

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

(Deemed to be University Under Section 3 of the UGC Act, 1956)
Kumaracoil, Thuckalay

DEPARTMENT OF
FIRE TECHNOLOGY AND SAFETY ENGINEERING



B.Tech. FIRE TECHNOLOGY AND SAFETY ENGINEERING
CURRICULUM AND SYLLABI

REGULATION 2021

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION, Kumaracoil

Regulation: 2021

Curriculum and Syllabi

B.Tech Degree Programme

DEPARTMENT OF FIRE TECHNOLOGY AND SAFETY ENGINEERING

B. TECH - FIRE TECHNOLOGY AND SAFETY ENGINEERING

Vision of the University

To be recognized by the Government and society at large as an institution able to deliver excellence with relevance in the field of higher education and research focusing on the needs of the nation in tune with the technological revolution to cope with the knowledge explosion and global competence.

Mission of the University

To develop the institution as a Centre of Excellence, keeping pace with the advances in the field, so as to provide quality higher education to the students and instill in them high standards of discipline and ethics so that they become enlightened individuals in the service of humanity and to carry out focused research in the frontier areas of science and technology.

Faculty of Mechanical Engineering

Department of Fire Technology and Safety Engineering

Vision of the Department

To provide quality education to the students and promote them as successful safety professionals and also make them internationally competent for a successful career in safety, occupational health, environmental management and fire protection Engineering.

Mission of the Department

M1: To prepare students as nationally and internationally competitive safety Professional for a successful career in safety, occupational health, environmental management and fire protection using global standards.

M2: To impart high-quality professional training and make to graduates with sound knowledge in safety.

M3: To nurture leading-edge research in the fast-changing field of safety engineering and make students to be successful professionals, committed to lifelong learning.

M4: To make graduate trained in latest technology in the field of fire and safety.

M5: To prepare graduates who can make better safety standards and contribute to the safety in the society.

Description of the programme

The Department of Fire Technology and Safety Engineering was started in the academic year 2011-2012. It offers the 4-year undergraduate program B.Tech. (Fire Technology and Safety Engineering.) This unique program offers students with the idea to create an environment of safety against fire. B.Tech. in Fire Technology and Safety engineering forms an integral part of various process industries like chemical production units, refineries, fluid treatment plants, food and beverage industry etc. To design the piping for such plants needs adequate knowledge, insight and experience. As the industrial sector is poised for an upsurge around the world including India, most of the associated services will have to be scaled up. The curriculum of Fire Technology and Safety includes all the requisite aspects to enter the field of piping design with confidence. Our team of experts include academic as well as industry professionals who stress on incorporating an easy learning pattern with in-depth domain knowledge. The department strives to introduce education to imbibe innovative learn in strategies to make thorough use of one's strengths and the employment opportunities.

Programme Educational Objectives - PEO	
PEO-01	To provide a sound platform in basic science, general engineering, scientific and engineering fundamentals necessary to, formulate, analyze, evaluate and solves engineering problems
PEO-02	To demonstrate their professionalism and innovative skills in designing, implementing, and evaluating safety systems or components that cater to the requirements of society and industries
PEO-03	To provide excellent guidelines to exhibit good communication, genuine professionalism and ethical behaviour also impart high-quality training to execute technical problem as teamwork for the betterment of effective safety engineering and management.
PEO-04	To engage in sustained learning through higher studies, professional improvement opportunities, self-directed learning and value-added courses to adopt them for the changes in safety technologies in the local and universal context.
PEO-05	By incorporating these modern engineering tools into fire and safety practices, professionals can enhance their ability to identify and address real-time problems, improve response times, and ultimately save lives and property.

Graduate	
GA-1	Innovative Engineering Solutions Develop creative and innovative solutions to complex engineering problems, incorporating the latest technologies and approaches to address current and future challenges.
GA-2	Global Perspective in Engineering Understand and apply engineering solutions in a global context, recognizing the diversity of global issues, standards, and the impact of engineering decisions on different cultures and communities.
GA-3	Sustainable Development and Green Engineering Design and implement engineering solutions that prioritize sustainability, resource efficiency, and environmental protection, contributing to a sustainable future.
GA-4	Social Responsibility and Community Engagement Demonstrate a commitment to social responsibility by engaging with and contributing to local communities, understanding societal needs, and addressing social challenges through engineering practices.
GA-5	Adaptability and Lifelong Learning Exhibit a proactive approach to continuous learning and adaptability, keeping pace with technological advancements and industry changes, and engaging in professional development activities.
GA-6	Entrepreneurship and Innovation Foster an entrepreneurial mindset, identifying opportunities for innovation and creating value through new technologies, products, and processes that meet market needs.
GA-7	Interdisciplinary Collaboration Work effectively in interdisciplinary teams, integrating knowledge from various fields to develop comprehensive solutions to complex engineering problems.
GA-8	Ethical Leadership and Integrity Lead with integrity and ethical principles, ensuring transparency, fairness, and respect in all professional and personal interactions.
GA-9	Digital and Data Literacy Utilize advanced digital tools and data analytics techniques to solve engineering problems, optimize processes, and make informed decisions based on data-driven insights.
GA-10	Safety, Health, and Risk Management Prioritize safety, health, and risk management in engineering practices, ensuring the well-being of individuals and communities while minimizing potential risks and hazards.
GA-11	Effective Communication and Negotiation Skills Communicate ideas, solutions, and technical information effectively to a variety of audiences, and engage in negotiation to resolve conflicts and reach consensus.
GA-12	Impact Assessment and Policy Making Assess the impact of engineering projects on society and the environment, and contribute to policy-making processes that promote sustainable and responsible engineering practices.

Programme Outcome – PO	
PO-A	Apply knowledge of mathematics, science, and engineering fundamentals and specialized engineering knowledge to solve the problems related to safety engineering.
PO-B	Identify, formulate and analyze the complex safety problems using the principles of mathematics, natural sciences, and engineering concepts.
PO-C	Design and conduct experiments, analyze and interpret data through appropriate methods in order to provide a valid conclusion.
PO-D	Design solutions for complex safety problems and design system components or processes to meet the desired needs in public health, safety and environmental consideration.
PO-E	Gain and use knowledge on contemporary issues and apply appropriate techniques, skills and engineering tools necessary for implementation in real-time safety issues.
PO-F	Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings
PO-G	Communicate effectively to the engineering community and with the society through effective reports, documents, presentations, symbols, guidelines, and drawings
PO-H	Assess the societal needs in the field of occupational health and safety and to bring effective solutions through professional engineering practice.
PO-I	Understand the impact of professional engineering solutions in the context of social, cultural and environmental responsibilities and the need for sustained development
PO-J	To provide excellent guidelines to exhibit ethical behaviour and to enrol as a professional in a competitive engineering society.
PO-K	Demonstrate the knowledge and understanding of the safety engineering and management principles and apply these to manage and execute projects, safety audits in the multidisciplinary environment.
PO-L	Recognize the need for, and have the preparation ability to effectively engage in the fast-changing field of safety engineering and make students to be successful safety professionals, committed to lifelong learning.

Mapping of Graduate Attributes and Programme Educational Objectives(PEO)

GAs PEOs	GA-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10	GA-11	GA-12
PEO-01	H	A	A	A	N	Not	A	Not	A	A	Not	A
PEO-02	A	Not	H	A	A	Not	Not	Not	Not	H	Not	A
PEO-03	Not	Not	Not	A	Not	Not	A	H	Not	A	H	Not
PEO-04	Not	Not	Not	Not	H	Not	Not	Not	A	A	Not	Not
PEO-05	Not	A	Not	Not	H	Not	Not	Not	H	A	A	A

H- Highly Associated

A- Associated

Not – Not Associated

Mapping of Graduate Attributes and Programme Outcomes (PO)

GAs PEOs	GA-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10	GA-11	GA-12
PO-A	H	A	Not	Not	Not	Not	Not	Not	Not	Not	Not	Not
PO-B	A	H	Not	Not	Not	Not	Not	Not	Not	Not	Not	Not
PO-C	Not	A	H	Not	Not	Not	Not	Not	Not	Not	Not	Not
PO-D	Not	Not	A	H	Not	Not	Not	Not	Not	A	Not	Not
PO-E	A	Not	Not	Not	H	Not	Not	Not	A	Not	Not	Not
PO-F	Not	Not	Not	Not	Not	Not	H	Not	Not	Not	Not	Not
PO-G	Not	Not	Not	Not	Not	Not	A	Not	Not	Not	H	Not

PO-H	Not	N ot	N ot	A	N ot	No t	No t	No t	Not	H	Not	Not
PO-I	Not	N ot	N ot	H	A	No t	No t	No t	Not	No t	Not	A
PO-J	Not	N ot	N ot	N ot	N ot	No t	No t	H	Not	A	Not	Not
PO-K	Not	N ot	N ot	N ot	N ot	No t	No t	No t	Not	A	Not	H
PO-L	Not	N ot	N ot	N ot	H	No t	No t	No t	Not	No t	Not	A

H- Highly Associated

A- Associated

Not – Not Associated

Mapping of Programme Educational Objective (PEOs) and Programme Outcomes (POs)

PEO	PEO-01	PEO-02	PEO-03	PEO-04	PEO-05
PO-A	H	A	Not	Not	Not
PO-B	H	H	Not	Not	Not
PO-C	Not	H	Not	Not	Not
PO-D	Not	H	Not	Not	A
PO-E	Not	A	Not	Not	H
PO-F	Not	Not	Not	H	Not
PO-G	Not	Not	H	Not	Not
PO-H	Not	A	H	Not	Not
PO-I	Not	H	Not	A	Not
PO-J	Not	Not	H	Not	Not
PO-K	Not	A	H	Not	Not
PO-L	Not	Not	Not	H	A

H- Highly Associated

A- Associated

Not – Not Associated

Duration of the programme : 4 Years/ 8 Semesters

Total credits : 165

CURRICULUM & SYALLABI
SEMESTER I

S.No.	Course Code	Course Title	L	T	P	Credit
3-WEEKS COMPULSORY INDUCTION PROGRAM						
1	EG3101	Technical English	3	1	0	4
2	MA3101	Engineering Mathematics – I	3	1	0	4
3	BS3101	Engineering Physics	3	0	0	3
4	BS3102	Engineering Chemistry	3	0	0	3
5	CS3101	Fundamentals of Computing and Python Programming	3	0	0	3
PRACTICAL						
6	CS3171	Problem Solving and Python Programming Laboratory	0	0	4	2
7	BS3171	Physics and Chemistry Laboratory	0	0	4	2
TOTAL			15	2	8	21

SEMESTER II

S.No.	Course Code	Course Title	L	T	P	Credit
1	EG3102	Communicative English	3	0	0	3
2	MA3102	Mathematics-II	3	1	0	4
3	BE3101	Basic Electrical and Electronics Engineering	3	0	0	3
4	BE3102	Basic Civil and Mechanical Engineering	3	0	0	3
5	ME3101	Engineering Graphics	3	0	2	4
PRACTICAL						
6	BE3171	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1
7	BE3172	Basic Civil and Mechanical Engineering Laboratory	0	0	2	1
TOTAL			15	1	06	19

SEMESTER III

S.No	Course Code	Course Title	L	T	P	Credit
THEORY						
1.	MA3201	Engineering Mathematics – III	3	1	0	4
2.	FS3201	Applied Mechanics	3	1	0	4
3.	FS3202	Basics of Fire Engineering	3	0	0	3
4.	FS3203	Basics of Safety Engineering	3	0	0	3
5.	FS3204	Machine Drawing	3	1	0	4
6.	FS3205	Management of Disaster and Emergency	3	0	0	3
PRACTICALS						
7.	FS3271	Emergency Life Support Laboratory	0	0	2	1
8.	FS3272	Fire Engineering Laboratory	0	0	2	1
9.	FS3273	Safety Engineering Laboratory	0	0	2	1
TOTAL			18	3	06	24

SEMESTER IV

S.No	Course Code	Course Title	L	T	P	Credit
THEORY						
1.	MA3207	Probability and Statistics	2	1	0	3
2.	BS3201	Environmental Studies	3	0	0	2
3.	FS3206	Accident Investigation and Analysis	3	0	0	3
4.	FS3207	Applied Thermodynamics & Fluid Mechanics	3	1	0	4
5.	FS3208	Manufacturing Processes	3	0	0	3
6.	FS3209	Solid Mechanics	3	1	0	4
PRACTICALS						
7.	FS3274	Manufacturing Processes Laboratory	0	0	2	1
8.	FS3275	Solid and Fluid mechanics Laboratory	0	0	2	1
9.	FS32P1	Industrial Training - I	0	0	2	2
TOTAL			17	3	6	23

SEMESTER V

S.No	Course Code	Course Title	L	T	P	Credit
THEORY						
1.	MS3201	Professional and Business Ethics	3	0	0	2
2.	FS3210	Fire Fighting and Protection Systems	3	0	0	3
3.	FS3211	Design of machine elements and piping	3	1	0	4
4.	FS3212	Industrial Chemical Technology	3	0	0	3
5.	FS3213	Hazard Identification and Risk Assessment	3	0	0	3
6.	FS3214	Instrumentation and Control	3	0	0	3
PRACTICALS						
7.	FS3276	Chemical Engineering Laboratory	0	0	2	1
8.	FS3277	Computer Aided Fire Safety Design Laboratory	0	0	2	1
9.	FS3278	Instrumentation and Control Laboratory	0	0	2	1
TOTAL			18	1	6	21

SEMESTER VI

S.No	Course Code	Course Title	L	T	P	Credit
THEORY						
1.	AI32D1	Fundamentals of Artificial Intelligence (Open Elective I)	3	0	0	3
2.	FS3215	Principles of Safety Management	3	0	0	3
3.	FS3216	Occupational Health and Hygiene	3	0	0	3
4.	FS3217	Safety in Construction Industries	3	0	0	3
5.	FS32XX	Professional Elective- I	3	0	0	3
6.	FS32XX	Professional Elective- II	3	0	0	3
PRACTICALS						
7.	FS3279	Industrial Hygiene Laboratory	0	0	2	1
8.	FS3280	Fire Safety and Emergency Preparedness Training Laboratory	0	0	2	1
9.	FS32P2	Industrial Training – II	0	0	2	2
TOTAL			18	0	6	22

SEMESTER VII

S.No	Course Code	Course Title	L	T	P	Credit
THEORY						
1.	MS3202	Principles of Management	3	0	0	2
2.	FS3218	Legal Aspects of Welfare Safety and Environment	3	0	0	3
3.	XXXXX	Open Elective – II	3	0	0	3
4.	FS32XX	Professional Elective- III	3	0	0	3
5.	FS32XX	Professional Elective- IV	3	0	0	3
PRACTICALS						
6.	FS3281	Environmental Engineering Laboratory	0	0	2	1
7.	FS3282	Fire, Smoke Modeling and Analysis Laboratory	0	0	2	1
8.	FS32P3	Design and Fabrication Project	0	0	3	3
TOTAL			15	0	7	19

SEMESTER VIII

S.No	Course Code	Course Title	L	T	P	Credit
THEORY						
1.	FS32XX	Professional Elective- V	3	0	0	3
2.	FS32XX	Professional Elective – VI	3	0	0	3
PRACTICALS						
3.	FS32P5	Project Work	0	0	20	10
TOTAL			6	0	20	16

LIST OF ELECTIVES (Regulation – 2021)

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	FS32A1	Process safety Management	3	0	0	3
2.	FS32A2	Electrical Systems and Safety	3	0	0	3
3.	FS32A3	Fire safety codes and Standardization	3	0	0	3
4.	FS32A4	Advanced Safety Systems in Industry	3	0	0	3
5.	FS32A5	Safety in Petroleum and petrochemical Industries	3	0	0	3
6.	FS32A6	Fire Safety materials in Building	3	0	0	3
7.	FS32A7	Fire safety Design for Buildings	3	0	0	3
8.	FS32A8	Safety in Engineering Industries	3	0	0	3
9.	FS32A9	Nuclear Safety and Handling Radioactive Materials	3	0	0	3
10.	FS32B1	Environmental Safety	3	0	0	3
11.	FS32B2	Chemical Processes Instruments & Safety	3	0	0	3
12.	FS32B3	Transport Systems and Safety	3	0	0	3
13.	FS32B4	OHSAS 18000 ISO 14000 and ISO: 45001	3	0	0	3
14.	FS32B5	Principles of Industrial Management	3	0	0	3
15.	FS32B6	Hazard Control in Manufacturing Industry	3	0	0	3
16.	FS32B7	Principles of Health and Safety Management	3	0	0	3
17.	FS32B8	Automobile Engineering and Safety	3	0	0	3
18.	FS32B9	Rescue Equipment and Handling Techniques	3	0	0	3
19.	FS32C1	Safety in Chemical Industries	3	0	0	3
20.	FS32C2	Safety in mines	3	0	0	3
21.	FS32C3	Fire Dynamics	3	0	0	3
22.	FS32C4	Building Fire and Smoke dynamics	3	0	0	3
23.	FS32C5	Industrial Safety, Health and Environment Acts	3	0	0	3
24.	FS32C6	Safety Management Techniques.	3	0	0	3

LIST OF OPEN ELECTIVES (REGULATION -2021)

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	FS32D1	Fundamentals of Safety Engineering	3	0	0	3
2.	FS32D2	Fundamentals of Industrial Safety	3	0	0	3

SEMESTER I

S.No.	Course Code	Course Title	L	T	P	Credit
3-WEEKS COMPULSORY INDUCTION PROGRAM						
1	EG3101	Technical English	3	1	0	4
2	MA3101	Engineering Mathematics – I	3	1	0	4
3	BS3101	Engineering Physics	3	0	0	3
4	BS3102	Engineering Chemistry	3	0	0	3
5	CS3101	Fundamentals of Computing and Python Programming	3	0	0	3
PRACTICAL						
6	CS3171	Problem Solving and Python Programming Laboratory	0	0	4	2
7	BS3171	Physics and Chemistry Laboratory	0	0	4	2
TOTAL			15	2	8	21

EG3101	TECHNICAL ENGLISH	L	T	P	C
		3	1	0	4

OBJECTIVES

- To develop the linguistic, communicative and critical thinking competencies of First Year Engineering students
- To enhance the understanding of the complex grammatical structures of the English language to students
- To improve the language proficiency of students in English with emphasis on Vocabulary, Grammar, Listening, Speaking, Reading, and Writing skills
- To introduce the students to the basic phonetics of English and make them grasp the various sounds of the English language to improve their pronunciation

Course Outcomes		Cognitive Skill
CO-01	The students will be able to improve their vocabulary relating to Engineering Technology and use articles and prepositions effectively in sentences.	R
CO-02	The students will be able to learn grammatical items like tense, voice, compound nouns etc. and thereby enhance their linguistic competence.	U
CO-03	The students will be able to learn definitions of technical terms, relative pronouns etc. which will develop their language competence.	A
CO-04	The students will be able to acquire the essentials of writing skills relating to CV, resume, Formal and Business Letters.	U
CO-05	The students will be able to learn English phonemes such as Vowels, Diphthongs and Consonants which will be instrumental in improving their pronunciation and speaking skills.	R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcomes with Programme Outcomes

PO \ CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	M	S	S	M	S	S	N	N	N	N	N
CO-02	M	S	M	M	S	S	M	S	N	N	N	N	N
CO-03	S	M	M	S	M	M	S	M	N	N	N	N	N
CO-04	M	S	M	M	S	M	S	M	N	N	N	N	N
CO-05	S	M	S	S	M	S	M	S	N	N	N	N	N

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT-I**9**

Word formation with prefixes and suffixes – Articles – Conjunctions – Prepositions – Expansion of Abbreviations and Acronyms – Writing Checklists – Writing Instructions.

UNIT-II**9**

Tense – Voice – Punctuation – Expansion of Compound Nouns – Writing Recommendations – Paragraph Writing – Types, Structures and Features of a Paragraph – Creating Coherence—Organizing Principles of Paragraphs in Documents.

UNIT-III**9**

Discourse Markers – Gerunds and Present Participles – Relative Pronouns – Conditional Clauses – Definitions of Technical Terms – Transcoding : Bar Chart - Flow Chart - Pie Chart - Tree Diagram - Tabular Column.

UNIT –IV**9**

Concord – Clauses – Phrases – Numerical Adjectives – CV/Resume Writing – Virtual Communication: E-Mail Writing – Essay Writing : Basic Format of an Essay - Types – Examples.

UNIT-V**9**

Basic Phonetics : Phonemes – Vowels, Diphthongs and Consonants – Classification : Pure Vowels/Monophthongs – Vowel Glides /Diphthongs.

L: 45 + T: 15, TOTAL: 60 HOURS**EXTENSIVE READING:**

Shiv Khera, *You Can Win*, Milan, Delhi, 2004

NOTE:

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

MA3101	ENGINEERING MATHEMATICS - I	L	T	P	C
		3	1	0	4

OBJECTIVE:

The course objective is to develop the required skill of the students in the area of Engineering Mathematics with special emphasis on the characteristic equation of matrices, differential calculus, Beta and Gamma functions and to develop basic knowledge to the students in double and triple integration.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the characteristic equation and find eigen values and Eigen vector of a real matrix. Compute the eigen value and eigen vector using properties. Verify Cayley Hamilton theorem and its applications. Apply orthogonal transformation of a symmetric matrix.	U, A, E, R
CO-02	Define the definitions and formula for curvature, radius of curvature, circle of curvature. Apply the formula and solve problems using the required formulas also find the evolute of the curves.	U, A, E, An

CO-03	Know about the differentiation formulae and apply on partial derivatives, total derivatives and Jacobians. Verify the functions be maximum or minimum and Lagrange's multiplier method. Express the Taylor's expansion for two variables.	U, A, E, R
CO-04	Know the Fundamental concepts of improper integrals, Beta and gamma function and their properties. Develop the skill in the relation between Beta and Gamma Functions. Calculate definite integral values using Beta and Gamma Functions.	U, A, An, E
CO-05	Evaluate the double and multiple integrals and can apply these concepts to find areas of regions on a plane or in space. Graph Cartesian and polar equations. Convert Cartesian coordinates into polar coordinates.	U, A, An, E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L	PO-M
CO-01	S	M	S	M	S	S	S	S	M	S	S	M	N
CO-02	S	M	M	M	S	S	M	S	M	M	M	M	N
CO-03	S	M	M	M	S	S	M	M	M	S	S	M	N
CO-04	S	M	S	M	S	M	S	S	M	S	S	M	N
CO-05	S	M	S	M	S	M	S	S	M	S	S	M	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT-I MATRICES

9

Characteristic equation - Eigen values and Eigen vectors of a real matrix - Properties of eigen values and eigen vectors(without proof)- Cayley Hamilton theorem (statement only), verification and its applications - Orthogonal and Symmetric matrices and their properties(excluding proof)- Orthogonal transformation of a symmetric matrix to diagonal form.

UNIT-II DIFFERENTIAL CALCULUS

9

Curvature - Cartesian co-ordinates and parametric form -Centre and radius of curvature, Circle of curvature - Evolutes.

UNIT-III FUNCTIONS OF SEVERAL VARIABLES

9

Partial derivatives - Total derivatives - Jacobians - Properties - Maxima and minima for functions of two variables - Lagrange Multiplier method- Taylor's expansion.

UNIT-IV IMPROPER INTEGRALS

9

Evaluation of improper integrals- Beta and Gamma functions - Properties - Relation between Beta and Gamma functions - Evaluation of integrals using Beta and Gamma functions.

UNIT-V MULTIPLE INTEGRALS

9

Evaluation of double and triple integrals - Area enclosed by plane curves as double integral in cartesian and polar co-ordinates - Change of order of integration- Transformation of Cartesian coordinates into polar coordinates.

L: 45 + T: 15, TOTAL: 60 HOURS

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics"- 40th Edition , Khanna Pub- lishers, Delhi 2007

REFERENCES:

1. M.Immaculate Mary , K.Uma Samundesvari,” Engineering Mathematics - I” Revised Edition, R.K Publishers, 2016.
2. Veerarajan T, ” Engineering Mathematics (for first year)”, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd.,New Delhi , 2007.
3. Erwin Kreyszig, ”Advanced Engineering Mathematics”, Seventh Edition, Wiley India, 2007.
4. P.Kandasamy , K.Thilagavathy , K.Gunavathy” Engineering Mathematics” Vol,1 ,S.Chand & Company Ltd.2002.
5. B.V. Ramana,”Higher Engineering Mathematics” Second Edition Tata McGraw- Hill, Publishing Company Ltd.,New Delhi, 2006 .

BS3101	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES

The course objective is to provide basic ideas about the principles of physics related to properties of matter, wave optics, heat, quantum concepts and materials. engineering problems.

Course Outcome–Cos		Cognitive Skill
CO-01	Students will be able to understand and apply knowledge about the properties of materials.	R, U, A
CO-02	Students will be able to understand the types of oscillations and the wave nature of light in interference, diffraction and polarization phenomenon.	R,U,A,E
CO-03	Students will be able to state and explain the various laws of thermodynamics, understand entropy and its application.	R,U,A,An, ,E
CO-04	Students gain basic knowledge about quantum mechanics and will be able to solve time dependent and time independent Schrodinger equation for simple potentials.	R,U,A,E,S
CO-05	Students will be able to know the different types of crystal structures and also gain basic knowledge about nanomaterials and biomaterials.	R,U,A,E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

[illegible]

CO-03	S	S	S	S	N	N	N	N	N	N	N	N	N
CO-04	S	M	S	S	N	N	N	N	N	N	N	N	N
CO-05	S	S	M	M	N	N	N	N	N	N	N	N	N

S-Strong, M-Medium, L-Low, N-Not Relevant

UNIT I: PROPERTIES OF MATTER

9

Elasticity – Poisson’s ratio – Stress-strain diagram – factors affecting elasticity – bending of beams – cantilever depression – Young’s Modulus- theory and experiment of Young’s modulus determination (uniform and non-uniform bending) –Shear Modulus – twisting couple – hollow cylinder – torsion pendulum – determination of rigidity modulus - Bulk Modulus - applications of elastic behaviours of materials.

UNIT II: OSCILLATIONS AND WAVE OPTICS

9

Oscillations - Rectilinear motion - Oscillations or Vibrations - Simple Harmonic Motion - Damped Harmonic motion - Real oscillatory system - Forced or Driven oscillation. Wave optics -Interference of light – Photons - Young's Double Slit Experiment - Huygens's Principle - Diffraction - Diffraction Grating - Polarization.

UNIT III: THERMAL PHYSICS

9

Transfer of heat energy (conduction, convection and radiation) - thermal expansion of solids and liquids – expansion joints – bimetallic strips-Thermal conductivity- Forbe’s and Lee’s disc methods (theory and experiment)- thermal insulation in buildings -Laws of thermodynamics- heat exchanger -solar power- applications of solar power (solar water heater, photo voltaic cell)

UNIT IV: QUANTUM PHYSICS

9

Matter waves- de-Broglie wavelength - Schrodinger’s wave equation-time independent and time dependent equations- physical significance of wave function- uncertainty principle and its application- energy and momentum operators-particle in a one dimensional box- scanning electron microscope- transmission electron microscope-scanning tunnelling microscope.

UNIT V: MATERIAL 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. Introduction and applications of Metallic glasses, Shape Memory Alloys (SMA), Nanomaterials, Biomaterials.

TOTAL: 45 HOURS

TEXT BOOKS

1. Engineering Physics I by Bindhu B, Sagi Rani C, Meenadevi V N, Ganapathi Raman R, RK Publishers 2015.
2. Engineering Physics II by Bindhu B, Geetha Kumari R, Sugirtha Suni N Y, RK Publishers 2016.
3. Engineering Physics by R K Gaur And S L Gupta, Dhanpat Rai Publications 2011.
4. A Text Book Oscillations, Waves & Acoustics by Dr. M. Gosh, Dr. D. Battacharya, S. Chand, Revised Edition.

REFERENCES:

1. Engineering Physics by Rajendran V, McGraw-Hill, New Delhi, 2013
2. Engineering Physics by Arumugam M, Anuradha Publications, 2014.
3. Principles of Physics by Halliday D, Resnick R and Walker J, Wiley 2015.

- Physics for scientist and Engineers by Serway R A and Jewett J W, Cengage Learning 2010.
- Engineering Physics by Bhattacharya D K and Poonam T, Oxford University Press 2015.
- Engineering Physics by Pandey B K and Chaturvedi, Cengage Learning India 2011

BS3102	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES

To make the students conversant with the principles of the following topics:

- (i) Use of free energy in chemical equilibria (ii) Water chemistry (iii) Periodic properties (iv) Spectroscopic techniques and applications and (v) Organic reactions and synthesis of a drug molecule.

Course Outcome		Cognitive Skill
CO-01	Students will be able to understand the estimation of free energy and entropy	U,A,An
CO-02	Students will be able to apply the different techniques in water technology	R,A
CO-03	Students will be able to analyze the properties of periodic tables.	E,A,E
CO-04	Students will be able to describe the different types of spectroscopic techniques.	An,U
CO-05	Students will be able to predict the structure of organic molecules.	S,U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	L	S	N	N	N	N	N	N	N	N
CO-02	M	S	L	S	S	N	N	N	N	N	N	N	N
CO-03	S	S	S	M	S	N	N	N	N	N	N	N	N
CO-04	S	M	S	S	S	N	N	N	N	N	N	N	N
CO-05	S	L	M	S	S	N	N	N	N	N	N	N	N

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I: USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA

9

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

UNIT II: WATER CHEMISTRY**9**

Water as a universal solvent – hard and soft water – reasons for hardness – disadvantages of hard water in washing and industrial purposes - estimation of hardness by EDTA method, problems; boiler feed water – characteristics- softening methods - external conditioning – demineralization (ion exchange) process, desalination by reverse osmosis method- internal conditioning (phosphate, calgon and carbonate conditioning methods); stages in domestic water treatment – disinfection by chlorination, ozone and UV treatments.

UNIT III: PERIODIC PROPERTIES**9**

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

UNIT IV: SPECTROSCOPIC TECHNIQUES AND APPLICATIONS**9**

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

UNIT V: ORGANIC REACTIONS AND SYNTHESIS OF A DRUG MOLECULE**9**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

TOTAL: 45 HOURS**TEXT BOOKS**

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition.

CS3101	FUNDAMENTALS OF COMPUTING 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.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the basics of algorithmic problem solving.	R,U

CO-02	Ability to analyze various techniques for read and write simple Python programs.	A
CO-03	Introduce Python programs with conditionals and loops.	An
CO-04	Evaluate and Define Python functions, call them and use Python data structures – lists, tuples, dictionaries.	E
CO-05	Apply input/output with files in Python.	A

R - Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J	PO- K
CO-01	N	M	S	L	M	M	L	N	N	N	
CO-02	N	S	L	L	M	S	S	N	N	N	N
CO-03	M	L	S	M	L	L	M	N	N	N	N
CO-04	M	L	L	S	M	M	L	N	N	N	N
CO-05	M	L	L	L	M	S	L	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

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 CONTROLFLOW, 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, merge sort, histogram.

9

TOTAL: 45 HOURS

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

1. John V Guttag, —Introduction to Computation and Programming Using Python“, Revisedand 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. KennethA.Lambert,—Fundamentals ofPython:FirstPrograms‡,CENGAGELearning,2012.
Charles Dierbach, —Introduction to Computer Science using Python: A Computational ProblemSolving Focus, Wiley India Edition,2013.
5. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction to Computer Science using Python 3‡, Second edition, Pragmatic Programmers, LLC.2013.

BS3171	PHYSICS & CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

The course objective is to teach students, the importance of physics through involvement in experiments and to have knowledge of the world due to constant interplay between observations and hypothesis.

Course Outcome – Cos		Cognitive Skill
CO-01	The students will be able to analyse the physical principle involved in various instruments and also relate the principle to new applications.	R,U,A,An,E
CO-02	Various experiments in the areas of optics, properties of matter and ultrasonics will nurture the students in all branches of engineering.	R,U,A,An,E
CO-03	The students will be able to think innovatively and also improve the creative skills that are essential for engineering.	R,U,A,An,E
CO-04	The students will be able to gain knowledge of new concept in the solution of practical oriented problems and theoretical problems.	R,U,A,An,E
CO-05	The students will be able to understand measurement technology ,usage of new instruments and real time applications in engineering studies.	R,U,A,An,E

Mapping of Course Outcome with Programme Outcome

[illegible]

CO-02	S	S	S	M	N	N	N	N	N	N	N	N	N
CO-03	S	S	S	S	N	N	N	N	N	N	N	N	N
CO-04	S	M	S	S	N	N	N	N	N	N	N	N	N
CO-05	S	S	M	M	N	N	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

PHYSICS LAB

List of experiments: Physics Laboratory (Any Five Experiments)

1. Determination of velocity of ultrasonic waves and compressibility of the given liquid by Ultrasonic interferometer. (Real and Virtual Lab)
2. Determination of rigidity modulus by Torsional pendulum. (Real and Virtual Lab)
3. Determination of coefficient of viscosity by Poiseulli's method.
4. Determination of Youngs modulus by non-uniform bending method.(Real and Virtual Lab)
5. Determination of LASER parameters using LASER diode. (Real and Virtual Lab)
6. Determination of band gap of the semi-conductor.(Real and Virtual Lab)
7. Determination of wavelength of mercury spectrum by diffraction grating.(Real and virtual lab)
8. Determination of wavelength of light by Newton's rings.(Real and Virtual Lab)
9. Determination of angle of the prism using spectrometer. (Real and Virtual Lab)

CHEMISTRY LAB

(Any FIVE experiments)

Aim

The objective of the course is to develop the interest among the students regarding chemistry and their applications in engineering.

Course Outcomes

The student at the end of the course will

Course Outcome – Cos		Cognitive Skill
CO-01	Learn and apply basic techniques used in chemistry laboratory for small/large scale water analyses/purification.	U,A
CO-02	Be able estimate the ions/metal ions present in domestic/industry waste water.	A, An
CO-03	Utilize the fundamental laboratory techniques for analyses such as titrations, separation/purification and spectroscopy.	A,An
CO-04	Able to analyze and gain experimental skill.	A, An

List of Experiments

1. Determination of conductance of solutions
2. Potentiometry - determination of redox potentials and emfs
3. Synthesis of drug
4. Determination of Chloride content
5. Determination of hardness of water sample
6. Determination of Alkalinity of water sample
7. Virtual lab experiments

CS3171	FUNDAMENTALS OF COMPUTING AND PYTHON PROGRAMMING LAB	L	T	P	C
		0	0	4	2

OBJECTIVES:

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

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the basic syntax of python	U
CO-02	Understand the problem-solving techniques	An,U
CO-03	Analyze data structure concept in python	U
CO-04	Understand all tools of python	An
CO-05	Understand pygame with simulation	E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-I	PO-J	PO-K	PO-G
CO-01	M	L	S	M	L	L	S	N	N	N	N
CO-02	L	L	M	M	S	M	L	N	N	N	N
CO-03	M	M	L	L	M	S	L	N	N	N	N
CO-04	S	L	L	M	M	M	L	N	N	N	N
CO-05	L	L	L	S	L	L	S	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

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. Mergesort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (wordcount)
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

TOTAL: 45 HOURS

SEMESTER II

S.No.	Course Code	Course Title	L	T	P	Credit
1	EG3102	Communicative English	3	0	0	3
2	MA3102	Mathematics-II	3	1	0	4
3	BE3101	Basic Electrical and Electronics Engineering	3	0	0	3
4	BE3102	Basic Civil and Mechanical Engineering	3	0	0	3
5	ME3101	Engineering Graphics	3	0	2	4
PRACTICAL						
6	BE3171	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1
7	BE3172	Basic Civil and Mechanical Engineering Laboratory	0	0	2	1
TOTAL			15	1	06	19

EG3102	COMMUNICATIVE ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES

- To widen and expand students' knowledge of English vocabulary
- To develop skills of students in the areas of vocabulary, grammar, listening, speaking, reading, and writing
- To develop the knowledge, skills and strategies the student must possess to become proficient readers
- To make the students learn the importance and purpose of communication skills and overcome the communication barriers by gaining confidence
- To make the students understand how to apply technical information and knowledge in practical documents

Course Outcomes		Cognitive Skill
CO-01	The students will be able to understand the basic vocabulary items, sentence structures and error detection and correction which will expand their knowledge of the English language.	R
CO-02	The students will be able to grasp the LSRW Skills and gain exposure to assimilate comprehension and Note-making.	U
CO-03	The students will get real time practice in speaking through oral presentation, small talk, role play, debate , Group Discussion etc.	A
CO-04	The students will be able to develop writing skills through exposure to Report Writing and Letter Writing.	U
CO-05	The students will be able to learn the Theory of Communication , the importance of communication, and will be introduced to the various facets of Verbal and Non verbal Communication.	R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcomes with Programme Outcomes

PO \ CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	M	S	S	M	S	S	N	N	N	N	N
CO-02	M	S	M	M	S	S	M	S	N	N	N	N	N
CO-03	S	M	M	S	M	M	S	M	N	N	N	N	N
CO-04	M	S	M	M	S	M	S	M	N	N	N	N	N
CO-05	S	M	S	S	M	S	M	S	N	N	N	N	N

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT – I – VOCABULARY AND GRAMMAR

9

Parts of Speech – Sentence Structures – Technical Vocabulary – Synonyms – Antonyms – Homonyms – Homophones – Misspelled Words – One word Substitutes – Odd Words Out –

Changing words from one form to another – Common Errors in English – Correction of Errors in Sentences.

UNIT – II – LISTENING AND READING 9

Reading Comprehension – Skimming – Scanning – Predicting the Content – Comprehension Questions – Inductive Reading – Close Reading – Note Making – Précis Writing.

UNIT – III – SPEAKING 9

Introducing Oneself – Exchanging Personal Information – Small Talk : Family, Friends, Studies, Profession – Speaking : Greeting , Taking Leave – Product Description – Completing information – Gap Exercises – Presentation / Public Speaking Skills – Group Discussion – Debate – Role Play.

UNIT – IV- TECHNICAL WRITING 9

Report Writing – Characteristics of a Report – Categories of Reports – Letter Writing (Formal Letters) : Job Application Letter with Resume – Letter Seeking Permission – Letter of Invitation – Letter Declining an Invitation – Letter of Complaint – Letter of Requisition.

UNIT – V- TECHNICAL COMMUNICATION 9

The Theory of Communication – Definition and Scope – Nature, Importance and Types – Different Communication Models – Barriers to Communication – Effective Communication (Verbal / Non-verbal).

TOTAL: 45 HOURS

EXTENSIVE READING :

CanField Jack, *Chicken Soup for the Soul*, Westland, Chennai, 1999.

NOTE:

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

REFERENCE BOOKS:

1. Communication Skills. Oxford University Press.
2. Wood, F. T. (2007). Remedial English Grammar. Macmillan.
3. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
4. The Four Skills for Communication – Josh Sreedharan – Foundation Books
5. Communicative English – E. Sureshkumar and P. Sreehari – Orient Blackswan

MA3102	ENGINEERING MATHEMATICS – II	L	T	P	C
		3	1	0	4

OBJECTIVE:

To develop basic knowledge to the students in differential equations and vector calculus. This subject is further broadened to the functions of complex variables and complex integration. A thorough knowledge about Laplace transforms is also covered to aid the students solve the differential equations.

	Course Outcome – Cos	Cognitive Skill
CO-01	The students will be able to solve ordinary differential equations	An , E , S

CO-02	The students will be able to solve complex variable	E
CO-03	The students will be able to synthesize complex integration	S
CO-04	The students will be able to solve Vector Calculus	E , S
CO-05	The students will be able to Synthesize Laplace transforms	S

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO -A	PO -B	PO -C	PO -D	PO -E	PO -F	PO- G	PO- H	PO- I	PO - J	PO-k	PO- L	PO-M
CO-01	M	S	M	S	S	N	M	M	S	S	M	M	M
CO-02	S	M	L	N	L	M	S	L	L	S	M	M	S
CO-03	S	L	S	S	L	L	S	S	M	M	S	S	M
CO-04	S	L	M	S	N	L	S	S	M	S	S	M	S
CO-05	S	L	M	M	M	L	N	S	M	M	M	S	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I ORDINARY DIFFERENTIAL EQUATIONS

9

Linear differential equations of second order with constant and variable coefficients- Cauchy's and Legendre's linear equations – Method of variation of parameters.

UNIT II: COMPLEX VARIABLES

9

Functions of a complex variable – Analytic function – Necessary conditions- Cauchy- Riemann equations in cartesian and polar co-ordinates - Sufficient conditions(excluding proof) –Properties of analytic function – Harmonic and its conjugate – Construction of analytic function by Milne Thomson method – Conformal mappings $w = z + c$, cz , $1/z$ and Bilinear transformation.

UNIT III: COMPLEX INTEGRATION

9

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula –Laurent's expansion – Singular points – Residues – Cauchy's Residue theorem – Evaluation of real definite

integral using contour integration(excluding poles on the real axis) - $\int_0^{2\pi} f(\cos \theta, \sin \theta) d\theta$ and

$$\int_{-\infty}^{\infty} \frac{f(x)}{g(x)} dx$$

UNIT IV: VECTOR CALCULUS

9

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

UNIT V: LAPLACE TRANSFORMS

9

Laplace transform –Existence condition– Transforms of elementary functions – Basic properties – Transforms of derivatives and integrals – Transform of Periodic functions. Inverse Laplace transform

– Convolution, Initial and Final value theorems (statement only) – Solutions of linear ordinary differential equation of second order with constant coefficients using Laplace transform techniques.

L: 45 + T: 15 = TOTAL 60 HOURS

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”- 40th Edition , Khanna Publishers, Delhi 2007.

REFERENCES:

2. M.Immaculate Mary , K.Uma Samundesvari, Engineering Mathematics – II” First Edition, Anuradha Publications, ,2013.
3. Erwin Kreyszig, “ Advanced engineering Mathematics”, Seventh Edition, Wiley India, 2007.
4. Veerarajan T, “ Engineering Mathematics (for first year)”, Tata McGraw- Hill Publishing Company Ltd.,New Delhi,2007.
5. P.Kandasamy , K.Thilagavathy , K.Gunavathy” Engineering Mathematics” S.Chand & Company Ltd.2002.
6. B.V. Ramana,”Higher Engineering Mathematics” Second Edition Tata McGraw- Hill, Publishing Company Ltd.,New Delhi, 2006.

BE3101	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

To understand the basic concepts of AC and DC circuits, measuring instruments, electronic devices and Communication system.

Course Outcome – Cos		Cognitive Skill
CO-01	To study the basic principle and operation of AC and DC machines.	U
CO-02	To study the fundamental operations of measuring instruments.	R
CO-03	To understand the fundamental operation and characteristics of Electron devices	U,A
CO-04	To understand the implementation of Boolean expression using logic gates.	R
CO-05	To become familiar with basic concepts of Communication system.	U,R

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J
CO-01	S	S	S	M	L	L	M	S	M	S
CO-02	S	S	S	M	L	L	M	M	M	S
CO-03	S	S	M	S	S	S	M	M	M	S
CO-04	S	M	S	S	S	S	M	L	S	S
CO-05	S	S	M	M	M	M	M	L	S	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT: 1 – ELECTRICAL CIRCUITS**9**

Ohms Law, Kirchhoff's laws, Mesh and Nodal Analysis for DC Circuits.

Introduction to AC Circuits, Faraday's Law of Electromagnetic Induction, Lenz law, Inductor, Capacitor, Power factor, Waveforms and RMS value, Average Value, Peak factor and Form factor, Single phase circuits- Series and Parallel, Three phase balanced circuits. Fundamentals of wiring and earthing.

UNIT: II – ELECTRICAL MEASUREMENTS, MACHINES AND POWER SYSTEM 9

Operating principles of Moving coil and Moving iron instruments (Ammeter and voltmeter), Dynamometer type watt meter and Energy meter, Errors in Measurements.

Construction, Principle of operation and Applications of DC Generators, DC Motors, Single phase transformers. Structure of power system.

UNIT- III SEMI CONDUCTOR DEVICES**9**

Introduction to Semiconductors, PN Junction diode-Zener diode and its characteristics-Half wave and Full wave Rectifiers-Bipolar Junction transistor-CB,CE,CC Configuration and characteristics-JFET and MOSFET construction, operation ,characteristics (CS only) and uses.

UNIT-IV DIGITAL ELECTRONICS**9**

Number systems-binary arithmetic--Boolean algebra-laws and theorems-Simplification of Boolean expression- logic gates –Implementation of Boolean expression using logic gates-standard forms of Boolean expression.

UNIT – V COMMUNICATION SYSTEMS**9**

Block diagram of basic communication system-need for modulation-Types of modulation- Principles of Amplitude and Frequency modulation – pulse analog and digital modulation-AM and FM transmitter and receiver (Block diagram description only) –Satellite Communication Radar Systems-Data transmission and MODEM.

TOTAL: 45 HOURS**REFERENCES:**

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, (2006).
2. V.N. Mittle "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.
3. V.K.Mehta "Principles of Power System", S.Chand & Company Ltd, New Delhi, 2001.
4. R.S.Sedha,"Applied electronics"S.Chand&Co.,2006.

BE3102	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

To enable the students to understand the Basic Civil and Mechanical Engineering concepts.

	Course Outcome - COs	Cognitive Skill
CO-01	To understand the Surveying : Objects – types – classification – principles – measurements of distances – angles –leveling–determination	R,U,A
CO-02	To understand the Types, Bearing capacity– Requirement of good foundation	R,U,A

CO-03	To understand the Statics –Basics Concepts, Fundamental principles & concepts: Newton’s laws, gravitation, force, couple,	R,U,A
CO-04	To understand the Introduction to IC Engines, Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles,	R,U,A,
CO-05	To understand the Foundry-Investment casting, Die casting, Centrifugal casting, Continuous casting, Stir casting, Squeeze casting.	R,U,A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	M	L	L	M	L	L	L	M	M	L	M
CO-02	M	N	M	L	N	M	L	L	S	M	L	M
CO-03	S	M	L	L	N	M	L	L	L	N	M	L
CO-04	S	L	M	M	N	M	M	L	N	M	M	M
CO-05	S	L	N	M	N	M	L	L	M	M	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

A– CIVIL ENGINEERING

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 9

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

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

UNIT II BUILDING COMPONENTS AND STRUCTURES 9

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

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

B– MECHANICAL ENGINEERING

UNIT III FUNDAMENTALS OF ENGINEERING MECHANICS 9

Statics –Basics Concepts, Fundamental principles & concepts: Newton’s laws, gravitation, force, couple, moment (about point and about axis), Varignon’s theorem, resultant of concurrent and non-concurrent coplanar forces, Problem formulation concept; 2-D statics, two and three force members, alternate equilibrium equations, 3-D statics.

UNIT IV BASIC CONCEPTS OF THERMAL ENGINEERING 9

Introduction to IC Engines, working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles, Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants, Principle of vapour compression and absorption system.

UNIT V BASIC MANUFACTURING PROCESSES 9

Foundry-Investment casting, Die casting, Centrifugal casting, Continuous casting, Stir casting, Squeeze casting. Metal fusion welding processes- Oxyfuel gas welding – Arc welding processes. Additive Manufacturing-3D Printing.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Shanmugam G and Palanichamy MS, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi,(1996).
2. Ramamrutham S., “Basic Civil Engineering”, DhanpatRai Publishing Co.(P)Ltd. (1999).

REFERENCES:

1. Seetharaman S., “Basic Civil Engineering”, Anuradha Agencies,(2005).
2. Venugopal K. and Prahu Raja V., “Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam,(2000).
3. Shantha KumarSRJ., “Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai,(2000)

ME3101	ENGINEERING GRAPHICS	L	T	P	C
		3	0	2	4

OBJECTIVES

1. To develop skills for communication of concepts, ideas and design of Engineering Products.
2. To expose them to existing national standards related to technical drawings

Course Outcome – Cos		Cognitive Skill
CO-01	Able to draw parabola, ellipse, hyperbola, involute and cycloidal curves	A
CO-02	Able to draw projection of points, lines and planes	A
CO-03	Able to draw projection of solids and section of solids	A
CO-04	Able to draw isometric projection of solids	A
CO-05	Able to draw development of surfaces and orthographic projection.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	N	N	S	N	N	N	N	N
CO-02	N	N	N	N	N	N	S	N	N	N	N	N
CO-03	N	N	N	N	N	N	S	N	N	N	N	N
CO-04	N	N	N	N	N	N	S	N	N	N	N	N
CO-05	N	N	N	N	N	N	S	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I – INTRODUCTION**9**

Concepts and conventions: Use of drafting instruments, BIS conventions and specifications – Size, layout and folding of drawing sheets, Lettering and dimensioning. General principles of orthographic projection, First angle projection – Layout of views. **(Not for examination)**

General Plane Curves

Conic sections including the Rectangular Hyperbola (General method); Cycloid, Epicycloid, Hypocycloid and Involute.

UNIT II - PROJECTION OF POINTS, LINES & PLANES**9**

Projection of points, Projection of straight lines located in the first quadrant. Determination of true lengths and true inclinations. Projection of planes- parallel to any one reference plane, perpendicular to any one reference plane, Inclined to any one reference plane and inclined to both reference planes

UNIT III - PROJECTION OF SOLIDS & SECTION OF SOLIDS**9**

Prisms, pyramids, cylinder and cone, axis perpendicular to any one reference plane. Axis parallel to both the planes. Axis inclined to any one reference plane.

Sectioning of solids- Prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane. Obtaining the true shape of section

UNIT IV –DEVELOPMENT OF SURFACES & ISOMETRIC PROJECTION**9**

Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone, Isometric view, Isometric scale to draw Isometric projection, Non-Isometric lines, construction of Isometric view from given orthographic views and to construct Isometric view of a Pyramid, Cone, Sphere.

UNIT V – ORTHOGRAPHIC PROJECTION & PERSPECTIVE PROJECTION**9**

Fundamental of projection along with classification, Projections from the pictorial view of the object on the principal planes for view from front, top and sides using first angle projection method and third angle projection method, full sectional view. Perspective Projection of Solids (Any one Method).

L: 45+P: 15 = TOTAL: 60 HOURS**TEXT BOOKS:**

1. Venugopal K and Prabhu Raja V, “Engineering Graphics”, New Age International Publishers, 2007.
2. Luzadder W J, “Fundamentals of Engineering Drawing”, Prentice Hall Book Co., New York, 1998
3. Bhat, N.D.& M. Panchal , Engineering Drawing, Charotar Publishing House,2008

REFERENCES:

1. Kumar M S, “Engineering Graphics”, Ninth Edition, DD Publications, Chennai, 2007.
2. Bureau of Indian Standards, “Engineering Drawing Practices for Schools and Colleges SP 46-2003”, BIS, New Delhi, 2003.
3. Shah, M.B. & B.C. Rana , Engineering Drawing and Computer Graphics, Pearson Education,2008

BE3171	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

To understand the electric circuit connection, measurement of electrical parameters, Characteristics of electron devices and its applications.

Course Outcome – Cos		Cognitive Skill
CO-01	To study the basic symbols for electrical circuits	U
CO-02	To make basic electrical connection	R
CO-03	To measure the electrical parameters	U,A

CO-04	To obtain the characteristics of Electron devices	R
CO-05	To verify the operation of logic gates.	U,R

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO- B	PO- C	PO- D	PO- E	PO- F	PO- G	PO- H	PO- I	PO- J
CO-01	S	S	S	M	S	S	M	L	M	L
CO-02	S	S	S	M	S	S	M	L	M	L
CO-03	S	S	S	S	M	S	S	S	M	M
CO-04	S	S	S	S	M	M	M	S	M	S
CO-05	S	S	S	M	S	S	M	S	L	M

S- Strong, M- Medium, L-Low, N- Not Relevant

I. Electrical Engineering Lab

- 1 Study of Symbols, Cables and Earthing.
- 2 Residential house wiring using switches, fuse, indicator, lamp and energy meter.
- 3 Fluorescent lamp wiring.
- 4 Stair case wiring / Lamp control from three different places/ Doctor Room control/ Go down control
- 5 Measurement of electrical quantities – voltage, current, power & computation of power factor in RLC circuit.
- 6 Measurement of energy using single phase energy meter.
- 7 Fan Wiring.

II. Electronics Engineering Lab

1. Study of Electronic components and equipments – Resistor, colour coding, Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Characteristics of PN Junction diode
3. Characteristics of Zener diode
4. Voltage Regulator using Zener diode
5. Measurement of ripple factor of HWR and FWR.
6. Study of logic gates AND, OR, EX-OR and NOT, NAND and NOR.
7. Generation of Clock Signal.
8. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.

TOTAL: 30 HOURS

BE3172	BASIC CIVIL AND MECHANICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVE:

To provide exposure to the students with hands on experience on various basic Engineering practices in Civil & Mechanical Engineering.

Course Outcome – Cos		Cognitive Skill
CO-01	Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in house hold fittings.	U,An
CO-02	Study of pipe connections requirements for pumps and turbines.	U,An
CO-03	Preparation of plumbing line sketches for water supply and sewage works.	U,An
CO-04	Preparation of arc welding of butt joints, lap joints and tee joints.	A,An
CO-05	Demonstration on foundry, fitting and sheet metal exercises.	A,An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

I Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	L	M	M	L	M	M	M	L	S	S	L
CO-02	S	S	S	L	L	M	S	S	L	S	S	L
CO-03	S	S	S	M	L	S	M	M	L	S	S	L
CO-04	S	S	M	L	S	M	M	S	L	S	S	L
CO-05	S	S	S	L	S	M	S	S	L	S	S	L

S- Strong, M- Medium, L-Low, N- Not Relevant

I. CIVIL ENGINEERING PRACTICE

Buildings:

- Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

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

Carpentry using Power Tools only:

- Study of the joints in roofs, doors, windows and furniture.
- Hands-on-exercise:
Wood work, joints by sawing, planning and cutting.

II. MECHANICAL ENGINEERING PRACTICE

Welding:

Preparation of arc welding of butt joints, lap joints and tee joints.

Basic Machining:

Simple Turning and Taper turning

Dynamics:

Experiment using Gyroscope/Four bar link mechanism.

Demonstration on:

- (a) Demonstration on foundry, fitting and sheet metal exercises.
- (b) Demonstration on the working principle of two stroke and four stroke I.C. engines.

TOTAL: 30 HOURS

SEMESTER III

S.No	Course Code	Course Title	L	T	P	Credit
THEORY						
1.	MA3201	Engineering Mathematics – III	3	1	0	4
2.	FS3201	Applied Mechanics	3	1	0	4
3.	FS3202	Basics of Fire Engineering	3	0	0	3
4.	FS3203	Basics of Safety Engineering	3	0	0	3
5.	FS3204	Machine Drawing	3	1	0	4
6.	FS3205	Management of Disaster and Emergency	3	0	0	3
PRACTICALS						
7.	FS3271	Emergency Life Support Laboratory	0	0	2	1
8.	FS3272	Fire Engineering Laboratory	0	0	2	1
9.	FS3273	Safety Engineering Laboratory	0	0	2	1
TOTAL			18	3	06	24

MA3201	ENGINEERING MATHEMATICS III	L	T	P	C
		3	1	0	4

OBJECTIVE:

To develop the skill of the students in the areas of boundary value problems and Transform techniques. This will be necessary for their effective studies in a large number of Engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. This course will also serve as a prerequisite for post graduate and specialized studies and research.

Course Outcome – Cos At the end of the course students should be able to		Cognitive Skill
CO-01	Recognize a Partial Differential Equation and formulate a Partial Differential Equation from a given equation. Solve linear Partial Differential Equation of both first and second order using various methods.	U,A,E
CO-02	Derive a Fourier series expansion for a given periodic function by evaluating Fourier coefficient and expand Fourier cosine and Sine series for given function. Also find the Fourier series expansion for a given set of numerical values by applying harmonic analysis.	U,A,E
CO-03	Classify the second order Partial Differential Equation and solve second order Partial Differential Equations such as wave equation, heat equation and Laplace equation with boundary and initial conditions applying Fourier series expansion.	U,A,E
CO-04	Know fundamental and mathematical properties of Fourier transform. Calculate the Fourier transform of a given function and inverse Fourier transform of function. Know the applications of Parseval's and convolution theorem.	U,A,E
CO-05	Understand the characteristics and properties of Z-transform. Compute Z-transform of simple functions and inverse z transform of given functions and apply Z-transform for solving difference equations.	U,A,E

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	S	S	M	M	N	N	N	N	N	N	N	N
CO-02	S	S	M	M	N	N	N	N	N	N	N	N
CO-03	S	S	M	M	N	N	N	N	N	N	N	N
CO-04	S	S	M	M	N	N	N	N	N	N	N	N
CO-05	S	S	M	M	N	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I : PARTIAL DIFFERENTIAL EQUATIONS

9

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of Clairaut's equations – Lagrange's linear equation – Homogeneous linear partial differential equations of second order with constant coefficients.

UNIT II: FOURIER SERIES

9

Dirichlet's conditions – Fourier series – Change of interval - Odd and Even functions – Half range sine and cosine series – Parseval's identity – Harmonic Analysis.

UNIT III: BOUNDARY VALUE PROBLEMS**9**

Classification of second order linear partial differential equations – One dimensional wave and heat equations – Assumptions – Fourier series solution – Steady state solution of two dimensional heat equation (insulated edges excluded) – Fourier series solution in Cartesian co-ordinates.

UNIT IV: FOURIER TRANSFORMS**9**

Statement and meaning of Fourier integral theorem – Fourier transform — Properties - Inverse Fourier transform – Fourier Sine and Cosine transforms – Inverse sine and cosine transforms – Properties -Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V: Z-TRANSFORMS**9**

Z- transform – Elementary properties – convolution theorem-Inverse Z-transform –Partial fraction Method, Inversion integral method and Convolution – Initial and Final value theorems –Formation of difference equations – Solution of difference equations using Z-transform

TOTAL:45+15 = 60**TEXT BOOK**

1. Grewal B.S., “Higher Engineering Mathematics” – 40th Edition, Khanna Publishers, Delhi 2011.

REFERENCES

1. Erwin Kreyszig, “Advanced Engineering Mathematics”,10th Edition, John Wiley & Sons, Inc., USA, 2011
2. Kandasamy P, Thilagavathy K, and Gunavathy K., “Engineering Mathematics Volume III”, First Edition, S.Chand& Company Ltd., New Delhi.
3. Veerarajan T., “Engineering Mathematics(for Semester III), Third Edition, Tata McGraw – Hill Publishing Company Limited, New Delhi 2007.
4. Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Seventh Edition, Lakshmi Publications Pvt. Ltd., New Delhi, 2009.

FS3201	APPLIED MECHANICS	L	T	P	C
		3	1	0	4

OBJECTIVES

- Apply the concepts of force, work, and energy to calculate work done, power required& efficiency for various simple machines.
- To develop the capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

Course Outcome – Cos		Cognitive Skill
CO-01	Illustrate the vectorial and scalar representation of forces and moments	A
CO-02	Analyze the rigid body in equilibrium	An
CO-03	Evaluate the properties of surfaces and solids	A
CO-04	Gain knowledge about dynamics of particles	A
CO-05	Understand the concepts of frictional force	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	S	S	S	N	N	N	N	N	N	N	N	N
CO-02	M	S	M	N	N	N	N	N	N	N	N	N
CO-03	M	M	M	N	N	N	N	N	N	N	N	N
CO-04	M	M	L	N	N	N	N	N	N	N	N	N
CO-05	L	M	L	N	N	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I COPLANAR CONCURRENT FORCES 9

Scalar & Vector Quantities –force, pressure, velocity, acceleration. Statics & Dynamics –Kinetics & Kinematics MKS, CGS & SI units and its conversion along with FPI and Metric System Principles of forces such as Principle of Superposition, Principle of transmissibility Composition & Resolution of Forces Resultant & Equilibrium forces conditions of equilibrium Analytical & graphical method for Law of Parallelogram, Law of Triangle, Lami's Theorem, Law of Polygon, Equilibrium of a particle–Forces in space–Equilibrium of a particle in space–Equivalent systems of forces.

UNIT II COPLANAR NON-CONCURRENT FORCES 9

Principal of Moment - Couple, application, properties of couple, conditions of equilibrium types of supports, end conditions –Hinge, free end, roller, fix, types of loads -point load, U.D.L, U.V.L, Couple, Analytical method to Evaluate reactions in statically determinate beam subjected to point load and/ or U.D.L by analytical method of solving Statically determinate beams. 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

First moment of area; to find Centroid –standard shapes of I, L, Channel & T sections, axis of symmetry First moment of mass - to find C.G of standard solids sections, Axis of symmetry 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

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

UNIT V - FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 9

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 (L: 45+T:15): 60 HOURS

TEXT BOOKS:

- 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. VelaMurali, "Engineering Mechanics", Oxford University Press (2010)
3. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
4. Hibbeler, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.

REFERENCES

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

FS3202	BASICS OF FIRE ENGINEERING	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.

Course Outcome – Cos		Cognitive Skill
CO-01	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.	U
CO-02	Learn about the products of combustion-flame, heat, smoke, fire gases and their characteristics.	U
CO-03	Acquire the knowledge about the use and operation of fire service equipment, machineries and accessories	A
CO-04	Calculate the water requirement and the pump capacity for firefighting and understand the basic fire ground operations	A
CO-05	Gain knowledge about fire ground operations	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	L	S	S	N	N	N	N	N	N	N	N
CO-02	N	M	S	M	N	N	N	N	N	N	N	N
CO-03	N	N	N	L	N	N	N	N	N	N	N	N
CO-04	N	L	N	M	S	N	N	N	N	N	N	N
CO-05	N	M	N	L	S	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I INTRODUCTION

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, Spill over, Boil over, Dust explosion, BLEVE, UVCE; Classification of fire based on material.

UNIT II PRODUCT OF COMBUSTION

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 FIRE SERVICE EQUIPMENT'S, VEHICLES AND ACCESSORIES

9

Use, operation and maintenance of fire service equipment's 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 equipment's used during firefighting; 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 FIRE HYDRAULICS

9

Fire stream-path, range; nozzles-types, calculation of discharge capacity, nozzle reaction, water hammer; 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.

UNIT V FIRE GROUND OPERATIONS

9

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.

TOTAL :45 HOURS

TEXT BOOKS

1. Ron Hirst, "Under downs Practical Fire Precautions", Gower Publishing Company Ltd., England, 1989.
2. HMSO, "Manual of Firemanship 1 to 13",
3. Jain V.K., "Fire Safety in Buildings", New Age International (P) Ltd., New Delhi, 1996
4. Clark, W.E., "Firefighting principles & practices" Published by Fire Engineering (1974)

REFERENCES:

1. Gupta R.S., "A Hand Book of Fire Technology", UBS publishers and Dist., New Delhi.2010
2. Kevin Cassidy, "Fire Safety and loss Prevention", Published by Butterworth-Heinemann, Woburn, MA, 1992.
3. Barendra Mohan Sen, "Fire protection and prevention the essential handbook", Penguin Books Ltd, 2008
4. M. Ya. Roytman, "Principles of Fire Safety Standards for Building Construction", Published by Amerind, 1975.

FS3203	BASICS OF SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the basic needs of safety Engineering
- To understand the basic methodology for safety Training
- To learn the use of PPE
- To understand the fundamentals of Cost and Accident analysis Techniques

Course Outcome – Cos		Cognitive Skill
CO-01	Demonstrate the basic knowledge and responsibilities in the field of safety Engineering	U
CO-02	Demonstrate the different types of training in safety field	U
CO-03	Knowledge about PPE and its application in safety field.	U
CO-04	4.a). Computation of cost, Plant safety inspection, 4.b). Job safety analysis and job survey.	A An
CO-05	Gain knowledge about accident analysis	An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	S	M	N	N	M	N	L	N	N	N	N	N
CO-02	M	L	N	N	M	N	S	N	N	N	N	N
CO-03	S	M	N	L	N	N	L	N	N	N	N	N
CO-04	N	S	M	M	L	L	M	N	N	N	N	N
CO-05	M	M	S	S	N	-	S	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I - INTRODUCTION**9**

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

UNIT II – SAFETY TRAINING, PPE STANDARD'S**9**

Accident prevention Methods- Engineering, Education and Enforcement. 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. 5 s of housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

UNIT III PERSONAL PROTECTIVE EQUIPMENT'S CONSTRUCTION**9**

Personal protection in the work environment, Types of PPEs, Personal protective equipment- respiratory and non respiratory equipment. Selection of RPE and suitability of RPE for various applications Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate.

UNIT IV - COST ANALYSIS IN SAFETY,**9**

Cost of accidents-Computation of Costs- Utility of Cost data. Safety surveys, Safety audits, Plant safety inspection, types, inspection procedure. Safety sampling techniques. Job safety analysis (JSA), Inventory systems for safety.

UNIT V - ACCIDENT ANALYSIS**9**

Accident investigation –Why? When? Where? Who? & How? Basics- Man- Environment & 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 HOURS**TEXT BOOKS**

1. N.V. Krishnan, Safety Management in Industry, Jaico Publishing House, 1997
2. Ronald P. Blake, Industrial Safety: Prentice Hall, New Delhi, 1973.

REFERENCES

1. David L. Goetsch, Occupational Safety and health, Prentice Hall
2. Ted S. Ferry, Modern Accident Investigation and Analysis, John Wiley & Sons
3. Willie Hammer, Occupational Safety Management and Engineering, Prentice Hall
4. Alan Waring, Safety Management System, Chapman & Hall
5. John V. Grimaldi and Rollin H. Simonds, Safety Management, All India Traveller Book Seller, Delhi.
6. Accident Prevention Manual for Industrial Operations: National Safety Council, Chicago

FS3204	MACHINE DRAWING	L	T	P	C
		3	1	0	4

OBJECTIVES

- To provide the basic concept of Orthographic views which will enable them to interpret a drawing
- To understand and draw assemblies of machine parts and to draw their sectional view

Course Outcome – Cos		Cognitive Skill
CO-01	To learn the significance of personal protective equipments	R
CO-02	To study the fundamentals and need of personal protective equipments	U
CO-03	To study and fabricate any protective equipment.	U
CO-04	Gain knowledge in fits and tolerances	U
CO-05	Gain knowledge in the types of joints	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	N	N	S	N	N	N	N	N
CO-02	N	N	N	N	N	N	M	N	N	N	N	N
CO-03	N	N	N	N	N	N	M	N	N	N	N	N
CO-04	N	N	N	N	N	N	S	N	N	N	N	N
CO-05	N	N	N	N	N	N	S	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I INTRODUCTION

9

Limits, fits & tolerances: IS 919 code, cylindrical fits, tolerance symbols, standard preferred sizes and fits, hole-based dimensioning, symbology for form, location tolerance for position, concentricity, location, roundness, perpendicularity and runout.

UNIT II RIVET JOINT AND ITS TYPES

9

Drawing of lap and butt joint of riveted joints-single, double, triple, quadruple, diamond, zig-zag, riveted joints.

UNIT III TEMPORARY JOINTS

9

Screwed fastenings: Screw thread forms, vee and square threads, conventional representation of threads, hexagonal headed bolt and nut, square headed bolt, nut locking arrangements, various types of machine screws and set screws.

UNIT IV PARTS AND ASSEMBLY DRAWING OF COTTER AND PIN JOINTS

9

Parts and assembly of cotter and Pin joints: socket and spigot joints, Jib and cotter joint, sleeve and cotter joints, knuckle joint.

UNIT V PARTS AND ASSEMBLY OF MACHINE COMPONENTS

9

Parts and assembly of the machine components of screw jack, Plummer block, machine vice, lathe tailstock, flange coupling, IC engine connecting rod

TOTAL (L: 45+T:15): 60 HOURS

TEXT BOOKS

1. Gopalakrishna K R, "Machine Drawing", Seventeenth Edition, Subhas Stores, Bangalore, 2003
2. Varghese P I and John K C, "Machine Drawing", Jovast Publishers, Thrissur, 2007.
3. CAD/CAM Manual, PSG College of Technology. Coimbatore, 2002.

REFERENCES

1. Faculty of Mechanical Engineering, PSG College of Technology," Design Data Book", M/s.DPV,Printers, Coimbatore,1993.
2. SP:46-2003 – “Engineering Drawing Practice for Schools and Colleges”, Bureau of Indian Standards, New Delhi, 2003.

FS3205	MANAGEMENT OF DISASTER AND EMERGENCY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the role and responsibilities of a emergency life support
- To gain knowledge how to react in emergency situation.
- To handle the emergencies to rescue in the disaster.

Course Outcome – Cos		Cognitive Skill
CO-01	Gain knowledge on the actions needed at the time of disaster.	U
CO-02	Identify the major structures of the respiratory, circulatory, nervous, and musculoskeletal systems.	U
CO-03	Explain the disaster management.	U
CO-04	Describe how to control bleeding, and explain what care to give to minimize shock.	U
CO-05	handle injured person in the emergency situation.	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	N	M	N	L	N	N	N	N
CO-02	N	N	N	N	N	M	N	M	N	N	N	N
CO-03	N	N	N	N	N	S	N	S	M	N	N	L
CO-04	N	N	N	N	N	S	N	S	M	N	N	L
CO-05	N	N	N	N	N	S	N	S	M	N	N	L

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT – I TYPES OF DISASTER

9

Earthquakes – high winds (without flooding), tidal waves / flash floods, slow-onset flood, landslides, volcanoes / lahars and their effects.

UNIT – II MANAGEMENT OF DISASTERS

9

Management sequence of sudden, onset disaster, disease control, disaster mitigation, nutrition, rehabilitation, personal protection, disaster preparedness, disasters in India and World, man-made disasters, disaster recovery team.

UNIT – III FIRST AID

9

Principles of first aid, scope, general management of a case, quick response, calm and confidence, treating injuries, first aid materials, crowd, reassurance.

UNIT – IV PROTOCOLS FOR BASIC LIFE SUPPORT (BLS)**9**

CPR (Compression), cardiac arrest, shock (recovery position), bleeding, burns – rule of nines, chemical burns, electric burns, fire burns, radiation burns, cold burns, poisoning – corrosive acids and alkaline, insecticides, narcotics, drugs (sedatives), food, carbon monoxide, etc., eye trauma – corrosive chemicals in eye, wounds, bleeding, airway, breathing, Automated External Defibrillation (AED), O₂ administration.

UNIT – V EMERGENCY TREATMENT**9**

Fractures, splints in fractures, slings in fractures, immobilization, Elements in dressing, wounds, drowning, choking, Heimlich maneuver, snake bite, electrocution, unconsciousness – fainting, hyperventilation, convulsions, and hypoglycaemia.

TOTAL 45 HOURS**TEXT BOOKS:**

1. Advance Emergency Life Support Protocols 1st/2015 (English, Paperback, Dr. Gireesh Kumar K.P.) Paras Medical Books Pvt. Ltd., Hyderabad
2. A Complete guide to Family Safety and First -Aid 1st Edition (English, Paperback, Ashwani Bhardwaj) Goodwill Publishing House, ISBN: 9788172452988, 8172452985

REFERENCE BOOKS

1. The First Aid Family - An Early Introduction to First Aid by Annabel Wood, Brent James

FS3271	EMERGENCY LIFE SUPPORT LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To have knowledge and understand the selection of different emergencies
- To assist with emergencies to rescue in the workplace.
- To understand the role and responsibilities of a first aider
- Understand how to manage a variety of conditions

Course Outcome – Cos		Cognitive Skill
CO-01	Gain knowledge on the actions needed for a life-threatening emergency.	A
CO-02	Identify the major structures of the respiratory, circulatory, nervous, and musculoskeletal systems.	A
CO-03	Knowledge about emergency actions in Safety	A
CO-04	Describe and demonstrate how to control bleeding, and explain what care to give to minimize shock.	A
CO-05	Gain knowledge about basic steps for burn care.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	S	M	N	M	N	N	N	N
CO-02	N	N	N	N	M	N	N	S	N	N	N	N
CO-03	N	N	N	N	M	N	N	S	N	N	N	M

CO-04	N	N	N	N	S	N	N	M	N	N	N	N
CO-05	N	N	N	N	S	N	N	M	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS:

1. First Aid training
2. First Aid provided on Critical Incident Stress & Victim Death
3. First Aid for Breathing
4. First Aid for Compressions (Cardiac Pulmonary Resuscitation)
5. First Aid for Deadly Bleeding
6. First Aid for External Bleeding
7. First Aid for Shock
8. First Aid for Hyperventilation
9. First Aid for Burns
10. First Aid for Electrocution
11. First Aid for Chest & Abdominal Injuries
12. First Aid for Musculoskeletal Injuries
13. First Aid for Immobilization
14. First Aid for Automated External Defibrillation.

Note: Students should produce Government approved First Aid trained certificate before appearing for the university practical examination

TOTAL: 45 HOURS

FS3272	FIRE ENGINEERING LAB	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To learn about testing standards for the test on DCP and foam
- To study the performance tests of portable extinguishers
- To study the Firefighting equipment's

Course Outcome – Cos		Cognitive Skill
CO-01	Impart knowledge about flash point, fire point of flammable liquid	U
CO-02	Observe, analyze data and arrive at conclusions.	An
CO-03	Understand the method of tests for DCP, CO2 fire extinguishers	A
CO-04	Knowledge about rescue & firefighting techniques	A
CO-05	Impart knowledge about basic firefighting equipment's.	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	S	L	N	N	N	N	N	N	N	N

CO-02	N	M	S	M	N	N	N	N	N	N	N	N
CO-03	N	L	S	L	N	N	N	N	N	N	N	N
CO- 04	N	N	N	N	S	N	N	N	N	N	N	L
CO-05	N	N	N	N	S	N	N	N	N	N	N	L

S- Strong, M- Medium, L-Low, N- Not Relevant

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 extinguishers
5. Tests on Foam as per relevant Indian standard specifications
6. Test of non –combustibility of Building Materials.
7. Study and demonstration of First aid Fire protection (Fire bucket, Sand bucket and fire blanket)
8. Study and demonstration of fire service equipment's and accessories (Hose, hose reels and hose fittings)
9. Study and demonstration of fire fighting vehicles and appliances (pumps, rescue tenders, control vans, Ladders and lighting sets).
10. Study and demonstration of different types of knots, bend and hitches used in firefighting.
11. Study and demonstration of Fire detectors, Automatic water sprinklers and Fire alarms.

TOTAL: 45 HOURS

FS3273	SAFETY ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVES

- To know the different Personal Protective Equipment's
- To understand the views about the safety audit
- To understand how to prepare the reports in safety professional

Course Outcome – Cos		Cognitive Skill
CO-01	Gain knowledge about usage of PPE	U
CO-02	Learn the procedure for safety audit in various industries	A
CO-03	Learn the basics about accident analysis, calculation of cost, investigation report preparation, job safety analysis	A
CO-04	Knowledge about the work permit system, confined space entry, Incident and accident report generation procedure	A
CO-05	Knowledge about layout of plants using AUTOCAD.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	M	M	N	N	N	N	N	N	N

CO-02	N	N	N	M	M	N	M	N	N	N	N	N
CO-03	N	N	N	M	M	N	S	N	N	N	N	N
CO-04	N	N	N	M	S	N	S	N	N	N	N	N
CO-05	N	N	N	M	L	N	S	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS

1. Study of PPE's.
2. Development of Incident/Accident Reporting, Investigation and Analysis
3. Preparation of Hazard identification and risk control Document with suitable real time scenario.
4. Calculation of cost of accidents.
5. Preparation of work permit for any construction site
6. Safety assessment in a construction site.
7. Preparation of confined Space Entry procedure.
8. Assessment of the safety performance in an industry and preparation of report.
9. Accident investigation and Analysis – Exercises
10. Job safety analysis – Exercises
11. Study of HSE planning and Auditing procedure
12. Preparation of a P & I diagram.
13. Preparation of the layout of a chemical plant.

TOTAL: 45 HOURS

SEMESTER IV

S.No	Course Code	Course Title	L	T	P	Credit
THEORY						
1.	MA3207	Probability and Statistics	2	1	0	3
2.	BS3201	Environmental Studies	3	0	0	2
3.	FS3206	Accident Investigation and Analysis	3	0	0	3
4.	FS3207	Applied Thermodynamics & Fluid Mechanics	3	1	0	4
5.	FS3208	Manufacturing Processes	3	0	0	3
6.	FS3209	Solid Mechanics	3	1	0	4
PRACTICALS						
7.	FS3274	Manufacturing Processes Laboratory	0	0	2	1
8.	FS3275	Solid and Fluid mechanics Laboratory	0	0	2	1
9.	FS32P1	Industrial Training - I	0	0	2	2
TOTAL			17	3	6	23

MA3207	PROBABILITY AND STATISTICS	L	T	P	C
		2	1	0	3

OBJECTIVE:

To provide the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.

Course Outcome – Cos		Cognitive Skill
At the end of the course students should be able to		
CO-01	Know the basic concepts of probability and Random Variables. Understand the characteristic of density random variable and continuous random variable. Able to compute mean, variance and generate moment generating functions. Understand the different distributions ie Binomial, Poisson, Uniform, Exponential, gamma and normal distribution and its properties.	U,A,E
CO-02	Acquire skills in handling situations involving more than one random variable and functions of random variables. Understand the central tendency, correlation and correlation coefficient and also regression.	U,A,E
CO-03	Apply t – test , F-test, Chi square test and large sample test by the transformation of hypothesis and analyze their conclusions using various level of significance.	U,A,E
CO-04	Apply various principles of analyzing the variance and also apply Monte Carlo simulation method to solve simultaneous problems	U,A,E
CO-05	Expose the basic characteristic features of quality control chart for mean, range, attributes, p chart and c chart.	U,A,E

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	S	S	M	M	N	N	N	N	N	N	L	N
CO-02	S	S	M	M	M	N	N	N	N	N	M	N
CO-03	S	S	M	M	L	N	N	N	N	N	M	N
CO-04	S	S	M	M	M	N	N	N	N	N	M	N
CO-05	S	S	M	M	M	N	N	N	N	N	M	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I: PROBABILITY AND RANDOM VARIABLES

9

Axioms of Probability – Independent events – Conditional Probability – Random Variable – Probability mass function – Probability density function – Distribution function – Properties – Expectation – Binomial, Poisson, Uniform, Exponential and Normal distributions (Problems only).

UNIT II: TWO DIMENSIONAL RANDOM VARIABLES

9

Joint distributions - Marginal and Conditional distributions –Expectation-Independence- Covariance – Correlation and Regression.

UNIT III: TESTING OF HYPOTHESIS**9**

Sampling distribution – Standard error – Sample size – Type I error and Type II error - One tailed and Two tailed tests – large sample tests- Proportions – means and difference of means – Small sample tests – t-tests : Single mean, difference of means – F test for variances – Chi square test for independence of attributes and goodness of fit.

UNIT IV: ANALYSIS OF VARIANCE AND SIMULATION**9**

Analysis of Variance- Principles of design of experiments - Completely randomized design Randomized block design and Latin Square Design. Discrete Event Simulation - Monte Carlo Simulation - Generation of Random Numbers using Congruent method (Simple Production Problems)

UNIT V: STATISTICAL QUALITY CONTROL**9**

Quality Control –Chance causes and Assignable causes - Control charts for variables – Control chart for Mean ($\bar{X}$) and Range (R). Control charts for Attributes, Proportion of defective (p chart), Number of defectives per unit (c chart).

TOTAL: 30+15 = 45**TEXT BOOKS**

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Eight Edition, Sultan Chand & Sons, 1996. Unit 1, 2, 3
2. Venkatraman M.K, “Numerical Methods” Fifth Edition, National Pub. Company, Chennai 2005 Unit 4, 5

TEXT BOOKS

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Eight Edition, Sultan Chand & Sons, 1996. Unit 1, 2, 3
2. Venkatraman M.K, “Numerical Methods” Fifth Edition, National Pub. Company, Chennai 2005 Unit 4, 5

BS3201	ENVIRONMENTAL STUDIES	L	T	P	C
		3	0	0	2

OBJECTIVES

- To understand the basic concepts in environmental science
- To gain the knowledge about structure and natural cycles of environment.
- To get an idea about control methods of pollution.
- To know the information about conservation methods of forest and wild life.

Course Outcome		Cognitive Skill
CO-01	Student will be able to demonstrate a general understanding of interdisciplinary nature of environmental uses and able to characterize natural resources.	U, A, An
CO-02	Students will be able to explain the effects of air, water, soil, noise and thermal pollution environment and suggest ways to reduce them.	R, E, A
CO-03	Students will be able to explain the effects of air, water, soil, noise and thermal pollution environment and suggest ways to reduce them.	R, U, A
CO-04	Students will be able to understand the effects of human population and know about the awareness programme.	R, A, E

CO-05	Students apply systems concept and methodologies to analyse and understand interaction between social and environmental process.	R, A, An
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R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	M	M	S	S	S	M	S	S	M	S
CO-02	M	M	S	M	S	S	S	S	M	S	S	M	M
CO-03	M	M	S	M	S	S	S	S	M	S	S	M	M
CO-04	M	M	S	S	M	S	S	S	M	S	S	M	L
CO-05	M	M	S	S	L	S	M	S	M	S	S	L	M

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I: NATURE OF ENVIRONMENT STUDIES AND NATURAL RESOURCES 9

Environment studies- definition – scope and importance- need for public awareness-Methods to create environmental awareness- Natural resources- Forest resources- energy resources- food resources- water resources – land resources - mineral resources.

UNIT II: ECO SYSTEMS AND BIO-DIVERSITY 9

Concept and component of eco systems- producer, consumer, decomposer- structure and function of eco system- food chain and food web- energy flow model- aquatic eco system-forest eco system- desert eco system- pyramid of biomass- ocean eco system- grass land eco system- Bio diversity in India- value of bio diversity- biodiversity threatens- biodiversity protection- In-situ and Ex-situ conservation.

UNIT III: ENVIRONMENTAL POLLUTION 9

Meaning of pollution- air pollution- acid rain – global warming- water pollution- water pollution control- soil pollution- urban waste and soil pollution- marine pollution- noise pollution- thermal pollution- solid and hazardous waste management- waste disposal methods- solid waste and India- natural disaster and disaster management.

UNIT IV: HUMAN POPULATION AND ENVIRONMENT 9

Population growth- distribution of population- factors affecting variation in population theories of population- future of human population- family welfare programme- HIV and AIDS- environment and human health- human rights- value education- women and child welfare.

UNIT V: SOCIAL ISSUES AND THE ENVIRONMENT 9

Unsustainable to sustainable development- sustainable development in India- water conservation, watershed management and water harvesting- environmental ethics- role of engineer in environmental protection.

TOTAL: 30 HOURS

TEXT BOOKS

1. Cunningham & saigo: 'Environmental science :A global concern' 4th Ed.W.c. Brown Publishers. USA. 1997
2. Chauhan A.S, 'Environmental studies' 2nd revised ed.2004, Jain Brother publishers, New Delhi

REFERENCES:

1. Benny Joseph : 'Environmental Science and Engineering', 2006, Tata McGraw- Hill Publication.
2. Siddique K.A. : Elements of Ecology and Environmental Pollution, 1st Ed. 2002, Kushal Publication, Varanasi. M

FS3209	SOLID MECHANICS	L	T	P	C
		3	1	0	4

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.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the concepts of stress and strain in simple and compound bars, the temperature of principal stresses and planes	U
CO-02	Understand load transferring mechanism in beams and stress distribution due to shearing force and bending moment	A
CO-03	Apply basic equation of simple torsion and designing of shaft and helical springs	A
CO-04	Calculate the slope and deflection in beams using different methods	An
CO-05	Analyze and design the thin and thick cylinder for the applied internal pressure.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	S	M	M	M	N	N	N	N	N	N	N	N
CO-02	M	S	S	M	N	N	N	N	N	N	N	N
CO-03	S	M	M	S	N	N	N	N	N	N	N	N
CO-04	L	S	M	M	N	N	N	N	N	N	N	N
CO-05	M	M	S	S	N	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

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.

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 — Shear stress distribution

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,

Slopes and deflections in beams - Double Integration method – Macaulay's method – Area moment method.

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.

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2007
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007

1. Egor. P.Popov “Engineering Mechanics of Solids” Prentice Hall of India, New Delhi, 2001
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series,2007.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2007
4. Ferdinand P. Beer, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005

- To define the reasons for an effective accident investigation
- To study the causes, analyze and prevent the accidents
- To understand the stages of accident investigation

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	L	N	N	S	N	L	N	N	N	N	N
CO-02	N	L	N	N	S	N	L	N	N	N	N	N
CO-03	N	M	S	L	M	N	M	N	N	N	N	N
CO-04	M	S	M	M	S	N	S	N	N	N	N	N
CO-05	M	M	S	S	S	N	S	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT – I INTRODUCTION

9

Accidents – types – causes– models of event causation – accident causation theories – domino theory – safety pyramid – multiple causation theories – pure chance theory – energy transfer theories.

UNIT – II ACCIDENT INVESTIGATION

9

Accident investigations – purpose – stages – data collection – entities involved – retrospective investigations – statistical investigations – large loss investigations – systems investigations – human error and accident management – accidents and human errors – types of human errors.

UNIT – III EVIDENCES

9

Process of investigation – tools – data collection – handling witnesses – evidences – demonstrative evidence – photographs – illustrative forms of evidence – documentary evidence – testimonial evidence – burn patterns – types – camera matching – photogrammetry –reporting writing – accident report format – reporting procedures – custody – access to records.

UNIT – IV ACCIDENT PERFORMANCE INDICATORS

9

Accident data analysis – safety performance indicators – categories of performance indicators – trailing indicators –current indicators – leading indicators – benefits and limitations.

UNIT – V ACCIDENT ANALYSIS

9

Methods – casual analysis – expert analysis – organizational analysis - analysis framework – steps – critical incident technique – fault tree analysis - barrier analysis – tire mark analysis – vehicle speed estimation–Management oversight and Risk Tree (MORT) Analysis – Techniques of Operations Review (TOR).

TOTAL: 45 HOURS

TEXT BOOKS:

1. Lee N VandenHeuvel, Donald K Lorenzo, Randal L Montgomery, Root Cause Analysis Handbook: A Guide to Efficient and Effective Incident Investigation, ABS Consulting, Rothstein Associates, Incorporated; 3rd edition (August 1, 2008). Bookfield, USA.
2. Modern Accident Investigation and Analysis, 2nd Edition, Ted S. Ferry, ISBN: 978-0-470-17223-0, November 2007.

REFERENCE BOOKS:

1. Accident Incident Prevention Techniques 2Nd Edition by Charles D. Reese, Taylor & Francis Ltd, December 2018.
2. Jeffrey S. Oakley, Accident Investigation Techniques, American Society of Safety Engineers; 2nd Revised ed. edition (1 January 2012).

FS3207	APPLIED THERMODYNAMICS AND FLUID MECHANICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To explain the various laws of thermodynamics
- To explain the operation of boiler
- To explain the different types of pumps and turbines
- To explain the concept of flow through the closed conduit.

Course Outcome – Cos		Cognitive Skill
CO-01	The ability to understand the working principle of thermal cycles, Carnot cycles and gas turbine and to solve design and performance problem.	U
CO-02	The ability to understand the fundamental of heat and mass transfer and to perform thermal heat system and performance problem	A
CO-03	Understanding of basic physics of fluids gaining knowledge to calculate and design engineering applications	A
CO-04	Understanding of dimensional and model analysis systems in terms of Rayleigh's and Buckingham's methods	U
CO-05	Understand the importance of various types of flows in pumps and turbines	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	S	L	N	M	N	N	N	N	N	N	L	N
CO-02	S	M	N	N	N	N	N	N	N	N	N	N
CO-03	S	L	L	N	L	N	N	N	N	N	M	N
CO-04	S	L	S	N	M	N	N	N	N	N	N	N
CO-05	M	M	M	N	S	N	N	N	N	N	L	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I LAWS OF THERMODYNAMICS AND THERMAL CYCLES 9

Systems zeroth law, first law of thermodynamics – concept of internal energy and enthalpy Applications to closed and open systems – second law of thermodynamics – concept of entropy – Clausius inequality and principles of increase in irreversible processes. Thermal cycles – Carnot cycle, Otto cycle, Brayton Cycle - Gas turbines and Compressor.

UNIT II REFRIGERATION, HEAT AND MASS TRANSFER 9

Basic thermodynamics of refrigerators and heat pumps. Refrigeration cycle- COP- Conduction in Slab and Thin cylinder, Convection – Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes, Blank's law. Radiation- Black Body Radiation – Grey body radiation, Stefan Boltzmann law –Modes of Heat Transfer – Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion, Fluidized bed.

UNIT III BASIC CONCEPT OF FLUID MECHANICS & FLOW OF FLUIDS 9

Introduction – classification – types of fluids – properties – laws of pressure – atmospheric, gauge, absolute pressure, pressure measurement – manometers – mechanical gauges. Types of fluid flow –

velocity – rate equation of continuity – energy of a liquid in motion – head of a liquid – Bernoulli's theorem – orifice and mouthpiece.

UNIT IV **DIMENSIONAL ANALYSIS**

9

Introduction – dimensions – dimensional analysis – Rayleigh's and Buckingham's method-similitude- dimensionless numbers and their significance – similarity laws.

UNIT V **PUMPS AND TURBINES**

9

Introduction – types of pumps – reciprocating pump – construction details – co-efficient of discharge – slip – power required – centrifugal pump – classification – working principle – specific speed – turbines – classification – working principle – Specifications of pumps - Applications.

TOTAL (L:45+T:15): 60 HOURS

TEXT BOOKS:

1. Nag, P.K., Engineering Thermodynamics, Tata McGraw-Hill Co. Ltd., 2007.
2. BANSAL.R.K,'Fluid Mechanics and Hydraulic Machines', Laxmi Publications' (P) Ltd, 2005.
3. Yunus A. Çengel, Michael A. Boles, Thermodynamics: An Engineering Approach, McGraw-Hill Higher Education, 2006.

REFERENCES:

1. Reynolds, Thermodynamics, Int. Student Edition, McGraw-Hill Co. Ltd., 1990.
2. Ramalingam. K.K." Thermodynamics", Sci-Tech Publications, 2006.
3. Holman.J.P, 3rd Edition, McGraw-Hill, 2007.
Shames, I.H., 'Mechanics of fluids', Kogakusha, Tokyo, 1998.
4. Kumar, K.L., 'Fluid Mechanics', Eurasia publishers, 1990.

FS3208	MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the engineering materials, properties and properties modification methods
- To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and sheet metal works.
- To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching

Course Outcome – Cos		Cognitive Skill
CO-01	Knowledge of basic Engineering materials, properties and properties modification methods.	U
CO-02	Knowledge of various metal casting equipment's and their working principles.	U
CO-03	Knowledge of various welding processes and its application.	U
CO-04	Gain knowledge about metal forming processes	U
CO-05	Upon completion of this course, the students can able to understand and compare the functions and applications of different metal cutting tools	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	S	N	N	M	N	N	N	N	N	N	N	N
CO-02	N	M	N	N	S	N	N	N	N	N	N	N
CO-03	N	M	N	N	S	N	N	N	N	N	N	N
CO-04	N	N	N	N	S	N	N	N	N	N	N	N
CO-05	N	N	N	N	S	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I ENGINEERING MATERIALS

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 CASTING PROCESSES

9

Metal casting–Type of patterns–Pattern Materials– Pattern allowances– Moulding sand Properties and testing–Cores–Types and applications– Moulding machines–Types and applications; Melting furnaces: Blast and Cupola Furnaces; Principle of special casting processes: Shell moulding – investment casting – Pressure die casting–Centrifugal Casting–CO2 process–Stir casting; Defects in Sand casting.

UNIT III METAL JOINING PROCESSES

9

Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas Welding–Types–Flame characteristics; Manual metal arc welding– Gas Tungsten arc welding– Gas metal arc welding– Submerged arc welding–Electro slag welding; Operating principle and applications of - Resistance welding, Solid state welding - Plasma arc welding– Laser beam welding Electron beam welding–Friction welding and Friction Stir Welding; Weld defects: types, causes and cure.

UNIT IV METAL FORMING PROCESSES

9

Hot working and cold working of metals–Forging processes–Open, impression and closed die forging–forging operations. Rolling of metals –Types of Rolling–Flat strip rolling–shape rolling operations. Principle of rod and wire drawing–Tube drawing–Principles of Extrusion–Types–Hot and Cold extrusion. Sheet metal characteristics–shearing, bending and drawing operations–Stretch forming operations–Formability of sheet metal–Test methods–special forming processes–Working principle and applications–Hydro forming–Rubber pad forming–Metal spinning–Introduction of Explosive forming, Electro Hydraulic Forming magnetic pulse forming,

UNIT V METAL CUTTING PROCESSES

9

Machining – Metal cutting, Orthogonal and oblique cutting – cutting tool materials. Classification of machine tool – Lathe, shaper, milling machine drilling machine – construction and working, grinding machine – types and operation. Advanced machining methods ECM, EDM, USM, UJM.

TOTAL :45 HOURS

TEXT BOOKS:

1. Hajra Choudhary S.K and Hajra Choudhury. A.K., "Elements of workshop Technology", volume I, Media promoters and Publishers Private Limited, Mumbai, 1997.

- HajraChoudhury, "Elements of Workshop Technology", Vol.II.,Media Promoters
- Rao.P.N "Manufacturing Technology-Metal Cutting and Machine Tools", Tata McGraw-Hill, New Delhi, 2003.
- Kalpajian.S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2006.

REFERENCES:

- Gowri P. Hariharan, A.Suresh Babu, "Manufacturing Technology I", Pearson Education, 2008
- Roy. A. Lindberg,"Processes and Materials of Manufacture", PHI / Pearson education, 2006
- Paul Degarma E, Black J.T and Ronald A.Kosher, "Materials and Processes, in Manufacturing" EightEdition, Prentice–Hall of India, 1997.
- Sharma, P.C., "A Textbook of production Technology", S.Chand and Co. Ltd., 2004.
- Rao,P.N."Manufacturing Technology Foundry, Forming and Welding",2ndEdition,TMH-2003;2003.
- HMT,"Production Technology", Tata McGraw Hill,1998.GeofreyBoothroyd,"Fundamentals of Metal Machining and Machine Tools", Mc GrawHill,1984
- Roy. A. Lindberg, "Process and Materials of Manufacture"Fourth Edition, PHI/Pearson Education 2006

FS3274	SOLID AND FLUID MECHANICS LAB	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To determine the strength of materials under externally applied loads.
- To have a clear understanding of the design for strength and stiffness of springs.
- To perform different destructive testing of materials to understand its characteristics.
- To understand the principles behind flow measuring devices.
- To know the principles and working construction of turbines and pumps.

Course Outcome – Cos		Cognitive Skill
CO-01	The students will have the required knowledge in the area of testing of materials and components of structural elements experimentally	A
CO-02	Ability to use the measurement equipment's for flow measurement.	A
CO-03	Ability to do performance test on different turbines.	An
CO-04	Ability to do performance test on different pumps.	An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	M	N	S	N	N	N	N	N	N	N
CO-02	N	N	M	N	S	N	N	N	N	N	N	N
CO-03	N	N	S	N	S	N	N	N	N	N	N	N
CO-04	N	N	S	N	S	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod
2. Torsion test on mild steel rod
3. Impact test on metal specimen
4. Hardness test on metals – Brinell, Rockwell and Vicker Hardness Number
5. Deflection test on beams
6. Compression test on helical springs
7. Determination of the Coefficient of discharge of given Venturi meter.
8. Conducting experiments and drawing the characteristic curves of centrifugal pump
9. Conducting experiments and drawing the characteristic curves of reciprocating pump.
10. Conducting experiments and drawing the characteristic curves of Pelton wheel.
11. Conducting experiments and drawing the characteristics curves of Francis turbine.
12. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

TOTAL :45 HOURS

FS3275	MANUFACTURING PROCESS LAB	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To Study and acquire knowledge on various basic machining operations in special purpose
- To learn the machines and its applications in real life manufacture of components in the industry.

Course Outcome – Cos		Cognitive Skill
CO-01	Ability to use different machine tools for fabrication work	A
CO-02	Ability to use different machine tools for finishing operations	A
CO-03	Impart Knowledge about metal removal process	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	S	N	N	N	N	N	N	L
CO-02	N	N	N	N	S	N	N	N	N	N	N	L
CO-03	N	N	N	N	S	N	N	N	N	N	N	L

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS

1. Exercises on foundry operations. (Solid, split and Loose piece pattern)
2. Exercises on welding. (Lap, butt joint)
3. Exercises on Sheet Metal. (Square Tray, Funnel etc)
4. Exercise on Lathe (Turning, Step Turning, Taper Turning, Knurling, Thread Cutting)
5. Exercises on Vertical Milling machines -Keyway cutting
6. Exercises on shaping machines (Rectangular groove, V groove, gear milling.etc.)
7. Exercises on surface grinder (Square rod).

8. Exercises on capstan and turret lathes.
9. Exercises on drilling machine.

TOTAL: 45 HOURS

FS32P1	INDUSTRIAL TRAINING I	L	T	P	C
		0	0	2	2

OBJECTIVES

- This training is to provide an industrial exposure.
- To gain knowledge about role of Safety Officers in Industries.
- To provide a learning platform to know about the safety Sector in Industries

Course Outcome – Cos		Cognitive Skill
CO-01	Provide basic knowledge about the importance of safety in various industries	U
CO-02	Gain knowledge in real time safety applications in industries	U
CO-03	Gain knowledge about the safety equipment's used in various industries	U
CO-04	Gain knowledge in Safety Audits performed in industries	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	L	N	N	N	N	N	L	S
CO-02	N	N	N	N	L	N	N	N	N	N	M	S
CO-03	N	N	N	N	M	N	N	N	N	N	M	S
CO-04	N	N	N	N	M	N	N	N	N	N	L	M

- The students may undergo Industrial training during semester vacation. In this case the training has to be undergone continuously for the entire period.
- Students may practice in industry about how to carry out risk assessment, Accident Report generation, Job Safety Analysis, Work Method statement, Work permit systems in construction sites, Shipyard and other industries.
- The students may undergo Internship at Research organization / Refineries/ Oil and Gas industries Chemical Industries after due approval from the Department Consultative Committee In lieu of Industrial training.
- The students should spend atleast 30 hours in industry premises and produce valid certificate from the industries also submit a detailed report about the training to the review committee.
- Industrial training and seminar shall carry 100 marks and shall be evaluated through internal and external assessment.

SEMESTER V

S.No	Course Code	Course Title	L	T	P	Credit
THEORY						
1	MS3201	Professional and Business Ethics	3	0	0	2
2	FS3210	Fire Fighting and Protection Systems	3	0	0	3
3	FS3211	Design of machine elements and piping	3	1	0	4
4	FS3212	Industrial Chemical Technology	3	0	0	3
5	FS3213	Hazard Identification and Risk Assessment	3	0	0	3
6	FS3214	Instrumentation and Control	3	0	0	3
PRACTICALS						
7	FS3276	Chemical Engineering Laboratory	0	0	2	1
8	FS3277	Computer Aided Fire Safety Design Laboratory	0	0	2	1
9	FS3278	Instrumentation and Control Laboratory	0	0	2	1
TOTAL			18	1	6	21

MS3201	PROFESSIONAL AND BUSINESS ETHICS	L	T	P	C
		3	0	0	2

OBJECTIVES

1. To Recognize legal and ethical issues in business decision-making.
2. To Understand and apply ethical rules and constraints.
3. To Enhance analytical problem-solving skills and ethical decision-making abilities.

Course Outcome – Cos		Cognitive Skill
CO-01	To understand human values.	R,U
CO-02	To gain knowledge in engineering ethics.	U
CO-03	To practice engineering as social experimentation.	A
CO-04	To understand safety responsibilities and rights.	An
CO-05	To understand and evaluate global issues regarding engineering.	U,E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	M	M	S	L	S	L	S	N	N	N	N	N
CO-02	N	N	M	M	L	N	M	N	N	N	N	N
CO-03	L	S	M	N	M	S	N	N	N	N	N	N
CO-04	S	M	N	L	N	M	L	N	N	N	N	N
CO-05	N	L	L	S	N	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I: HUMAN VALUES

6

Morals, Values, and Ethics - Integrity and Work Ethic - Caring, Sharing, and Honesty -Commitment, Empathy, and Self-Confidence.

UNIT II: ENGINEERING ETHICS

6

Senses of 'Engineering Ethics' and Moral Issues -Moral Autonomy and Ethical Theories - Models of Professional Roles.

UNIT III: ENGINEERING AS SOCIAL EXPERIMENTATION

6

Engineering as Experimentation - Engineers as Responsible Experimenters - Codes of Ethics and Legal Perspectives.

UNIT IV: SAFETY, RESPONSIBILITIES, AND RIGHTS

6

Safety, Risk, and Risk Assessment - Collegiality, Loyalty, and Respect for Authority - Professional and Employee Rights.

UNIT V: GLOBAL ISSUES**6**

Multinational Corporations and Environmental Ethics - Engineers as Managers, Consultants, and Expert Witnesses.

TOTAL: 30 HOURS**TEXTBOOKS:**

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering," McGraw-Hill, New York, Latest edition: 4th edition (2022).
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics," Prentice Hall of India, New Delhi, Latest edition: 2nd edition (2021).

REFERENCES:

1. Charles D. Fleddermann, "Engineering Ethics," Pearson Education/Prentice Hall, New Jersey, Latest edition: 4th edition (2022).
2. Charles E Harris, Michael S. Protchard, and Michael J Rabins, "Engineering Ethics - Concepts and Cases," Wadsworth Thompson Learning, United States, Latest edition: 2nd edition (2023).
3. John R Boatright, "Ethics and the Conduct of Business," Pearson Education, New Delhi, Latest edition: 8th edition (2021).
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers," Oxford University Press, Oxford, Latest edition: 2nd edition (2022).

FS3210	FIRE FIGHTING AND PROTECTION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVE

- Actions taken to control fires are based on a full and accurate assessment of the incident, using all available sources of information
- The order of priority, timing and sequence of actions are appropriate to the overall requirements of the incident and to minimize damage, injuries to the personnel
- Personal safety during fire control activities is safeguarded at all times

Course Outcome – Cos		Cognitive Skill
CO-01	Illustrate the principle and working of various fire smoke and flame detection methods, and testing procedures	R ,U
CO-02	the basic principles about different fire extinguishment equipment and their characteristics.	R, U
CO-03	Demonstrate the concepts and types of automatic suppression systems.	R, U
CO-04	Design principles of fixed fire protection systems to application.	R, U
CO-05	Operate fir alarms and implement fire ground operations.	R, U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	S	N	L	N	N	N	N	L

CO-02	N	N	N	N	S	N	M	N	N	N	N	M
CO-03	N	N	N	N	M	N	L	N	N	N	N	M
CO-04	N	N	N	N	S	N	L	N	N	N	N	M
CO-05	N	N	N	N	S	N	M	M	N	N	N	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I FIRE DETECTION 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(BIS); Comparison of detectors; Performance characteristics of detectors; Lag time associated with fire detection.

UNIT II – BASIC 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 AUTOMATIC FIRE SUPPRESSION 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; - Performance and effectiveness of water sprinkler system - Principles of sprinkler system design as per relevant standards (BIS).

UNIT IV FIXED FIRE FIGHTING SYSTEM

9

Fixed firefighting system - CO2 Fire Suppression system, Clean Agent suppression system – Design – Installation - Application. Dry chemical powder, and Foam - concept of total flooding and local application, advantages and disadvantages of each system; Basic system components; Design principles of fixed firefighting systems for total flooding and for local application as per relevant standards (BIS) - Application to typical hydrocarbon storage tank protection problems.

UNIT V FIRE ALARM SYSTEM & FIRE GROUND OPERATIONS

9

Fire alarm system- classification of alarm system as per NBC; Manually operated system; Automatic alarm system; Component and features of Local system, Auxiliary system, Remote station system, Central station system and Proprietary system - Selection and planning of alarm system as per relevant BIS - General requirements and guidelines for the selection and installation of fire detection and alarm system in buildings of different occupancy classification - Performance and effectiveness of automatic fire detectors.

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.

TOTAL: 45 HOURS

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
3. Ron Hirst, "Underdowns Practical Fire Precautions", Gower Publishing Company Ltd., England, 1989.
4. Jain V.K., "Fire Safety in Buildings", New Age International (P) Ltd., New Delhi, 1996
5. Clark, W.E., "Firefighting principles & practices",
6. HMSO: Manual of Firemanship, No. 4 to 7.

REFERENCES

1. 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.
2. Introduction to Fire Safety Management The handbook for students on NEBOSH and other fire safety courses Andrew Furness CFIOSH, GI FireE, Dip2OSH, MIIRSM, MRSH Martin Muckett MA, MBA, CMIOSH, MIFireE, Dip2OSH., Elsevier Ltd.
3. 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.
4. N F P A. Fire protection hand book Relevant IS codes

FS3211	DESIGN OF MACHINE ELEMENTS AND PIPING	L	T	P	C
		3	1	0	4

OBJECTIVES (Use of P S G Design Data Book is permitted)

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components

Course Outcome – Cos		Cognitive Skill
CO-01	Explain the influence of steady and variable stresses in machine component design.	A
CO-02	Able to design shafts, keys and couplings.	An
CO-03	Able to design temporary and permanent joints.	E
CO-04	Ability to design energy absorbing members	An
CO-05	Able to design cylindrical vessels and pipe line	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	L	L	M	M	S	N	N	N	N	N	N	L
CO-02	L	L	M	M	M	N	N	N	N	N	N	M
CO-03	L	L	M	S	S	N	N	N	N	N	N	M

CO-04	L	L	M	M	M	N	N	N	N	N	N	M
CO-05	L	L	S	S	S	N	N	N	N	N	N	L

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – Factor of safety - theories of failure – Design based on strength and stiffness – stress concentration – Design for variable loading.

UNIT II SHAFTS AND COUPLINGS 9

Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys, keyways and splines - Rigid and flexible couplings.

UNIT III TEMPORARY AND PERMANENT JOINTS 9

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints.

Riveted Joints – Stresses in Riveted Joints – Design of Riveted Joints subjected to central and eccentric Loads – Boiler and Tank Joints – Structural Joints.

Welded Joints – Types of Welded Joints – Design of Welded Joints Subjected to axial, Torsion and Eccentric Loads.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS 9

Springs – Stresses in Helical Springs- Deflection of Helical Compression and tension spring – Design of spring subjected to static and fatigue loading – Design of Concentric spring. Leaf Spring – Design of automotive Leaf Spring-Design of fly wheel.

Power Shafting- Design for static loads- combined stresses- design of shaft for strength and deflection- axial load on shaft.

UNIT V DESIGN OF CYLINDRICAL VESSELS AND STORAGE TANKS 9

Design of cylindrical and spherical vessels for internal and external pressures – Design of head and enclosures – tall vessels – supports for vessels – pipeline design, Design of Storage Tank.

L: 45 + T: 15 = TOTAL: 60 HOURS

TEXT BOOKS:

1. Bhandari V, “Design of Machine Elements”, 4 th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 9th Edition, Tata McGraw-Hill, 2011.

REFERENCES:

1. Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw-Hill Book Co. (Schaum’s Outline), 2010
2. P.C. Gope, “Machine Design – Fundamental and Application”, PHI learning private ltd, New Delhi, 2012.
3. R.B. Patel, “Design of Machine Elements”, MacMillan Publishers India P Ltd., Tech-Max Educational resources, 2011.
4. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, 4 th Edition, Wiley, 2005.
5. Sundararajamoorthy T. V. Shanmugam N, “Machine Design”, Anuradha Publications, Chennai, 2015.

FS3212	INDUSTRIAL CHEMICAL TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the processes of Sulphur and bi-products processing
- To provides an exposure about fuel, chemical and gas processes in industries
- To learn the chemical processes of pulp, sugar and stretch extraction in Industries
- To understand the chemical processes in petroleum industries
- To learn the various processes in rubber and other fire industries

Course Outcome – Cos		Cognitive Skill
CO-01	Grasp knowledge about various chemical processes in mining and cement industries	U
CO-02	Gain knowledge about processes in fertilizers industries	A
CO-03	Exposure about chemical processes in pulp, sugar and stretch Industries	A
CO-04	Grasp knowledge in processing of petroleum products extraction and its Bi- products	A
CO-05	Knowledge about processing of rubber, polymers and synthetic fiber	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	L	L	N	M	S	N	N	N	N	N	N	L
CO-02	L	L	N	M	M	N	N	N	N	N	N	M
CO-03	L	L	N	S	S	N	N	N	N	N	N	M
CO-04	M	M	N	M	M	N	N	N	N	N	N	M
CO-05	M	M	N	S	S	N	N	N	N	N	N	H

S- Strong, M- Medium, L-Low, N- Not Relevant

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 diene – Chemicals from Aromatics - Benzene, Toluene and Xylene.

UNIT 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 HOURS**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).

FS3213	HAZARD IDENTIFICATION AND RISK ASSESMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

To be knowledgeable in various techniques for hazard identification. reliability analysis, estimation of frequency of occurrence of hazards, consequence analysis, risk quantification and human reliability analysis.

Course Outcome – Cos		Cognitive Skill
CO-01	Evaluate the hazard indices, HAZOP, PHA and What if analysis for the identification of hazards in a process.	An
CO-02	Estimate the consequences of fire, explosion and toxic gas release using suitable empirical models.	A
CO-03	Assess the probability of occurrence of an event using fault tree and event tree analysis	An
CO-04	Quantify the risk involved in a process.	A
CO-05	Carryout human reliability analysis suitable the application or environment	An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	L	N	S	S	N	M	N	N	N	L	S
CO-02	N	L	N	M	S	N	N	N	N	N	N	L
CO-03	N	N	N	M	S	N	N	N	N	N	M	M

CO-04	N	N	N	S	L	N	M	N	N	N	N	S
CO-05	N	M	N	S	S	N	L	N	N	N	L	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I HAZARD IDENTIFICATION CONCEPTS 9

Hazard and risk, Types of hazards– Hazard Triangle - fire, explosion and toxic gas release, Structure of hazard identification and risk assessment.

Identification of hazards-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(PHA), Hazard and Operability study (HAZOP).

UNIT II ENVIRONMENTAL HEALTH HAZARDS 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 fireball, confined explosions, pool fires, jet fires, Effect models- Toxic gas effects, thermal effects, explosion effects - Software application for effect and damage calculations.

UNIT III 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 - Fault tree analysis–logic symbols, minimal cut set, logic gates, fault tree quantification – MOCUS Algorithm. Event Tree Analysis–notation, event tree construction, advantages and disadvantages of ETA – Bowtie – terminologies – Bowtie tool and management.

Failure mode and Effect Analysis (FMEA) – methodology, criticality analysis, corrective action and follow-up.

UNIT IV INDIVIDUAL AND SOCIETAL RISK 9

Quantification of risk: Quantitative Risk Analysis, 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.

UNIT V HUMAN RELIABILITY ANALYSIS 9

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).

TOTAL: 45 HOURS

TEXT BOOKS

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, Guide lines for Chemical Process Quantitative Risk Analysis second edition. Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York, 2000.
3. Probabilistic Risk Assessment for Engineer and Scientist, Komamoto and Henley, IEEE, press, 1995
4. Industrial Accident Prevention, Heinrich et al., Mc Graw Hill 1998.
5. Techniques for Safety Management – A system Approach, Peterson G, ASSE 1998.

REFERENCES

1. Lees F.P. Loss Prevention in the Process Industries second edition. Butter worths, London,1996.

FS3214	INSTRUMENTATION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce various types of measurement devices
- To understand concepts in pressure, flow, strain, temperature measurements.
- To introduce PLC, servo motor concepts.
- To learn basics of control systems and PID controller concepts.

Course Outcome – Cos		Cognitive Skill
CO-01	Learn about basic measurement and instrumentation-based devices	U
CO-02	Gain knowledge in functioning of measuring devices for different system variables	U
CO-03	Develop skills in selection of measuring devices for pressure, temperature, flow and level, also indicators	A
CO-04	Knowledge in electrical systems and concepts of PLC controllers and programming	An
CO-05	Understand the concepts of advanced control systems and PID controllers	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	M	L	N	L	L	N	N	N	N	N	N	M
CO-02	M	L	N	M	L	N	N	N	N	N	N	M
CO-03	M	M	N	M	M	N	N	N	N	N	N	M
CO-04	L	M	N	M	M	N	N	N	N	N	N	L
CO-05	M	M	N	M	M	N	N	N	N	N	N	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I FUNCTIONS OF INSTRUMENTS AND MEASUREMENT SYSTEM 9

Elements of measurement - Fundamental standards, Quality of measurement, meaning of measurement, Errors in measuring instruments, Need for accuracy and precision-Precision and accuracy, Calibration principle, Static and dynamic characteristics of measuring instruments, General configuration and functional element of measuring instrument

UNIT II: PRESSURE, STRAIN AND FORCE MEASUREMENT 9

High pressure measuring instruments- Burden pressure gauge, diaphragm gauge, bellow gauge. Low pressure measuring instruments- Mcload gauge, Knudsen gauge, thermal conductivity gauge. Strain measuring instruments-wire, foil, bonded strain gauges. Force Measurement-Load cell, Hydraulic, Pneumatic, Electrical methods of force measurement.

UNIT III: TEMPERATURE, LIQUID LEVEL, SPEED AND FLOW MEASUREMENT 9

Temperature Measurement- bi-metallic strips, pressure thermo meter, thermocouple, thermistor. Liquid Level Measurement-displacement or force transducers, pressure sensitivity bubbler or purge system, capacitance variation type, resistance variation type. Speed Measurement-Tachometer and stroboscopes. Flow Measurement-Positive displacement flow meter, turbine meter, rotameter.

UNIT IV CONTROL SYSTEMS 9

Working principles and applications- AC&DC servo motors, AC&DC drives and Electric actuators. Programmable Logic Controllers (PLC)- Architecture, I/O processing, Ladder diagram, simple programming, PLC for industrial process control application.

UNIT V CONTROL SYSTEMS 9

Basic elements of control system – open loop and closed loop systems, Transfer function. Simple modelling of electric systems- translational and rotational, mechanical systems and thermal systems. Controllers -study of P, PI, PD and PID controllers.

Advanced Control Systems - 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: 45 HOURS.

TEXT BOOKS

1. E.O. Deobline, “Measurement systems, application and design” McGraw-hill, 4th edition, 1990.
2. Jain R.K, Engineering metrology, Khanna publications, 1985
3. Nagrath. I.J. and Gopal M., „Control Systems Engineering“, New Age International Publishers, 2003
4. Beckwith, Marangoni & Lienhard, “Mechanical measurements”, Addison-Wesley, 5th edition, 2000. E.O.
5. Jain R.K, Engineering metrology, Khanna publications, 1985

REFERENCES

1. S. Reganathan “Transducers Engineering”, Allied publishers Limited, 1999
2. Deobline, “Measurement systems, application and design” McGraw- hill, 4th edition, 1990.
3. CS Rangan, VSV Mani, G.R. Sharma, Instrumentation devices and systems, Tata McGraw hill 1983.
4. ASTM Handbook of Industrial Metrology, prentice hall of India, ND, 1988.
5. Collette & Hope, Engineering Measurement”, Longman Higher Education 1986.

FS3276	CHEMICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

To understand the practical aspects of various unit operation employed in process industries.

Course Outcome – Cos		Cognitive Skill
CO-01	Determine the surface characteristics of solid particles	R
CO-02	Determine the requirement for size reduction equipment	U
CO-03	Compare the efficiency of different types of distillation	U

CO-04	Analyze the Sedimentation of different slurry	A
CO-05	Possess the Knowledge about heat transfer concepts	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	M	N	S	N	N	N	N	N	N	N	N	N
CO-02	M	N	S	N	N	N	N	N	N	N	N	N
CO-03	L	N	M	N	N	N	N	N	N	N	N	N
CO-04	L	N	M	N	N	N	N	N	N	N	N	N
CO-05	L	N	M	N	N	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS

1. Verification of material balance equation and Rayleigh's equation for simple distillation.
2. Leaching – leaching a mixture of salt and sand.
3. Study of the kinetics of chemical reaction in a batch reactor.
4. Steam distillation setup – generate organic solvent free product
5. 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.
6. Study of the working of Plate and frame filter press.
7. Free settling – To find out the drag coefficient of a falling sphere in a fluid and verification of Stoke's law.
8. Sedimentation – To study batch sedimentation of slurry and to determine the area of the continuous thickener.
9. Working of Drop weight crusher – Crushing hard material and compare the load difference.
10. Heat transfer from steam to air – Determination of overall heat transfer coefficient.
11. study and find out effect of the Ball Mill and determine its critical speed and its efficiency.

TOTAL: 30 HOURS

FS3277	COMPUTER AIDED FIRE SAFETY DESIGN LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

To gain practical experience in handling 2D drafting and 3D modeling software systems and its application in fire and safety field

Course Outcome – Cos		Cognitive Skill
CO-01	Knowledge about 3D drawing using CAD software	A
CO-02	Draw the layouts of firefighting systems	A
CO-03	Draw the fire protection symbols.	U
CO-04	Draw the CAD symbols for fire extinguishers	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	S	S	N	N	N	N	N	N
CO-02	N	N	N	N	S	S	N	N	N	N	N	N
CO-03	N	L	N	N	S	S	N	N	N	N	N	N
CO-04	N	L	N	N	S	S	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS

1. Introduction of 3D Modeling software Creation of 3D assembly model of following machine elements using 3D Modeling software
2. Layout of fire suppression system assembly using 3D Modeling software
3. Design of fire safety piping layout in multistory building using 3D Modeling software
4. Design of simple fire exit, assembly point
5. Design a 2D layout of Fire Hydrant system using 3D Modeling software
6. Design of Screw Jack using 3D Modeling software
7. Design of Machine Vice using 3D Modeling software Crosshead
8. Design of Safety Valves using 3D Modeling software
9. Design of Sprinkler system using CAD Software
10. Design of fire piping systems
11. Symbols for fire protection elements and systems in CAD
12. Symbols for fire protection elements and systems in industrial safety

TOTAL: 30 HOURS

FS3278	INSTRUMENTATION AND CONTROL LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- To obtain knowledge about various measuring instruments.
- To gain knowledge about PLC, PID controllers.

Course Outcome – Cos		Cognitive Skill
CO-01	Measure various parameters using different instruments.	A
CO-02	Operate on PLC & Servo motors.	A
CO-03	Simulate various controllers using MATLAB.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	S	S	N	N	S	N	N	N	N	N	N	N
CO-02	M	M	N	N	S	N	N	N	N	N	N	N
CO-03	M	L	N	N	S	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS

1. Study and measure the temperature of the components using thermocouple
2. Measurement of Linear displacement of multiple surfaces using LVDT
3. Measurement of force using load cell
4. Measurement of torque using torque transducer.
5. Measurement of torsional vibration using laser vibrometer
6. Development of PLC controller for process control application
7. Load characteristics of AC servomotor
8. Load characteristics of AC servomotor
9. Determination of closed loop response for a non-linear system
10. Simulation of P, PI, PD, PID controllers

TOTAL: 30 HOURS

SEMESTER VI

S.No	Course Code	Course Title	L	T	P	Credit
THEORY						
1.	AI32D1	Fundamentals of Artificial Intelligence (Open Elective I)	3	0	0	3
2.	FS3215	Principles of Safety Management	3	0	0	3
3.	FS3216	Occupational Health and Hygiene	3	0	0	3
4.	FS3217	Safety in Construction Industries	3	0	0	3
5.	FS32XX	Professional Elective- I	3	0	0	3
6.	FS32XX	Professional Elective- II	3	0	0	3
PRACTICALS						
7.	FS3279	Industrial Hygiene Laboratory	0	0	2	1
8.	FS3280	Fire Safety and Emergency Preparedness Training Laboratory	0	0	2	1
9.	FS32P2	Industrial Training – II	0	0	2	2
TOTAL			18	0	6	22

FS3215	PRINCIPLES OF SAFETY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understanding of the principles of safety management.
- Enable the students to learn about various functions in safety management
- Prepare students to conduct safety training, inspection and write audit report effectively in auditing situations.
- Wide knowledge about safety performance monitoring.
- Familiarize students to conduct accident investigation

Course Outcome – Cos		Cognitive Skill
CO-01	Impart knowledge bout basics of safety management	U
CO-02	Learn about roles of safety in any organization	A
CO-03	Impart knowledge about importance safety education and Training	A
CO-04	Provide an exposure about importance safety performance monitoring and its output.	A
CO-05	Provide a base about management roles in accident investigation and analysis	An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	N	N	S	M	N	N	M	M
CO-02	N	N	N	N	N	M	M	S	N	N	L	S
CO-03	N	N	N	N	N	H	L	M	N	N	H	M
CO-04	N	N	N	N	N	M	M	M	N	N	H	S
CO-05	N	N	N	N	N	M	H	S	N	N	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

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- MORT-Multi Events Sequencing-TOR.

TOTAL : 45 HOURS

TEXTBOOKS

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.

FS3216	OCCUPATIONAL HEALTH AND HYGIENE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the types of physical hazards with permissible levels and their effects, measurements.
- To have knowledge about the types of chemical hazards and their measurement procedures.
- To enable the students to learn about various biological and ergonomical hazards with their effects.
- To enable the students to learn about various functions of occupational health services and industrial toxicology.
- To have the knowledge about occupational physiology.

Course Outcome – Cos		Cognitive Skill
CO-01	The students will be able to identify various types of physical hazards and their effects.	U

CO-02	Understand the different chemical hazards and their measurement procedures.	U
CO-03	Identify various biological and ergonomical hazards and design of safety buildings.	A
CO-04	Identify notifiable occupational diseases arising out of Occupation and suggest methods for the prevention of such diseases.	An
CO-05	Understand the various physiological functions of our body and the test methods for periodical monitoring of health.	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	L	N	N	S	M	N	N	M
CO-02	N	N	N	N	L	N	L	S	L	N	N	L
CO-03	N	N	N	N	L	N	N	S	M	N	N	L
CO-04	N	N	L	N	L	N	N	S	M	N	N	M
CO-05	N	N	N	N	L	N	L	S	M	N	N	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I PHYSICAL HAZARDS

9

Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage, risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, noise control program, industrial audio metry. Vibration, types, effects, instruments, permissible exposure limit.

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.

Ionizing radiation and non-ionizing radiation- types, effects and monitoring instruments. 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 CHEMICAL HAZARDS

9

Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure vs. dose, TLV - Methods of Evaluation, process or operation description, Field Survey, Sampling methodology, Industrial Hygiene calculations, Comparison with OSHAS Standard.

Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures, Gas and Vapour monitors, dust sample collection devices, personal sampling

Methods of Control - Engineering Control, Design maintenance considerations, design specifications - General Control Methods - training and education

UNIT III BIOLOGICAL AND ERGONOMICAL HAZARD

9

Classification of Biohazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets - building design.

Work Related Musculoskeletal Disorders –carpal tunnel syndrome CTS- Tendon pain-disorders of the neck- back injuries.

UNIT IV OCCUPATIONAL HEALTH AND TOXICOLOGY 9

Concept and spectrum of health - functional units and activities of occupational health services, pre-employment and post-employment medical examinations - occupational related diseases, 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 etc) their effects and prevention – cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests. Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems.

UNIT V OCCUPATIONAL AND PSYCHOLOGICAL HAZARDS 9

Elements of Industrial Psychology-Mental Health in Industries- Organizational Behaviour, Motivational Theory, Job Satisfaction Value system, Habits, Drug Abuse-Alcoholism in Industry, Communications, Organizing Health education and Training Programme for employees, Psychological Hazards - Workplace Stress- General Adaptation Syndrome Eustress –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 HOURS

TEXT BOOKS:

1. Benjamin O.Alli, Fundamental Principles of Occupational Health and Safety ILO 2008.
2. Danuta Koradecka, Handbook of Occupational Health and Safety, CRC, 2010.
3. E.J. McCornick, and M. S Sanders, Human Factors in Engineering and Design, Tata McGraw-Hill, 1992.

REFERENCES

1. Encyclopedia of “Occupational Health and Safety”, Vol.I and II, published by International Labour Office, Geneva, 1985.
2. Hand book of “Occupational Safety and Health”, National Safety Council, Chicago, 1982.
3. Lawrence Slote, Handbook of occupational safety and health, Wiley, 2001.
4. Louis J. Di Berardinis, Handbook of occupational safety and health Wiley, 1999.

FS3217	SAFETY IN CONSTRUCTION INDUSTRIES	L 3	T 0	P 0	C 3
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OBJECTIVES

- Learn the safety aspects in construction industries.
- Knowledge about safety in material handling and equipment's.
- Gain knowledge about the human safety in construction industries.
- Learn the rules and acts in construction sectors

	Course Outcome – Cos	Cognitive Skill
CO-01	Learn the construction site safety issues	U
CO-02	Understand the safety requirements in various construction operations and develop guidelines to ensure safety at construction site.	U

CO-03	Provides an exposure about safety requirements in material handling and Equipment's and develop guidelines to ensure safety at construction site.	A
CO-04	Gain knowledge about Demolition safety and Human safety Aspects	U
CO-05	Learn the legal provisions with respect to the health and welfare of workers at construction site.	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	L	N	M	N	N	L	N	N	N	S
CO-02	N	N	M	N	L	N	N	L	N	N	N	M
CO-03	N	N	M	N	S	N	N	M	N	N	N	M
CO-04	N	N	M	N	S	N	N	M	N	N	N	M
CO-05	N	N	L	N	M	N	N	L	L	N	N	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I INTRODUCTION TO CONSTRUCTION INDUSTRY

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 VARIOUS CONSTRUCTION OPERATIONS

9

Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds – Tunneling – Blasting – Demolition – Pneumatic caissons – Confined space – Temporary Structures. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety.

UNIT III CONSTRUCTION MACHINERY HANDLING

9

Safety in material handling and equipment's – Safety in storage & stacking of construction materials. Safety in the use of construction equipment's – excavators, graders and dozers – cranes – hoists & lifts – other – chain-pulley blocks – mixers – conveyors – pneumatic and hydraulic tools in construction. Temporary power supply.

UNIT IV SAFETY IN DOMLITION & HUMAN SAFETY ASPECTS

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.

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. Electrical fires – hazards of static electricity. Safe procedures for electrical maintenance

UNIT V CONTRACT LABOUR (R&A) ACT AND CENTRAL RULES:

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 Workers (RE & CS) Act, 1996 and Central Rules, 1998: Applicability, Administration, Registration, Welfare Board & Welfare Fund, Training of

Building workers, General Safety, Health & Welfare provisions, Penalties. Code of Practices - Risk assessment in construction site -Preventive measures against Hazards at work places.

TOTAL 45 HOURS

TEXT BOOKS

1. James B. Fullman, Construction Safety, Security & Loss Prevention, John Wiley & Sons,1984.
2. R.T. Ratay, Handbook of Temporary Structures in Construction, Mc Graw-Hill,2012.
3. Hudson, R., “Construction hazard and Safety Handbook”, Butter Worth’s,1985.
4. Raymond Elliot Levitt, Nancy Morse Samelson, “Construction Safety Management, McGraw Hill, London,1987.

REFERENCES

1. K.N. Vaid (Ed.), “Construction Safety Management”, National Institute of Construction Management and Research, Bombay.
2. Linger L, Modern Methods of Material Handling
3. V.J. Davies & K. Tomasin, “Construction Safety Handbook”, Thomas Telford Publishing, London. ,1990.
4. Jnathea D.Sime ,“Safety in the Build Environment”,London,1988.
5. Davies, V. J., and Tomasin, K. (1996). Construction safety hand book. Thomas Telford Publishing ,London.

FS3279	INDUSTRIAL HYGIENE LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVE

The main objective is to gain knowledge on various industrial hygiene practices and measurements.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the usage of PPE and safety equipment’s	U
CO-02	Learn the purpose & measurement procedures of heat stress & noise level	An
CO-03	Illustrate the working of different Air quality measuring instruments	An
CO-04	Learn to estimate the hygiene of an industry.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	S	N	N	N	N	N	N	S
CO-02	N	N	N	N	S	N	N	N	N	N	N	S
CO-03	N	N	N	N	S	N	N	N	N	N	N	S
CO-04	N	N	N	N	M	N	N	N	N	N	N	S

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS

1. To determine the dust in working atmosphere using High volume sampler
2. To determine the dust in working atmosphere using Ambient air sampling Analysis

3. Study of safety equipment's
4. Auto Exhaust analysis
5. Color blindness and Vision Test
6. Study and use of SCBA & CABA
7. Noise Level Measurement Digital Sound Level Meter
8. Measurement of heat stress using area heat stress monitor.
9. Study of lungs functioning Test
10. Determine the toxic level of the gases using Portable Multi Gas Alert device.
11. Determine the PH value using Ph meter.
12. Determine the wind speed measurement using Anemometer.
13. Analysis of thermal stress and relative humidity

TOTAL 30 HOURS

FS3280	FIRE SAFETY AND EMERGENCY PREPAREDNESS TRAINING LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVE

The main objective is to provide an exposure about various firefighting techniques.

Course Outcome – Cos		Cognitive Skill
CO-01	To train the operation of fire service equipment's	U, A
CO-02	Demonstrate the operation of different extinguishers and its purpose.	A
CO-03	Illustrate the procedure for handling hose drills	A
CO-04	Learn the different fire protection symbols.	A
CO-05	Demonstrate the rescue methods in emergency situation.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	S	N	N	N	M	N	M	S
CO-02	N	N	N	N	S	N	N	N	M	N	M	S
CO-03	N	N	N	N	M	N	N	N	M	N	M	S
CO-04	N	N	N	N	M	N	N	N	L	N	M	M
CO-05	N	N	N	N	M	N	N	N	L	N	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS

1. Study and demonstration of different types of knots, bend and Hitches
2. Study and demonstration of firefighting equipment using fire Hydrant system
3. Demonstration of Rescue using Fire Suit.
4. Study of different fire fighting vehicles
5. Hands on training about Disaster rescue demonstration
6. Firefighting with (CO₂, water type Extinguishers DCP, foam) Extinguishers.
7. Fire rescue without firefighting equipment's.
8. Refilling different types of extinguishers.
9. Study and demonstration of hoses coupling and branches
10. Hose Drill – Laying one hose

11. Hands on Training – Mock Fire Drill
12. Study of fire protection graphic symbols and safety signs
13. Study of Hand Signals.
14. Study and demonstration of Rescue Methods.

TOTAL: 30 HOURS

FS32P2	INDUSTRIAL TRAINING II	L	T	P	C
		0	0	2	2

OBJECTIVE

The objective of this training is to provide an industrial exposure

Course Outcome – Cos		Cognitive Skill
CO-01	Provide basic knowledge about the importance of safety in various industries	U
CO-02	Gain knowledge in real time safety applications in industries	U
CO-03	Gain knowledge about the safety equipment's used in various industries	U
CO-04	Gain knowledge in Safety Audits performed in industries	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	L	N	N	S	N	N	S	S
CO-02	N	N	N	N	L	N	N	S	N	N	M	S
CO-03	N	N	N	N	M	N	N	S	N	N	M	S
CO-04	N	N	N	N	M	N	N	S	N	N	S	M

- The students may undergo Industrial training during summer / winter vacation. In this case the training has to be undergone continuously for the entire period.
- Training should be done in the area of Risk assessment, Fire Fighting Techniques, accident investigation and implement Hazard identification Techniques in any industrial sector
- The students may undergo Internship at Research organization / Refineries/ Oil and Gas industries Chemical Industries after due approval from the Department Consultative Committee In lieu of Industrial training.
- The students should produce valid certificate from the industries and also submit a detailed report about the training to the review committee.
- Industrial training and seminar shall carry 100 marks and shall be evaluated through internal and external assessment.

TOTAL: 45 HOURS

SEMESTER VII

S.No	Course Code	Course Title	L	T	P	Credit
THEORY						
1	MS3202	Principles of Management	3	0	0	2
2	FS3218	Legal Aspects of Welfare Safety and Environment	3	0	0	3
3	XXXXX	Open Elective – II	3	0	0	3
4	FS32XX	Professional Elective- III	3	0	0	3
5	FS32XX	Professional Elective- IV	3	0	0	3
PRACTICALS						
6	FS3281	Environmental Engineering Laboratory	0	0	2	1
7	FS3282	Fire, Smoke Modeling and Analysis Laboratory	0	0	2	1
8	FS32P3	Design and Fabrication Project	0	0	3	3
TOTAL			15	0	7	19

MS3202	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	2

OBJECTIVES

- To introduce students to the basic concepts and functions of management.
- To understand the role and responsibilities of managers in various organizational settings.
- To develop an understanding of the planning, organizing, leading, and controlling functions of management.
- To examine the impact of management theories and practices on organizational performance.
- To equip students with the skills necessary to manage people and processes effectively in a technical environment.

Course Outcome – Cos		Cognitive Skill
CO-01	Define and explain the key concepts and functions of management.	U
CO-02	Analyse the roles and responsibilities of managers in different organizational contexts.	U
CO-03	Apply planning, organizing, leading, and controlling principles to real-world scenarios.	U
CO-04	Evaluate the effectiveness of different management theories and practices	U.A
CO-05	Demonstrate management skills necessary for leading teams and projects in a technical environment	U, A

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	N	M	N	L	L	N	S	S
CO-02	N	N	N	N	N	M	N	L	L	N	M	M
CO-03	N	N	N	N	N	M	N	L	L	N	S	M
CO-04	N	N	N	N	N	M	N	L	L	N	M	L
CO-05	N	N	N	N	N	M	N	L	L	N	S	L

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I: INTRODUCTION TO MANAGEMENT

7

Definition, nature, and importance of management - Functions of management: Planning, Organizing, Leading, Controlling - Roles and skills of managers - Evolution of management thought: Classical, Behavioral, and Modern theories - Scientific Management (Taylor) - Administrative Theory (Fayol) - Human Relations Movement (Mayo) - Contemporary approaches (Systems Theory, Contingency Theory)

UNIT II: PLANNING

5

Nature and purpose of planning - Types of plans: Strategic, Tactical, Operational - Planning process and techniques - SWOT Analysis, SMART Goals, Scenario Planning - Decision making:

Process, types, and tools- Rational Decision-Making Model - Bounded Rationality - Group Decision-Making Techniques (Brainstorming, Delphi Technique)

UNIT III: ORGANIZING

5

Organizational structure and design - Types of organizational structures: Functional, Divisional, Matrix, Network - Authority, responsibility, and delegation - Coordination and communication within organizations - Formal and Informal Communication Channels - Role of Technology in Organizational Communication (Emails, Video Conferencing, Collaborative Tools)

UNIT IV: LEADING

7

Leadership theories and styles - Trait Theory - Behavioral Theories (Ohio State Studies, Michigan Studies) - Contingency Theories (Fiedler's Model, Path-Goal Theory) - Transformational vs. Transactional Leadership - Motivation theories and practices, Maslow's Hierarchy of Needs, Herzberg's Two-Factor Theory, McClelland's Theory of Needs, Modern Approaches (Self-Determination Theory) -Group dynamics and team management - Stages of Team Development (Forming, Storming, Norming, Performing) - Managing Virtual Teams

UNIT V: CONTROLLING

6

Nature and purpose of control - Control process and techniques, Establishing Standards, Measuring Performance, Correcting Deviations - Types of control: Feed forward, Concurrent, Feedback - Quality control and management, Total Quality Management (TQM), Six Sigma, Lean Management, Use of Data Analytics in Quality Control

TOTAL: 30 HOURS

TEXTBOOKS (Latest Editions)

1. Robbins, S. P., Coulter, M., & DeCenzo, D. A. (2020). *Fundamentals of Management* (11th ed.). Pearson.
2. Griffin, R. W. (2022). *Management: Principles and Practices* (12th ed.). Cengage Learning.
3. Jones, G. R., & George, J. M. (2021). *Essentials of Contemporary Management* (9th ed.). McGraw-Hill Education.

REFERENCE BOOKS (Latest Editions)

1. Daft, R. L. (2021). *Management* (14th ed.). Cengage Learning.
2. Bateman, T. S., & Snell, S. A. (2020). *Management: Leading & Collaborating in a Competitive World* (14th ed.). McGraw-Hill Education.
3. Schermerhorn, J. R. (2021). *Management* (14th ed.). Wiley.
4. Hill, C. W. L., Schilling, M. A., & Jones, G. R. (2020). *Strategic Management: Theory & Cases* (13th ed.). Cengage Learning.
5. Kinicki, A., & Williams, B. K. (2021). *Management: A Practical Introduction* (10th ed.). McGraw-Hill Education.

FS3218	LEGAL ASPECTS OF WELFARE SAFETY AND ENVIRONMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The objective of the course is to provide or gain sufficient knowledge on the signification and regulations welfare safety and environment of professionals working in major domains in Engineering environment.

Course Outcome – Cos		Cognitive Skill
CO-01	knowledge about factory act rules and regulations, duty and power of officials	R, U
CO-02	Conversion with welfare acts implemented for workers benefits	R, U
CO-03	Grasp knowledge about explosive & Petroleum acts	R, U
CO-04	Exposures with water and air acts and its rules, function and powers	R, U
CO-05	Gain knowledge about environmental act and rules, safety audit	U, A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	N	S	L	N	M	N	N	M
CO-02	N	N	N	N	N	M	M	N	L	N	N	M
CO-03	N	N	N	N	N	M	L	N	M	N	N	M
CO-04	N	N	N	N	N	S	L	N	M	N	N	M
CO-05	N	N	N	N	N	M	M	M	S	N	N	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I - FACTORIES ACT

9

Factories Act- Definitions, Objective, Principle, Significant of hazardous processes, Welfare, Working hours of adults, Employment of young persons, Special provisions. Labor Act and regulation (Safety, Health and Welfare)– Definitions Power of Inspectors, Power of Government to direct enquiry, Obligation of labor. Duties of Safety Officers, Reporting of accidents, Emergency Action Plan, Safety Committee.

UNIT II - 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.

UNIT III - SAFETY 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. Explosives Rules, Petroleum Act with important rules - definitions, Control over Petroleum import, Transport, Storage, Production, refining and blending, Need for license, exception, Notice of accidents and enquiry. SMPV Rules and Gas Cylinder Rules (in brief)., safety in the import, transport, storage, license, exemption, notice of accidents. Safety acts of different autonomous factory.

UNIT IV - WATER AND AIR ACTS

9

Water Act – Definition, Power and Functions of Boards, Provisions regarding prevention and control of water pollution, Power of make rules, Rules on consent for establishment and operation.

Air Act – Definition, Power & Functions of boards, Prevention & Control of Air Pollution, Consent as per Air Pollution rules.

UNIT V – ENVIRONMENTAL ACTS

9

Environment Protection Act and Rules – Definition, general powers of central government, prevention, control and abatement of environmental pollution, standards for emission, prohibition and restrictions on sitting and operation of industries, MSHC Rules – Definitions, Duties of authorities, Notification of Major Accidents, Safety reports, Safety Audit, MSDS, On-site & Off-site Emergency plan, Safety information to Public. Introduction of ISO 14000.

TOTAL :45 HOURS

TEXT BOOKS:

1. K.T. Narayanan, “Safety, Health and Environment Handbook Hardcover”, 1st Edition, McGraw Hill Education (India) private limited, 2017
2. Explosives Act and related Rules & The Gas Cylinder Rules, 2004, Professional Book publishers

REFERENCES:

1. Environmental Management Handbook for Hydrocarbon Processing Indus; James B. Well Factories Act, 1948.
2. Gayle wood side and Dianna Koeurek, “Environmental Safety and Health Engineering 1997
3. Petroleum Act and Rules & The Petroleum Act, 1934 © Universal Law publishing
4. ISO – 14000 - Manual
5. Environmental Acts & relevant Rules as above

FS3281	ENVIRONMENTAL ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

1. To analyse water, air and soil qualities.
2. To understand the environmental audit process and prepare the Audit report.

Course Outcome – Cos		Cognitive Skill
CO-01	Attain the ability to analyze the water, air and soils	An
CO-02	Identify the suitable method for pollution control and prevention in industries.	An

Mapping of Course Outcomes and Program outcomes

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	N	N	N	S	N	N	N	N	N	N	N	M
CO-02	N	N	N	S	L	N		N	N	N	N	N

S – Strong M – Medium L – Low N – Not Relevant

LIST OF EXPERIMENTS

1. Determination of solids (total, dissolved, organic, inorganic and settleable) in water
2. Determination of alkalinity, pH, hardness and chlorides in water.
3. Determination of iron, manganese, sulphates and sulphides in water.
4. Determination of D.O and B.O.D of waste water
5. Determination of available chloride in bleaching powder and the chlorine dose required to treat the given water sample.

6. Determination of CO, CO₂, O₂ and hydrocarbon emission using Auto Exhaust Analyzer.
7. Determine the Percentage of smoke emission using Smoke meter.
8. Determine the Specific Gravity of sand particles using Pycno meter.
9. Field Density test (core cutter and sand replacement method) using Core cutter and sand replacement apparatus.
10. Preparation of environmental Audit report.

TOTAL: 45 HOURS

FS3282	FIRE, SMOKE MODELING AND ANALYSIS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- To familiarize modeling of firefighting components and Firefighting system piping layout using CAD software.
- Basic knowledge about data analysis using statistical software package and risk analysis using ALOHA.
- To provide basic knowledge about Fault detection using MATLAB/SCILAB.
- To provide knowledge open-source software for smoke modeling and analysis

Course Outcome – Cos		Cognitive Skill
CO-01	Knowledge about modeling of firefighting components and Firefighting system piping layout using CAD software.	A,An
CO-02	Use of software package for dataand risk analysis.	A,An
CO-03	Gain knowledge about Fault detection using MATLAB/SCILAB	A,An
CO-04	Learn some of the open source software for smoke modeling and analysis	A,An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	M	L	N	N	N	N	N	N	N	N	L	M
CO-02	M	L	N	N	L	N	N	N	N	N	L	M
CO-03	M	L	N	N	N	N	N	N	N	N	L	M
CO-04	M	L	N	N	M	N	N	N	N	N	L	M

S- Strong, M- Medium, L-Low, N- Not Relevant

LIST OF EXPERIMENTS:

1. Modeling of Firefighting system piping layout using CAD software with the following.
 - Commercial Buildings
 - Hospitals
 - Industry buildings
2. Analysis of heat of mixing the vapour pressure with empirical and molecular formula using spread sheet.
3. Analysis of fire safety data using statistical software package.

4. Applications of risk analysis using software ALOHA.
5. Programming in MATLAB/SCILAB to solve fault tree problems.
6. Programming in MATLAB/SCILAB to solve fire dynamics problems
7. Graphical representation of various data related to safety and fire engineering.
8. Fire and smoke modeling and simulation using the open source software.

TOTAL: 45 HOURS

FS32P3	DESIGN AND FABRICATION PROJECT	L	T	P	C
		0	0	3	3

OBJECTIVES:

The main objective is to give an opportunity to the student to fabrication of one or more components of a complete working model applicable in fire and safety field, which is designed by them.

Course Outcome – Cos		Cognitive Skill
CO-01	Use of design principles and develop conceptual and engineering design of any components.	A,An
CO-02	Ability to fabricate any components relevant to fire safety using different manufacturing tools.	A,An

Mapping of Course Outcomes and Program outcomes

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	N	M	S	M	M	N	N	N	N	S	N	L
CO-02	N	M	S	M	M	N	N	N	N	S	N	L

S – Strong M – Medium L – Low N – Not Relevant

GUIDELINE FOR REVIEW AND EVALUATION

- The students may be grouped 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.
- It is mandatory to file patent for their fabrication works before the end of the semester examination.

SEMESTER VIII

S.No	Course Code	Course Title	L	T	P	Credit
THEORY						
1.	FS32XX	Professional Elective- V	3	0	0	3
2.	FS32XX	Professional Elective – VI	3	0	0	3
PRACTICALS						
3.	FS32P5	Project Work	0	0	20	10
TOTAL			6	0	20	16

FS32P5	PROJECT WORK	L	T	P	C
		0	0	20	10

OBJECTIVES:

1. To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
2. To train the students in preparing project reports and to face reviews and viva voce examination.

Course Outcome – Cos		Cognitive Skill
CO-01	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.	A
CO-02	Ability to solve the real time safety problem.	A, E
CO-03	Gain knowledge about present scenario in safety field.	A, C

Mapping of Course Outcomes and Program outcomes

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	N	S	N	N	S	M	N	N	N	N	L	L
CO-02	N	M	N	N	M	L	N	N	N	N	L	L
CO-03	N	L	N	N	M	L	N	N	N	N	N	N

S – Strong M – Medium L – Low N – Not Relevant

GUIDELINE FOR REVIEW AND EVALUATION

- The students should be carryout industrial projects in reputed central and state government industries.
- The students should take the latest problem in industries and solve these using Engineering concepts.
- 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 Controller of examination.

TOTAL: 60 HOURS

LIST OF ELECTIVES (Regulation – 2021)

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1	FS32A1	Process safety Management	3	0	0	3
2	FS32A2	Electrical Systems and Safety	3	0	0	3
3	FS32A3	Fire safety codes and Standardization	3	0	0	3
4	FS32A4	Advanced Safety Systems in Industry	3	0	0	3
5	FS32A5	Safety in Petroleum and petrochemical Industries	3	0	0	3
6	FS32A6	Fire Safety materials in Building	3	0	0	3
7	FS32A7	Fire safety Design for Buildings	3	0	0	3
8	FS32A8	Safety in Engineering Industries	3	0	0	3
9	FS32A9	Nuclear Safety and Handling Radioactive Materials	3	0	0	3
10	FS32B1	Environmental Safety	3	0	0	3
11	FS32B2	Chemical Processes Instruments & Safety	3	0	0	3
12	FS32B3	Transport Systems and Safety	3	0	0	3
13	FS32B4	OHSAS 18000 ISO 14000 and ISO: 45001	3	0	0	3
14	FS32B5	Principles of Industrial Management	3	0	0	3
15	FS32B6	Hazard Control in Manufacturing Industry	3	0	0	3
16	FS32B7	Principles of Health and Safety Management	3	0	0	3
17	FS32B8	Automobile Engineering and Safety	3	0	0	3
18	FS32B9	Rescue Equipment and Handling Techniques	3	0	0	3
19	FS32C1	Safety in Chemical Industries	3	0	0	3
20	FS32C2	Safety in mines	3	0	0	3
21	FS32C3	Fire Dynamics	3	0	0	3
22	FS32C4	Building Fire and Smoke dynamics	3	0	0	3
23	FS32C5	Industrial Safety, Health and Environment Acts	3	0	0	3
24	FS32C6	Safety Management Techniques.	3	0	0	3

FS32A1	PROCESS SAFETY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- Ability to learn the basic concepts of process safety management
- To learn the management strategies to handle the risks in process industries
- To provides an exposure about role of safety management in regular processes in industries
- To learn the hazard controls in process industries
- To learn the fire and explosion controls in process industries

Course Outcome – Cos		Cognitive Skill
CO-01	Exposure about overview of process safety management	U
CO-02	Learn the purpose and importance of establishing a process safety management system and its key elements	U
CO-03	Grasp knowledge about use of process safety management systems in regular works in industries	E
CO-04	Provides and exposure about process safety hazard controls	An
CO-05	Learn about fire and explosion hazards relating to process industries and its mitigations	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	S	N	N	N	N	N	L	S
CO-02	N	N	L	L	S	N	N	N	N	N	S	L
CO-03	N	N	M	M	S	N	N	N	N	N	M	M
CO-04	N	N	L	L	L	N	N	N	N	N	N	S
CO-05	N	N	L	L	N	N	N	N	N	N	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I INTRODUCTION

6

process safety Management – Definition, Leadership - Organization learning – source of PSM information -Management to change – worker engagement - safety committees, discussion groups, safety circles, departmental meetings Competence of employees - Training and development of process safety risk – standard, non-standard, emergencies.

UNIT II MANAGEMENT OF PROCESS RISK

10

Reason – PSMS – Moral, Legal, Financial, Key elements PSMS – PDCA, License to operate - Major accident prevention policy (MAPP) – Development and implementation of Performance safety indicators (PSIs) – Leading Indicators, Lagging safety performance indicators – Auditing Compliance – purpose of risk assessment – General risk assessments - advanced risk assessments – qualitative, semi qualitative and quantitative risk assessments – barrier models - application of risk assessment tools – Hazard realization, overview – Bow Tie Model – HAZOP – HAZID – FMEA – ETA – Concepts of ALARP – Hierarchy of risk controls

UNIT III RISK MANAGEMENT IN REGULAR WORKS

9

Asset – Asset Integrity - Integrity standards – selection of equipment's – Asset integrity through life cycle – plant maintenance documents – risk-based calibration and maintenance – permit to work system – Types, Shift handover requirements – contractor management.

UNIT IV PROCESS SAFETY HAZARD CONTROL

10

Safe operating envelope (SOE) – purpose, examples, types, Limitation – Types of start-up and Shut-down - Safety critical element (SCE) – FARSI model, uses of steam in processing industries- Saturated steam, Super-heated steam, steam hazards – water hazard – Inert gases – Inerting / purging– blanketing of storage tank – fire-fighting agent – pipeline freezing operation hazards and risk – hazards of electricity – types of static – spark discharges, corona discharge, brush discharge, conical pile discharge – physical form of dangerous substances – reaction hazards – bulk storage operation hazards

UNIT V FIRE AND EXPLOSION PROTECTION

10

Mode of heat transfer – ignition source process industry – jet fire – pool fire – confined space vapour cloud explosion - unconfined space vapour cloud explosion - Fire and explosion protection – leak detectors, spot and line detectors, smoke detectors, flame detectors – active and passive fire protection – hazardous area classification and zoning – explosion protection systems – fire protection for tank farms – mitigation of lightning strikes – mitigation of dust explosion – development of emergency plan

TOTAL: 45 HOURS

TEXT BOOKS:

1. Wiley, (June 2016), Guidelines for implementing Process safety management, 2nd Edition, ISBN 978-1-118-94948-1
2. Waddah S. Ghanem Al Hashmi, Process Safety Management and Human Factors: A Practitioner's Experiential Approach, 1st edition published by ICHOME, Advanced chemical Engineering world wide 13-Nov-2020.
3. U.S. Department of Labor Process Safety Management, published by Create space Independent Pub (19 March 2014), ISBN-10 : 1497388309,
4. Heinrich H. W., "Industrial Accident Prevention" McGraw-Hill Company, New York, 1969, 4th Edition.
5. Krishnan N.V., "Safety Management in Industry", Jaico Publishing House, Bombay, 1997.

REFERENCES

1. Probabilistic Risk Assessment for Engineer and Scientist, Komamoto and Henley, IEEE, press, 1995
2. Industrial Accident Prevention, Heinrich et al., Mc Graw Hill 1998.
3. Techniques for Safety Management – A system Approach, Peterson G, ASSE 1998.
4. John V. Grimaldi and Rollin H. Simonds. (1989) Safety management, All India Traveller Book Seller, Delhi.
5. Ronald P. Blake. (1973), Industrial safety. Prentice Hall, New Delhi.
6. Alan Waring, (1996), Safety management system, Chapman & Hall, England.
7. Akhil Kumar Das, "Principles of Fire Safety Management" Eastern Economy Edition, 2020.

FS32A2	ELECTRICAL SYSTEMS AND SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the safety precautions in DC and AC machines.
- To learn the safety installation of Fuses and grounding systems, plants.

Course Outcome – Cos		Cognitive Skill
CO-01	Know the constructional and operational features of dc machines and single-phase transformers	U
CO-02	Understand the types and applications of synchronous machines, induction motors and circuit breakers.	U
CO-03	Understand the working principles of fuses, grounding and earthing mechanisms.	U
CO-04	Identify the safety precautions to be taken during installation of plant and equipment and understand the significance of hazardous zone.	A
CO-05	Illustrate about safety precaution and guidelines for using electrical apparatus	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	M	L	N	M	S	N	N	N	N	N	N	M
CO-02	L	L	N	M	M	N	N	N	N	N	N	L
CO-03	L	L	N	M	S	N	N	N	N	N	N	L
CO-04	M	M	N	S	S	N	N	N	N	N	N	M
CO-05	M	L	N	S	M	N	N	N	N	N	N	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I DC MACHINES

9

Construction and Principle of operation of DC 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 MACHINES

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 FUSES, GROUNDING 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 IN 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 equipment's 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 PRECAUTIONS

9

power factor improvement – equipment's – Importance of P.F. improvement – Disadvantages of low power factor – Causes of low P.F. – Personal Protective equipment's (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 HOURS

TEXT BOOKS:

1. H. Cotton : Electrical Technology, Wheeler Publishing Company. CBS publishers ,2005.
2. S.L. Uppal : A Textbook of Electrical Engineering, Khanna Publishers, Delhi..2001.
3. M.G. Say : Electrical Earthing and Accident prevention, Newnes, London, 1954.
4. Rao, S. and Saluja, H.L., “Electrical Safety, Fire Safety Engineering and Safety Management”, Khanna Publishers, 1988.
5. Pradeep Chaturvedi, “Energy Management Policy, Planning and Utilization”, Concept Publishing Company, 1997

REFERENCES:

1. Nagrath, I.J. and Kothari, D.P., “Power System Engineering”, Tata McGraw Hill, 1998.
2. Wadhwa, C.L., “Electric Power Systems”, New Age International, 2004
3. J. Maxwell Adams. Electrical Safety A guide to the causes and prevention of electrical hazards, Published by The Institution of Engineering and Technology, London, United Kingdom, First published 1994 Reprinted 1997, 2004, 2009
4. Fordham-Cooper, W. (1998). Electrical safety engineering. Elsevier by Amsterdam. Bill Atkinson & Roger Lovegrove & Gary Gundry(auth.) Electrical Installation Designs, Fourth Edition @ 2013, John Wiley & Sons, Ltd.

FS32A3	FIRE SAFETY CODES AND STANDARDISATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the safety precautions in DC and AC machines.
- To learn the safety installation of Fuses and grounding systems, plants.

Course Outcome – Cos		Cognitive Skill
CO-01	To enable the students to acquire knowledge of Fire and Safety Studies	U
CO-02	Impart knowledge about the emergency tender and its codes	U
CO-03	Learn the codes and practices in fire extinction/suppression Technology	A
CO-04	Gain knowledge about the method of fire protection of structural members and their repair due to fire damage.	A
CO-05	Learn about various fire safety building codes	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	S	N	N	S	N	N	M	M
CO-02	N	N	N	N	M	N	N	M	N	N	S	L
CO-03	N	N	N	N	S	N	N	S	N	N	L	L
CO-04	N	N	N	N	S	N	N	S	N	N	N	M
CO-05	N	N	N	N	M	N	N	M	N	N	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I SPECIFICATION OF RESCUE AND FIRE

9

Fighting equipment and appliances viz., TP, Water Tender C. F. T. and I.S. Standard (IS 948, IS 950 IS 6067, IS 10460, IS 4989 (PART-1) IS -4989(PART-3), IS -949, IS 951, IS 944, IS 2930, IS-947 IS 6070, IS 957, IS-946 ,942, IS-8090, IS-2190, IS-903 IS-636

UNIT II SALVAGE TENDER

9

Salvage Tender Emergency Tender, Rescue tender, DCP Tender IS-10993, IS-949 Fire Science Basic Principles Basic Principles of Combustion Process

UNIT III FIRE EXTINCTION/SUPPRESSION TECHNOLOGY

9

Fire Extinction/Suppression Technology, Constituents of Fire Methods of Fire Extinguishment Extinguishing Media, Fixed Fire Extinguishing Systems, First-aid Fire Fighting Equipment Code concerning construction and design of buildings. NBC -1983

UNIT IV CONSTRUCTION CODE OF PRACTICE

9

Code of practice for construction of temporary structures and pandals IS -8758 Codes relating to fire ratings of materials used.

UNIT V FIRE PREVENTION GUIDELINES**9**

Municipal Bye- Laws in relating to fire prevention, industrial fire Prevention and Protection enforcement. Fire Protection/Fire Safety Management for various classes of Occupancies Building Codes and Regulations.

TOTAL 45 HOURS**TEXT BOOK**

1. Hand book on Building Fire Codes by G.B. Menon IIT Kanpur
2. Fire Safety In Building by V K Jain 3rd edition New Age International Publishers

REFERENCES

1. Principles of Fire Safety Engineering by Das Akhil Kumar PHI Learning Pvt Ltd 109
2. A Handbook on Industrial Safety and Fire Management by Ravi Kant Pandey, 1st edition Chetan prakashan publication
3. International code of fire safety systems by International Maritime Organization, International Maritime Organization publications 2007 edition.
4. Industrial Safety, Health and Environment Management Systems Paperback – 1 January 2000 by R. K. Jain (Author), Sunil S. Rao (Author)
5. Manual of Fire Safety Paperback – 30 October 2017 by Prekash Sesha (Author) CBS Publisher.

FS32A4	ADVANCED SAFETY SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Overview of emerging techniques in safety engineering and management.
- To impart knowledge about protection analysis tools used in industries
- Learn about safety systems used in chemical industries
- Knowledge about safety systems in process industries
- Understand the concept of safety Management systems.

Course Outcome – Cos		Cognitive Skill
CO-01	Learn the advanced safety systems in industries	U
CO-02	Impart knowledge about protection analysis tools in industries	A
CO-03	Gain knowledge about advanced safety systems in Chemical Industries	U
CO-04	Learn about Site security and safety guidelines in process industries	E
CO-05	Gain knowledge about application of Safety management systems	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	S	N	N	N	N	N	N	M
CO-02	N	N	N	M	M	N	N	N	N	N	N	L
CO-03	N	N	N	M	S	N	N	N	N	N	L	L
CO-04	N	N	N	S	S	N	N	N	N	N	N	M
CO-05	N	N	N	S	M	N	N	N	N	N	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I OVERVIEW OF SAFETY SYSTEM DEVELOPMENT

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.

UNIT II PROTECTION ANALYSIS CONCEPTS AND TECHNIQUES

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, safety instrumented function.

UNIT III SAFETY IN CHEMICAL PROCESS INDUSTRIES

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.

UNIT IV SAFETY SECURITY IN PROCESS INDUSTRIES

9

Site security for process industries - Essential elements - threat analysis, security counter measures, mitigation and emergency response. Specific security measures - information security, cyber security, physical security, policies and procedures, training, mitigation and response, inherently safer processes. Case study.

UNIT V SAFETY MANAGEMENT SYSTEMS

9

Behavior- 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. Manager's role in developing BBS culture. BBS steering committee. Main steps of True BBS approach. Safety Management Systems: SHEMS, OHSAS 18001 and OSHA's PSM - Policy, planning, training, implementation, management control and review.

TOTAL: 45 HOURS

TEXT BOOKS:

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.

REFERENCES:

1. Thomas R. Krause. (1996). The Behavior - based safety process: Managing involvement for an injury-free culture.(second edition). John Wiley & Sons.
2. Kaila, H.L. (2010). Behavior based safety in organizations- a practical guide. IK International, New Delhi.
3. Handbook of Fire and Explosion Protection Engineering Principles. For Oil, Gas, Chemical and Related by Dennis P. Nolan (Auth.)
4. Handbook for Explosion Protection by Dipl.-Phys. Dr. rer. nat. Heinrich Groh Copyright © 2004 Expert Verlag GmbH, Renningen, Germany.

FS32A5	SAFETY IN PETROLEUM AND PETROCHEMICAL INDUSTRIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the various processes employed in petroleum refineries , petro chemical industries and its fire protection methods
- Identify the various processes employed in petroleum refining and petrochemical industries
Ability to design the fire protection facilities in oil refineries, Depots and terminals
- Demonstrate and ability to recognise the hazard involved in On shore and off shore drilling
- To learn the oil and gas rules and guidelines in India

Course Outcome – Cos		Cognitive Skill
CO-01	Exposure about components of petroleum and petrochemical industries.	U
CO-02	Learn the potential fire hazards in petroleum and petrochemical industries.	U
CO-03	Knowledge about the fire protection facilities in Oil Refineries	A
CO-04	Learn the drilling methods in petroleum and petrochemical industries.	A
CO-05	Understand the Petroleum and Oil & Gas explorations rules and regulations in India.	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	L	L	N	N	L	N	N	N	L	N	M	L
CO-02	N	N	S	M	S	N	N	N	M	N	M	L
CO-03	N	N	N	M	M	N	N	N	S	N	L	L
CO-04	N	N	N	N	L	N	N	N	S	N	L	L
CO-05	N	N	N	N	M	N	N	N	M	N	S	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I INTRODUCTION

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 POTENTIAL 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 arrangement sin 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 FIRE PROTECTION FACILITIES IN OIL REFINERIES, DEPOTS & TERMINALS

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. Internal Safety Audits in (Procedures and Checklist) Transportation of Bulk Petroleum Products. Storage and Handling of Bulk Liquefied Petroleum Gas.

UNIT IV ON- SHORE AND OFF- SHORE DRILLING

9

On- Shore and Off- shore drilling. Classification of wells. Drilling method. Rotary drilling. Drilling equipment. Ground and off shore structures for drilling. Off shore platforms and drilling vessels. Drilling mud-functions, classification and properties. Blow-off, well kicks, Blowout preventer. Shallow gas. Directional drilling. Well killing procedure. Emergency shutdown, Methods of Rescue & Fire Fighting.

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 HOURS

TEXT BOOKS

1. Frank P Lees: "Loss prevention in Process Industries-Vol.I, II &III", Butterworth-Heinemann Publishing Company, UK.2004
2. Alireza Bahadori, "Personnel Protection and Safety Equipment for the Oil and Gas Industries" 1st Edition, Gulf Professional Publishing, 2015.
3. Dennis P. Nolan, "Application of HAZOP and What if Reviews to the Petroleum, Petrochemical and Chemical Process Industries", Noyes Publications, 1994.
4. 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.
4. Aven, T. and Vinnem, J.E. "Risk management with applications from the offshore petroleum industry". Springer-Verlag, U.K, 2007.
5. John C. Reis, "Environmental Control in Petroleum Engineering", Gulf Publishing Company, 1996.

FS32A6	FIRE SAFETY MATERIALS FOR BUILDING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn effects of fire on materials used for construction
- Identify the method of test for non-combustibility and fire resistance
- Learn about the approximate method of calculation of fire resistance rating of structural materials
- To learn about the fire area, fire stopped area and different types of fire resistance Doors
- To learn the method of fire protection of structural members and their repair due to fire damage.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the effect of fire on different materials used for construction	U
CO-02	Learn about the test for non-combustibility and fire resistance	U
CO-03	Ability to select the different structural elements and its dimensions for a particular fire resistance rating of a building	An
CO-04	Understand the design concepts of fire walls, fire screens and fire doors and able to select them appropriately to prevent fire	An
CO-05	To identify the method of fire protection on RCC, steel and wooden structural elements and its repair methods due to fire damage	E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	S	M	N	N	N	M	N	N	L
CO-02	N	N	N	M	M	N	N	N	M	N	N	M
CO-03	N	N	N	S	M	N	N	N	M	N	N	M
CO-04	N	N	N	S	S	N	N	N	M	N	N	L
CO-05	N	N	N	M	S	N	N	N	M	N	N	L

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I STRUCTURAL AND NON-STRUCTURAL MATERIALS

9

Effect of temperature on the properties of structural materials- concrete, steel, masonry and wood; Behavior of non-structural materials on fire- plastics, glass, textile fibers, Composites 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). Compartment fire-factors controlling fire severity, ventilation controlled and fuel-controlled fires; Spread of fire in rooms, within building and between buildings.

UNIT II FIRE RESISTANCE

9

Experimental determination of fire resistance – types of furnaces; Approximate methods for calculating the fire resistance of structural elements- Schematic diagrams, influencing

factors; Concept of static, thermal engineering and experimental methods for the calculation of fire resistance; Principle of the calculation of the fire resistance limits of structures-coefficient of fire resistance, fire duration; Approximate calculation of the required fire resistance for a building

UNIT III FIRE AREA

9

Classification of Fire- 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.

UNIT IV FIREPROOF MATERIALS AND ASSESSMENT

9

Fire doors- Low combustible, Noncombustible and Spark-proof doors; suspension of doors; Air-tight sealing of doors; Specification, test and performance criteria of Plate, Metal covered and Rolling type fire doors as per relevant standards (BIS). Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements – Wooden, Steel, RCC, and Plastic structures; Reparability of fire damaged structures- Assessment of fire severity, Assessment of damage to concrete, steel, masonry and timber structures.

UNIT V ELECTRICAL SAFETY ASPECTS IN BUILDING

9

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

TOTAL 45 HOURS

TEXT BOOKS

1. E.Gorden Butcher E. G. and Parnell A. C., “Designing of fire safety”, John Wiley and Sons Ltd., New York, U.S.A., 1983.
2. 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.
3. Swan. H.W, “Electrical Safety” TBS ,1959.
4. S. Rao, and H.L. Saluja: Electrical Safety, Fire Engineering and Safety Management, Khanna Publishers, Delhi.,1997

REFERENCES

1. Roytman M.Ya., “Principles of Fire Safety Standards for Building Construction”, Amerind Publishing Co. Pvt. Ltd., New Delhi, 1975
2. Marchant E.W., “A Complete Guide to Fire and Building”, Medical and Technical Publishing Co, 1972
3. Adam and Charles Black, “Fire safety in Buildings”,1972.
4. BIS, “IS-12777- Fire safety-flame-spread of products- Method for classification, Bureau of Indian Standards, New Delhi, 1989.
5. BIS, “IS 3614 (Part-1) – Specification of fire check doors-part 1: Plate, metal covered and rolling type” Bureau of Indian Standards, New Delhi, 1966.
6. BIS, “IS 3614 (Part-2) – Specification of metallic and non-metallic fire check doors-part 2: Resistance test and performance criteria, Bureau of Indian Standards, New Delhi, 1992.

FS32A7	FIRE SAFETY DESIGN FOR BUILDINGS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the importance of life safety in building fire.
- To understand the method of evacuation.
- To design the buildings with fire protection.

Course Outcome – Cos		Cognitive Skill
CO-01	Learn importance of life safety in building fire.	U
CO-02	Understand the method of evacuation.	U
CO-03	Ability to design the buildings with fire protection	A
CO-04	Learn the working of different firefighting systems	A
CO-05	Illustrate about fire training and education	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	S	N	S	N	N	N	N	L
CO-02	N	N	N	N	M	N	N	N	N	N	N	L
CO-03	N	N	N	N	S	N	N	N	N	N	N	M
CO-04	N	N	N	N	L	N	N	N	N	N	N	M
CO-05	N	N	N	N	M	N	S	N	N	N	N	L

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I EMERGENCY EVACUATION

9

Process of emergency evacuation - special features of personnel movement. Parameter characteristics of the movement of people-practical methods of designing evacuation passages and exists. Evacuation exits and routes - stages of evacuation; Exit Requirements- Planning of evacuation routes and exits - Seating arrangement - Passages and corridors; Assembly point – Head Count, Smoke control during building design; Mechanical Ventilation; Compartment fires and tactical ventilation.

UNIT II INSTALLATION OF FIRE SAFETY EQUIPMENTS IN BUILDINGS

9

Classification of building based on occupancy; Fire zone; classification of type of construction according to fire resistance; General fire safety requirements applicable to all individual occupancies. Sitting of detectors as per relevant standards (ISI); General requirements and guidelines for the installation of fire detection and alarm system in buildings of different occupancy classification – Equipment's and Instruments. Selection and planning of alarm system as per relevant standards (ISI).

UNIT III EXIT REQUIREMENTS IN BUILDING**9**

General exit requirements as per NBC; Internal staircases; Pressurisation of stair 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 IV FIXED FIRE FIGHTING SYSTEMS**9**

Portable extinguishers – Types, classes and other fire protection equipment's and systems for different occupancy classification as per NBC. Planning of fixed firefighting installation, classification- sprinkler system; total flooding system; CO2 system; foam system;

UNIT V FIRE SAFETY REQUIREMENTS TRAINING AND EDUCATION**9**

Fire safety requirements as per NBC for special occupancy types- Fire safety requirements applicable to all individual occupancies in addition to the general fire safety requirements; additional fire safety requirements for high rise buildings; Special fire safety requirements for Atriums, Commercial kitchens, and car parking facilities

Fire training and education- Arson - Fire safety audits - Risk assessment -Fire insurance. Fire Investigation.

TOTAL: 45 HOURS**TEXT BOOKS**

1. Roytman M. Ya., "Principles of Fire Safety Standards for Building Construction", Amerind Publishing Co. Pvt. Ltd., New Delhi, 1975.
2. E.Gorden Butcher E. G. and Parnell A. C., "Designing of fire safety", John Wiley and Sons Ltd., New York, U.S.A., 1983.
3. G. J. Langdon-Thomas, "Fire safety in Buildings", ADAM & CHARLES BLACK. London, 1972.

REFERENCES

1. Earnest Beam Ltd, Fire prevention standard recommendations
2. F.P.A., Fire prevention Notes for Industrial premises
3. BIS, "NBC Part 4- Fire and Life safety", Bureau of Indian Standards, New Delhi, 2005.
4. G.B. Menon" Handbook of building Fire codes", Document no: IITK-GSDMA-Fire05-V.03
5. Rolf Janssen , "Fire protection for the design professional"
6. Warre J. Baker, Automation- A challenge to fire protection Engineers

FS32A8	SAFETY IN ENGINEERING INDUSTRY	L	T	P	C
		3	0	0	3

OBJECTIVES

- Know the safety rules and regulations, standards and codes applicable for engineering Industry.
- To learn the operation safeguard of machines used in Industries
- To gain knowledge about the safety implementation of
- Know the working principle of mechanical engineering processes such as metal Forming andjoining Process and their safety risks.
- Developing the knowledge related to health and welfare measures in engineering Industry.

Course Outcome – Cos		Cognitive Skill
CO-01	Outline the safety rules, standards and codes in various mechanical engineering equipment's	U
CO-02	Explain various machine guarding systems for lathe, drilling, boring and milling Machines	A
CO-03	Impart knowledge about safe procedures for welding, gas cutting, storage and handling of heat treatment processes	A
CO-04	Learn safety measures for cold forming and hot working of metals.	A
CO-05	Learn the safety and welfare measures to be taken during finishing, Inspection and Testing of various Mechanical processes	E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	L	N	N	N	M	N	N	N	N	N	N	M
CO-02	L	N	N	N	M	N	N	N	N	N	N	L
CO-03	M	N	N	N	S	N	N	N	N	N	N	L
CO-04	M	N	N	N	S	N	N	N	N	N	N	L
CO-05	M	N	N	N	M	N	N	N	N	N	N	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNITI INTRODUCTION

9

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards

UNITII MACHINERY SAFEGUARD

9

Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS — guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. Selection and suitability: lathe-drilling-boring-milling-grinding-shaping- sawing-shearing presses-forge hammer-flywheels-shafts couplings- gears-sprockets wheels and chains pulleys and belts-authorized entry to hazardous installations, ILO Codes for Machine Guards

UNITIII SFAETY IN WELDING AND HEAT TREATMENT

9

Gas welding and oxygen cutting, resistance welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing— explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor

UNITIV MOULDING AND FORMING INDUSTRIES**9**

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot- operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, Foundry production cleaning and finishing foundry processes.

UNIT V SAFETY IN FINISHING, INSPECTION AND TESTING**9**

Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation.

TOTAL: 45 HOURS**TEXT BOOKS**

1. John V. Grimaldi and Rollin H. Simonds, “Safety Management”, All India Travelers Book seller, New Delhi,1989.
2. N.V. Krishnan “Safety in Industry” Jaico Publisher House,1996.
3. “Occupational safety Manual” BHEL, Trichy, 1988.
4. John V. Grimaldi and Rollin H. Simonds, “Safety Management”, Richard D Irwin, 1994.
5. Krishnan N.V. “Safety Management in Industry” Jaico Publishing House, Bombay, 1997.

REFERENCES

1. Accident Prevention Manual for Industrial Operations: National Safety Council, Chicago,1974.
2. NC Balchin, “Health and Safety in Welding and Allied process”, Woodb head Publishing; 5th edition, 2002.
3. Indian Boiler acts and Regulations, Government of India.
4. “The Indian boilers act 1923 with amendments”, Law Publishers (India) Pvt. Ltd., Allahabad.

FS32A9	NUCLEAR SAFETY AND HANDLING RADIOACTIVE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic concepts and working of nuclear power plant reactors
- To gain knowledge about nuclear safety operation
- To gain knowledge about the radioactive materials.
- To understand the concept in disposal of radioactive materials in nuclear power plant.
- To understand the radioactive material decay process

Course Outcome – Cos		Cognitive Skill
CO-01	Learn the basic concepts and working of nuclear reactor.	U
CO-02	Impart knowledge about safety measures in nuclear plants	U

CO-03	Learn about the effects of radioactive materials	U
CO-04	Understand the concepts of radioactive material disposal	A
CO-05	Impart knowledge about decay process in radioactive material	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	S	M	N	N	M	N	N	N	N	N	N	N
CO-02	M	L	N	N	M	N	L	N	N	N	N	N
CO-03	S	M	N	L	N	N	N	N	M	N	N	N
CO-04	N	S	N	M	L	N	N	N	M	L	N	M
CO-05	M	S	N	N	M	N	L	N	M	N	N	L

S- Strong, M- Medium, L-Low, N- Not Relevant.

UNIT I NUCLEAR ENGINEERING

9

Nuclear Reactor-LWR, PHWR type Reactor, Reactor physics, Fuel, Fuel elements Fuel behaviour, Low coolant flow, Loss of coolant, Heat transport system, Fuel channels, Fuel loading and refuelling systems, Containment-Types, (Inner Containment and Outer Containment) , Containment Cooling System, Containment Isolation System, Passive Heat Removal System (PHRS), Main Control Room Emergency Habitability System, Fission Product Control.

UNIT II SAFETY IN NUCLEAR POWER STATION

9

Responsibility for Safety; Radiation Safety in Nuclear Power Stations; Optimization of Protection; Prevention of Accidents; Emergency Preparedness and Response; Safety considerations during the various phases of the installation; safety in removal of Heat.

UNIT III INTRODUCTION TO RADIOACTIVE MATERIALS

9

Radio Active Material: Nuclear Reactor (Fission and Fusion) Nuclear fuel fabrication & reprocessing facilities, Basic theory Principles and Techniques of radiation dissymmetry. Techniques of area and air monitoring. Techniques of personnel radiation protection; Nuclear Materials in spent fuel and nuclear waste Responsibility for Safety, Emergency Preparedness and Response.

UNIT II DISPOSAL OF RADIOACTIVE MATERIALS

9

Sources and characteristics of radioactive waste and their types and their method of disposal, Handling and prevention of radiation emergencies and Storage requirements of radioactive materials; The Convention on Nuclear Safety Implementing measures;

UNIT V RADIOACTIVE ELEMENT DECAY PROCESS

9

Definition, Decay: classification of decay process, radioactive elements. Application of Radioactive Elements. Reactivity series and their salient features. Three Mile Island accident case study and health effects, INES (International Nuclear Event Scale) rating. Fukushima accident case study and health effects, INES (International Nuclear Event Scale) rating.

TOTAL: 45 HOURS

TEXT BOOKS

1. J.J. Duderstadt & L.J. Hamilton, “Nuclear Reactor Analysis”, John Wiley and Sons, 1976.
2. Principles of Radiation Dosimetry, G .W. White ,John Wiley and Sons,
3. Radioactive Wastes, their Treatment and disposal, J.C. Collins,E.F.NSpon Ltd.,
4. Environmental Radio activity, M.Eisembud, McGraw Hill Book Co.,
5. Industrial Safety, F.A.Patty (Ed.2007).

REFERENCES

1. J.R. Lamarsh, “Introduction to Nuclear Reactor Theory”, Addison-Wesley, 1966.
2. D.J. Bennet, “The Elements of Nuclear Power”, Longman Group Limited, 1972.
3. John R. Lamarsh, “Introduction to Nuclear Engineering”, Addison-Wesley Publishing Company, 1983, ISBN0-201-14200-7.
4. Hand book of nuclear engineering, Cacuci, Dan Gabriel (Ed)Nuclear Engineering, Glasstone & Sesoske.
5. Radiation Hygiene Handbook, Henson Blat.2(Ed)McGraw Hill.
6. Effects of Nuclear Weapons, S. Glasstone.
7. Source Book of Atomic Energy S. Glasstone,3rd Ed., Affiliated East-West Press,New Delhi.

FS32B1	ENVIRONMENTAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn about the environmental safety
- To understand the cause of water pollution and its impacts for environment.
- To learn about the hazard waste management.
- To gain knowledge about environmental hazards and the regulations.
- To obtain knowledge about the E waste management and recycling methods.

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the important of environmental safety	U
CO-02	understand the cause of water pollution and its impacts for environment	U
CO-03	Grasp knowledge about Hazardous waste management techniques	U
CO-04	Gain knowledge about the device used for measure environmental hazards and the regulations	A
CO-05	Gain knowledge about E waste management and recycling methods	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	N	N	N	N	M	N	L	L
CO-02	N	N	N	N	N	N	N	N	S	N	L	L
CO-03	N	N	N	N	N	N	N	N	M	N	L	M

CO-04	N	N	N	N	N	N	N	N	S	N	L	L
CO-05	N	N	N	N	N	N	N	N	S	N	M	M

S- Strong, M- Medium, L-Low, N- Not Relevant

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

9

Classification of water pollutants-health hazards-sampling and analysis of water-water treatment - different industrial effluents and their treatment and disposal -advanced wastewater treatment - effluent quality standards and laws- chemical industries, tannery, textile effluents-common treatment.

UNIT III HAZARDOUS WASTE MANAGEMENT

9

Hazardous waste management in India-waste identification, characterization and classification-technological options for collection, treatment and disposal of hazardous waste-selection charts for the treatment of different hazardous wastes-methods of collection and disposal of solid wastes-health

Hazards-toxic and radioactive wastes-incineration and vitrification - hazards due to bio-process-dilution-standards and restrictions – recycling and reuse.

UNIT IV ENVIRONMENTAL MEASUREMENT AND CONTROL

9

Sampling and analysis – dust monitor – gas analyzer, particle size analyzer – lux meter-pH meter – gas chromatograph – atomic absorption spectrometer - Pollution Control Board-laws. Environmental Management in industries, Principles 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 waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials

TOTAL: 45 HOURS

TEXT BOOKS

1. Rao, CS, “Environmental pollution Engineering: Wiley Eastern Limited, New Delhi,1992.
2. Environmental Management Handbook by Marcel Dekker.
3. Environmental Management Handbook for Hydrocarbon Processing Indus; James B. Well
4. Environmental Safety and Health Engineering by Gayle wood side and Dianna Koeurek

REFERENCES

1. S.P. Mahajan, “Pollution control in process industries”, Tata McGraw Hill Publishing Company, New Delhi,1993.

- Varma and Braner, "Air pollution equipment", Springer Publishers, Second Edition., 1981.
- Waste Management by Rajiv K. Sinha
- Hazardous Waste Management by J.M. Goel
- E-Waste Managing the Digital Dump Yard, Edited by Vishakha Munshi, ICFAI University Press
- E-waste: Implications, Regulations and Management in India and Current Global Best

FS32B2	CHEMICAL PROCESSES INSTRUMENTS & SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide a knowledge about design of chemical process plants
- To gain knowledge about the safety in the operation of chemical plants
- To gain knowledge about the piping systems used in chemical process plants
- To gain knowledge about the storage and handling of chemicals used in plants
- To gain knowledge about the different reaction hazards

Course Outcome – Cos		Cognitive Skill
CO-01	Ability to learn the process for design of chemical process plants in safety aspects	U
CO-02	Learn about the safety in the operation of chemical plants	U
CO-03	Obtain knowledge about the piping systems used in chemical process plants	U
CO-04	Learn about the storage and handling of chemicals used in plants	U
CO-05	Gain knowledge about the different reaction hazards	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	M	S	N	N	N	N	N	N	N
CO-02	N	N	N	M	M	N	N	N	N	N	N	N
CO-03	N	N	N	M	S	N	N	N	N	N	N	N
CO-04	N	N	N	S	L	N	N	N	M	N	N	L
CO-05	N	N	N	S	M	N	N	N	L	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I SAFETY ASPECTS IN DESIGN OF THE PLANT

9

Safety In The Design Of Chemical Process Plants :-Design principles – reliability and safety in designing – inherent safety – engineered safety - piping and instrumentation – safety during startup and shutdown – safety checks in the design of the equipment's – reactor safety - safety in erection and commissioning of chemical plants - nondestructive testing methods – pressure and leak testing – emergency safety devices – scrubbers and flares – new concepts in safety design and operation- Pressure vessel testing standards - Gas cylinder rules, SMPV rules – Inspection techniques for boilers and reaction vessels.

UNIT II SAFETY ASPECTS IN THE OPERATION

9

Safety in the Operation of Chemical Process Plants: - Properties of chemicals – Material Safety Data Sheets – the various properties and format 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.

UNIT III SAFE DESIGN OF PIPING SYSTEMS

9

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 IV SAFETY IN THE STORAGE AND HANDLING

9

Safety in the storage and handling of chemicals and gases: -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 V 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, Case studies. - Prevention and control of explosions and detonations – diluting a release, purging and inerting, venting, explosion relief, flame arrestors, explosion suppression, Classification of hazardous areas.

TOTAL: 45 HOURS

TEXT BOOKS

1. Ralph King and Ron Hirst, “King’s Safety in the Process Industries”, Arnold, London, 1998.
2. Sax N Irvin, Dangerous properties of industrial materials, Van Nostrand Reinhold; 6th edition (1984).

REFERENCES

1. Industrial Environment and its Evolution and Control: NIOSH
2. Accident Prevention Manual for Industrial Operations : Vol. I & II NSC Chicago,1982.

FS32B3	TRANSPORT SYSTEMS AND SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To gain knowledge about the safety measures in transportation of hazard goods
- To gain knowledge about the safety in road transport
- To learn the importance of Safety systems in Railway sectors.
- To learn the basics of transportation safety in Harbor and Docks
- Learn about safety in air transport.

Course Outcome – Cos		Cognitive Skill
CO-01	Learn about the safety measures in transportation of hazardous goods	U
CO-02	Provides an exposure about safety in road transport and highway Engineering	U
CO-03	Illustrate about Railway Engineering and its safety.	A
CO-04	Learn the Transport safety in Harbors and Docks	U
CO-05	Learn about safety in Air Transportation	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	M	N	N	N	N	N	M	M
CO-02	N	N	N	N	M	N	N	N	N	N	M	S
CO-03	N	N	N	N	M	N	N	N	N	N	S	M
CO-04	N	N	N	N	L	N	N	N	N	N	M	S
CO-05	N	N	N	N	M	N	N	N	N	N	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I TRANSPORTATION OF HAZARDOUS GOODS

9

Transport emergency card (TREM) – driver training-parking of tankers on the highways-speed of the vehicle – warning symbols – design of the tanker lorries -static electricity-responsibilities of driver – inspection and maintenance of vehicles-check list- loading and decanting procedures – communication

UNIT II ROAD TRANSPORT AND HIGHWAY ENGINEERING

9

Introduction – factors for improving safety on roads – causes of accidents due to drivers and pedestrians-design, selection, operation and maintenance of motor trucks-preventive maintenance- check lists-motor vehicles act – motor vehicle insurance and surveys.

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 RAILWAY ENGINEERING

9

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

UNIT IV HARBOUR AND DOCK ENGINEERING

9

Introduction of Harbor & 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 -Applications –Air way accidents & safety

TOTAL: 45 HOURS**TEXT BOOKS:**

1. Popkes, C.A. "Traffic Control and Road Accident Prevention" Chapman and Hall Limited, 1986.
2. Babkov, V.F., "Road Conditions and Traffic Safety" MIR Publications, Moscow, 1986.
3. John Khisty C, Kent Lall B, "Transportation Engineering – An Introduction, 3rd Edition, Prentice Hall of India, New Delhi, 2002
4. B.S.Dhillon, "Transportation systems, reliability and safety" CRC Press,

REFERENCES

1. Kadiyali, "Traffic Engineering and Transport Planning" Khanna Publishers, New Delhi, 1983.
2. Motor Vehicles Act, 1988, Government of India.
3. "Accident Prevention Manual for Industrial Operations", NSC, Chicago, 1982.
4. Pasricha, "Road Safety guide for drivers of heavy vehicle" Nasha Publications, Mumbai, 1999.
5. K.W. Ogden, "Safer Roads – A guide to Road Safety Engineering" Gower Technical, 1995.

FS33B4	OHSAS 18000 ISO 14000 AND ISO 45001	L	T	P	C
		3	0	0	3

OBJECTIVS

- To introduce basic concepts of OHSAS and ISO standards.
- To know development of OH and S policies.
- To understand the concepts of ISO 14000
- To understand ISO 45001 implementation strategy.

Course Outcome – Cos		Cognitive Skill
CO-01	Study the Basics of OHSAS standards	U
CO-02	Exposure about guidelines and planning of OSHAS 18001	U
CO-03	Illustrate about the effective implementation of OSHAS 18001	A
CO-04	Ability to learn the basics and implementation benefits of of ISO 14001	A
CO-05	Ability to learn the basics and implementation benefits of ISO 45001	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	N	N	S	N	N	N	S	M
CO-02	N	N	N	N	N	N	S	N	N	N	S	S
CO-03	N	N	N	N	N	N	S	N	N	N	M	M

CO-04	N	N	N	N	N	N	S	N	N	N	M	S
CO-05	N	N	N	N	N	N	S	N	N	N	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I OHSAS STANDARD

9

Introduction – Development of OHSAS standard – Structure and features of OSHAS 18001 – Benefits of certification-certification procedure – OH and S management system element, specification and scope - correspondence between OHSAS 18001, ISO 14001:1996 and ISO 9001:1994 – Guidelines (18002:2000) for implementing OHSAS 18001.

UNIT II OHSAS 18001 POLICY AND PLANNING

9

Developing OH and S policy– Guidelines – Developments - procedure - Content of OH and S policy – General principle, strategy and planning, specific goals, compliance – methodology. Planning – Guidelines, methodology steps developing action plan – Analysis and identify the priorities, objective and Targets, short term action plan, benefits and cost of each option, Development of action plan.

UNIT III IMPLEMENTATION AND OPERATION, CHECKING AND REVIEW

9

Guidelines for structure and Responsibilities, Top Management, middle level management, co-ordinator and employees - Developing procedures, identifying training needs, providing training, documentation of training, Training methodology consultation and communications.

Checking and Review; performance measurement and monitoring, Proactive and Reactive monitoring, measurement techniques, inspections, measuring equipment - Accidents reports, Process and procedures, recording, investigation corrective action and follow up - records and records management. Handling documentation, information, records.

UNIT IV ISO-14001

9

EMS, ISO 14001, specifications, objectives, Environmental Policy, Guidelines and Principles (ISO 14004), clauses 4.1 to 4.5. Documentation requirements, 3 levels of documentation for a ISO 14000 based EMS, steps in ISO 14001.

Implementation plan, Registration, Importance of ISO 14000 to the Management. Auditing ISO 14000- General principles of Environmental Audit, Auditor, steps in audit, Audit plan, Audit results management review-Continual improvement - Advantages. EIA in EMS, Types of EIA, EIA methodology EIS, Scope, Benefits.

UNIT V ISO 45001

9

Introduction – Aim of OHMS -Scope – success factors - Plan-Do-Check-Act cycle - Terms and definitions - Context of the organization - Principles of ISO 45001, – difference ISO 45001 and OHSAS 18001 - OHS key elements related to ISO 45001 - Organization implementation Issues. The structure of ISO 45001 - Context of the organization - Leadership and worker participation - OH&S policy - standard-Planning, Support, Operation, Performance evaluation, improvements

TOTAL: 45 HOURS

TEXT BOOKS

1. Dr. K.C. Arora, “ISO 9000 to OHSAS 18001”, S.K. Kataria and Sons, Delhi, 2012
2. Tuominen, Kari “Occupational Health and Safety - OHSAS 18001:2007 - Part 5”, 2008.
3. International Standard, BS ISO 45001:2018, Occupational health and safety management systems Requirements with guidance for use, First edition 2018-03-12

REFERENCES

1. ILO, Geneva: Major Hazard Control – a Practical Manual., 1993.
2. Richard B Clements “Complete Guide to ISO 14000”, Prentice Hall, 1996.

FS32B5	PRINCIPLES OF INDUSTRIAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Understanding of the principles of management.
- To enable the students to learn about various functions and activities in management system.
- To have knowledge about the organization structure
- To familiarize students with project management Techniques

Course Outcome – Cos		Cognitive Skill
CO-01	Learn the concept of organization and management and define the functions of human resources, operations and project management.	U
CO-02	Knowledge about different types of organization structures also summarize the role of human resources, operations and project managers.	U
CO-03	Learn the appropriate organization structures for specific applications	A
CO-04	Outline about application benefit of using different tools for human resources, operations and project management.	A
CO-05	Outline about the different project management techniques and tools	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	S	M	N	L	N	N	L	M
CO-02	N	N	N	N	M	M	N	M	N	N	M	S
CO-03	N	N	N	N	M	M	S	S	N	N	M	M
CO-04	M	M	N	M	M	L	N	S	N	N	M	S
CO-05	M	M	N	M	S	S	N	S	N	N	S	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I ORGANIZATION CONCEPT

9

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

UNIT II PERSONNEL MANAGEMENT

9

Personnel Management: Motivation theories, Leadership theories, 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

Production Management: Production System-Functions- Product - Product Life Cycle. Demand forecasting for operations - components of demand - methods of prediction and forecasting - forecasting models – casual & time series PPC-Functions -Models

UNIT IV CAPACITY PLANNING**9**

Capacity Planning - Evaluating future capacity - capacity requirement –Aggregate Planning
Inventory Control-Objectives-Costs-Models: Basic, Production, Shortage-ABC Analysis.

UNIT V PROJECT MANAGEMENT TECHNIQUES**9**

Module IV 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 off and crashing procedure.

TOTAL: 45 HOURS**TEXT BOOKS:**

1. Kootnz, H Principles of Management. Tata McGraw Hill Education. (2004).
2. Buffa, E.S. Modern Production and Operations Management. (Eighth edition). John Wiley and Sons. (2007).

REFERENCES:

1. Prasanna Chandra. Projects: Planning, Analysis, Selection, Implementation & Review. (7th edn). Tata McGraw Hill, New Delhi. (2009).
2. Martand Telsang., Industrial Engineering and Production management. (3rd edition). S.Chand & Co., New Delhi. (2014).

FS32B6	HAZARD CONTROL IN MANUFACTURING INDUSTRY	L	T	P	C
		3	0	0	3

OBJECTIVS

- Learn about the various hazards associated with the manufacturing processes in Engineering industries and methods used to safeguard the operators and others
- Understand the concepts of safety precaution in different manufacturing processes
- To learn the fire safety measures in heat treatment processes.
- To provide knowledge about safety in Material handlings.
- To learn the safety precaution in oil and gas well erection technology.

Course Outcome – Cos		Cognitive Skill
CO-01	Impart knowledge about various hazards associated with hot working of metals and methods of control	U
CO-02	Learn various hazards associated with cold working and cutting of metals and methods of control	U
CO-03	Provide exposure about hazards associated with welding and cutting of metals and methods of control	A
CO-04	Provide knowledge about material handling methods and systems and its hazards and methods of control	A
CO-05	Learn the safety measures in oil and gas erection and operation.	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	L	N	N	N	N	N	L	M
CO-02	N	N	N	N	M	N	N	N	N	N	L	M
CO-03	N	N	N	N	M	N	N	N	N	N	L	M
CO-04	N	N	N	N	L	N	N	N	N	N	L	L
CO-05	N	N	N	N	M	N	N	N	N	N	L	L

S- Strong, M- Medium, L-Low, N- Not Relevant

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 i 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 -health precautions, exposure to hazardous fumes, source of fumes.

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 VSAFETY 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 HOURS

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 Vishakha Munshi, ICFAI University Press
4. J.M. Goel," Hazardous Waste Management" Perspectives in Nuclear Toxic and Hazardous Waste by Kadambari Sharma.
5. D.A. Crowl and J.F. Louvar, Chemical Process Safety (Fundamentals with Applications), Prentice Hall,2011.

FS32B7	PRINCIPLES OF HEALTH AND 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 safety management system.
- To have knowledge about sources of information for safety promotion and training.
- To familiarize students with evaluation of safety performance.

Course Outcome – Cos		Cognitive Skill
CO-01	Learn the importance of health and safety management in workplace	U
CO-02	Exposure about health and Safety Policy, Guidelines and roles	A
CO-03	Exposure about Health and Safety Culture	A
CO-04	Ability to learn the importance of risk assessment and Safe system of work	A
CO-05	Knowledge about monitoring of Health and Safety Performance	An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	S	M	N	L	N	N	M	M
CO-02	N	N	N	N	M	M	N	M	N	N	M	L
CO-03	N	N	N	N	M	M	S	S	N	N	M	M
CO-04	N	N	N	N	M	L	N	S	N	N	M	M
CO-05	N	N	N	N	S	L	N	S	N	N	S	M

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I WORK PLACE HEALTH AND SAFETY MANAGEMENT 9

Management of Health and Safety – Moral and Money – Problem Size – Reason for Managing Health and Safety, Regulating Health and Safety – Roles in Enforcement agencies, Standards, Responsibility of Employer and Employee, Rights of Employees. Organization Structure – Directors, Managers, Supervisors, Health and Safety Personnel, Control of premises, Designers, suppliers and Manufacturers, Managing Contractors.

UNIT II ROLES OF HEALTH AND SAFETY MANAGEMENT SYSTEM 9

Health and Safety Management system- roles – purpose of HSE Policy – Review – Standard and Guidelines of HSE Policy. Managing Risk - People and Processes

Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety Officer-responsibilities, authority. Safety committee- needs, types, advantages.

UNIT III HEALTH AND SAFETY CULTURE 9

Health and Safety culture – Features of positive Safety Culture, performance, Safety Culture indicators - Management commitment, Competence, effective communication, Training, Cooperation and Consultation with employees. Factors influences behaviour - positive and Negative, Organization Factor, Job factors, Individual factors, Link between the factors.

UNIT IV RISK ASSESSMENT AND SAFE SYSTEM OF WORK 9

Assessing Risk – Hazard, Risk, objectives of Risk assessment, Suitable and Sufficient risk assessment, Steps of risk assessment, Management of Change – Change identification, Control Measures to mitigate the impact to change, Review of Change.

Safe System of Works – Purpose, workers involvement, importance of written procedure, Technical Procedural and Behavioral control, Develop Safe system of work. Emergency Procedure – Importance, Crisis management, Characteristics of emergencies, Arrangement, first aid requirements, facilities, assessing the requirements, First aid equipment's, Maintenance records.

UNIT V HEALTH AND SAFETY MONITORING SYSTEMS 9

Health and Safety Monitoring – performance standards, Inspections, report writing, sampling, surveys and tours – Reactive monitoring methods – Leading and lagging indicators, differences. Investigating Incidents – roles and needs, Factors considered, investigation team, Procedure for investigation

Health and Safety Audits – definition, purpose, scopes – difference between audit and inspection – types of audits – stages, Responsibilities of Audits – advantages of External and internal Audits, Audit action plan. Review of Health and Safety Performance – Purpose of review, Factors to be consider for review, action and development plans – continuous improvement.

TOTAL: 45 HOURS

TEXT BOOKS

1. Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York,,1969 4thEdition
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.

FS32B8	AUTOMOBILE ENGINEERING AND SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic components of automobiles
- To gain knowledge about electrical and transmission systems in automobile
- To obtain knowledge about safety systems used in different vehicle

Course Outcome – Cos		Cognitive Skill
CO-01	Learn about the basic regulations in automobile sectors	U
CO-02	Learn the major components of automobile	U
CO-03	Understand the differential systems in the automobile	U
CO-04	Illustrate the various electrical systems and its safety	A
CO-05	Learn the safety systems used in different vehicles	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	M	N	N	M	N	N	N	N	N	N	N
CO-02	N	L	N	N	M	N	N	N	N	N	N	N
CO-03	N	M	L	L	L	N	N	N	N	N	N	N
CO-04	N	S	L	M	L	N	N	N	N	N	N	N
CO-05	N	S	N	N	M	N	N	N	N	N	N	M

UNIT I INTRODUCTION

9

Types of automobiles. Limiting Dimensions as per Central Motor Vehicles Rules. Engines – Classification, Construction, Materials of engine components. Proto type Testing as per Central Motor Vehicles Rules. Emission Standards as per CMV Rules.

UNIT II AUTOMOBILE COMPONENTS

9

Engine Classification, construction, details of Engine Components. Combustion in S.I. Engines, Combustion in C.I. Engines, Study of fuel system components, Function of carburetors, construction details, Type of Study of diesel fuel feed systems-, Carburetion and mass distribution of mixture, supercharging, fuel injection and injection sections, Clutch, Types, Construction, Operation and Fault finding of clutches. Transmission assembly, Types of Gear box, Functions of gear box, operation and maintenance of gear box.

UNIT II DIFFERENTIAL SYSTEMS IN AUTOMOBILE

9

Necessity, Construction of differential systems, Axles, Types and Application-, Brakes, Types, Construction and Operation of Hydraulic, Pneumatic Brake Systems, Maintenance of Brakes. Suspension, Necessity, Types, Construction and operation, Shock absorber, Coil springs, independent suspension, Steering, Systems, Constructional details, types of steering

gear box, steering geometry, caster, camber, king pin inclination, Effect of steering geometry on directional stability, Power steering.

UNIT IV ELECTRICAL SYSTEM

9

Electrical System–Storage Battery Operations and Maintenance. Ignition System–Coil and Magneto Ignition System, Battery Ignition, Electronic Ignition, Merits and Demerits, Working Starting System - Self Starter, Dynamo voltage regulator, Lighting System, Horn System–Wind Shield Wiper Motors, Fans, Heaters, Traficators. Automobile air conditioning. Central Motor Vehicles Rules regarding Lighting, Wind shields, Wipers. Battery construction, operation and maintenance; pollution, Air-pollution, Euro norms, Pollution Control techniques

UNIT V SAFETY DEVICES IN AUTOMOBILE

9

Types, Components, Lubricating oil, Cooling System, Detail 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, Fire fighting vehicles & Appliances. Construction & operation of fire fighting vehicles & appliances, Construction & Operation of Fire boats & other Water borne applications, Rules & regulations of RTO; Laboratory testing of vehicles; Road testing of vehicles. Automobile safety devices.

TOTAL: 45 HOURS

TEXT BOOKS

1. William H. Crouse, “Automobile Chassis and Body Construction, Operation and Maintenance”. McGraw Hill Publishing Co.Ltd.,1958.
2. William H. Crouse, “Automotive Electrical Equipment’s”. McGraw -Hill 1976.
3. The Indian Electricity act 2003 with rules”, Law publishers (India) Pvt Ltd., New Delhi.

REFERENCES

1. Joseph Heitner, “Automotive Mechanics-Principles & Practices” CBS 2006
2. P.L Kohli, “Automotive Electrical Equipment’s”. Mc Graw-Hill 2017.
3. TheCentralMotorVehiclesRules,1989
4. GBS Narang, “Automobile Engineering”, Khanna Publishers,1995.
5. Kirpal Singh, “Automobile Engineering.” Standard Publishers ,2010.

FS32B9	RESCUE TECHNIQUES AND DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES

- Exposure rescue tools and equipment’s
- To gain knowledge about advanced rescue equipment’s
- To provide exposure about rescue techniques
- To learn about the handling of Rescue and respiratory tools
- To obtain knowledge about safety systems used in different vehicles.

Course Outcome – Cos		Cognitive Skill
CO-01	Learn about different rescue tools and equipment’s	U
CO-02	Exposure about Working Principles and operation of hydraulically and pneumatically operated Rescue equipment’s	A

CO-03	Provides a wide exposure about different lifting techniques during emergency.	A
CO-04	Learn the use of rescue and respiratory equipment	A
CO-05	knowledge about Rescue systems in safety.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	M	N	N	M	N	N	N	N	N	N	S
CO-02	N	L	N	N	M	N	N	N	N	N	N	S
CO-03	N	M	L	L	L	N	N	N	N	N	N	S
CO-04	N	S	L	M	L	N	N	N	N	N	N	S
CO-05	N	S	N	N	M	N	N	N	N	N	N	S

UNIT I INTRODUCTION TO RESCUE EQUIPMENT

9

Emergency Rescue Tender, Water Tender, Foam tender, Multipurpose Tender Hydraulic Platform, Turn Table Ladder, Canteen Van and Ambulance; Fire Extinguishers: - Their types and Applications. Rescue equipment's in confined space, Rescue by Ordinary Means

UNIT II HYDRAULICALLY AND PNEUMATICALLY OPERATED TOOLS AND EQUIPMENTS

9

Hydraulic Jack, Hydraulic Cutter, Hydraulic Expander. Air Lifting Bags, Electric Power Tools: - Electric Cutter, Electric Saw, Chain Saw etc. Small Gears: - Their types, Applications and working principal Ladders: Constructional features, their types, Material and applications Ropes: - Their types, material and applications.

UNIT III RESCUE TECHNIQUES

9

Fireman carry, two men carry, three men carry, four men carry, chair carry, stretcher carry and different types of Drags. Rescue problems and their remedies, Rescue from High rise buildings, Rescue from major disasters Earthquake, Flood, Drought, Tsunami etc. Rescue from Fire incident

UNIT IV RESCUE AND RESPIRATORY EQUIPMENTS

9

Rope, Rope Materials, Rope Braiding, Webbing, Carabiners, Swivels, Personal Protective Equipment - SCBA, CABA, Composition of Air, Breathing, Breathing Rate, Calculation of the capacity & time duration of the B.A. Set. Artificial Respiration and their techniques, Renunciator, B.A. Set: - Their types, Constructional features, Working Principal and Applications, Gas Masks: Their types, Constructional features, Working Principal and Applications.

UNIT V RESCUE SYSTEM IN SAFETY

9

Anchor Systems- Rappelling, Ascending- Purcell Prusiks - Yosemite Ascending System – Rescue Lowering Systems- Edge Management and Edge Protection- Mechanical Advantage, Knot Passing Technique – Litter Lower/Raise Technique – Medical Considerations.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Safety and Technical Rescue Equipment, City of Chicago Department of Procurement Services, Rfq Number: 4682
2. National Park Service Technical Rescue Handbook, Eleventh Edition. August 2014 Published by the U.S. Department of the Interior, National Park Service. First edition initially publication 1995. Tenth edition published 2005.

REFERENCES:

1. Personal Protective Equipment, Occupational Safety and Health Administration, OSHA 3151- 12R, 2004.
2. Manual of fireman ship Incidents involving aircraft, shipping and railways HMSO publishing center, third impression 1990
3. Rescue Service Manual by HMSO, Rescue Service Manual by HMSO,2008, published by TSO

FS32C1	SAFETY IN CHEMICAL INDUSTRIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge on design features for a process industry and safety in the operation of various equipment in industry.
- To understand the various hazards and prevention in commissioning stage of industry.
- To recognize and identify the safe operation of equipment in process industry.
- To plan and trained for emergency planning in a process industry.
- To get fundamental knowledge on safe storage of chemicals.

Course Outcome – Cos		Cognitive Skill
CO-01	This course would make familiar of safe design of equipment which are the essential to chemical industry and leads to design of entire process industries.	U
CO-02	Course would be helpful to understand the design of pressure systems.	A
CO-03	Students would understand the problems and find innovative solutions while industries facing Problems in commissioning and maintenance stages.	An
CO-04	Students can prepare the emergency planning for chemical industry problems	A
CO-05	Students would be able to create safe storage systems.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	S	M	M	N	N	N	N	N	N	N
CO-02	N	N	S	M	M	N	N	N	N	N	N	N
CO-03	N	N	L	S	L	N	N	N	N	N	N	N
CO-04	N	N	M	S	L	N	N	N	N	N	N	N
CO-05	N	N	M	S	L	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM DESIGN 9

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

UNIT II PLANT COMMISSIONING AND INSPECTION 9

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

UNIT III PLANT OPERATIONS 9

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

UNIT IV PLANT MAINTENANCE, MODIFICATION AND EMERGENCY PLANNING 9

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

UNIT V STORAGES 9

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

TOTAL: 45 HOURS

TEXT BOOKS

1. Accident Prevention Manual for Industrial Operations” NSC, Chicago, 1982.
2. Quantitative Risk Assessment in Chemical Process Industries” American Institute of Chemical Industries, Centre for Chemical Process safety.
3. Carbide of Calcium Rules, Government of India.

REFERENCES

1. Fawcett, H.h. and Wood, “Safety and Accident Prevention in Chemical Operations” Wiley inters, Second Edition.
2. GREEN, A.E., “High Risk Safety Technology”, John Wiley and Sons, 1984.
3. Lees, F.P. “Loss Prevention in Process Industries” Butterworths and Company, 1996 7. Petroleum Act and Rules, Government of India.

FS32C2	SAFETY IN MINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide in depth knowledge on Safety of mine s of various types.
- To study, know and understand about the types of mines and various risk involved in the mining operations.
- To get exposed to various types of accidents happened in mines and how to manage during accidents.
- To analyze the nature of mining activities and developing a safety system to reduce the risk and also to implement the Emergency preparedness in the working environment of mines and to plan for the disaster management

Course Outcome – Cos		Cognitive Skill
CO-01	This course would make the student familiar with the concept of safety aspects in the mining industries.	U
CO-02	Course would be helpful in understanding the various types of mining activities like open case mines, underground mines and tunnel ling.	U
CO-03	The students will understand about the various risks involved in the mining activities and come to know about the various safety activities to be taken to ensure the safety of the workers.	U
CO-04	Students could able to implement the techniques like risk assessment Disaster management and emergency preparedness with the proper knowledge on accident prevention.	A
CO-05	Course would equip the students to effectively employ their knowledge on accident prevention in mines.	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	L	N	N	M	N	N	L	S
CO-02	N	N	N	N	L	N	N	S	N	N	M	M
CO-03	N	N	N	N	L	N	N	S	N	N	M	L
CO-04	N	N	N	N	N	N	N	S	N	N	L	L
CO-05	N	N	N	N	N	N	N	M	N	N	L	S

S- Strong, M- Medium, L-Low, N- Not Relevant.

UNIT I OPEN CAST MINES

9

Causes and prevention of accident from: Heavy machinery, belt and bucket conveyors, drilling, hand tools-pneumatic systems, pumping, water, dust, electrical systems, fire prevention. Garage safety – accident reporting system-working condition-safe transportation – handling of explosives.

UNIT II UNDERGROUND MINES

9

Fall of roof and sides-effect of gases-fire and explosions-water flooding-warning sensors-gas detectors-occupational hazards-working conditions-winding and transportation.

UNIT III TUNNELLING

9

Hazards from: ground collapse, inundation and collapse of tunnel face, falls from platforms and danger from falling bodies. Atmospheric pollution (gases and dusts) – trapping –transport-noise electrical hazards-noise and vibration from: pneumatic tools and other machines – ventilation and lighting – personal protective equipment.

UNIT IV RISK ASSESSMENT

9

Basic concepts of risk-reliability and hazard potential-elements of risk assessment – statistical methods – control charts-appraisal of advanced techniques-fault tree analysis-failure mode and effect analysis – quantitative structure-activity relationship analysis-fuzzy model for risk assessment.

UNIT V ACCIDENT ANALYSIS AND MANAGEMENT

9

Accidents classification and analysis-fatal, serious, minor and reportable accidents – safety audits recent development of safety engineering approaches for mines-frequency rates-accident occurrence investigation-measures for improving safety in mines-cost of accident-emergency preparedness – disaster management.

TOTAL: 45 HOURS

TEXT BOOKS

1. DGMS Circulars-Ministry of Labour, Government of India press, OR Lovely Prakashan - DHANBAD, 2002.
2. Kejiriwal, B.K. Safety in Mines, Gyan Prakashan, Dhanbad, 2001.
3. “Mine Health and Safety Management”, Michael Karmis ed., SME, Littleton, Co.2001.

FS32C3	FIRE DYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To give the basic idea of fire science combustion, Heat transfer and qualitative description of fire sequence.
- To recognize the importance of fire dynamics on fire strategy.

Course Outcome – Cos		Cognitive Skill
CO-01	Impart knowledge in fire sequence, ignition, flame spreading, heat release rate mass burning rate, time dependency of heat release rate and effects of the enclosure on heat release rate.	U
CO-02	Study the importance of fire plumes, flames, mean flame height, flame height co relations plumes co relations, ceiling jets etc.	U
CO-03	Understanding on pressure profiles and air flow in buildings.	U
CO-04	Gain knowledge about Gas temperatures. Energy balance, rate of heat transfer, correlations for computing gas temperatures. Fully-developed fires, ISO 834, temperature calculation.	An
CO-05	Attain knowledge about smoke filling, pressure build in the filling enclosure, transient smoke filling models, Effect of sprinklers on smoke filling and its Correlations, fire safety engineering system for handling and control of combustion gases and CFD models.	An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	S	M	M	N	N	N	N	N	N	N
CO-02	N	N	M	L	L	N	N	N	N	N	N	N
CO-03	N	N	S	M	S	N	N	N	N	N	N	N
CO-04	N	N	L	S	L	N	N	N	N	N	N	N
CO-05	N	N	M	S	M	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I QUANTITATIVE DESCRIPTION OF ENCLOSURE FIRES 9

Qualitative description of a fire sequence. Ignition, flame spreading. Various ways of categorizing a fire. Stages in fire development, Factors influencing fire development. 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 $\alpha-t^2$, the effect of the enclosure on the heat release rate, extraction of a power curve.

UNIT II FIRE PLUMES AND FLAME HEIGHTS 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 PRESURE PROFILES AND VENT FLOWS 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.

UNIT IV GAS TEMPERATURE IN VENTILATED ENCLOSURE FIRES 9

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 V SMOKE FILLING, COMBUSTION PRODUCTS AND COMPUTER MODELING OF ENCLOSURE FIRES 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. 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 3D Modeling. Sub-models for computer models. Model constraints. CFD models.

TOTAL 45 HOURS

TEXT BOOKS

1. Karlsson B, Quintiere. J. G: Enclosure Fire Dynamics. CRC press, 1999.

REFERENCES

1. Gregory E. Gorbett, James L. Pharr, "Fire Dynamics" Pearson, 1st Edition, 2010.

FS32C4	BUILDING FIRE AND SMOKE DYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Basic idea about the fundamentals of fire phenomena and firefighting.
- Provide the students an illustration of significance of the Fire Engineering Profession in the Protection life, property and environment.
- Learn the basic various heat transfer process.
- Basic knowledge about flame and its characteristics of flame behaviors
- Teach the ignition behaviors and various stages of flame and fire.

Course Outcome – Cos		Cognitive Skill
CO-01	Impart knowledge about fire Science	R
CO-02	Learn the basic concepts of flame mixtures leads combustion	U
CO-03	Illustrate different types of flames and stage of fire flowing	U
CO-04	Details about premixed flames and its behaviors	An
CO-05	Understand methods of calculating fire resistance from burning compartments.	E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	M	N	S	M	M	N	N	N	N	N	N	N
CO-02	L	N	M	L	L	N	N	N	N	N	N	N
CO-03	L	N	S	M	S	N	N	N	N	N	N	N
CO-04	L	N	L	S	L	N	N	N	N	N	N	N
CO-05	M	N	M	S	M	N	N	N	N	N	N	N

S- Strong, M- Medium, L-Low, N- Not Relevant

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, and 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.

UNIT IV BEHAVIOR OF IGNITION**9**

Ignition: The Initiation of Flaming Combustion: Ignition of flammable vapor/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.

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 behavior, 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 compartment.

TOTAL: 45 HOURS**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, Yingzhenli, Anders Lönnermark

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 119 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. Hinckley

FS32C5	INDUSTRIAL SAFETY, HEALTH AND ENVIRONMENT ACTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act.
- To familiarize students with powers of inspectorate of factories.
- To help students to learn about Environment act and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.

Course Outcome – Cos		Cognitive Skill
CO-01	Grasp knowledge about important legislations related to health, Safety and Environment.	U
CO-02	Familiar about the Industrial safety act for the prevention of accidents.	U
CO-03	Exposure about health and welfare provisions given in factories act.	U
CO-04	Familiar about the statutory requirements for an Industry on registration, license and its renewal.	U
CO-05	Familiar about the rules and acts of boilers electricity and building acts	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	N	N	N	N	M	N	L	N	N	N	L	M
CO-02	N	N	N	N	M	N	L	N	N	N	L	L
CO-03	N	N	N	N	L	N	L	L	N	N	L	L
CO-04	N	N	N	N	L	N	L	N	N	N	L	M
CO-05	N	N	N	N	M	N	L	N	N	N	L	L

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I FACTORIES ACT

9

Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young person's – special provisions – Employees Compensation Act. Penalties and procedures-Tamil Nadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948. Recent Amendments based on Indian standard.

UNIT II INDUSTRIAL SAFETY ACT

9

Definitions – duties of authorities – responsibilities of occupier – notification of major accidents – information to be furnished – preparation of offsite and onsite plans – list of hazardous and toxic chemicals – safety reports – safety data sheets. Recent Amendments based on Indian standard.

UNIT – III OCCUPATIONAL SAFETY AND HEALTH

9

Occupational Safety, Health and Environment Management: Bureau of Indian standards on safety and health 14489 - 1998 and 15001 – 2000 OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS – 18001, EPA Standards, Performance measurements to determine effectiveness of PSM, Preservation of Natural resources, Environmental Impact Assessment (EIA). Recent Amendments based on Indian standard.

UNIT IV ENVIRONMENT ACT

9

Central Government powers, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board.

Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures. Recent Amendments based on Indian standard.

UNIT V OTHER ACTS AND RULES

9

Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, rules – electricity act and rules - The building and other construction workers act 1996., Petroleum rules, Gas cylinder rules-Explosives Act 1983-Pesticides Act, Industrial Dispute acts. Recent Amendments based on Indian standard.

TOTAL: 45 HOURS

TEXT BOOKS

1. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.

2. The Mines Act 1952, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.
3. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.
4. Grimaldi and Simonds, Safety Management, AITBS Publishers, New Delhi (2001)

REFERENCES

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
3. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt.Ltd., New Delhi.
4. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.

FS32C6	SAFETY MANAGEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

1. To learn the Environmental risk assessment and safety management in a process industries.
2. To learn the safety management systems.

Course Outcome – Cos		Cognitive Skill
CO-01	Able to understand Domino incident investigation, unavailability analysis of protective systems and reliability analysis of programmable electronic systems.	U
CO-02	Able to understand environmental risk assessment, human health risk assessment and ecological risk assessment.	U
CO-03	To understand safety management of chemical industries.	U
CO-04	To understand safety management of process industries.	U
CO-05	To understand general safety management systems.	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	S	N	N	N	M	N	N	N	N	N	S	N
CO-02	S	N	N	N	M	N	N	N	N	N	S	N
CO-03	M	N	N	N	M	N	N	N	N	N	S	N
CO-04	M	N	N	N	M	N	N	N	N	N	S	N
CO-05	M	N	N	N	M	N	N	N	N	N	S	N

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT INTRODUCTION

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

UNIT II ENVIRONMENTAL RISK ASSESSMENT 9

Environmental risk assessment – Human health risk assessment (HHRA), Ecological risk assessment (ECRA), Receptor, stressor and exposure. Steps in ECRA – identification of potential sites, identification and characterization of stressors, identifying receptors, identification of potential ecological effects, selection of assessment and measurement end points, developing a conceptual model and risk hypotheses, approach for risk assessment.

UNIT III SAFETY MANAGEMENT OF CHEMICAL PROCESS INDUSTRIES 9

Security for chemical process industries - Assessments and regulatory environment, methods for assessing security vulnerability, Strategies and counter measures –prevention of intentional releases and theft of chemical releases at process facilities.

UNIT IV SAFETY MANAGEMENT OF PROCESS INDUSTRIES 9

Site security for process industries – Essential elements – threat analysis, security counter measures, mitigation and emergency response. Specific security measures – information security, cyber security, physical security, policies and procedures, training, mitigation and response, inherently safer processes. Case study.

UNIT V SAFETY MANAGEMENT SYSTEMS 9

Management Systems: SHEMS, OHSAS 18001, ISO 45000 – Different Clauses, OSHA's PSM – Policy, planning, training, implementation, management control and review. Basics of Layer of Protection Analysis (LOPA), Independent protection layers (IPL) and Safety integrity level (SIL).

TOTAL: 45 HOURS

TEXT BOOKS

1. Krishnan N.V., "Safety Management in Industry", Jaico Publishing House, Bombay, 1997.
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.

REFERENCES

1. Prof. Sunil S. Rao, R.K. Jain (2000) Industrial Safety, Health and Environment Management Systems, Khanna Publishers.
2. Das Akhil Kumar (2000), Principles of Industrial Safety Management Understanding the Ws of Safety at Work Paperback – 1 January 2020.

LIST OF OPEN ELECTIVES (REGULATION -2021)

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
3.	FS32D1	Fundamentals of Safety Engineering	3	0	0	3
4.	FS32D2	Fundamentals of Industrial Safety	3	0	0	3

FS32D1	FUNDEMENTALS OF SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the basic needs of safety Engineering
- To understand the basic methodology for safety Training
- To learn the use of PPE
- To understand the fundamentals of Cost and Accident analysis Techniques

Course Outcome – Cos		Cognitive Skill
CO-01	Understand the basic knowledge and responsibilities in the field of safety Engineering	U
CO-02	Learn the different types of Safety training and importance of work permit systems	U
CO-03	Exposure about different PPE and its application in safety field.	A
CO-04	Knowledge about cost analysis, computation of cost, Plant safety inspection, Job safety analysis and job survey.	An
CO-05	Learn the accident investigation and analysis Techniques	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	P0-A	P0-B	P0-C	P0-D	P0-E	P0-F	P0-G	P0-H	P0-I	P0-J	P0-K	P0-L
CO-01	S	M	N	N	M	N	N	N	N	N	N	N
CO-02	M	L	N	N	M	N	L	N	N	N	N	M
CO-03	S	M	L	L	L	N	N	N	L	N	N	N
CO-04	S	S	M	M	L	L	N	N	N	L	N	N
CO-05	M	M	S	S	N	N	L	N	N	N	N	L

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I - INTRODUCTION

9

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

UNIT II –SAFETY TRAINING AND WORK PERMIT SYSTEMS

9

Accident prevention Methods- Engineering, Education and Enforcement. 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. 5 s of housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

UNIT III - PERSONAL PROTECTIVE EQUIPMENTS**9**

Personal protection in the work environment, Types of PPEs, Personal protective equipment-respiratory and non-respiratory equipment. Selection of RPE and suitability of RPE for various applications Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate.

UNIT IV - COST ANALYSIS IN SAFETY,**9**

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, Safety audits. Safety Inventory Technique.

UNIT V – INTRODUCTION TO ACCIDENT ANALYSIS**9**

Accident investigation –Why? When? Where? Who? & How? Basics- Man- Environment & Systems - Safety Performance indicators - 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 HOURS**TEXT BOOKS:**

- 1.N.V. Krishnan, Safety Management in Industry, Jaico Publishing House, 1997
- 2.Ronald P. Blake, Industrial Safety: Prentice Hall, New Delhi, 1973
- 3.David L. Goetsch, Occupational Safety and health, Prentice Hall

REFERENCES:

1. Ted S. Ferry, Modern Accident Investigation and Analysis, John Wiley & Sons
2. Willie Hammer, Occupational Safety Management and Engineering, Prentice Hall
3. Alan Waring, Safety Management System, Chapman & Hall
4. John V. Grimaldi and Rollin H.Simonds, Safety Management, All India Traveller Book Seller, Delhi.
5. Accident Prevention Manual for Industrial Operations: National Safety Council, Chicago

FS32D2	FUNDEMENTALS OF INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Understand the basic Terminologies of industrial safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To impart skills to Conduct various Safety activities in the industry.
- To provide knowledge about Workplace Hazards.
- To provide basic knowledge about Risk Assessment Techniques.

Course Outcome – Cos		Cognitive Skill
CO-01	Illustrate fundamental concepts about industrial safety	U
CO-02	Able to learn different industrial safety standards and regulation	U
CO-03	Provide an exposure about safety activities role and responsibilities in Industry	A
CO-04	Knowledge about various Workplace Hazards	U
CO-05	Impart knowledge about various Hazard identification Techniques	An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	N	N	S	L	M	N	N	N	N	N	M	M
CO-02	N	N	S	L	M	N	N	N	N	N	M	M
CO-03	N	N	L	M	L	N	N	N	N	N	M	S
CO-04	N	N	M	S	L	N	N	N	N	N	M	S
CO-05	N	N	M	S	L	N	N	N	N	N	L	S

S- Strong, M- Medium, L-Low, N- Not Relevant

UNIT I SAFETY TERMINOLOGIES

9

Risk – Accident types - Hazard-Types of Hazards- Hazard Triangle - Risk-Hierarchy of Hazards Control Measures-Safety performance measurement - Leading indicator, lagging Indicators - Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- ALARP - acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS

9

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006.

UNIT III SAFETY ACTIVITIES

9

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Safety Culture – Safety Inspection - Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HAZARDS

9

Hazard Category – Noise, vibration; radiation; mental ill-health; violence at work; substance abuse at work, Work related upper-limb disorders (ergonomics, workstation design etc); manual handling; load handling equipment, Hazardous substances, Health, welfare and work environment; working at height; confined spaces; lone working; slips and trips; movement of people and vehicles in the workplace; work-related driving, Work equipment and machinery, Fire, Electricity.

UNIT V HAZARD IDENTIFICATION TECHNIQUES

9

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability (HAZOP) - Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative

Risk Assessment - Root cause analysis- Fish Bone Analysis - What-If Analysis- and Hazard Identification and Risk Assessment.

TOTAL: 45 HOURS

TEXTBOOKS

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER

2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education
3. Probabilistic Risk Assessment for Engineer and Scientist, Komamoto and Henley, IEEE, press, 1995
4. Industrial Accident Prevention, Heinrich et al., Mc Graw Hill 1998.
5. Techniques for Safety Management – A system Approach, Peterson G, ASSE 1998.

REFERENCES

1. Frank Lees (2012), Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring. (1996). Safety management system: Chapman &Hall, England
5. NPTEL Course Industrial Safety Engineering