

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur, Chengalpattu Dt.-603203, Tamil Nadu.

DEPARTMENT OF MECHANICAL ENGINEERING



M.E. INDUSTRIAL SAFETY ENGINEERING POST GRADUATE CURRICULA AND SYLLABI (REGULATIONS 2019)

SRM VALLIAMMAI ENGINEERING COLLEGE

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

REGULATION - 2019

M.E. INDUSTRIAL SAFETY ENGINEERING

CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- PEO1** Possess a mastery of Health safety and environment knowledge and safety management skills, to reach higher levels in their profession.

- PEO2.** Knowledgeable safety Engineer rendering professional expertise to the industrial and societal needs at national and global level subject to legal requirements.

- PEO3.** Well 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.

PROGRAMME OUTCOMES (POs)

- PO1.** Apply knowledge of Mathematics, Science, Engineering fundamentals and an engineering Specialization for hazard identification, risk assessment, analysis the source of incidents and control of occupational diseases & hazards.

- PO2.** Design, Establish, Implement maintain and continually improve an occupation health and safety management system to improve safety.

- PO3.** Conduct investigations on unwanted incidents using e.g. (Root cause analysis, what if analysis) and generate corrective and preventive action to prevent repetition and happening of such incidents.

- PO4.** Design complex man, machine, and material handling systems using human factors, engineering tools so as to achieve comfort, worker satisfaction, efficiency, error free, safe work practice and workplace environment.

- PO5.** Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings so as to provide practical solutions to safety problems.
- PO6.** Communicate effectively on occupational health and safety matters among the employees and with society at large.
- PO7.** Demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to occupation health and safety practices.
- PO8.** Understand and commit to comply with legal and contractual requirements, professional ethics and responsibilities and general norms of engineering practice.
- PO9.** Understand the impact of Health safety and environment solutions on productivity, quality and humanity protection at large.
- PO10.** Demonstrate the use of state of the art occupational health and safety practices in controlling risks of complex engineering activities and understand their limitations.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Upon completion of Industrial Safety Engineering program, students can be able to:

- PSO1.** Analyse, review safety of industries and to design safety protection system.
- PSO2.** Assess hazards, risk in process and manufacturing industries to devise remedial measures and also ensure safety management systems.
- PSO3.** Evaluate the occupational health, environmental issues, associated with industrial activities and design control measures with traditional, modern computational tools based on acts and codes.
- PSO4.** Analyse the application of ergonomic principles in the industries and various transportation modes.

PEO / PO / PSO MAPPING

Programme Educational Objectives	Programme Outcomes										Programme Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
1	2	2	2									3		1
2		2		2	3		3			2			2	
3						3		2	2				2	

SEMESTER COURSE WISE PEO MAPPING

	Subject	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4		
YEAR-1	SEM -1	Probability and Statistical Methods	1		1										1		
		Principles of Safety Management		2		2	2								3		
		Environmental Safety						1, 3		1, 3		1, 3	2	1			
		Occupational Health and Industrial Hygiene						2, 3		2, 3	2, 3				3		
		Industrial Safety, Health and Environment Acts								2			2	2		1	
		Professional Elective - I															
		Technical Seminar - I								2			2				1
YEAR-1	SEM -2	Fire Engineering and Explosion Control		2		2	2							2			
		Computer Aided Hazard Analysis	1		1										3		
		Electrical Safety		2		2	2						1		1		
		Safety in Chemical Industries						3		3	3		1		1		
		Professional Elective-II															
		Professional Elective-III															
		Industrial Safety Laboratory								2			2			3	2

		Technical Seminar-II							2			2				
YEAR-2	SEM -3	Reliability Engineering	1		1									1		
		Professional Elective-IV														
		Professional Elective-V														
		Project Work Phase - I				2, 3	2, 3	2, 3						2,3	2,3	
	Industrial Safety Assessment – Internship				2, 3	2, 3	2, 3					1		2,3	2	
	SEM -4	Project Work Phase - II				2, 3	2, 3	2, 3					1	3	3	2

Contribution:

1: Reasonable

2: Significant

3: Strong

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**M.E. INDUSTRIAL SAFETY ENGINEERING
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM**

I TO IV SEMESTERS CURRICULA & SYLLABI

SEMESTER - I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1918107	Probability and Statistical Methods	FC	4	4	0	0	4
2.	1914101	Principles of Safety Management	PC	3	3	0	0	3
3.	1914102	Environmental Safety	PC	4	4	0	0	4
4.	1914103	Occupational Health and Industrial Hygiene	PC	3	3	0	0	3
5.	1914104	Industrial Safety, Health and Environment Acts	PC	4	4	0	0	4
6.	19xxxxx	Professional Elective - I	PE	3	3	0	0	3
PRACTICAL								
7.	1914110	Technical Seminar - I	EEC	2	0	0	2	1
TOTAL				23	21	0	2	22

SEMESTER - II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1914201	Fire Engineering and Explosion Control	PC	3	3	0	0	3
2.	1914202	Computer Aided Hazard Analysis	PC	4	4	0	0	4
3.	1914203	Electrical Safety	PC	3	3	0	0	3
4.	1914204	Safety in Chemical Industries	PC	3	3	0	0	3
5.	19xxxxx	Professional Elective - II	PE	3	3	0	0	3
6.	19xxxxx	Professional Elective - III	PE	3	3	0	0	3
PRACTICAL								
7.	1914211	Industrial Safety Laboratory	PC	4	0	0	4	2
8.	1914212	Technical Seminar - II	EEC	2	0	0	2	1
TOTAL				25	19	0	6	22

SEMESTER- III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1914301	Reliability Engineering	PC	3	3	0	0	3
2.	19xxxxx	Professional Elective - IV	PE	3	3	0	0	3
3.	19xxxxx	Professional Elective - V	PE	3	3	0	0	3
PRACTICAL								
4.	1914306	Project Work Phase - I	EEC	12	0	0	12	6
5.	1914307	Industrial Safety Assessment - Internship	EEC	4	0	0	4	2
TOTAL				25	9	0	16	17

SEMESTER- IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1.	1914401	Project Work Phase - II	EEC	24	0	0	24	12
TOTAL				24	0	0	24	12

SUMMARY

SL. NO.	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL	Percentage [%]
		I	II	III	IV		
1.	FC	4	-	-	-	4	05.46
2.	PC	14	15	3		32	43.84
3.	PE	3	6	6		15	20.55
4.	EEC	1	1	8	12	22	30.14
	Total	22	22	17	12	73	

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 73

LIST OF ELECTIVES FOR M.E. INDUSTRIAL SAFETY ENGINEERING

SEMESTER- I (PROFESSIONAL ELECTIVE - I)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1914105	Plant Layout and Material Handling	PE	3	3	0	0	3
2.	1914106	Work Study and Ergonomics	PE	3	3	0	0	3
3.	1914107	Dock Safety	PE	3	3	0	0	3
4.	1914108	Human Factors in Engineering	PE	3	3	0	0	3
5.	1914109	Maintainability Engineering	PE	3	3	0	0	3

SEMESTER – II (PROFESSIONAL ELECTIVE – II)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1914205	Transport Safety	PE	3	3	0	0	3
2.	1914206	Fireworks Safety	PE	3	3	0	0	3
3.	1914207	Safety in Construction	PE	3	3	0	0	3

SEMESTER – II (PROFESSIONAL ELECTIVE - III)

SL. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1914208	Nuclear Engineering and Safety	PE	3	3	0	0	3
2.	1914209	Safety in Textile Industry	PE	3	3	0	0	3
3.	1914210	Safety in Mines	PE	3	3	0	0	3

SEMESTER – III (PROFESSIONAL ELECTIVE - IV)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1914302	Safety in Engineering Industry	PE	3	3	0	0	3
2.	1914303	Quality Engineering in Production Systems	PE	3	3	0	0	3
3.	1917310	Disaster Management	PE	3	3	0	0	3

SEMESTER- III (PROFESSIONAL ELECTIVE - V)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1914304	Artificial Intelligence and Expert Systems	PE	3	3	0	0	3
2.	1914305	Data Analytics	PE	3	3	0	0	3
3.	1915008	OHSAS 18000 and ISO 14000	PE	3	3	0	0	3
4.	1915009	Research Methodology	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1914110	Technical Seminar - I	EEC	2	0	0	2	1
2.	1914212	Technical Seminar - II	EEC	2	0	0	2	1
3.	1914306	Project Work Phase - I	EEC	12	0	0	12	6
4.	1914307	Industrial Safety Assessment – Internship	EEC	4	0	0	4	2
5.	1914401	Project Work Phase - II	EEC	24	0	0	24	12

FOUNDATION COURSES (FC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1918107	Probability and Statistical Methods	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1914101	Principles of Safety Management	PC	3	3	0	0	3
2.	1914102	Environmental Safety	PC	4	4	0	0	4
3.	1914103	Occupational Health and Industrial Hygiene	PC	3	3	0	0	3
4.	1914104	Industrial Safety, Health and Environment Acts	PC	4	4	0	0	4
5.	1914201	Fire Engineering and Explosion Control	PC	3	3	0	0	3
6.	1914202	Computer Aided Hazard Analysis	PC	4	4	0	0	4
7.	1914203	Electrical Safety	PC	3	3	0	0	3
8.	1914204	Safety in Chemical Industries	PC	3	3	0	0	3
9.	1914211	Industrial Safety Laboratory	PC	4	0	0	4	2
10.	1914301	Reliability Engineering	PC	3	3	0	0	3

SEMESTER – I

1918107

PROBABILITY AND STATISTICAL METHODS

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 modelling.
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 – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT-II: ESTIMATION THEORY 12

Principle of least squares – Regression – Multiple and partial correlations – Estimation of parameters – Maximum likelihood estimates – 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 – 2 2 Factorial designs.

UNIT-V: TIME SERIES 12

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

TOTAL: 60 PERIODS

OUTCOMES:

After completing this course, students should demonstrate competency in the following topics:

1. Basic probability axioms and rules and the moments of discrete and continuous random variables.
2. Least squares, correlation, regression, consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
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										PSO			
	1	2	3	4	5	6	7	8	9	10	1	2	3	4
CO1	3	2	2	1										
CO2	3	2	2	1										
CO3	3	2	2	1										
CO4	3	2	2	1										
CO5	3	2	2	1										

1914101

PRINCIPLES OF SAFETY MANAGEMENT

L T P C
3 0 0 3

OBJECTIVES :

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

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:**

Upon completion of this course, the students will be able:

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.
8. “Safety and Good House Keeping”, N.P.C., New Delhi, 1985.

CO	PO										PSO				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	
1	2	2	2	2		3		3	2	2	2	2	2		
2			2			3		2	2	2	2	2			
3			3			3		2	2	2	2	2			
4			2			2		2	2	2	2	2			
5			2			2		2	2	2	2	2			

OBJECTIVES :

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

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:

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

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										PSO				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	
1	2		3	2		2	3					2			
2			3	2			2					2			
3			3	2		3	2								
4	2	2	3			3	3								
5	2	2	3			3	3					2			

1914103	OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE	L	T	P	C
		3	0	0	3

OBJECTIVES :

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

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 Biohazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Biohazard control program,

employee health program-laboratory safety program-animal care and handling-biological safety cabinets - building design. Work Related Musculoskeletal Disorders –carpal tunnel syndrome CTS- Tendon pain-disorders of the neck- back injuries.

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:

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

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

REFERENCES:

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

CO	PO										PSO			
	1	2	3	4	5	6	7	8	9	10	1	2	3	4
1			3			3								
2			3			3								
3			3			3								
4			3			3								
5			3			3								

1914104	INDUSTRIAL SAFETY, HEALTH AND ENVIRONMENT ACTS	L	T	P	C
		4	0	0	4

OBJECTIVES :

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

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-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – 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 Williams - 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:**

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

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., New Delhi.
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										PSO			
	1	2	3	4	5	6	7	8	9	10	1	2	3	4
1						3		3						
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1914110

TECHNICAL SEMINAR - I

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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.

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	1	2	3	4	5	6	7	8	9	10	1	2	3	4	
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3						3	2								

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:**

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

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.
8. Relevant Indian Acts and rules, Government of India.

CO	PO										PSO			
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2			3			3		3						
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4			3			3		3						
5			2			3		3						

OBJECTIVES :

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

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 various software available for risk quantification.
4. To describe the consequences of fire, explosion and toxic release.
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**

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, HANGARS modules on Heat radiation, Pool fire, Jet, Explosion. Reliability software's 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:

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

1. Familiarize the basic concepts in risk and hazard.
2. Helpful to understand the various instruments to bring safety in Industries.
3. Find solution for risk assessment studies through the use of software.
4. Analyze risk assessment technique to quantify the risk.
5. 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, Commonwealth Science Council, UK
8. Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety.

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OBJECTIVES :

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

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:**

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

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.

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1914204

SAFETY IN CHEMICAL INDUSTRIES

L T P C
3 0 0 3

OBJECTIVES :

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

1. To provide knowledge on safe design features for a process industry.
2. To understand the various hazards and prevention in commissioning stage of industry.
3. To recognize and identify the safe operation of equipment in process industry.
4. To plan and train 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's, utilities. Pressure system, pressure vessel design, standards and codes- pipe works and valves- heat exchangers- process machinery- over pressure protection, pressure relief devices and design, fire relief, vacuum and thermal relief, special situations, disposal- flare and vent systems- failures in pressure system.

UNIT –II: PLANT COMMISSIONING AND INSPECTION 9

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

UNIT- III: PLANT OPERATIONS 9

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

UNIT- IV: PLANT MAINTENANCE, MODIFICATION AND EMERGENCY PLANNING 9

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

controls of modifications. Emergency planning, disaster planning, onsite emergency- offsite emergency, APELL.

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:

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

1. Familiarize the safe design of equipment which are the essential for smooth functioning of chemical industry.
2. Analyze the design of pressure systems.
3. Predict the problems and find innovative solutions during commissioning and maintenance stages.
4. Prepare the emergency planning for chemical industry problems.
5. 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.
5. GREEN, A.E., "High Risk Safety Technology", John Wiley and Sons,. 1984.
6. Lees, F.P. "Loss Prevention in Process Industries" Butterworths and Company, 1996
7. Petroleum Act and Rules, Government of India.

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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.

NOISE LEVEL MEASUREMENT AND ANALYSIS:

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

FRICTION TEST:

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

IMPACT TEST:

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

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

Auto ignition temperature test.

EXHAUST GAS MEASUREMENT AND ANALYSIS

Measurement of Sox, Nox, Cox, hydrocarbons.

ENVIRONMENTAL PARAMETER MEASUREMENT

Dry Bulb Temperature, Wet Bulb Temperature, Determination of relative humidity, wind flow and effective corrective effective. Particle size Measurement, Air sampling analysis.

TRAINING IN USAGE AND SKILL DEVELOPMENT**Personal protective equipment:**

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

Fire extinguishers and its operations

Water CO₂

Foam

Carbon dioxide (CO₂)

Dry chemical powder and

Currently amendment fire safety systems

Static charge testing on plastic, rubber, ferrous and non-ferrous materials.

Illumination testing by lux meter and photo meter.

Electrical safety

Insulation resistance for motors and cables

Estimation of earth resistance

Earth continuity test

Sensitivity test for MCB, ELCB, RCCB, MCCB

Software Usage

Dispersion modeling of various highly dangerous chemicals using ALOHA software

First-Aid

Road safety signals and symbols.

EQUIPMENTS REQUIRED

1.	Noise level meter	1 No
2.	Friction tester	1 No
3.	Impact tester	1 No
4.	Exhaust gas analyzer:	1 No
5.	High volume sampler :	1 No
6.	PPE Set	1 No
7.	Fire extinguisher set	1 No
8.	Static charge tester	1 No
9.	First aid kit	1 No
10.	Lock out/Tag out	1 No
11.	Software: ALOHA, CAMEO	

TOTAL : 60 PERIODS

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.

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5							2			2				

1914212

TECHNICAL SEMINAR-II

L T P C
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OBJECTIVES:

- To enrich the communication skills of the student through presentation of topics in recent advances in Industrial safety engineering/technology

TOTAL : 30 PERIODS

OUTCOMES:

- Students will develop skills to read, write, comprehend and present research papers.
- Students shall give presentations on recent areas of research in industrial safety engineering in two cycles.
- Depth of understanding, coverage and quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.

CO	PO										PSO				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	
1	3					3						2	2		1
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3						3	2								

SEMESTER - III

1914301

RELIABILITY ENGINEERING

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OBJECTIVES :

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

1. To understand about basic concepts of reliability.
2. To know about analysis of failure data.
3. To describe reliability prediction models.
4. To understand about reliability management.
5. To illustrate risk assessment.

UNIT- I: RELIABILITY CONCEPT

9

Reliability function – failure rate – mean time between failures (MTBF) – mean time to failure (MTTF) – A priori and a posteriori concept - mortality curve – useful life – availability – maintainability – system effectiveness.

UNIT- II: FAILURE DATA ANALYSIS

9

Time to failure distributions – Exponential, normal, Gamma, Weibull, ranking of data – probability plotting techniques – Hazard plotting.

UNIT- III: RELIABILITY PREDICTION MODELS

9

Series and parallel systems – RBD approach – Standby systems – m/n configuration – Application of Bayes' theorem – cut and tie set method – Markov analysis – Fault Tree Analysis – limitations.

UNIT- IV: RELIABILITY MANAGEMENT

9

Reliability testing – Reliability growth monitoring – Non-parametric methods – Reliability and life cycle costs – Reliability allocation – Replacement model.

UNIT-V: RISK ASSESSMENT

9

Definition and measurement of risk – risk analysis techniques – risk reduction resources – industrial safety and risk assessment.

TOTAL : 45 PERIODS

OUTCOMES:

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

1. Analyze the various concepts of failure, mortality curve to improve system effectiveness
2. Appraise time to failure distributions, probability and hazard plotting techniques.
3. Evaluate reliability prediction models and application of Bayes' theorem.
4. Interpret reliability testing, reliability allocation and replacement model.
5. Analyze risk assessment technique to ensure industrial safety.

REFERENCES:

1. "Srinath L.S, "Reliability Engineering", Affiliated East-West Press Pvt. Ltd, New Delhi, 1998.
2. Modarres, "Reliability and Risk analysis", Maral Dekker Inc.1993.
3. John Davidson, "The Reliability of Mechanical system" published by the Institution of Mechanical Engineers, London, 1988.
4. Smith C.O. "Introduction to Reliability in Design", McGraw Hill, London, 1976.

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4	2	2	2												
5	3	2	3												

1914306

PROJECT WORK PHASE – I

L T P C

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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 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										PSO				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	
1	2	3	2				2	2				2	2	3	2
2	2					3									

1914307

INDUSTRIAL SAFETY ASSESSMENT – INTERNSHIP

L T P C
0 0 4 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 3-4 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										PSO				
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	
1	1	2	2				2	2				1	2	1	
2		1		2											

SEMESTER - IV

1914401

PROJECT WORK PHASE – II

L T P C
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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 develop in handling industrial oriented projects.
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

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	1	2	3	4	5	6	7	8	9	10	1	2	3	4	
1	2	3	2				2	2				2	2	3	2
2	2			2	2	3				3			2	2	

SEMESTER- I (PROFESSIONAL ELECTIVE - I)

1914105	PLANT LAYOUT AND MATERIAL HANDLING	L	T	P	C
		3	0	0	3

OBJECTIVES :

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

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 chain slings, 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:

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

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

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1914106

WORK STUDY AND ERGONOMICS

L T P C

3 0 0 3

OBJECTIVES :

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

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:

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

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, New Delhi,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.

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1914107

DOCK SAFETY

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OBJECTIVES :

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

1. To understand safety legislation related to dock activities in India.
2. To know the safe working on board the ship and storage in the yards.
3. To identify various lifting appliances for safe operation.
4. To understand different types of transport devices for safe operation.
5. To study about dock workers rules and regulations 1990.

UNIT- I: WORK STUDY

9

History of dock safety statues in India-background of present dock safety statues- dock workers (safety, health and welfare) act 1986 and the rules and regulations framed there under, other statues like marking of heavy packages act 1951 and the rules framed there under - manufacture, storage and import of hazardous chemicals. Rules 1989 framed under the environment (protection) act, 1989– few cases laws to interpret the terms used in the dock safety statues. Responsibility of different agencies for safety, health and welfare involved in dock work – responsibilities of port authorities – dock labour board – owner of ship master, agent of ship – owner of lifting appliances and loose gear etc. – employers of dock workers like stevedores – clearing and forwarding agents – competent persons and dock worker. Forums for promoting safety and health in ports – Safe Committees and Advisory Committees. Their functions, training of 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: MAN MACHINE SYSTEMS**9**

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:**

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

1. Familiarize the various operations carried out in a dock.
2. Formulate safe working on different types of ships.
3. Analyzing different types of lifting appliances for applications to ensure safe lifting.
4. Evaluate the safe operation of various types of material handling equipment.
5. Inventing on site emergency plan in a dock and analysis of dock workers rules and regulations 1990.

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".

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OBJECTIVES :

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

1. To understand the applications of ergonomic principles and physiology of workers.
2. To discriminate human behavior.
3. To understand anthropometry and work design.
4. To know the applications of human factors engineering.
5. To describe human skill and performance.

UNIT- I: ERGONOMICS AND ANATOMY**9**

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

UNIT- II: HUMAN BEHAVIOR**9**

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

UNIT- III: ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND**9****SEATED WORKS**

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.

UNIT-IV: MAN - MACHINE SYSTEM AND REPETITIVE WORKS AND MANUAL HANDLING TASK 9

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

UNIT-V: HUMAN SKILL AND PERFORMANCE AND DISPLAY, CONTROLS AND VIRTUAL ENVIRONMENTS 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

1. Analysis of modern ergonomics and anatomy for comfortable working.
2. Evaluate human behavior and motivate to ensure job satisfaction.
3. Analysis of work design for standing and seated works and ensure cost effectiveness.
4. Evaluation of applications of human factors engineering and designing of safe manual handling tasks.
5. Analysis of human skill, performance, virtual display and research promotion.

REFERENCES:

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

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1914109

MAINTAINABILITY ENGINEERING

L T P C
3 0 0 3

OBJECTIVES :

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

1. To understand about the basic concept of maintenance engineering.
2. To describe on various maintenance models, maintenance policies and replacement model of various equipment.
3. To understand basic knowledge on logistics for the effective utilization of existing resources and facilities.
4. To describe maintenance excellence and reliability centered maintenance.
5. To illustrate Total Productive Maintenance.

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.

UNI-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:

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

1. Analyze the maintenance challenges, zero - technology to reduce maintenance cost.
2. Analyze various maintenance models to optimize profit/downtime.
3. Appraise maintenance logistics and plan maintenance, spare parts and scheduling.
4. Evaluate maintenance quality to ensure maintenance excellence.
5. Implementation of Total Productive Maintenance to ensure overall improvement.

REFERENCES:

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

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SEMESTER- II (PROFESSIONAL ELECTIVE - II)

1914205	TRANSPORT SAFETY	L	T	P	C
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OBJECTIVES :

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

1. To understand 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 understand driver safety programme and training.
4. To understand road safety and safety practices.
5. To describe safe driving of all elements in the shop floor.

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 9

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 10

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 9

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

8

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:

Upon completion of this course, 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. Analysis of driver training to ensure safe driving.
4. Appraise safety practices to ensure road safety.
5. Analysis of shop floor and repair shop safety for effective transportation.

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.

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OBJECTIVES :

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

1. To understand 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 understand material handling and transportation of loose chemicals.
5. To describe waste control in fireworks 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.

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:**

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

1. Analyze the properties fireworks chemicals to avoid fire and explosion.
2. Appraise earthing, hazards in firework factories and personal protective equipment.
3. Design of process safety for fire prevention and control.
4. Design of vehicles for transportation of explosives.
5. Evaluate waste disposal, methods adopted in other countries.

REFERENCES:

1. "Seminar on explosives", Dept. 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.

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OBJECTIVES :

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

1. To understand the causes of accidents related to construction industry and training.
2. To have the knowledge in hazards of construction and prevention methods.
3. To understand fall protection methods in construction industry.
4. To understand the selection, operation of 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 this course, the students will be able to:

1. Analyze the problems impeding safety in construction industries and assure quality.
2. Distinguish types and causes of accidents, and designing aids for safe construction.
3. Evaluate the safety procedure for working at heights during construction.
4. Analyze selection, operation, inspection and testing of various construction machinery.
5. Evaluate 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.

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SEMESTER- II (PROFESSIONAL ELECTIVE - III)

1914208

NUCLEAR ENGINEERING AND SAFETY

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OBJECTIVES :

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

1. To know about nuclear energy and fission fusion process.
2. To understand reactor operation, control and monitoring.
3. To gain knowledge in reactor types, liquid metal coolants and nuclear power plants in India.
4. To understand safety design principles of nuclear reactor.
5. To describe radiation shielding, nuclear waste management.

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:**

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

1. Demonstrate nuclear fission and fusion process and their utilization.
2. Implement control requirements in design considerations and online central data processing.
3. Analysis of reactor types, liquid metal coolants, nuclear power plants in India.
4. Evaluate the safety design principles of nuclear reactor and safety regulation process.
5. Validate nuclear radiation exposure, limits and waste management system.

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.

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OBJECTIVES :

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

1. To understand 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.
5. To understand about textile industry act, rules and other statutes.

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 shuttless 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:**

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

1. Predict about the overall picture about the textile industries and its operations.
2. Analyze accident hazards in textile industry will be able to apply the control measures to mitigate the risk emanating from the hazard.
3. Analyze different operations, effluent treatment in textile process.
4. Select special precautions for specific hazardous work environments.
5. Invent effluent treatment and waste disposal in textile industry.

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.

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OBJECTIVES :

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

1. To describe in depth knowledge on safety of opencast mines.
2. To understand about underground mines and various risk involved in the mining operations.
3. To get exposed to various types of accidents happened in mines and how to manage during accidents.
4. To know the basic concept of risk reliability.
5. To describe the emergency preparedness in the working environment of mines and to know about the disaster management.

UNIT- I: OPENCAST MINES**9**

Causes and prevention of accident from: Heavy machinery, belt and bucket conveyors, drilling, hand tools-pneumatic systems, pumping, water, dust, electrical systems, fire prevention. Garage safety – accident reporting system-working condition-safe transportation – handling of explosives.

UNIT- II: UNDERGROUND MINES**9**

Fall of roof and sides-effect of gases-fire and explosions-water flooding-warning sensors-gas detectors-occupational hazards-working conditions-winding and transportation.

UNIT- III: TUNNELLING**9**

Hazards from: ground collapse, inundation and collapse of tunnel face, falls from platforms and danger from falling bodies. Atmospheric pollution (gases and dusts) – trapping –transport-noise-electrical hazards-noise and vibration from: pneumatic tools and other machines – ventilation and lighting – personal protective equipment.

UNIT-IV: RISK ASSESSMENT**9**

Basic concepts of risk-reliability and hazard potential-elements of risk assessment – statistical methods – control charts-appraisal of advanced techniques-fault tree analysis-failure mode and effect analysis – quantitative structure-activity relationship analysis-fuzzy model for risk assessment.

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:**

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

1. Analyze opencast mines operations and safety precautions to prevent accidents.
2. Appraise underground mines working conditions to ensure safety.
3. Analyze the hazards due to tunneling and ensure personal protective equipment.
4. Implement the techniques like risk assessment techniques to ensure safety.
5. Disaster management and emergency preparedness with the proper knowledge on accident prevention in mines.

REFERENCES:

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

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SEMESTER – III (PROFESSIONAL ELECTIVE - IV)

1914302	SAFETY IN ENGINEERING INDUSTRY	L	T	P	C
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OBJECTIVES :

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

1. To know the safety rules and regulations, standards, codes various mechanical machines and their safety importance
2. To understand the principles of machine guarding and operation of protective devices.
3. To describe welding and gas cutting process and safety precautions.
4. To know the working principle of mechanical engineering processes such as metal forming and joining process and their safety risks.
5. To develop the knowledge related to safety in finishing, inspection and testing.

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, wood working 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-forgehammer – 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, foundry production cleaning and finishing foundry processes.

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:

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

1. Implement safety rules, standards and codes in various mechanical engineering processes.
2. Design machine guarding systems for various machines such as lathe, drilling and milling etc.,
3. Implement the safety concepts in welding, gas cutting, storage and handling of gas cylinders, metal forming processes etc.,
4. Analyze safety in cold forming and hot working of metals.
5. Implement safety in finishing, inspection and testing.

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.

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OBJECTIVES :

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

1. To know the quality engineering concepts in product design and development processes.
2. To describe 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

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 dont’s - readiness of organization – planning-management role- six sigma tools – sustaining six sigma.

TOTAL : 45 PERIODS**OUTCOMES:**

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

1. Analyze the loss function derivation and quality engineering in product design and development processes.
2. Appraise the knowledge in online quality control systems and process a control parameters.
3. Improve the production and process diagnosis and production process.
4. Implement ISO quality management systems and TPM in the industry.
5. Analyze six sigma concepts and implement in the industry.

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: Break through and Beyond”, Tata McGraw-Hill, New Delhi, 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

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OBJECTIVES:

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

1. To know about the disaster types and their control using space technology.
2. To study about on site and off site emergency plans.
3. To create awareness on global warming, eco-friendly products, environmental impact assessment and environmental policies with proper case studies.
4. To study about the marine pollution and earthquake disasters and their effects.
5. To understand environmental education including laws, risk & disaster assessment disaster profile of India.

UNIT- I: EXPOSURE OF DISASTER 9

Philosophy of Disaster management-Introduction to Disaster mitigation-Hydrological, Coastal and Marine Disasters-Atmospheric disasters-Geological, meteorological phenomena Mass Movement and Land Disasters-Forest related disasters-Wind and water related disasters-deforestation-Use of space technology for control of geological disasters-Master thesis.

UNIT- II: DISASTER MANAGEMENT CASE STUDIES 9

Technological Disasters-Case studies of Technology disasters with statistical details Emergencies and control measures-APELL-Onsite and Offsite emergencies-Crisis management groups-Emergency centers and their functions throughout the country-Software on emergency controls-Monitoring devices for detection of gases in the atmosphere-Right to know act.

UNIT- III: SUSTAINABLE DEVELOPMENT 9

Introduction to Sustainable Development-Bio Diversity-Atmospheric pollution-Global warming and Ozone Depletion-ODS banking and phasing out-Sea level rise-El Nino and climate changes-Eco friendly products-Green movements-Green philosophy-Environmental Policies-Environmental Impact Assessment-case studies-Life cycle .

UNIT-IV: ENVIRONMENTAL ISSUES 9

Offshore and onshore drilling-control of fires-Case studies-Marine pollution and control Toxic, hazardous & Nuclear wastes-state of India's and Global environmental issues -carcinogens-

complex emergencies-Earthquake disasters-the nature-extreme event analysis- the immune system-proof and limits.

UNIT-V: RISK ASSESSMENT

9

Environmental education-Population and community ecology-Natural resources conservation-Environmental protection and law-Research methodology and systems analysis Natural resources conservation-Policy initiatives and future prospects-Risk assessment process, assessment for different disaster types-Assessment data use, destructive capacity-risk adjustment-choice-loss acceptance-disaster aid- public liability insurance-stock taking and vulnerability analysis-disaster profile of the country-national policies-objectives and standards-physical event modification-preparedness, forecasting and warning, land use planning.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Analyze the philosophy of disaster management and their control using the sophisticated technologies.
2. To appraise the emergency measures and how to control with monitoring devices.
3. Analyze earth quake disasters and nuclear wastes disposals.
4. Appraise risk and disaster assessment processes including standards, and national policies.
5. Assess factors of vulnerability and its impacts.

REFERENCES:

1. Introduction to Environmental Engineering and Science, Gilbert, M. Masters
2. Environmental Science, Miller, G. Tylor
3. Environmental Science sustaining the earth, G. Tylor, Miller
4. Principles of Environmental Science and Engineering, Bagad Vilas.
5. Principles of Environmental Science and Engineering, R. Sivakumar
6. United Nations Secretary General.(2017).Report to the 66th General Assembly on the implementation of the strategy for disaster Reduction. UN,New York.

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SEMESTER- III (PROFESSIONAL ELECTIVE -V)

1914304

ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

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OBJECTIVES :

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

1. To know the fundamental concepts and applications of Artificial intelligence.
2. To understand the concepts of cognitive psychology.
3. To familiarize with knowledge engineering.
4. To understand the various features of expert system
5. 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:**

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

1. Apply various aspects of intelligence to diverse industrial situations.
2. Analyze the mind and artificial vision system.
3. Appraise the role of knowledge engineer and learning systems.
4. Analyze features and applications of expert system.
5. Implement neural network concepts in safety engineering discipline.

REFERENCES:

1. Charnaik, E., and McDermott, D., "Introduction to Artificial Intelligence", Addison Wesley, 1985.
2. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Prentice Hall of India, 1992.
3. Elaine R., and Kevin, "Artificial Intelligence", 2nd Edition, Tata McGraw Hill, 1994.
4. Nilsson, N.J., "Principles of AI", Narosa Publishing House, 1990.
5. Rajasekaran S and Vijayalakshmi Pai, G.A, "Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications", PHI, 2003.
6. Schalkoff, R.J., "Artificial Intelligence" – An Engineering Approach", McGraw Hill International 9th Edition, Singapore, 1992.
7. Winston, P.H., "Artificial Intelligence", Addison Wesley, 1990.

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1914305

DATA ANALYTICS

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OBJECTIVES :

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

The Student should be made to

1. To expose to big data.
2. To learn the different ways of Data Analysis.
3. To familiar with data streams.
4. To learn the mining and clustering.
5. To understand visualization concepts.

UNIT- I: INTRODUCTION TO BIG DATA 8

Introduction to Big Data Platform – Challenges of conventional systems - Web data – Evolution of Analytic scalability, analytic processes and tools, Analysis vs reporting - Modern data analytic tools, Statistical concepts: Sampling distributions, resampling, statistical inference, prediction error.

UNIT- II: DATA ANALYSIS 12

Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics - Rule induction - Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods.

UNIT- III: MINING DATA STREAMS 8

Introduction to Streams Concepts – Stream data model and architecture - Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window – Real time Analytics Platform(RTAP) applications - case studies - real time sentiment analysis, stock market predictions.

UNIT-IV: FREQUENT ITEM SETS AND CLUSTERING 9

Mining Frequent item sets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent item sets in a stream – Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data – CLIQUE and

PROCLUS – Frequent pattern based clustering methods – Clustering in non- euclidean space – Clustering for streams and Parallelism.

UNIT-V: FRAMEWORKS AND VISUALIZATION 8

Map Reduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed file systems – Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications.

TOTAL : 45 PERIODS

OUTCOMES:

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

1. Apply the statistical analysis methods.
2. Compare and contrast various soft computing frameworks.
3. Design distributed file systems.
4. Apply Stream data model.
5. Use frame works and visualization techniques.

REFERENCES:

1. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.
2. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2012.
3. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007Pete Warden, Big Data Glossary, O'Reilly, 2011.
4. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.
5. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.

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OBJECTIVES:

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

1. To understand occupational Health and Safety Management System and Environmental Management System Standards.
2. To know about OHSAS 18001 policy and planning.
3. To inculcate the knowledge on terms and terminologies used in the OHSAS and EMS.
4. To educate about the various steps to be taken for certification of OHSAS and ISO14001 standards.
5. To impart knowledge on Environmental Impact Assessment (EIA), Life Cycle Assessment of Product and principles of Eco Labeling.

UNIT – I: OHSAS STANDARD**9**

Introduction – Development of OHSAS standard – Structure and features of OSHAS 18001 – Benefits of certification-certification procedure – OH and S management system element, specification and scope - correspondence between OHSAS 18001, ISO 14001:1996 and ISO 9001:1994 – Guidelines (18002:2000) for implementing OHSAS 18001.

UNIT – II: OHSAS 18001 POLICY AND PLANNING**9**

Developing OH and S policy– Guidelines – Developments - procedure - Content of OH and S policy – General principle, strategy and planning, specific goals, compliance – methodology. Planning – Guidelines, methodology steps developing action plan – Analysis and identify the priorities, objective and Targets, short term action plan, benefits and cost of each option, Development of action plan.

UNIT – III: IMPLEMENTATION AND OPERATION, CHECKING AND REVIEW**9**

Guidelines for structure and Responsibilities, Top Management, middle level management, coordinator and employees - Developing procedures, identifying training needs, providing training, documentation of training, Training methodology consultation and communications. Checking and Review; performance measurement and monitoring, Proactive and Reactive monitoring, measurement techniques, inspections, measuring equipment - Accidents reports, Process and procedures, recording, investigation corrective action and follow up - records and records management. Handling documentation, information, records.

UNIT – IV: ISO 14001**9**

EMS, ISO 14001, specifications, objectives, Environmental Policy, Guidelines and Principles (ISO 14004), clauses 4.1 to 4.5. Documentation requirements, 3 levels of documentation for an 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.

UNIT – V: ENVIRONMENT IMPACT ASSESSMENT**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. Audit-methodology, Auditors Audit results management review-Continual improvement.

TOTAL: 45 PERIODS**OUTCOMES:**

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

1. Implement the standards for maintaining employee health and maintenance of the environment.
2. Analyze the occupational health and safety policy.
3. Implement the procedures relating to OHSAS for getting the certification.
4. Provide knowledge for the implementation of various aspects of Quality systems.
5. Appraise Environment Impact Assessment.

REFERENCES:

1. ISO 9000 to OHSAS 18001, Dr. K.C. Arora, S.K. Kataria and Sons, Delhi, 2012
2. Corbet,C.J., & Kirsch,D.A.(2004). Response to “Revisiting ISO 14000 diffusion: a new look at the drivers of certification“. Production and Operations Management, 13 (3), 268-271.
3. Anholon,R, Rampasso,I.S., Ordeonez,R.E.C., Silva , D, Quelhas,O.L.G.,& Leal Filho,W.(2018.)Observed difficulties during implementation of quality management systems in Brazilian manufacturing companies. Journal of Manufacturing Technology Management, 29(1).

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OBJECTIVES:

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

1. Introduce the students about the concept of research and the principles of scientific enquiry.
2. To understand about experimental design procedures.
3. To know about various data collection methods.
4. To impart scientific, statistical and analytical knowledge for carrying out research work effectively.
5. To know about report preparation with the all relevant details.

UNIT – I: INTRODUCTION TO RESEARCH 9

The hallmarks of scientific research – Building blocks of science in research – Concept of Applied and Basic research – Quantitative and Qualitative Research Techniques –Need for theoretical frame work – Hypothesis development – Hypothesis testing with quantitative data. Research design – Purpose of the study: Exploratory, Descriptive, Hypothesis Testing.

UNIT – II: EXPERIMENTAL DESIGN 9

Laboratory and the Field Experiment – Internal and External Validity – Factors affecting internal validity. Measurement of variables – Scales and measurements of variables. Developing scales – Rating scale and attitudinal scales – Validity testing of scales –Reliability concept in scales being developed – Stability Measures.

UNIT – III: DATA COLLECTION METHODS 9

Interviewing, Questionnaires, etc. Secondary sources of data collection. Guidelines for Questionnaire Design – Electronic Questionnaire Design and Surveys. Special Data Sources: Focus Groups, Static and Dynamic panels. Review of Advantages and Disadvantages of various Data-Collection Methods and their utility. Sampling Techniques – Probabilistic and non-probabilistic samples. Issues of Precision and Confidence in determining Sample Size. Hypothesis testing, Determination of Optimal sample size.

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