

Syllabus for M. Tech (2024-26 Admission Batch onwards)

Industrial Safety and Engineering

(Approved by Academic Council and Board of Studies)



GIFT Autonomous, Bhubaneswar

(Approved by AICTE, New Delhi, Affiliated to BPUT, Rourkela)

Recognized under section 2(f) of the UGC act, 1956

At-Gramadiha, Po.Gangapada, Via-Janla, Dist-Khorda, Pincode:752054

Program Outcomes (PG Engineering)

Graduates Attributes (GAs) form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The Program Outcomes (POs) for UG Engineering programmes defined by NBA.

- PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2: Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- PO3: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give

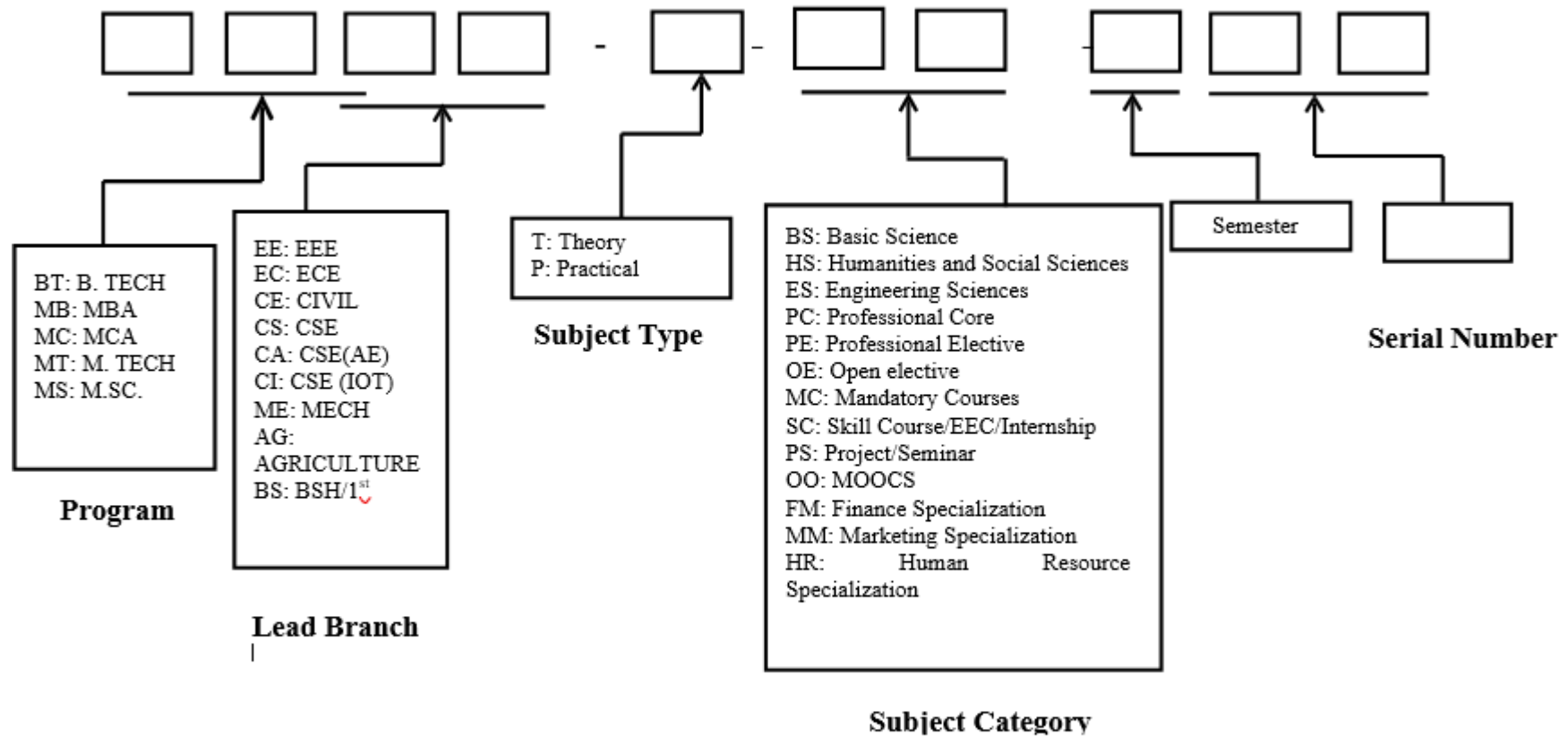
and receive clear instructions.

- PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Types & Definitions

L	Lecture
T	Tutorial
P	Laboratory/Practical/ Sessional
WCH	Weekly Contact Hours
BS	Basic Sciences
HS	Humanities & Social Sciences (including Management)
ES	Engineering Sciences
PC	Professional Core
PE	Professional Elective
OE	Open Elective
MC	Mandatory Course
SC	Skill Course
EEC	Employability Enhancement Course
SEPD	Skill Enhancement and Personality Development

Subject Code Format





GIFT AUTONOMOUS, BHUBANESWAR

Course structure of M. Tech (2024-26) (Industrial Safety Engineering)

1 st Semester				2 nd Semester			
CODE	SUBJECT	L-T-P	CREDIT	CODE	SUBJECT	L-T-P	CREDIT
MT-EE-T-PC-101	Principles of Safety Management	4-0-0	4	MT-EE-T-PC-201	Safety in Process Equipment	4-0-0	4
MT-EE-T-PC-102	Environmental Engineering and Safety	4-0-0	4	MT-EE-T-PC-202	Computer Aided Hazard Analysis	4-0-0	4
MT-EE-T-PC-103	Regulation for Health Safety and Environment	4-0-0	4	MT-EE-T-PC-203	Nuclear and Radiation Engineering and Safety	4-0-0	4
MT-EE-T-PC-104	Occupational Health Safety	4-0-0	4	MT-EE-T-PC-204	Fire Engineering and Explosion Control	4-0-0	4
MT-EE-T-PE-105	1. Industrial Pollution Control 2. Industrial Noise and Vibration Control 3. Internet of Things 4. Probability and Statistics	4-0-0	4	MT-EE-T-PE-205	1. Quality and Reliability Management 2. Environmental Protection and Management 3. Artificial Intelligence and Expert Systems 4. Sensitivity measurements and evaluation of energetic material	4-0-0	4
CREDIT (THEORY)			20	CREDIT (THEORY)			20
PRACTICALS/SESSIONALS				PRACTICALS/SESSIONALS			
MT-EE-P-PC-101	Industrial Safety Lab-I	0-0-2	2	MT-EE-P-PC-201	Industrial Safety Lab-II	0-0-2	2
MT-EE-P-PS-102	Report Writing & Seminar-I	0-0-4	4	MT-EE-P-PS-202	Report Writing & Seminar-II	0-0-4	4
CREDIT (PRACTICALS/SESSIONAL)			6	CREDIT (PRACTICALS/SESSIONAL)			6
TOTAL SEMESTER CREDITS			26	TOTAL SEMESTER CREDITS			26
TOTAL CUMULATIVE CREDITS			26	TOTAL CUMULATIVE CREDITS			52
3 rd Semester				4 th Semester			
CODE	SUBJECT	L-T-P	CREDIT	CODE	SUBJECT	L-T-P	CREDIT
MT-MB-T-OO-301	Research Methodology and IPR (NPTEL Course)	1-0-0	4				
MT-EE-T-PE-302	1. Construction Safety 2. Mining Safety 3. Operational Safety	4-0-0	4				
CREDIT (THEORY)			7	CREDIT (THEORY)			0
PRACTICALS/SESSIONALS				PRACTICALS/SESSIONALS			
MT-CC-P-PS-304	Pre Dissertation Work Evaluation		10	MT-P-PS-401	Dissertation Evaluation and Open Defence		16
CREDIT (PRACTICALS/SESSIONAL)			10	MT-P-PS-402	Viva Voce		4
TOTAL SEMESTER CREDITS			19	CREDIT (PRACTICALS/SESSIONAL)			16
TOTAL CUMULATIVE CREDITS			70	TOTAL SEMESTER CREDITS			20
				TOTAL CUMULATIVE CREDITS			90

Evaluation process

1. Evaluation Process of Theory Subjects:

Components	Marks	Frequency	Calculated from	Assigned To
Quiz Test	10	4	15	Concerned Faculty
Assignment	10	2	10	Concerned Faculty
Attendance	15	Closing of Instruction	15	To be retrieved from CMS
Subject Specific Project	100	1 (Before Closing of Instruction)	10	Concerned Faculty
Modular Test	25	3	50	Examination
End-Semester Examination	100	1	100	Examination Cell
Total	200			

Mtech 1st semester CIE Model (2024-25)

Sl. No.	Category	Mark X Frequency	Calculated From
1	Modular test	25X3	50
2	Quiz test	10X4	15
3	Assignment	10X2	10
4	SSP	100X1	10
5	Attendance	15(will be taken from CMS)	15
Total mark			100

2. Evaluation Process of Practical Subjects:

Components	Marks	Frequency	Assigned To
Attendance	10	Closing of Instruction	To be retrieved from CMS
Daily Performance & Viva-voce	40	On the day of Experiment	Concerned Faculty (Upload in CMS in weekly basis)

Lab Record	20	On the day of Experiment	Concerned Faculty
End-Semester Lab Test	30	1	At the end of the semester as per the schedule published by Examination Cell
Total	100		

3. Evaluation Process of Skill Courses:

Components	Marks	Frequency	Assigned
End-Semester Examination	100	1	Examination Cell/ Concerned Faculty
Total	100		

4. Evaluation Process of Mandatory Courses:

Components	Marks	Frequency	Assigned
In-Semester Evaluation	100	1	Examination Cell/ Concerned Faculty
Total	100		

First Semester

ype	Code	Principles of Safety Management	L-T-P	Credits	Marks
PC	MT-EE-T-PC-101		4-0-0	4	200
Objectives	The objective of this course is to familiarize the students with the 1. To understand and apply modern safety concepts, techniques, and organizational structures in various industrial settings. 2. To develop skills for conducting thorough accident investigations, safety performance monitoring, and implementing effective safety education and training programs. 3. To explore advanced topics in safety management, including the integration of modern technologies and ethical considerations in safety practices.				
Pre-Requisites	Basic understanding of workplace safety principles and practices, including knowledge of common safety regulations and standards.				
Teaching Scheme	Regular classroom lectures with use of ICT as and when required,sessions are planned to be interactive with focus on problem solving activities.				
Detailed Syllabus:					
Module	Topics				Hours
Module-I	Evolution of modern safety concepts, safety policy, safety organization, line and staff functions for safety, safety committee, budgeting for safety.				7
Module-II	Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit, Pareto Analysis				7
Module-III	Concept of an accident, reportable and non-reportable accidents, accident frequency rate, accident severity rate, unsafe acts and conditions, principles of accident prevention, supervisory role, role of safety committee, accident causation models, cost of accidents, overall accident investigation process, response to accidents, India reporting requirement, planning documents, planning matrix, investigators kit, functions of investigator, types of evidence, records of accidents, accident reports, class exercise with case study, cause and effect analysis				8
Module-IV	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, problems				6
Module V	Importance of training, identification of training needs, training methods, programs, seminars, conferences, competitions, methods of promoting safe practice, motivation and communication, role of government and private consulting agencies in safety training, creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign, domestic safety and training				8

Module-VI	Integration of modern safety technologies, case studies of industrial applications, recent advancements in safety management, ethical considerations in safety practices, future trends in safety management, safety management in different sectors	7
Total		43 Hours

Text Books:

1. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997.
2. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980.

Reference Books:

1. Accident Prevention Manual for Industrial Operations", N.S.C.Chicago, 1982
2. John Ridley, "Safety at Work", Butterworth & Co., London, 1983.
3. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 1973.

Course Outcomes: At the end of this course, the students will be able to:

CO1	Understand modern safety concepts and organizational structures.
CO2	Apply various safety techniques.
CO3	Conduct accident investigations and reporting.
CO4	Monitor safety performance through accident indices.
CO5	Develop and deliver safety education and training.
CO6	Explore advanced topics in safety management.

Type	Code	Environmental	L-T-P	Credits	Marks
PC	MT-EE-T-PC-102	Engineering and Safety	4-0-0	4	200
Objectives	The objective of this course is to familiarize the students with the 1. To understand ecological concepts, environmental chemistry, and their application in environmental engineering. 2. To develop skills for managing waste treatment processes, including waste water, air pollution, and solid and hazardous waste. 3. To implement effective safety management practices in various industrial settings, focusing on occupational safety, fire prevention, and the use of personal protective equipment.				
Pre-Requisites	Foundational understanding of basic environmental science and engineering principles.				
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.				
Detailed Syllabus:					
Module	Topics				Hours
Module-I	Ecological Concepts and Environmental Chemistry: Biotic components, ecosystem processes (energy, food chain, water cycle, oxygen cycle, nitrogen cycle, etc.), environmental gradients, tolerance levels of environmental factors, EU, US and Indian environmental law. Atmospheric chemistry, soil chemistry, noise pollution (standards, measurement, and control). Water treatment: water quality standards and parameters, groundwater, water treatment processes (pre-treatment, conventional, advanced).				7
Module-II	Waste Water Treatment and Air Pollution: Waste water treatment: DO and BOD, pre-treatment, primary and secondary treatment, activated sludge treatment (anaerobic digestion, reactor configurations, methane production). Air pollution: pollutants, criteria pollutants, acid deposition, global climate change (greenhouse gases), non-criteria pollutants, air pollution meteorology, atmospheric dispersion. Industrial air emission control: flue gas desulphurization, NOx removal, fugitive emissions.				7
Module-III	Solid Waste and Hazardous Waste Management: Solid waste management: source classification, composition of MSW, separation, storage, transportation, reuse, recycling, waste minimization techniques. Hazardous waste management: generation, transportation, treatment (incinerators, inorganic waste treatment), EIA, environmental auditing.				8

Module-IV	Occupational Safety and Health: Occupational Safety and Health Acts, safety procedures, types of accidents, chemical and heat burns, prevention of accidents involving hazardous substances, human error and hazard analysis.	6
Module V	Safety Measures and Fire Prevention: Hazard control measures in integrated steel industry, petroleum refinery, LPG bottling, pharmaceutical industry. Fire prevention: detection, extinguishing fire, electrical safety, product safety.	8
Module-VI	Safety Management and Personal Protective Equipment: Safety management: handling and storage of hazardous materials, corrosive substances, gas cylinders, hydrocarbons, and wastes. Personal protective equipment.	7
Total		43 Hours

Text Books:

1. Environmental Engineering Irwin/ McGraw Hill International Edition, 1997, G. Kiely
2. Environmental Engineering by Prof B.K. Mohapatra, Dhanpat Rai & Co Publication
3. Industrial Safety Management, L. M. Deshmukh, Tata McGraw Hill Publication.

Reference Books:

1. Environmental Engineering by Arcadio P. Sincero & Gergoria A. Sincero PHI Publication
2. Principles of Environmental Engineering and Science, M. L. Davis, McGraw Hill International Edition, 2004
3. Environmental Science, Curringham & Saigo, TMH

Course Outcomes: At the end of this course, the students will be able to:

CO1	Understand ecological concepts and environmental chemistry.
CO2	Apply waste water treatment and air pollution control techniques.
CO3	Manage solid and hazardous waste.
CO4	Comprehend occupational safety and health principles.
CO5	Implement safety measures and fire prevention techniques.
CO6	Develop safety management strategies and use personal protective equipment.

Type	Code	Regulation for Health, Safety and Environment	L-T-P	Credits	Marks
PC	MT-EE-T-PC-103		4-0-0	4	200
Objectives	The objective of this course is to familiarize the students with the 1. Understand and apply key industrial safety acts and regulations. 2. Manage safety and compliance in industrial settings. 3. Gain and apply knowledge of OHSAS 18000, ISO 14000, and ISO 9000 standards.				
Pre-Requisites	Basic understanding of industrial safety principles.				
Teaching Scheme	Regular classroom lectures with use of ICT as and when required,sessions are planned to be interactive with focus on problem solving activities.				
Detailed Syllabus:					
Module	Topics				Hours
Module-I	Factories and Workmen Compensation Acts:Factories Act and Rules, Workmen Compensation Act.				7
Module-II	Explosives and Environment Protection Acts:Indian Explosive Act, Explosives Rules, 2008, Gas Cylinder Rules, 2004, SMPV(U) Rules, 1981, Indian Petroleum Act, 1934 and Rules, 2002, Environment Protection Act, 1986.				7
Module-III	Hazardous Chemicals Rules:Manufacture, Storage and Import of Hazardous Chemical Rules, 1989.				8
Module-IV	Electricity and Construction Workers Acts: Indian Electricity Act, 2003 and Rules, 1956, The Building and Other Construction Workers (Regulation of Employment and Condition of Service) Act, 1996, The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Central Rules, 1998.				6
Module V	OHSAS and ISO Standards: Overview of OHSAS 18000, ISO 14000, ISO 9000.				8
Module-VI	Review and Integration of Acts and Standards: Comprehensive review and integration of the above acts, rules, and standards, including their applications and implications in various industries.				7
Total					43 Hours

Text Books:

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.

Reference Books:

1. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt.Ltd., New Delhi.
2. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
3. Explosive Act, 1884 and Explosive rules, 2008 (India), Eastern Book company, Lucknow, 10th Edition & www.peso.gov.in
4. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.
5. ISO 9000 to OHSAS 18001, Dr. K.C. Arora, S.K. Kataria& Sons, Delhi.

Course Outcomes: At the end of this course, the students will be able to:

CO1	Understand the Factories Act and Workmen Compensation Act.
CO2	Comprehend regulations under the Indian Explosive Act and Environment Protection Act.
CO3	Apply rules for hazardous chemicals.
CO4	Interpret the Indian Electricity Act and construction workers' safety regulations.
CO5	Gain knowledge about OHSAS 18000, ISO 14000, and ISO 9000 standards.
CO6	Integrate various acts, rules, and standards in industrial contexts.

Type	Code	Occupational Health Safety	L-T-P	Credits	Marks
PC	MT-EE-T-PC-104		4-0-0	4	200
Objectives	The objective of this course is to familiarize the students with the 1. Apply safety principles for various workplace hazards. 2. Develop skills in occupational health management. 3. Implement and manage safety programs in industrial settings.				
Pre-Requisites	A basic understanding of workplace safety principles, chemical properties, and environmental science.				
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.				
Detailed Syllabus:					
Module	Topics				Hours
Module-I	Physical Hazards: Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage, risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, noise control program, industrial 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), hot environments (thermal comfort, heat stress indices, acclimatization, estimation and control).				7
Module-II	Chemical Hazards: 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).				7
Module-III	Biological and Ergonomic Hazards: Classification of biohazardous agents (examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases), biohazard control program, employee health program (laboratory safety program, animal care and handling, biological safety cabinets, building design), work-related musculoskeletal disorders (carpal tunnel syndrome CTS, tendon pain, disorders of the neck, back injuries).				8

Module-IV	Occupational Health: 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 (silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis, anthrax), lead, nickel, chromium, and manganese toxicity, gas poisoning (CO, ammonia, coal and dust), effects and prevention, cardiopulmonary resuscitation, audiometric tests, eye tests, vital function tests.	6
Module V	Industrial Toxicology and Physiology: Industrial toxicology (local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems), 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).	8
Module-VI	Safety and Control Programs: Implementation of safety control programs based on the identified hazards, including noise control, radiation safety, chemical hazard management, biological hazard control, ergonomic solutions, occupational health strategies, toxicology management, physiological assessments, and comprehensive safety training and education.	7
Total		43 Hours

Text Books:

1. Benjamin O.Alli, Fundamental Principles of Occupational Health and Safety ILO 2008.
2. DanutaKoradecka, Handbook of Occupational Health and Safety, CRC, 2010.
3. E.J. McCornick, and M. S Sanders, Human Factors in Engineering and Design, Tata McGraw-Hill, 1992.
4. Encyclopedia of "Occupational Health and Safety", Vol.I and II, published by International Labour Office, Geneva, 1985
5. Hand book of "Occupational Safety and Health", National Safety Council, Chicago, 1982.

Reference Books:

1. Lawrence Slote, Handbook of occupational safety and health, Wiley, 2001.
2. Louis J. Di Berardinis, Handbook of occupational safety and health Wiley, 1999.

Course Outcomes: At the end of this course, the students will be able to:

CO1	Identify and control physical hazards.
CO2	Recognize and manage chemical hazards.
CO3	Classify and address biological and ergonomic hazards.
CO4	Understand occupational health principles and toxicology.
CO5	Evaluate job physiological requirements and manage health programs.
CO6	Implement comprehensive safety programs.

Type	Code	Industrial Pollution Control	L-T-P	Credits	Marks
PC	MT-EE-T-PC-105		4-0-0	4	200
Objectives	The objective of this course is to familiarize the students with the 1. To understand and apply water and air pollution laws, standards, and control methods. 2. To develop skills in managing wastewater treatment, sludge treatment, and disposal in various industries. 3. To analyse and implement integrated pollution control strategies using practical case studies.				
Pre-Requisites	Basic understanding of environmental science and engineering principles.				
Teaching Scheme	Regular classroom lectures with use of ICT as and when required,sessions are planned to be interactive with focus on problem solving activities.				
Detailed Syllabus:					
Module	Topics				Hours
Module-I	Water Pollution Laws and Standards:Water pollution laws and standards, industrial wastewater treatment, processes and equipment.				7
Module-II	Water Pollution Control in Chemical Industries:Water pollution control methods specific to different chemical industries, air pollution laws.				7
Module-III	Air Pollution Monitoring and Analysis:Air pollutants monitoring equipment, methods of analysis, air pollution control methods in industries.				8
Module-IV	Sludge Treatment and Disposal:Sludge treatment processes, disposal methods, regulatory standards for sludge management.				6
Module V	Integrated Pollution Control Strategies:Combining water and air pollution control strategies, cross-media pollution prevention.				8
Module-VI	Case Studies and Practical Applications:Case studies of successful pollution control in industries, practical applications and best practices.				7
Total					43 Hours

Text Books:

1. Rao M.N. & Rao H, Air Pollution, Tata Mcgraw Hill
2. Mahajan S.P., Pollution Control in Process Industries, Tata Mcgraw Hill
3. Mccaff&Eddy , Waste Water Treatment

4. Peavy, Environmental Engineering
5. Rao C.S., Environmental Pollution Control Engineering, New Age Int. Pub.
6. Gerard Kiely, Environmental Engineering, McGraw Hill

Reference Books:

1. Nelson & Nemerow, Industrial Water Pollution-Origin, Characteristics and Treatment, Addison, Wesley Publishing Co.
2. Sincero A.P. & Sincero G.A., Environmental Engineering, A Design Approach, Prentice Hall Of India
3. Babbitt H.E, Sewage & Sewage Treatment, John Wiley
4. Abbasi S.A, & Ramasami E, Biotechnical Methods of Pollution Control, Universities Press (India) Ltd.
5. S C. Bhatia, Handbook of industrial pollution control vol-1 and 2.

Course Outcomes: At the end of this course, the students will be able to:

CO1	Understand water pollution laws and wastewater treatment processes.
CO2	Control water pollution in chemical industries and understand air pollution laws.
CO3	Use and analyse air pollution monitoring equipment.
CO4	Manage sludge treatment and disposal.
CO5	Develop integrated pollution control strategies.
CO6	Analyse case studies of successful pollution control.

Type	Code	Industrial Safety Lab-I	L-T-P	Credits	Marks
PC	MT-EE- P-PC-101		4-0-0	4	200
Objectives	The objective of this course is to familiarize the students with the 1. Apply safety principles for various workplace hazards. 2. Develop skills in occupational health management. 3. Implement and manage safety programs in industrial settings.				
Pre-Requisites	Basic understanding of environmental science and engineering principles.				
Teaching Scheme	Regular classroom lectures with use of ICT as and when required,sessions are planned to be interactive with focus on problem solving activities.				
Detailed Syllabus:					
Module	Topics				Hours
Experiment-1	To measure and analyze the sound pressure level of impact noise sources.				2
Experiment-2	To measure and analyze the sound pressure level of continuous noise sources.				2
Experiment-3	To measure and analyze the sound pressure level of intermittent noise sources.				2
Experiment-4	To determine the friction sensitivity of explosive materials.				2
Experiment-5	To evaluate the impact sensitivity of explosive materials.				2
Experiment-6	To measure the burst strength of various packaging materials.				2
Experiment-7	To determine the auto ignition temperature of materials.				2
Experiment-8	To measure the concentrations of Sox, Nox, and Cox in exhaust gases.				2
Experiment-9	To measure and determine environmental parameters such as temperature and humidity.				2
Experiment-10	To measure particle size distribution and analyze air samples.				2
Total					20 Hours

Text Books:

1. "Environmental Science and Engineering" by Maulin P. Shah and DeepanwitaDeka
2. "Introduction to Environmental Engineering and Science" by M. M. Khilar

Reference Books:

1. "Fundamentals of Industrial Hygiene" by Barbara Plog and Patricia Quinlan
2. "Proctor and Hughes' Chemical Hazards in the Workplace" by Gloria J. Hathaway, Nick H. Proctor, and James P. Hughes

Course Outcomes: At the end of this course, the students will be able to:

CO1	Identify and control physical hazards.
CO2	Recognize and manage chemical hazards.
CO3	Classify and address biological and ergonomic hazards.
CO4	Understand occupational health principles and toxicology.
CO5	Evaluate job physiological requirements and manage health programs.
CO6	Implement comprehensive safety programs.

Second Semester

Type	Code	Safety in Process Equipment	L-T-P	Credits	Marks
PC	MT-EE-T-PC- 201		4-0-0	4	200
Objectives	The objective of this course is to familiarize the students with the 1. Apply safety principles in process and pressure system design. 2. Develop skills in evaluating reactor and system safety. 3. Implement comprehensive safety management programs.				
Pre-Requisites	Basic understanding of chemical engineering principles.				
Teaching Scheme	Regular classroom lectures with use of ICT as and when required,sessions are planned to be interactive with focus on problem solving activities.				
Detailed Syllabus:					
Module	Topics				Hours
Module-I	Safety in Process Design and Pressure System Design:Design process, conceptual design and detail design, assessment, inherently safer design, chemical reactors (types, batch reactors), reaction hazard evaluation, reactor safety, operating conditions, unit operations and equipment, utilities. Pressure system, pressure vessel design, standards and codes, pipe works and valves, heat exchangers, process machinery, overpressure protection, pressure relief devices and design, fire relief, vacuum and thermal relief, special situations, disposal, flare and vent systems, failures in pressure system, hazard assessment.				7
Module-II	Plant Commissioning and Inspection: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 monitoring, vibration, corrosion, acoustic emission, pipeline inspection.				7
Module-III	Plant Maintenance, Modification, and Emergency Planning: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 and controls. Emergency planning: disaster planning, onsite emergency, offsite emergency, APELL.				8

Module-IV	Storages and Transportation: General considerations for storage: petroleum product storages, storage tanks and vessels, storage layout, segregation, separating distance, secondary containment. Venting and relief: atmospheric vent, pressure, vacuum valves, flame arrestors, spark arrestor, fire relief, fire prevention and protection. LPG storages: pressure storages, layout, instrumentation, vaporizers, refrigerated storages. Cryogenic storage: LNG storages, hydrogen storages, toxic storages, toxic release and control methodologies, chlorine storages, ammonia storages, other chemical storages, underground storages, loading and unloading facilities, drum and cylinder storage, pressure vessel storage, importance of ullage, warehouse storage. Hazard assessment of LPG and LNG, hazards during transportation, pipeline transport.	6
Module V	Plant Operations: Operating discipline, operating procedure and inspection, format, emergency procedures, handover and permit system, startup and shutdown operation, refinery units, operation of fired heaters, dryers, storage, operating activities and hazards, trip systems, exposure of personnel. Specific safety considerations for cement, paper, pharmaceutical, petroleum, petrochemical, rubber, fertilizer, and distilleries.	8
Module-VI	Integrated Safety Management: Integration of safety principles across design, commissioning, operations, maintenance, and emergency planning. Application of safety standards and regulations, development of comprehensive safety management plans, continuous improvement of safety practices, and implementation of industry best practices.	7
Total		43 Hours

Text Books:

1. "Safety and Health for Engineers" by Roger L. Brauer
2. "Environmental Engineering: Fundamentals, Sustainability, Design" by James R. Mihelcic and Julie B. Zimmerman

Reference Books

1. "Lees' Loss Prevention in the Process Industries" by Sam Mannan
2. "Industrial Safety and Health Management" by C. Ray Asfahl and David W. Rieske

Course Outcomes: At the end of this course, the students will be able to:

CO1	Identify and control physical hazards.
CO2	Manage chemical hazards in industrial settings.
CO3	Address biological and ergonomic hazards.
CO4	Implement occupational health and safety principles.
CO5	Evaluate and improve reactor and pressure system safety.

CO6

Apply safety standards in design and operations.

Type	Code	Computer Aided Hazard Analysis	L-T-P	Credits	Marks
PC	MT-EE-T-PC- 202		4-0-0	4	200
Objectives	The objective of this course is to familiarize the students with the 1. To understand and apply methodologies for hazard and risk assessment. 2. To develop skills in using advanced instruments and software for safety testing and risk analysis. 3. To implement effective risk management strategies in industrial settings.				
Pre-Requisites	Basic understanding of chemical engineering principles and industrial safety concepts.				
Teaching Scheme	Regular classroom lectures with use of ICT as and when required,sessions are planned to be interactive with focus on problem solving activities.				
Detailed Syllabus:					
Module	Topics				Hours
Module-I	Hazard, Risk Issues, and Hazard Assessment: Introduction to hazards, risk issues, hazard monitoring, 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 procedures, methodologies, safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis (PHA), human error analysis, hazard operability studies (HAZOP), safety warning systems.				7
Module-II	Computer-Aided Instruments: Applications of advanced equipment 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), Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test.				7
Module-III	Risk Analysis Quantification and Software: Fault Tree Analysis, 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 for risk analysis, CISCON, FETI, HAMGARS modules on heat radiation, pool fire, jet explosion, reliability software for FMEA for mechanical and electrical systems.				8

Module-IV	Consequences Analysis and Credibility of Risk Assessment Techniques: 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 vapor release, liquid release, two-phase release, heat radiation effects, BLEVE, pool fires and jet fire, gas/vapor dispersion, explosion, UVCE and flash fire, explosion effects and confined explosion, toxic effects, plotting the damage distances on plant/layout, past accident analysis for hazard and consequences analysis, Mexico disaster, Flixborough, Bhopal, Seveso, Pasadena, Feyzin disaster (1966), Port Hudson disaster, convey report, hazard assessment of non-nuclear installations, Rijnmond report, risk analysis of potentially hazardous industrial objects, Rasmussen masses report, reactor safety study of nuclear power plants.	6
Module V	Integration and Application of Safety Principles: Integration of hazard and risk assessment techniques into industrial operations, application of advanced instruments and software for safety testing, development of comprehensive safety management strategies, continuous improvement of safety practices.	8
Module-VI	Case Studies and Practical Applications: Analysis of real-world case studies and past accidents, application of risk assessment and safety management strategies, practical exercises and simulations to reinforce learning.	7
Total		43 Hours

Text Books:

1. Brown, D.B. System analysis and Design for safety, Prentice Hall, 1976.
2. Course Material Intensive Training Programme on Consequence Analysis, by IICT, Tarnaka and CLRI, Chennai.
3. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process safety, AIChE 1992
4. Hazop and Hazom, by Trevor A Klett, Institute of Chemical Engineering.

Reference Books

1. ILO- Major Hazard control- A practical Manual, ILO, Geneva, 1988.
2. Loss Prevention in Process Industries-Frank P. Less Butterworth-Hein UK 1990 (Vol.I, II and III)
3. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council, UK
4. Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety.

Course Outcomes: At the end of this course, the students will be able to:

CO1	Understand and apply hazard and risk assessment methodologies.
CO2	Utilize advanced computer-aided instruments for safety testing.
CO3	Perform quantitative risk analysis using specialized software.
CO4	Analyze the consequences of chemical hazards and accidents.
CO5	Develop effective risk management strategies based on past accident analysis.
CO6	Ensure safety in nuclear and other high-risk industrial environments.

Type	Code	Nuclear and Radiation Engineering Safety	L-T-P	Credits	Marks
PC	MT-EE-T-PC- 203		4-0-0	4	200
Objectives	The objective of this course is to familiarize the students with the 1. Apply nuclear physics principles in reactor design. 2. Evaluate reactor safety and radiation control measures. 3. Learn from historical nuclear incidents to improve safety.				
Pre-Requisites	Basic understanding of physics and nuclear engineering concepts.				
Teaching Scheme	Regular classroom lectures with use of ICT as and when required,sessions are planned to be interactive with focus on problem solving activities.				
Detailed Syllabus:					
Module	Topics				Hours
Module-I	Introduction to Nuclear Physics and Radiation:Binding energy, fission process, radioactivity, alpha rays, beta rays, 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.				7
Module-II	Reactor Control and Types:Control requirements in design considerations, means of control, control and shutdown rods, operation and operational problems, control rod worth, control instrumentation and monitoring, online central data processing system, boiling water reactors, radioactivity of steam system, direct cycle and dual cycle power plants, pressurized water reactors, pressurized heavy water reactors, fast breeder reactors, role in power generation in the Indian context, conversion and breeding, doubling time, liquid metal coolants, nuclear power plants in India.				7
Module-III	Safety of Nuclear Reactors: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, emergency preparedness, accident case studies, Three Mile Island accident, Chernobyl accident.				8
Module-IV	Radiation Control: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.				6

Module V	Integrated Safety and Operational Practices: Integration of safety design principles in reactor operations, application of control and safety systems, continuous monitoring and management of radiation, development of comprehensive safety strategies, public safety and emergency preparedness programs.	8
Module-VI	Case Studies and Practical Applications: Analysis of historical nuclear reactor accidents, application of safety and radiation control measures, practical exercises and simulations to reinforce safety protocols, review of nuclear power plants in India, lessons learned, improvements in safety standards.	7
Total		43 Hours

Text Books:

1. “Loss prevention in the process Industries” Frank P.Lees Butterworth-Hein-UK, 1990.
2. Loffness, R.L., “Nuclear Power Plant” Van Nostrand Publications, 1979.
3. M.M.E.L.Wakil, “Nuclear Energy Conversion”, International Text Book Co.
4. M.M.E.L.Wakil, “Nuclear Power Engineering”, International Text Book Co.
5. R.L.Murray, “Introduction to Nuclear Engineering”, Prentice Hall.

Reference Books

1. Sri Ram K, “Basic Nuclear Engineering” Wiley Eastern Ltd., New Delhi, 1990.
2. StermanU.S.””Thermal and Nuclear Power Stations”, MIR Publications, Moscow, 1986.

Course Outcomes: At the end of this course, the students will be able to:

CO1	Understand binding energy, fission, and radioactivity.
CO2	Analyze reactor control mechanisms and types.
CO3	Apply nuclear reactor safety principles.
CO4	Manage radiation control and exposure.
CO5	Study historical nuclear accidents.
CO6	Understand nuclear power generation in India.

Type	Code	Fire Engineering and Explosion Control	L-T-P	Credits	Marks
PC	MT-EE-T-PC- 204		4-0-0	4	200
Objectives	The objective of this course is to familiarize the students with the 1. Apply fire physics and chemistry principles. 2. Develop fire prevention and suppression skills. 3. Improve safety practices from incident analysis.				
Pre-Requisites	Basic knowledge of chemistry, physics, and engineering.				
Teaching Scheme	Regular classroom lectures with use of ICT as and when required,sessions are planned to be interactive with focus on problem solving activities.				
Detailed Syllabus:					
Module	Topics				Hours
Module-I	Physics and Chemistry of Fire:Fire properties of solids, liquids, and gases, fire spread, toxicity of combustion products, theory of combustion and explosion, vapour clouds, flash fires, 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).				7
Module-II	Fire Prevention and Protection:Sources of ignition, fire triangle, principles of fire extinguishing, active and passive fire protection systems, classes of fires (A, B, C, D, E), types of fire extinguishers, fire stoppers, hydrant pipes, hoses, monitors, fire watchers, layout of standpipes, fire station, fire alarms and sirens, maintenance of fire trucks, foam generators, escape from fire, rescue operations, fire drills, notice, first aid for burns.				7
Module-III	Fire Suppression Systems:Sprinklers, hydrants, standpipes, special fire suppression systems (deluge and emulsifier), selection criteria, 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 in flammability, firefighting systems.				8
Module-IV	Building Fire Safety: Objectives of fire-safe building design, fire load, fire-resistant material and fire testing, structural fire protection, structural integrity, concept of egress design, exits, width calculations, fire certificates, fire safety requirements for high-rise buildings.				6

Module V	Explosion Protecting Systems: Principles of explosion, detonation and blast waves, explosion parameters, explosion protection, containment, flame arrestors, isolation, suppression, venting, explosion relief of large enclosures, explosion venting, inert gases, plant for generation of inert gas, rupture disc in process vessels and lines, explosion suppression system based on carbon dioxide (CO ₂) and halons, hazards in LPG, ammonia (NH ₃), sulphur dioxide (SO ₂), chlorine (Cl ₂), etc.	8
Module-VI	Case Studies and Practical Applications: Case studies on Flixborough, Mexico disaster, Pasadena Texas, Piper Alpha, Peterborough and Bombay Victoria dock ship explosions, analysis of fire and explosion incidents, lessons learned, and best practices for prevention and protection.	7
Total		43 Hours

Text Books:

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

Reference Books

1. Fire fighters hazardous materials reference book Fire Prevention in Factories”, anNostrand Rein Hold, New York, 1991.
2. Gupta, R.S., “Hand Book of Fire Technology” Orient Longman, Bombay 1977.
3. Relevant Indian Acts and rules, Government of India.

Course Outcomes: At the end of this course, the students will be able to:

CO1	Understand fire properties and behaviours.
CO2	Identify fire prevention systems.
CO3	Implement fire suppression techniques.
CO4	Design fire-safe buildings.
CO5	Apply explosion protection principles.
CO6	Analyse fire and explosion case studies.

Type	Code	Quality and Reliability Management	L-T-P	Credits	Marks
PC	MT-EE-T-PE- 205		4-0-0	4	200
Objectives	The objective of this course is to familiarize the students with the 1. To understand and apply the principles of quality management and control. 2. To develop skills in statistical process control, acceptance sampling, and reliability analysis. 3. To implement and improve quality standards and techniques in various industrial settings.				
Pre-Requisites	Basic understanding of statistics, probability, and fundamental engineering concepts.				
Teaching Scheme	Regular classroom lectures with use of ICT as and when required,sessions are planned to be interactive with focus on problem solving activities.				
Detailed Syllabus:					
Module	Topics				Hours
Module-I	Attributes of Quality and Quality Management Evolution:Attributes of quality, evolution of quality management (inspection, quality control, quality assurance, Total Quality Management), cost of quality.				7
Module-II	Acceptance Sampling:Design of single sampling plan, double, multiple, and sequential sampling plans, O.C. curve, producer's risk, consumer's risk, AOQ (Average Outgoing Quality), AOQL (Average Outgoing Quality Limit).				7
Module-III	Statistical Process Control and Experimental Designs:Statistical process control, use of control charts (X-Chart, R-Chart, p-chart, np-chart, c-chart, cusum-chart), process capability analysis, statistical tolerance analysis, experimental designs, factorial experiments, 2k factorial experiments, Taguchi philosophy, loss function, signal to noise ratio, orthogonal arrays for parameter and tolerance design.				8
Module-IV	Reliability and Maintenance:Reliability vs. quality, reliability function (MTBF, MTTR, availability), bathtub curve, time-dependent failure models (distributions: normal, Weibull), reliability of system and models (serial, parallel, combined configuration), economic analysis, life cycle cost, proactive maintenance, preventive maintenance, predictive maintenance, maintainability, availability				6
Module V	Quality Improvement and Standards:Fundamentals of TQM (Total Quality Management), philosophies (Deming, Juran, Crosby), quality circle, QC tools, service quality, quality standards (product and process standard), ISO 9000 and 14000 standards, Six Sigma, lean management, TPM (Total Productive Maintenance).				8

Module-VI	Advanced Quality Techniques: Advanced quality control techniques, integration of quality management systems, continuous improvement processes, case studies of successful quality management implementations.	7
Total		43 Hours

Text Books:

1. Srinath L.S, “Reliability Engineering”, Affiliated East-West Press Pvt Ltd, New Delhi, 1998.
2. Modarres, “Reliability and Risk analysis”, Maral Dekker Inc.1993.
3. John Davidson, “The Reliability of Mechanical system” published by the Institution of Mechanical Engineers, London, 1988.

Reference Books

1. Smith C.O. “Introduction to Reliability in Design”, McGraw Hill, London, 1976.

Course Outcomes: At the end of this course, the students will be able to:

CO1	Understand the attributes and evolution of quality management.
CO2	Design and implement acceptance sampling plans.
CO3	Utilize statistical process control and experimental designs.
CO4	Apply reliability concepts and maintenance strategies.
CO5	Implement quality improvement philosophies and standards.
CO6	Integrate advanced quality techniques into continuous improvement processes.

Third Semester

Type	Code	Construction Safety	L-T-P	Credits	Marks
PE	MT-EE-T-PE-302		4-0-0	4	200
Objectives	The objective of this course is 1. To understand the causes and management of construction-related accidents. 2. To develop skills in hazard prevention and safety practices. 3. To apply safe working techniques and standards in various construction activities.				
Pre-Requisites	Basic understanding of construction processes and safety regulations.				
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.				
Detailed Syllabus:					
Module	Topics				Hours
Module-I	Accidents Causes and Management Systems: Problems impeding safety in the construction industry, causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accidents, construction regulations, contractual clauses, pre-contract activities, preconstruction meeting, design aids for safe construction, permits to work, quality assurance in construction, compensation, recording of accidents and safety measures, education and training.				7
Module-II	Hazards of Construction and Prevention: Excavations, basement and wide excavation, trenches, shafts, scaffolding, types, causes of accidents, scaffold inspection checklist, false work, erection of structural framework, 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.				7
Module-III	Working at Heights: Fall protection in construction OSHA 3146, OSHA requirements for working at heights, safe access and egress, safe use of ladders, scaffoldings, requirements 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.				8
Module-IV	Construction Machinery: Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist, 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.				6

Module V	Safety in Demolition Work: Safety in demolition work, manual, mechanical, using explosives, 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 prevention methods, interesting experiences at the construction site against fire accidents.	8
Module-VI	Case Studies and Practical Applications: Analysis of real-world case studies, application of safety management systems, practical exercises and simulations, lessons learned from past accidents, best practices for prevention and protection in the construction industry.	7
Total		43 Hours

Text Books:

1. Hudson, R., "Construction hazard and Safety Hand book, Butter Worth's, 1985.
2. JnatheaD.Sime, "Safety in the Build Environment", London, 1988.
3. V.J.Davies and K.Thomasin "Construction Safety Hand Book" Thomas Telford Ltd., London, 1990.

Reference Books:

1. Handbook of OSHA Construction safety and health charles D. Reese and James V. Edison
2. Fulman, J.B., *Construction Safety, Security, and Loss Prevention*, John Wi

Course Outcomes: At the end of this course, the students will be able to:

CO1	Identify and analyze the causes of accidents in the construction industry.
CO2	Implement effective safety measures and management systems in construction.
CO3	Understand and prevent various construction hazards.
CO4	Apply safe working practices for heights and machinery.
CO5	Ensure safety in demolition work.
CO6	Analyze case studies to improve safety standards in construction.

Type	Code	Mining Safety	L-T-P	Credits	Marks
PE	MT-EE-T-PE-302		4-0-0	4	200
Objectives	The objective of this course is 1. To understand the causes and management of mining-related accidents. 2. To develop skills in hazard prevention and safety practices in mining. 3. To apply risk assessment and accident management techniques in various mining activities.				
Pre-Requisites	Basic understanding of mining processes and safety regulations.				
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.				
Detailed Syllabus:					
Module	Topics				Hours
Module-I	Safety in Opencast Mines: Causes and prevention of accidents from heavy machinery, belt and bucket conveyors, drilling, hand tools, pneumatic systems, pumping, water, dust, electrical systems, fire prevention, garage safety, accident reporting system, working conditions, safe transportation, handling of explosives.				7
Module-II	Safety in Underground Mines: Fall of roof and sides, effect of gases, fire and explosions, water flooding, warning sensors, gas detectors, occupational hazards, working conditions, winding and transportation.				7
Module-III	Tunnelling Safety: Hazards from ground collapse, inundation and collapse of tunnel face, falls from platforms and danger from falling bodies, atmospheric pollution (gases and dusts), trapping, transport, noise, electrical hazards, noise and vibration from pneumatic tools and other machines, ventilation and lighting, personal protective equipment.				8
Module-IV	Risk Assessment: Basic concepts of risk, reliability and hazard potential, elements of risk assessment, statistical methods, control charts, appraisal of advanced techniques, fault tree analysis, failure mode and effect analysis, quantitative structure-activity relationship analysis, fuzzy model for risk assessment.				6
Module V	Accident Analysis and Management: Accidents classification and analysis (fatal, serious, minor and reportable accidents), safety audits, recent developments in safety engineering approaches for mines, frequency rates, accident occurrence, investigation, measures for improving safety in mines, cost of accidents, emergency preparedness, disaster management.				8

Module-VI	Case Studies and Practical Applications: Analysis of real-world case studies, practical exercises and simulations, lessons learned from past accidents, best practices for prevention and protection in mining safety.	7
Total		43 Hours

Text Books:

1. “Mine Health and Safety Management”, Michael Karmis ed., SME, Littleton, Co.2001.

Reference Books:

1. Kejriwal, B.K. Safety in Mines, GyanPrakashan, Dhanbad, 2001.
2. DGMS Circulars-Ministry of Labour, Government of India press, OR Lovely Prakashan-DHANBAD, 2002.

Course Outcomes: At the end of this course, the students will be able to:

CO1	Identify and analyze the causes of accidents in opencast mines.
CO2	Implement effective safety measures in underground mines.
CO3	Apply tunnelling safety practices to prevent hazards.
CO4	Conduct thorough risk assessments in mining operations.
CO5	Analyze and manage mining accidents efficiently.
CO6	Apply lessons from case studies to improve mining safety standards.