P C**
0 0 2 1

OBJECTIVES: The course 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

TOTAL :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. Open Source Software
2. Win English

REFERENCES:

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

SF8701 HAZARD ANALYSIS AND RISK ASSESSMENT L T P C
3 0 0 3

OBJECTIVES:

- To learn the various techniques for hazard identification, reliability analysis, estimation of frequency of occurrence of hazards, consequence analysis, risk quantification and human reliability analysis.
- To provide knowledge in Quantitative Risk Analysis Process Industries
- To provide in-depth knowledge of risk Control and Management
- To familiarize the student with various types of Hazard Identification techniques
- Identify various Hazards related to the work practices and activity using various technique.

UNIT I HAZARD IDENTIFICATION AND RISK ANALYSIS 9

Hazard and risk, Types of hazards - fire, explosion and toxic gas release, Structure of hazard identification and risk assessment. Identification of hazards : Inventory analysis, Fire and explosion hazard rating of process plants - The Dow Fire and Explosion Hazard Index, The Mond Index, Plant layout and unit hazard rating, Preliminary hazard analysis, Hazard and Operability study (HAZOP), What If analysis, Case studies.

UNIT II RISK CONTROL & MANAGEMENT 9

Plant availability and process reliability: ways of improving plant availability, MTBF and MTTF, the reliability function, failure rate, bathtub curve, probability relationships, simple reliability estimation. Estimation of frequency of occurrence of a hazard: The logic tree approach, set theory and Boolean algebra, application to probability, Boolean manipulation. Fault tree analysis - logic symbols, minimal cut set, logic gates, fault tree quantification. Event tree analysis - notation, event tree construction, advantages and disadvantages of ETA. Failure mode and Effect Analysis (FMEA) - methodology, criticality analysis, corrective action and follow-up.

UNIT III ENVIRONMENTAL HEALTH RISKS 9

Consequence modeling:Source models - discharge rate models, flash and evaporation, dispersion models. Explosions and fires -vapour cloud explosions, flash fires, physical explosions, BLEVE and fire ball, confined explosions, pool fires, jet fires. Effect models -dose-response functions, probit functions, toxic gas effects, thermal effects, explosion effects - Software application for effect and damage calculations.

UNIT IV HAZARDS MONITORING AND EMERGENCY MANAGEMENT 9

Quantification of risk: QRA, Vulnerability analysis, accepted and imposed risk, perception of risk, risk indices, individual risk and societal risk, acceptance criteria for risk, ALARP, Presentation of measures of risk - risk contour, F-N curve. Calculation of individual risk and societal risk.Human reliability analysis (HRA): factors leading to human error, characteristics of HRA techniques, Technique for Human Error Rate Prediction (THERP), Accident Sequence Evaluation Program (ASEP), Techniques using expert judgment, Operator Action tree (OAT).

UNIT V DISASTER MANAGEMENT IN INDIA AND RELIEF 9

History of disasters - various disasters in various countries - Disasters in India Relief and rehabilitation in disasters at local, national and global levels, Gaps in disaster management identified on analysis, Worldwide Aid and Agencies, Study of different case studies on natural disaster & man-made disaster

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course the student would be able to:

- Attain the ability to use the hazard indices, HAZOP, PHA and What if analysis for the identification of hazards in a process
- Attain the ability to assess probability of occurrence of an event using fault tree and event tree analysis
- Estimate the consequences of fire, explosion and toxic gas release using suitable empirical models
- Quantify the risk involved in a process
- Identify various Hazards related to the work practices and activity using various technique.

TEXT BOOKS

1. Geoff Wells, “Hazard Identification and Risk Assessment”,1997.
2. Marvin Rausand ,”Risk Assessment”, John Wiley & Sons, Inc,2011

REFERENCES:

1. AIChE/CCPS.”Guidelines for Hazard Evaluation Procedures”. (Second edition). Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York, 1992.
2. AIChE/CCPS.”Guidelines for Chemical Process Quantitative Risk Analysis”. (Second edition). Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York,2000.
3. Sam Mannan (Editor).”Lee´s Loss Prevention in the Process Industries”. (Fourth edition). Butterworth-Heinemann Ltd., UK,2012.
4. Government of India, Ministry of Home Affairs, National Disaster Management Division, Disaster Management in India – A Status Report,2004
5. National Policy on Disaster Management, NDMA, Government of India,2009.

SF8702 TRANSPORTATION SYSTEMS AND SAFETY L T P C
3 0 0 3

OBJECTIVES:

- To learn the basic working principles involved in various transportation systems
- To learn their safety aspects of various transportation
- To learn and identify defects in planning and design of transportation systems.
- To learn the awareness of traffic rules and regulations and prevent the accidents.
- To learn the basics layout of Harbour and docks.

UNIT I RAILWAY ENGINEERING 9

Introduction of Railway Engineering: Permanent way. Curves, super-elevation, negative super-elevation, transition curve, grade compensation on curves. Railway operation ð control - points and crossings turn-out. Signaling and interlocking. Centralized traffic control. Railway accidents & safety. Rapid transit railways - types, merits & demerits.

UNIT II HIGHWAY ENGINEERING 9

Introduction of Highway Engineering: Classification of highways and urban road patterns. Typical cross section of roads. Factors controlling the alignment of roads. Basic geometric design - stopping and overtaking sight distances.

UNIT III TRAFFFIC ENGINEERING 9

Introduction of Traffic Engineering: Traffic characteristics. Various traffic studies and their applications. Traffic signals. Carriage-way markings. Traffic islands. Highway intersections. Principles of highway lighting. Road Accidents - prevention, investigation and reduction.

UNIT IV HARBOUR AND DOCK ENGINEERING 9

Introduction of Harbour & Dock Engineering: Water transportation, classification of harbours, accessibility and size, ports, Indian ports. Layout of ports, breakwater, facilities (in brief) for docking, repair, approach, loading and unloading, storing and guiding.

UNIT V AIR TRANSPORTATION ENGINEERING. 9

Classification of air transportation, Types of air craft engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity -Applications – space flights. Air way accidents & safety.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course the student will develop a broad understanding of the

- Working of railways and safety aspects in railway operation
- Basic geometric design features of roads
- Traffic studies and traffic safety
- Basic layout and facilities of docks and harbour
- Working of airways and safety aspects in airway operation

TEXT BOOK :

1. John Khisty C, Kent Lall B, "Transportation Engineering – An Introduction, 3rd Edition, Prentice Hall of India, New Delhi, 2002
2. B.S.Dhillon, Transportation systems, reliability and safety" CRC Press,2011

REFERENCES:

1. Chandra, S. & Agarwal, M. M. "Railway Engineering". Oxford University Press, New Delhi,2007.
2. Khanna, S. K. and Justo, C. E. G.,"Highway Engineering" (9th ed).Nem Chand & Brothers, New Delhi,2001.
3. Geetham Tiwari & Dinesh Mohan,"Transport Planning & Traffic safety"
4. Srinivasan, R.,"Harbour, Dock and Tunnel Engineering". Charotar Publishing House Pvt. Ltd, Anand,2013.
5. Kadiyali, L. R.,"Traffic Engineering and Transport Planning", Khanna Publishers, New Delhi,2004

SF8703 PRINCIPLES OF INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To learn the basic principles, elements and functions of industrial management.
- On successful completion of the course the student will be aware of the various aspects of management and would be equipped with the knowledge to manage men and systems.
- To learn the personal management like leadership, maintain the good relationship with other and self evaluation.
- To learn the various aspects of production management.
- To learn the various strategy involved in petroleum industry.

UNIT I ORGANIZATION 9

Introduction of Organisation : Concept of organization, characteristics of organisation, elements of organization, organizational structure, organisation charts, Types of organisation- line & staff organization, functional organisation, project organisation, matrix organisation, Management: Functions, Evolution of management theory, Principles of scientific management,

UNIT II PERSONAL MANAGEMENT 9

Introduction of Personnel Management: Motivation theories, Leadership theories and mo On successful completion of the course the student will be aware of dels, Recruitment and training, labour turnover, operator training, Wages and Incentives: feature of wages, time and piece rate, incentive plans, profit sharing. Job evaluation, Merit rating methods- factors of comparison and point rating-defects. Industrial Relations: industrial disputes, collective bargaining, trade unions, workers´ participation in management, labour welfare.

UNIT III PRODUCTION MANAGEMENT 9

Introduction of Production Management: Production System-Functions-Product Desi On successful completion of the course the student will be aware of gn-Product Life Cycle. Demand forecasting for operations - components of demand - methods of prediction and forecasting - forecasting models - casual & time series PPC-Functions – Models Capacity Planning - Evaluating future capacity - capacity requirement - Aggregate Planning Inventory Control-Objectives-Costs-Models: Basic, Production, and Shortage-ABC Analysis.

UNIT IV PROJECT MANAGEMENT 9

Introduction of Project Management: Project Appraisal - Feasibility Analysis, Market feasibility, Technical feasibility, Financial feasibility, Economic feasibility, Financial and Economic appraisal of a project, Social Cost- Benefit Analysis in India, Project Report. On successful completion of the course the student will be aware of Project Scheduling: Network Techniques, PERT, CPM, GANTT charts, GERT, Time cost trade ou and crashing procedure

UNIT V STRATEGIC MANAGEMENT 9

Introduction of Strategic Management: Vision, Mission, Goals, Strategy – Elements of corporate planning .Process – Environmental Scanning – SWOT analysis-Steps in Strategy Formulation and Implementation, Generic Strategy Alternatives, Global strategies, Theories of Multinational Companies.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course the student will be able to have

- Knowledge of various aspects of organization and principles of scientific management
- Knowledge of different functions of human resource management including motivation and leadership
- Knowledge of various aspects of production management like forecasting, production systems, inventory control and PPC
- Knowledge of important aspects project management like appraisal, feasibility study, project report and network analysis.
- Knowledge of various aspect of strategic management like implementation, formulations.

TEXT BOOK:

1. John Christie Duncun,"Principles of Industrial Management",2010
2. L.P.Alford, "Principles of Industrial Management", The Ronald press company, New York

REFERENCES:

1. Kootnz, H, "Principles of Management", Tata McGraw Hill Education,2004.
2. Buffa, E.S. "Modern Production and Operations Management". (Seventh edition). John Wiley and Sons,1983.
3. Prasanna Chandra. "Projects Planning, Analysis, Selection, Implementation & Review". (4th edn). Tata Mcgraw Hill, New Delhi,1995.
4. Martand Telsang. "Industrial Engineering and Production management". (2nd edn). S.Chand & Co., New Delhi.

SF8704 SAFETY IN PETROLEUM AND PETROCHEMICAL INDUSTRIES L T P C
3 0 0 3

OBJECTIVES:

- To learn the various process employed in petroleum refining and Manufacturing of petrochemicals.
- To learn the fire prevention and fire protection methods employed in storage tank farms, depots, and terminals.
- To learn the on- shore and off-shore drilling.
- To learn the transportation facilities in petroleum industry
- To learn the Petroleum and Oil & Gas explorations rules and regulations in India

UNIT I PETROLEUM REFINERY 9

Simplified Flow diagrams of a typical refinery - distillation unit, catalytic cracker, reformer, treating unit (hydro forming, gas purification, Sulphur recovery, lubricating oil unit) Simplified Flow diagrams of Petrochemical Industry - steam cracking, butadiene extraction, ethane recovery, butyl rubber polymerization.

UNIT II PETROLEUM HAZARDS 9

Potential fire hazards in petroleum and petrochemical industries (ignition by local sources, spark, flame, hot surface, ignition of oil mists and fumes.). Storage tank farms of petroleum and petrochemical industries - Identification of Hazards, Type of Tanks, Design, Layout, Fire prevention measures including lightning protection. Fire protection arrangements in large tank farms, Design concepts of various fixed fire protection systems like Foam- Water Systems, Halogen & DCP systems. Lock out procedures. Salient features of codes / standards: NFPA, API, OISD and SHELL.

UNIT III PETROLEUM TRANSPORTATIONS 9

Fire protection facilities in Oil Refineries, Depots & Terminals- Transportation of petroleum and petrochemical products (safety considerations, statutory considerations). Design and Construction requirements for cross country hydrocarbon pipelines. Liquefied Petroleum Gas (LPG) Bottling Plant Operations. Design Philosophies. Operating Practices- Safety and Fire Protection in bottling plants. Transportation of Bulk Petroleum Products. Storage and Handling of Bulk Liquefied Petroleum Gas.

UNIT IV PETROLEUM WELL DRILLING OPERATION 9

On- Shore and Off- shore drilling. Classification of wells. Drilling method. Rotary drilling. Drilling equipment. Ground and offshore structures for drilling. Offshore platforms and drilling vessels. Drilling mud - functions, classification and properties. Blow-off, well kicks, Blow out preventer. Shallow gas. Directional drilling. Well killing procedure. Emergency shutdown, Methods of Rescue & Fire Fighting. Petroleum and Natural Gas (Safety in Offshore Operations) Rules, 2008.

UNIT V OIL & GAS RULES AND REGULATION 9

Petroleum and Oil & Gas rules and regulations in India, The Oil fields regulations and development Act, New Exploration Licensing Policy (NELP), Functions of directorate general of hydrocarbons, Petroleum and Natural Gas Regulatory Board.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course the student would be able to:

- Identify the various processes employed in petroleum refining and petrochemical industries
- Attain ability to design fire protection systems for storage tank farms
- Attain ability to design fire protection facilities in oil refineries, depots and terminals
- Demonstrate an ability to recognize the hazards involved in on- shore and off-shore drilling
- Know the oil and gas explorations rules and regulations in india

TEXT BOOK:

1. Dennis P. Nolan,"Application of HAZOP and What if Reviews to the Petroleum, Petrochemical and Chemical Process Industries",Noyes Publications, 1994.
2. Dhananjoy Ghosh," Safety in Petroleum Industries, CRC Press,2021

REFERENCES:

1. Gopal Rao, M. and Sittig, M (Eds)."Dryden´s outlines of chemical technology for the 21st century". (Third edition). Affiliated East West Press, New Delhi,2010.
2. Sam Mannan (Editor). "Lee´s loss prevention in the process industries" (fourth edition). Butterworth-Heinemann Ltd., UK,2012.
3. Davorin Matanovic. Nedilika Gaurina- Medjimurec. And Katarina Simon."Risk analysis for prevention of hazardous situations in petroleum and natural gas engineering". Engineering Science Reference, Hershey PA,2014.
2. Aven, T. and Vinnem, J.E. "Risk management with applications from the offshore petroleum industry". Springer-Verlag, U.K,2007.
3. John C. Reis,"Environmental Control in Petroleum Engineering", Gulf Publishing Company, 1996.

ME8682	DESIGN AND FABRICATION PROJECT	L	T	P	C
		0	0	4	2

OBJECTIVE:

- The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1 Design and Fabricate the machine element or the mechanical product.

CO2 Demonstrate the working model of the machine element or the mechanical product.

SF8711 FIRE ENGINEERING LABORATORY L T P C
0 0 4 2

OBJECTIVES

- To learn about testing standards for the test on DCP, foam and performance tests of portable extinguishers

LIST OF EXPERIMENTS

1. Determination of flash Point, fire point and pour point of hydrocarbons.
2. Tests on Dry Chemical Powder as per relevant Indian standard specifications
3. Performance Tests on Portable DCP Fire Extinguishers (Cartridge Type)
4. Performance Tests on Portable CO2 Fire Extinguisher
5. Rs Tests on Foam as per relevant Indian standard specifications
6. Test of non-combustibility of Building Materials.

OUTCOMES

On completion of this course the student will be able to

- Understand the method of conducting experiments.
- Observe and analyse data and arrive at conclusions.
- Demonstrate understanding of the method of tests for DCP
- Demonstrate understanding of the method of tests for CO2

Note: 50 % marks is earmarked for continuous evaluation, and 50 % marks for end semester examination to be assessed by two examiners. A candidate shall secure a minimum of 50 % marks in the aggregate and 45 % minimum in the end semester examination for a pass.

TOTAL: 60 PERIODS

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

REFERENCES

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

SF8811 **PROJECT WORK** **L T P C**
0 0 20 10

OBJECTIVE:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination. The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

OUTCOME:

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

SF8001 **LIFE SAFETY IN BUILDING FIRE** **L T P C**
3 0 0 3

OBJECTIVES

- To find out Safety Management System.
- To learn about the human behavior under emergency movement and to plan evacuation routes and exits.
- To learn about the various fire and life safety requirements; planning and distribution of portable & fixed firefighting systems in buildings as per BIS
- To learn about the need and procedure for fire investigation, arson identification, fire training, fire safety audit and fire risk assessment.
- To know the Rules and regulation of safety department.

UNIT I BASIC BUILDING PLANNING AND DESIGN 9

Process of emergency evacuation - special features of personnel movement. Parameter characteristics of the movement of people; Stages of evacuation; Planning and design of evacuation routes and exits; planning of seating arrangements in large assembly buildings.

UNIT II NBC CODES FOR BUILDINGS 9

Classification of buildings based on occupancy and type of construction according to fire resistance as per NBC; Fire zone; General fire safety requirements applicable to all individual occupancies. General exit requirements as per NBC; Internal staircases; horizontal exits; fire tower; ramps; fire lifts; external fire escape ladders; Planning of location and calculation of capacity, number and width of exit as per NBC for different occupancy classification.

UNIT III FIRE PREVENTION AND BIS STANDARDS 9

Fire and life safety requirements in different groups of buildings-Hotel, Schools & Colleges, Hospitals, Theatres, Shopping malls, etc.; Fire protection and prevention in high rise buildings; Fire protection in underground structures and in buildings under construction. Sitting of detectors as per relevant Indian standard specifications; Selection and planning of alarm system as per relevant standards (BIS). General requirements and guidelines for the installation of fire detection and alarm system in buildings of different occupancy classification.

UNIT IV FIRE PROTECTION EQUIPMENTS AND SAFETY AUDITS 9

Selection and distribution of portable extinguishers (for class A and B fires) and other fire protection equipment and systems for different occupancy classification as per NBC; Planning of fixed fire fighting installation for different occupancy classification- sprinkler system; total flooding system; CO2 system; foam system; Fire Investigation; Detection of arson; Fire training and education-fire drill, fire order;-Fire safety audits; Fire risk assessment.

UNIT V FIRE SAFETY AND CODES 9

Causes of fire in buildings. Stages of fire and how it spreads. Fire drill. Heat / fire / smoke detection. Alarm and extinguisher systems. Fire safety standards. General guidelines for egress design formulti-storey buildings. Understanding all the above through product literature/ field visits. Exercise on design of fire safety systems for different building types through choice, calculations, layout and drawings.

TOTAL: 45 PERIODS

OUTCOMES

On completion of this course the student will be able to

- Understand the human behavior under emergency movement and the concept of planning and design of seating arrangements in assembly buildings, evacuation routes and exits.
- Understand the general life safety requirements applicable to all buildings and to plan, design and locate exits in buildings.
- Understand the fire and life safety requirements for buildings of specific occupancy.
- Plan and distribute portable and fixed firefighting systems in buildings of different occupancies as per BIS
- Understand the method of carrying out fire investigation, arson identification, fire training, fire safety audit and fire risk assessment.

TEXT BOOK:

1. Roytman, M. Ya.(1975). Principles of fire safety standards for building construction. Amerind Publishing Co. Pvt. Ltd., NewDelhi
2. Butcher, E.G.andParnell, A.C.(1983).Designing of fire safety. John Wiley and Sons Ltd., New York,U.S.A

REFERENCES:

1. Jain, V.K. (2010). Fire safety in buildings (2nd edn.). New Age International (P) Ltd., New Delhi.
2. Barendra Mohan Sen (2013). Fire protection and prevention the essential handbook. UBS Publishers and Dist., NewDelhi.
3. Huang, Kai. 2009. Population and Building Factors That Impact Residential Fire Rates in Large U.S. Cities. Applied Research Project. Texas State University.
4. William H. Severns and Julian R Fellows, 'Air conditioning and Refrigeration', John Wiley andSons, London, 1988.
5. Life Safety Code Handbook, National Fire Protection Association, 1991. Lathrop, James K. Ed. NFPA

SF8002 FOOD AND BIO-SAFETY L T P C

3 0 0 3

OBJECTIVES:

- To learn about food quality
- To learn about physical, chemical and biological contamination in food and sanitation.
- To learn the quality, challenges in food industry.
- To learn basics about food quality auditing.
- To learn the chemical, technological and toxicological aspects of food additives and food contaminants and the legal and socio-economic aspects of biotechnology.

UNIT I FOOD QUALITY 9

Objective and importance of quality control, classification of quality attributes and its role in food quality, quality assessment of food materials (fruits, cereals, milk and meat), types of quality characteristics of food, methods used for determination of the quality in food industry, factors in fluencing the quality of food, sample and sampling methods of quality evaluation.

UNIT II FOOD SANITATION 9

Factors contributing to physical, chemical and biological contamination in food chain, prevention and control of food borne hazards, definition and regulation of food sanitation, sources of contamination, personal hygiene-food handlers, cleaning compounds, sanitation methods and pest control, sanitation and safety in foodservices.

UNIT III FOOD SAFETY 9

Principles of food safety and quality, quality assurance, Total quality management (TQM). Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Good Veterinary Practice (GVP), risk analysis, riskassessment, risk management. Applications of HACCP in food safety, Current challenges to food safety.

UNIT IV FOOD LAWS AND REGULATIONS 9

Basic concepts of food standards, Role of national regulatory agencies: Food safety and Standards Act:salient provision and prospects, FSSAI, PFA, certification- AGMARK, ISI (BIS). Role of international regulatory agencies: USDA, FDA, BRC, WHO, FAO, Codex Alimentarius commission, WTO agreements: SPS and TBT agreements, ISO and its standards for food quality and safety (ISO 9000, ISO 17025, ISO 22000, and ISO14000).

UNIT V FOOD SAFETY AUDITING 9

Food surveillance: International and national practices, procedure and protocols, food alerts, traceability and food product recall. Export and import of food in India: introduction, import and export policies, FDA import policy, export-import policy, export control systems. Import intelligence and alert systems, packaging and labelling, specifications and certifications.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course the student will be able to:

- Understand the food quality in food industry.
- Identify the food additives and food contaminants and their chemical and toxicological properties
- Recognize the effects of pests on food and the various methods for controlling them
- Attain knowledge about the national and international regulations for biosafety.
- Demonstrate an ability to recognize the environmental, social and ethical implications of biotech applications"

TEXT BOOK:

1. Biological Safety, Principles and Practices, 4th ed. (Fleming & Hunt) ASM Press 2006.
2. Fawatt, H.H. and Wood, W.S., “Safety and Accident Prevention in Chemical Operation“,Wiley Interscience, 1965.

REFERENCES:

1. Food Quality Assurance - Principles & Practices, (2018), I. Alli. 2004. CRC Press, India, ISBN: 9781138034532.
2. Principles of Food Sanitation, 5thedition (2018), N.G. Marriott, G.W. Schilling and B. Robert; Springer, US, ISBN:97803870250250.
3. Guide to Quality Management Systems for the Food Industry,1stedition (2005), R. Early; Springer, US, ISBN: 9781461358879.
4. Total Quality Assurances for the Food Industries, 1stedition (2001), W.A Gould; Elsevier-Woodhead Publishers, UK, ISBN: 9781845696009.
5. The Food Safety Information handbook by Cynthia A. Robert, 2009.

ME8792	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

UNIT I COAL BASED THERMAL POWER PLANTS 9

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boil*ing Water Reactor* (BWR), P*ressurized Water Reactor* (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV POWER FROM RENEWABLE ENERGY 9

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, *Solar* Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1 Explain the layout, construction and working of the components inside a thermal power plant.

CO2 Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.

CO3 Explain the layout, construction and working of the components inside nuclear power plants.

CO4 Explain the layout, construction and working of the components inside Renewable energy power plants.

CO5 Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

TEXT BOOK:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.

REFERENCES:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

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

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.

SF8003 ARTIFICIAL INTELLIGENT AND EXPERT SYSTEMS L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Intelligence – Definition, types cognitive aspect approach, measuring intelligence – early efforts, IQ and AI: aspects of intelligence – learning, problem solving, creativity, behaviour and biology. Artificial intelligence: Historical background, applications of AI, objections and myths, AI languages: Introduction to PROLOG and LISP.

UNIT II COGNITIVE PSYCHOLOGY 11

The mind – informative and cybernetics, components for thought, modes of perception – visual, auditory and other systems: memory mechanisms, problem solving – planning, search, the GPS systems; types of learning – rote, parameter, method and concept: Game playing, reasoning, Artificial Vision – picture processing – identifying real objects; Vision programs, factory vision systems.

UNIT III KNOWLEDGE ENGINEERING 9

Introduction – role of knowledge engineer, knowledge representation – psychology, production rules, logic and programming, Common sense and fuzzy logic, semantic networks, learning systems.

UNIT IV EXPERT SYSTEMS 9

Introduction, knowledge acquisition for Expert system, features of Expert systems –System structure, inference Engines, uncertainties, memory mechanisms, range of applications, actual expert systems – VP expert. Assignment – Development of a simple expert system.

UNIT V INTRODUCTION TO NEURAL NETWORKS 7

Neural Network Architecture – Learning methods – Architecture of a Back Propagation Network – Selection of parameters – Simple variations of BPN.

TOTAL: 45 PERIODS

TEXT BOOK

1. Elaine R., and Kevin, “Artificial Intelligence”, 2nd Edition, Tata McGraw Hill, 1994.

REFERENCES

1. Rajasekaran S and Vijayalakshmi Pai, G.A, “Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications”, PHI, 2003.
2. Charnaik, E., and McDermott, D., “Introduction to Artificial Intelligence”, Addison Wesley, 1985.
3. Dan W.Patterson, “Introduction to Artificial Intelligence and Expert Systems”, Prentice Hall of India, 1992.
4. Winston, P.H., “Artificial Intelligence”, Addison Wesley, 1990.
5. Nilsson, N.J., “Principles of AI”, Narosa Publishing House, 1990.
6. Schalkoff, R.J., “Artificial Intelligence” – An Engineering Approach”, McGraw Hill International Edition, Singapore, 1992.

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 Characterization 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.

SF8004 AUTOMOBILE ENGINEERING AND SAFETY L T P C

3 0 0 3

OBJECTIVES:

- To learn basics of automobile engineering and emission rules.
- To learn the battery storage system, ignition system and electrical controls of an automobile.
- To learn the power transmission system, braking systems and its safety rules.
- To understand the knowledge about lubrication system, cooling system and rules.
- To get the knowledge in sensors provided in the vehicle to avoid the crash and to detect the defects in the vehicle.

UNIT I INTRODUCTION AND EMISSION 9

Types of automobiles. Limiting Dimensions as per Central Motor Vehicles Rules. Engines - Classification, Construction, Materials of engine components. Prototype Testing as per Central Motor Vehicles Rules. Fuel System - Fuel tank, Fuel filter, Types of Fuel system. Carburettor – Simple and Modern, Fuel injection System. Emission Standards as per CMV Rules.

UNIT II ELECTRICITY STORAGE AND ITS UTILLIZATION 9

Electrical System - Storage Battery Operations and Maintenance. Ignition System - Coil and Magneto Ignition System. Starting System, Lighting System, Horn System-Wind Shield Wiper Motors, Fans, Heaters, Trafficators. Automobile air conditioning. Central Motor Vehicles Rules regarding Lighting, Windshields, Wipers.

UNIT III TRANSMISSION SYSTEM AND BRAKING SYSTEM 9

Transmission System - Clutches - operation and fault finding of clutches, Fluid Flywheel, Gear Box-types, Steering Systems, Chassis Springs, and Suspension. Differential, Dead and Live axles, Rims, Tyre etc. Brakes - Types, construction and fault finding. CMV Rules-Brakes, Steering & Tyre.

UNIT IV LUBRICATION AND COOLING SYSTEM 9

Lubrication Systems-Types, Components, Lubricating oil, Cooling system- Details of components, Study of Systems, Types. Miscellaneous - Special gadgets and accessories for fire fighting vehicles. Automobile accidents. CMV Rules regarding Safety devices for drivers, passengers.

UNIT V PASSIVE AND ACTIVE SAFETY 9

Design of body for safety, deceleration of vehicle, passenger. Concept of crumble zone, Safety Cage. Optimum crash pulse, deceleration on impact with stationary and movable obstacles. Deformation behaviour of vehicle body. Barrier test. Crash tests. Deformation behavior of Lightweight materials. Antilock braking system, Stability Control. Adaptive cruise control, Lane Keep Assist System, Collision warning, avoidance system, Blind Spot Detection system, Driver alertness detection System. ADAS, DAT.

TOTAL : 45 PERIODS

OUTCOMES:

On completion of this course the student will be able to have

- Knowledge of automobile engines, fuel systems and CMV rules for proto type testing and emission standards.
- Knowledge of electrical systems-ignition, lighting, horn, wipers, HVAC and concerned CMV rules
- Knowledge of transmission systems - clutch, gearbox, steering, and differential. Chassis-springs, axles and brakes and corresponding CMV rules.
- Knowledge of lubricating systems, cooling systems and miscellaneous systems. CMV rules for safety devices.
- Design a bumper with respect to safety.

TEXT BOOK:

1. Robert Bosch GmbH - “Safety, Comfort and Convenience Systems”- Wiley; 3rd edition,2007.
2. Ljubo Vlacic, Michel Parent, Fumio Harashima – “Intelligent Vehicle Technologies Theoryand Applications” -Butterworth-Heinemann, 2001.

REFERENCES:

1. GBS Narang, Automobile Engineering, Khanna Publishers, Delhi,2014
2. Kirpal Singh, Automobile EngineeringVol.I &II. Standard publishes- distributors-Delhi,13ed,2012
3. JosephHeitner,AutomotiveMechanics-Principles & Practices, CBS Publisher-Delhi; 2 ed.2006
4. P. L. Kohli, Automotive Electrical Equipments. McGraw Hill Education, New Delhi,1993
5. The Central Motor Vehicles Rules,

SF8005 EXPLOSIVES TECHNOLOGY AND SAFETY L T P C
3 0 0 3

OBJECTIVES

- To teach the fundamental principles of explosives and the safety aspects of explosives operations, storage and transportation
- To teach the fire building and its mechanisms and behaviors
- To teach the explosive prediction and controlling elements
- To aware of industrial fire production system and its usage
- To learn testing and fire explosives of an industry

UNIT I PHYSICS AND CHEMISTRY OF FIRE 9

Chemistry of Explosives - Chemical reactions - Categories of explosives by chemical type - Use forms of Explosives, Propellants, and Pyrotechnics. Mechanics of Burning - Burning model - Geometry shape of grains - Calculating the state of the gas - interior ballistics.

UNIT II MECHANISM OF SOUND AND SHOCK 9

Sound, shock and Detonation - Sound waves - shock waves - Detonation waves - Explosive output tests. Initiation and initiators - Initiation theory and criteria - Initiation sensitivity testing - Non electric initiators - Hot-wire initiators - exploding bridge wire detonators - Slapper detonators.

UNIT III BUILDING FIRE SAFETY 9

Scaling in Design and Analysis - Geometric similarity - Accelerating metal with explosives - Shock waves in air - Shock waves in water - Craters from explosives - Conical - shaped chargers. Off-the - Shelf explosive Devices - Linear explosive products - Mechanical / explosive devices.

UNIT IV EXPLOSION PROTECTING SYSTEMS 9

"Classification, Transportation and Storage of Explosives - Explosives classification - Transportation of explosives - Storage of explosives.

Explosive Facilities and Explosives Operations - Explosive facilities - Explosive operations - Good work practices - Maintenance - Explosive waste- Spills and general cleaning - Explosive handling - Testing and firing of explosives - Licenses, permits and penalties."

UNIT V INDUSTRIAL FIRE PROTECTION SYSTEMS 9

Sprinkler-hydrants-stand pipes – special fire suppression systems like deluge and emulsifier, selection criteria of the above installations, reliability, maintenance, evaluation and standards – alarm and detection systems. Other suppression systems – CO2 system, foam system, dry chemical powder (DCP) system, halon system – need for halon replacement – smoke venting. Portable extinguishers – flammable liquids – tank farms – indices of inflammability-fire fighting systems.

TOTAL: 45 PERIODS

OUTCOMES

On completion of this course the student will be able to

- To make familiar about basic concepts of fire and explosion science.
- To know the different source of ignition and their prevention techniques.
- To understand the operation of various types of firefighting equipments.
- To understand the causes and prevention of explosion.
- To equip the students to effectively employ explosion protection techniques and their significances to suit the industrial requirement.

TEXT BOOK:

1. Handbook of FIRE AND EXPLOSION PROTECTION ENGINEERING PRINCIPLES third edition 2014, DENNIS P. NOLAN, 525 B Street, Suite 1900, San Diego, CA 92101-4495, USA
2. Gupta, R.S., "Hand Book of Fire Technology" Orient Longman, Bombay 1977

REFERENCES:

1. Handbook of Fire and Explosion Protection Engineering Principles. For Oil, Gas, Chemical and Related by Dennis P. Nolan (Auth.)
2. Hand book for Explosion Protection by Dipl.-Phys. Dr. rer. nat. Heinrich Groh Copyright © 2004 Expert Verlag GmbH, Renningen, Germany.
3. Fire fighters hazardous materials reference book Fire Prevention in Factories", an Nostrand Rein Hold, New York, 1991..
4. Hand book of explosion prevention and protection wiley-vce verlag GmbH & co. KGaA, ISBN 3-527-30718-4
5. Derek, James, "Fire Prevention Hand Book", Butter Worths and Company, London, 1986.

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. ISO 9001-2015 standards

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

SF8006 FIRE AND SMOKE DYNAMICS L T P C
3 0 0 3

OBJECTIVES:

- To get basic idea about the fundamentals of fire phenomena and firefighting.
- To provide the students an illustration of significance of the Fire Engineering profession in the protection life, property and environment.
- To learn basic various heat transfer process.
- To get the basic knowledge about flame and its characteristics of flame behaviors
- To teach the ignition behaviors and various stages of flame and fire.

UNIT I FIRE SCIENCE AND AERODYNAMICS 9

Fire Science and Combustion: Fuels and the combustion process, The physical chemistry of combustion in fire. Heat Transfer and Aerodynamics: Summary of the heat transfer equations, Conduction, Convection, Radiation.

UNIT II FLAMMABILITY AND PREMIXED FLAMES 9

Limits of Flammability and Premixed Flames: Limits of Flammability, The structure of a premixed flame, Heat losses from premixed flames, Measurement of burning velocities, Variation of burning velocity with experimental parameters.

UNIT III FIRE FLAME AND PUMPS 9

Diffusion Flames and Fire Plumes: Laminar jet flames, Turbulent jet flames, Flames from natural fires, Some practical applications. Steady Burning of Liquid and Solid Fuels: Burning of liquids, Burning of solids.

UNIT IV BEHAVIOR OF IGNITION 9

Ignition: The Initiation of Flaming Combustion: Ignition of flammable vapour/air mixtures, Ignition of liquids, Pilot ignition of solids, Spontaneous ignition of combustible solids, Surface ignition, Extinction of flame. Spread of Flame: The phenomenology of flame spread, Theoretical models of flame spread, Spread of flame through open fuel beds, Applications. Spontaneous Ignition within Solids and Smouldering Combustion Spontaneous ignition in bulk solids, Smouldering combustion, Glowing combustion.

UNIT V STAGES OF FIRE 9

The Pre-Flashover Compartment Fire: The growth period and the definition of flashover, Growth to flashover. The Post-Flashover Compartment Fire: Regimes of burning, Fully-developed fire behaviour, Temperatures achieved in full-developed fire, Fire resistance and fire severity, Methods of calculating fire resistance, Projection of flames from burning compartments, Spread of fire from a compartment.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the fire opposition and its procedure
- Analysis of fire behavior and fire problems.
- Get the knowledge about stage of fire flowing and detail about ignition.
- Understand methods of calculating fire resistance from burning compartments.
- We learn details about premixed flames and its characteristics.

TEXT BOOKS

1. An Introduction to Fire Dynamics, Third Edition 2011 by Dougal Drysdale,university of Edinburgh, Scotland,uk by john wiley & sons,ltd
2. A text book for tunnel fire dynamics, Haukur Ingason,ying zhen li,Anders lonnermark

REFERENCES:

1. Text book for fire safety engineering design of structure for john A.Purkis, Bsc(eng),PhD,MICE,MIFS at Butterworth Heinemann, first published 1996.
2. An Introduction to Fire Dynamics written by Dougal Drysdale
3. SFPE Hand Book for Fire Protection Engineering, NFPA
4. Smoke Movement in buildings by J.H. McGuire "Fire Tech.3 (1967)
5. NFPA 204M, Guide for Smoke & Heat Venting Rates of Production of Hot Gases in Roof Venting Experiments by P.L. Hinkley

MG8491	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

UNIT I LINEAR MODELS 15

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS 8

Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.

UNIT III INVENTORY MODELS 6

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

UNIT IV QUEUEING MODELS 6

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

UNIT V DECISION MODELS 10

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.

TOTAL: 45 PERIODS

OUTCOME:

- Upon completion of this course, the students can able to use the optimization techniques for use engineering and Business problems

TEXT BOOK:

1. Hillier and Libeberman, “Operations Research”, Holden Day, 2005
2. Taha H.A., “Operations Research”, Sixth Edition, Prentice Hall of India, 2003.

REFERENCES:

1. Bazara M.J., Jarvis and Sherali H., “Linear Programming and Network Flows”, John Wiley, 2009.
2. Budnick F.S., “Principles of Operations Research for Management”, Richard D Irwin, 1990.
3. Philip D.T. and Ravindran A., “Operations Research”, John Wiley, 1992.
4. Shennoy G.V. and Srivastava U.K., “Operation Research for Management”, Wiley Eastern, 1994.
5. Tulsian and Pasdey V., “Quantitative Techniques”, Pearson Asia, 2002.

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

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
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

SF8007 FIRE RISK CALCULATIONS L T P C

3 0 0 3

OBJECTIVE:

- Educate students about how to reduce work place hazards and to encourage the standard of safety health & environment programme,
- To Train and motivate students in maintaining and improving the quality of the environment and preventing and abating environment pollution.
- To create awareness among students about Fire safety and Fire prevention
- Educate students about how to reduce work place hazards and to encourage the standard of Safety
- To familiarize students with the design, installation, working and use of different types of Fire protection systems

UNIT I APPLICATION OF FIRE RISK ANALYSIS: 9

Basic field of application, Methods of application Probability Concept: Basic concept of Probability Theory, Independence and conditionality, Random Variables and Probability Distributions, Key parameters of probability Distributions, Commonly used Probability Distributions.

UNIT II STATISTICS & EXTREME VALUE THEORY 9

Introduction, Basic concept of statistical analysis, Key parameters of descriptive statistics, Correlation, Regression and Analysis of Variance, Hypothesis Testing in Classical Statistical Inference, Sampling Theory.

Extreme Order Distribution, Behaviour of Large Losses, Average Loss, Economic Value of Fire Protection Measures, Factor Affecting fire damages, Analysis of test results, Fire Severity and fire resistance.

UNIT III RELIABILITY 9

Component Life, Failure Rate, Estimating the parameters of a Distribution, System Reliability, Bayesian Methods. Probability Models in Fire Protection Engineering: Decision Trees, Fault Trees, Markov Chains, Queuing Models of Fire Company Availability, Stress-Strength model in Fire Safety, Engineering Economics.

UNIT IV UTILITY THEORY 9

Utility, Utility Functions, Fire Protection and Insurance, Decision Analysis, Construction of Utility Function Value of Human Life: Methods of Valuing Human Life, Applications, Cost-Benefit Analysis, General Decisions

UNIT V COMPUTER SIMULATION FOR FIRE PROTECTION 9

Engineering Computer Simulation Methodology, Tools of Simulation, Variance Reduction Techniques, Statistical Termination Tests, Flexibility versus Computation, Simulation Languages.

TOTAL: 45 PERIODS

OUTCOMES:

- To apply concept of probability theory in fire analysis
- To apply concept of factor affecting fire damages
- To apply concept of Fire Protection Engineering
- To apply concept of Fire Protection and Insurance
- To apply concept of simulation software in calculations

TEXT BOOK:

1. An introduction to fire dynamics – Dougal Drysdale
2. Enclosed Fire Dynamics – Bjorn karlsson, Jammes G Quintiere
3. Fundamentals of Firefighter skills-by IAFC"- J&B learning, 2013 edition
4. "Fire Service Pump Operator-by IAFC"- J&B learning, 2013 edition
5. "Fire Service Hydraulics & Pump Operation"- Paul Spurgeon, Fire Engineering Series, Penwell Publications

REFERENCES:

1. Approved document A – U.K.
2. Approved Document B – U.K.
3. British Standard 9999
4. Tariff Advisory Committee
5. NFPA fire design engineering

SF8008 FIRE AND ARSON INVESTIGATION L T P C

3 0 0 3

OBJECTIVES:

- Plans the investigation and assembles tools, equipment, and personnel
- Examines the scene and collects data
- Collects, tests, evaluates, and documents evidence
- Applies the scientific method to analyze the information obtained
- To know the aspect of fire scene

UNIT I THE NATURE AND BEHAVIOUR OF FIRE: 9

Elements of Combustion, Flaming and Glowing Fire, Explosive Combustion, Heat Transfer, Sequence of Room Fire, Effects of Environmental Conditions, Combustion Properties of Liquid & Gaseous Fuels.

UNIT II COMBUSTION PROPERTIES OF SOLID FUELS 9

Pyrolysis, Papers, Plastics, Paints, Metals, Coals, Flame Colour & Smoke production. Source of Ignition: Primary Igniter, the role of services and appliances in starting fire (Gas lines, Gas Appliances, L.P. Gas, Electricity). The role of hot & burning fragments in kindling fire, lightening, spontaneous combustion, electric light bulb.

UNIT III STRUCTURE FIRE & THEIR INVESTIGATION 9

Elements of building construction, General principals of fire behaviour, Investigative information during suppression, Examination of structure fire scene, Documenting the fire scene.

UNIT IV GRASS AND WILD LAND FIRES INVESTIGATION 9

Grass and Wild Fires, Automobile Motor Vehicle and Ship Fires. Electrical causes of Fire: Basic Electricity, Wiring systems, Ignition by Electrical Means. Investigation of Electrical-related fire: Post – Fire Indicator, Laboratory Examination. Clothing & Fabric Fire, Explosion & Explosive Combustion, Chemical Fire & Hazardous Material.

UNIT V LABORATORY SERVICES: 9

Availability of Laboratory Services: General Fire Evidence, Identification of Charred or Burned Materials & Documents, Failure Analysis-Forensic Engineers, Evaluation of Appliances & Wiring, Miscellaneous Laboratory Test. Identification of Volatile Accelerants: Gas Chromatography, Sample Handling, Extraction of Volatile Accelerants, Identification of Volatiles. Chemical Incendiaries Non-Fire-Related Criminal Evidence: Fingerprints, Blood, Impression Evidence, Trace Evidence.

TOTAL: 45 PERIODS

OUTCOMES

- To know about fire investigation technology
- To know about arson investigation
- To know about fire cause determination
- To know about techniques of fire investigation
- To know about fire cause determination
- To know about volatile accelerants

TEXT BOOKS

1. Jones, R. Investigation of arson, crime scenes and vehicular problems. Wichita, KS: Inform Milton Helpern International Center for Forensic Sciences, 1976.
2. Kamlsar, Y. Police interrogation and confessions: Essays in law and policy. Ann Arbor, MI: University of Michigan Press, 1980.
3. Karchmer, C.L. The government executive's guide to arson prevention and control: A handbook on information systems. Washington, DC: United States Fire Administration, 1981.
4. Scientific protocols for Fire Investigation– Boca Raton
5. The investigation of major disaster.
6. Fire service manual – The stationery office publication

References:

1. NFPA Hand book
2. Kirk's Fire Investigation by Jhon D. DeHaan
3. Arson Investigation by Thomas J. Bouquard
4. Fire & Arson Investigation by Russell K. Chandler.
5. Kirk's fire investigation – Brady Fire.

GE8072 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

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

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

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

UNIT III DESIGN AND TESTING 9

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

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

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

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

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

TEXT BOOKS:

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

REFERENCES:

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

SF8009 HUMAN FACTORS ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To learn how man, machine and environment interact effectively to make the work and workplace better for ease of work and to maximize production."
- To Learn Physical Ergonomics
- To Learn Cognitive Ergonomics
- To Learn organizational ergonomics
- To learn about methodology of arranging components

UNIT I HUMAN FACTORS BASICS 9

Human factors - objectives and approach. Systems thinking - human - machine systems, characteristics of systems, system reliability. Human beings as information processors- information theory, displaying information, coding of information, characteristics of good coding system, compatibility, types of compatibility, perception, memory, decision making, attention, age and information processing, mental workload and its measurement."

UNIT II HUMAN-MACHINE SYSTEM 9

Process of seeing, visual capabilities, accommodation, visual acuity, contrast sensitivity, factors affecting visual acuity and contrast sensitivity, adaptation, colour discrimination, perception. Design of hard copy and VDT screens. Graphic representations - symbols, objectives and criteria for selection, perceptual principles of symbolic design. Codes - dimension, colour. Design of dynamic information displays, uses of dynamic information, design of quantitative visual displays, design of qualitative visual displays, design of signal and

warning lights, recommendations regarding signal and warning lights, representational displays, head-up displays. Hearing, nature and measurement of sound, complex sound, anatomy of ear, conversion of sound waves to sensations, masking. Auditory displays, detection of signals, relative discrimination and absolute identification of auditory signals, sound localization, principles of auditory display, cutaneous senses, tactual displays, substitutes for hearing and seeing, olfactory senses and displays."

UNIT III HUMAN PERFORMANCE IN THE WORKPLACE 9

Physical work - muscle physiology, work physiology, measures of physiological strain, physical work load, work efficiency, energy consumption, grades of work, factors affecting energy consumption," "Controlling energy expenditure, strength and endurance, measurement of strength, factors affecting strength. Manual materials handling - lifting tasks, carrying tasks, pushing tasks, limits of MMH tasks, reducing risks of MMH overexertion. Motor skills - bio mechanics of human motion, types of body movements, range of movements, classes of motor movements, Speed of movements - reaction time, movement time, accuracy of movements. Human control of systems - compatibility, spatial compatibility, movement compatibility. Supervisory control. Control's devices - functions of control, factors in control design. Principles of hand tool and device design."

UNIT IV PHYSIOLOGICAL PRINCIPLES 9

Work place design - anthropometry, static dimensions, dynamic dimensions, principles in the application of anthropometric data. Work spaces - work- space envelopes for sitting and standing personnel, out-of-reach and clearance requirements. Design of work surfaces. Science of seating - general principles of seat design. VDT workstations. Arrangement of components within a physical space - principles of arranging components, methodologies for arranging components, types and uses of various data, link diagrams, general location of various controls and displays within work space, specific arrangements of controls and displays within work space, spacing of control devices. General guidelines in designing individual workplaces."

UNIT-V DESIGN OF HEALTH AND SAFETY 9

Introduction to Human Factors Research Methods- Design and Evaluation Tools .Design and Evaluation Tools. Visual Sensory System. Visual Sensory System Auditory, Tactile, and Vestibular Systems Auditory, Tactile, and Vestibular Systems Cognition Decision Making Mardi Gras holiday, Displays Control. **TOTAL: 45 PERIODS**

OUTCOMES:

On completion of this course the student will be able to

- Understand human information processing ability and the parameters influencing it.
- Gain knowledge about information receptors and the visual and auditory displays.
- Understand physical work load, energy consumption for various works, motor skills and hand tool design.
- Apply workspace design and arranging components in work space."
- apply Vestibular Systems Cognition Decision Making

TEXT BOOK

1. Wickens, C.D., Lee, J.D., Liu, Y., Gordon Becker, S.E. (2004). An Introduction to Human Factors in Engineering (2nd Ed.). Upper Saddle River, New Jersey: Pearson Prentice-Hall.
2. Task description methods. Chapter 3. (pp. 81-145). In B. Kirwan & L. K. Ainsworth (eds.) (1992.) A guide to task analysis. London: Taylor & Francis. (Handout).
3. Norman, D. (2002). Design of everyday things. NY:Basic Books.
4. Carl Goodson, "Essentials of fire fighting" Fire protection publications; 5th edition
5. Pann Well, "Fire engineering's skill drills for Fire Fighter", Pann Well; 1st & 2nd edition.

REFERENCES:

1. Sanders, M.M. and McCormick, E.J. (1993). Human factors in engineering a design, (seventh edition). McGraw-Hill, New York.
2. Martin Helander. (1996). A guide to ergonomics of manufacturing. Tata McGraw Hill, New Delhi.
3. Bridger, R.S. (2008). Introduction to ergonomics. (Third edition). CRC Press"
4. Fire Safety – Employer's guide – The stationary office publication

SF8010 ENGINEERING ECONOMICS L T P C
3 0 0 3

OBJECTIVES

- To make fundamentally strong base for decision making skills by applying the concepts of economics.
- Educate the students on how to systematically evaluate the various cost elements of a typical manufactured product
- Prepare engineering students to analyze profit and Interest
- To carry out make economic analysis in the decision making process to justify or reject alternatives/projects.
- To Develop the skills to analyze financial analysis

UNIT I INTRODUCTION TO ECONOMICS 9

Cash Flow Concept:- Time value of money cash flow diagram, Interest calculation.

UNIT II INTRODUCTION TO PVIF AND COMPOUND INTEREST 9

Interest Factor:- Compared amount factors, present worth and factors, Interest periods series payments.

UNIT III METHODS OF CALCULATING INTEREST 9

Other Interest Calculation Concept:- Calculation cash flow, capitalized cost beginning of period payment, Gradient

UNIT IV CAPITAL BUDGETING AND DISCOUNT RATE 9

Comparison of alternatives:- Income-expansion cost reduction, selection of discount rate, Inflation and discount rate, present worth.

UNIT V COST-BENEFIT AND BREAK- EVEN ANALYSIS 9

Benefit-Cost analysis:- Identification of relevant benefit and cost, measurements of benefits & cost, selection of appropriate comparison, Break- even-analysis, Linear and non-linear model.

TOTAL: 45 PERIODS

OUTCOMES

- Understand major principles of economic analysis for decision making among alternative courses of action in engineering.
- Apply economic principles to prices and quantities in competitive supply and demand for goods and for money.
- Solve economic problems involving comparison and selection of alternatives by using analytical techniques including benefit-cost ratio and breakeven analysis.
- To Understand Ethical Business Practices.
- To perform the cost and effect analysis of engineering products

TEXT BOOKS:

1. Principles of Economics: P.N. Chopra (Kalyani Publishers)
2. Modern Economic Theory – K.K. Dewett (S.Chand)

REFERENCES:

1. C S Park, “Contemporary Engineering Economics”, Pearson Education, 2002.
2. J S Chandan, “Statistics for Business and Economics”, Vikas Publishing.
3. H. L. Ahuja, “Principles of Microeconomics”, S. Chand (G/L) & Company Ltd, 2002.
4. D. N. Dwivedi, “Macroeconomics Theory and Policy”, Tata McGraw-Hill Publishing Company, 2010.
5. S Damodaran, “Managerial Economics”, Oxford University Press, 2010.

SF8011 ADVANCED SAFETY ENGINEERING AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To give an overview of a few emerging techniques in safety engineering and management
- To familiarizes the concepts on Layer of Protection Analysis.
- To understand the knowledge related to risk assessment
- To educate the students towards the safety measures in organizations

UNIT I INTRODUCTION TO DOMINO INCIDENT INVESTIGATION AND MORT ANALYSIS 9

Domino incident investigation - technique, logic diagram, input requirements, output, example. Unavailability analysis of protective systems - technique, logic diagram, input requirements, example. Reliability analysis of automatic control systems - PES safety system development logic diagram system analysis, calculation of fractional dead time, application, strengths and weaknesses. Introduction to MORT analysis, Sneak analysis.

UNIT II BASIC CONCEPTS ON LOPA 9

Layer of Protection Analysis (LOPA) - Overview of relevant standards and guidelines, risk tolerance criteria. Preparation of LOPA-LOPA methodology, the LOPA team. Scenario development - components, inherently safe considerations. Initiating causes / effects - identification, estimation of frequencies. Independent protection layers - IPL criteria, allocation of IPL credit - basic process control systems, operator response, pressure relief device, safety instrumented system, and safety instrumented function. Safety integrity level (SIL) assignment, Interpreting LOPA results and making recommendations.

UNIT III SECURITY RISK ASSESSMENT AND PROTECTION 9

Security for chemical process industries - Assessments and regulatory environment, methods for assessing security vulnerability, emerging security regulations, government development and industry activities that relate to security for process facilities. Strategies and counter measures – prevention of intentional releases and the ft of chemical releases at process facilities. Case study.

UNIT IV BEHAVIOUR BASED SAFETY IN ORGANIZATIONS 9

Behaviour- Based Safety (BBS) - Fundamentals of BBS Management - people based safety, BBS experience, Outcomes of BBS work, psychology of BBS, Implementation problems in BBS, Behavioral safety Observation Process. Mangers role in developing BBS culture. BBS steering committee. Main steps of True BBS approach.

UNIT V SAFETY MANAGEMENT SYSTEMS 9

Safety Management Systems: SHEMS, OHSAS 18001 and OSHA´s PSM - Policy, planning, training, implementation, management control and review.

TOTAL: 45 PERIODS

OUTCOMES

On completion of this course the student will be able to:

- Analyse domino effects and conduct MORT analysis
- Analyse the layer of protection required for process industries
- Gain knowledge on essential elements of plant security
- Understand the concept of behavior based safety

TEXT BOOK

1. Fred A. Manuele, "Advanced Safety Management: Focusing on Z10.0, 45001, and Serious Injury Prevention"
2. DAS AKHIL KUMAR "Principles of Fire Safety Engineering: Understanding Fire and Fire Protection"

REFERENCES:

1. Centre for Chemical Process Safety, AIChE: Guidelines for Chemical Process Quantitative Risk Analysis, second edition, 2000.
2. ACC: Site Security Guidelines for the U.S Chemical Industry, American Chemistry Council, Washington DC, 2001.
3. Thomas R. Krause. (1996). The Behaviour - based safety process: Managing involvement for an injury-Free Culture. (Second edition). John Wiley & Sons.
4. Kaila, H.L. (2010). Behaviour based safety in organisations - a practical guide. IK International, New Delhi.

SF8012 ENVIRONMENTAL PROTECTION AND WASTE MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To Understand the basic problems in Environment Pollution
- To know the cause and prevention of Water Pollution
- To educate the students about the Solids Waste Management
- To familiarizes the concepts on Environmental Auditing and Management
- To teach the students in E-Waste Technology and Recycling Methods

UNIT I INTRODUCTION TO ENVIRONMENT POLLUTION 9

Air Pollution Management, Air Pollution Measurement, Air quality monitoring, Air Pollution modeling, Air Pollution control Technology & method, Equipment Selection, Equipment design, Particulate emission control, Sources corrective methods, Air quality Management concept.

UNIT II WATER POLLUTION AND MANAGEMENT 9

Water pollution Management concepts of water pollution, characteristics of waste water, standards of pollution parameters methodology of waste water treatment, Water Treatment process, Sedimentation, Coagulation and flocculation, Filtration, Advanced water Treatment processes, industrial water pollution Management.

UNIT III SOLIDS WASTE MANAGEMENT AND TREATMENT 9

Solid and hazardous waste Management & risk analysis; sources, Classification and composition of MSW (Municipal Solid Waste), Waste Minimization of MSW, Thermal treatment (Combustion) of MSW, Hazardous Waste Transport & Treatment facilities, Treatment system for hazardous waste & handling of treatment plant residues.

UNIT IV INTRODUCTION TO ENVIRONMENTAL AUDITING AND MANAGEMENT 9

Environmental Management in industries, Principals and requirements of ISO 14001 EMS, Environmental auditing & Auditing of waste minimization. Environment Impact Assessment, Environmental Management Plan. EIA, EMP and Environmental Auditing Environmental Impacts, Evaluation of Impact.

UNIT V E-WASTE TECHNOLOGY AND RECYCLING METHODS 9

E-waste growth- An overview, hazards of E-waste, what is E-waste, digital dump yard, how to minimize E-waste, Hazardous substances waste Electrical and Electronic Equipment, characteristics of pollutants, batteries, electrical and electronic components, plastic and flame retardants, circuit boards, pollutants in waste electrical and electronic equipment

E-Waste Recycling

Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course the student will be able to

- Give qualitative description of fire sequence, ignition, flames spreading, heat release rate, mass burning rate, time dependency of heat release rate and effect of the enclosure on heat release rate etc.
- Recognize the importance off ireplumes, flames, mean flame height, flame height co relations plumes co relations, ceiling jets etc.
- Develop understanding on pressure profiles and air-Flow in buildings
- Attain knowledge about smoke filing, pressure build in the fire enclosure, transient smoke filing models, effect of sprinklers on smoke filing and its correlations, fire safety engineering system for handling and control of combustion gases and CFD models.

TEXT BOOKS

1. Environmental Management Handbook by Marcel Dekker.
2. Environmental Management Handbook for Hydrocarbon Processing Indus; James B. Well
3. Environmental Safety and Health Engineering by Gayle wood side and Dianna Koeurek

REFERENCES

1. Waste Management by Rajiv K. Sinha
2. Hazardous Waste Management by J.M. Goel
3. E-Waste Managing the Digital Dump Yard, Edited by Vishakha Munshi, ICFAI University Press
4. E-waste: Implications, Regulations and Management in India and Current Global Best Practices, Edited by Rakesh Johri, The Energy and Resources Institute, New Delhi
5. Perspectives in Nuclear Toxic and Hazardous Waste by Kadambari Sharma.
6. Water Pollution, Cases Effects and Control by P.K. Goel
7. A to Z of Environmental Audit, A. Mehrotra
8. Elements of Biotechnology- P.K. Gupta.
9. A text book on Biotechnology by H. D. Kumar

SF8013 **FIRE DYNAMICS** **L T P C**
3 0 0 3

OBJECTIVES:

- The objective of the course is to teach the fundamentals of heat release in a fire, fir plumes and flames, pressure profiles and smoke filling.

UNIT I INTRODUCTION TO FIRE DYNAMICS 9

Qualitative description fa fires sequence. Ignition, flame spreading. Various ways of categorizing a fire. The effect of the building on the fire. Heat release rate. Mass burning rate and time-dependency of the heat release rate, the order of magnitude of the heat release rate, the strengths and weaknesses of various test methods, growth of alfa-t2, the effect of the enclosure on the heat release rate, extraction of a power curve.

UNIT II OVERVIEW OF FIRE PLUMES 9

Fire plumes and flames. Froude number, mean flame height, flame-height correlations, various profiles in a plume, ideal plumes, strong and weak plumes, plume correlations, ceiling jets, special issues to be considered in the design process, quasi-stationary conditions, selecting a plume model.

UNIT III ENERGY RELEASE RATES 9

Pressure profiles. Background on air-Flow in buildings. Bernoulli's equation. Various forms of pressure. Computing pressure, rate and mass air-Flow through openings. Gas temperatures. Energy balance, rate of heat transfer, correlations for computing gas temperatures. Fully-developed fires, ISO 834, temperature calculation. The influence of high temperatures on structural elements of steel or wood.

UNIT IV SMOKE IN FIRE DYNAMICS 9

Smoke filling. Pressure build-up in the fire enclosure. Transient smoke filling models. Stationary models for control of combustion gases. Various fire safety engineering systems for handling and control of combustion gases.

UNIT V SMOKE IN FIRE MODELING 9

Continuity equations. Effect of sprinklers on smoke filling. Correlations. Combustion products. Equivalency ratios. Soot production. Visibility, dosage. How soot particles are formed. CO, CO2.Computer modelling. Sub-models for computer models. Model constraints. CFD models.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course the student will be able to

- Give qualitative description of fire sequence, ignition, flames spreading, heat release rate, mass burning rate, time dependency of heat release rate and effect of the enclosure on heat release rate etc.
- Recognize the importance off ireplumes, flames, mean flame height, flame height co relations plumes co relations, ceiling jets etc.
- Develop understanding on pressure profiles and air-Flow in buildings
- Attain knowledge about smoke filing, pressure build in the fire enclosure, transient smoke filing models, effect of sprinklers on smoke filing and its correlations, fire safety engineering system for handling and control of combustion gases and CFD models.

TEXT BOOKS

1. Karlsson, B., Quintiere, J G: Enclosure Fire Dynamics. CRC Press, 1999
2. Dougal Drysdale “An Introduction to Fire Dynamics”

REFERENCES :

1. James G. Quintiere, “Principles of Fire Behavior”
2. Gregory E. Gorbett, James L. Pharr, Scott Rockwell, “Fire Dynamics”

IE8691 FACILITY LAYOUT AND MATERIALS HANDLING L T P C
3 0 0 3

OBJECTIVE:

- To explain the basic principles in facilities planning, location, layout designs and material handling systems

UNIT I PLANT LOCATION 9

Introduction, Factors affecting location decisions , Location theory , Qualitative models , Semi-Quantitative models -Composite measure , Brown & Gibbs model , Break-Even analysis model, Single facility location problems – Median model, Gravity location model, Mini-Max model, Multi-facility location problems, Network and warehouse location problems.

UNIT II FACILITY LAYOUT DESIGN 9

Need for Layout study, Factors influencing plant layout, Objectives of a good facility layout, Classification of layout, Layout procedure – Nadler's ideal system approach, Immer's basic steps, Apple's layout procedure, Reed's layout procedure –Layout planning – Systematic Layout Planning – Information gathering, flow analysis and activity analysis, relationship diagram, space requirements and availability, designing the layout. Utilities planning

UNIT III COMPUTERISED LAYOUT PLANNING 9

Concepts, Designing process layout – CRAFT, ALDEP, CORELAP – Trends in computerized layout, Algorithms and models for Group Technology.

UNIT IV DESIGNING PRODUCT LAYOUT 9

Line balancing - Objectives, Line balancing techniques – Largest Candidate rule- Kilbridge and Wester method- RPW method- COMSOAL.

UNIT V MATERIAL HANDLING AND PACKAGING 9

Objectives and benefits of Material handling, Relationship between layout and Material handling, Principles of material handling, Unit load concept, Classification of material handling equipments, Equipment selection, Packaging.

TOTAL: 45 PERIODS

OUTCOME

Students must analyse, design and apply layout principles for layout product, material handling and packaging.

TEXT BOOK:

1. Francis, R.L., and White, J.A, "Facilities layout and Location", Prentice Hall of India, 2002.

REFERENCES:

1. James, Apple, "Material Handling System design", Ronald Press, 1980.
2. Krajewski, J. and Ritzman, "Operations Management – Strategy and Analysis", Addison Wesley publishing company, 5th Edition, 1999.
3. Pannerselvam.R, "Production and Operations Management", PHI, 2nd Edition, 2005
4. Tompkins, White et al., "Facilities planning", John Wiley & Sons, inc. 2003.