

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur -603 203.

(Approved by AICTE, Affiliated to Anna University, 'A' Grade Accredited by NAAC, NBA

Accredited, ISO 9001: 2015 Certified)



CURRICULA AND SYLLABI

M.E. INDUSTRIAL SAFETY ENGINEERING

REGULATIONS - 2023

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

M.E. INDUSTRIAL SAFETY ENGINEERING REGULATIONS - 2023

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Possess a mastery of health, safety, environment knowledge and safety management skills to reach higher levels in their profession.
2. Knowledgeable safety engineers, rendering professional expertise to the industrial and societal needs at national and global level subject to legal requirements.
3. Communicate the information on health, safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities.

2. PROGRAMME OUTCOMES (POs)

After going through the two years of study, our Industrial Safety Engineering Graduates will exhibit ability to:

PO#	Graduate Attribute	Programme Outcomes
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
2	Problem analysis	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health, safety, cultural, societal and environmental considerations.

4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions
5	Modern tool usage	Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.

3. PROGRAMME SPECIFIC OUTCOMES (PSOs)

By the completion of Industrial Safety Engineering program the student will have following Program specific outcomes

1. Analyze, review safety of industries and to design safety protection system.
2. Assess hazards, risk in process and manufacturing industries to devise remedial measures and also ensure safety management systems.
3. Evaluate the occupational health, environmental issues, associated with industrial activities and design control measures with traditional, modern computational tools based on acts and codes.

4. PEO / PO / PSO MAPPING

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAM OUTCOMES					PROGRAM SPECIFIC OUTCOMES		
	1	2	3	4	5	1	2	3
1	2	2	2				3	
2		2		2	3			2
3								2

Contribution 1- low, 2-medium, 3-high

		Subject code & Name	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
YEAR-1	SEM -1	MA3125 - Advanced Mathematics for Industrial Safety Engineering	3	2	2.2	1	-	-	-	-
		IS3162 - Principles of Safety Management	2	2	2.2	2	-	-	-	-
		IS3163 - Environmental Safety	2	2	3	2	-	-	-	-
		IS3164 - Industrial Safety, Health and Environment Acts	2	2	3	2	-	-	-	-
		IS3165 - Occupational Health and Industrial Hygiene	-	-	3	2	-	-	-	-
		PIS10X - Professional Elective- I								
		IS3167 - CAD Laboratory	1	1	1	1	1	1	-	-

SEM- 2										
		IS3168 - Industrial Safety Laboratory - I	1	1	1	1	1	1	-	-
		IS3261 - Electrical Safety	-	-	2.4	-	-	-	-	-
		IS3262 - System Simulation and Hazard Analysis	-	-	2.4	-	-	-	-	-
		IS3263 - Fire Engineering and Explosion Control	-	-	2	-	-	-	-	-
		IS3264 - Safety in Process Industries	-	-	2	-	-	-	-	-
		PIS20X - Professional Elective- II								
		PIS20X - Professional Elective- III								
		IS3267 - Industrial Safety Laboratory - II	1	1	1	1	1	1	-	-
	IS3248 - Mini project	3	-	2	-	-	2	2	-	

YEAR-2	SEM -3	BA3371 - Research Methodology and IPR	-	2	-	-	-	2	2	-
		PIS30X - Professional Elective- IV								
		PIS30X - Professional Elective- V								
		IS3344 - Project Work Phase - I	2	3	2	-	-	2	2	3
		IS3345 - Internship (4 Weeks)	1	1.5	2	2	-	1	2	1
		IS3346 - Technical Seminar	3	-	-	-	-	2	2	1
	SEM -4	IS3441 - Project Work Phase - II	2	3	2	2	-	-	-	-

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REGULATIONS 2023

CHOICE BASED CREDIT SYSTEM

M.E.-INDUSTRIAL SAFETY ENGINEERING

CURRICULUM FOR SEMESTERS I TO IV

Semester - I								
S.No.	Course code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA3125	Advanced Mathematics for Industrial Safety Engineering	BSC	4	4	0	0	4
2	IS3162	Principles of Safety Management	PCC	3	3	0	0	3
3	IS3163	Environmental Safety	PCC	3	3	0	0	3
4	IS3164	Industrial Safety, Health and Environment Acts	PCC	3	3	0	0	3
5	IS3165	Occupational Health and Industrial Hygiene	PCC	3	3	0	0	3
6	PIS10X	Professional Elective- I	PEC	3	3	0	0	3
PRACTICAL								
7	IS3167	CAD Laboratory	PCC	4	0	0	4	2
8	IS3168	Industrial Safety Laboratory - I	PCC	4	0	0	4	2
TOTAL				27	19	0	8	23
Semester - II								
S.No.	Course code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	IS3261	Electrical Safety	PCC	3	3	0	0	3
2	IS3262	System Simulation and Hazard Analysis	PCC	3	3	0	0	3
3	IS3263	Fire Engineering and Explosion Control	PCC	3	3	0	0	3
4	IS3264	Safety in Process Industries	PCC	3	3	0	0	3
5	PIS20X	Professional Elective- II	PEC	3	3	0	0	3
6	PIS20X	Professional Elective- III	PEC	3	3	0	0	3
PRACTICAL								

7	IS3267	Industrial Safety Laboratory - II	PCC	4	0	0	4	2
8	IS3248	Mini project	EEC	4	0	0	4	2
TOTAL				26	18	0	8	22

Semester - III								
S.No.	Course code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	BA3371	Research Methodology and IPR	RMC	3	3	0	0	3
2	PIS30X	Professional Elective- IV	PEC	3	3	0	0	3
3	PIS30X	Professional Elective- V	PEC	3	3	0	0	3
PRACTICAL								
4	IS3344	Project Work Phase - I	EEC	12	0	0	12	6
5	IS3345	Internship (4 Weeks)	EEC	0	0	0	0	2
6	IS3346	Technical Seminar	EEC	2	0	0	2	1
TOTAL				23	9	0	14	18

Semester - IV								
S.No.	Course code	Course Title	Category	Contact Periods	L	T	P	C
PRACTICAL								
1	IS3441	Project Work Phase - II	EEC	24	0	0	24	12
TOTAL				24	0	0	24	12

SUMMARY

S.No	Name of the Programme: M.E ISE					
	SUBJECT AREA	CREDITS PER SEMESTER				TOTAL CREDITS
		I	II	III	IV	
1	BSC	4	-	-	-	4
2	PCC	16	14	-	-	30
3	PEC	3	6	6	-	15
4	RMC	-	-	3	-	3
5	EEC	-	2	9	12	23
TOTAL CREDIT		23	22	18	12	75

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 75

BASIC SCIENCE COURSES (BSC)

S.No.	Course code	Course Title	Periods Per Week			C	Semester
			L	T	P		
1	MA3125	Advanced Mathematics for Industrial Safety Engineering	4	0	0	4	1

PROGRAM CORE COURSES (PCC)

S.No.	Course code	Course Title	Periods Per Week			C	Semester
			L	T	P		
1	IS3162	Principles of Safety Management	3	0	0	3	1
2	IS3163	Environmental Safety	3	0	0	3	1
3	IS3164	Industrial Safety, Health and Environment Acts	3	0	0	3	1
4	IS3165	Occupational Health and Industrial Hygiene	3	0	0	3	1
5	IS3167	CAD Laboratory	0	0	4	2	1
6	IS3168	Industrial Safety and Simulation Laboratory	0	0	4	2	1
7	IS3261	Electrical Safety	3	0	0	3	2
8	IS3262	System Simulation and Hazard Analysis	3	0	0	3	2
9	IS3263	Fire Engineering and Explosion Control	3	0	0	3	2
10	IS3264	Safety in Process Industries	3	0	0	3	2
11	IS3267	Industrial Safety Laboratory- II	0	0	4	2	2
TOTAL CREDITS						30	

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S.No.	Course code	Course Title	Periods Per Week			C	Semester
			L	T	P		
1	BA3371	Research Methodology and IPR	3	0	0	3	3

PROFESSIONAL ELECTIVES

SEMESTER I, ELECTIVE I

S.No.	Course code	Course Title	Periods Per Week			Total Contact Periods
			L	T	P	
1	PIS101	Plant Layout and Material Handling	3	0	0	3
2	PIS102	Work Study and Ergonomics	3	0	0	3
3	PIS103	Human Factors in Engineering	3	0	0	3
4	PIS104	Maintainability Engineering	3	0	0	3
5	PIS105	Optimization Techniques	3	0	0	3

SEMESTER II, ELECTIVE II & III

S.No.	Course code	Course Title	Periods Per Week			Total Contact Periods
			L	T	P	
1	PIS201	Transport Safety	3	0	0	3
2	PIS202	Fireworks Safety	3	0	0	3
3	PIS203	Safety in Construction	3	0	0	3
4	PIS204	Nuclear Engineering and Safety	3	0	0	3
5	PIS205	Safety in Textile Industry	3	0	0	3
6	PIS206	Safety in Mines	3	0	0	3
7	PIS207	Dock Safety	3	0	0	3

SEMESTER III, ELECTIVE IV & V

S.No.	Course code	Course Title	Periods Per Week			Total Contact Periods
			L	T	P	
1	PIS301	Safety in Engineering Industry	3	0	0	3
2	PIS302	Quality Engineering in Production Systems	3	0	0	3
3	PIS303	ISO 45001 and ISO 14000	3	0	0	3
4	PIS304	Artificial Intelligence and Expert Systems	3	0	0	3
5	PIS305	Design of Experiments	3	0	0	3
6	PIS306	Data Analytics	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No.	Course code	Course Title	Periods Per Week			C	Semester
			L	T	P		
1	IS3248	Mini project	0	0	4	2	2
2	IS3344	Project Work Phase - I	0	0	12	6	3
3	IS3345	Internship	0	0	0	2	3
4	IS3346	Technical Seminar	0	0	2	1	3
5	IS3441	Project Work Phase - II	0	0	24	12	4
TOTAL CREDITS						23	

SEMESTER – I

MA3125 ADVANCED MATHEMATICS FOR INDUSTRIAL SAFETY ENGINEERING

L T P C
4 0 0 4

OBJECTIVES:

1. This course is designed to provide the solid foundation on topics in probability and various statistical methods
2. Which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling.
3. It is framed to address the issues and the principles of estimation theory, testing of hypothesis.
4. This course gives detailed idea about time series analysis.
5. This course is designed to provide the solid foundation on Design of Experiments.

UNIT-I: PROBABILITY AND RANDOM VARIABLES

12

Probability – Axioms of probability – Conditional probability – Baye’s theorem -
Random variables – Probability function – Moments – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT-II: ESTIMATION THEORY

12

Estimators : Unbiasedness, Consistency, Efficiency and sufficiency – Maximum likelihood estimation – Method of moments.

UNIT-III: TESTING OF HYPOTHESIS

12

Sampling distributions – Small and large samples and problems – Tests based on Normal, t - distribution, Chi -square, Goodness of fit and F – distributions.

UNIT-IV: DESIGN OF EXPERIMENTS

12

Analysis of variance – Completely randomized design – Randomized block design – Latin square design.

UNIT-V: TIME SERIES

12

Characteristics and representation – Moving averages – Exponential smoothing – Auto regressive processes.

TOTAL: 60 PERIODS

OUTCOMES:

1. Basic probability axioms and rules and the moments of discrete and continuous random variables.
2. Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation
3. Use statistical tests in testing hypotheses on data, and recognize the key historical figures in Design of Experiments.
4. Differentiate between various time series models and application of these models appropriately to engineering problems.
5. The students should have the ability to use the fundamental and applied Mathematical and statistical knowledge, methodologies and modern computational tools.

REFERENCE BOOKS:

1. Anderson, O.D, "Time Series Analysis: Theory and Practice", North - Holland, Amsterdam, 1982.
2. Devore, J. L., "Probability and Statistics for Engineering and Sciences", 8th Edition, Cengage Learning, 2014.
3. Gupta, S.C and Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan and Chand Company, New Delhi, 1999.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers, Pearson Education, Asia, 8th Edition, 2015.
5. Montgomery D.C and Johnson, L.A, "Forecasting and Time Series", 6th Edition, McGraw Hill, 1990.

CO - PO and CO - PSO MAPPING

MA3111	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	3	2	2	1	-	-	-	-
CO2	3	2	2	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-
Average	3	2	2.2	1	-	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

1. To understand the concepts and techniques of safety management and to know the techniques to optimize productivity.
2. To distinguish about various functions and activities of safety audit and to understand about non conformity report.
3. To understand about accident investigation and documentation of accidents.
4. To know about various levels of work injury and to understand about accident indices.
5. To create awareness on safety education and training.

UNIT- I: CONCEPTS AND TECHNIQUES**9**

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

UNIT- II: SAFETY AUDIT - INTRODUCTION**9**

Components of safety audit, types of audit, audit methodology, nonconformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list – identification of unsafe acts of workers and unsafe conditions in the shop floor.

UNIT- III: ACCIDENT INVESTIGATION AND REPORTING**9**

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

UNIT -IV: SAFETY PERFORMANCE MONITORING

9

ANSI (Z16.1) Recommended practices for compiling and measuring work injury experience – permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems.

UNIT - V: SAFETY EDUCATION AND TRAINING

9

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

TOTAL: 45 PERIODS

OUTCOMES:

1. To analyze the basic concepts of safety management system, and to ensure optimization of productivity and quality.
2. To implement safety audit and evaluate the unsafe condition.
3. To analyze accident investigation and apply the principles to prevent accidents.
4. To develop practices for analyzing work injuries and calculation of accident indices.
5. To promote safe practices and develop effective motivation techniques to ensure safety.

REFERENCES:

1. “Accident Prevention Manual for Industrial Operations”, N.S.C.Chicago, 1982.
2. Blake R.B., “Industrial Safety” Prentice Hall, Inc., New Jersey, 1973.
3. Dan Petersen, “Techniques of Safety Management”, McGraw-Hill Company, Tokyo, 1981.
4. Heinrich H.W. “Industrial Accident Prevention” McGraw-Hill Company, New York, 1980
5. John Ridley, “Safety at Work”, Butterworth and Co., London, 1983
6. Lees, F.P., "Loss prevention in Process Industries" Butterworth publications, London, 2nd edition 1990.
7. Relevant Indian Standards and Specifications, BIS, New Delhi.

CO - PO and CO - PSO MAPPING

IS3162	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	2	2	2	2	-	-	-	-
CO2	-	-	2	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-
Average	2	2	2.2	2	-	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

1. To know about the air pollutants, radiation impacts in air.
2. To give understanding of water pollutants and water treatment.
3. To create awareness in hazardous waste management, recycling and reuse.
4. To know about emission measurement devices.
5. To categorize pollution control in various industrial sectors.

UNIT- I: AIR POLLUTION**12**

Classification and properties of air pollutants – Pollution sources – Effects of air pollutants on human beings, Animals, Plants and Materials - automobile pollution-hazards of air pollution-concept of clean coal combustion technology - ultra violet radiation, infrared radiation, radiation from sun- hazards due to depletion of ozone - deforestation-ozone holes-automobile exhausts- chemical factory stack emissions-CFC.

UNIT- II: WATER POLLUTION**12**

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

UNIT- III: HAZARDOUS WASTE MANAGEMENT**12**

Hazardous waste management in India-waste identification, characterization and classification- technological options for collection, treatment and disposal of hazardous waste-selection charts for the treatment of different hazardous wastes-methods of collection and disposal of solid wastes-health hazards-toxic and radioactive wastes-incineration and vitrification - hazards due to bio- process-dilution-standards and restrictions – recycling and reuse.

UNIT- IV: ENVIRONMENTAL MEASUREMENT AND CONTROL**12**

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

UNIT- V: POLLUTION CONTROL IN PROCESS INDUSTRIES**12**

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

TOTAL : 60 PERIODS**OUTCOMES:**

1. Analyze the ways in which environmental health problems have arisen due to air pollution.
2. Analyze the ways in which environmental health problems have arisen due to water pollution.
3. Illustrate the role of hazardous waste management and use of critical thinking to identify and assess environmental health risks.
4. Analyze the concepts of emissions and able to control the emission by using different devices.
5. Implement pollution control methodologies in the process industries.

REFERENCES:

1. E. C Wolfe, Race to Save to Save Planet, Wadsworth Publishing Co., Belmont, CA 2006.
2. G. T Miller, Environmental Science: Working with the Earth, 11th Edition, Wadsworth Publishing Co., Belmont, CA, 2006.
3. M.J Hammer, and M.J Hammer, Jr., Water and Wastewater Technology, Pearson Prentice Hall, 2006.
4. Rao, CS, “Environmental pollution engineering: Wiley Eastern Limited, New Delhi, 1992.
5. S. P. Mahajan, “Pollution control in process industries”, Tata McGraw Hill Publishing Company, New Delhi, 1993.

6. Varma and Braner, "Air pollution equipment", Springer Publishers, Second Edition.

CO - PO and CO - PSO MAPPING

IS3163	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	2	-	3	2	-	-	-	-
CO2	-	-	3	2	-	-	-	-
CO3	-	-	3	2	-	-	-	-
CO4	2	2	3	-	-	-	-	-
CO5	2	2	3	-	-	-	-	-
Average	2	2	3	2	-	-	-	-

1- low, 2-medium, 3-high

IS3164	INDUSTRIAL SAFETY, HEALTH AND ENVIRONMENT ACTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To provide exposure about safety and health provisions related to hazardous processes as laid out in Factories act 1948.
2. To learn about environment act 1986 and rules framed under the act.
3. To understand about manufacture, storage and import of hazardous chemicals.
4. To describe different acts and rules of various types of industries.
5. To interpret international acts and standards.

UNIT- I: FACTORIES ACT – 1948

10

Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Tamil nadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948

UNIT- II: ENVIRONMENT ACT – 1986

10

General powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-Thenoise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution controlboard. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollutionand water pollution – fund – accounts and audit, penalties and procedures.

**UNIT- III: MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS
CHEMICAL RULES 1989**

10

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**20**

Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, 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.

UNIT- V: INTERNATIONAL ACTS AND STANDARDS**10**

Occupational Safety and Health act of USA (The Williames - Steiger Act of 1970) – Health and safety work act (HASAWA 1974, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI).

TOTAL : 60 PERIODS**OUTCOMES:**

1. Analyze important legislations related to health, Safety and Environment.
2. Appraise requirements mentioned in factories act for the prevention of accidents.
3. Evaluate the health and welfare provisions given in factories act.
4. Analyze the statutory requirements for an Industry on registration, license and its renewal.
5. Prepare onsite and offsite emergency plan.

REFERENCES:

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt. Ltd., NewDelhi.
3. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India)Pvt. Ltd., New Delhi.
4. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India)Pvt. Ltd., New Delhi.
5. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.

6. The Mines Act 1952, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.
7. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.

CO - PO and CO - PSO MAPPING

IS3164	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	2	-	3	2	-	-	-	-
CO2	-	-	3	2	-	-	-	-
CO3	-	-	3	2	-	-	-	-
CO4	2	2	3		-	-	-	-
CO5	2	2	3		-	-	-	-
Average	2	2	3	2	-	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES :

1. To understand the basic knowledge on physical hazards and techniques to control.
2. To understand the basic knowledge on chemical hazards and techniques to control.
3. To have knowledge about types of hazards arising out of biological and ergonomical agents.
4. To have knowledge on occupational hazards and toxicology.
5. To illustrate occupational physiology and personal hygiene.

UNIT- I: PHYSICAL HAZARDS**9**

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

UNIT - II: CHEMICAL HAZARDS**9**

Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure vs. dose, TLV - Methods of Evaluation, process or operation description, Field Survey, Sampling methodology, Industrial Hygiene calculations, Comparison with OSHAS Standard. Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures, Gas and Vapour monitors, dust sample collection devices, personal sampling Methods of Control - Engineering Control, Design maintenance considerations, design specifications - General Control Methods - training and education

UNIT- III: BIOLOGICAL AND ERGONOMICAL HAZARDS 9

Classification of Bio hazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets - building design. Work Related Musculoskeletal Disorders –carpal tunnel syndrome CTS-Tendon pain-disorders of the neck- back injuries.

UNIT- IV: OCCUPATIONAL HEALTH AND TOXICOLOGY 9

Concept and spectrum of health - functional units and activities of occupational health services, pre- employment and post-employment medical examinations - occupational related diseases, levels of prevention of diseases, notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax, lead-nickel, chromium and manganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc.) their effects and prevention – cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests. Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems.

UNIT- V: OCCUPATIONAL PHYSIOLOGY 9

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 PERIODS

OUTCOMES:

1. Formulate different types of physical hazards and evaluate suitable techniques to control.
2. Appraise different types of chemical hazards and discriminate suitable techniques to control.
3. Predict biological and ergonomical hazards and justify the methods to control.
4. Analyze the functions and activities of occupational health services and evaluate suitable methods to prevent occupational diseases.

- Distinguish occupational physiology and develop methodologies to maintain personal hygiene.

REFERENCES:

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

CO - PO and CO - PSO MAPPING

IS3165	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO 1	-	-	3	2	-	-	-	-
CO 2	-	-	3	2	-	-	-	-
CO 3	-	-	3	2	-	-	-	-
CO 4	-	-	3	-	-	-	-	-
CO 5	-	-	3	-	-	-	-	-
Average	-	-	3	2	-	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

1. To make the students understand and interpret drawings of machine components
2. To prepare assembly drawings both manually and using standard CAD packages
3. To familiarize the students with Indian Standards on drawing practices and standard components
4. To gain practical experience in handling 2D drafting and 3D modeling software systems.

PART I DRAWING STANDARDS & FITS AND TOLERANCES 12

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerancing of individual dimensions – Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of geometric dimensioning & tolerancing.

PART II INTRODUCTION TO 2D DRAFTING 16

Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing. Bearings - Bush bearing, Plummer block, Valves – Safety and non-return valves.

PART III 3D GEOMETRIC MODELING, ASSEMBLY AND SIMULATION 32

Sketcher - Datum planes – Protrusion – Holes - Part modeling – Extrusion – Revolve – Sweep – Loft –Blend – Fillet - Pattern – Chamfer - Round - Mirror – Section – Harnesses, Lanyards, Cable Grab, Energy Absorber, Cable Unitensioner

TOTAL: 60 PERIODS

Note: 25% of assembly drawings must be done manually and remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D / 3D CAD software

OUTCOMES:

- 1 Follow the drawing standards, Fits and Tolerances
- 2 Re-create part drawings, sectional views and assembly drawings as per standards

TEXT BOOK:

1. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013

REFERENCES:

1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 48th Edition, Charotar Publishers, 2013
2. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004
3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing", published by Tata Mc GrawHill, 2006
4. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007

Software Required: Auto CAD, CREO with compatible computers

CO - PO and CO - PSO MAPPING

IS3167	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	1	-	-	-	-	-	-	-
CO2	-	-	-	-	1	1	-	-
CO3	-	1		1	-		-	-
CO4	-	-	1	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	1	1	1	1	1	1	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

1. To provide opportunity to operate the equipment to acquire practical knowledge.
2. To know the various PPEs and standards
3. To carry out experiments to find out the environmental parameters.
4. To know the Fire Extinguisher operations and types.

NOISE LEVEL MEASUREMENT AND ANALYSIS**9**

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

ILLUMINATION MEASUREMENT AND ANALYSIS**9**

Measurement of intensity of light was measured in LUX, continuous and intermittent sources at various places.

ENVIRONMENTAL PARAMETER MEASUREMENT**9**

Dry Bulb Temperature, Wet Bulb Temperature, Determination of relative humidity, wind flow measurement, Particle size Measurement.

TRAINING IN USAGE AND SKILL DEVELOPMENT**9****PERSONAL PROTECTIVE EQUIPMENT:**

Respiratory and non-respiratory-demonstration-self-contained breathing apparatus.

Safety helmet, belt, hand gloves, goggles, safety shoe, gum boots, ankle shoes, face shield, nose mask, ear plug, earmuff, anti-static and conducting plastics/rubber materials, apron and leg guard.

FIRE EXTINGUISHERS AND ITS OPERATIONS**8**

Water, Foam, Carbon dioxide (CO₂), Dry chemical powder and Currently amendment fire safety systems

SAFETY MEASURES**1**

Lockout tagout, Fire Hydrant, Fire alarm, Sprinklers.

Total: 45 Periods

Equipment Required

1. Noise level meter : 1No
2. Lux meter : 1 No
3. Sling Physcrometer : 1No
4. Anemometer : 1 No
5. Gyratory Sieve Shaker : 1 No
6. PPE Set : 1 No
7. Fire extinguisher set : 1 No
8. Lockout/Tag out : 1No

OUTCOMES:

1. Run the various equipment to bring out the safety environment in the industry.
2. Identify the different illumination test for determination of intensity of light.
3. Analyze the various environmental parameters and measure the particle size.
4. Use personal protective equipment.
5. Operate fire extinguishers in emergency situations

CO - PO and CO - PSO MAPPING

IS3168	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	1	-	-	-	-		-	-
CO2	-	-	-	1	1	1	-	-
CO3	-	1	1	1	-	-	-	-
CO4	-	-	1	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	1	1	1	1	1	1	-	-

1- low, 2-medium, 3-high

SEMESTER – II

IS3261

ELECTRICAL SAFETY

L	T	P	C
3	0	0	3

OBJECTIVES:

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

UNIT- I: CONCEPTS AND STATUTORY REQUIREMENTS

9

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

UNIT- II: ELECTRICAL HAZARDS

9

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

UNIT –III: PROTECTION SYSTEMS

9

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

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

UNIT- IV: SELECTION, INSTALLATION, OPERATION AND MAINTENANCE 9

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

UNIT- V: HAZARDOUS ZONES 9

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

TOTAL: 45 PERIODS

OUTCOMES:

1. Familiarize the basic concepts in electrical circuit and hazards involved in it.
2. Analyze the electrical hazards in Industries.
3. Evaluate various electrical hazards for protection.
4. Analyze different factors and devices to ensure safety.
5. Recognize different hazardous zones in Industries.

REFERENCES:

1. "Accident prevention manual for industrial operations", N.S.C., Chicago, 1982.
2. Indian Electricity Act and Rules, Government of India.
3. Power Engineers – Handbook of TNEB, Chennai, 1989.

4. Martin Glov Electrostatic Hazards in powder handling, Research Studies Pvt. Ltd.,England, 1988.

CO - PO and CO - PSO MAPPING

IS3261	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	-	2	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-
CO4	-	-	3	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-
Average	-	-	2.4	-	-	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

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

UNIT I HAZARD, RISK ISSUES AND HAZARD ASSESSMENT**12**

Introduction, hazard, hazard monitoring-risk issue, group or societal risk, individual risk, voluntary and involuntary risk, social benefits Vs technological risk, approaches for establishing risk acceptance levels, Risk estimation. Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis (PHA), human error analysis, hazard operability studies(HAZOP),safety warning systems.

UNIT II COMPUTER AIDED INSTRUMENTS**12**

Applications of Advanced Equipments and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter(DSC), Thermo Gravimetric Analyser(TGA), Accelerated Rate Calorimeter(ARC), Reactive Calorimeter(RC), Reaction System Screening Tool(RSST) - Principles of operations, Controlling parameters, Applications, advantages.

Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitiveness Test, Impact Sensitiveness Test(BAM) and Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test.

UNIT III RISK ANALYSIS QUANTIFICATION AND SOFTWARES**12**

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

UNIT IV CONSEQUENCES ANALYSIS 12

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

UNIT V CREDIBILITY OF RISK ASSESSMENT TECHNIQUES 12

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

TOTAL: 60 PERIODS**OUTCOMES:**

1. This course would make familiarizing of basic concepts in risk and hazard
2. Course would be helpful to understand the various instruments to bring safety in Industries
3. Students would be trained to find solution for risk assessment studies through the use of software.
4. Students would be able to make use of a risk assessment technique to quantify the risk
5. Course would equip the students effectively to employ hazard analysis techniques in Industry and helpful to prevent the accidents in Industry

REFERENCES

1. Brown, D.B. System analysis and Design for safety, Prentice Hall, 1976.
2. Course Material Intensive Training Programme on Consequence Analysis, by Process Safety Centre, Indian Institute of Chemical Technology, Tarnaka and CLRI, Chennai.
3. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process safety, AIChE 1992
4. Hazop and Hazom, by Trevor A Klett, Institute of Chemical Engineering.
5. ILO- Major Hazard control- A practical Manual, ILO, Geneva, 1988.
6. Loss Prevention in Process Industries-Frank P. Less Butterworth-Hein UK 1990 (Vol.I, II and III)

7. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Common wealth Science Council, UK
8. Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety.

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IS3262	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	-	2	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-
CO4	-	-	3	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-
Average	-	-	2.4	-	-	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

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

UNIT- I: PHYSICS AND CHEMISTRY OF FIRE 9

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

UNIT- II: FIRE PREVENTION AND PROTECTION 9

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

UNIT- III: INDUSTRIAL FIRE PROTECTION SYSTEMS 9

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

UNIT- IV: BUILDING FIRE SAFETY**9**

Objectives of fire safe building design, Fire load, fire resistant material and fire testing – structural fire protection – structural integrity – concept of egress design - exists – width calculations - fire certificates – fire safety requirements for high rise buildings – snookers.

UNIT- V: EXPLOSION PROTECTING SYSTEMS**9**

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

TOTAL : 45 PERIODS**OUTCOMES:**

1. Analyze the concept of fire and explosion science.
2. Appraise the different sources of ignition and their prevention techniques.
3. Illustrate the operation of various types of firefighting equipment.
4. Equip the students to effectively employ explosion protection techniques and their significances to suit the industrial requirement.
5. Evaluate various agencies, support institutions and government organizations involved in safety training and promotion.

REFERENCES:

1. "Accident Prevention manual for industrial operations" N.S.C., Chicago, 1982.
2. "Davis Daniel et al, "Hand Book of fire technology"
3. "Fire Prevention and firefighting", Loss prevention Association, India.
4. Derek, James, "Fire Prevention Hand Book", Butter Worths and Company, London, 1986.
5. Dinko Tuhtar, "Fire and explosion protection"
6. Fire fighters hazardous materials reference book Fire Prevention in Factories", anNostrandReinHold, New York, 1991.
7. Gupta, R.S., "Hand Book of Fire Technology" Orient Longman, Bombay 1977.

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IS3263	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	-	2	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-
Average	-	-	2	-	-	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

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

UNIT I SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM DESIGN 9

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

UNIT II PLANT COMMISSIONING AND INSPECTION 9

Commissioning phases and organization, pre-commissioning documents, process commissioning, commissioning problems, post commissioning documentation - Plant inspection, pressure vessel, pressure piping system, non-destructive testing, pressure testing, leak testing and monitoring- plant monitoring, performance monitoring, condition, vibration, corrosion, acoustic emission-pipe line inspection.

UNIT III PLANT OPERATIONS 9

Operating discipline, operating procedure and inspection, format, emergency procedures- hand over and permit system- start up and shut down operation, refinery units- operation of fired heaters, driers, storage-operating activities and hazards- trip systems- exposure of personnel

UNIT IV PLANT MAINTENANCE, MODIFICATION AND EMERGENCY PLANNING 9

Management of maintenance, hazards- preparation for maintenance, isolation, purging, cleaning, confined spaces, permit system- maintenance equipment- hot works- tank cleaning, repair and demolition- online repairs- maintenance of protective devices- modification of plant, problems-

controls of modifications. Emergency planning, disaster planning, onsite emergency.

UNIT V STORAGES

9

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

TOTAL: 45 PERIODS

OUTCOMES:

1. This course would make familiar of safe design of equipment which are the essential to chemical industry and leads to design of entire process industries.
2. Course would be helpful to understand the design of pressure systems.
3. Students would understand the problems and find innovative solutions while industries facing problems in commissioning and maintenance stages.
4. Students can prepare the emergency planning for chemical industry problems
5. Students would be able to create safe storage systems.

REFERENCES

1. "Accident Prevention Manual for Industrial Operations" NSC, Chicago, 1982.
2. "Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety.
3. Carbide of Calcium Rules, Government of India.
4. Fawcett, H.h. and Wood, "Safety and Accident Prevention in Chemical Operations" Wiley inters, Second Edition.

CO - PO and CO - PSO MAPPING

IS3264	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	-	2	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-
Average	-	-	2	-	-	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES :

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

FRICTION TEST**9**

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

IMPACT TEST**9**Explosive materials like barium nitrate, white powder, amerce composition etc.
Burst strength test of packaging materials like paper bags, corrugated cartoons, wood etc.**EXHAUST GAS MEASUREMENT AND ANALYSIS****9**Measurement of SO_x, NO_x, CO_x, hydrocarbons.**ENVIRONMENTAL PARAMETER MEASUREMENT****9**

Air sampling analysis

TRAINING IN USAGE AND SKILL DEVELOPMENT**3**Road safety signals and
symbols
First-Aid training**STATIC CHARGE TESTING****2**

On plastic, rubber, ferrous and non-ferrous materials.

ELECTRICAL SAFETY**2**Insulation resistance for motors and
cables
Estimation of earth resistance
Earth continuity test**SOFTWARE USAGE****2**

Dispersion modeling of various highly dangerous chemicals using ALOHA software

Total: 45 Periods**Equipment's Required:**

1. Friction tester : 1 No
2. Impact tester : 1 No
3. Exhaust gas analyser : 1 No

- 4. High volume sampler : 1 No
- 5. First aid kit : 1No
- 6. Static charge tester : 1 No
- 7. Earth continuity tester : 1 No
- 8. Earth resistance meter : 1 No
- 9. Software : ALOHA,CAMEO

OUTCOMES:

The students will be able to

- 1. Analyze and run the various equipment to ensure safety environment in the industry.
- 2. Helpful to measure the particulate matter and assess the impact of air pollution.
- 3. Conduct experiments to find out various environmental parameters.
- 4. Use personal protective equipment independently.
- 5. Recognize the use of software to predict the real situations on major accidents.

CO - PO and CO - PSO MAPPING

IS3267	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	1	-	-	-	-	-	-	-
CO2	-	-	-	-	1	1	-	-
CO3	-	1	-	1	-	-	-	-
CO4	-	-	1	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	1	1	1	1	1	1	-	-

1- low, 2-medium, 3-high

OBJECTIVE:

1. The main objective is to give an opportunity to the student to get hands on training in the fabrication of safety devices integrated with IOT.

GUIDELINE FOR REVIEW AND EVALUATION

The students may work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 60 PERIODS**OUTCOMES:**

Upon the completion of this course the students will be able to

- 1 Design and Fabricate the machine element or the mechanical product.
- 2 Demonstrate the working model of the machine element or the mechanical product.

CO - PO and CO - PSO MAPPING

IS3248	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	3	-	2	-	-	2	2	-
CO2	3	-	2	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-
Average	3	-	2	-	-	2	2	-

1- low, 2-medium, 3-high

SEMESTER - III

BA3371

RESEARCH METHODOLOGY AND IPR

L T P C

3 0 0 3

OBJECTIVES:

1. To impart knowledge on formulation of research problem,
2. To impart knowledge on formulation of research methodology
3. To impart knowledge on importance of IPR protection.

UNIT I RESEARCH DESIGN

9

Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES

9

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING

9

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS

9

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS

9

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent,

Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL: 45 PERIODS

OUTCOMES:

1. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
2. Understand research problem formulation & Analyze research related information and Follow research ethics

REFERENCES

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley,2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice",September 2013.

CO - PO and CO - PSO MAPPING

IS3311	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	3	2	3	-	-	2	2	-
CO2	2	2	2	-	-			-
CO3	3	2	3	-	-			-
CO4	2	2	2	-	-			-
CO5	3	2	3	-	-			-
Average	-	2	-	-	-	2	2	-

1- low, 2-medium, 3-high

OBJECTIVES:

The main learning objective of this course is to prepare the students:

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

The student works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the three reviews. The review committee may be constituted by the head of the department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the head of the department.

OUTCOMES:

The students will be able to:

1. Solve a specific problem right from its identification and literature review till the successful solution of the same.
2. Develop the project reports and to face reviews and viva voce examination.

TOTAL: 180 PERIODS

CO - PO and CO - PSO MAPPING

IS3344	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	2	3	2	-	-	2	2	3
CO2	2	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	2	3	2	-	-	2	2	3

1- low, 2-medium, 3-high

IS3345

Internship (4 Weeks)

L	T	P	C
0	0	0	2

OBJECTIVES:

1. To get an industrial exposure through various industrial environmental experiences and learning safety measures.
2. To enhance the collective skills between theoretical knowledge and real-time safety implementations.

GUIDELINES:

1. The students are expected to undergo meaningful, practical and hands-on-work experiences related to safety measures through industrial training.
2. A faculty guide is to be allotted and he / she will guide and monitor the progress of the Student's training activities and maintain attendance also.
3. Minimum duration of internships period is 4 weeks.
4. Post internship program, Students should submit a report (within 50 pages) which contains brief observations of training (process, product, layout, safety measures and methods etc.,) and give a presentation.
5. Internship should be evaluated through final presentation with viva-voce exam.

TOTAL: 60 PERIODS

OUTCOMES:

The students will be able to:

1. Select and analyze the effective industry safety methods for the given field applications.
2. Enhance the collective skills between theoretical knowledge and real-time safety implementations.

CO - PO and CO - PSO MAPPING

IS3345	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	1	2	2		-	1	2	1
CO2		1		2	-	-	-	-
CO3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	1	1.5	2	2	-	1	2	1

1- low, 2-medium, 3-high

OBJECTIVES:

1. To develop journal paper reading and understanding skill.
2. To improve communication and presentation skill of students

GUIDELINES, CONCEPTS AND TECHNIQUES

1. The students are expected to make a presentation on the state of research on a particular topic based on current journal publications in that topic.
2. A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
3. Students are encouraged to use various teaching aids such as overhead projectors, Power Point presentation and demonstrative models.

TOTAL: 30 PERIODS**OUTCOMES:**

The students will be able to:

1. Select the method, analyze and optimize the given problem for the given field applications.
2. Identify the applicability of modern software tools and technology.
3. Invent creative methods for presentation.

CO - PO and CO - PSO MAPPING

IS3346	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	3	-	-	-	-	2	2	1
CO2	3	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	3	-	-	-	-	2	2	1

1- low, 2-medium, 3-high

SEMESTER - IV

IS3441

PROJECT WORK PHASE –II

L T P C

0 0 24 12

OBJECTIVES:

The main learning objective of this course is to prepare the students:

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

The student works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the three reviews. The review committee may be constituted by the head of the department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the head of the department.

OUTCOMES:

The students will be able to:

1. Take up any challenging practical problems.
2. Find solution by formulating proper innovative methodology.

TOTAL: 360 PERIODS

CO - PO and CO - PSO MAPPING

IS3441	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	2	3	2	-	-	-	-	-
CO2	2	-	-	2	-	-	-	-
CO3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	2	3	2	2	-	-	-	-

1- low, 2-medium, 3-high

SEMESTER- I (PROFESSIONAL ELECTIVE - I)

PIS101	PLANT LAYOUT AND MATERIAL HANDLING	L	T	P	C
		3	0	0	3

OBJECTIVES :

1. To understand about the selection of plant and safe location.
2. To know about safe plant layout for different types of industries.
3. To describe about the basic things of working condition which includes ventilation, comfort, lighting and its effect based on various nature of work.
4. To identify manual material handling and lifting methods to prevent common injury.
5. To discover mechanical material handling devices for safe operation.

UNIT- I: PLANT LOCATION 9

Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions. Safe location of chemical storages, LPG, LNG, CNG, acetylene, ammonia, chlorine, explosives and propellants.

UNIT - II: PLANT LAYOUT 9

Safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, approach roads, plant railway lines, security towers. 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.

UNI - III: WORKING CONDITIONS 9

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

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

UNIT-V: MECHANICAL MATERIAL HANDLING

9

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

TOTAL: 45 PERIODS

OUTCOMES:

1. Analyze the plant location to identify proper territorial parameters to ensure plant safety.
2. Appraise plant layout for safe effluent treatment to safeguard different process and engineering industries.
3. Evaluate safe working condition like adequate ventilation, lighting system and 5S concept.
4. Design an efficient manual material handling system to ensure safe transportation.
5. Design an efficient mechanical material handling system to ensure safe transportation.

REFERENCES:

1. "Accident prevention manual for industrial operations" N.S.C., Chicago, 1982.
2. Alexandrov. M.P. "Material handling equipment" Mir Publishers, Moscow, 1981
3. APPLE M. JAMES "Plant layout and material handling", 3rd edition, John Wiley and sons.
4. "Encyclopedia of occupational safety and health", ILO Publication, 1985

CO - PO and CO - PSO MAPPING

PIS101	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	2	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-
CO3	2	-	-	2	-	-	-	-
CO4	-	-	-	-	2	-	-	-
CO5	-	-	-	-	2	-	-	-
Average	2	-	-	2	2	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

1. To understand work content, movement at the work place, usage of latest devices.
2. To study the applications of ergonomic principles and physiology of workers.
3. To know the concepts of personal protective equipment and its usages.
4. To describe the knowledge in process and equipment design in safety aspects.
5. To illustrate training on machines, fatigue and measurement characteristics.

UNIT - I: WORK STUDY**9**

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

UNIT- II: ERGONOMICS**9**

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

UNIT- III: PERSONAL PROTECTION**9**

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

UNIT-IV: PROCESS AND EQUIPMENT DESIGN**9**

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

UNIT- V: MAN MACHINE SYSTEMS

9

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

TOTAL: 45 PERIODS

OUTCOMES:

1. Analyze the machine operations, how to substitute advanced machines to ensure safety, quality and productivity.
2. Evaluate the applications of ergonomic principles in the shop floor.
3. Evaluate the ergonomic considerations in personal protective equipment design.
4. Designing the process, equipment to prevent hazards.
5. Evaluate the machine interface to ensure enhanced performance.

REFERENCES::

1. "Accident Prevention Manual for Industrial Operations", NSC Chicago, 1982.
2. "Work Study", National Productivity Council, New Delhi, 1995.
3. E.J.McCormick and M.S.Sanders "Human Factors in Engineering and Design", TMH, NewDelhi,1982.
4. Hunter, Gomas, "Engineering Design for Safety", Mc Graw Hill Inc., 1992.
5. Introduction to Work Study", ILO, Oxford and IBH Publishing company, Bombay, 1991".
6. Mundel, Motion and Time Study, 6th Edition, Allied Publishers, Madras, 1989.
7. W.Benjamin Neibal Motion and Time Study, 7th Edition.

CO - PO and CO - PSO MAPPING

PIS102	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	2	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	2	2	-	3	-	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

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

UNIT I ERGONOMICS AND ANATOMY 9

Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, future directions for ergonomics, Anatomy, Posture and Body Mechanics: Some basic body mechanics, anatomy of the spine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioural aspects of posture, effectiveness and cost effectiveness, research directions

UNIT II HUMAN BEHAVIOR 9

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

UNIT III ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND SEATED WORKS 9

Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design for standing workers, design for seated workers, work surface design, visual display units, guidelines for design of static work, effectiveness and cost effectiveness, research directions

CO - PO and CO - PSO MAPPING

PIS103	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	-		3	-	-	-	-
CO2	-	-	3		-	-	-	-
CO3	2	-	-	-	-	-	-	-
CO4	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	2	-	3	3	3	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

1. To enable the students know about the basic concept of maintainability engineering.
2. To impart knowledge on various maintenance models, maintenance policies and replacement model of various equipment.
3. To provide knowledge on logistics for the effective utilization of existing resources and facilities availability of spares parts.

UNIT I	MAINTENANCE CONCEPT	6
Maintenance definition – Need for maintenance – Maintenance objectives and challenges – Tero technology – Maintenance costs - Scope of maintenance department.		
UNIT II	MAINTENANCE MODELS	12
Proactive/Reactive maintenance – Imperfect maintenance – Maintenance policies – PM versus b/d maintenance – PM schedule and product characteristics – Inspection models-Optimizing profit/downtime – Replacement decisions.		
UNIT III	MAINTENANCE LOGISTICS	11
Human factors – Maintenance staffing: Learning curves – Simulation – Maintenance resource requirements: Optimal size of service facility – Optimal repair effort – Maintenance planning and scheduling – Spare parts planning.		
UNIT IV	MAINTENANCE QUALITY	8
Maintenance excellence – Five Zero concept –FMECA –Root cause analysis – System Effectiveness- Design for maintainability – Reliability Centered Maintenance.		
UNIT V	TOTAL PRODUCTIVE MAINTENANCE	8
TPM features – Chronic and sporadic losses – Equipment defects – Six major losses – Overall Equipment Effectiveness – TPM pillars – Autonomous maintenance – TPM implementation		

TOTAL: 45 PERIODS

OUTCOMES:

1. Understand the various terms and terminologies about the maintenance concept.
2. Understand the various maintenance modes and logistics meant for the execution of various services.
3. Apply their knowledge in areas where the down time, over replacement are existing and could lead to improve the productivity and quality.

REFERENCES

1. Andrew K.S.Jardine & Albert H.C.Tsang, "Maintenance, Replacement and Reliability", Taylor and Francis, 2006.
2. Bikas Badhury & S.K.Basu, "Tero Technology: Reliability Engineering and Maintenance Management", Asian Books, 2003.
3. Seichi Nakajima, "Total Productive Maintenance", Productivity Press, 1993.

CO - PO and CO - PSO MAPPING

PIS104	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	-	-	-	3	-	-	-
CO2	-		3	-	-	-	-	-
CO3	-	2		-	-	-	-	-
CO4	-	-	-	2	-	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	-	2	3	2	3	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

1. To understand the non-linear problem.
2. To know about multi-objective problem.
3. To create awareness of Meta heuristic algorithms.

UNIT I INTRODUCTION**5**

Classification of optimization problems, concepts of design vector, Design constraints, constrains surface, objective function surface and multi-level optimization, parametric linear programming

UNIT II DECISION ANALYSIS**10**

Decision Trees, Utility theory, Game theory, Multi Objective Optimization, MCDM- Goal Programming, Analytic Hierarchy process, ANP

UNIT III NON-LI NEAR OPTIMIZATION**15**

Unconstrained one variable and multi variable optimization, KKT Conditions, Constrained optimization, Quadratic programming, Convex programming, Separable programming, Geometric programming, on-Convex programming

UNIT IV NON-TRADITIONAL OPTIMIZATION -1**10**

Classes P and NP, Polynomial time reductions, Introduction to NP- Hard problems, Overview of Genetic algorithms, Simulated Annealing, neural network based optimization.

UNIT V NON-TRADITIONAL OPTIMIZATION -2**5**

Particle Swarm optimization, Ant Colony Optimization, Optimization of Fuzzy Systems.

TOTAL: 45 PERIODS**OUTCOMES:**

1. The students will gain familiarity with some of the well-known optimization techniques and their applicability in a real setting.
2. The students will gain awareness on the usefulness and limitation of optimization.

REFERENCES

1. Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006
2. Fredrick S.Hillier and G.J.Liberman, "Introduction to Operations Research", McGraw Hill Inc. 1995.
3. Kalymanoy Deb, "Optimization for Engineering Design", PHI,2003
4. Ravindran – Phillips –Solberg, "Operations Research – Principles and Practice", John Wiley India,2006.
5. Singiresu S.Rao, "Engineering optimization – Theory and practices", John Wiley and Sons, 1996.

CO - PO and CO - PSO MAPPING

PIS105	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	-	-	-	3	-	-	-
CO2	-	-	2	-	-	-	-	-
CO3	-	1	-	-	-	-	-	-
CO4	-	-	-	2	-	-	-	-
CO5	-	-	2		-	-	-	-
Average	-	1	2	2	3	-	-	-

1- low, 2-medium, 3-high

SEMESTER- II (PROFESSIONAL ELECTIVE – II & III)

PIS201

TRANSPORT SAFETY

L T P C

3 0 0 3

OBJECTIVES:

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

UNIT I TRANSPORTATION OF HAZARDOUS GOODS

9

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

UNIT II ROAD TRANSPORT

8

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

UNIT III DRIVER AND SAFETY

9

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

UNIT IV ROAD SAFETY

10

Road alignment and gradient-reconnaissance-ruling gradient-maximum rise per k.m.- factors influencing alignment like tractive resistance, tractive force, direct alignment, vertical curves-breaking- characteristics of vehicle-skidding-restriction of speeds-significance of speeds-Pavement conditions –Sight distance – Safety at intersections – Traffic control lines and guide

posts-guard rails and barriers - street lighting and illumination overloading-concentration of driver. Plant railway: Clearance- track-warning methods-loading and unloading-moving cars-safety practices.

UNIT V SHOP FLOOR AND REPAIR SHOP SAFETY

9

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

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

1. Recognize various safety activities undertaken in transporting of hazardous goods
2. Understand the various symbols which are specific to the road safety and able to reduce the accidents occurred in the roads.
3. Apply for the safe transportation of hazardous goods, creating TREM card and safe loading and unloading procedure.

REFERENCES:

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

CO - PO and CO - PSO MAPPING

PIS201	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	-	-	3		-	-	-
CO2	-	-	3	-	2	-	-	-
CO3	2	-	-	-		-	-	-
CO4	-	-	-	-	-	-	-	-
CO5	-	-		-	-	-	-	-
Average	2	0	3	3	2	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

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

UNIT I PROPERTIES OF FIREWORKS CHEMICALS 9

Fire properties – potassium nitrate (KNO₃), potassium chlorate (KClO₃), barium nitrate (BaNO₃), calcium nitrate (CaNO₃), Sulphur (S), Phosphorous (P), antimony (Sb), Pyro Aluminum (A1) powder- Reactions-metal powders, Borax, ammonia (NH₃) – Strontium Nitrate, Sodium Nitrate, Potassium per chloride. Fire and explosion, impact and friction sensitivity.

UNIT II STATIC CHARGE AND DUST 9

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

UNIT III PROCESS SAFETY 8

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

UNIT IV MATERIAL HANDLING AND TRANSPORTATION: 10

Manual handling – wheel barrows-trucks-bullock carts-cycles-automobiles-fuse handling – paper caps handling-nitric acid handling in snake eggs manufacture-handling the mix in this factory-material movement – godown - waste pit. Packing-magazine-design of vehicles for

explosive transports loading into automobiles-transport restrictions-case studies-overhead power lines-driver habits-intermediate parking-fire extinguishers- loose chemicals handling and transport.

UNIT V WASTE CONTROL AND USER SAFETY

9

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

TOTAL : 45 PERIODS

OUTCOMES:

1. To gain knowledge of the chemical reactions of Fireworks chemicals
2. To know safe manufacture of Fireworks items
3. To improve process safety in fireworks industries
4. To analyse safety measures applicable against static electricity
5. To suggest safe practices for handling of fireworks in factories, transport and at user end

REFERENCES:

1. “Seminar on explosives”, Dept.of of explosives.
2. J.A.Purkiss, “Fireworks-Fire Safety Engineering”
3. Bill of once, “Fireworks Safety manual”
4. “Goeff, “Dust Explosion prevention, Part 1”
5. A.Chelladurai, “Fireworks related accidents”
6. A.Chelladurai, “Fireworks principles and practice”
7. A.Chelladurai, “History of the fireworks in India” Brock, “History of fireworks”
8. K.N.Ghosh, “Principles of fireworks”, H.Khatsuria, Sivakasi, 1987.
9. “Proceedings of National seminar on Fireworks Safety-1999”, MSEC-1999.

CO - PO and CO - PSO MAPPING

PIS202	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	3	-	-	-	-	-	-
CO2	-	-	-	3	2	-	-	-
CO3	2	-	2	-		-	-	-
CO4	-	-	-	3	-	-	-	-
CO5	-	-	2	-	-	-	-	-
Average	2	3	2	3	2	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

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

UNIT I ACCIDENTS CAUSES AND MANAGEMENT SYSTEMS 9

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

UNIT II HAZARDS OF CONSTRUCTION AND PREVENTION 9

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

UNIT III WORKING AT HEIGHTS 9

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

UNIT IV CONSTRUCTION MACHINERY 9

Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist - builder's hoist, winches, chain pulley blocks – use of conveyors -

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

UNIT V SAFETY IN DEMOLITION WORK

9

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

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course the students will be able

1. To identify the problems impeding safety in construction industries.
2. To identify types and causes of accidents, and designing aids for safe construction.
3. To understand the hazards during construction of power plant, road works and high rise buildings.
4. To understand the safety procedure for working at heights during construction.
5. To have knowledge in selection, operation, inspection and testing of various construction machinery.
6. To list out construction regulations and Indian standards for construction and demolition work.

REFERENCES

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

CO - PO and CO - PSO MAPPING

PIS203	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	2	-	-	-	-	-	-	-
CO2	-	-	-	3	-	-	-	-
CO3	-	3	-	-	-	-	-	-
CO4	-	-	-	2	2	-	-	-
CO5	-	-	2	-	-	-	-	-
Average	2	3	2	3	2	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

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

UNIT I INTRODUCTION**9**

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

UNIT II REACTOR CONTROL**9**

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

UNIT III REACTOR TYPES**9**

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

UNIT IV SAFETY OF NUCLEAR REACTORS**9**

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

UNIT V RADIATION CONTROL**9**

Radiation shielding – radiation dose – dose measurements – units of exposure – exposure limits – barriers for control of radioactivity release – control of radiation exposure to plant

personnel – health physics surveillance – waste management and disposal practices – environmental releases.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

1. Demonstrate nuclear fission and fusion process and their utilization.
2. Understand types of reactors and their Control requirements.
3. Explain the safety design principles and safety regulation process.

REFERENCES

1. “Loss prevention in the process Industries” Frank P.Lees Butterworth-Hein-UK, 1990.
2. Loffness, R.L., “Nuclear Power Plant” Van Nostrand Publications, 1979.
3. M.M.E.L.Wakil, “Nuclear Energy Conversion”, International Text Book Co.
4. M.M.E.L.Wakil, “Nuclear Power Engineering”, International Text Book Co.
5. R.L.Murray, “Introduction to Nuclear Engineering”, Prentice Hall.
6. Sri Ram K, “Basic Nuclear Engineering” Wiley Eastern Ltd., New Delhi, 1990.
7. Sterman U.S.”Thermal and Nuclear Power Stations”, MIR Publications, Moscow, 1986.

CO - PO and CO - PSO MAPPING

PIS203	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	-	-	2	-	-	-	-
CO2	-	-	-	-	2	-	-	-
CO3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	-	-	-	2	2	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

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

UNIT I INTRODUCTION**9**

Introduction to process flow charts of i) short staple spinning, ii) long staple spinning, iii) viscose rayon and synthetic fibre, manufacturer, iv) spun and filament yarn to fabric manufacture, v) jute spinning and jute fabric manufacture-accident hazard, guarding of machinery and safety precautions in opening, carding, combing, drawing, flyer frames and ring frames, doubles, rotor spinning, winding, warping, softening/spinning specific to jute.

UNIT II TEXTILE HAZARDS I**9**

Accident hazards i) sizing processes- cooking vessels, transports of size, hazards due to steam ii) Loom shed – shuttle looms and shuttleless looms iii) knitting machines iv) non-wovens.

UNIT III TEXTILE HAZARDS II**9**

Scouring, bleaching, dyeing, punting, mechanical finishing operations and effluents in textile processes.

UNIT IV HEALTH AND WELFARE**9**

Health hazards in textile industry related to dust, fly and noise generated-control measures-relevant occupational diseases, personal protective equipment-health and welfare measures

specific to textile industry, Special precautions for specific hazardous work environments.

UNIT V SAFETY STATUS

9

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

TOTAL: 45 PERIODS

OUTCOMES:

1. The student will able to know about the overall picture about the textile industries and its operations.
2. The student could understand the various concepts underlying in the processes involved in processing of fibres to yarn.
3. The student will be able to find out various hazards in the textile industry and will be able to apply the control measures to mitigate the risk emanating from the hazard.
4. The student could have the capability to handle the various health and welfare activities as per the Factories act and could implement statutory requirements.
5. The student could create of his own arrangement in designing various methods meant for mitigating the risk and able to guide his subordinates in executing the work safely.

REFERENCES:

1. 100 Textile fires – analysis, findings and recommendations LPA
2. Groover and Henry DS, “Hand book of textile testing and quality control”
3. “Quality tolerances for water for textile industry”, BIS
4. Shenai, V.A. “A technology of textile processing”, Vol.I, Textile Fibres
5. Little, A.H., “Water supplies and the treatment and disposal of effluent”
6. “Safety in Textile Industry” Thane Belapur Industries Association, Mumbai.

CO - PO and CO - PSO MAPPING

PIS205	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	-	-	-	2	-	-	-
CO2	-	-	-	3	-	-	-	-
CO3	-	-	2	-	-	-	-	-
CO4	-	-	-	2	-	-	-	-
CO5	-	-	-	-	2	-	-	-
Average	-	-	2	1.5	2	-	-	-

1- low, 2-medium, 3-high

UNIT V ACCIDENT ANALYSIS AND MANAGEMENT

9

Accidents classification and analysis-fatal, serious, minor and reportable accidents – safety audits- recent development of safety engineering approaches for mines-frequency rates- accident occurrence-investigation-measures for improving safety in mines-cost of accident-emergency preparedness – disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

1. This course would make the student familiar with the concept of safety aspects in the mining industries.
2. Course would be helpful in understanding the various types of mining activities like open case mines, underground mines and tunnel ling.
3. The students will understand about the various risks involved in the mining activities and come to know about the various safety activities to be taken to ensure the safety of the workers.
4. Students could able to implement the techniques like risk assessment Disaster management and emergency preparedness with the proper knowledge on accidentprevention.
5. Course would equip the students to effectively employ their knowledge on accident prevention in mines.

REFERENCES:

1. DGMS Circulars-Ministry of Labour, Government of India press, OR Lovely Prakashan - DHANBAD, 2002.
2. Kejriwal, B.K. Safety in Mines, Gyan Prakashan, Dhanbad, 2001.
3. "Mine Health and Safety Management", Michael Karmis ed., SME, Littleton, Co.2001.

CO - PO and CO - PSO MAPPING

PIS206	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	3	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-
CO3	-	2	-	-	2	-	-	-
CO4	-	-	-	-	-	-	-	-
CO5	-	-	-	-	2	-	-	-
Average	-	1.5	-	-	2	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

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

UNIT I HISTORY OF SAFETY LEGISLATION**9**

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

UNIT II WORKING ON BOARD THE SHIP**9**

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

– electricity and electrical management – Storage – types, hazardous cargo.

UNIT III LIFTING APPLIANCES

9

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

UNIT IV TRANSPORT EQUIPMENT

9

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

UNIT V EMERGENCY ACTION PLAN AND DOCK WORKERS (SHW)

REGULATIONS 1990

9

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

TOTAL: 45 PERIODS

OUTCOMES:

1. This course would make the student to familiar of various operations carried out in a dock.
2. Students would know the different acts and rules for safe dock operations.
3. Students could be able to understand the operation of various types of material handling equipment.
4. Students would be prepared to response at the time of emergency in a dock.
5. Students can recognize the various problems associated with the use of lifting equipment and in the storage yards.

REFERENCES

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

CO - PO and CO - PSO MAPPING

PIS207	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	-	-	-	3	-	-	-
CO2	-	3	-	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	2	-	-	-
CO5	-	-	2	-	-	-	-	-
Average	-	3	2	3	1.5	-	-	-

1- low, 2-medium, 3-high

SEMESTER- III (PROFESSIONAL ELECTIVE – IV & V)

PIS301

SAFETY IN ENGINEERING INDUSTRY

L T P C

3 0 0 3

OBJECTIVES:

1. To know the safety rules and regulations, standards and codes
2. To study various mechanical machines and their safety importance
3. To understand the principles of machine guarding and operation of protective devices.
4. To know the working principle of mechanical engineering processes such as metal forming and joining process and their safety risks.
5. Developing the knowledge related to health and welfare measures in engineering industry

UNIT I SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES 9

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

UNIT II PRINCIPLES OF MACHINE GUARDING

9

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

UNIT III SAFETY IN WELDING AND GAS CUTTING

9

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

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

UNIT V SAFETY IN FINISHING, INSPECTION AND TESTING

9

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

TOTAL: 45 PERIODS

OUTCOMES:

1. Students can have the knowledge in safety rules, standards and codes in various mechanical engineering processes
2. They can design machine guarding systems for various machines such as lathe, drilling, boring, milling etc.,
3. They can implement the safety concepts in welding, gas cutting, storage and handling of gas cylinders, metal forming processes etc.,
4. Students will have knowledge in testing and inspection as per rules in boilers, heat treatment operations etc.,
5. They can take preventive measures in health and welfare of workers' aspects in

engineering industry.

REFERENCES

1. "Accident Prevention Manual" – NSC, Chicago, 1982.
2. "Occupational safety Manual" BHEL, Trichy, 1988.
3. "Safety Management by John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, 1989.
4. "Safety in Industry" N.V. Krishnan Jaico Publishery House, 1996.
5. Indian Boiler acts and Regulations, Government of India.
6. Safety in the use of wood working machines, HMSO, UK 1992.
7. Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London, 1989.

CO - PO and CO - PSO MAPPING

PIS301	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	3	-	-	3	-	-	-
CO2	-	-	-	3	-	-	-	-
CO3	-	3	-	-	-	-	-	-
CO4	-	-	-	-	2	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	-	3	-	3	1.5	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

1. To know the quality engineering concepts in product design and development processes.
2. To know the control and process parameters' characteristics with feedback system.
3. To know the methods for production and diagnosis process improvements.
4. To have knowledge on ISO quality systems and types of quality tools such as failure and effect analysis.
5. To understand the six-sigma concepts and its implementation in engineering industries.

UNIT I INTRODUCTION TO QUALITY ENGINEERING AND LOSS FUNCTION 9

Quality value and engineering- overall quality system-quality engineering in product design - quality engineering in design of production processes - quality engineering in production - quality engineering in service. Loss function Derivation – use-loss function for products/system- justification of improvements-loss function and inspection- quality evaluations and tolerances- N type, S type, L type.

UNIT II ON-LINE QUALITY CONTROL 9

On-line feedback quality control variable characteristics-control with measurement interval- one unit, multiple units-control systems for lot and batch production. On-line process parameter control variable characteristics- process parameter tolerances- feedback control systems- measurement error and process control parameters.

UNIT III ON-LINE QUALITY CONTROL ATTRIBUTES AND METHODS FOR PROCESS IMPROVEMENTS 9

Checking intervals- frequency of process diagnosis. Production process improvement method- process diagnosis improvement method- process adjustment and recovery improvement methods.

UNIT IV QUALITY ENGINEERING AND TPM 9

Preventive maintenance schedules- PM schedules for functional characteristics- PM schedules for large-scale systems. Quality tools–fault tree analysis, event tree analysis, failure mode and effect analysis. ISO quality systems.

UNIT V SIX SIGMA AND ITS IMPLEMENTATION

9

Introduction- definition-methodology- impact of implementation of six sigma-DMAIC method- roles and responsibilities –leaders, champion, black belt, green belts. Do's and don't's - readiness of organization - planning-management role- six sigma tools – sustaining six sigma.

TOTAL: 45 PERIODS

OUTCOMES:

1. Students can understand the loss function derivation and quality engineering in product design and development processes.
2. Students can develop their knowledge in online quality control systems and process control parameters.
3. The students will be able to improve the production and process diagnosis and production process.
4. The students will be able to gain knowledge in ISO quality management systems.
5. The students will be able to list the roles and responsibilities of leaders.

REFERENCES:

1. Brue G, "Six Sigma for Managers", Tata-McGraw Hill, New Delhi, Second reprint, 2002.
2. De Feo J A and Barnard W W, "Six Sigma: Breakthrough and Beyond", Tata McGraw-Hill, NewDelhi, 2005.
3. Pyzdek T and Berger R W, "Quality Engineering Handbook", Tata-McGraw Hill, New Delhi, 1996
4. Taguchi G, Elsayed E A and Hsiang, T.C., "Quality Engineering in Production Systems", Mc-Graw-Hill Book company, Singapore, International Edition, 1989

CO - PO and CO - PSO MAPPING

PIS302	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	-	2	-	-	-	-	-
CO2	1	-	-	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-
CO5		-	2	-	-	-	-	-
Average	1	-	2	-	-	1	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

1. The course could provide the basic knowledge on Occupational Health and Safety Management System and Environmental Management System standards.
2. To inculcate the knowledge on various terms and terminologies which are used in the Occupational Health, Safety and Environmental Management system.
3. To educate about the various steps to be taken for certification of ISO 45001(Occupational health and safety management systems) and ISO14001 (Environmental Management Systems) standards.
4. To impart knowledge on Environment Impact Assessment (EIA), Life Cycle Assessment of product and principles of Eco labelling.

UNIT I OH & S MANAGEMENT SYSTEM STANDARD 9

Introduction to ISO 45001 – Development of various OHSMS standards – aim of OH & S management system–success factors– plan do check act cycle- contents and scope of ISO 45001- terms and definitions –leadership and worker participation –leadership and commitment - OH & S policy- organizational roles and responsibilities and authorities – consultation and participation of workers

UNIT II PLANNING 9

Actions to address risk and opportunities – hazard identification and assessment of risks and opportunities –determination of legal and other requirements-planning action- OH & S objectives and planning to achieve them- support – resources – competence –awareness-communication – documented information –operation planning & control –management of change – procurement – Emergency preparedness and response.

UNIT III PERFORMANCE EVALUATION 9

Monitoring, measurement, analysis and performance evaluation -evaluation of compliance- Internal audit-management review- Improvement- Incident, nonconformity and corrective

action – continual improvement- guidance of the use of the document ISO 45001 - benefits of certification- certification procedure.

UNIT IV ISO 14001& ISO 19011

9

EMS, ISO 14001, specifications, objectives, Environmental Policy, Guidelines and Principles (ISO14004), clauses 4.1 to 4 5. Documentation requirements, 3 levels of documentation for a ISO 14000 based EMS, steps in ISO 14001.Implementation plan, Registration, Importance of ISO 14000 to the Management. Auditing ISO14000-General principles of Environmental Audit, Auditor, steps in audit, Audit plan.ISO 19011- Guidelines for auditing management Systems-General principles, managing audit programme- audit activities, steps in audit, audit plan-competence of auditors.

UNIT V ENVIRONMENT IMPACT ASSESSMENT AND RELIABILITY

9

ISO 14040(LCA), General principles of LCA, Stages of LCA, Report and Review. ISO 14020 (Eco labeling) – History, 14021, 14024, Type I labels, Type II labels, ISO 14024, principles, rules for eco labeling before company attempts for it. Advantages. EIA in EMS, Types of EIA, EIA methodology EIS, Scope, Benefits, Case study in Reliability. Audit-methodology, Auditors Audit results management review-Continual improvement.

TOTAL: 45 PERIODS

OUTCOMES:

1. The student would be able to remember the various standards which is meant mainly for maintaining the Health of the employee and for the maintenance of the Environment.
2. The student could be able to understand the basic difference between the ISO 9000 series and ISO45001 and ISO 14000 standards and the various clauses which governs the system in maintaining the standard.
3. The course could provide the sufficient knowledge on various clauses and subsequent preparation of procedures and related documents and could be able to apply their knowledge in preparing the ISO manual for getting the certification from the external certifying agencies.
4. Course could help the students in acquiring the knowledge on various standards and provide the skill in analysing the various clauses and its suitability and applicability on the

nature of organization.

REFERENCES:

1. “BS 8800: 2004 Occupational Health and Safety Management Systems-Guide” BSI, UK, 2004.
2. “ISO 19011:2011 Guidelines for Auditing Management Systems”, ISO, 2011.
3. “ISO 14040:2006 Environmental Management- Life Cycle Assessment –Principles and Framework” ISO, 2006.
4. “ISO 14025:2006 Environmental Labels and Declarations -Type III Environmental Declarations -Principles and Procedures”, ISO, 2006.
5. “ISO 14021:1999 Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II environmental labelling)”, ISO, 1999.
6. “ISO 14020:2000 Environmental Labels and Declarations-General Principles”, ISO, 2000.

CO - PO and CO - PSO MAPPING

PIS303	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	-	-	-	-	-	-	-	-
CO2		-	-	-	-	-	-	-
CO3	1	1	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-
CO5		-	2	-	-	-	-	-
Average	1	1	2	-	-	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

1. To know the fundamental concepts and applications of Artificial intelligence.
2. To familiarize with AI languages like PROLOG and LISP.
3. To understand the various features of expert system
4. To have knowledge about Neural Network and corresponding selection of parameters.

UNIT I INTRODUCTION 9

Intelligence – Definition, types cognitive aspect approach, measuring intelligence – early efforts, IQ and AI: aspects of intelligence – learning, problem solving, creativity, behaviour and biology. Artificial intelligence: Historical background, applications of AI, objections and myths, AI languages: Introduction to PROLOG and LISP.

UNIT II COGNITIVE PSYCHOLOGY 11

The mind – informative and cybernetics, components for thought, modes of perception – visual, auditory and other systems: memory mechanisms, problem solving – planning, search, the GPS systems; types of learning – rote, parameter, method and concept: Game playing, reasoning, Artificial Vision – picture processing – identifying real objects; Vision programs, factory vision systems.

UNIT III KNOWLEDGE ENGINEERING 9

Introduction – role of knowledge engineer, knowledge representation – psychology, production rules, logic and programming, Common sense and fuzzy logic, semantic networks, learning systems.

UNIT IV EXPERT SYSTEMS 9

Introduction, knowledge acquisition for Expert system, features of Expert systems –System structure, inference Engines, uncertainties, memory mechanisms, range of applications, actual expert systems –VP expert. Assignment – Development of a simple expert system.

UNIT V INTRODUCTION TO NEURAL NETWORKS 7

Neural Network Architecture – Learning methods – Architecture of a Back Propagation Network – Selection of parameters – Simple variations of BPN.

TOTAL: 45 PERIODS

OUTCOMES:

1. To apply various aspects of intelligence to diverse industrial situations
2. To list out the applications of expert system To develop a simple expert system related to industrial safety Engineering.
3. To apply neural network concepts in safety engineering discipline.

REFERENCES:

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2. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Prentice Hall of India, 1992.
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CO - PO and CO - PSO MAPPING

PIS304	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	3	-	2	3	-	-	-	-
CO2	3	3	3	3	-	-	-	-
CO3	-	2	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-
CO5		-	-	-	-	-	-	-
Average	3	1.5	1.5	3	-	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

1. Impart knowledge on principles and steps in designing a statistically designed experiment.
2. Build foundation in analysing the data in single factor experiments and to perform post adhoc tests.
3. Provide knowledge on analysing the data in factorial experiments.
4. Educate on analysing the data analysis in special experimental designs and Response Surface Methods.
5. Impart knowledge in designing and analysing the data in Taguchi's Design of Experiments to improve Process/Product quality.

UNIT I EXPERIMENTAL DESIGN FUNDAMENTALS 9

Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression models.

UNIT II SINGLE FACTOR EXPERIMENTS 9

Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests.

UNIT III MULTIFACTOR EXPERIMENTS 9

Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F- tests. 2^K factorial Experiments.

UNIT IV SPECIAL EXPERIMENTAL DESIGNS: 9

Blocking and confounding in 2^K designs. Two level Fractional factorial design, nested designs, Split plot design, Introduction to Response Surface Methods.

UNIT V TAGUCHI METHODS 9

Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design-control and noise factors, S/N ratios, parameter design, Multi-level experiments, Multi-response

optimization, Introduction to Shainin DOE.

TOTAL: 45 PERIODS

OUTCOMES:

1. Understand the fundamental principles of DOE
2. Analyze data in the single factor experiments.
3. Analyze data in the multifactor experiments.
4. Understand the special experimental designs & Response Surface Methods.CO5: Apply Taguchi based approach to evaluate quality.

REFERENCES:

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PIS305	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	1	1	-	-	-	-	-	-
CO2	-	-	1	1	-	-	-	-
CO3	-	-	1	1	-	-	-	-
CO4	-	-	1	1	1	-	-	-
CO5	2	1	1	-	-	-	-	-
Average	1.5	1	1	1	1	-	-	-

1- low, 2-medium, 3-high

OBJECTIVES:

1. Recognize the importance of data analytics
2. Exhibit competence on data analytics packages
3. Apply solution methodologies for industrial problems.

UNIT I INTRODUCTION 9

Introduction to Multivariate Statistics-Degree of Relationship among Variables-Review of Univariate and Bivariate Statistics-Screening Data Prior to Analysis-Missing Data, Outliers, Normality, Linearity, and Homoscedasticity.

UNIT II MULTIPLE REGRESSION 9

Multiple Regression- Linear and Nonlinear techniques- Backward-Forward-Stepwise Hierarchical regression-Testing interactions (2way interaction) - Analysis of Variance and Covariance (ANOVA & ANCOVA) - Multivariate Analysis of Variance and Covariance (MANOVA & MANCOVA).

UNIT III LOGISTIC REGRESSION 9

Regression with binary dependent variable -Simple Discriminant Analysis Multiple Discriminant analysis-Assessing classification accuracy- Conjoint analysis (Full profile method).

UNIT IV PRINCIPAL COMPONENT ANALYSIS 9

Principal Component Analysis -Factor Analysis- Orthogonal and Oblique Rotation-Factor Score Estimation-Multidimensional Scaling-Perceptual Map-Cluster Analysis (Hierarchical Vs Nonhierarchical Clustering).

UNIT V LATENT VARIABLE MODELS 9

Latent Variable Models an Introduction to Factor, Path, and Structural Equation Analysis- Time series data analysis (ARIMA model) – Decision tree analysis (CHAID, CART) - Introduction to Big Data Management.

OUTCOMES:

1. To recognize the importance of data analytics
2. To Exhibit competence on data analytics packages
3. To apply solution methodologies for industrial problems.

REFERENCES:

1. Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. "Multivariate data analysis", (7th edition). Pearson India. 2015
2. Tabachnick, B. G., & Fidell, L. S., "Using multivariate statistics", (5th edition). Pearson Prentice Hall, 2001
3. Gujarati, D. N. , "Basic econometrics", Tata McGraw-Hill Education, 2012
4. Malhotra, N. K., " Marketing research: An applied orientation", 5/e. Pearson Education India,2008
5. Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. " Applied multiple regression/correlation analysis for the behavioral sciences", Routledge., 2013
6. Han, J., Kamber, M., & Pei, J. "Data mining: concepts and techniques: concepts and techniques", Elsevier, 2011.

CO - PO and CO - PSO MAPPING

PIS306	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	1	1	-	1	1	-	-	-
CO2	1	1	-	1	1	-	-	-
CO3	1	1	-	1	1	-	-	-
CO4	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	1	1	-	1	1	-	-	-

1- low, 2-medium, 3-high