

M.E. (Industrial Safety Engineering)
2024 Regulations, Curriculum & Syllabi



BANNARI AMMAN INSTITUTE OF TECHNOLOGY

An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with 'A+' Grade

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M.E-INDUSTRIAL SAFETY ENGINEERING

Vision of the Department

Seek excellence in the field of Mechanical Engineering education through knowledge and skills to cater to the requirements of the society.

Mission of the Department

- I. To continuously improving the teaching and learning process to enable students to meet the global needs.
- II. To upgrade the knowledge and skills of students, members of faculty and supporting staff through regular training.
- III. To produce the best minds of engineers capable of meeting expectations of Industry, Society and Entrepreneurship development.

M.E. INDUSTRIAL SAFETY ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- I. Possess a mastery of health safety and environmental knowledge and safety management skills to reach higher levels in their profession.
- II. Competent safety engineer rendering professional expertise to the industrial and societal needs at national and global level subject to legal requirements.
- III. Effectively communicate information on health, safety, and environment, facilitating collaboration with experts across various disciplines to create and execute safe methodology in complex engineering activities.

PROGRAMME OUTCOMES (POs)

The Graduate will be able to

1. Apply knowledge of Engineering Specialization for Hazard identification risk assessment analysis of the cause of the incident and control of occupational health safety and environmental problems
2. Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.
3. Recognize and evaluate occupational health safety, and legal issues at the workplace to determine appropriate hazard controls following the hierarchy of controls relevant to occupational health and safety practices.
4. Conduct investigation analyzes the root cause and can generate corrective and preventive measures to prevent recurrence of accidents in industries.
5. Create, select, and apply modern Safety and Fire Engineering and IT tools to complex engineering activities with an understanding of the limitations.
6. Effectively communicate the safety matters rules, and regulations to the employee's society for safe handling of equipment and maintain the safe working environment in industries.

MAPPING OF PEOs WITH POs

POs	1	2	3	4	5	6
PEO I	X	X				X
PEO II		X	X	X	X	X
PEO III				X	X	X

ME INDUSTRIAL SAFETY ENGINEERING-R2024										
Minimum Credits to be Earned: 71										
I SEMESTER										
Course Code	Course Title	L	T	P	C	Hours/Week	Maximum Marks			Category
							CA	SEE	Total	
24RM11	Research Methodology and IPR	2	0	0	2	2	40	60	100	ES
24IS12	Mathematics for Engineering Application	3	0	0	3	3	40	60	100	BS
24IS13	Occupational Health and Hygiene	3	0	0	3	3	40	60	100	PC
24IS14	Regulations for Health, Safety and Environment	4	0	0	4	4	40	60	100	PC
24IS15	Safety Management	3	0	0	3	3	40	60	100	PC
24IS16	Plant Layout and Material Handling	3	0	0	3	3	40	60	100	PC
24IS17	Environmental Analysis Laboratory	0	0	4	2	4	60	40	100	PC
24IS18	Industrial Hygiene and Ergonomics Laboratory	0	0	4	2	4	60	40	100	PC
	Audit course I	2	0	0	-	2	100	0	100	EEC
Total		20	0	8	22	28	-	-	-	-
II SEMESTER										
Course Code	Course Title	L	T	P	C	Hours/Week	Maximum Marks			Category
							CA	SEE	Total	
24IS21	Safety in Engineering Industry	3	0	0	3	3	40	60	100	PC
24IS22	Fire Engineering and Explosion Control	3	0	0	3	3	40	60	100	PC
24IS23	Electrical Safety	3	0	0	3	3	40	60	100	PC
24IS24	Risk Analysis	3	0	0	3	3	40	60	100	PC
	Program Elective I	3	0	0	3	3	40	60	100	PE
	Program Elective II	3	0	0	3	3	40	60	100	PE
24IS26	Industrial Fire and Electrical Safety Laboratory	0	0	4	2	4	60	40	100	PC
24IS27	Mini Project	0	0	4	2	4	100	0	100	PC
	Audit course II	2	0	0	-	2	100	0	100	EEC
Total		20	0	8	22	28	-	-	-	-
III SEMESTER										
Course Code	Course Title	L	T	P	C	Hours/Week	Maximum Marks			Category
							CA	SEE	Total	
	Program Elective III	3	0	0	3	3	40	60	100	PE
	Program Elective IV	3	0	0	3	3	40	60	100	PE
	Program Elective V	3	0	0	3	3	40	60	100	PE
24IS34	Dissertation Phase I	0	0	12	6	12	60	40	100	EEC
Total		9	0	12	15	21	-	-	-	-

IV SEMESTER										
Course Code	Course Title	L	T	P	C	Hours/Week	Maximum Marks			Category
							CA	SEE	Total	
24IS41	Dissertation Phase II	0	0	24	12	24	60	40	100	EEC
Total		0	0	24	12	24	-	-	-	-

ELECTIVES										
PROFESIONAL ELECTIVES										
Course Code	Course Title	L	T	P	C	Hours/Week	Maximum Marks			Category
							CA	SEE	Total	
LIST OF PROFESIONAL ELECTIVES										
24IS51	Artificial Intelligence and Industrial Safety	3	0	0	3	3	40	60	100	PE
24IS52	Nuclear Engineering and Safety	3	0	0	3	3	40	60	100	PE
24IS53	Industrial Noise and Vibration Control	3	0	0	3	3	40	60	100	PE
24IS54	Safety in Powder Handling	3	0	0	3	3	40	60	100	PE
24IS55	Safety in Chemical Industries	3	0	0	3	3	40	60	100	PE
24IS56	Environmental Pollution Control	3	0	0	3	3	40	60	100	PE
24IS57	Environmental Impact Assessment	3	0	0	3	3	40	60	100	PE
24IS58	Safety in Petrochemical Industries	3	0	0	3	3	40	60	100	PE
24IS59	Transport Safety	3	0	0	3	3	40	60	100	PE
24IS60	Safety in On-Shore and Off-Shore Drilling	3	0	0	3	3	40	60	100	PE
24IS61	Safety in Mines	3	0	0	3	3	40	60	100	PE
24IS62	Maintenance Engineering	3	0	0	3	3	40	60	100	PE
24IS63	Work Study and Ergonomics	3	0	0	3	3	40	60	100	PE
24IS64	Waste Water Management	3	0	0	3	3	40	60	100	PE
24IS65	Reliability Engineering	3	0	0	3	3	40	60	100	PE
24IS66	Management System Standards	3	0	0	3	3	40	60	100	PE
24IS67	Safety in Construction	3	0	0	3	3	40	60	100	PE
24IS68	Safety in Textile Industry	3	0	0	3	3	40	60	100	PE
LIST OF AUDIT COURSES I & II										
24XE01	English for Research Paper Writing	2	0	0	-	2	100	0	100	EEC
24XE02	Cost Management of Engineering Projects	2	0	0	-	2	100	0	100	EEC
24XE03	Stress Management	2	0	0	-	2	100	0	100	EEC
24XE04	Disaster Management	2	0	0	-	2	100	0	100	EEC

24XE05	Value Education	2	0	0	-	2	100	0	100	EEC
24XE06	Pedagogy Studies	2	0	0	-	2	100	0	100	EEC
24XE07	Business Analytics	2	0	0	-	2	100	0	100	EEC

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER				TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV			Min	Max
1	BS	3	-	-	-	3	4.22	2%	10%
2	ES	2	-	-	-	2	2.81	2%	10%
3	HSS	-	-	-	-	-	-	-	-
4	PC	12	12	-	-	24	33.80	30%	40%
5	PE	-	6	9	-	15	21.12	20%	30%
6	EEC	5	4	6	12	27	38.02	30%	40%
Total		22	22	15	12	71	100	-	-

- BS - Basic Sciences
 ES - Engineering Sciences
 HSS - Humanities and Social Sciences
 PC - Professional Core
 PE - Professional Elective
 EEC - Employability Enhancement Course
 CA - Continuous Assessment
 ES - End Semester Examination

24RM11	RESEARCH METHODOLOGY AND IPR				L	T	P	C
					2	0	0	2
Pre-requisite				Assessment Pattern				
<ul style="list-style-type: none"> Knowledge of research process. Research ethics. 				Mode of Assessment			Weightage(%)	
				Continuous Internal Assessment			40	
				Semester End Examinations			60	
Course Objectives								
<ul style="list-style-type: none"> To introduce the basics of research methodology. To know the sampling methods used in research methodology. To study the method of hypothesis testing. To learn the procedures for carrying out design of experiments. To educate on optimization and report writing. 								
Programme Outcomes (POs)								
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Analyze the research problem formulation.							
CO2	Analyze research related information.							
CO3	Apply the IPR in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property.							
CO4	Right to be promoted among students in general & engineering.							
CO5	Analyze IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1	3			3			
	2	3			3			
	3	3			3			
	4	3			2			
	5	3			2			
Unit I	Meaning Of Research Problem							6 Hours
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.								

Unit II	Effective Literature	6 Hours
Effective Literature studies approaches-analysis-Plagiarism-Research ethics- Review of the literature, Searching the existing literature, reviewing the selected literature, developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.		
Unit III	Effective Technical Writing	6 Hours
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.		
Unit IV	Nature Of Intellectual Property	6 Hours
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.		
UNIT V	Patent Rights	6 Hours
Patent Rights: Scope of Patent Rights, Licensing and transfer of Technology, Patent information and databases-Geographical Indications. New Developments in IPR: Administration of Patent system, IPR of Biological systems, Computer Software-Traditional knowledge - Case studies.		
Total		30 Hours
References		
<ol style="list-style-type: none"> 1. Stuart Melville and Wayne Goddard, Research methodology: An introduction for science & engineering students,1996. 2. Wayne Goddard and Stuart Melville, Research Methodology: An Introduction 3. Ranjit Kumar, 2nd Edition, Research Methodology: A Step-by-Step Guide for beginners 4. Halbert, Resisting Intellectual Property, Taylor & Francis Ltd, 2007. 5. Mayall, Industrial Design, McGraw Hill, 1992. 6. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 4th Edition, Cengage Learning, 2012. 7. Bansal K and Bansal P, Fundamentals of Intellectual Property for Engineers, BS Publications, 2013. 8. Markel, Mike, Technical Communication. 11th Edition, Mac Millan, 2015. 9. Pagadala Suganda Devi, Research Methodology: A Handbook for Beginners, Notion Press, 2017. 		

24IS12	MATHEMATICS FOR ENGINEERING APPLICATION			L	T	P	C		
				3	0	0	3		
Pre-requisite				Assessment Pattern					
<ul style="list-style-type: none"> Basic Statistics inference techniques. Hypothesis testing and analysis of variance to engineering problems. 				Mode of Assessment			Weightage(%)		
				Continuous Internal Assessment			40		
				Semester End Examinations			60		
Course Objectives									
<ul style="list-style-type: none"> Exemplify the different approaches of Probability theory, which will enable them in the decision making in the face of uncertainty. Summarize and apply the concepts of Statistics in solving safety engineering problems. Understand the concept of joint, marginal and conditional probability distribution. Provide knowledge on root causes of the failure events using the concepts of testing of hypothesis. Understand the design of experiments can help in optimizing the industrial processes. 									
Programme Outcomes (POs)									
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.								
PO4	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.								
Course Outcomes (COs)									
The students will be able to									
CO1	Construct probabilistic models for observed phenomena in risk analysis for the safety of industries.								
CO2	Apply the knowledge of probability distributions for designing safety criteria of national and international grounding standards.								
CO3	Demonstrate the concept of joint, marginal and conditional probability distribution involving two random variables for assessing the radioactive waste disposal in industries.								
CO4	Analyze the root causes of the failure events using the concepts of testing of hypothesis.								
CO5	Illustrate how design of experiments can help in optimizing the industrial processes operated under open-loop control systems.								
Articulation Matrix									
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6		
	1	3			2				
	2	3			3				
	3	3			3				
	4	3			2				
	5	2			2				

Unit I	Probability	9 Hours
Axioms of probability - Addition and multiplication theorems on probability - Conditional probability - Bayes theorem (problems only) - Random variable: Continuous and discrete random variables - Discrete distributions: Binomial and Poisson - Continuous distributions: Normal, Exponential and Weibull - Simple problems and properties.		
Unit II	Correlation And Curve Fitting	9 Hours
Correlation properties and problems - Rank correlation - Multiple and Partial Correlations Principle of least squares: Fitting of straight line, exponential curve and power curve.		
Unit III	Parametric Methods	9 Hours
Hypothesis testing: One sample and two sample tests for mean and proportion of large samples (z-test) - One sample and two sample tests for means of small samples (t-test) - F-test.		
Unit IV	Non-Parametric Methods	9 Hours
Chi-square test for independence of attributes and goodness of fit - Sign test for paired data - Kolmogorov Smirnov test for goodness of fit - Rank sum test: Mann–Whitney U test, Kruskal Wallis test - One sample run test - Rank correlation.		
UNIT V	Design Of Experiments	9 Hours
Basic principles of experimental designs - Analysis of variance: one-way, Two-way classifications - Latin square design - 2 Factorial Design.		
		Total
		45 Hours
References		
<ol style="list-style-type: none"> 1. Johnson R.A., Miller & Friends: Probability and Statistics for Engineers , Pearson Education, 8th Edition, 2013. 2. Walpole R.E , Myers R.H, Myers R.S.L and Ye K, Probability and Statistics for Engineers and Scientists , Pearsons Education, Delhi , 2002. 3. Lipschutz S and Schiller J, Schaums outline Series: Introduction to Probability and Statistics, McGraw Hill Publications, New Delhi, 1998. 4. Ross. S , A first Course in Probability , 8th Edition, Pearson Education , New Jersey, 2010. 5. D. C. Lay, Linear Algebra and its Applications, Addison Wesley, Massachusetts, Fourth edition, 2012. 		

24IS13	OCCUPATIONAL HEALTH AND HYGIENE				L	T	P	C
					3	0	0	3
Pre-requisite				Assessment Pattern				
<ul style="list-style-type: none"> Threshold limit values hazardous exposure. Workplace exposure assessment. 				Mode of Assessment			Weightage(%)	
				Continuous Internal Assessment			40	
				Semester End Examinations			60	
Course Objectives								
<ul style="list-style-type: none"> To provide knowledge on physical hazards of an industrial unit. To provide knowledge on chemical hazards of an industrial unit. To expose the biological and ergonomic hazards present in an industrial unit. To impart knowledge on occupational health and toxicology. To introduce the topic of occupational physiology. 								
Programme Outcomes (POs)								
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognize and evaluate occupational health safety, and legal issues at the workplace to determine appropriate hazard controls following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	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.							
Course Outcomes (COs)								
The students will be able to								
CO1	Identify the physical hazards present in the occupation of an industrial unit.							
CO2	State the chemical hazards present in the occupation an industrial unit.							
CO3	Indicate the biological and ergonomic hazards present in an industrial unit.							
CO4	Find out the toxic effects on heath while handling different chemicals.							
CO5	Use the elements of occupational physiology of an industrial unit.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1		3	3	2			
	2		3	2	3			
	3		3	3	3			
	4		3	2	2			
	5		2	2	2			
Unit I	Physical Hazards							10 Hours
Noise, compensation aspects, noise exposure regulation occupational damage, risk factors, sound measuring instruments, octave band analyser, 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, TLV- cold environments, hypothermia, wind chill index, control measures- hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control.		
Unit II	Chemical Hazards	10 Hours
Recognition of chemical hazards- types, concentration, Exposure vs. dose, TLV - Methods of Evaluation, process or operation description, Field Survey, Sampling methodology, Industrial Hygiene calculations, Comparison with OSHAS Standard. Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures, Gas and Vapour monitors, dust sample collection devices, personal sampling. Methods of Control - Engineering Control, Design maintenance considerations, design specifications - General Control Methods - training and education.		
Unit III	Biological And Ergonomic Hazards	9 Hours
Classification of Biohazardous agents - bacterial agents, rickettsia and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets - building design. Work Related Musculoskeletal Disorders - carpal tunnel syndrome CTS- Tendon pain- disorders of the neck- back injuries.		
Unit IV	Occupational Health And Toxicology	9 Hours
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. Gas poisoning their effects and prevention - cardiopulmonary resuscitation, audiometric tests, eye tests, vital function tests - Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems.		
UNIT V	Occupational Physiology	9 Hours
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.		
Total		45 Hours
References		
<ol style="list-style-type: none"> 1. Louis J. Di Berardinis, Handbook of occupational safety and health, Wiley, 1999 2. Danuta Koradecka, Handbook of Occupational Health and Safety, CRC, 2010. 3. Lawrence Slote, Handbook of occupational safety and health, Wiley, 2001. 4. John W. Cherrie, Reducing occupational exposure to chemical carcinogens, Oxford journal of occupational medicine (2009). 5. Barbara A.Plog, Patricia J.Quinlan, MPH, CIH and Jennifer Villareal Fundamentals of Industrial Hygiene, 6th edition 2012, National Safety Council, 2012. 6. Encyclopaedia of , Vol.I and II, International Labour Office, Geneva, 2011. 		

24IS14	REGULATIONS FOR HEALTH, SAFETY AND ENVIRONMENT				L	T	P	C
					4	0	0	4
Pre-requisite		Assessment Pattern						
<ul style="list-style-type: none"> Interpret the safety and health provision. Compensations towards social security. 		Mode of Assessment				Weightage(%)		
		Continuous Internal Assessment				40		
		Semester End Examinations				60		
Course Objectives								
<ul style="list-style-type: none"> To introduce the statutory provisions of The Factory Act and Rules. To familiarize Tamil Nadu Factories Rules. To introduce Environment Act. To highlight the important provisions in Air Act. To study the provisions of Water Act. 								
Programme Outcomes (POs)								
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognize and evaluate occupational health safety, and legal issues at the workplace to determine appropriate hazard controls following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Use research-based knowledge and research methods including design of experiments, and interpretation of data, and synthesis of the information to provide valid conclusions.							
Course Outcomes (COs)								
The students will be able to								
CO1	Find the relevant references in The Factory Act, related to the industry involved.							
CO2	Implement the provisions of Environment Act of an industrial unit.							
CO3	Implement the provisions of Hazardous Chemical Rules applicable to an industrial unit.							
CO4	Predict the provisions of Boiler Act, SMPV Rules, Petroleum Act and Gas Cylinder Rules.							
CO5	Classify the provisions of Occupational Safety and Health act of USA and Health and safety work act (HASAWA 1974, UK).							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1		3	2	2			
	2		3	3	3			
	3		3	3	2			
	4		3	2	2			
	5		2	2	3			
Unit I	Occupational Safety, Health And Working Conditions Code						12 Hours	
Statutory authorities - inspecting staff, health, safety, provisions relating to hazardous processes, welfare - special provisions - penalties and procedures- Tamil Nadu Factories Rules under Safety and health chapters of OSHWC Code, Tamil Nadu Safety Officer Rules 2005. Power of Govt. to direct inquiry.								

Unit II	Environment Protection Act - 1986	12 Hours
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.		
Unit III	Manufacture, Storage And Import Of Hazardous Chemical Rules 1989	12 Hours
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 Hours
Indian Boiler Act 2007, Static and mobile pressure vessel rules (SMPV), Motor vehicle rules, The Mines and Minerals (Development and Regulation) Act, 2010, Employees compensation code, rules - Electricity act and rules - Hazardous wastes (management and handling) rules, 1989, with amendments in 2000 - The building and other construction workers act 1996, Petroleum rules, Gas cylinder rules-Explosives Act 1983-Pesticides Act – Tamil Nadu lifts act 1997, .Boiler operating Engineers - rules -2011, Dock Workers (Safety, Health, and Welfare) Act 1986.		
UNIT V	International Acts And Standards	12 Hours
Occupational Safety and Health act of USA - Health and safety work act (HASAWA 1974, UK), OSHAS 21000, ISO 45000, ISO 14000 - benefits and elements.		
		Total
		60 Hours
References		
<ol style="list-style-type: none"> 1. Bakshi P M , The Constitution of India , Lexis Nexis, 17th Edition ,2020 2. Srinivasan S,The Factories Act 1948 with Tamil Nadu Factories Rules 1950 Madras Book Agency, Chennai, 28th Edition, 2017. 3. The Factories Act 1948 with Tamilnadu factories rules 1950, Madras Book Agency,21st ed., Chennai, 2000. 4. The Environment Act(Protection) 1986 with allied rules, Law Publishers (India) Pvt Ltd., Allahabad,2014 5. Water(Prevention and control of pollution) act 1974, Law publishers (India) Pvt. Ltd., Allahabad,2016 6. Air (Prevention and control of pollution) act 1981, Law Publishers (India) Pvt. Ltd., Allahabad,2021 		

24IS15	SAFETY MANAGEMENT				L	T	P	C
					3	0	0	3
Pre-requisite				Assessment Pattern				
<ul style="list-style-type: none"> Theoretical concepts and practices of industrial safety. Principles of management to safety. 				Mode of Assessment			Weightage(%)	
				Continuous Internal Assessment			40	
Semester End Examinations			60					
Course Objectives								
<ul style="list-style-type: none"> To introduce the evaluation of safety concepts. To impart hazardous identification techniques. To understand the procedure for accident investigation. To study the methods of safety performance monitoring. To impart knowledge on safety education and training. 								
Programme Outcomes (POs)								
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognize and evaluate occupational health safety, and legal issues at the workplace to determine appropriate hazard controls following the hierarchy of controls relevant to occupational health and safety practices.							
PO6	Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Derive the concepts of Safety management relevant to the industry and the society.							
CO2	Implement the techniques resolving the safety problems related to industries.							
CO3	Execute the accident investigation to find out the root cause to prevent the re occurrence of accidents.							
CO4	Determine the accident indices to indicate the safety performance of an industry.							
CO5	Demonstrate organizing and handling safety training classes to different level of employees.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1		3	3			3	
	2		3	2			3	
	3		3	2			3	
	4		3	2			2	
	5		2	3			2	
Unit I	Safety Concepts							9 Hours
Introduction - Evolution of modern safety concept- Safety policy-Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety, Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA).								

Unit II	Safety Performance Monitoring	9 Hours
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, safety survey, safety inspection, safety sampling, Safety Audit, Behaviour based safety.		
Unit III	Accident Investigation And Reporting	9 Hours
Concept of an accident, reportable and non-reportable accidents, unsafe act and condition - principles of accident prevention - Heinrich theory, Supervisory role- Role of safety committee - Accident causation models - Cost of accident. Overall accident investigation process -Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidence, Records of accidents, accident reports -Class exercise with case study.		
Unit IV	Safety Education and Training	9 Hours
Importance of training-identification of training needs -Training methods - programme, seminars, conferences, competitions - method of promoting safe practice- motivation - 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 - Home safety training - 5S concepts.		
UNIT V	Artificial Intelligence in Safety	9 Hours
Definition and scope of AI in industrial safety - Supervised, unsupervised, and reinforcement learning - Importance of data in AI for industrial safety - Predictive modelling for hazard identification - Internet of Things (IoT) and its role in safety monitoring.		
		Total
		45 Hours
References		
<ol style="list-style-type: none"> Chales D. Reese (2017) Occupational Health and Safety management. Frank Lees (2012) Lees Loss Prevention in Process Industries. Butterworth-Heinemann publications. Philip Hagan, Accident Prevention Manual for Business and Industry, N.S.C.Chicago, 13th Edition, 2009 V. Subramanian, The Factories Act 1948 with Tamilnadu factories rules 1950, Madras Book Agency,Chennai, 2000. C.Ray Asfahl, Industrial Safety and Health management, Pearson Prentice Hall, 2003. National Safety Council, Accident Prevention Manual for Industrial Operations, N. S. C. Chicago. An Introduction to Artificial Intelligence, Charu C Aggrawal. Russell and Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2022 		

24IS16	PLANT LAYOUT AND MATERIAL HANDLING			L	T	P	C
				3	0	0	3
Pre-requisite		Assessment Pattern					
<ul style="list-style-type: none"> Selection of Plant Locations. Manual Material Handling equipment. 		Mode of Assessment				Weightage(%)	
		Continuous Internal Assessment				40	
		Semester End Examinations				60	
Course Objectives							
<ul style="list-style-type: none"> To provide knowledge in Selection of plant locations. To enhance knowledge in developing layout for various industries incorporating the safety aspects. To develop knowledge on creating and maintaining safe working environment. To impart knowledge in Manual Material Handling and Lifting Tackles. To educate on Manual Material Handling equipment. 							
Programme Outcomes (POs)							
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.						
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.						
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.						
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.						
Course Outcomes (COs)							
The students will be able to							
CO1	Select plant locations suitable to the process requirements of an industrial unit.						
CO2	Develop layout for various industries incorporating the safety aspects considering the society.						
CO3	Create and maintain safe working environment without any harm to employee and society.						
CO4	Select suitable Manual Material Handling and Lifting Tackles and proper.						
CO5	Explain Manual Material Handling equipment and testing requirement.						
Articulation Matrix							
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6
	1	3	3	3	2		
	2	2	3	3	2		
	3	2	3	3	3		
	4	3	3	2	3		
	5	2	2	2	3		
Unit I	Plant Location						9 Hours
Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansion's Safe location of chemical storages in the form of bullets, spheres, cylinders for LPG, LNG, CNG, acetylene, ammonia, chlorine - explosives and propellants.							

Unit II	Plant Layout	9 Hours
Safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, Safe layout for process industries, engineering industry, construction sites, pharmaceuticals, pesticides, fertilizers, refineries, food processing, nuclear power stations, thermal power stations, metal powders manufacturing, fireworks and match works.		
Unit III	Working Conditions	9 Hours
Principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation, hood and duct design, air conditioning, ventilation standards, application. Purpose of lighting, types, advantages of good illumination, glare and its effect, lighting requirements for various work, standards- Housekeeping, principles of 5S.		
Unit IV	Manual Material Handling And Lifting Tackles	9 Hours
Material handling, Principle and methods of manual handling. Preventing common injuries, lifting by hand, team lifting and carrying - 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. Fibre 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.		
UNIT V	Mechanical Material Handling	9 Hours
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 Hours
References		
<ol style="list-style-type: none"> 1. Encyclopedia of occupational safety and health, ILO Publication, 2009. 2. Accident prevention manual for industrial operations N.S.C., Chicago, 2012. 3. M.P. Alexandrov. Material handling equipment Mir Publishers, Moscow,1981 4. Apple M. James Plant layout and material handling, 3rd edition, John Wiley and sons.1978 5. Spivakosky, Conveyors and related Equipment, Vol.I and II Peace Pub. Moscow, 1985. 6. Industrial ventilation (A manual for recommended practice), American conference of Governmental Industrial Hygiene, USA, 1984. 		

24IS17	ENVIRONMENTAL ANALYSIS LABORATORY				L	T	P	C		
					0	0	4	2		
Pre-requisite				Assessment Pattern						
<ul style="list-style-type: none"> Various methods of analysis of water and wastewater. 				Mode of Assessment			Weightage(%)			
				Continuous Internal Assessment			100			
				Semester End Examinations						
Course Objectives										
<ul style="list-style-type: none"> To provide basic knowledge on the various methods of analysis of water and wastewater To emphasize the students to know how to carryout different experiments related to safety. To introduce determination of chemicals. To highlight the important in estimation of BOD, COD. To provide knowledge in measurement of dust and fumes. 										
Programme Outcomes (POs)										
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.									
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.									
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.									
Course Outcomes (COs)										
The students will be able to										
CO1	Demonstrate the various characteristics of water and wastewater sample.									
CO2	Analyse a given water sample to find out the properties.									
CO3	Determine the properties of chemicals used in an industrial unit.									
CO4	Compute the estimation of BOD, COD for the samples taken from the unit.									
CO5	Apply the measurement of dust and fumes available in the working environment.									
Articulation Matrix										
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6			
	1	3		3	3					
	2	3		2	2					
	3	2		2	3					
	4	2		2	2					
	5	3		3	2					
Unit I	Experiment 1						5 Hours			
Estimation of Hardness										

Unit II	Experiment 2	5 Hours
Determination of pH for a given sample.		
Unit III	Experiment 3	5 Hours
Estimation of Alkalinity in Wastewater.		
Unit IV	Experiment 4	5 Hours
Determination of chlorides		
UNIT V	Experiment 5	5 Hours
Determination of Total solids, Suspended solids and Dissolved solids.		
UNIT VI	Experiment 6	5 Hours
Estimation of Sulphates in the given sample		
UNIT VII	Experiment 7	5 Hours
Determination of Iron		
UNIT VIII	Experiment 8	5 Hours
Estimation of Dissolved oxygen		
UNIT IX	Experiment 9	5 Hours
Determination of bio chemical oxygen demand in the given sample (titration method)		
UNIT X	Experiment 10	5 Hours
Indian standards of drinking water- A Study		
UNIT XI	Experiment 11	5 Hours
Exhaust Gas analysis using ORSAT Apparatus		
UNIT XII	Experiment 12	5 Hours
Analysis of flue gas using portable Flue Gas Analyser		
Total		60 Hours

24IS18	INDUSTRIAL HYGIENE AND ERGONOMICS LABORATORY			L	T	P	C
				0	0	4	2
Pre-requisite				Assessment Pattern			
<ul style="list-style-type: none"> Carry out ergonomic assessment using RULA and REBA. Apply fire mock drill in industries. 				Mode of Assessment			Weightage(%)
				Continuous Internal Assessment			100
				Semester End Examinations			
Course Objectives							
<ul style="list-style-type: none"> To provide basic knowledge on the various methods of exhaust gas, particulate matter measurement. To emphasize the students to know how to carryout heat stress index, relative humidity measurement. To provide knowledge on of earth resistance and ground resistivity measurement To carry out ergonomic assessment using RULA and REBA To apply fire mock drill in industries. 							
Programme Outcomes (POs)							
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.						
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.						
Course Outcomes (COs)							
The students will be able to							
CO1	Analyse the various characteristics of exposure measurement to dust fumes and gaseous pollutants.						
CO2	Analyse heat stress index, moisture, temperature for a given working condition.						
CO3	Analyse luminance level, emissivity measurement						
CO4	Analyse sound level measurement of an industrial unit						
CO5	Analyse Ergonomic impacts of working population in an industrial unit.						
Articulation Matrix							
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6
	1	3			3		
	2	3			2		
	3	2			3		
	4	2			2		
	5	3			2		
Unit I	Experiment 1						5 Hours
Personal Exposure measurement to Dust And Fumes using Personal Air Sampler							
Unit II	Experiment 2						5 Hours
Measurement of Particulate and Gaseous Pollutants in the Ambient air using High Volume Sampler.							

Unit III	Experiment 3	5 Hours
Measurement of heat stress index using WBGT instrument.		
Unit IV	Experiment 4	5 Hours
Measurement of moisture and temperature using Relative Humidity Meter.		
UNIT V	Experiment 5	5 Hours
Measurement and monitoring of Temperature using Infrared Thermometer and Thermal imaging camera.		
UNIT VI	Experiment 6	5 Hours
Emissivity Measurement		
UNIT VII	Experiment 7	5 Hours
Measurement of Luminance of Light Using Lux Meter.		
UNIT VIII	Experiment 8	5 Hours
Sound Pressure Level Measurement.		
UNIT IX	Experiment 9	5 Hours
Assessment of Ergonomic impact using RULA .		
UNIT X	Experiment 10	5 Hours
Assessment of Ergonomic impact using REBA.		
UNIT XI	Experiment 11	5 Hours
Air Conditioning Test.		
UNIT XII	Experiment 12	5 Hours
Vibration Measurement.		
Total		60 Hours

24IS21	SAFETY IN ENGINEERING INDUSTRY			L	T	P	C
				3	0	0	3
Pre-requisite		Assessment Pattern					
<ul style="list-style-type: none"> Principles of machine guarding. Safe methods in finishing, inspection, testing. 		Mode of Assessment				Weightage(%)	
		Continuous Internal Assessment				40	
		Semester End Examinations				60	
Course Objectives							
<ul style="list-style-type: none"> To provide knowledge on safe operation of metal and woodworking machineries. To introduce the principles of machine guarding. To learn the safety methods in welding and gas cutting. To provide knowledge safety in cold and hot working of metals. To study safe methods in finishing, inspection and testing. 							
Programme Outcomes (POs)							
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.						
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.						
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.						
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.						
PO6	Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.						
Course Outcomes (COs)							
The students will be able to							
CO1	Identify the safe operation of metal and wood working machinery.						
CO2	Demonstrate the principles of machine guarding for relevant machines.						
CO3	Apply the safe methods in welding and gas cutting to prevent the hazards.						
CO4	Elaborate the safe methods of cold and hot working of metals to minimize injury.						
CO5	Apply the safe methods in finishing, inspection and testing to prevent accidents.						
Articulation Matrix							
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6
	1	3	3	3	3		2
	2	3	3	2	2		2
	3	3	3	2	2		3
	4	2	3	2	2		3
	5	2	2	3	3		3

Unit I	Safety In Metal Working Machinery And Wood Working Machines	9 Hours
General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machines, planning machines and grinding machines, CNC machines, Woodworking machinery, types, safety principles, electrical guards, work area, inspection, standards and codes- saws, types, hazards. material handling, Principle and methods of manual handling.		
Unit II	Principles Of Machine Guarding	9 Hours
Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS - guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. benefits of good guarding systems flywheels-shafts- couplings- gears-sprockets wheels and chains-pulleys and belts-Lifting tackles.		
Unit III	Safety In Welding And Gas Cutting	9 Hours
Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing - explosive welding, selection, care and maintenance of the associated equipment and instruments - safety in generation, distribution and handling of industrial gases-colour coding - flashback arrestor - leak detection-pipe line safety-storage and handling of gas cylinders.		
Unit IV	Safety In Cold Forming And Hot Working Of Metals	9 Hours
Cold working, power presses, point of operation safeguarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes - Hot-working safety in forging, hot rolling mill operation, safeguards in hot rolling mills - hot bending of pipes, hazards and control measures - Safety in Gas Furnace Operation, Cupola, Crucibles, Ovens, Foundry Health Hazards, Work Environment, Foundry Production Cleaning and Finishing Foundry Processes.		
UNIT V	Safety In Finishing, Inspection And Testing	9 Hours
Heat treatment operations, Electro Plating, Paint Shops, Sand And Shot Blasting, Safety In Inspection And Testing, Dynamic Balancing, Hydro Testing, Valves, Boiler Drums And Headers, Pressure Vessels, Air Leak Test, Steam Testing, Safety In Radiography, Personal Monitoring Devices, Radiation Hazards, Engineering And Administrative Controls, Indian Boilers Regulation.		
Total		45 Hours
References		
<ol style="list-style-type: none"> 1. Philip E. Hagan, John Franklin Montgomery, James T. O'Reilly, Accident Prevention Manual NSC, Chicago, 2009. 2. Charles D. Reese, Occupational Health and Safety Management, CRC Press, 2003. 3. Grimaldi, J.V. and Simonds, R.H, Safety Management, 5th edition, Richard d Irwin, 1994 4. John Davies, Alastair Ross, Brendan Wallace, Safety Management: A Qualitative Systems Approach, CRC Press, 2003. 5. J Blunt, N C Balchin Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London,2002 6. Anil Mital Advances in Industrial Ergonomics and Safety Taylor and Francis Ltd, London, 1989 		

24IS22	FIRE ENGINEERING AND EXPLOSION CONTROL			L	T	P	C
				3	0	0	3
Pre-requisite		Assessment Pattern					
<ul style="list-style-type: none"> Knowledge of Fire Protection System. Knowledge of Fire Prevention and Protection. 		Mode of Assessment				Weightage(%)	
		Continuous Internal Assessment				40	
		Semester End Examinations				60	
Course Objectives							
<ul style="list-style-type: none"> To introduce the topic of physics and chemistry of fire. To impart knowledge on fire prevention and protection. To study the industrial fire protection system. To develop knowledge on building fire safety. To provide knowledge on explosion protection systems. 							
Programme Outcomes (POs)							
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.						
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.						
PO6	Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.						
Course Outcomes (COs)							
The students will be able to							
CO1	Introduce the topic of physics and chemistry of fire for relevant to the industry.						
CO2	Impart knowledge on fire prevention and protection of an industrial unit.						
CO3	Study the industrial fire protection system for implementation.						
CO4	Develop knowledge on building fire safety for better practice.						
CO5	Provide knowledge on explosion protection systems of an industrial unit.						
Articulation Matrix							
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6
	1		3	3			2
	2		3	2			2
	3		3	2			3
	4		2	2			3
	5		2	3			3
Unit I	Physics And Chemistry Of Fire						9 Hours
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 - Bombay Victoria dock ship explosions, Mahul refinery explosion, Nagothane vapour cloud explosion and Vizag refinery disaster.							

Unit II	Fire Prevention And Protection	9 Hours
Sources of ignition - fire triangle-IS 2190 - principles of fire extinguishing - active and passive fire protection systems - various classes of fires Fire extinguishing agents Water, Foam, Dry chemical powder, Carbon-dioxide-Halon alternatives Halocarbon compounds Inert gases, dry powders - 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 Hours
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 in flammability-firefighting systems. IS-15105 (guidelines for installation of sprinklers).		
Unit IV	Building Fire Safety	9 Hours
Objectives of fire safe building design, Fire load, fire resistant material and fire testing -structural fire protection - structural integrity -concept of egress design - exit - width calculations - fire certificates - fire safety requirements for high rise buildings - Snookers-Tamil Nadu fire and rescue services act-1985.		
UNIT V	Explosion Protecting Systems	9 Hours
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 (SO2), chlorine (Cl) etc. -Installation of fire protection system.		
Total		45 Hours
References		
<ol style="list-style-type: none"> 1. R.S.Gupta., Hand Book of Fire Technology, Orient Blackswan, 2010 2. Arthur E Cote Fire protection Handbook NFPA 2008. 3. Jain V K, Fire Safety in Buildings, New Age International (P) Limited Publishers,New Delhi, 2nd Edition, 2015. 4. Nolan, Handbook of Fire and protection principles, Elseiver ,2014. 5. Charles J. Baker, Fire Fighter"s Handbook of Hazardous Materials, Van No strand Rein Hold, Jones and Bartlett Learning, New York, 2006. 6. Danial E.Della Giustina, Fire safety management,3rd edition, 2014 7. Barendra Mohan Sen (2013). Fire protection and prevention the essential handbook, UBS publishers and Dist., New Delhi. 8. Rasbas D, Ramachandran G, Kandola B, Watts J, and Law M, Evaluation of Fire Safety, John Wiley & Sons Ltd. England, 2004 		

24IS23	ELECTRICAL SAFETY				L	T	P	C
					3	0	0	3
Pre-requisite			Assessment Pattern					
<ul style="list-style-type: none"> Knowledge of Electrical Hazards. Concept and statutory requirement of electrical safety. 			Mode of Assessment				Weightage(%)	
			Continuous Internal Assessment				40	
				Semester End Examinations				60
Course Objectives								
<ul style="list-style-type: none"> To introduce the concepts and statutory requirements of electrical safety. To impart knowledge on electrical hazards. To understand electrical protection systems for avoiding accidents. To study the selection, installation, operation and maintenance of electrical devices. To introduce the classification of electrical hazardous zones. 								
Programme Outcomes (POs)								
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO6	Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Indicate the concepts and statutory requirements of electrical safety.							
CO2	Estimate the hazards in handling electrical system to prevent accidents.							
CO3	Derive the importance of electrical protection systems for preventing accidents.							
CO4	Formulate the method of selection, installation, operation and maintenance of electrical devices.							
CO5	Explain the importance of classifying electrical hazardous zones.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1		3	2				2
	2		3	2				2
	3		3	3				3
	4		2	2				3
	5		2	2				3
Unit I	Concepts And Statutory Requirements							9 Hours
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 Hours
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-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 codes - IS codes - Lightning hazards, lightning arrestor, installation - specifications, earth resistance, earth pit maintenance.		
Unit III	Protection Systems	9 Hours
Fuse, circuit breakers and overload relays - 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 handheld electrical appliances tools and medical equipment.		
Unit IV	Selection, Installation, Operation And Maintenance	9 Hours
Role of environment in selection-safety aspects in application - protection and interlock self-diagnostic features and fail-safe concept-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 Hours
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 Hours
References		
<ol style="list-style-type: none"> 1. John Cadick Mary Capelli-Schellofeffer, Dennis K Neitzel and Al Winfield, Electrical Safety Handbook, Mc Graw Hill Education, 4 th Edition, 2012. 2. Rao S, Saluja H L, Electrical Safety, Fire Safety Engineering and Safety Management, Khanna Publishers, New Delhi, 2009. 3. W. Fordham Cooper, Electrical Safety Engineering, Butterworth and -Heinemann Ltd, London, Third edition, 1998. 4. Dr .Massim A.G .Mitolo, Electrical safety of Low voltage systems, Mc Graw Hill, 2009 5. Accident prevention manual for industrial operations, N.S.C. Chicago, 1982. 6. Indian Electricity Act and Rules Government of India, 2003.& Sons Ltd. England, 2004 		

24IS24	RISK ANALYSIS				L	T	P	C
					3	0	0	3
Pre-requisite				Assessment Pattern				
<ul style="list-style-type: none"> Basics of instrumentation. Knowledge about various hazards assessment. 				Mode of Assessment			Weightage(%)	
				Continuous Internal Assessment			40	
				Semester End Examinations			60	
Course Objectives								
<ul style="list-style-type: none"> To introduce hazard, risk issues and hazard assessment. To learn about the basics of instrumentation. To study the method of risk analysis quantification and software. To get exposed to the method of consequence analysis. To educate on the credibility of risk assessment techniques. 								
Programme Outcomes (POs)								
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
PO6	Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Indicate the hazard, risk issues and hazard assessment for the betterment of an industry.							
CO2	Select the appropriate instrument for measuring parameters to find out the healthiness.							
CO3	Analyze the method of risk analysis quantification and use the software in relevant area							
CO4	Formulate the method of applying consequence analysis of an industrial unit.							
CO5	Explain the strength of risk assessment techniques for better utilization.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1		3	3	3		2	
	2		3	2	2		2	
	3		2	2	2		3	
	4		2	2	2		3	
	5		3	3	3		3	
Unit I	Hazard, Risk Issues and Hazard Assessment						9 Hours	
Introduction, hazard monitoring-risk issue - Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis (PHA), hazard operability studies (HAZOP).								

Unit II	Instrumentation	9 Hours
Applications of Advanced Equipment and Instruments, Thermo calorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyser(TGA), Accelerated Rate Calorimeter(ARC). Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitive Test, Impact Sensitive Test (BAM) and Friction Sensitive Test (BAM), Shock Sensitive Test, Card Gap Test.		
Unit III	Risk Analysis Quantification and Software's	9 Hours
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)- Bow Tie Analysis, Introduction to LOPA, Basic concepts of Software on Risk analysis, FETI, ALOHA.		
Unit IV	Consequences Analysis	9 Hours
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 Flashfire, Explosion effects and confined explosion- Toxic effects- Plotting the damage distances on plot plant/layout.		
UNIT V	Credibility Of Risk Assessment Techniques	9 Hours
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 nonnuclear installation- Rijnmond report, risk analysis of size potentially Hazardous Industrial objects- Rasmussen masses report, Reactor safety study of Nuclear power Plant.		
Total		45 Hours
References		
<ol style="list-style-type: none"> 1. Methods in Chemical Process Safety, Volume 1 (1st Edition) - 7th April 2017. 2. Risk Analysis,Wiley; 2nd edition (2 October 2015) 3. P. Frank. Less Butterworth-Hein, Loss Prevention in Process Industries (Vol.I, II and III), Butterworth-Hein UK 1990. 4. F.I. Khan, S.A. Abbasi, Advanced Risk Assessment In Chemical Process Industries, Discovery Publishing House, 2000. 5. Center for Chemical Process Safety (CCPS), Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety. second Edition, 2000. 6. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process safety, AICHE 2008 		

24IS26	INDUSTRIAL FIRE AND ELECTRICAL SAFETY LABORATORY			L	T	P	C
				0	0	4	2
Pre-requisite				Assessment Pattern			
<ul style="list-style-type: none"> Selection of Personal protective equipment Apply fire mock drill in industries. Various methods of vibration measurement 				Mode of Assessment			Weightage(%)
				Continuous Internal Assessment			100
				Semester End Examinations			
Course Objectives							
<ul style="list-style-type: none"> To study the selection of Personal protective equipment. To provide basic knowledge on the various methods of vibration measurement. To provide knowledge on of earth resistance and ground resistivity measurement To provide knowledge on first aid fire fighting equipment and to apply fire mock drill in industries To apply software for dispersion modelling of dangerous chemicals. 							
Programme Outcomes (POs)							
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.						
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.						
Course Outcomes (COs)							
The students will be able to							
CO1	Demonstrate the usage different Personal Protective Equipment (PPE) relevant to the industry.						
CO2	Determine earth resistance and ground resistivity and static electricity hazards within the industries						
CO3	Identify suitable fire extinguisher for fire fighting of an industrial unit and demonstrate fire mock drill in industries.						
CO4	Demonstrate various methods of vibration measurement, Friction and Air condition test.						
CO5	Compute dispersion modelling using software of an industrial unit.						
Articulation Matrix							
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6
	1	3			3		
	2	3			2		
	3	2			3		
	4	2			2		
	5	3			2		
Unit I	Experiment 1						5 Hours
Study of Fire Extinguishers							
Unit II	Experiment 2						5 Hours
Study and Demonstration of Fire Mock Drill.							

Unit III	Experiment 3	5 Hours
Study on Active and Passive Fire protection system.		
Unit IV	Experiment 4	5 Hours
Study of Personal Protective Equipment.		
UNIT V	Experiment 5	5 Hours
Study on Static Electricity Hazards, Discharging of The same and use of Antistatic Materials In Vulnerable areas.		
UNIT VI	Experiment 6	5 Hours
Determination of Frictional Sensitivity of An Energetic Material using Friction Tester.		
UNIT VII	Experiment 7	5 Hours
Whirling of Shaft-Determination of Critical Speed of Shaft With Concentrated Loads.		
UNIT VIII	Experiment 8	5 Hours
Sound Pressure Level Measurement.		
UNIT IX	Experiment 9	5 Hours
Assessment of Ergonomic impact using RULA .		
UNIT X	Experiment 10	5 Hours
Toxic release dispersion modelling using ALOHA Software.		
UNIT XI	Experiment 11	5 Hours
Self-Learning - Safety Audit.		
UNIT XII	Experiment 12	5 Hours
Self-Learning - Energy Audit		
Total		60 Hours

24IS27	MINI PROJECT				L	T	P	C	
					0	0	4	2	
Pre-requisite				Assessment Pattern					
<ul style="list-style-type: none"> Develop skills to identify and convert a real-world problem into a technical problem 				Mode of Assessment			Weightage(%)		
				Continuous Internal Assessment			100		
				Semester End Examinations					
Course Objectives									
<ul style="list-style-type: none"> To develop skills to identify and convert a real-world problem into a technical problem. To teach use of new tools and techniques required to carry out the project. To teach use of new tools and techniques required to carry out the project. To make familiar in developing the proof of concept. To provide guidelines to prepare standard project report. 									
Programme Outcomes (POs)									
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.								
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.								
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.								
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.								
PO6	Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.								
Course Outcomes (COs)									
The students will be able to									
CO1	Develop the solutions for the real-world problem.								
CO2	Identify the suitable strategies and methodologies to carry out the project.								
CO3	Use of required new tools and techniques to carry out the project.								
CO4	Test and validate the developed proof of concept.								
CO5	Prepare a standard project report with demonstration.								
Articulation Matrix									
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6		
	1	3	3	3	3		2		
	2	3	3	3	2		2		
	3	3	3	2	2		3		
	4	2	2	2	2		3		
	5	3	3	3	3		3		
								Total	4 Hours

24IS34	DISSERTATION PHASE I				L	T	P	C
					0	0	12	6
Pre-requisite				Assessment Pattern				
<ul style="list-style-type: none"> Develop skills to identify and convert a real-world problem into a technical problem 				Mode of Assessment			Weightage(%)	
				Continuous Internal Assessment			60	
				Semester End Examinations			40	
Course Objectives								
<ul style="list-style-type: none"> To develop skills to identify and convert a real world problem into a technical problem. To provide knowledge on methodology of carrying out project in phases. To teach use of new tools and techniques required to carry out the project. To make familiar in developing the proof of concept. To provide guidelines to prepare standard project report. 								
Programme Outcomes (POs)								
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.							
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
PO6	Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Develop the solutions for the real world problem.							
CO2	Identify the suitable strategies and methodologies to carry out the project.							
CO3	Use of required new tools and techniques to carry out the project.							
CO4	Test and validate the developed proof of concept.							
CO5	Prepare a standard project report with demonstration.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1	3	3	3	3		2	
	2	3	3	3	2		2	
	3	3	3	2	3		3	
	4	2	3	3	2		3	
	5	3	3	3	3		3	
Total								12 Hours

24IS41	DISSERTATION PHASE II			L	T	P	C			
				0	0	24	12			
Pre-requisite				Assessment Pattern						
<ul style="list-style-type: none"> Develop skills to identify and convert a real-world problem into a technical problem 				Mode of Assessment			Weightage(%)			
				Continuous Internal Assessment			60			
				Semester End Examinations			40			
Course Objectives										
<ul style="list-style-type: none"> To develop skills to identify and convert a real world problem into a technical problem. To provide knowledge on methodology of carrying out project in phases. To teach use of new tools and techniques required to carry out the project. To make familiar in developing the proof of concept. To provide guidelines to prepare standard project report. 										
Programme Outcomes (POs)										
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.									
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.									
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.									
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.									
PO6	Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.									
Course Outcomes (COs)										
The students will be able to										
CO1	Develop the solutions for the real-world problem.									
CO2	Identify the suitable strategies and methodologies to carry out the project.									
CO3	Use of required new tools and techniques to carry out the project.									
CO4	Test and validate the developed proof of concept.									
CO5	Prepare a standard project report with demonstration.									
Articulation Matrix										
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6			
	1	3	3	3	3		2			
	2	3	3	3	2		2			
	3	3	3	2	3		3			
	4	2	3	3	2		3			
	5	3	3	3	3		3			
						Total	24 Hours			

24IS51	ARTIFICIAL INTELLIGENCE AND INDUSTRIAL SAFETY			L	T	P	C
				3	0	0	3
Pre-requisite		Assessment Pattern					
<ul style="list-style-type: none"> • Concepts of Artificial Intelligence in safety. • Knowledge on predictive models for hazard identification. 		Mode of Assessment				Weightage(%)	
		Continuous Internal Assessment				40	
		Semester End Examinations				60	
Course Objectives							
<ul style="list-style-type: none"> • To study the concepts of Artificial Intelligence in safety. • To provide knowledge on predictive models for hazard identification. • To learn the activities involved in computer vision and sensor technologies for safety supervision. • To introduce the Fuzzy logic concepts and related operations. • To infer the operational methods of neural network architectures. 							
Programme Outcomes (POs)							
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.						
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.						
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.						
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.						
Course Outcomes (COs)							
The students will be able to							
CO1	Identify the fundamental concepts of artificial intelligence (AI) in safety.						
CO2	Demonstrate the predictive models to identify potential hazards.						
CO3	Use computer vision and sensor technologies for safety monitoring.						
CO4	Apply fuzzy logic concepts to handle uncertainties in safety-critical applications.						
CO5	Execute the operational methods of neural network architectures for safety applications.						
Articulation Matrix							
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6
	1	3	2	3	3		
	2	2	3	2	2		
	3	2	3	2	2		
	4	3	3	2	2		
	5	3	2	3	3		

Unit I	Concept Of AI	9 Hours
Definition of AI-Foundation of Artificial Intelligence- State of Art- Intelligent Agents- Agents and environment-Structure of Agents and scope of AI in industrial safety, AI tools and frameworks for industrial applications.		
Unit II	Predictive Modelling For Hazard Detection	9 Hours
Importance of data in AI for industrial safety-Techniques for data collection and storage-Data pre-processing and cleaning for industrial datasets-Introduction to predictive modelling for hazard identification-Case studies on predicting potential accidents using AI-Hands-on exercises with data and model building.		
Unit III	Computer Vision And Sensor Technologies For Safety Monitoring	9 Hours
Basics of computer vision in industrial safety-Object detection, image classification, and video analysis-Application of computer vision for monitoring unsafe conditions-Overview of sensors for industrial safety-Internet of Things (IoT) and its role in safety monitoring-Integrating sensor data with AI for real-time safety insights.		
Unit IV	Fuzzy Logic	9 Hours
Basic concepts of fuzzy set theory – operations of fuzzy sets –properties of fuzzy sets – Crisp relations – Fuzzy relational equations – operations on fuzzy relations – fuzzy systems – propositional logic – Inference – Predicate Logic – Inference in predicate logic – fuzzy logic principles – fuzzy quantifiers – fuzzy inference – fuzzy rule-based systems – fuzzification and defuzzification – types.		
UNIT V	Neural Networks	9 Hours
Fundamentals of neural networks – model of an artificial neuron –neural network architectures – Learning methods – Taxonomy of Neural network architectures –Standard back propagation algorithms – selection of various parameters – variations. Applications of back propagation algorithms.		
		Total 45 Hours
References		
<ol style="list-style-type: none"> 1. Rajasekaran. S. Vijayalakshmi Pai. G.A. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications, Prentice Hall of India Private Limited, 2003. 2. Timothy J.Ross, Fuzzy logic with Engineering Applications, McGraw Hill, 1995. 3. Zurada J.M, Introduction to Artificial Neural Systems, Jaico Publishing House,1994. 4. Artificial Intelligence, A modern approach, Stuart Russel, Peter Norvig, Third Edition, Pearson Publications,. 5. Nielsen, Michael A, Neural Networks and Deep Learning, 2nd edition, Determination Press, 2015 6. Brian Russell, Drew Van Duren, Practical Internet of Things Security: Design a security framework for an Internet connected ecosystem, 2nd Edition, Packt Publishing, 2018. 		

24IS52	NUCLEAR ENGINEERING AND SAFETY				L	T	P	C
					3	0	0	3
Pre-requisite				Assessment Pattern				
<ul style="list-style-type: none"> Safety of Nuclear Reactors. Learn about the Radiation Control. 				Mode of Assessment			Weightage(%)	
				Continuous Internal Assessment			40	
				Semester End Examinations			60	
Course Objectives								
<ul style="list-style-type: none"> To know about the radioactive material and its effects. To know about the reactor, design consideration in controls and operational problems. To learn the role of reactors in power generation and the nuclear power plants in India. To learn the Safety of Nuclear Reactors with case studies. To learn about the radiation control. 								
Programme Outcomes (POs)								
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Demonstrate the radioactive material and its effects on human being.							
CO2	Explain the reactor, design consideration in controls and operational problems.							
CO3	Indicate the role of reactors in power generation and the nuclear power plants in India.							
CO4	Explain the Safety of Nuclear Reactors with case studies of an industrial unit.							
CO5	Interpret about the radiation control of an industrial unit.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1	3			2			
	2	2			3			
	3	2			3			
	4	3			3			
	5	3			2			
Unit I	Introduction							9 Hours
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 Hours

Design considerations in Control requirements -means of control-control and shutdown rods- their operation and operational problems - control rod worth - control instrumentation and monitoring - online central data processing system.		
Unit III	Reactors	9 Hours
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 its 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 Hours
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 Hours
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 Hours
References		
<ol style="list-style-type: none"> 1. Robert E Masterson, Nuclear Engineering Fundamentals-A Practical Perspective, CRC Press, 1st Edition, 2017. 2. Micheal R Greenberg, Nuclear Waste, Management, Nuclear Power and Energy Choices, Springer, 2013. 3. Sam Mannan, Lees Loss Prevention in Process Industries, Vol1, Vol2, Vol3, Butterworth-Heinemann,, London, 4th Edition 2012. 4. John R Marsh, Introduction to Nuclear Engineering, Prentice Hall, 2001 5. Frank P. Lees Butterworth- Hein-UK, Loss prevention in the process Industries, 2004. 6. R.L Loffness, Nuclear Power Plant Vann strand Publications, 2008. 		

24IS53	INDUSTRIAL NOISE AND VIBRATION CONTROL			L	T	P	C
				3	0	0	3
Pre-requisite		Assessment Pattern					
<ul style="list-style-type: none"> Knowledge on Noise Control. Learn about the industrial noise and vibration control. 		Mode of Assessment				Weightage(%)	
		Continuous Internal Assessment				40	
		Semester End Examinations				60	
Course Objectives							
<ul style="list-style-type: none"> To introduce the topic of industrial noise and vibration control. To provide knowledge on instrumentation and auditory effects of noise. To study the source of noise and procedure for carrying out rating. To develop knowledge on noise control. To learn the methods of noise abatement. 							
Programme Outcomes (POs)							
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.						
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.						
Course Outcomes (COs)							
The students will be able to							
CO1	Demonstrate the radioactive material and its effects on human being.						
CO2	Explain the reactor, design consideration in controls and operational problems.						
CO3	Indicate the role of reactors in power generation and the nuclear power plants in India.						
CO4	Explain the Safety of Nuclear Reactors with case studies of an industrial unit.						
CO5	Interpret about the radiation control of an industrial unit.						
Articulation Matrix							
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6
	1	3			3		
	2	2			2		
	3	2			2		
	4	3			2		
	5	3			3		
Unit I	Introduction						9 Hours
Basic definitions used in Vibrations and acoustics - Mathematical concepts and degrees of freedom in vibratory systems - Natural frequencies and vibration modes - continuous systems and wave theory concept - wave equation and relation to acoustics - theory of sound propagation and terminology involved - Plane wave and spherical waves - Concepts of free field and diffuse field, near field and far field - frequency analysis and vibration and noise spectrum - Signature analysis and condition monitoring.							

Unit II	Instrumentation And Auditory	9 Hours
Sensors used in vibration and measurements - Frequency and spectrum analyzers - Weighting networks - Hearing mechanism - relation between subjective and objective sounds -Auditory effects of noise and audiometric testing - Speech interference levels and its importance.		
Unit III	Sources Of Noise And Ratings	9 Hours
Mechanism of noise generation and propagation in various machinery and machine components, vehicles etc. - Directivity index - Concept of Leq and estimation - Noise ratings and standards for various sources like industrial, construction, traffic, aircraft community etc. - industrial safety and OSHA regulations - Noise legislations and management.		
Unit IV	Noise Control	9 Hours
Energy transferring and dissipating devices Source: Structure borne and flow excited. Vibration isolation and absorption. Spring and damping materials, Dynamic absorbers, Mufflers and silencers, Path: Close filter and loosely covered enclosures - Acoustic treatment and materials - Transmission loss and absorption coefficient of materials and structures and their estimation - Reverberation time and room constant - Design for minimum noise. Receiver: Measure to control at the receiver end- use of enclosures, earmuffs and other protective devices.		
UNIT V	Abatement Of Noise	9 Hours
Active noise attenuators and scope for abatement of industrial noise - Methods of control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers- spectrum analysis, Anechoic chamber.		
Total		45 Hours
References		
<ol style="list-style-type: none"> 1. V,Rao. Dukkupati and J.Srinivas, Text book of Mechanical Vibrations, Prentice-Hall of India P Ltd, New Delhi.2004. 2. David A.Bies, Colin Hansen, Carl Howard, Engineering Noise Control - 2017 3. Frank Fahy, David Thompson, Fundamentals of Sound and Vibration-2015 4. John Fenton, Handbook of Automotive body Construction and Design Analysis, Professional Engineering Publishing, 5. R.G White, J.G Walker, Noise and Vibration, John Wiley and sons New York, 2008. 6. Irwing Crandall, Theory of Vibrating Systems and Sound, D. Vannostrand Company, New Jercy, 2006. 		

24IS54	SAFETY IN POWDER HANDLING				L	T	P	C
					3	0	0	3
Pre-requisite				Assessment Pattern				
<ul style="list-style-type: none"> The characteristics of handling powders. Knowledge of dust handling plants and electrostatic hazards. 				Mode of Assessment			Weightage(%)	
				Continuous Internal Assessment			40	
				Semester End Examinations			60	
Course Objectives								
<ul style="list-style-type: none"> To introduce the safe handling of powders. To understand the characteristics of handling powders. To study the process of dust explosions. To develop knowledge of dust handling plants and electrostatic hazards. To learn the method of dust evaluation and control. 								
Programme Outcomes (POs)								
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Indicate the safe methods of handling powders of an industrial unit.							
CO2	Analyze the hazards involved in unsafe handling of powders in the relevant Industry.							
CO3	Identify Industrial dust and explosions accidents and its control.							
CO4	Explain the working of dust handling plants and the nature of electrostatic hazards.							
CO5	Resolve dust evaluation methods and suggest control measures.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1		3	3	3			
	2		3	3	2			
	3		3	3	2			
	4		2	2	2			
	5		3	2	3			
Unit I	Introduction							9 Hours
Powder classification-physical, chemical and other properties-metal powders-other non- metallic powders-handling methods-manual, mechanical - Synthesis of Nano powders - automatic-charges on powders-charge distribution-charging of powders.								

Unit II	Metal Powders And Characterization	9 Hours
Atomization, types - milling - electro deposition - spray drying, Production of iron powder, Aluminium powder, Titanium - screening and cleaning of metals - Explosivity and pyrophoricity - toxicity Particle size and size distribution-measurement, types and significance-particle shape analysis-SEM, AFM, particle size analyser, surface area, density, porosity, flow rate - testing.		
Unit III	Dust Explosion	9 Hours
Industrial dust, dust explosion accidents - explosibility characteristics, minimum explosive concentration, minimum ignition energy, explosion pressure characteristics, maximum permissible oxygen concentration - explosibility tests, Hartmann vertical tube apparatus, horizontal tube apparatus, inflammatory apparatus, Godbert and Greenward furnace.		
Unit IV	Dust Handling Plants And Electro Static Hazards	9 Hours
Grinding mills, conveyors, bucket elevators, dust separators, dust filters, cyclones, driers, spray driers, silos, grain elevators, typical applications, hazards. Electrostatic charges-energy released- type of discharge-spark-carona-insulating powders-propagating brush discharge-discharge in bulk lightning hazards in powder coating-electroplating - handling of Nano powders in the presence of flammable gases and vapour.		
UNIT V	Dust Evaluation And Control	9 Hours
Evaluation, methodology, Quantitative, sampling, measurements - control of dust sources, dust transmission - role of workers, PPE and work practice - Housekeeping - storage -labeling - warning sign - restricted areas - Environmental protections. Evaluation procedures and control measures for particulates (Respirable), Asbestos and other fibers, silica in coal mine - NIOSH guide to the selection and use of particulate respirators - case studies.		
Total		45 Hours
References		
<ol style="list-style-type: none"> 1. SRMC, Hazard recognition and prevention in the work place-airborne dust, Vol. I and II, Chennai, 2000. 2. A.S. Edelstein and R.C. Cammarata, Nano materials: Synthesis, Properties and Applications, Taylor and Francis, New York, 1996. 3. Martin Glor, Electro Static Hazard in Powder Handling, Research studies Press Ltd., England, 1988. 4. International Labour Organization, Major hazard control, Geneva, 1991. 5. Safety considerations when handling metal powders, Journal of the Southern African Institute of Mining and Metallurgy. Johannesburg Jan.2012. Vol.112 suppl.1 6. http://www.chilworth.co.uk/ 		

24IS55	SAFETY IN CHEMICAL INDUSTRIES				L	T	P	C
					3	0	0	3
Pre-requisite		Assessment Pattern						
<ul style="list-style-type: none"> Safety in process design, pressure system design. Operational methods of various industries. 		Mode of Assessment				Weightage(%)		
		Continuous Internal Assessment				40		
Semester End Examinations				60				
Course Objectives								
<ul style="list-style-type: none"> To study the safety in process design and pressure system design. To provide knowledge on plant commissioning and inspection procedures. To learn the activities involved in plant maintenance, modification and emergency planning. To introduce the various methods of storage and safe transportation of hazardous chemicals. To infer the operational methods of various industries. 								
Programme Outcomes (POs)								
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.							
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
PO6	Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Formulate the steps of process design and pressure system design.							
CO2	Identify the safety features while commissioning and follow inspection procedures.							
CO3	Use the safe methods of plant maintenance and modifications and carryout emergency planning.							
CO4	Identify the methods of storage and safe transportation of hazardous chemicals.							
CO5	Execute the operational methods of various industries.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1	3	2	2	3		3	
	2	3	3	2	2		2	
	3	2	2	2	3		3	
	4	2	3	3	2		2	
	5	3	3	2	2		2	
Unit I	Safety In Process Design And Pressure System Design						9 Hours	
Design process, conceptual design and detail design, assessment, inherently safer design-chemical reactor, types, batch reactors, reaction hazard evaluation, assessment, reactor safety, operating conditions, unit operations and								

equipment, utilities. Pressure system, pressure vessel design, standards and codes- pipe works and valves- heat exchangers- pressure relief devices and design, fire relief, vacuum and thermal relief, disposal- flare and vent systems-failures in pressure system.		
Unit II	Plant Commissioning And Inspection	9 Hours
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 Maintenance, Modification And Emergency Planning	9 Hours
Management of maintenance, hazards- preparation for maintenance, isolation, purging, cleaning, confined spaces, permit system- maintenance equipment- hot works- tank cleaning, repair and demolition- online repairs- maintenance of protective devices- modification of plant, problems- controls of modifications. Emergency planning, disaster planning, onsite emergency- offsite emergency, APELL.		
Unit IV	Storages And Transportation	9 Hours
General consideration, petroleum product storages, storage tanks and vessel- storages layout- segregation, separating distance, secondary containment- venting and relief, atmospheric vent, pressure, vacuum valves, flame arrestors, fire relief- fire prevention and protection-LPG storages, pressure storages, layout, instrumentation, vaporizer, refrigerated storages-LNG storages, hydrogen storages, toxic storages, chlorine storages, ammonia storages, loading and unloading facilities- drum and cylinder storage- ware house, storage hazard assessment of LPG and LNG Hazards during transportation - pipeline transport.		
UNIT V	Plant Operations	9 Hours
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. Specific safety consideration for Cement, paper, pharmaceutical, petroleum, Petro-chemical, rubber, fertilizer and distilleries.		
		Total
		45 Hours
References		
<ol style="list-style-type: none"> 1. Lees, F.P. Loss Prevention in Process Industries Butterworths and Company, 2012. 2. Green, A.E., High Risk Safety Technology, John Wiley and Sons, 2003. 3. Fawcett, H.H. and Wood, Safety and Accident Prevention in Chemical Operations Wiley inters, Second Edition.2008 4. Guidelines for Chemical Process Quantitative Risk Analysis, American Institute of Chemical Industries, Centre for Chemical Process safety, Wiley Publications,1999. 5. Accident Prevention Manual for Industrial Operations NSC, Chicago, 1982. 		

24IS56	ENVIRONMENTAL POLLUTION CONTROL			L	T	P	C	
				3	0	0	3	
Pre-requisite		Assessment Pattern						
<ul style="list-style-type: none"> Control measures of gaseous pollutants. Knowledge on Water pollution, Solid waste management, Hazardous waste. 		Mode of Assessment				Weightage(%)		
		Continuous Internal Assessment				40		
		Semester End Examinations				60		
Course Objectives								
<ul style="list-style-type: none"> To introduce the elements of Air pollution and equipment. To study the control measures of gaseous pollutants. To learn the effects of water pollution. To impart knowledge on solid waste management. To provide knowledge on pollution control measures adopted in various hazardous industries. 								
Programme Outcomes (POs)								
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
PO6	Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Gain knowledge on Air Pollution and the constructional details of equipment's.							
CO2	Predict the effect of gaseous pollutants of an industrial unit.							
CO3	Find out the effects of water pollution on the receiving body.							
CO4	Identify the methods for solid waste management of an industrial unit.							
CO5	Evaluate the pollution control measures adopted in various industries.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1	3		3	3		3	
	2	3		2	2		3	
	3	2		3	2		2	
	4	2		2	2		2	
	5	3		2	3		2	
Unit I	Air Pollution						9 Hours	
Air pollution - Classification and properties of Air pollutants - Meteorological aspects of air pollutant dispersion –Temperature lapse rates and stability, wind velocity and turbulence. Pollution sources- Control of air pollution - Gravitational settling chambers -Cyclone separators, ESP, Wet scrubber, Fabric Filters.								

Unit II	Control Of Gaseous Pollutants	9 Hours
Dispersion of Air pollutants -Plume behaviour - The Gaussian Plume Model- Control of gaseous pollutants, Sulphur dioxides, nitrogen oxides, Carbon monoxide and Hydrocarbons. Air pollution laws and Standards.		
Unit III	Water Pollution	9 Hours
Water pollution- Classification of water pollutant and their effects on receiving bodies. Advanced wastewater treatments by Physical, Chemical, Biological and Thermal Methods-Effluent quality standards.		
Unit IV	Solid Waste Management	9 Hours
Solid waste management - methods of collection - Disposal of solid waste, land filling, Handling of toxic and radioactive wastes - Incineration and Verification. Vermicomposting, Pyrolysis.		
UNIT V	Pollution Control In Industries	9 Hours
Pollution control in process industries - Cement, paper, petroleum, fertilizer and petrochemical.		
		Total
		45 Hours
References		
<ol style="list-style-type: none"> 1. Rao C S, Environmental Pollution Control Engineering, New Age International, 2007. 2. Guidelines for EIA of Industrial and other Projects Ministry of Environment and Forests, Government of India, 2009. 3. P, R Trivedi, Environmental Pollution and Control, Paragon-Nivin Shahdara, New Delhi, 2008 4. G.T Miller, Environmental Science: Working with the Earth, 11th Edition, Wadsworth Publishing Co., Belmont, CA, 2006 5. Planet, Wadsworth Publishing Co., Belmont, CA 2006 6. M.J Hammer, and M.J Hammer, Jr., Water and Wastewater Technology, Pearson Prentice Hall, 2006 		

24IS57	ENVIRONMENTAL IMPACT ASSESSMENT			L	T	P	C
				3	0	0	3
Pre-requisite		Assessment Pattern					
<ul style="list-style-type: none"> Knowledge on EIA assessment and techniques. Environmental Management Plan. 		Mode of Assessment				Weightage(%)	
		Continuous Internal Assessment				40	
		Semester End Examinations				60	
Course Objectives							
<ul style="list-style-type: none"> To introduce the Environmental Impact Assessment. To study the Environmental Impact Assessment techniques. To learn the Environmental Impact Assessment evaluation techniques. To impart knowledge on Environmental Management Plan. To provide knowledge on Environmental Impact Assessment on projects. 							
Programme Outcomes (POs)							
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.						
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.						
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.						
Course Outcomes (COs)							
The students will be able to							
CO1	Demonstrate the Environmental Impact Assessment (EIA), Impact Statement (EIS) and Environmental Risk Assessment (ERA.)						
CO2	Compute the environmental assessment techniques for Environmental Analysis.						
CO3	Determine the Environmental Impact Assessment and the evaluation criteria.						
CO4	Execute the Environmental Management Plan and document it.						
CO5	Justify previous environmental cases and their causes.						
Articulation Matrix							
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6
	1		3	3	3		
	2		3	2	2		
	3		2	2	2		
	4		2	3	2		
	5		3	3	3		
Unit I	Introduction						9 Hours
Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS)-Environmental Risk Assessment (ERA) - Legal and Regulatory aspects in India - Types and limitations of EIA - Terms of Reference in EIA- Issues in EIA - national - cross sectorial - social and cultural.							

Unit II	Environmental Analysis And Assessment Techniques	9 Hours
Components - screening - setting - analysis - prediction of impacts - mitigation. Matrices Networks - Checklists - Importance assessment techniques - cost benefit analysis - analysis of alternatives - methods for Prediction and assessment of impacts. Standards and guidelines for evaluation. Public Participation in environmental decision-making.		
Unit III	Environmental Impact Assessment Evaluation	9 Hours
Trends in EIA practice and evaluation criteria - capacity building for quality assurance. Expert System in EIA - use of regulations and AQM.		
Unit IV	Environmental Management Plan	9 Hours
Document planning - collection and organization of relevant information - use of visual display materials - team writing - reminder checklists. Environmental monitoring - guidelines - policies - planning of monitoring programmes. Environmental Management Plan. Post project audit.		
UNIT V	Case Studies	9 Hours
Case studies of EIA of developmental projects.		
		Total
		45 Hours
References		
<ol style="list-style-type: none"> 1. L W Canter, Environmental Impact Assessment, McGraw Hill, New York, 1996. 2. J Petts, Handbook of Environmental Impact Assessment, Vol. I and II, Blackwell Science, London, 1999. 3. The World Bank Group, Environmental Assessment Sourcebook, Vol. I, II and III, World Bank, Washington, 1991. 4. G. Burke, B. R. Singh and L. Theodore, Handbook of Environmental Management and Technology, 2nd Ed., John Wiley and Sons, 2000 5. C. H. Eccleston, Environment Impact Statements: A Comprehensive Guide to Project and Strategic Planning, John Wiley and Sons, 2000. 6. www.cpcb.nic.inhttp://www.chilworth.co.uk/ 		

24IS58	SAFETY IN PETROCHEMICAL INDUSTRIES				L	T	P	C
					3	0	0	3
Pre-requisite				Assessment Pattern				
<ul style="list-style-type: none"> Controlling of safety and Relief systems. Knowledge on various risks and hazards involved in petrochemical industries. 				Mode of Assessment			Weightage(%)	
				Continuous Internal Assessment			40	
				Semester End Examinations			60	
Course Objectives								
<ul style="list-style-type: none"> To recognize the various risks and hazards involved in petrochemical industries - and its control Measures To impart knowledge on risk analysis, toxic effect and planning for onsite and-offsite emergency planning in petrol chemical industries To acquire knowledge on Controlling of safety systems and Relief systems and to acquire knowledge on design activities of safety and relief systems. 								
Programme Outcomes (POs)								
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.							
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Familiarize with the terminologies involved in the safety of petrochemical industries.							
CO2	Understand Risk analysis, hazard assessment and toxicity in petrol chemical industries.							
CO3	Control the risk factors by applying the various safety techniques in mitigating the hazards in petrochemical industries							
CO4	Attain ability to design fire protection facilities in oil refineries, depots and terminals.							
CO5	Attain ability to design fire protection systems for storage tank farms.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1	3	3	3	3			
	2	3	2	3	2			
	3	2	3	3	2			
	4	2	2	2	2			
	5	3	2	2	3			
Unit I	Introduction							9 Hours
Simplified Flow diagrams of a typical refinery - distillation unit, catalytic cracker, reformer, treating unit (hydro forming, gas purification, Sulphur recovery, lubricating oil unit) Simplified Flow diagrams of Petrochemical Industry - steam cracking, butadiene extraction, ethane recovery, butyl rubber polymerization.								

Unit II	Control Of Safety Systems	9 Hours
<p>Concept of risk, selection of design bases for safety systems, guidelines for risk tolerability, potential process safety systems and design solutions. Control of safety systems, safety system characteristic and design - Safety system computer control - Control of trip, interlock and emergency shut-down systems - Programmable logic and electronic system - Layered control systems for safety.</p>		
Unit III	Control Of Relief System	9 Hours
<p>Relief Systems: Preventive and protective management from fires and explosion-inert, static electricity passivation, ventilation, and sprinkling, proofing, relief systems- relief valves, flares, scrubbers. Design of flares, scrubbers and condensers for toxic release from chemical process industries; Design of tank farms for liquid/gaseous fuel storage.</p>		
Unit IV	Toxicology Of Petro Chemical Industries	9 Hours
<p>Toxicology: Hazards identification-toxicity, fire, static electricity, noise and dust concentration; Material safety data sheet, hazards indices- Dow and Mond indices, hazard operability (HAZOP) and hazard analysis (HAZAN).</p>		
UNIT V	Controlling Of Leakages And Associated Hazards	9 Hours
<p>Leaks and Leakages: Spill and leakage of liquids, vapours, gases and their mixture from storage tanks and equipment; Estimation of leakage/spill rate through hole, pipes and vessel burst; Isothermal and adiabatic flows of gases, spillage and leakage of flashing liquids, pool evaporation and boiling; Release of toxics and dispersion. Naturally buoyant and dense gas dispersion models; Effects of momentum and buoyancy; Mitigation measures for leaks and releases. Hazards Associated with Hydrocarbon and Other Chemical Products: Crude oil, natural gas, LPG, CNG, LNG, oxygenated hydrocarbons, chlorine, ammonia, hydrogen fluoride.</p>		
Total		45 Hours
References		
<ol style="list-style-type: none"> 1. L W Canter, Environmental Impact Assessment, McGraw Hill, New York, 1996 2. J Petts, Handbook of Environmental Impact Assessment, Vol. I and II, Blackwell Science, London, 1999. 3. The World Bank Group, Environmental Assessment Sourcebook, Vol. I, II and III, World Bank, Washington, 1991. 4. G. Burke, B. R. Singh and L. Theodore, Handbook of Environmental Management and Technology, 2nd Ed., John Wiley and Sons, 2000 5. C. H. Eccleston, Environment Impact Statements: A Comprehensive Guide to Project and Strategic Planning, John Wiley and Sons, 2000. 6. http://envfor.nic.in/ 		

24IS59	TRANSPORT SAFETY				L	T	P	C
					3	0	0	3
Pre-requisite		Assessment Pattern						
<ul style="list-style-type: none"> Knowledge about hazardous goods. Roles and responsibilities while driving. 		Mode of Assessment				Weightage(%)		
		Continuous Internal Assessment				40		
		Semester End Examinations				60		
Course Objectives								
<ul style="list-style-type: none"> To provide the steps to be followed for safe handling of hazardous goods during transportation To illustrate the road accident and the roles and responsibilities of a driver and the Safety training needed for the drivers. To inculcate the need for safe driving and give an over view of the motor vehicle act and rules. To develop knowledge on road safety including the laying of road and traffic control lines. To educate safety aspects in handling material and the material handling equipment in the shop floor. 								
Programme Outcomes (POs)								
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Apply the safety measures in handling of hazardous goods during transportation.							
CO2	Formulate the causes for accident and the roles and responsibilities of a driver and the Safety training needed for the drivers.							
CO3	Identify the need for safe driving and understand an over view of the motor vehicle act and rules.							
CO4	Demonstrate the rules on road safety including the laying of road and traffic control lines.							
CO5	Indicate the safety aspects in handling material and the material handling equipment in the shop floor.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1		3	3	3		3	
	2		3	3	2		3	
	3		2	3	2		2	
	4		2	2	2		2	
	5		3	2	3		2	
Unit I	Transportation of Hazardous Goods						9 Hours	
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	9 Hours
Introduction - factors for improving safety on roads- signage and mandatory signs - 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 Hours
Driver safety programme - selection of drivers - driver training-tacho-graph-driving test driver 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 Hazmat codes.		
Unit IV	Road Safety	9 Hours
Road alignment and gradient-reconnaissance-ruling gradient-maximum rise per km.- 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.		
UNIT V	Shop Floor Safety	9 Hours
Transport precautions-safety on manual, mechanical handling equipment operations safe driving movement of cranes-conveyors etc., equipment.		
		Total
		45 Hours
References		
<ol style="list-style-type: none"> 1. Kadiyali, Traffic Engineering and Transport Planning Khanna Publishers, New Delhi, 1983. 2. Motor Vehicles Act, 1988, Government of India, Universal Law Publishing,2016 3. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982. 4. Pasricha, Road Safety guide for drivers of heavy vehicle Nasha Publications, Mumbai, 1999. 5. C.A Popkes, Traffic Control and Road Accident Prevention Chapman and Hall Limited, 1986 6. V.F Babkov, Road Conditions and Traffic Safety MIR Publications, Moscow, 1986. 		

24IS60	SAFETY IN ON-SHORE AND OFF-SHORE DRILLING				L	T	P	C
					3	0	0	3
Pre-requisite		Assessment Pattern						
<ul style="list-style-type: none"> Knowledge about various petroleum products. Onshore and offshore drilling operations. 		Mode of Assessment					Weightage(%)	
		Continuous Internal Assessment					40	
		Semester End Examinations					60	
Course Objectives								
<ul style="list-style-type: none"> To provide knowledge on various petroleum products, the hazards involved, the control and preventive measures. To impart knowledge on shore and off shore operations, the hazards associated with it and the safety requirements. To develop knowledge on oil drilling, the hazards associated with it and the safety requirements. To provide knowledge on petroleum extraction and transportation, the hazards associated with it and the protective measures. To impart knowledge on storage of petroleum products and the storage equipment and the hazards associate with it. 								
Programme Outcomes (POs)								
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
PO6	Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Identify various petroleum products, the hazards involved, and suggest the control and preventive measures.							
CO2	Compare with on shore and offshore operations, the hazards associated with it and the safety requirements.							
CO3	Indicate about oil drilling, the hazards associated with it and the safety requirements.							
CO4	Explain the petroleum extraction and transportation, the hazards associated with it and the protective measures.							
CO5	Determine the method of storage of petroleum products and the storage equipment and the hazards associate with it.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1		3	3	3		3	
	2		3	3	2		3	
	3		2	3	2		2	
	4		2	2	2		2	
	5		3	2	3		2	

Unit I	Petroleum Products	9 Hours
Petroleum and Petroleum products - Fuels- Petroleum solvents - Lubricating oils - Petroleum wax, greases- Miscellaneous product.		
Unit II	On and Off Shore Operations	9 Hours
On and off shore oil operation - Construction of Installation - Pipe Line Construction - Maintenance and repair activities - Safety and associated hazards.		
Unit III	Drilling	9 Hours
Drilling oil- Technique and equipment- Work position - Working condition - safety and associated hazards- lightning and its effects.		
Unit IV	Extraction and Transportation	9 Hours
Petroleum Extraction and transport by sea - Oil field products - Operation - Transport of crude by sea - Crude oil hazards.		
UNIT V	Storage and Cleaning	9 Hours
Petroleum product storage and transport - Storage equipment - Precaution - Tank cleaning.		
		Total
		45 Hours
References		
<ol style="list-style-type: none"> 1. Encyclopaedia of Occupational Health and Safety, Vol. II, International Labour Organisation, Geneva, 1985 and I. 2. Dr. Paul Bommer A Primer of Oilwell Drilling A Basic Text of Oil and Gas Drilling Seventh Edition published by The University of Texas Continuing Education petroleum extension service.2008 3. S. Tanaka, Y. Okada, Y. Ichikawa, Offshore Drilling And Production Equipment, in Civil Engineering, in Encyclopaedia of Life Support Systems, Developed under the Auspices of the UNESCO, Eolss Publishers, Oxford, UK, 2005 4. Management and Engineering of Fire Safety and Loss Prevention: Onshore and offshore, BHR group and Taylor and francis,1991. 5. Ian Sutton, Off shore safety Management, Elseiver,2013. 6. Huacan Fang, Menglan Duan, Offshore Oil and Gas Drilling Engineering and Equipment, Offshore Operation Facilities-2014, Pages 141-340 		

24IS61	SAFETY IN MINES				L	T	P	C
					3	0	0	3
Pre-requisite		Assessment Pattern						
<ul style="list-style-type: none"> Knowledge about hazardous goods. Roles and responsibilities while driving. 		Mode of Assessment				Weightage(%)		
		Continuous Internal Assessment				40		
		Semester End Examinations				60		
Course Objectives								
<ul style="list-style-type: none"> To create knowledge on various types of mines and the hazards associated with it. To develop knowledge on underground mines, occupational hazards and the safety aspects. To impart knowledge on tunnelling and the personal protection. To identify the risk, potential hazards and do the risk assessment. To give an exposure to various accidents happened in mines and the way to manage situation during accidents. 								
Programme Outcomes (POs)								
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.							
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Identify various types of mines and the hazards associated with it.							
CO2	Demonstrate underground mining, the occupational hazards and the safety aspects.							
CO3	Explain on tunnelling and the personal protection.							
CO4	Identify the risk, potential hazards and do the risk assessment.							
CO5	Classify the accidents, investigate and analyze the accidents							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1	2	3	3	3			
	2	3	3	2	2			
	3	2	3	3	2			
	4	3	2	3	2			
	5	3	2	3	3			
Unit I	Opencast Mines						9 Hours	
Causes and prevention of accident from: Heavy machinery, belt and bucket conveyors, drilling, hand tools-pneumatic systems, pumping, water, dust, electrical systems, fire prevention. Garage safety - accident reporting system-working condition - safe transportation - handling of explosives.								

Unit II	Underground Mines	9 Hours
Fall of roof and sides - effect of gases - fire and explosions - water flooding-warning sensors - gas detectors - occupational hazards - working conditions-winding and transportation.		
Unit III	Tunneling	9 Hours
Hazards from: ground collapse, inundation and collapse of tunnel face, falls from platforms and danger from falling bodies. Atmospheric pollution (gases and dusts) - trapping -transport-noise- electrical hazards- noise and vibration from - pneumatic tools and other machines - ventilation and lighting - personal protective equipment.		
Unit IV	Risk Assessment	9 Hours
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.		
UNIT V	Accident Analysis and Management	9 Hours
Accidents classification and analysis-fatal, serious, minor and reportable accidents - safety audits- recent development of safety engineering approaches for mines-frequency rates-accident occurrence- investigation-measures for improving safety in mines-cost of accident-emergency preparedness - disaster management.		
		Total
		45 Hours
References		
<ol style="list-style-type: none"> 1. Michael Karmis, Mine Health and Safety Management, SME, Littleton, Co. 2001. 2. B.K Kejiriwal, Safety in Mines, Publisher Gyan Prakashan, Dhanbad, 2002. 3. DGMS Circulars-Ministry of Labour, Government of India press, OR Lovely Prakashan- DHANBAD, 2002. 4. Dhillon, S Balbir Mine safety- A modern Approach, Springer Publication,2010 5. Hartmann, Introduction to mining engineering, Wiley Publications, 2007. 7. Fred G. Bell, J. Laurance, Mining and its impact on environment, Taylor and Francis, 2006. 		

24IS62	MAINTENANCE ENGINEERING				L	T	P	C
					3	0	0	3
Pre-requisite				Assessment Pattern				
<ul style="list-style-type: none"> Basic principles of maintenance of goods. Basic understanding of logistic layout. 				Mode of Assessment			Weightage(%)	
				Continuous Internal Assessment			40	
				Semester End Examinations			60	
Course Objectives								
<ul style="list-style-type: none"> To learn the basic concept of maintainability engineering. To gain knowledge on various maintenance methods, maintenance policies and replacement models. To obtain information on maintenance logistics. To develop knowledge on maintenance quality by various analysis. To learn about Total Productive Maintenance. 								
Programme Outcomes (POs)								
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Explain the basic concept of maintainability engineering of an Industrial Unit.							
CO2	Implement various maintenance methods, maintenance policies and replacement models.							
CO3	Demonstrate maintenance logistics of an Industrial Unit.							
CO4	Compute maintenance quality by various analysis.							
CO5	Indicate Total Productive Maintenance of an Industrial Unit.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1		3	3	3			
	2		3	3	2			
	3		2	3	2			
	4		2	2	2			
	5		3	2	3			
Unit I	Maintenance Concept						9 Hours	
Need for maintenance - Maintenance definition - Maintenance objectives - Challenges of Maintenance management - Tero technology - Scope of maintenance department - Maintenance costs.								

Unit II	Maintenance Models	9 Hours
Proactive/Reactive maintenance - Imperfect maintenance - Maintenance policies - PM versus b/d maintenance - Optimal PM schedule and product characteristics - Optimal Inspection frequency: Maximizing profit Minimizing downtime - Replacement models.		
Unit III	Maintenance Logistics	9 Hours
Human factors - Crew size decisions: Learning curves - Simulation - Maintenance resource requirements: Optimal size of service facility - Optimal repair effort - Maintenance planning - Maintenance scheduling - Spare parts control - Capital spare.		
Unit IV	Maintenance Quality	9 Hours
Maintenance excellence - Five Zero concept - FMECA - Root cause analysis - System effectiveness - Design for maintainability - Maintainability allocation - CMMS - Reliability Centered Maintenance.		
UNIT V	Total Productive Maintenance	9 Hours
TPM features - Chronic and sporadic losses - Equipment defects - Six major losses - Overall Equipment Effectiveness - TPM pillars - TPM implementation Autonomous maintenance.		
		Total
		45 Hours
References		
<ol style="list-style-type: none"> Higgins & Morrow , Maintenance Engineering Handbook,Eighth Edition,2008 K.S Andrew, Jardine and Albert H.C.Tsang, Maintenance, Replacement and Reliability, Taylor and Francis, 2006. Bikas Badhury and S.K.Basu, Tero Technology: Reliability Engineering and Maintenance Management, Asian Books, 2003. Kelly and M J. Harris, Management of Industrial Maintenance, Butter worth and Company Limited, 2001 R. C.Mishra and K.Pathak , Maintenance Engineering and Management, PHI, 2005. Sushil Kumar Srivatsava, Industrial Maintenance Management, S Chand and Company, 2005. 		

24IS63	WORK STUDY AND ERGONOMICS			L	T	P	C
				3	0	0	3
Pre-requisite		Assessment Pattern					
<ul style="list-style-type: none"> Basic principles of ergonomics. Personal Protective Equipment. 		Mode of Assessment				Weightage(%)	
		Continuous Internal Assessment				40	
		Semester End Examinations				60	
Course Objectives							
<ul style="list-style-type: none"> To learn about the concepts of work study To develop knowledge on application of ergonomic principles and physiology of workers. To study the concept of personal protective equipment, section and usage. To understand process and equipment design incorporating safety. To understand the man machine system 							
Programme Outcomes (POs)							
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.						
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.						
Course Outcomes (COs)							
The students will be able to							
CO1	Compare the work and indicate methods for safe operation.						
CO2	Implement ergonomic principles in an Industrial Unit.						
CO3	Identify different Personal protective equipment for usage based on the hazard.						
CO4	Explain built in safety for different process and equipment.						
CO5	Indicate the human risk factors in the man machine system.						
Articulation Matrix							
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6
	1	3			3		
	2	3			2		
	3	2			2		
	4	2			2		
	5	3			3		
Unit I	Work Study						9 Hours
Selection of plant locations, Safe layout, equipment layout, 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 Hours
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 - accident- physiology of workers.		
Unit III	Personal Protection	9 Hours
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 Hours
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 Hours
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.		
		Total
		45 Hours
References		
<ol style="list-style-type: none"> 1. Introduction to Work Study, ILO, Oxford and IBH Publishing company, 3rd edition, 2008. 2. Work Study, National Productivity Council, New Delhi, 1995. 3. E J Mc Cormick. and M.S Sanders Human Factors in Engineering and Design, TMH, New Delhi, 1993. 4. W Benjamin Neibal., Motion and Time Study, 7th Edition. 5. Mundel, Motion and Time Study, 6th Edition, Allied Publishers, Madras, 1989. 6. McElroy, E Frank., Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1980. 		

24IS64	WASTE WATER MANAGEMENT				L	T	P	C
					3	0	0	3
Pre-requisite				Assessment Pattern				
<ul style="list-style-type: none"> Sources of wastewater. Physical and chemical treatment processes. 				Mode of Assessment			Weightage(%)	
				Continuous Internal Assessment			40	
				Semester End Examinations			60	
Course Objectives								
<ul style="list-style-type: none"> To develop knowledge on characteristic of water the sources of water pollutants and wastewater treatment. To impart knowledge on physical treatments processes such as sedimentation, reverse osmosis, Nano filtration, electro dialysis etc. To provide knowledge on chemical treatment processes such as coagulation flocculation, precipitation, flotation, ion exchange, electrolytic etc. To develop skill in Design of Conventional Water Treatment Plants. To afford knowledge on Design of Industrial Water Treatment and Reclamation. 								
Programme Outcomes (POs)								
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Explain the characteristic of water, the sources of water pollutants and wastewater treatment.							
CO2	Indicate the physical treatments processes such as sedimentation, reverse osmosis, Nano filtration, electro dialysis etc.							
CO3	Identify and explain the chemical treatment processes such as coagulation flocculation, precipitation, flotation, ion exchange, electrolytic etc.							
CO4	Assess the Design of Conventional Water Treatment Plants.							
CO5	Execute the Industrial Water Treatment and Reclamation							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1		3	2	3			
	2		3	2	2			
	3		2	2	2			
	4		2	3	2			
	5		3	3	3			
Unit I	Introduction							9 Hours
Characteristics of wastewater - Aerobic Treatment of Wastewater - Suspended growth processes, Activated sludge process, Aerated lagoons Anaerobic Treatment of Wastewater - Sludge digesters, Suspended growth								

Processes, Attached growth Processes Standards for performance - Significance and need for physico-chemical treatment.		
Unit II	Physical Treatment Principles	9 Hours
Principles of Screening - Mixing, equalization- Sedimentation - Filtration - Modelling - Back washing - Evaporation - Incineration - Gas transfer - Mass transfer coefficients - Adsorption - Isotherms Principles, equilibrium and kinetics, reactors, regeneration, membrane separation, Reverse Osmosis, Nano filtration ultra-filtration and hyper filtration - Electro dialysis, distillation - Stripping and crystallization - Recent Advances.		
Unit III	Chemical Treatment Principles	9 Hours
Principles of Chemical treatment - Coagulation flocculation - Precipitation - flotation, solidification and stabilization - Disinfection - Ion exchange, Electrolytic methods, Solvent extraction - advance oxidation reduction - Recent Advances.		
Unit IV	Design of Conventional Treatment Plants	9 Hours
Aerators chemical, feeding-Flocculation-clarifier filters Rapids and filter, slow sand filter, pressure filter Chlorinators Displacement and gaseous type. Layouts - flow charts- Hydraulic Profile O and M aspects Case studies Residue management- Up gradation of existing plants Recent Advances.		
UNIT V	Design Of Industrial Water Treatment and Reclamation	9 Hours
Selection of process - Design of softeners- Demineralizers - Wastewater reclamation - Reverse osmosis plants - Residue management - O and M aspects - Recent Advances - Case studies.		
		Total
		45 Hours
References		
<ol style="list-style-type: none"> 1. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw-Hill, Fourth Edition, 2009 2. Lee, and Shundar Lin, Handbook of Environmental Engineering Calculations, McGraw- Hill, 1999. 3. S.R Qasim, E M Motley, and G Zhu, Water works Engineering Planning, Design and Operation, Prentice Hall, 2002. 4. T J.Casey, Unit Treatment Processes in Water and Wastewater Engineering, John Wiley and Sons, 1993. 5. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, 1999. 6. www.gpcb.gov.in 		

24IS65	RELIABILITY ENGINEERING				L	T	P	C
					3	0	0	3
Pre-requisite				Assessment Pattern				
<ul style="list-style-type: none"> Basics of reliability terms Information about probability distribution 				Mode of Assessment			Weightage(%)	
				Continuous Internal Assessment			40	
				Semester End Examinations			60	
Course Objectives								
<ul style="list-style-type: none"> To develop knowledge on the reliability concept. To impart knowledge on Failure data analysis. To provide knowledge on various reliability prediction modelling. To create knowledge on Reliability Management. To inculcate knowledge on risk assessment. 								
Programme Outcomes (POs)								
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Understand the reliability concept for system effectiveness.							
CO2	Do Failure data analysis and plotting techniques.							
CO3	Gain knowledge on various reliability prediction modelling.							
CO4	Familiarise with Reliability Management.							
CO5	Do risk assessment in industry.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1	3			3			
	2	3			2			
	3	2			2			
	4	2			2			
	5	3			3			
Unit I	Reliability Concept						9 Hours	
Reliability function -failure rate - mean time between failures (MTBF) - mean time to failure (MTTF) - A priori and a posteriori concept - mortality curve - useful life - availability -maintainability - system effectiveness.								

Unit II	Failure Data Analysis	9 Hours
Time to failure distributions-Exponential, normal, Gamma, Weibull, ranking of data probability plotting techniques- Hazard plotting.		
Unit III	Reliability Prediction Models	9 Hours
Series and parallel systems -RBD approach -Standby systems - m/n configuration-Application of Bayes theorem - cut and tie set method - Markov analysis - Fault Tree Analysis - limitations.		
Unit IV	Reliability Management	9 Hours
Reliability testing - Reliability growth monitoring - Non-parametric methods - Reliability and life cycle costs - Reliability allocation - Replacement model.		
UNIT V	Risk Assessment	9 Hours
Definition and measurement of risk- risk analysis techniques -risk reduction resources-industrial safety and risk assessment.		
		Total
		45 Hours
References		
<ol style="list-style-type: none"> 1. L.S. Srinath, Reliability Engineering, Affiliated East-West Press, New Delhi, 2005 2. Charles Ebling, An Introduction to Reliability and Maintainability Engineering, Tata McGraw Hill, New Delhi, 2000. 3. Singiresu S.Rao, Reliability Engineering, Pearson Education India, New Delhi, 2016. 4. K.C. Kapur and L.R. Lamberson, Reliability in Engineering Design, Wiley India, New Delhi, 2009 5. Roger D. Leitch, Reliability Analysis for Engineers – An Introduction, Oxford University Press, 1995 		

24IS66	MANAGEMENT SYSTEM STANDARDS			L	T	P	C	
				3	0	0	3	
Pre-requisite		Assessment Pattern						
<ul style="list-style-type: none"> Basics of Occupational Safety Information about Environmental Impact Assessment. 		Mode of Assessment				Weightage(%)		
		Continuous Internal Assessment				40		
		Semester End Examinations				60		
Course Objectives								
<ul style="list-style-type: none"> Explain the importance of OHSMS, standard, its development and structure. Demonstrate OHSMS policy and planning, implementation and documentation. Formulate for checking and reviewing as per OHSMS guidelines. Indicate the ISO 14000 and ISO 9000 requirements for an Industrial unit. Identify the activity to carry out Environment impact assessment. 								
Programme Outcomes (POs)								
PO2	Establish, implement, and maintain continuous improvement on industrial safety management to ensure a risk-free working environment.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Explain the importance of OHSMS, standard, its development and structure.							
CO2	Demonstrate OHSMS policy and planning, implementation and documentation.							
CO3	Formulate for checking and reviewing as per OHSMS guidelines.							
CO4	Indicate the ISO 14000 and ISO 9000 requirements for an Industrial unit.							
CO5	Identify the activity to carry out Environment impact assessment.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1		3	2	3			
	2		3	2	2			
	3		2	2	2			
	4		2	3	2			
	5		3	3	3			
Unit I	OHS Management System Standard						9 Hours	
Introduction ISO 45001- Development of OHSMS standard Structure and features of OSHMS Benefits of certification-certification procedure OH and S management system element, specification and scope, success factors, plan do check act cycle- contents and scope of ISO 45001, terms and definitions.								

Unit II	Policy and Planning, Implementation and Operation	9 Hours
General requirements, OH and S policy, Planning- Hazard identification, risk assessment and determining controls -Legal and other requirements-Objectives and program (s), Implementation and operation-Resources, roles responsibility, accountability and authority- Competence, training and awareness -Communication, participation and consultation Documentation - Control of documents - Operational control-Emergency preparedness and response.		
Unit III	Checking and Review Guidelines	9 Hours
Checking- Performance measurement and monitoring-Evaluation of compliance-Incident investigation, nonconformity, corrective action and preventive action- Control of records-Internal audit-Management review - guidelines for implementation of ISO 45001 -Examples of items for hazard identification checklist Comparison of risk assessment tool and methodologies.		
Unit IV	ISO 14001 and ISO 9000	9 Hours
ISO 14001 -Environmental management systems Requirements with guidance for use - Environmental policy-Environmental aspects - Legal and other requirements - Objectives, targets and programme(s)- Implementation and operation - Checking - Management review- Guidance for use - Principles (ISO 14004), clauses 4.1 to 4.5. Documentation requirements, 3 levels of documentation for ISO 14000 based EMS, steps in ISO 14001 - Implementation plan, Registration, Importance of ISO 14000 to the Management. Guidelines for environmental management systems auditing -General principles, Managing audit programme - Audit activities, steps in audit, Audit plan. Competence of auditors.		
UNIT V	Environment Impact Assessment	9 Hours
ISO 14040(LCA), General principles of LCA, Stages of LCA, Report and Review. ISO 14020 (Eco-labelling) - History, 14021, 14024, Type I labels, Type II labels, ISO 14024, principles, rules for eco-labelling before company attempts for it. Advantages - EIA in EMS, Types of EIA, EIA methodology EIS, Scope, Benefits. Audit-methodology, Auditors Audit results management review- Continual improvement.		
Total		45 Hours
References		
<ol style="list-style-type: none"> Occupational Health and Safety Assessment Series BS (OHSAS) 21001:2007 BSI, UK, 2007. OHSAS 21002, Occupational Health and Safety Management Systems - Guidelines for the implementation of OHSAS 21001, OHSAS project group, 2008. ISO 14001:2004, Environmental Management Systems - Requirements with guidance for use ISO, 2004. Dr K.C. Arora. ISO 9000 to OHSAS 21001, S. K. Katariaand Sons, 2012. Guidelines on Occupational Health and Safety Management Systems (OSH-MS) International Labour Organization: 2001. http://pozhproekt.ru/nsis/bs/management/BS-8800-2004.pdf 		

24IS67	SAFETY IN CONSTRUCTION				L	T	P	C
					3	0	0	3
Pre-requisite			Assessment Pattern					
<ul style="list-style-type: none"> Basics of construction industry Basic information about various heavy construction machinery. 			Mode of Assessment				Weightage(%)	
			Continuous Internal Assessment				40	
			Semester End Examinations				60	
Course Objectives								
<ul style="list-style-type: none"> To study the accident causes and management systems in construction. To understand the hazards of construction and prevention. To provide knowledge on safety while working at heights. To educate on the safe operation and maintenance of construction machineries. To expose to the conditions of safety in demolition works. 								
Programme Outcomes (POs)								
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.							
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.							
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
PO6	Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.							
Course Outcomes (COs)								
The students will be able to								
CO1	Identify the accident causes and management systems in construction.							
CO2	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.							
CO3	Demonstrate the safety provisions while working at heights.							
CO4	Classify the safety operation and maintenance of construction machineries.							
CO5	Identify safe operation of demolition works.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1	3		2	3		3	
	2	3		2	2		2	
	3	2		2	2		2	
	4	2		3	2		3	
	5	3		3	3		3	

Unit I	Accidents Causes and Management Systems	9 Hours
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 Hours
Excavations, basement and wide excavation, trenches, shafts - scaffolding, types, causes of accidents, scaffold inspection checklist - false work - erection of structural framework, dismantling -tunnelling - 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.		
Unit III	Working at Heights	9 Hours
Fall protection in construction OSHA3146-OSHA requirement for working at heights, Safe access and egress - safe use of ladders- Scaffoldings, requirement for safe work platforms, stairways, gang ways 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.		
Unit IV	Construction Machinery	9 Hours
Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist -builders 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.		
UNIT V	Safety In Demolition Work	9 Hours
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 Hours
References		
<ol style="list-style-type: none"> 1. Safety Handbook for the Building and Construction, Incolink (Australian construction association),2013 2. Sharma S C and Vineet kumar, Safety, Occupational Health and Environmental Management in Construction, Khanna Publishers, 1 st Edition,2013. 3. Construction Safety Paperback, 1 May 2013 by R.K. Mishra 4. Bhattacharjee S K, Safety Management in Construction, Khanna Publishers,2013. 5. V.J.Davies and K.Tomasin Construction Safety Hand Book Thomas Telford Ltd., London,2008 6. Charles D.Reese and James V.Edison Handbook of OSHA Construction safety and health, CRC Press Taylor and Francis group, 2006. 		

24IS68	SAFETY IN TEXTILE INDUSTRY			L	T	P	C
				3	0	0	3
Pre-requisite		Assessment Pattern					
<ul style="list-style-type: none"> Basics of textile machinery Hazards in textile processing units. 		Mode of Assessment				Weightage(%)	
		Continuous Internal Assessment				40	
		Semester End Examinations				60	
Course Objectives							
<ul style="list-style-type: none"> To provide the knowledge on textile Machineries, products and the hazards involved. To learn the hazards in textile processing such as looms, knitting and non-ovens. To study various hazards in textile processing such as bleaching, dyeing, punting, finishing and effluents. To enhance and develop the knowledge on Health hazards in textile industry, welfare measures specific to textile industry, statues applicable to textile industry, including effluent treatment and waste disposal in textile industry. 							
Programme Outcomes (POs)							
PO1	Apply knowledge of engineering specialisation for hazard identification and risk assessment, analyse the cause of an incident, and control occupational health safety and environmental problems.						
PO3	Recognise and evaluate occupational health safety and legal issues at the workplace to determine appropriate hazard controls, following the hierarchy of controls relevant to occupational health and safety practices.						
PO4	Conduct investigation, analyse the root cause and generate corrective and preventive measures, to prevent recurrence of accidents in industries.						
PO6	Effectively communicate the safety matters, rules and regulations to the employees and society for safe handling of equipment and maintaining a safe working environment in industries.						
Course Outcomes (COs)							
The students will be able to							
CO1	Analyze the overview of the textile Machineries, products and the hazards involved.						
CO2	Identify the hazards in textile processing such as looms, knitting and non-ovens.						
CO3	Explain various hazards in textile processing such as bleaching, dyeing, punting, finishing and effluents.						
CO4	Infer knowledge on Health hazards in textile industry and welfare measures specific to textile industry						
CO5	Implement the statues applicable to textile industry, including effluent treatment and waste disposal in textile industry.						
Articulation Matrix							
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6
	1	3		3	3		3
	2	3		2	2		2
	3	2		2	2		2
	4	2		2	2		3
	5	3		3	3		3

Unit I	Introduction	9 Hours
Introduction to process flow charts of i) short staple spinning, ii) long staple spinning, iii) viscose rayon and synthetic fiber, 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 Hours
Accident hazards i) sizing processes- cooking vessels, transports of size, hazards due to steam ii) Loom shed shuttle looms and shuttle less looms iii) knitting machines iv) nonwovens.		
Unit III	Textile Hazards II	9 Hours
Scouring, bleaching, punting, mechanical finishing operations and effluents in textile processes.		
Unit IV	Health and Welfare	9 Hours
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.		
UNIT V	Safety Status	9 Hours
Relevant provision of factories Act and rules and other statues applicable to textile industry effluent treatment and waste disposal in textile industry		
		Total 45 Hours
References		
<ol style="list-style-type: none"> 1. Safety in Textile Industry, Thane Belapur Industries Association, Mumbai,2007. 2. 100 Textile fires analysis, findings and recommendations LPA,2008. 3. E.B.Groover and D.S.Hamby, Hand book of textile testing and quality control, New York: Textile Book Publishers, 1960. 4. Quality tolerances for water for textile industry,BIS,1992. 5. V,A.Shenai, A technology of textile processing, Vol. I, Textile Fibres, Sevak, 1975. 6. Little, A.H., Water supplies and the treatment and disposal of effluent, Manchester: Textile Institute, 1975. 		

24XE01	ENGLISH FOR RESEARCH PAPER WRITING				L	T	P	C																											
					2	0	0	0																											
Pre-requisite				Assessment Pattern																															
<ul style="list-style-type: none"> Basics English comprehension. 				Mode of Assessment				Weightage(%)																											
				Continuous Internal Assessment				100																											
				Semester End Examinations																															
Course Objectives																																			
<ul style="list-style-type: none"> Illustrate that how to improve your writing skills and level of readability. Learn about what to write in each section. Recognize the skills needed when writing a Title. Ensure the good quality of paper at very first-time submission. 																																			
Programme Outcomes (POs)																																			
<table border="1"> <tr> <td>PO2</td> <td colspan="8">An ability to write and present a substantial technical report/document.</td> </tr> </table>									PO2	An ability to write and present a substantial technical report/document.																									
PO2	An ability to write and present a substantial technical report/document.																																		
Course Outcomes (COs)																																			
The students will be able to																																			
<table border="1"> <tr> <td>CO1</td> <td colspan="8">Illustrate the research ideas and writing journal papers.</td> </tr> <tr> <td>CO2</td> <td colspan="8">Creating research paper writing.</td> </tr> </table>									CO1	Illustrate the research ideas and writing journal papers.								CO2	Creating research paper writing.																
CO1	Illustrate the research ideas and writing journal papers.																																		
CO2	Creating research paper writing.																																		
Articulation Matrix																																			
<table border="1"> <thead> <tr> <th>CO. No.</th> <th>PO1</th> <th>PO2</th> <th>PO3</th> <th>PO4</th> <th>PO5</th> <th>PO6</th> <th colspan="2"></th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td colspan="2"></td> </tr> <tr> <td>2</td> <td></td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td colspan="2"></td> </tr> </tbody> </table>									CO. No.	PO1	PO2	PO3	PO4	PO5	PO6			1		2							2		3						
CO. No.	PO1	PO2	PO3	PO4	PO5	PO6																													
1		2																																	
2		3																																	
Unit I								6 Hours																											
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.																																			
Unit II								6 Hours																											
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.																																			
Unit III								6 Hours																											
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.																																			
Unit IV								9 Hours																											
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.																																			

UNIT V		6 Hours
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.		
	Total	30 Hours
References		
<ol style="list-style-type: none"> 1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) 2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press 3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. 4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011. 		

24XE02	COST MANAGEMENT OF ENGINEERING PROJECTS				L	T	P	C		
					2	0	0	0		
Pre-requisite				Assessment Pattern						
<ul style="list-style-type: none"> Basics of cost aspects and stages of project execution. 				Mode of Assessment			Weightage(%)			
				Continuous Internal Assessment			100			
				Semester End Examinations						
Course Objectives										
<ul style="list-style-type: none"> To understand the cost concepts and different stages of project execution and its activities. To understand cost behaviour, management and its quantitative techniques. 										
Programme Outcomes (POs)										
PO1	An ability to independently carry out research / investigation and development work to solve practical problems.									
PO3	Students should be able to demonstrate a degree of mastery over the area of Computer Science and Engineering.									
PO4	Efficiently design, build and develop system application software for distributed and centralized computing environments in varying domains and platforms.									
PO5	Understand the working of current Industry trends, the new hardware architectures, the software components and design solutions for real world problems by Communicating and effectively working with professionals in various engineering fields and pursue research orientation for a lifelong professional development in computer and automation arenas.									
Course Outcomes (COs)										
The students will be able to										
CO1	Apply the cost concepts in decision making.									
CO2	Analyze the various stages of project execution and its activities.									
CO3	Analyze the cost behaviour and various types of costing.									
CO4	Analyze the cost management and budget related decisions.									
Articulation Matrix										
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6			
	1	1		1	1	1				
	2	1		1		1				
	3					1				
	4					1				
Unit I	Cost Concepts in Decision-Making						6 Hours			
Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.										
Unit II	Project						9 Hours			
Meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed										

Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance.		
Unit III	Cost Behaviour and Profit Planning Marginal Costing	9 Hours
Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning.		
Unit IV	Total Quality Management and Theory of Constraints	9 Hours
Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.		
UNIT V	Quantitative Techniques for Cost Management	9 Hours
Relevant provision of factories Act and rules and other statues applicable to textile industry effluent treatment and waste disposal in textile industry		
		Total
		30 Hours
References		
<ol style="list-style-type: none"> 1. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd. 2. Charles T. Horngren and George Foster, Advanced Management Accounting 3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting 4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher 		

24XE03	STRESS MANAGEMENT				L	T	P	C		
					2	0	0	0		
Pre-requisite				Assessment Pattern						
<ul style="list-style-type: none"> Basics of yoga. 				Mode of Assessment			Weightage(%)			
				Continuous Internal Assessment			100			
				Semester End Examinations						
Course Objectives										
<ul style="list-style-type: none"> To achieve overall health of body and mind. To overcome stress by practicing yoga. 										
Programme Outcomes (POs)										
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.								
Course Outcomes (COs)										
The students will be able to										
CO1		Develop healthy mind in a healthy body thus improving social health also.								
CO2		Improve Efficiency of the body by practicing breathing exercises and yoga.								
Articulation Matrix										
		CO. No.	PO1	PO2	PO3	PO4	PO5	PO6		
		1	1	1						
		2		1						
Unit I							10 Hours			
Definitions of Eight parts of yoga. (Ashtanga)										
Unit II							10 Hours			
Yam and Niyam. Dos and Donts in life.i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.										
Unit III							10 Hours			
Asan and Pranayam, i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects-Types of pranayam.										
						Total	30 Hours			
References										
<ol style="list-style-type: none"> Yogic Asanas for Group Training-Part-I Janardan Swami Yogabhyasi Mandal, Nagpur. Model Curriculum of Engineering & Technology PG Courses [Volume-I][47]. Rajayoga or conquering the Internal Nature by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata. 										

24XE04	DISASTER MANAGEMENT				L	T	P	C
					2	0	0	0
Pre-requisite		Assessment Pattern						
<ul style="list-style-type: none"> Disaster risk reduction. The strengths and weaknesses of disaster management approaches. 		Mode of Assessment				Weightage(%)		
		Continuous Internal Assessment				100		
		Semester End Examinations						
Course Objectives								
<ul style="list-style-type: none"> Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in. 								
Programme Outcomes (POs)								
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.							
Course Outcomes (COs)								
The students will be able to								
CO1	Illustrate the key concepts in disaster risk reduction and humanitarian response.							
CO2	Interpret the strengths and weaknesses of disaster management approaches, planning and programming.							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1	1	1					
	2	2						
Unit I	Introduction						5 Hours	
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.								
Unit II	Repercussions of Disasters and Hazards						5Hours	
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms and Cyclones, Tsunamis and Floods, Droughts and Famines, Landslides and Avalanches Man-made disaster Nuclear Reactor Meltdown, Industrial Accidents and Oil Slicks and Spills Outbreaks of Disease and Epidemics War and Conflicts.								
Unit III	Disaster Prone Areas in India						5 Hours	

Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.		
Unit IV	Disaster Preparedness and Management	5 Hours
Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.		
Unit V	Disaster Mitigation	9 Hours
Disaster mitigation meaning, concept and strategies of disaster mitigation, emerging trends in mitigation. Structural mitigation and non-structural mitigation, programs of disaster mitigation in India.		
		Total
		30 Hours
References		
<ol style="list-style-type: none"> 1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies " , New Royal book Company. 2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi 3. Goel S. L. "Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi. 		

24XE05	VALUE EDUCATION				L	T	P	C		
					2	0	0	0		
Pre-requisite				Assessment Pattern						
<ul style="list-style-type: none"> Awareness about ethics and human value 				Mode of Assessment			Weightage(%)			
				Continuous Internal Assessment			100			
				Semester End Examinations						
Course Objectives										
<ul style="list-style-type: none"> Interpret value of education and self- development. Imbibe good values in students. Let the should know about the importance of character. 										
Programme Outcomes (POs)										
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.									
Course Outcomes (COs)										
The students will be able to										
CO1	Knowledge of self-development.									
CO2	Learn the importance of Human values.									
CO3	Developing the overall personality.									
Articulation Matrix										
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6			
	1	1								
	2	1								
	3		1							
Unit I								8 Hours		
Values and self-development- Social values and individual attitudes-Work ethics- Indian vision of humanism-Moral and non- moral valuation-Standards and principles-Value judgements.										
Unit II								7 Hours		
Importance of cultivation of values- Sense of duty Devotion- Self-reliance- Confidence-Concentration-Truthfulness- Cleanliness-Honesty- Humanity- Power of faith- National Unity- Patriotism- Love for nature-Discipline.										
Unit III								8 Hours		
Personality and Behavior Development - Soul and Scientific attitude- Positive Thinking- Integrity and discipline-Punctuality- Love and Kindness- Avoid fault Thinking- Free from anger- Dignity of labour-Universal brotherhood and religious tolerance-True friendship-Happiness Vs suffering- love for truth-Aware of self-destructive habits-Association and Cooperation-Doing best for saving nature.										

Unit IV		7 Hours
Character and Competence -Holy books vs Blind faith, Self-management and Good health. Science of reincarnation, Equality, Nonviolence ,Humility, Role of Women. All religions and same message, Mind your Mind, Self-control. Honesty, Studying effectively.		
	Total	30 Hours
References		
1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi.		

24XE06	PEDAGOGY STUDIES				L	T	P	C
					2	0	0	0
Pre-requisite		Assessment Pattern						
<ul style="list-style-type: none"> Awareness about basic teaching techniques 		Mode of Assessment				Weightage(%)		
		Continuous Internal Assessment				100		
		Semester End Examinations						
Course Objectives								
<ul style="list-style-type: none"> Review existing evidence on the review topic to inform programmer design and policy making undertaken by the DfID, other agencies and researchers Identify critical evidence gaps to guide the development. 								
Programme Outcomes (POs)								
PO1	An ability to independently carry out research / investigation and development work to solve practical problems.							
Course Outcomes (COs)								
The students will be able to								
CO1	What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?							
CO2	What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?							
CO3	How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? overall personality							
Articulation Matrix								
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6	
	1	1						
	2	1						
	3	1						
Unit I	Introduction and Methodology						8 Hours	
Aims and rationale- Policy background- Conceptual framework and terminology-Theories of learning-Curriculum- Teacher education-Conceptual framework- Research questions-Overview of methodology and Searching.								
Unit II	Thematic Overview						7 Hours	
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.								
Unit III	Evidence on the Effectiveness of Pedagogical Practices						8 Hours	
Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school, curriculum and guidance materials best support effective pedagogy. Theory of change, Strength and nature of the body of evidence for effective pedagogical, practices, Pedagogic theory and pedagogical approaches, Teachers" attitudes and beliefs and Pedagogic strategies.								

Unit IV	Professional Development	7 Hours
Alignment with classroom practices and follow up, Support Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes.		
		Total
		30 Hours
References		
<ol style="list-style-type: none"> 1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261. 2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379 3. Akyeampong K (2003) Teacher training in Ghana - does it count. Multi-site teacher education research project (MUSTER) country report 1. London: DFID 4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282 5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell. 6. Chavan M (2003) Read India: A mass scale, rapid, "learning to read" campaign. 		

24XE07	BUSINESS ANALYTICS				L	T	P	C		
					2	0	0	0		
Pre-requisite				Assessment Pattern						
<ul style="list-style-type: none"> Business analytics within an organization. 				Mode of Assessment			Weightage(%)			
				Continuous Internal Assessment			100			
				Semester End Examinations						
Course Objectives										
<ul style="list-style-type: none"> Illustrate the role of business analytics within an organization. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making. To become familiar with processes needed to develop, report, and Analyze business data. Use decision-making tools/Operations research techniques and Manage business process using analytical and management tools. 										
Programme Outcomes (POs)										
PO1	An ability to independently carry out research / investigation and development work to solve practical problems.									
PO4	Efficiently design, build and develop system application software for distributed and centralized computing environments in varying domains and platforms.									
PO5	Understand the working of current Industry trends, the new hardware architectures, the software components and design solutions for real world problems by Communicating and effectively working with professionals in various engineering fields and pursue research orientation for a lifelong professional development in computer and automation arenas.									
PO6	Model a computer based automation system and design algorithms that explore the understanding of the tradeoffs involved in digital transformation.									
Course Outcomes (COs)										
The students will be able to										
CO1	Implement the knowledge of data analytics.									
CO2	Apply the ability of think critically in making decisions based on data and deep analytics.									
CO3	Analyze the ability to use technical skills in predicative and prescriptive modelling to support business decision-making.									
CO4	Determine the ability to translate data into clear, actionable insights.									
CO5	Analyze the decision problems in business analytics.									
Articulation Matrix										
	CO. No.	PO1	PO2	PO3	PO4	PO5	PO6			
	1	2			2	1	1			
	2	2			2	2	1			
	3	1			1					
	4	1								
	5	2			1					

Unit I	Business Analytics and Statistical Tools	6 Hours
Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics-Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.		
Unit II	Trendiness and Regression Analysis	6 Hours
Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.		
Unit III	Organization Structures of Business Analytics	6 Hours
Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.		
Unit IV	Forecasting Techniques	6 Hours
Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.		
Unit V	Decision Analysis	6 Hours
Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.		
Total		30 Hours
References		
<ol style="list-style-type: none"> 1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press 2. Business Analytics by James Evans, persons Education. 		