



EXCEL ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NBA, NAAC with "A+" and Recognised by UGC (2f & 12B)
KOMARAPALAYAM – 637303

DEPARTMENT OF AERONAUTICAL ENGINEERING

M.E. INDUSTRIAL SAFETY ENGINEERING

REGULATION 2022

CHOICE BASED CREDIT SYSTEM

I TO IV SEMESTER CURRICULUM

I SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
22PMA105	Advanced Numerical Methods	FC	3	2	0	4	40	60	100
22PIS101	Principles of Safety Management	PC	3	0	0	3	40	60	100
22PIS102	Environmental Safety	PC	3	2	0	4	40	60	100
22PIS103	Occupational Health and Industrial Hygiene	PC	3	0	0	3	40	60	100
22PIS104	Industrial Safety, Health and Environment Acts	PC	3	2	0	4	40	60	100
22PISEXX	Professional Elective I	PE	3	0	0	3	40	60	100
Practical Course									
22PIS105	Technical Seminar - I	EEC	0	0	2	1	100	0	100
TOTAL			18	6	2	22	340	360	700
II SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Course(s)									
22PIS201	Fire Engineering and Explosion Control	PC	3	0	0	3	40	60	100
22PIS202	Computer Aided Hazard Analysis	PC	3	0	0	3	40	60	100
22PIS203	Electrical Safety	PC	3	0	0	3	40	60	100
22PIS204	Safety in Chemical Industries	PC	3	0	0	3	40	60	100
22PISEXX	Professional Elective II	PE	3	0	0	3	40	60	100
22PISEXX	Professional Elective III	PE	3	0	0	3	40	60	100
Practical Course									
22PIS205	Industrial Safety Laboratory	PC	0	0	4	2	50	50	100
Employability Enhancement Course									
22PIS206	Technical Seminar -II	EEC	0	0	2	1	100	0	100
	TOTAL		18	0	6	21	390	410	800


CHAIRMAN - BOARD OF STUDIES

III SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Theory Courses									
22PEE301	Research Methodology and Intellectual Property Rights	PC	3	0	0	3	40	60	100
22PISEXX	Professional Elective IV	PE	3	0	0	3	40	60	100
22PISEXX	Professional Elective V	PE	3	0	0	3	40	60	100
Employability Enhancement Course									
22PIS302	Project Work Phase – I	EEC	0	0	12	6	50	50	100
TOTAL			9	0	12	15	170	230	400

IV SEMESTER									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
Employability Enhancement Course									
22PIS401	Project Work Phase – II	EEC	0	0	24	12	50	50	100
TOTAL			0	0	24	12	50	50	100

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 70

CREDITS SUMMARY

S. No	CATEGORY	CREDITS PER SEMESTER				TOTAL CREDIT (AICTE)	CREDITS in %
		I	II	III	IV		
1	FC	4				4	5.714
2	PC	14	14	3		31	44.28
3	PE	3	6	6		15	21.42
4	EEC	1	1	6	12	20	28.50
Total		22	21	15	12	70	100%

FC - Foundation Course

PC - Professional Core

PE - Professional Electives

EEC - Employability Enhancement Courses

MC - Mandatory Courses (Non-Credit Courses)

CA - Continuous Assessment

FE - Final Examination


CHAIRMAN - BOARD OF STUDIES

**LIST OF ELECTIVES FOR M.E. INDUSTRIAL SAFETY ENGINEERING
SEMESTER I**

Professional Elective I									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
22PISE01	Plant Layout and Materials Handling	PE	3	0	0	3	40	60	100
22PISE02	Work Study and Ergonomics	PE	3	0	0	3	40	60	100
22PISE03	Dock Safety	PE	3	0	0	3	40	60	100
22PISE04	Human Factors in Engineering	PE	3	0	0	3	40	60	100

**LIST OF ELECTIVES FOR M.E. INDUSTRIAL SAFETY ENGINEERING
SEMESTER II**

Professional Elective II & III									
Code No.	Course	Category	Periods / Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
22PISE10	Transport Safety	PE	3	0	0	3	40	60	100
22PISE11	Fireworks Safety	PE	3	0	0	3	40	60	100
22PISE12	Safety in Construction	PE	3	0	0	3	40	60	100
22PISE13	Nuclear Engineering and Safety	PE	3	0	0	3	40	60	100
22PISE14	Safety in Textile Industry	PE	3	0	0	3	40	60	100

**LIST OF ELECTIVES FOR M.E. INDUSTRIAL SAFETY ENGINEERING
SEMESTER III**

Professional Elective IV & V									
Code No.	Course	Category	Periods/ Week			C	Maximum Marks		
			L	T	P		CA	FE	Total
22PISE21	Safety in Engineering Industry	PE	3	0	0	3	40	60	100
22PISE22	Quality Engineering in Production Systems	PE	3	0	0	3	40	60	100
22PISE23	Disaster Management	PE	3	0	0	3	40	60	100
22PISE24	OHSAS 18000 and ISO 14000	PE	3	0	0	3	40	60	100

22PISE25	Artificial Intelligence and Expert Systems	PE	3	0	0	3	40	60	100
22PISE26	Research Methodology	PE	3	0	0	3	40	60	100
22PISE27	Industrial Psychology	PE	3	0	0	3	40	60	100

22PMA105	Advanced Numerical Methods	L	T	P	C
		3	2	0	4
Nature of Course	Foundation Core				
Pre requisites	Basics in numerical methods				

Course Objectives

The course is intended to

1. Numerical methods aided by technology to solve algebraic, transcendental and differential equations
2. Apply finite element methods for solving the boundary value problems in differential equations.
3. Develop problem solving skills in numerical integration and differential equations.
4. Understanding of the application of various methods in solving engineering problems.
5. Serve as a precursor for future research.

Course Outcomes

CO. No.	Course Outcome	Bloom's Level
CO1	List the common numerical methods and how they are used to obtain approximate solutions.	Remember
CO2	Demonstrate the Eigen Value Problems And Curve Fitting.	Understand
CO3	Analyze and evaluate the accuracy of common numerical methods.	Analyze
CO4	Solve the numerical methods to obtain approximate solutions to mathematical problems.	Apply
CO5	Evaluate the numerical methods for various mathematical operations and tasks.	Evaluate

Course Contents:

UNIT I Numerical Solutions for Linear and Non-Linear Equations 12

System of linear equation: Gauss Elimination Method, Gauss Jordan Method, Choleski Method, Gauss-Seidel Method – System of Non-Linear equations : Method of Iteration, Newton-Raphson Method.

UNIT II Eigen Value Problems and Curve Fitting 12

Eigen value problem: Power Method – Curve fitting: Least Square approximations – Fitting a straight line – Regression Lines – Non-Linear curve fitting – Method of least square for continuous functions.

UNIT III Numerical Integration 12

Trapezoidal Rule - Simpson's Rules-Adaptive Quadrature Method – Gaussian Quadrature-Double integrals using Trapezoidal and Simpson's rule, Electrical Installations Devices

UNIT IV Numerical Solutions of Ordinary Differential Equations 12

Single step methods: Euler's Methods – Modified Euler's Method - Runge-Kutta Method of fourth order – Multi Step methods: Milne's and Adam's Predictor and Corrector Methods. Numerical solution of Ordinary Differential Equation by Finite Difference Method

UNIT V Numerical Solutions of Partial Differential Equations 12

Laplace Equation: Gauss Jacobi Method, Gauss Seidel Method – Poisson Equation: Finite difference method. Parabolic Equation: Crank Nicholson Method – Hyperbolic Equation: Explicit method

TOTAL: 60 PERIODS

Text books

1. P.Kandasamy, K.Thilagavathy, K.Gunavathy, "Numerical Methods", S.Chand and Company Ltd.,Ramnagar, New Delhi, 2010.
2. Veerarajan.T and Ramachandran.T., "Numerical Methods with Programming C", Tata McGraw Hill Publishers, New Delhi, 2007.

Reference

1. S.R.K.Iyengar, R.K.Jain, "Numerical Methods", New Age International Publishers, New Delhi, 2020.
2. Grewal. B. S.,andGrewal. J.S., "Numerical Methods in Engineering and Science", Seventh Edition, Khanna Publishers, New Delhi, 2007.
3. C.F. Gerald and Wheatley. P.O., "Applied Numerical Analysis", (Seventh Edition), Pearson Education,Asia, New Delhi,2007.
4. M.K.Jain, S.R.K. Iyengar and R.K.Jain, "Numerical Methods for Scientific and Engineering Computation", Wiley Eastern Limited, New Delhi, 2007.
5. Bala Gurusamy .E., "Numerical Methods", Tata McGraw Hill Publishers, New Delhi,1999, reprint 2007.
6. S.S.Sastry, "Introductory Methods of Numerical Analysis", Prentice Hall of India, Seventh Edition,New Delhi,2005.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3						2	2	2			3	1	
CO2	3	3						2	2	2			3	1	
CO3	3	3						2	2	2			3	1	
CO4	3	3						2	2	2			3	1	
CO5	3	3						2	2	2			3	1	
3	High					2	Medium					1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE - I (7.5)	IAE - II (7.5)	IAE - III (10)	
Remember	1 0	1 0	1 0	20
Understand	3 0	3 0	3 0	60
Apply	1 0	1 0	1 0	20
Analyze				
Evaluate				
Create				

22PIS101	Principles of Safety Management	L	T	P	C
		3	0	0	3
Nature of Course	Professional core				
Pre requisites	Principle of Management				

Course Objectives

The course is intended

1. To achieve an understanding of principles of safety management.
2. To enable the students to learn about various functions and activities of safety department.
3. To enable students to conduct safety audit and write audit reports effectively in auditing situations.
4. To have knowledge about sources of information for safety promotion and training.
5. To familiarize students with evaluation of safety performance

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	List out and describe the various functions and activities of safety engineering department.	Understand
CO2	Examine the safety audit and prepare a report for the audit.	Apply
CO3	Analyze the accident investigation report and estimate the cost due to accident.	Analyze
CO4	Evaluate the safety performance of an organization from accident records.	Evaluate
CO5	Identify various agencies, support institutions and government organizations involved in safety training and promotion.	Apply

Course Contents:**UNIT I Concepts and Techniques 9**

History of Safety movement –Evolution of modern safety concept- general concepts of management –line and staff functions for safety-budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

UNIT II Safety Audit 9

Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list – identification of unsafe acts of workers and unsafe conditions in the shop floor-IS 14489 : 1998 Code of practice on occupational Safety and health audit.

UNIT III Accident Investigation and Reporting 9

Concept of an accident, near miss incident, reportable and non-reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – role of safety committee –cost of accident.

UNIT IV Safety Performance Monitoring 9

ANSI (Z16.1) Recommended practices for compiling and measuring work injury experience – permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate ,Total Injury illness incidence rate, Lost workday cases incidence rate (LWDI), Number of lost workdays rate– problems.

UNIT V Safety Education and Training**9**

Importance of training-identification of training needs-training methods – programmes, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training DGFASLI, NSC, ASSE, HSE, OSHA-NEBOSH – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge safety incentive scheme, safety campaign.

TOTAL: 45 PERIODS**References**

1. Ray Asfahl. C “Industrial Safety and Health Management” Pearson Prentice Hall, 7th Edition 2019.
2. Lees, F.P & M. Sam Mannan, “Loss Prevention in Process Industries: Hazard Identification, Assessment and Control”, Butterworth-Heinemann publications, London, 4th edition, 2012.
3. Philip Hagan, “Accident Prevention Manual for Business and Industry”, N.S.C.Chicago, 13th edition, 2009.
4. Blake R.B., “Industrial Safety” Prentice Hall, Inc., New Jersey, 2000
5. John V.Grimaldi and Rollin H. Simonds, “Safety Management”, Richard D Irwin, 1994.
6. Dan Petersen, “Techniques of Safety Management”, McGraw-Hill Company, Tokyo, 1981.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2				1	1		1				2	3	
CO2	2	2				1	1		1				2	3	
CO3	3	2				1	1		1				2	3	
CO4	2	2	3			1	1		1				2	3	
CO5	2	3	1			1	1		1				2	3	
3	High					2	Medium					1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE- I (7.5)	IAE - II (7.5)	IAE - III (10)	
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

22PIS102	Environmental Safety	L	T	P	C
		3	2	0	4
Nature of Course	Professional core				
Pre requisites	Nil				

Course Objectives

The course is intended

1. To provide in depth knowledge in Principles of Environmental safety and its applications in various fields.
2. To give understanding of air and water pollution and their control.
3. To expose the students to the fundamentals of waste management.
4. To design emission measurement devices.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Illustrate the basic concepts of air pollution and its effects.	Understand
CO2	Design the health hazards of water pollution and its various treatment methods.	Evaluate
CO3	Explain various types of hazardous waste and respective treatment methods.	Understand
CO4	Identify and suggest various instruments and devices for environmental parameter measurement and control.	Apply
CO5	Explain and suggest various pollution control measures for various process industries.	Understand

Course Contents:**Unit I Air Pollution****12**

Classification and properties of air pollutants – Pollution sources – Effects of air pollutants on human beings, Animals, Plants and Materials - automobile pollution hazards of air pollution-concept of clean coal combustion technology - ultra violet radiation, infrared radiation, radiation from sun-hazards due to depletion of ozone - deforestation- automobile exhausts-chemical factory stack emissions-Ozone Depletion substances. Guide lines on Air (prevention and control of pollution) act, 1981 and rules 1982.

Unit II Water Pollution**12**

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**12**

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. Environmental impact assessment (EIA)-scope, guidelines, activities and methodologies.

Unit IV Environmental Measurement And Control**12**

Sampling and analysis – dust monitor – gas analyzer, particle size analyzer – lux meter, pH meter – gas chromatograph – atomic absorption spectrometer. Gravitational settling chambers-cyclone separators-scrubbers- electrostatic precipitator - bag filter – maintenance - control of gaseous emission by adsorption, absorption and combustion methods- Pollution Control Board-laws.

Unit V Pollution Control in Process Industries

Pollution control in process industries like cement, paper, and petroleum products textile- tanneries-thermal power plants – dying and pigment industries - eco-friendly energy.

TOTAL: 60 PERIODS**Reference**

1. "Guidelines for EIA of Industrial and other Projects" Ministry of Environment and Forests, Government of India, 2020.
2. Rao C S, "Environmental Pollution Control Engineering", New Age International, 2007
3. Pollution Control Law Series: Pollution Control Acts, Rules and Notification Issued There under, Central Pollution Control Board, Ministry of Environment and Forest, Government of India, 2006.
4. Mahajan S.P, "Pollution Control in Process Industries", Tata McGraw Hill Publishing Company, New Delhi, 2006.
5. Varma and Braner, "Air pollution equipment", Springer Publishers, Second Edition. 2004

TOTAL: 60 PERIODS

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2				1	1		1				2	3	
CO2	2	2				1	1		1				2	3	
CO3	3	2				1	1		1				2	3	
CO4	2	2	3			1	1		1				2	3	
CO5	2	3	1			1	1		1				2	3	
3	High					2	Medium					1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE - I (7.5)	IAE - II (7.5)	IAE - III (10)	
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

22PIS103	Occupational Health and Industrial Hygiene	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Food Processing				

Course Objectives

The course is intended

1. To understand the basic knowledge on anatomy of few important human organs and its basic functions.
2. To enable the students to learn about various functional and activities of occupational health services.
3. To enable the students to compare the hazards of chemicals with the permissible levels.
4. To acquire knowledge about types of hazards arising out of physical, chemical and biological agents.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Understand the various physiological functions of our body , exposure roots of toxic materials into the body and the test methods for periodical monitoring of health	Understand
CO2	Understand the various effects of physical hazards on human health and the various control measures taken to rectify the same.	Understand
CO3	Analyze various types of hazards present in the chemicals processing and testing methodology followed monitoring and controlling the same.	Analyze
CO4	To analyze various types of hazards caused by the biological agents and Work related activities.	Analyze
CO5	Understand the notifiable occupational diseases and the impact of toxicity arising out of occupation and to suggest methods for the prevention of such diseases.	Understand

Course Contents:

Unit I Anatomy, Physiology, Hazard and Pathology

9

Definition- Anatomy and Physiology of human organs – The lungs, Skin, Ear , Eyes and skin – Functions of organs – Impairment of organs – Effects of various hazards on organs - Cardio pulmonary resuscitation - audiometric tests, eye tests, vital functional tests. Exposure routes of toxic materials and protective mechanisms, Recognition of health hazards, Methods for measuring and evaluating health hazards.

Unit II Physical Hazards

9

Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage, risk factors, noise networks, noise surveys, noise control program, industrial audiometry, hearing conservation programs-vibration, types, effects, instruments, surveying procedure, permissible exposure limit. Ionizing radiation, types, effects, monitoring instruments, control programs, OSHA standard- non-ionizing radiations, effects, types, radar hazards, microwaves and radio waves, lasers, TLV- cold environments, hypothermia, wind chill index, control measures of hot environments, thermal comfort, heat stress indices, Methods for controlling thermal exposures, acclimatization, estimation and control, Industrial illumination and design of lighting system.

Unit III 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. Toxicology, classes of toxicants, metals, agriculture chemicals, solvents, food additives,

cosmetics.– human health risk assessment and Environmental risk assessment.

Unit IV Biological and Ergonomical Hazards

9

Classification of Bio-hazardous 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 V Occupational Health, Physiology 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. Man as a system component – allocation of functions – efficiency – occupational work capacity – aerobic and anaerobic work – evaluation of physiological requirements of jobs – parameters of measurements – categorization of job heaviness – work organization – stress – strain – fatigue – rest pauses – shift work – personal hygiene. Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems. Lead-nickel, chromium and manganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc...) their effects and prevention.

TOTAL: 45 PERIODS

Reference

1. Barbara A. Plog, Patricia J. Quinlan, MPH, CIH and Jennifer Villareal "Fundamentals of Industrial Hygiene", 6th edition 2012, National Safety Council, 2012.
2. Jearne Mager Stellman, "Encyclopedia of Occupational Health and Safety", Vol. I and II, published by International Labour Organisation, Geneva, 2012.
3. Hand book of "Occupational Safety and Health", National Safety Council, Chicago, 2010.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2					1		1				1	3	
CO2	3	2					1		1				1	3	
CO3	3	2					1		1				1	3	
CO4	3	2					1		1				1	3	
CO5	3	2					1		1				1	3	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE- I (7.5)	IAE - II (7.5)	IAE - III (10)	
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

22PIS104	Industrial Safety, Health and Environment (SHE) Acts	L	T	P	C
		3	2	0	4
Nature of Course	Professional Core				
Pre requisites	Nil				

Course Objectives

The course is intended

1. To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948.
2. To familiarize students with powers of inspectorate of factories.
3. To help students to learn about Environment act 1948 and rules framed under the act.
4. To provide wide exposure to the students about various legislations applicable to an industrial unit

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1.	List out important legislations related to health, Safety and Environment.	Understand
CO2.	Examine the requirements mentioned in factories act for the prevention of accidents.	Analyze
CO3.	Understand the health and welfare provisions given in factories act.	Understand
CO4.	Identify the statutory requirements for an Industry on registration, license and its renewal.	Apply
CO5.	Choose the onsite and offsite emergency plan.	Analyze

Course contents

Unit I **Factories Act – 1948** **12**

Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare – special provisions – penalties and procedures-Tamilnadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948 - Tamilnadu safety officer rules 2005.

Unit II **Environment Act – 1986** **12**

General powers of the central government, 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.

Unit III **Manufacture, Storage & Import of Hazardous Chemical Rules 1989** **12**

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.

Unit IV **Other Acts and Rules** **12**

Indian Boiler (Amendments) Act 2007, static and mobile pressure vessel rules (SMPV), motor vehicle rules, the Mines and Minerals (Development & Regulation) Amendment Act, 2015, workman compensation act, rules – electricity act and rules – hazardous wastes (management, handling and transboundary) rules, 2008 - the building and other construction workers act 1996., Petroleum rules, Gas cylinder rules 2016, Explosives Act 1884 - Pesticides Act – E waste (management) rules 2016.

Unit V International Acts and Standards

12

Occupational Safety and Health act of USA (The William- Steiger's Act of 1970) – Health and safety work act (HASAWA 1974, UK) – OHSAS 18000 – ISO 14000 – ISO 45001 - Benefits and Elements.

TOTAL: 60 PERIODS**Reference**

1. Subramanian.V., "The Factories Act 1948 with Tamilnadu factories rules 1950", Madras Book Agency, Chennai, 21st edition.,2000.
2. "The Environment Act (Protection) 1986 with allied rules", Law Publishers (India) Pvt. Ltd.,Allahabad.
3. "Air (Prevention and control of pollution) act 1981", Law Publishers (India) Pvt. Ltd.,Allahabad.
4. "Water (Prevention and control of pollution) act 1974", Law publishers (India) Pvt. Ltd.,Allahabad.
5. "The Indian boilers act 1923 with amendments", Law Publishers (India) Pvt. Ltd.,Allahabad.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1		1	1							1	3	
CO2	2	3	1		1	1							1	3	
CO3	3	1	2		2	2							2	3	
CO4	3	1	2		2	2							2	3	
CO5	2	3	1		1	1							1	3	
3 High					2	Medium						1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE- I (7.5)	IAE - II (7.5)	IAE - III (10)	
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

22PIS105	TECHNICAL SEMINAR	L	T	P	C
		0	0	2	1
Nature of Course	Employability Enhancement Course				
Pre requisites	Undergraduate Project Presentation				

Course objectives:

1. To Enhance the ability of self-study
2. To encourage the students to study advanced engineering developments
3. To Improve presentation and communication skills
4. To prepare and present technical reports.
5. To encourage the students to use various teaching aids such as overhead projectors, PowerPoint presentation and demonstration models.

Course outcomes:

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

CO. No.	Course Outcome	Bloom's Level
CO1	To review, prepare and present technological developments	Analyze
CO2	To face the placement interviews	Analyze
CO3	To improve the speaking skills	Analyze
CO4	To express confidence in handling information, making useful notes, and presenting an argument	Understand
CO5	To infer the research and development knowledge	Analyze

Guidelines

- The student is expected to present a seminar in one of the current topics in the field of Thermal Engineering related issues / technology.
- The seminar shall be of 30 minutes duration and give presentation to the Seminar Assessment Committee (SAC).
- A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
- In a session of two periods per week, 4 students are expected to present the seminar.
- Students are encouraged to use various teaching aids such as power point presentation and demonstrative models.
- Students are required to prepare a seminar report in the prescribed format given by the department.

TOTAL: 30 PERIODS

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-			3	2	3	2	3	2	2	-	-	-
CO2	-	-	-	-	-	1	1	3	3	3	2	2	-	-	-
CO3	-	-	-	-	-	3	1	2	2	2	3	3	-	-	-
CO4	-	-	-	-	-	2	2	3	3	2	3	2	-	-	-
CO5	-	-	-	-	-	3	1	3	2	2	3	3	-	-	-
	3	High					2		Medium			1	Low		

Assessment based on Continuous and Final Examination			
Bloom's Level	Continuous Assessment (50 marks) (Attendance – 5 marks)		Final Examination [50 marks]
	Rubric based Continuous Assessment [25 marks]	Model Examination [20 marks]	
Remember			
Understand	40	40	40
Apply			
Analyze			
Evaluate	60	60	60
Create			


CHAIRMAN - BOARD OF STUDIES

UNITIV**Manual Material Handling and lifting tackles****9**

Preventing common injuries, lifting by hand, team lifting and carrying, handling specific shape machines and other heavy objects – accessories for manual handling, hand tools, jacks, hand trucks, dollies and wheel barrows – storage of specific materials - problems with hazardous materials, liquids, solids – storage and handling of cryogenic liquids - shipping and receiving, stock picking, dock boards, machine and tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car loading – personal protection- ergonomic considerations, Fiber rope, types, strength and working load inspection, rope in use, rope in storage - wire rope, construction, design factors, deterioration causes, sheaves and drums, lubrication, overloading, rope fitting, inspection and replacement – slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection

UNITV**Mechanical Material handling****9**

Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, maintenance safety rules, inspection and inspection checklist – conveyors, precautions, types, applications, Powered industrial trucks, requirements, operating principles, operators selection and training and performance test, inspection and maintenance, electric trucks, gasoline operated trucks, LPG trucks – power elevators, types of drives, hoist way and machine room emergency procedure, requirements for the handicapped, types- Escalator, safety devices and brakes, moving walks – man lifts, construction, brakes, inspection.

TOTAL: 45 PERIODS**References**

1. "Encyclopedia of occupational safety and health", ILO Publication, 1998
2. "Accident prevention manual for industrial operations" N.S.C., Chicago, 1982.
3. Alexandrov. M.P. "Material handling equipment" Mir Publishers, Moscow, 1981
4. APPLE M. JAMES "Plant layout and material handling", 3rd edition, John Wiley and sons.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	1	1	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	1	2	-	-
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE- I (7.5)	IAE - II (7.5)	IAE - III (10)	
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

22PISE02	Work Study and Ergonomics	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Engineering Ergonomics, Production planning and control				

Course Objectives

The course is intended to

1. To study the applications of ergonomic principles and physiology of workers
2. To know the concepts of personal protective equipment and its usages
3. To create the knowledge in process and equipment design in safety aspects

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	To know in work procedure and applications in hazardous	Apply
CO2	Incorporate human factors in design of Personal protective equipment	Apply
CO3	Know the process safety	Apply
CO4	Understand the Material Handling and Transportation	Understand
CO5	Know the risk factors, guide lines for safe design of man machine systems considering human factors	Apply

Course contents:

UNIT I Work Study 9

Study of operations – work content – work procedure – breakdown – human factors – safety and method study – methods and movements at the workplace – substitution with latest devices – robotic concepts – applications in hazardous workplaces – productivity, quality and safety (PQS)

UNIT II Ergonomics 9

Definition – applications of ergonomic principles in the shop floor – work benches – seating arrangements – layout of electrical panels- switch gears – principles of motion economy – location of controls – display locations – machine foundations – work platforms, fatigue, physical and mental strain – incidents of accident – physiology of workers.

UNIT III Personal Protection 9

Concepts of personal protective equipment – types – selection of PPE – invisible protective barriers – procurement, storage, inspection and testing – quality – standards – ergonomic considerations in personal protective equipment design.

UNIT IV Process and Equipment Design 9

Process design – equipment – instrument – selection – concept modules – various machine tools - in- built safety – machine layout-machine guarding-safety devices and methods – selection, inspection, maintenance and safe usage – statutory provisions, operator training and supervision – hazards and prevention.

UNIT V**Man Machine Systems****9**

Job and personal risk factors – standards - selection and training - body size and posture - body dimension (static/dynamic) – adjustment range – penalties – guide lines for safe design and postures - evaluation and methods of reducing posture strain, Man-machine interface - controls - types of control - identification and selection - types of displays - compatibility and stereotypes of important operations - fatigue and vigilance - measurement characteristics and strategies for enhanced performance.

TOTAL: 45 PERIODS**References**

1. Introduction to Work Study", ILO, Oxford and IBH Publishing company, Bombay, 2015".
2. "Work Study", National Productivity Council, New Delhi, 1995.
3. W.Benjamin Neibal Motion and Time Study, 7th Edition, 1992.
4. Hunter, Gomas, "Engineering Design for Safety", McGraw Hill Inc., 1992.
5. Mundel, Motion and Time Study, 6th Edition, Allied Publishers, Madras, 1989.
6. "Accident Prevention Manual for Industrial Operations", NSC Chicago, 1982.
7. E.J.McCormick and M.S.Sanders "Human Factors in Engineering and Design", TMH, New Delhi, 1982.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	2	2	-	-
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE – I (7.5)	IAE – II (7.5)	IAE – III (10)	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

22PISE03	Dock Safety	L	T	P	C
-----------------	--------------------	----------	----------	----------	----------


 CHAIRMAN - BOARD OF STUDIES

		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Principle of management, Total quality management				

Course Objectives

The course is intended to

1. To understand safety legislation related to dock activities in India.
2. To understand the causes and effects of accidents during dock activities.
3. To know the various material handling equipment and lifting appliances in dock.
4. To know the safe working on board the ship and storage in the yards.
5. To understand the safe operation of crane, portainers, lift trucks and container handling equipment.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	This course would make the student to familiar of various operations carried out in a dock.	Apply
CO2	Students would know the different acts and rules for safe dock operations.	Apply
CO3	Students could be able to understand the operation of various types of material handling equipments.	Apply
CO4	Students would be prepared to response at the time of emergency in a dock.	Understand
CO5	Students can recognize the various problems associated with the use of lifting equipments and in the storage yards.	Apply

Course contents:**UNIT I History of Safety Legislation****9**

History of dock safety statues in India-background of present dock safety statues- dock workers (safety, health and welfare) act 1986 and the rules and regulations framed there under, other statues like marking of heavy packages act 1951 and the rules framed there under - manufacture, storage and import of hazardous chemicals. Rules 1989 framed under the environment (protection) act, 1989, few cases laws to interpret the terms used in the dock safety statues, Responsibility of different agencies for safety, health and welfare involved in dock work – responsibilities of port authorities – dock labour board – owner of ship master, agent of ship – owner of lifting appliances and loose gear etc. – employers of dock workers like stevedores – clearing and forwarding agents – competent persons and dock worker, Forums for promoting safety and health in ports – Safe Committees and Advisory Committees. Their functions, training of dockworkers

UNIT II Working on Board the Ship**9**

Types of cargo ships – working on board ships – Safety in handling of hatch beams – hatch covers including its marking, Mechanical operated hatch covers of different types and its safety features – safety in chipping and painting operations on board ships – safe means of accesses – safety in storage etc. – illumination of decks and in holds – hazards in working inside the hold of the ship and on decks – safety precautions needed – safety in use of transport equipment - internal combustible engines like forklift trucks-pay loaders etc. Working with electricity and electrical management – Storage – types, hazardous cargo

UNITIII Lifting Appliances**9**

Different types of lifting appliances – construction, maintenance and use, various methods of rigging of derricks, safety in the use of container handling/lifting appliances like portainers, transtainer, top lift trucks and other containers – testing and examination of lifting appliances – portainers – transtainers, top lift trucks – derricks in different rigging etc. Use and care of synthetic and natural fiber ropes – wire rope chains, different types of slings and loose gears

UNIT IV Transport equipment

9

The different types of equipment for transporting containers and safety in their use – safety in the use of self loading container vehicles, container side lifter, fork lift truck, dock railways, conveyors and cranes. Safe use of special lift trucks inside containers – Testing, examination and inspection of containers – carriage of dangerous goods in containers and maintenance and certification of containers for safe operation, Handling of different types of cargo – stacking and unshackling both on board the ship and ashore – loading and unloading of cargo identification of berths/walking for transfer operation of specific chemical from ship to shore and vice versa – restriction of loading and unloading operations.

UNIT V Emergency action plan and dock workers (SHW)

9

Regulations 1990 Emergency action Plans for fire and explosions - collapse of lifting appliances and buildings, sheds etc., - gas leakages and precautions concerning spillage of dangerous goods etc., - Preparation of on-site emergency plan and safety report. Dock workers (SHW) rules and regulations 1990-related to lifting appliances, Container handling, loading and unloading, handling of hatch coverings and beams, Cargo handling, conveyors, dock railways, forklift.

TOTAL: 45 PERIODS

REFERENCES

1. Srinivasan "Harbour, Dock and Tunnel Engineering", 28th Edition, 2016
2. Safety and Health in Dock work, 11th Edition, ILO, 1992.
3. "Dock Safety" Thane Belapur Industries Association, Mumbai.
4. Bindra SR "Course in Dock and Harbour Engineering"
5. Taylor D.A., "Introduction to Marine Engineering".

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	2	2	-	-
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE – I (7.5)	IAE – II (7.5)	IAE – III (10)	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

22PISE04	Human Factors in Engineering	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Professional ethics, Environmental engineering				

Course Objectives

The course is intended to

1. Studying the work procedure and understanding the relationships between the workers and working environments.
2. To study the applications of ergonomic principles and physiology of workers.
3. To know the concepts of personal protective equipment and its usages.
4. To create the knowledge in process and equipment design in safety aspects.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Students can have the knowledge in work procedure and applications in hazardous workplaces.	Apply
CO2	To known human behavior	Apply
CO3	Students can design their own safety devices and equipment to reduce the accidents possibilities.	Apply
CO4	Students will be able to incorporate human factors in design of Personal protective equipment.	Understand
CO5	They know the risk factors, guide lines for safe design of man machine systems considering human factors	Apply

Course contents:

UNIT I Ergonomics and anatomy 9

Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, and future directions for ergonomics

Anatomy, Posture and Body Mechanics: Some basic body mechanics, anatomy of the spine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioural aspects of posture, effectiveness and cost effectiveness, research directions

UNIT II Human Behavior 9

Individual differences, Factors contributing to personality, fitting the man to the job, Influence of difference on safety, Method of measuring characteristics, Accident Proneness, Motivation, Complexity of Motivation, Job satisfaction. Management theories of motivation, Job enrichment theory, Frustration and Conflicts, Reaction to frustration, Emotion and Frustration, Attitudes- Determination of attitudes, Changing attitudes Learning, Principles of Learning, Forgetting, Motivational requirements

UNIT III Anthropometry and work design for standing and Seated works 9

Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness.

Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design for standing workers, design for seated workers, work surface design, visual display units, guidelines for design of static work, effectiveness and cost effectiveness, research directions

UNITIV**Man - machine system and repetitive works and Manual handling task****9**

Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Man vs Machine. Ergonomics interventions in Repetitive works, handle design, key board design- measures for preventing in work related musculoskeletal disorders (WMSDs), reduction and controlling, training Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the work place, design of manual handling tasks, carrying, postural stability

UNITV**Human skill and performance and display, Controls and virtual environments****9**

A general information-processing model of the users, cognitive system, problem solving, effectiveness, Principles for the design of visual displays- auditory displays- design of controls- combining displays and controls- virtual (synthetic) environments, research issues.

TOTAL: 45 PERIODS**References**

1. Ergonomic design for organizational effectiveness, Michael O'Neill, 1998
2. Human factors in engineering and design, MARKS.SANDERS, 1992
3. Introduction to Ergonomics, R.S. Bridger, Taylor and Francis
4. The Ergonomics manual, Dan McLeod, Philip Jacobs and Nancy Larson

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	2	2	-	-
	3	High				2	Medium					1	Low		

Formative assessment

Bloom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE – I (7.5)	IAE – II (7.5)	IAE – III (10)	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

22PIS201	Fire Engineering and Explosion Control	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Thermodynamics and Thermal Engineering				

Course Objectives

The course is intended to

1. To provide an in depth knowledge about the science of fire.
2. To understand the causes and effects of fire.
3. To know the various fire prevention systems and protective equipments.
4. To understand the science of explosion and its prevention techniques.
5. To understand the various fire prevention techniques to be followed in a building.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1.	To make familiar about basic concepts of fire and explosion science.	Understand
CO2.	To know the different source of ignition and their prevention techniques.	Apply
CO3.	To understand the operation of various types of firefighting equipment.	Understand
CO4.	To understand the causes and prevention of explosion.	Understand
CO5.	To equip the students to effectively employ explosion protection techniques and their significances to suit the industrial requirement.	Understand

Course Contents:

UNIT I Physics and Chemistry of Fire 9

Fire properties of solid, liquid and gases - fire spread - toxicity of products of combustion - theory of combustion and explosion – vapour clouds – flash fire – jet fires – pool fires – unconfined vapour cloud explosion, shock waves - auto-ignition – boiling liquid expanding vapour explosion – case studies – Flixborough, Mexico disaster, Pasadena Texas, Piper Alpha, Peterborough and Bombay Victoria dock ship explosions.

UNIT II Fire Prevention and Protection 9

Sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D, E – types of fire extinguishers – fire stoppers – hydrant pipes – hoses – monitors – fire watchers – layout of stand pipes – fire station-fire alarms and sirens – maintenance of fire trucks – foam generators – escape from fire rescue operations – fire drills-Notice-first aid for burns.

UNIT III Industrial Fire Protection systems 9

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

UNIT IV Building fire Safety 9

Objectives of fire safe building design, Fire load, fire resistant material and fire testing – structural fire protection – structural integrity – concept of egress design - exists – width calculations - fire

certificates – fire safety requirements for high rise buildings –snookers.

UNIT V Explosion Protecting Systems

9

Principles of explosion-detonation and blast waves-explosion parameters – Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure-explosion venting-inert gases, plant for generation of inert gas-rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO₂) and halons-hazards in LPG, ammonia (NH₃), sulphur dioxide (SO₃), chlorine (CL₂) etc.

TOTAL: 45 PERIODS

REFERENCES

1. "Dinko Tuhtar, "Fire and explosion protection"1989
2. Derek, James, "Fire Prevention Hand Book", Butter Worths and Company, London,1986.
3. "Accident Prevention manual for industrial operations" N.S.C., Chicago,1982.
4. "Davis Daniel et al, "Hand Book of fire technology"
5. "Fire Prevention and firefighting", Loss prevention Association, India.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	1	1	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	1	2	-	-
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE- I (7.5)	IAE - II (7.5)	IAE - III (10)	
Remember	1 0	1 0	1 0	20
Understand	3 0	3 0	3 0	60
Apply	1 0	1 0	1 0	20
Analyze				
Evaluate				
Create				

22PIS202	Computer Aided Hazard Analysis	L	T	P	C
		3	0	0	3
Nature of Course	Professional Core				
Pre requisites	Computer Aided Design				

Course Objectives

The course is intended to

1. To provide knowledge on risk, hazard and their assessment techniques in Industry
2. To understand the principles of operation of various equipment for safety application
3. To know the consequences of fire, explosion and toxic release
4. To know the various software available for risk quantification
5. To conduct a risk assessment technique in Industries.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	This course would make familiarizing of basic concepts in risk and hazard	Apply
CO2	Course would be helpful to understand the various instruments to bring safety in Industries	Apply
CO3	Students would be trained to find solution for risk assessment studies through the use of software	Apply
CO4	Students would be able to make use of a risk assessment technique to quantify the risk	Understand
CO5	Course would equip the students effectively to employ hazard analysis techniques in Industry and helpful to prevent the accidents in Industry	Apply

Course contents:

UNIT I Hazard, Risk Issues and Hazard Assessment 9

Introduction, hazard, hazard monitoring-risk issue, group or societal risk, individual risk, voluntary and involuntary risk, social benefits Vs technological risk, approaches for establishing risk acceptance levels, Risk estimation.

Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis (PHA), human error analysis, hazard operability studies (HAZOP), safety warning systems.

UNIT II Computer Aided Instruments 9

Applications of Advanced Equipments and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter(DSC), Thermo Gravimetric Analyser (TGA), Accelerated Rate Calorimeter(ARC), Reactive Calorimeter(RC), Reaction System Screening Tool(RSST) - Principles of operations, Controlling parameters, Applications, advantages, Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitiveness Test, Impact Sensitiveness Test(BAM) and Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test.

UNIT III Risk Analysis Quantification and Software's 9

Fault Tree Analysis and Event Tree Analysis, Logic symbols, methodology, minimal cut set ranking - fire explosion and toxicity index(FETI), various indices - Hazard analysis(HAZAN)- Failure Mode and Effect Analysis(FMEA)- Basic concepts of Reliability- Software on Risk analysis, CISCON, FETI, HAMGARS modules on Heat radiation, Pool fire, Jet, Explosion. Reliability software's on FMEA for mechanical and electrical systems

UNIT IV Consequences Analysis 9


 CHAIRMAN - BOARD OF STUDIES

Logics of consequences analysis- Estimation- Hazard identification based on the properties of chemicals- Chemical inventory analysis- identification of hazardous processes- Estimation of source term, Gas or vapour release, liquid release, two phase release- Heat radiation effects, BLEVE, Pool fires and Jet fire- Gas/vapour dispersion- Explosion, UVCE and Flash fire, Explosion effects and confined explosion- Toxic effects- Plotting the damage distances on plot plant/layout.

UNIT V**Credibility of Risk Assessment Techniques****9**

Past accident analysis as information sources for Hazard analysis and consequences analysis of chemical accident, Mexico disaster, Flixborough, Bhopal, Seveso, Pasadena, Feyzin disaster(1966), Port Hudson disaster- convey report, hazard assessment of non-nuclear installation- Rijnmond report, risk analysis of size potentially Hazardous Industrial objects- Rasmussen masses report, Reactor safety study of Nuclear power plant

TOTAL: 45 PERIODS

(Use of Standard and approved Steam Table and Mollier Chart permitted)

REFERENCES:

1. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process safety, AIChE1992
2. Loss Prevention in Process Industries-Frank P. Less Butterworth-Hein UK 1990 (Vol.I, II andIII)
3. ILO- Major Hazard control- A practical Manual, ILO, Geneva,1988.
4. Brown, D.B. System analysis and Design for safety, Prentice Hall,1976.
5. Course Material Intensive Training Programme on Consequence Analysis, by Process Safety Centre, Indian Institute of Chemical Technology, Tarnaka and CLRI, Chennai.
6. Hazop and Hazom, by Trevor A Klett, Institute of Chemical Engineering.
7. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council,UK
8. Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	2	2	-	-
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE – I (7.5)	IAE – II (7.5)	IAE – III (10)	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

22PIS203	Electrical Safety	L	T	P	C
		3	0	0	3
Nature of course	Professional Core				
Pre requisites	Physics for Mechanical science, Electrical Drives and control				

Course Objectives

The course is intended to

1. To provide knowledge on basics of electrical fire and statutory requirements for electrical safety
2. To understand the causes of accidents due to electrical hazards
3. To know the various protection systems in Industries from electrical hazards
4. To know the importance of earthing
5. To distinguish the various hazardous zones and applicable fire proof electrical devices

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	This course would make familiar of basic concepts in electrical circuit and hazards involved in it.	Understand
CO 2	Ability to understand the various effects of electrical hazards	Understand
CO 3	Students would be able to understand the operation of various protection systems from electrical hazards	Understand
CO 4	Recognize different hazardous zones in Industries	Understand
CO 5	Course would be helpful to understand the electrical hazards in Industries.	Apply

Course Contents

UNIT I Concepts and statutory Requirements 9

Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety – first aid-cardio pulmonary resuscitation(CPR).

UNIT II Electrical Hazards 9

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy- current surges-Safety in handling of war equipment-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI. Safety of fuel cell - batteries - CNG vehicles.

UNIT III Protection Systems 9

Fuse, circuit breakers and overload relays – protection against over voltage and under voltage –

safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection-earth fault protection. FRLS insulation-insulation and continuity test-system grounding-equipment grounding-earth leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments.

UNIT IV Selection, Installation, Operation and maintenance 9

Role of environment in selection-safety aspects in application - protection and interlock-self diagnostic features and fail safe concepts-lock out and work permit system-discharge rod and earthing devices- safety in the use of portable tools-cabling and cable joints-preventive maintenance.

UNIT V Hazardous Zones 9

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies.

TOTAL: 45 PERIODS

References

1. Power Engineers – Handbook of TNEB, Chennai, 1989.
2. Martin Glov Electrostatic Hazards in powder handling, Research Studies Pvt. Ltd., England, 1988.
3. Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1986.
4. "Accident prevention manual for industrial operations", N.S.C., Chicago, 1982.
5. Indian Electricity Act and Rules, Government of India.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PS Os		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	3	2										2	2	
CO 2	2	3	2										2	2	
CO 3	2	3	2										2	2	
CO 4	2	3	2										2	2	
CO 5	2	3	2										2	2	
	3	High				2	Medium				1	Low			

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE – I (7.5)	IAE – II (7.5)	IAE – III (10)	
Remember	10	10	10	20
Understand	40	40	20	60
Apply			20	20
Analyze				
Evaluate				
Create				

22PIS204	Safety in Chemical Industries	L	T	P	C
		3	0	0	3
Nature of course	Professional Core				
Pre requisites	Engineering physics, Chemistry				

Course Objectives:

1. To provide knowledge on design features for a process industry and safety in the operation of various equipment in industry.
2. To understand the various hazards and prevention in commissioning stage of industry.
3. To recognize and identify the safe operation of equipment in process industry.
4. To plan and trained for emergency planning in a process industry.
5. To get fundamental knowledge on safe storage of chemicals.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	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.	Understand
CO2	Course would be helpful to understand the design of pressure systems.	Understand
CO3	Students would understand the problems and find innovative solutions while industries facing Problems in commissioning and maintenance stages.	Understand
CO4	Students can prepare the emergency planning for chemical industry problems	Understand
CO5	Students would be able to create safe storage systems.	Understand

Course Contents:**UNIT I Safety in Process Design and Pressure System Design 9**

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

UNIT II Plant Commissioning and Inspection 9

Commissioning phases and organization, pre-commissioning documents, process commissioning, commissioning problems, post commissioning documentation, Plant inspection, pressure vessel, pressure piping system, non destructive 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

UNITV STORAGE 9

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

TOTAL: 45 PERIODS
References

1. Lees, F.P. "Loss Prevention in Process Industries" Butterworths and Company, 1996
Petroleum Act and Rules, Government of India.
2. Carbide of Calcium Rules, Government of India.1985
3. GREEN, A.E., "High Risk Safety Technology", John Wiley and Sons,.1984.
4. "Accident Prevention Manual for Industrial Operations" NSC, Chicago, 1982.
5. "Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety.
6. Fawcett, H.h. and Wood, "Safety and Accident Prevention in Chemical Operations" Wiley inters, Second Edition.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO4	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO5	2	-	-	-	-	-	-	-	-	2	-	-	2	-	-
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE – I (7.5)	IAE – II (7.5)	IAE – III (10)	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

22PIS205	Industrial Safety Laboratory	L	T	P	C
		0	0	4	2
Nature of Course	Professional Core				
Pre requisites					

Course Objectives

The course is intended

1. To provide opportunity to operate the equipment to acquire practical knowledge.
2. To know the various PPEs and software.
3. To carry out experiments to find out the environmental parameters.
4. To assess the impact of sensitivity of chemicals on explosively.

To run the software to assess the consequence effects of major accidents

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	This course would make students to know and run the various equipment to bring out the safety environment in the industry.	Analyze
CO 2	Students would be trained to conduct experiments to find out various environmental parameters.	Analyze
CO 3	Course would be helpful for the students to measure the particulate matter and assess the impact of air pollution.	Analyze
CO 4	Students would be able to use personal protective equipment independently.	Analyze
CO 5	Students can recognize the various problems with the use of software and hence to predict the real situations on major accidents.	Analyze

Laboratory Components

Noise Level Measurement and Analysis

Measurement of sound pressure level in dB for Impact, continuous and intermittent sources at various networks, peak and average values for improving the ergonomics.

Friction Test

Explosive materials like barium nitrate, gun powder, white powder, amorces composition etc.

Impact Test

Explosive materials like gun powder, white powder, amerce composition etc.

Burst strength test of packaging materials like paper bags, corrugated cartoons, wood etc. Auto ignition temperature test

Exhaust Gas Measurement and Analysis

Measurement of Sox, Nox, Cox, hydrocarbons

Environmental Parameter Measurement

Dry Bulb Temperature, Wet Bulb Temperature, and Determination of relative humidity, wind flow and effective corrective effective

Particle size Measurement Air sampling analysis

Training In Usage and Skill Development

Personal protective equipment:

Respiratory and non-respiratory-demonstration-self contained breathing apparatus. Safety helmet, belt, hand gloves, goggles, safety shoe, gum boots, ankle shoes, face shield, nose mask, ear plug, ear muff, anti static and conducting plastics/rubber materials, apron and leg guard.

Fire extinguishers and its operationsWater Co₂ FoamCarbon dioxide (CO₂)

Dry chemical powder and

Currently amendment fire safety systems

Static charge testing on plastic, rubber, ferrous and non-ferrous materials**Illumination testing** - by lux meter and photo meter.**Electrical safety**

Insulation resistance for motors and cables Estimation of earth resistance

Earth continuity test

Sensitivity test for MCB, ELCB, RCCB, MCCB

Software Usage

Dispersion modeling of various highly dangerous chemicals using ALOHA software

First-Aid

Road safety signals and symbols

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Name of the equipment	Quantity	Experiment No.
1.	Noise level meter	1	1
2.	Friction tester	1	2
3.	Impact tester	1	3
4.	Exhaustgasanalyzer	1	4
5.	High volume sampler	1	5
6.	PPESet	1	6
7.	Fire extinguisher set	1	7
8.	Static charge tester	1	8
9.	Firstaidkid	1	9
10.	Lockout/Tag out	1	10
11.	Software: ALOHA,CAMEO		

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	3	-	-	-	-	2	-	-	-	2	-	-
CO2	3	3	3	3	-	-	-	-	2	-	-	-	2	-	-
CO3	3	3	3	3	-	-	-	-	2	-	-	-	2	-	-
CO4	3	3	2	3	-	-	-	-	2	-	-	-	2	-	-
CO5	3	3	2	3	-	-	-	-	2	-	-	-	2	-	-
	3	High				2	Medium				1	Low			

Assessment based on Continuous and Final Examination			
Bloom's Level	Continuous Assessment (50 marks) (Attendance – 5 marks)		Final Examination [50 marks]
	Rubric based Continuous Assessment [25 marks]	Model Examination [20 marks]	
Remember			
Understand	40	40	40
Apply			
Analyze			
Evaluate	60	60	60
Create			

22PIS206	Technical Seminar -II	L	T	P	C
		0	0	4	2
Nature of Course	EEC				
Pre requisites	Technical Seminar -I				

Course objectives:

1. To Enhance the ability of self-study
2. To encourage the students to study advanced engineering developments
3. To Improve presentation and communication skills
4. To prepare and present technical reports.
5. To encourage the students to use various teaching aids such as overhead projectors, PowerPoint presentation and demonstration models.

Course outcomes:

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

CO. No.	Course Outcome	Bloom's Level
CO1	To review, prepare and present technological developments	Analyze
CO2	To face the placement interviews	Analyze
CO3	To improve the speaking skills	Analyze
CO4	To express confidence in handling information, making useful notes, and presenting an argument	Understand
CO5	To infer the research and development knowledge	Analyze

Guidelines

- The student is expected to present a seminar in one of the current topics in the field of Thermal Engineering related issues / technology.
- The seminar shall be of 30 minutes duration and give presentation to the Seminar Assessment Committee (SAC).
- A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
- In a session of two periods per week, 4 students are expected to present the seminar.
- Students are encouraged to use various teaching aids such as power point presentation and demonstrative models.
- Students are required to prepare a seminar report in the prescribed format given by the department.

TOTAL: 30 PERIODS

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-			3	2	3	2	3	2	2	-	-	-
CO2	-	-	-	-	-	1	1	3	3	3	2	2	-	-	-
CO3	-	-	-	-	-	3	1	2	2	2	3	3	-	-	-
CO4	-	-	-	-	-	2	2	3	3	2	3	2	-	-	-
CO5	-	-	-	-	-	3	1	3	2	2	3	3	-	-	-
	3	High					2	Medium				1	Low		

Assessment based on Continuous and Final Examination			
Bloom's Level	Continuous Assessment (50 marks) (Attendance – 5 marks)		Final Examination [50 marks]
	Rubric based Continuous Assessment [25 marks]	Model Examination [20 marks]	
Remember			
Understand	40	40	40
Apply			
Analyze			
Evaluate	60	60	60
Create			

LIST OF ELECTIVES FOR M.E. INDUSTRIAL SAFETY ENGINEERING

SEMESTER II

Professional Elective II & III

20PISE10	Transport Safety	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Highway Engineering				

Course Objectives

The course is intended to

1. To provide the students about the various activities/steps to be followed in safe handling the hazardous goods transportation from one location to another location.
2. To educate the reasons for the road accident and the roles and responsibilities of a safe Driver and the training needs of the driver.
3. To inculcate the culture of safe driving and fuel conservation along with knowing of basic traffic symbols followed throughout the highways.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Recognize various safety activities undertaken in transporting of hazardous goods	Understand
CO2	Understand the various symbols which are specific to the road safety	Apply
CO3	Able to reduce the accidents occurred in the roads.	Understand
CO4	Apply for the safe transportation of hazardous goods,	Apply
CO5	Creating TREM card and safe loading and unloading procedure.	Understand

Course Contents:

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 8

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.

UNIT III Driver and Safety 9

Driver safety programme – selection of drivers – driver training-tacho-graph-driving test-driver's responsibility-accident reporting and investigation procedures-fleet accident frequency-safe driving incentives-slogans in driver cabin-motor vehicle transport workers act- driver relaxation and rest pauses – speed and fuel conservation – emergency planning and Haz mat codes

UNIT IV Road Safety**10**

Road alignment and gradient-reconnaissance-ruling gradient-maximum rise per k.m.- factors influencing alignment like tractive resistance, tractive force, direct alignment, vertical curves-breaking characteristics of vehicle-skidding-restriction of speeds-significance of speeds- Pavement conditions – Sight distance – Safety at intersections – Traffic control lines and guide posts-guard rails and barriers street lighting and illumination overloading-concentration of driver. Plant railway: Clearance-track-warning methods-loading and unloading-moving cars-safety practices.

UNITV Shop Floor and Repair shop safety**9**

Transport precautions-safety on manual, mechanical handling equipment operations-safe driving- movement of cranes-conveyors etc., servicing and maintenance equipment-grease rack operation- wash rack operation-battery charging-gasoline handling-other safe practices-off the road motorized equipment.

TOTAL: 45 PERIODS**REFERENCES**

1. Pasricha, "Road Safety guide for drivers of heavy vehicle" Nasha Publications, Mumbai, 1999.
2. Motor Vehicles Act, 1988, Government of India.
3. Babkov, V.F., "Road Conditions and Traffic Safety" MIR Publications, Moscow, 1986.
4. Popkes, C.A. "Traffic Control and Road Accident Prevention" Chapman and Hall Limited, 1986.
5. Kadiyali, "Traffic Engineering and Transport Planning" Khanna Publishers, New Delhi, 1983.
6. "Accident Prevention Manual for Industrial Operations", NSC, Chicago, 1982.
7. K.W.Ogden, "Safer Roads – A guide to Road Safety Engineering"

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
Cos	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	1	1	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	1	2	-	-
	3	High				2	Medium				1	Low			

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE - I (7.5)	IAE - II (7.5)	IAE - III (10)	
Remember	10	10	10	20
Understand	30	30	30	60
Apply	10	10	10	20
Analyze				
Evaluate				
Create				

20PISE11	Fireworks Safety	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Industrial Engineering				

Course Objectives

The course is intended to

1. To study the properties of pyrotechnic chemicals
2. To know about the hazards in the manufacture of various fireworks
3. To understand the hazards in fireworks industries related processes
4. To study the effects of static electricity
5. To learn pyrotechnic material handling, transportation and user safety

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	To gain knowledge of the chemical reactions of Fireworks chemicals	Apply
CO2	To know safe manufacture of Fireworks items	Apply
CO3	To improve process safety in fireworks industries	Apply
CO4	To analyze safety measures applicable against static electricity	Understand
CO5	To suggest safe practices for handling of fireworks in factories, transport and at user end	Apply

Course contents:

UNIT I Properties of fireworks Chemicals 9

Fire properties – potassium nitrate (KNO₃), potassium chlorate (KClO₃), barium nitrate (BaNO₃), calcium nitrate (CaNO₃), Sulphur (S), Phosphorous (P), antimony (Sb), Pyro Aluminum (Al) powder- Reactions-metal powders, Borax, ammonia (NH₃) – Strontium Nitrate, Sodium Nitrate, Potassium per chloride. Fire and explosion, impact and friction sensitivity

UNIT II Static Charge and Dust 9

Concept-prevention-earthing-copper plates-dress materials-static charge meter lightning, Causes- effects-hazards in fireworks factories-lightning arrestor: concept-installation-earth pit-maintenance- resistance-legal requirements-case studies.Dust: size-desirable, non-respirable-biologicalbarriers-hazards-personal protective equipment- pollution prevention.

UNIT III Process Safety 8

Safe-quantity, mixing-filling-fuse cutting – fuse fixing – finishing – drying at various stages-packing- storage-hand tools-materials, layout: building-distances- factories act – explosive act and rules – fire prevention and control – risk related fireworks industries.

UNIT IV Material Handling and transportation 10

Manual handling – wheel barrows-trucks-bullock carts-cycles-automobiles-fuse handling – paper caps handling-nitric acid handling in snake eggs manufacture-handling the mix in this factory-material movement-godown-waste pit Packing-magazine-design of vehicles for explosive transports loading into automobiles-transport restrictions-case studies-overhead power lines-driver habits-intermediate parking-fire extinguishers- loose chemicals handling and transport

UNITV

Waste Control and user Safety

9

Concepts of wastes – Wastes in fireworks-Disposal-Spillages-storage of residues, Consumer anxiety- hazards in display-methods in other countries-fires, burns and scalds-sales outlets-restrictions-role of fire service

TOTAL: 45 PERIODS

References

1. "Proceedings of National seminar on Fireworks Safety-1999", MSEC-1999.
2. K.N.Ghosh, "Principles of fireworks", H.Khatsuria, Sivakasi, 1987.
3. A.Chelladurai, "Fireworks related accidents", McGraw-Hill Company, New. York, 1980
4. J.A.Purkiss, "Fireworks-Fire Safety Engineering"
5. A.Chelladurai, "Fireworks principles and practice"
6. A.Chelladurai, "History of the fireworks in India" Brock, "History of fireworks"

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	2	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	2	2	-	-
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE – I (7.5)	IAE – II (7.5)	IAE – III (10)	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				
20PISE12	Safety in Construction			L T P C


CHAIRMAN - BOARD OF STUDIES

		3	0	0	3
Nature of course	Professional Elective				
Pre requisites	Construction Engineering				

Course Objectives

The course is intended to

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

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	To identify the problems impeding safety in construction industries.	Understand
CO 2	To identify types and causes of accidents, and designing aids for safe construction.	Understand
CO 3	To understand the hazards during construction of power plant, road works and high rise buildings.	Understand
CO 4	To understand the safety procedure for working at heights during construction.	Understand
CO 5	To have knowledge in selection, operation, inspection and testing of various construction machinery. To list out construction regulations and Indian standards for construction and demolition work.	Apply

Course Contents

UNIT I Accidents Causes and Management Systems 9

Problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accident – construction regulations, contractual clauses – Pre contract activates, preconstruction meeting - design aids for safe construction – permits to work – quality assurance in construction –compensation Recording of accidents and safety measures – Education and training

UNIT II Hazards of Construction and Prevention 9

Excavations, basement and wide excavation, trenches, shafts – scaffolding , types, causes of accidents, scaffold inspection checklist – false work – erection of structural frame work, dismantling – tunneling – blasting, pre blast and post blast inspection – confined spaces – working on contaminated sites – work over water - road works – power plant constructions – construction of high rise buildings-Application of drone in safety environment.

UNIT III Working at heights 9

Fall protection in construction OSHA 3146 – OSHA requirement for working at heights, Safe access and egress – safe use of ladders- Scaffoldings , requirement for safe work platforms, stairways, gangways and ramps – fall prevention and fall protection , safety belts, safety nets, fall arrestors, controlled access zones, safety monitoring systems – working on fragile roofs, work permit systems, height pass – accident case studies.

UNITIV Construction Machinery 9

Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist -


 CHAIRMAN - BOARD OF STUDIES

builder's hoist, winches, chain pulley blocks – use of conveyors - concrete mixers, concrete vibrators – safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps, welding machines, use of portable electrical tools, drills, grinding tools, manual handling scaffolding, hoisting cranes – use of conveyors and mobile cranes – manual handling.

UNITV Safety in Demolition Work

9

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

TOTAL: 45 PERIODS

References

1. V.J.Davies and K.Thomasin "Construction Safety Hand Book" Thomas Telford Ltd., London, 1990.
2. JnatheaD.Sime, "Safety in the Build Environment", London, 1988.
3. Hudson, R., "Construction hazard and Safety Hand book, Butter Worth's, 1985.
4. "Handbook of OSHA Construction safety and health", charles D. Reese and James V.Edison

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) Programme Specific Outcomes (PSOs)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	3	2										2	2	
CO 2	2	3	2										2	2	
CO 3	2	3	2										2	2	
CO 4	2	3	2										2	2	
CO 5	2	3	2										2	2	
	3	High				2	Medium					1	Low		

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE – I (7.5)	IAE – II (7.5)	IAE – III (10)	
Remember	10	10	10	20
Understand	40	40	20	60
Apply			20	20
Analyze				
Evaluate				
Create				

20PISE13	Nuclear Engineering and Safety	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Power Plant Engineering				

Course Objectives:

1. To know about nuclear energy and fission fusion process.
2. To gain knowledge in reactor types, design considerations and their operational problems.
3. To know the current status of India in nuclear energy.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO1	Demonstrate nuclear fission and fusion process and their utilization.	Apply
CO2	UnderstandControl requirements of reactor control	Understand
CO3	Understand types of reactors and their Control requirements.	Understand
CO4	To known the current status of India in nuclear energy	Apply
CO5	Explain the safety design principles and safety regulation process.	Apply

Course Contents:**UNIT I Introduction 9**

Binding energy – fission process – radio activity – alpha, beta and gamma rays radioactive decay – decay schemes – effects of radiation – neutron interaction – cross section – reaction rate – neutron moderation – multiplication – scattering – collision – fast fission – resonance escape – thermal utilization – criticality.

UNIT II Reactor Control 9

Control requirements in design considerations – means of control – control and shut down rods – their operation and operational problems – control rod worth – control instrumentation and monitoring – online central data processing system.

UNIT III Reactor Types 9

Boiling water reactors – radioactivity of steam system – direct cycle and dual cycle power plants- pressurized water reactors and pressurized heavy water reactors – fast breeder reactors and their role in power generation in the Indian context – conversion and breeding – doubling time – liquid metal coolants – nuclear power plants in India.

UNIT IV Safety of Nuclear reactors 9

Safety design principles – engineered safety features – site related factors – safety related systems – heat transport systems – reactor control and protection system – fire protection system – quality assurance in plant components – operational safety – safety regulation process – public awareness and emergency preparedness. Accident Case studies- Three Mile Island and Chernobyl accident

UNIT V Radiation Control 9

Radiation shielding – radiation dose – dose measurements – units of exposure – exposure limits – barriers for control of radioactivity release – control of radiation exposure to plant personnel – health physics surveillance – waste management and disposal practices – environmental releases.

TOTAL: 45 PERIODS**REFERENCES:**

1. Sri Ram K, "Basic Nuclear Engineering" Wiley Eastern Ltd., New Delhi, 1990.
2. "Loss prevention in the process Industries" Frank P.Lees Butterworth-Hein-UK, 1990.


CHAIRMAN - BOARD OF STUDIES

3. Sterman U.S. "Thermal and Nuclear Power Stations", MIR Publications, Moscow, 1986.
4. Loffness, R.L., "Nuclear Power Plant" Van Nostrand Publications, 1979.
5. M.M.E.L.Wakil, "Nuclear Energy Conversion", International Text Book Co.
6. M.M.E.L.Wakil, "Nuclear Power Engineering", International Text Book Co.
7. R.L.Murray, "Introduction to Nuclear Engineering", Prentice Hall. Third Edition.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO4	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO5	2	-	-	-	-	-	-	-	-	2	-	-	2	-	-
	3	High				2	Medium				1	Low			

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE – I (7.5)	IAE – II (7.5)	IAE – III (10)	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				

20PISE14	Safety in Textile Industry	L	T	P	C
		3	0	0	3
Nature of Course	Professional Elective				
Pre requisites	Textile technology and chemistry				

Course Objectives

The course is intended

1. To provide the student about the basic knowledge about the textile industries and its products by using various machineries.
2. To enforce the knowledge on textile processing and various processes in making the yarn from cotton or synthetic fibres.
3. To understand the various hazards of processing textile fibres by using various activities.
4. To inculcate the knowledge on health and welfare activities specific to the Textile industries as per the Factories Act.

Course Outcomes

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

CO. No.	Course Outcome	Bloom's Level
CO 1	The student will able to know about the overall picture about the textile industries and its operations.	Analyze
CO 2	The student could understand the various concepts underlying in the processes involved in processing of fibres to yarn.	Analyze
CO 3	The student will be able to find out various hazards in the textile industry and will be able to apply the control measures to mitigate the risk emanating from the hazard.	Analyze
CO 4	The student could have the capability to handle the various health and welfare activities as per the Factories act and could implement statutory requirements.	Analyze
CO 5	The student could create of his own arrangement in designing various methods meant for mitigating the risk and able to guide his subordinates in executing the work safely.	Analyze

Course Contents:

UNIT I	Introduction	9
Introduction to process flow charts of i) short staple spinning, ii) long staple spinning, iii) viscose rayon and synthetic fibre, manufacturer, iv) spun and filament yarn to fabric manufacture, v) jute spinning and jute fabric manufacture-accident hazard, guarding of machinery and safety precautions in opening, carding, combing, drawing, flyer frames and ring frames, doubles, rotor spinning, winding, warping, softening/spinning specific to jute.		
UNIT II	Textile Hazards I	9
Accident hazards i) sizing processes- cooking vessels, transports of size, hazards due to steam ii) Loom shed – shuttle looms and shuttles looms iii) knitting machines iv) non-woven's.		
UNIT III	Textile Hazards II	9
Scouring, bleaching, dyeing, punting, mechanical finishing operations and effluents in textile processes		
UNIT IV	Health and Welfare	9
Health hazards in textile industry related to dust, fly and noise generated-control measures-relevant occupational diseases, personal protective equipment-health and welfare measures specific to textile industry, Special precautions for specific hazardous work environments.		

UNITV**Safety status****9**

Relevant provision of factories act and rules and other statues applicable to textile industry – effluent treatment and waste disposal in textile industry

TOTAL: 45 PERIODS**References**

1. 100 Textile fires – analysis, findings and recommendations LPA
2. Groover and Henry DS, “Hand book of textile testing and quality control”
3. “Quality tolerances for water for textile industry”, IS
4. Shenai, V.A. “A technology of textile processing”, Vol.I, TextileFibres
5. Little, A.H., “Water supplies and the treatment and disposal of effluent”

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO4	3	-	-	-	-	-	-	-	-	3	-	-	2	-	-
CO5	2	-	-	-	-	-	-	-	-	2	-	-	2	-	-
	3	High				2	Medium				1	Low			

Formative assessment			
Bloom's Level	Assessment Component	Marks	Total marks
Remember	Online Quiz	5	15
Understand	Tutorial Class / Assignment	5	
	Attendance	5	

Summative Assessment				
Bloom's Category	Internal Assessment Examinations			Final Examination (60)
	IAE – I (7.5)	IAE – II (7.5)	IAE – III (10)	
Remember	10	10	10	20
Understand	10	10	10	20
Apply	30	30	30	60
Analyze				
Evaluate				
Create				