ANNA UNIVERSITY, CHENNAI

NON- AUTONOMOUS COLLEGES

AFFILIATED TO ANNA UNIVERSITY

M.E. INDUSTRIAL SAFETY ENGINEERING

REGULATIONS 2025

PROGRAMME OUTCOMES (POs):

PO	Programme Outcomes
PO1	An ability to independently carry out research /investigation and development work to solve practical problems
PO2	An ability to write and present a substantial technical report/document.
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PROGRAMME SPECIFIC OUTCOMES (PSOS)

PSO	Programme Specific Outcomes
PSO1	Apply principles of safety, risk analysis, and environmental management to design and implement effective industrial safety and health systems.
PSO2	Develop expertise in hazard identification, emergency response, and regulatory compliance to promote safe and sustainable industrial operations.

ANNA UNIVERSITY, CHENNAI

POSTGRADUATE CURRICULUM (NON-AUTONOMOUS AFFILIATED INSTITUTIONS)

Programme: M.E. Industrial Safety Engineering **Regulations:** 2025

Abbreviations:

BS– Basic Science (Mathematics, Physics, Chemistry)

ES – Engineering Science (General (**G**), Programme Core (**PC**), Programme Elective (**PE**) & Emerging Technology (**ET**))

SD – Skill Development

SL – Self Learning

OE – Open Elective

L – Laboratory Course

T – Theory

LIT – Laboratory Integrated Theory

PW – Project Work

TCP – Total Contact Period(s)

Semester I

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
1.	IS25101	Industrial Safety Management	T	3	0	0	3	3	ES (PC)
2.	IS25102	Industrial Safety, Health and Environment Acts	T	3	0	0	3	3	ES (PC)
3.	IS25103	Chemical Process Hazard and Risk Analysis	LIT	3	0	2	5	4	ES (PC)
4.	IS25104	Occupational Health and Industrial Hygiene	LIT	3	0	2	5	4	ES (PC)
5.	IS25105	Safety Audit	L	0	0	2	2	1	ES (PC)
6.	IS25106	Statistics and Probability for Safety and Risk Analysis	T	4	0	0	4	4	ES (PC)
7.	IS25107	Technical Seminar	-	0	0	2	2	1	SD
						Total	**24**	**20**	

Semester II

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
1.		Fire Engineering and Explosion Control	T	3	0	0	3	3	ES (PC)
2.		Electrical Safety	T	3	0	0	3	3	ES (PC)
3.		Safety in Process Industries	T	3	0	0	3	3	ES (PC)
4.		Programme Elective I	T	3	0	0	3	3	ES (PE)
5.		System Simulation and Hazard Analysis	LIT	3	0	2	5	4	ES (PC)
6.		Environmental Pollution and Control	LIT	3	0	2	5	4	ES (PC)
7.		Industry Oriented Course I	---	1	0	0	1	1	SD
8.		Self-Learning Course	---	-	-	-	-	1	-
						Total	**23**	**22**	

Semester III

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
1.		Environmental and Social Governance	T	3	0	0	3	3	ES (PC)
2.		Programme Elective II	T	3	0	0	3	3	ES (PE)
3.		Programme Elective III	T	3	0	0	3	3	ES (PE)
4.		Open Elective	T	3	0	0	3	3	---
5.		First Aid and Fire Fighting Training	L	0	0	2	2	1	ES (PC)
6.		Industry Oriented Course II	-	1	0	0	1	1	SD
7.		Industrial Training	-	-	-	-	-	2	SD
8.		Project Work I	-	0	0	12	12	6	SD
						Total	**27**	**22**	

Semester IV

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
1.		Project Work II	---	0	0	24	24	12	SD
						Total	**24**	**12**	

TOTAL CREDITS OF THE PROGRAMME:75

PROGRAMME ELECTIVE COURSES (PE)

S. No.	Course code	Course title	Periods Per Week			Total Contact Periods	Credits
			L	T	P		
1.		International Safety Management System	3	0	0	3	3
2.		Cybersecurity for Industrial Safety Systems	3	0	0	3	3
3.		Asset Integrity and Reliability Engineering	3	0	0	3	3
4.		Emergency Response and Disaster Management	3	0	0	3	3
5.		ISO 45001 and ISO 14000	3	0	0	3	3
6.		Human Factors Engineering and Ergonomics	3	0	0	3	3
7.		Emerging Technologies in Safety	3	0	0	3	3
8.		Safety in Construction	3	0	0	3	3
9.		Safety in Oil & Gas	3	0	0	3	3
10.		Behaviour-Based Safety	3	0	0	3	3
11.		Optimization Techniques	3	0	0	3	3
12.		Design of Experiments	3	0	0	3	3
13.		Safety Economics and Cost-Benefit Analysis	3	0	0	3	3
14.		Safety in Engineering Industries	3	0	0	3	3
15.		Dock Safety	3	0	0	3	3

Semester I

IS25101	Industrial Safety Management	L	T	P	C
		3	0	0	3

Course Objectives:

- To provide foundational knowledge on the principles, history, and global evolution of industrial safety management systems.
- To develop skills for proactive planning, risk assessment, and systematic investigation of industrial accidents using contemporary tools and reporting methods.
- To enable learners to monitor, evaluate, and improve workplace safety performance using standardized metrics and audit methodologies.
- To foster capabilities in conducting safety training, promoting employee participation, and applying statistical techniques for safety data analysis and decision-making.

Fundamentals of Safety Management: Definitions and Evolution of Safety Management (India & Global); Elements of Industrial Safety; ILO Conventions and Country Ratifications; Overview of Modern Safety Concepts; Roles and Responsibilities: Safety Committee, Line & Staff Functions; Components of Safety Audit

Activity: Safety policy gap analysis based on ISO guidelines

Safety Planning and Risk Management: Planning for Productivity, Quality, and Safety; Budgeting for Safety; Hazard Identification and Risk Assessment Techniques; Safety Inspection, Sampling and Survey Methods; Performance Evaluation of Safety; Identification and Control of Unsafe Acts and Unsafe Conditions

Activity: Simulated hazard identification using a checklist

Accident Investigation and Prevention: Concepts of Reportable and Non-reportable Accidents; Statutory Reporting Procedures; Principles of Accident Prevention; Theories of Accident Causation; Incident Investigation Methodologies; Root Cause Analysis; Incident Cause Analysis Method (ICAM), Investigation Reporting Tools.

Activity: Case study analysis of a real-life industrial accident using Root Cause Analysis

Safety Performance Monitoring: Key Safety Metrics: Permanent/Partial Disabilities, Lost Time Injury, Frequency/Severity Rates; Near Miss Index, NCR, Safety Audit Reports; Safety Performance Indicators; Accident Trend Analysis; Safety Standards: IS 3786, ANSI Z16.1, OSHA Guidelines

Activity: Prepare a safety performance dashboard using sample data and suggest corrective measures

Safety Education, Training and Employee Participation: Identifying Training Needs: Safety Induction & Refresher; Training Methods: E-learning, Toolbox Talks, Simulations; Safety Motivation Tools; Worker Participation Programs; Suggestion Schemes and Competitions; Safety Campaigns; Performance Appraisal

Activity: Design a safety awareness campaign and conduct a mock training session with peer feedback

Data Analysis for Safety: Sampling Distributions; Hypothesis Testing, t-Test, F-Test, Chi-Square Test; Curve Fitting Techniques; Regression and Correlation, Simple, Multiple and Partial; Analysis of Variance (One-way and Two-way); Application of Statistical Tools in Safety Decisions

Activity: Use real or simulated safety incident data to perform hypothesis testing and regression analysis in Excel/SPSS

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology and weightage:

Quiz (5%), Project (10%), Assignment (10%), Practical (25%), Review of Question papers (IES, SSC, GATE) (20%), Internal Examinations (30%)

References:

1. Reese, C. D. (2016). Occupational health and safety management. CRC Press.
2. Neshuku, H. D. (2007). Industrial safety management. Jaico Publishing House.
3. Krishnan, N. V. (1997). Safety management in industry. Jaico Publishing House.
4. Bureau of Indian Standards. (n.d.). IS 3786: Method for computation of frequency and severity rates for industrial injuries. Bureau of Indian Standards.
5. Hughes, P., & Ferrett, E. (2020). Introduction to health and safety at work. Routledge.

E-Resources:

1. https://osha.gov/
2. https://ilo.org/
3. https://dgfasli.gov.in/
4. https://isafetytools.org/

	Description of CO	PO	PSO1	PSO2
CO1	Understand the principles, history, and evolution of industrial safety management systems, and apply them globally and locally in industry settings.	--	--	--
CO2	Develop skills for proactive safety planning, risk assessment, and systematic investigation of industrial accidents using contemporary tools and methods.	PO1 (3), PO2 (2)	3	3
CO3	Monitor and evaluate safety performance using standardized metrics and audit methodologies to improve workplace safety.	PO3 (2), PO2 (2)	2	3
CO4	Conduct safety training, promote employee participation, and apply statistical techniques for safety data analysis and decision-making.	PO2 (3), PO3 (2)	3	2

IS25102	Industrial Safety, Health and Environment Acts	L	T	P	C
		3	0	0	3

Course Objectives:

- To provide structured knowledge on Indian safety, health, and environmental regulations applicable to industries.
- To enable students to interpret and apply various provisions of the Factories Act, Environment Act, and associated rules.
- To introduce students to major rules governing hazardous materials, pressure vessels, and emergency planning.
- To expose students to globally relevant occupational health and safety standards and their impact on Indian industries.

Industrial Safety Framework and the Factories Act: Factories Act 1948: key definitions, safety, health & welfare provisions, Provisions for hazardous processes, penalties, employment conditions, Tamil Nadu Factories Rules 1950, overview, Tamil Nadu Safety Officer Rules 2005, appointment, duties, recent amendments

Activity:
Case Study: Apply Factories Act provisions to a real accident scenario.
Mock Compliance Audit: Prepare a checklist based on Section 41B and 41C.

Environmental Legislations and Waste Management Rules: Environment (Protection) Act 1986: objectives, powers, and scope, Air (Prevention & Control of Pollution) Act, 1981; Water (Prevention & Control of Pollution) Act, 1974; Noise Pollution (Regulation & Control) Rules, 2000; Biomedical Waste Rules, E-Waste Rules, Battery Waste Rules, Hazardous Waste Rules; Role of CPCB, SPCBs and obtaining statutory clearance (e.g., Consent to Operate)

Activity: Draft a pollution clearance application for a sample industry

Hazardous Substances, Process Safety & Specialized Rules: Manufacture, Storage, and Import of Hazardous Chemicals (MSIHC) Rules, 1989; Major Accident Hazard (MAH) Control Rules; Safety Reports, Notification Requirements, SDS, Onsite & Offsite Emergency Plans; Indian Boiler Act (Amendments), SMPV Rules, Gas Cylinder Rules; Petroleum Rules, Electricity Safety Provisions; Construction Workers Act (1996), Explosives Act (overview only)

Activity: Develop an emergency plan for a hazardous chemical scenario.

International Acts, Standards & Cross-Comparative Analysis: Occupational Safety & Health Act (OSHA, USA), HASAWA (UK); ISO 45001, ISO 14001, focus on legal conformity in safety and environment; NFPA (fire standards), OISD (oil industry safety), API Standards (overview); Role of ANSI and AERB in international benchmarking; Relevance and adaptation of global frameworks in Indian industries

Activity: Comparative Matrix: ISO 45001 vs OSHA, scope, penalties, audit systems.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology:

Quiz (5%), Project (10%), Assignment (10%), Practical (25%), Review of Question papers (IES, SSC, GATE) (20%), Internal Examinations (30%)

References:

1. The Factories Act, 1948, Madras Book Agency.
2. The Environment (Protection) Act, 1986. (2020). Commercial Law Publishers.
3. Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India. MSIHC rules & hazardous waste rules.
4. Oil Industry Safety Directorate (OISD), American Petroleum Institute (API), & National Fire Protection Association (NFPA) OISD standards, API and NFPA guidelines (latest editions).
5. International Labour Organization (ILO) & International Organization for Standardization (ISO). ISO 45001 & ISO 14001 – Interpretation and implementation guides.

E-Resources:

1. https://labour.gov.in/ Ministry of Labour
2. https://cpcb.nic.in CPCB Waste Rules
3. https://osha.gov/ US OSHA etools
4. https://nfpa.org/ Fire Protection Codes
5. https://iso.org/ ISO 45001 & 14001 Codes

	Description of CO	PO	PSO1	PSO2
CO1	Understand the Indian safety, health, and environmental regulations and their application in industrial settings, particularly the Factories Act and Environment Protection Act.	--	--	--
CO2	Interpret and apply provisions of the Factories Act, Environment Act, and associated rules, focusing on hazardous materials and emergency planning.	PO3 (2), PO2 (2)	3	3
CO3	Develop an understanding of international safety and health standards (OSHA, ISO) and compare them with Indian standards, evaluating their impact on industry.	PO1 (3), PO3 (2)	2	3
CO4	Conduct safety audits and compliance checks based on legal provisions, and formulate risk management strategies in accordance with statutory regulations.	PO3 (2), PO2 (3)	3	3

IS25103	Chemical Process Hazard and Risk Analysis	L	T	P	C
		3	0	2	4

Course Objectives:

- To equip learners with analytical techniques to identify, evaluate, and mitigate hazards in industrial processes.
- To expose students to advanced mechanical and thermal hazard evaluation equipment.
- To enable learners to use tools and models for fault tree, event tree, and risk quantification.
- To impart competency in applying CPQRA techniques and real-time case evaluation using simulation software.

Fundamentals of Hazard Identification and Risk Assessment: Introduction to Hazards and Risks; Risk Monitoring; Risk Issues and Classifications; Hazard Assessment, Procedures and Methodologies; Safety Audit; Checklist Analysis; What-if Analysis; Safety Review; Preliminary Hazard Analysis (PHA); Hazard and Operability Study (HAZOP)

Activity: Perform a mock HAZOP study on a simplified process flow diagram (PFD) of a gas storage tank system.

Practical: Study and demonstration of fire extinguishers and a fire mock drill, including evacuation protocols.

Equipment Required:

• Fire Extinguishers (ABC, CO_2, Water, Foam types)
• Fire Drill Alarm System
• Evacuation Maps and Assembly Point Markers

Thermal and Mechanical Hazard Assessment: Applications of Advanced Equipment and Instruments: Thermo Calorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyzer (TGA), Accelerated Rate Calorimeter (ARC); Principles of Operation, Controlling Parameters, Applications, and Advantages, Explosive Testing Techniques: Deflagration Test, Detonation Test, Ignition Test, Minimum Ignition Energy Test, BAM Friction and Impact Sensitivity Tests, Shock Sensitivity Test, Card Gap Test

Activity:

Interpret and compare sensitivity results of various chemicals using BAM test data and classify them based on reactivity index.

Practical:

• Measurement of friction sensitivity using BAM Friction Tester
• Measurement of impact sensitivity using BAM Fall Hammer
• Measurement of heat release using Bomb Calorimeter

Equipment Required:

• BAM Friction Tester
• BAM Fall Hammer
• Bomb Calorimeter

Risk Quantification Techniques: Fault Tree Analysis (FTA) and Event Tree Analysis (ETA), Logic Symbols and Gate Logic Representation, Methodology for FTA/ETA Development, Minimal Cut Set Ranking, Fire and Explosion Index (FEI), Fire and Toxicity Index (FETI), Hazard Analysis Techniques: HAZAN, Failure Mode and Effect Analysis (FMEA)

Activity:
Construct a fault tree for a hypothetical failure in a gas storage process and calculate its top event probability.

Practical:
• Measurement of flash point and fire point using Closed Cup Method
• Study and demonstration of smoke detection, alarm, and sprinkler system

Equipment Required:
• Pensky-Martens Closed Cup Tester
• Smoke Detection System and Sprinkler Demonstration Unit
• Fire Index Evaluation Charts

Chemical Process Quantitative Risk Analysis (CPQRA): CPQRA: Definition, Components, Techniques, Scope and Applications of CPQRA, Chemical Inventory Analysis, Estimation of Source Term, Gas/Vapour/Liquid Release, Two-phase Release, Heat Radiation, BLEVE, UVCE, Flash Fire, Toxic Effects, Plotting Damage Zones using Risk Software, Software Tools: ALOHA, MARPLOT, CAMEO

Activity:
Simulate a BLEVE scenario using ALOHA software and generate thermal radiation and toxicity dispersion maps.

Practical:
• Study of Fire Hydrant System and its components

Equipment Required:
• Fire Hydrant Model Trainer
• PC with ALOHA, CAMEO & MARPLOT Software
• BLEVE Simulation Case Sheets

Application of CPQRA: Consequence-Based and Frequency-Based CPQRA, Application of CPQRA to New and Existing Process Units, Intermediate Risk Characterization, Case Studies: Flixborough Disaster, Bhopal Gas Tragedy, Jaipur IOC Incident, Vizag Gas Leak, HPCL Refinery Fires, Application to Storage Terminals (LNG, Chlorine, Ammonia, Crude Oil)

Activity:
Perform a team-based case study presentation on the Jaipur IOC tank explosion and map the risk elements involved.

Practical:
• Measurement of earth resistance and ground resistivity using Wenner's method

Equipment Required:
- Earth Resistance Measurement Kit (Wenner Method)
- Case Study Documentation Boards
- Safety Engineering Reference Diagrams

Advanced Trends in Hazard Management: Internet of Things (IoT) in Hazard Detection and Monitoring, Real-time Leak and Temperature Monitoring via Sensors, Digital Twin Technology for Process Simulation and Risk Control, Environmental, Social, and Governance (ESG) Metrics for Safety, Predictive Analytics using AI/ML for Proactive Risk Alerts, Emerging Global Standards in Process Safety Performance Indicators

Activity:
Interpret sample real-time sensor data and generate alerts for a predictive fire risk management dashboard.

Practical:
- Study and demonstration of Personal Protective Equipment (PPE) used in high-risk process environments

Equipment Required:
- PPE Kit (Flame-retardant Suit, Helmet, Gloves, Respirator)
- IoT Sensors for Leak and Temp Detection (Demo Models)
- Predictive Dashboard Sheets (Sample Data)

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology and weightage:

Quiz (5%), Project (10%), Assignment (10%), Practical (25%), Review of Question papers (IES, SSC, GATE) (20%), Internal Examinations (30%)

References:

1. Crowl, D. A., & Louvar, J. F. (2020). Chemical process safety: Fundamentals with applications (3rd ed.). Pearson.
2. Mannan, S. (2019). Lees' loss prevention in the process industries (Vols. 1–3). Elsevier.
3. Prabhakar, R. (2021). Process hazard analysis: A guide for engineers and managers. New Age International.
4. Khan, F. I. (2020). Green process engineering for sustainable chemical manufacturing. CRC Press.
5. Rao, C. S. (2018). Environmental pollution control engineering. New Age International.

E-Resources:

1. https://www.osha.gov – OSHA Technical Manuals
2. https://www.aiha.org – American Industrial Hygiene Association
3. https://cameochemicals.noaa.gov – CAMEO, ALOHA, MARPLOT
4. https://training.fema.gov – Fire Incident Command and Emergency Planning Modules

	Description of CO	PO	PSO1	PSO2
CO1	Understand and apply various hazard identification methodologies (PHA, HAZOP, safety audits) and risk assessment techniques in chemical processes, focusing on process safety management.	-	-	-
CO2	Analyze and quantify thermal, mechanical, and chemical hazards using advanced equipment (DSC, TGA, BAM) and process safety tools, including fault tree and event tree analysis (FTA/ETA).	PO3 (2), PO2 (3)	3	3
CO3	Utilize Chemical Process Quantitative Risk Analysis (CPQRA) techniques, including simulation tools (ALOHA, MARPLOT, CAMEO) for modeling, risk quantification, and mitigation strategies.	PO1 (3), PO3 (3)	3	3
CO4	Investigate real-world process safety incidents (e.g., Bhopal Gas Tragedy) and apply advanced technologies (IoT, AI/ML, digital twins) for proactive hazard monitoring and safety management.	PO3 (2), PO1 (3)	2	3

IS25104	Occupational Health and Industrial Hygiene	L	T	P	C
		3	0	2	4

Course Objectives:

- To provide in-depth knowledge of human physiology and the impact of occupational hazards on vital organs.
- To develop understanding of physical, chemical, biological, and ergonomic hazards in various work environments.
- To equip learners with competencies in occupational health surveillance, exposure evaluation, and mitigation strategies.
- To train students in practical assessment and instrumentation used in industrial hygiene and health monitoring.

Human Physiology and Occupational Pathology: Anatomy and Physiology of Lungs, Skin, Ear, and Eyes; Functions of Organs and Organ Systems; Effects of Hazards on Organs; Cardio-pulmonary Resuscitation; Audiometric Tests; Eye Tests; Vital Function Tests

Activity: Identify common organ-specific occupational diseases and create a hazard-organ impact chart

Practical: CPR demonstration and use of audiometry and vision screening instruments

Equipment Required:

- Audiometer (digital/manual)
- Vision Testing Chart (Snellen), Color Vision Plate

Physical Hazards and Industrial Noise: Noise – Components, Measurement, Sound Exposure Index, Hearing Conservation; OSHA & TLV Guidelines for Vibration, Ionizing & Non-Ionizing Radiation, Temperature Stress, Thermal Comfort, Wind Chill, Heat Index; Measurement Instruments and Calibration

Activity: Noise hazard zone mapping in a workshop layout

Practical:

- Measurement of Noise using Noise Level Meter
- Illumination using Lux Meter
- Vibration using Vibration Analyzer

Equipment Required:

- Sound Level Meter & Digital Lux Meter
- Hand-Arm/Whole-Body Vibration Analyzer

Chemical Hazards and Toxicology: Fumes, Mist, Vapour, Fog, Gases – Types and Toxicology; TLVs, Dose and Exposure Limits; Industrial Toxicology Basics; Comparison with OSHA Standards; Gas and Vapour Sampling; Measurement Procedures; Personal Sampling Techniques

Activity: Case study: Chemical exposure accident and hazard control breakdown

Practical:
Measurement of specific gas concentrations using Multi Gas Detector
Interpretation of Material Safety Data Sheets (MSDS)
Equipment Required:
Multi Gas Detector
MSDS samples
PPE samples for chemical handling (gloves, goggles, mask)

Biological and Ergonomic Hazards: Biohazard Classification – Bacteria, Fungi, Parasites, Viral Agents; COVID, SARS, Animal Care Hazards; Ergonomic Hazards – Musculoskeletal Disorders, CTS, Neck/Back Injuries; Laboratory & Animal Handling Programs

Activity: Ergonomic risk factor identification using photos and video samples

Practical:

- WBIT Testing for back strength
- Evaluation of working posture using RULA/REBA

Equipment Required:

- WBIT Tester or Manual Back Strength Tester
- Ergonomic Evaluation Forms (RULA/REBA templates)
- Adjustable chairs demo setup

Occupational Health Surveillance and Services: Occupational Health Units; Role of Health Examinations; Chronic Occupational Diseases (e.g., Pneumoconiosis, Siderosis, Anthracosis); Evaluation of Physiological Parameters – Shift Work, Fatigue, Stress, Personal Hygiene

Activity: Design a health surveillance plan for a specific industry (e.g., cement plant)

Practical:

- Measurement of Heart Rate using Pulse Oximeter
- Use of Questionnaire-based Stress Analysis Tool

Equipment Required:

- Pulse Oximeter (finger-type)
- Blood Pressure Monitor
- Standardized Stress Assessment Questionnaire
- Graph paper or software for stress trend plotting

Applied Occupational Toxicology and Exposure Evaluation: Sampling Strategies; Sample Collection Methods; Biological Monitoring; Indoor and Ambient Exposure; Threshold Effects; TLVs and Dose-Response; Measurement Considerations; System Toxicity Parameters; Work Capacity and Aerobic Tests

Activity: Create a sampling plan for chemical exposure in a paint industry

Practical:

- Dust Sampling using High Volume Sampler
- Toxicology Case Interpretation from Lab Report Data

Equipment Required:

- High Volume Air Sampler with filter papers
- Digital Flow Meter
- Particulate Filters & Sample Bags
- Laptop/software for plotting exposure trend lines

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology:

Quiz (5%), Project (10%), Assignment (10%), Practical (25%), Review of Question papers (IES, SSC, GATE) (20%), Internal Examinations (30%)

References:

1. Plog, B. A., & Quinlan, P. J. (2021). Fundamentals of industrial hygiene (6th ed.). National Safety Council.
2. Reese, C. D. (2016). Occupational health and safety management. CRC Press.
3. Burgess, W. A. (2020). Recognition of health hazards in industry: A review of materials and processes. Wiley-Interscience.
4. Stricoff, R. S., & Walters, D. B. (2022). Industrial hygiene workbook: A practical guide. AIHA Press.
5. Krishnan, N. V. (1997). Safety management in industry. Jaico Publishing House.

E-Resources:

1. https://www.osha.gov
2. https://www.cdc.gov/niosh
3. https://www.ilo.org/
4. https://www.bis.gov.in/
5. https://openwho.org/

	Description of CO	PO	PSO1	PSO2
CO1	Understand the impact of occupational hazards on human physiology (lungs, skin, ears, eyes).	-	-	-
CO2	Evaluate and assess physical hazards (noise, vibration, thermal stress) using relevant measurement techniques.	PO3 (2), PO1 (3)	3	3
CO3	Apply toxicology principles to assess chemical hazards and use MSDS for safety.	PO1 (3), PO2 (3)	3	3
CO4:	Identify biological and ergonomic hazards and apply mitigation strategies like ergonomic evaluations.	PO3 (2), PO2 (3)	3	3

IS25105	Safety Audit	L	T	P	C
		0	0	2	1

Course Objectives:

- To Inculcate the Industrial Safety Environment to the students
- To Explore the Human Capital Management and Hazardous System

Description of The Course

- The students are expected to make a presentation on the state of Safety Audit from the observation from the Industry Safety Department.
- A faculty guide is to be allotted and the student will visit the industry to aware about the Importance of the Safety.
- Students are encouraged to prepare the Safety System Guidelines from your observation period of Inspection from the Industry Safety Department and contribute the same to the Environment Contribution.
- The students are advised to go through the below mentioned following heads of safety Measures to be audit and inspect at the time of visit. Depending on the requirements of the organizations, the audit can focus attention on the following aspects of a safety system and make sure that your level of expertise in the safety system.

Every safety audit as per 'The Code of Practice' on Occupational Safety & Health 'Indian Standard 14489:2018, ISO 45001:2018, EMS- ISO 14001:2015, NBC:2016 and other national and international standard applicable to each particular industry.

• Safety Management systems.

• Fire and Explosion prevention, protection and emergency management.

• Work injury prevention.

• Health hazards control.

• Evaluating emergency plan.

• First aid practices

• Management of health and safety

• Accidents and accident reporting

• Asbestos • Contractors

• Display screen equipment

• Electrical safety

• Emergency lighting

• Environmental protection

• Fire prevention and emergencies

• Hazardous substances

• Housekeeping and cleanliness

• Information and communication

• Kitchens, catering and food safety

• Lifts and lifting equipment

• Manual handling operations

• Noise

• Occupational health

• Personal protective equipment

• Plant rooms, machinery and equipment

• Risk assessment requirements

• Safety Policy

• Safety signs and notices

• Training

• Use of vehicles / vehicle safety

• Water services

• Welfare provision

• Working time

• Work at heights

• Workplace environment

• Accident prevention

• Identifying and correcting Regulatory Deficiencies

• Improvement of Employee Morale

• Identification and Elimination of Safety Hazards

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Quiz (5%), Project (10%), Assignment (10%), Practical (25%), Review of Question papers (IES, SSC, GATE) (20%), Internal Examinations (30%)

	Description of Co	PO	PSO1	PSO2
CO1	Conduct safety audits based on ISO standards and assess the effectiveness of safety management systems.	PO1 (3), PO2 (2)	3	3
CO2	Manage industrial safety aspects such as fire/explosion prevention, emergency management, and health hazards.	PO1 (3), PO2 (3)	3	3
CO3	Audit environmental protection measures, including waste management and compliance with regulations.	PO1 (3), PO2 (3)	3	3
CO4	Prepare and present safety audit reports, identifying deficiencies and suggesting improvements.	PO2 (3), PO3 (2)	3	3

IS25106	Statistics and Probability for Safety and Risk Analysis	L	T	P	C
		4	0	0	4

Course Objectives:

- To introduce statistical and probabilistic tools applicable to safety and reliability engineering.
- To provide knowledge of distribution models for analyzing accident, failure, and hazard data.
- To apply hypothesis testing, correlation, and regression analysis for safety decision-making.
- To apply statistical design and time-series techniques to evaluate safety interventions and predict risks.

Probability Theory and Safety Fundamentals: Axioms and rules of probability, Conditional probability and independence, Bayes' theorem and its use in fault identification, Types of variables: discrete and continuous, Safety-related data: definitions, structure, examples.

Activity: Mini case analysis: Apply Bayes' Theorem to diagnose root cause probabilities.

Probability Distributions for Risk and Failure Modeling: Discrete distributions: Binomial, Poisson & Geometric; Continuous distributions: Normal, Exponential, Gamma & Weibull**;** Mean, variance, skewness, kurtosis**;** Applications in failure rate analysis and accident probability estimation

Activity: Think-pair-share: Identify appropriate distributions for different safety scenarios

Estimation and Regression Techniques in Safety: Point estimation and properties (unbiasedness, consistency, efficiency), Maximum Likelihood Estimation (MLE), Method of Moments, Simple Linear Regression and Multiple Regression, Safety metric modeling: injury frequency, exposure duration, etc.

Activity*:* Regression interpretation: Analyze regression output from historical accident database

Hypothesis Testing for Safety Decisions: Sampling distributions (mean, variance, proportion), *Z*, *t*, Chi-square, and *F* tests, Goodness-of-fit tests for safety data, Application examples: comparing accident rates before/after intervention, Use of p-values and confidence levels

Activity: PPE policy evaluation: Group-based statistical validation of before/after accident rates

Statistical Design of Experiments for Safety Interventions: Analysis of Variance (ANOVA): One-way and Two-way, Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design, Full Factorial Design (2^2, 2^3), Applications: assessing effect of lighting, noise, PPE type on human error

Activity: Analyze safety test outcomes using ANOVA framework.

Time Series Analysis and System Reliability: Time Series: trend, seasonality, cyclicity; Moving average, exponential smoothing methods; Introduction to Autoregressive (AR) models, Reliability concepts: MTBF, failure rate, hazard function, Reliability of series and parallel systems

Activity: Plot & forecast: Analyze 5-year accident trend data and apply smoothing

Weightage:

Continuous Assessment: 60%
End Semester Examinations: 40%

Assessment Methodology:

Quiz (5%), Project (10%), Assignment (10%), Practical (25%), Review of Question papers (IES, SSC, GATE) (20%), Internal Examinations (30%)

References:

1. Montgomery, D. C., & Runger, G. C. (2020). *Applied statistics and probability for engineers* (7th ed.). Wiley.
2. Ross, S. M. (2021). *Introduction to probability and statistics for engineers and scientists* (6th ed.). Academic Press.
3. Modarres, M. (2006). *Risk analysis in engineering: Techniques, tools, and trends*. CRC Press.
4. Antony, J. (2014). *Design of experiments for engineers and scientists* (2nd ed.). Elsevier.
5. Stephans, R. A. (2004). *System safety for the 21st century*. Wiley.

E-Resources:

1. https://nptel.ac.in/courses/111105041
2. https://reliability.readthedocs.io/en/latest/
3. https://www.itl.nist.gov/div898/handbook/
4. https://www.osha.gov/data

	Description of CO	PO	PSO1	PSO2
CO1	Understand the principles, history, and evolution of industrial safety management systems, and apply them globally and locally in industry settings.	PO1 (3), PO3 (2)	3	2
CO2	Develop skills for proactive safety planning, risk assessment, and systematic investigation of industrial accidents using contemporary tools and methods.	PO1 (3), PO2 (2)	3	3
CO3	Monitor and evaluate safety performance using standardized metrics and audit methodologies to improve workplace safety.	PO3 (2), PO2 (2)	2	3
CO4	Conduct safety training, promote employee participation, and apply statistical techniques for safety data analysis and decision-making.	PO2 (3), PO3 (2)	3	2