

**ANNA UNIVERSITY, CHENNAI**  
**NON- AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY**  
**M.E. - INDUSTRIAL SAFETY ENGINEERING (R 2021)**  
**REGULATIONS 2021**  
**CHOICEBASEDCREDITSYSTEM**

**I TO IV SEMESTERS CURRICULA & SYLLABI**

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):**

<b>I.</b>	Possess a mastery of Health safety and environment awareness and safety management skills, to reach higher levels in their profession.
<b>II.</b>	Proficient safety Engineer rendering professional expertise to the industrial and societal needs at national and global level subject to legal requirements.
<b>III.</b>	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.
<b>IV.</b>	Demonstrate professional and ethical attitude with awareness of current legal issues by rendering expertise to wide range of industries.

**PROGRAMME OUTCOMES (POs):**

<b>PO #</b>	<b>Programme Outcomes</b>
1	An ability to independently carry out research/investigation and development work to solve practical problems
2	An ability to write and present a substantial technical report/document
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4	Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to safety, health and environmental engineering activities with an understanding of the limitations.
5	Demonstrate the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to occupational health and safety practices.
6	Recognise the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously

**PEO/PO Mapping:**

<b>PEO</b>	<b>PO</b>					
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>I.</b>			<b>2</b>	<b>3</b>	<b>3</b>	
<b>II.</b>	<b>2</b>				<b>3</b>	<b>2</b>
<b>III.</b>	<b>2</b>			<b>3</b>	<b>2</b>	
<b>IV.</b>	<b>2</b>				<b>3</b>	<b>2</b>

**PROGRAM ARTICULATION MATRIX OF PG - INDUSTRIAL SAFETY ENGINEERING**

		<b>COURSE NAME</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>YEAR I</b>	<b>SEMESTER I</b>	Probability and Statistical Methods	3	2	2.5			
		Principles of Safety Management	3		2.5	2		
		Environmental Safety	3		2.5			
		Occupational Health and Industrial Hygiene	3		2.5			
		Industrial Safety, Health and Environment Acts	3		2.5			
		Research Methodology and IPR						
		Professional Elective - I						
	Safety Audit		2.5	2	3			
	<b>SEMESTER II</b>	Fire Engineering and Explosion Control		3	3	2	3	2
		System Simulation and Hazard Analysis		3	2	2	3	2.5
		Electrical Safety		3	2	2	3	2.5
		Safety in Process Industries		3	2	2	3	2
		Professional Elective II		2	3	3	3	2
		Professional Elective III						
Industrial Safety and Simulation Laboratory			2	3	3	3	2	
Technical Seminar - I	3			3	2			
<b>YEAR II</b>	<b>SEMESTER III</b>	Reliability Engineering		2	3	3	3	2
		Professional Elective IV						
		Professional Elective V						
		Open Elective						
		Project work -I						
	Industrial Safety Assessment – Internship		2	3		3	2	
<b>SEMESTER IV</b>	Project work- II							

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**REGULATIONS – 2021**  
**CHOICE BASED CREDIT SYSTEM**  
**I TO IV SEMESTERS CURRICULA AND SYLLABUS**

**SEMESTER I**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
<b>THEORY</b>								
1.	MA4114	Probability and Statistical Methods	FC	4	0	0	4	4
2.	IS4101	Principles of Safety Management	PCC	3	0	0	3	3
3.	IS4102	Environmental Safety	PCC	3	0	0	3	3
4.	IS4103	Occupational Health and Industrial Hygiene	PCC	3	0	0	3	3
5.	IS4104	Industrial Safety, Health and Environment Acts	PCC	3	0	0	3	3
6.	RM4151	Research Methodology and IPR	RMC	2	0	0	2	2
7.		Professional Elective - I	PEC	3	0	0	3	3
8.		Audit Course – I*	AC	2	0	0	2	0
<b>PRACTICAL</b>								
9.	IS4111	Safety Audit	EEC	0	0	2	2	1
<b>TOTAL</b>				<b>23</b>	<b>0</b>	<b>2</b>	<b>25</b>	<b>22</b>

\* Audit Course is optional

**SEMESTER II**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
<b>THEORY</b>								
1.	IS4201	Fire Engineering and Explosion Control	PCC	3	0	0	3	3
2.	IS4202	System Simulation and Hazard Analysis	PCC	4	0	0	4	4
3.	IS4203	Electrical Safety	PCC	3	0	0	3	3
4.	IS4204	Safety in Process Industries	PCC	3	0	0	3	3
5.		Professional Elective - II	PEC	3	0	0	3	3
6.		Professional Elective- III	PEC	3	0	0	3	3
7.		Audit Course - II*	AC	2	0	0	2	0
<b>PRACTICAL</b>								
8.	IS4211	Industrial Safety and Simulation Laboratory	PCC	0	0	2	2	1
9.	IS4212	Technical Seminar - I	EEC	0	0	2	2	1
<b>TOTAL</b>				<b>21</b>	<b>0</b>	<b>4</b>	<b>25</b>	<b>21</b>

\* Audit Course is optional

**SEMESTER III**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
<b>THEORY</b>								
1.	IS4351	Reliability Engineering	PCC	3	0	0	3	3
2.		Professional Elective - IV	PEC	3	0	0	3	3
3.		Professional Elective - V	PEC	3	0	0	3	3
4.		Open Elective	OEC	3	0	0	3	3
<b>PRACTICAL</b>								
5.	IS4311	Project Work I	EEC	0	0	12	12	6
6.	IS4312	Industrial Safety Assessment – Internship	EEC	0	0	4	4	2
<b>TOTAL</b>				<b>12</b>	<b>0</b>	<b>16</b>	<b>28</b>	<b>20</b>

**SEMESTER IV**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
<b>PRACTICAL</b>								
1.	IS4411	Project Work II	EEC	0	0	24	24	12
<b>TOTAL</b>				<b>0</b>	<b>0</b>	<b>24</b>	<b>24</b>	<b>12</b>

**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE: 75**

**FOUNDATION COURSES (FC)**

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	MA4114	Probability and Statistical Methods	4	0	0	4	1

**PROGRAM CORE COURSES (PCC)**

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	IS4101	Principles of Safety Management	3	0	0	3	1
2.	IS4102	Environmental Safety	3	0	0	3	1
3.	IS4103	Occupational Health and Industrial Hygiene	3	0	0	3	1
4.	IS4104	Industrial Safety, Health and Environment Acts	3	0	0	3	1
5.	IS4201	Fire Engineering and Explosion Control	3	0	0	3	2
6.	IS4202	System Simulation and Hazard Analysis	4	0	0	4	2
7.	IS4203	Electrical Safety	3	0	0	3	2
8.	IS4204	Safety in Process Industries	3	0	0	3	2
9.	IS4211	Industrial Safety and simulation Laboratory	0	0	4	1	2
10.	IS4351	Reliability Engineering	3	0	0	3	3
<b>TOTAL CREDITS</b>						<b>29</b>	

**RESEARCH METHODOLOGY AND IPR COURSES (RMC)**

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.		Research Methodology and IPR	2	0	0	2	1
<b>TOTAL CREDITS</b>							

**PROFESSIONAL ELECTIVES**

**SEMESTER I, ELECTIVE I**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	IL4076	Plant Layout and Material Handling	PEC	3	0	0	3	3
2	IS4001	Work Study and Ergonomics	PEC	3	0	0	3	3
3	IL4074	Human Factors in Engineering	PEC	3	0	0	3	3
4	IS4002	Maintainability Engineering	PEC	3	0	0	3	3
5	IS4003	Optimization Techniques	PEC	3	0	0	3	3

**SEMESTER II, ELECTIVE II & III**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	IS4004	Transport Safety	PEC	3	0	0	3	3
2	IS4005	Fireworks Safety	PEC	3	0	0	3	3
3	IS4006	Safety in Construction	PEC	3	0	0	3	3
4	IS4007	Nuclear Engineering and Safety	PEC	3	0	0	3	3
5	IS4008	Safety in Textile Industry	PEC	3	0	0	3	3
6	IS4009	Safety in Mines	PEC	3	0	0	3	3
7	IS4010	Dock Safety	PEC	3	0	0	3	3

**SEMESTER III, ELECTIVE IV & V**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	IS4011	Safety in Engineering Industry	PEC	3	0	0	3	3
2	IS4012	Quality Engineering in Production Systems	PEC	3	0	0	3	3
4	IS4013	ISO 45001 and ISO 14000	PEC	3	0	0	3	3
5	IS4014	Artificial Intelligence and Expert Systems	PEC	3	0	0	3	3
6	IL4072	Design of Experiments	PEC	3	0	0	3	3
7	IS4071	Data Analytics	PEC	3	0	0	3	3

**AUDIT COURSES (AC)**

Registration for any of these courses is optional to students

SL. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	AX4091	English for Research Paper Writing	2	0	0	0
2.	AX4092	Disaster Management	2	0	0	0
3.	AX4093	Constitution of India	2	0	0	0
4.	AX4094	நற்றமிழ் இலக்கியம்	2	0	0	0

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	IS4212	Technical Seminar - I	0	0	2	1	2
2.	IS4311	Project Work I	0	0	12	6	3
3.	IS4312	Industrial Safety Assessment – Internship	0	0	4	2	3
4.	IS4411	Project Work II	0	0	24	12	4
<b>TOTAL CREDITS</b>						<b>21</b>	

**SUMMARY**

Name of the Programme: M.E						
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	FC	4	-	-	-	4
2.	PCC	12	14	3	-	28
3.	PEC	3	6	6	-	15
4.	RMC	2	-	-	-	2
5.	OEC	-	-	3	-	3
6.	EEC	-	1	8	12	21
7.	Non Credit/Audit Course					
8.	CC	2				2
9.	<b>TOTAL CREDIT</b>					<b>75</b>

**COURSE OBJECTIVES:**

- To provide students with basic concepts of probability theory.
- To provide the most appropriate estimator of the parameter in statistical inference.
- To decide whether to accept or reject a specific value of a parameters.
- To avoid or at least to minimize, the problems of estimating the effects of the independent variable by experimental designs.
- To learn methods for analyzing time series data to extract meaningful statistical characteristic of data.

**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****COURSE OUTCOMES:**

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

- Basic probability axioms and rules and the moments of discrete and continuous random variables.
- Least squares, correlation, regression, consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments.
- Differentiate between various time series models and application of these models appropriately to engineering problems.



## REFERENCES:

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", 9<sup>th</sup> Edition, Cengage Learning, 2016.
3. Gupta S.C. and Kapoor V.K.," Fundamentals of Mathematical Statistics", 12<sup>th</sup> Edition, Sultan and Sons, New Delhi, 2020.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers, 9<sup>th</sup> Edition, Pearson Education, Asia, 2016.
5. Montgomery D.C and Johnson, L.A, "Forecasting and Time Series", 6<sup>th</sup> Edition, McGraw Hill, 1990.

IS4101

## PRINCIPLES OF SAFETY MANAGEMENT

L T P C  
3 0 0 3

### OBJECTIVES:

- To achieve an understanding of principles of safety management.
- To enable the students to learn about various functions and activities of safety department.
- To enable students to conduct safety audit and write audit reports effectively in auditing situations.
- To have knowledge about sources of information for safety promotion and training.
- To familiarize students with evaluation of safety performance.

### 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

9

Components of safety audit, types of audit, audit methodology, non-conformity 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:**

The students will be able to

- To understand the functions and activities of safety engineering department.
- To carry out a safety audit and prepare a report for the audit.
- To prepare an accident investigation report.
- To estimate the accident cost using supervisors report and data.
- To evaluate the safety performance of an organization from accident records.
- To identify 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, 13<sup>th</sup> Edition 2009.
2. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey,. 3<sup>rd</sup> Edition 2000.
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, 2<sup>nd</sup> 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 MAPPING:**

CO	PO					
	1	2	3	4	5	6
1	3		2		-	-
2	-		3		-	-
3	-		-		-	-
4	-		-	2	-	-
5	-		-		-	-
<b>AVG.</b>	3/1=3	-	(3+2)/2=2.5	2	-	-

1-low, 2-medium, 3-high, '-'- no correlation

**OBJECTIVES:**

- To provide in depth knowledge in Principles of Environmental safety and its applications in various fields.
- To give understanding of air and water pollution and their control.
- To expose the students to the basis in hazardous waste management.
- To design emission measurement devices.

**UNIT I AIR POLLUTION****9**

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****9**

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****9**

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 verification - hazards due to bio-process-dilution-standards and restrictions – recycling and reuse.

**UNIT IV ENVIRONMENTAL MEASUREMENT AND CONTROL****9**

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****9**

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

**TOTAL: 45 PERIODS****OUTCOMES:**

The students will be able to

- Illustrate and familiarize the basic concepts scope of environmental safety.
- Understand the standards of professional conduct that are published by professional safety organizations and/or certification bodies.
- Explain the ways in which environmental health problems have arisen due to air and water pollution.
- Illustrate the role of hazardous waste management and use of critical thinking to identify and assess environmental health risks.
- Discuss concepts of measurement of emissions and design emission measurement devices.

**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, 11<sup>th</sup> 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, 1<sup>st</sup> January 2018.
5. S. P. Mahajan, "Pollution control in process industries", Tata McGraw Hill Publishing Company, New Delhi, 2006.
6. Varma and Braner, "Air pollution equipment", Springer Publishers, Second Edition.

**CO-PO MAPPING:**

CO	PO					
	1	2	3	4	5	6
1	3		2		-	-
2	-		3		-	-
3	-		-		-	-
4	-		-		-	-
5	-		-		-	-
<b>AVg.</b>	3/1=3	-	(3+2)/2=2.5	-	-	-

1- low, 2-medium, 3-high, '-'- no correlation

IS4103

OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE

L T P C  
3 0 0 3**OBJECTIVES:**

- To understand the basic knowledge on anatomy of human organs and its basic functions.
- To enable the students to learn about various functions and activities of occupational health services.
- To enable students to compare the hazards with the permissible levels.
- To have knowledge about types of hazards arising out of physical, chemical and biological agents.

**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 – Covid SARS - 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:**

The students will be able

- To understand the various physiological functions of our body and the test methods for periodical monitoring of health.
- To understand the functions and activities of Occupational health services.
- To identify various types of hazards arising out of physical, chemical and biological agents in a process.
- To identify notifiable occupational diseases arising out of Occupation and suggest methods for the prevention of such diseases.

## 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, 2002.
6. Lawrence Slote , Handbook of occupational safety and health, Wiley, 2001.
7. Louis J. Di Berardinis, Handbook of occupational safety and health Wiley, 1999.
8. Interim guidance "COVID-19: Occupational health and safety for health workers", WHO & ILO,2021.

## CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	3		2		-	-
2	-		3		-	-
3	-		-		-	-
4	-		-		-	-
5	-		-		-	-
AVg.	3/1=3	-	(3+2)/2=2.5	-	-	-

1 - low, 2-medium, 3-high, '-'- no correlation

IS4104

INDUSTRIAL SAFETY, HEALTH AND ENVIRONMENT ACTS

L T P C  
3 0 0 3

### OBJECTIVES:

- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948.
- To familiarize students with powers of inspectorate of factories.
- To help students to learn about Environment act 1986 and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.

### UNIT I FACTORIES ACT – 1948

9

Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Tamilnadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948. Forms, Registers and notices – Tamilnadu Safety Officer Rules 2005- with updated Amendments.

### UNIT II ENVIRONMENT ACT – 1986

9

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 AND MAJOR ACCIDENT HAZARD CONTROL RULES AND AMENDMENT 9**

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. Major Accident Hazard Control Rules. Hazardous Wastes (management, handling and Transboundary Movement) Rules 2016.

**UNIT IV OTHER ACTS AND RULES 9**

Indian Boiler (Amendments) Act 2007, static and mobile pressure vessel rules (SMPV), motor vehicle rules, The Mines and Minerals (Development & Regulation) Amendment Act, 2015, workman compensation act, rules – electricity act and rules – hazardous wastes (management, handling and transboundary) rules, 2008 - the building and other construction workers act 1996., Petroleum rules, Gas cylinder rules 2016, Explosives Act 1884 - Pesticides Act – E waste (management) rules 2016.

**UNIT V INTERNATIONAL ACTS AND STANDARDS 9**

Occupational Safety and Health act of USA (The Williames - Steiger Act of 1970) – Health and safety work act (HASAWA 1974, UK) – ISO 14001 – ISO 45001 , European Safety and Health Legislations, American Petroleum Institute (API) Standards, Oil Industry Safety Directorate (OISD) Standards, National Fire Protection Association (NFPA) Standards, Atomic Energy Regulatory Board (AERB), American National Standards Institute(ANSI).

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students will be able

- To list out important legislations related to health, Safety and Environment.
- To list out requirements mentioned in factories act for the prevention of accidents.
- To understand the health and welfare provisions given in factories act.
- To understand the statutory requirements for an Industry on registration, license and its renewal.
- To 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.
8. Srinivasan S , “The Tamil Nadu Safety Officers Rules 2005” Madras Book Agency, Chennai, 28th Edition, 2017

## CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	3		2		-	-
2	-		3		-	-
3	-		-		-	-
4	-		-		-	-
5	-		-		-	-
<b>AVg.</b>	3/1=3	-	(3+2)/2=2.5	-	-	-

1- low, 2-medium, 3-high, ‘-‘- no correlation

RM4151

RESEARCH METHODOLOGY AND IPR

L T P C  
2 0 0 2

### UNIT I RESEARCH DESIGN

6

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

### UNIT II DATA COLLECTION AND SOURCES

6

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

### UNIT III DATA ANALYSIS AND REPORTING

6

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

### UNIT IV INTELLECTUAL PROPERTY RIGHTS

6

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

### UNIT V PATENTS

6

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

**TOTAL : 30 PERIODS**

### REFERENCES

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



**OBJECTIVES:**

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

**DESCRIPTION OF THE COURSE**

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

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

- Safety Management systems.
- Fire and Explosion prevention, protection and emergency management.
- Work injury prevention.
- Health hazards control.
- Evaluating emergency plan.
- First aid practices
- Management of health and safety
- Accidents and accident reporting
- Asbestos
- Contractors
- Display screen equipment
- Electrical safety
- Emergency lighting
- Environmental protection
- Fire prevention and emergencies
- Hazardous substances
- Housekeeping and cleanliness
- Information and communication
- Kitchens, catering and food safety
- Lifts and lifting equipment
- Manual handling operations
- Noise
- Occupational health
- Personal protective equipment
- Plant rooms, machinery and equipment
- Risk assessment requirements
- Safety Policy
- Safety signs and notices

- Training
- Use of vehicles / vehicle safety
- Water services
- Welfare provision
- Working time
- Work at heights
- Workplace environment
- Accident prevention
- Identifying and correcting Regulatory Deficiencies
- Improvement of Employee Morale
- Identification and Elimination of Safety Hazards

**TOTAL: 30 PERIODS**

### OUTCOMES

The students will be able to

1. To Minimize the Labor turnover by existence of Safety Measures of an Employee.
2. To Promote the Fatigue Study it will lead to good production.
3. To Implement the Human Resource Management Practices.
4. To impart the Health Consciousness to the Working Community.

### CO-PO MAPPING:

CO	PO					
	1	2	3	4	5	6
1	-	3	-	-	-	-
2	-	2	2	-	-	-
3	-	-	-	3	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
<b>AVg.</b>	-	5/2=2.5	2/1=2	3/1=3	-	-

1 - low, 2-medium, 3-high, ‘-‘- no correlation

IS4201

**FIRE ENGINEERING AND EXPLOSION CONTROL**

**L T P C**

**3 0 0 3**

### OBJECTIVES:

- To provide an in depth knowledge about the science of fire.
- To understand the causes and effects of fire.
- To know the various fire prevention systems and protective equipments.
- To understand the science of explosion and its prevention techniques.
- To understand the various fire prevention techniques to be followed in a building.

### UNIT I PHYSICS AND CHEMISTRY OF FIRE

**9**

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

**UNIT II FIRE PREVENTION AND PROTECTION 9**

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

**UNIT III INDUSTRIAL FIRE PROTECTION SYSTEMS 9**

Sprinkler-hydrants-stand pipes – special fire suppression systems like deluge and emulsifier, selection criteria of the above installations, reliability, maintenance, evaluation and standards – alarm and detection systems. Other suppression systems – CO<sub>2</sub> system, foam system, dry chemical powder (DCP) system, halon system – need for halon replacement – smoke venting. Portable extinguishers – flammable liquids – tank farms – indices of inflammability-fire fighting systems.

**UNIT IV BUILDING FIRE SAFETY 9**

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

**UNIT V EXPLOSION PROTECTING SYSTEMS 9**

Principles of explosion-detonation and blast waves-explosion parameters – Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure-explosion venting-inert gases, plant for generation of inert gas-rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO<sub>2</sub>) and halons-hazards in LPG, ammonia (NH<sub>3</sub>), sulphur dioxide (SO<sub>3</sub>), chlorine (CL<sub>2</sub>) etc.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- To make familiar about basic concepts of fire and explosion science.
- To know the different source of ignition and their prevention techniques.
- To understand the operation of various types of firefighting equipments.
- To understand the causes and prevention of explosion.
- To equip the students to effectively employ explosion protection techniques and their significances to suit the industrial requirement.

**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", an Nostrand Rein Hold, 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 MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	3	-	-	-	-
2	-	-	3	-	-	-
3	-	-	-	2	-	-
4	-	-	-	-	3	-
5	-	-	-	-	-	2
<b>AVG.</b>	-	3/1=3	3/1=3	2/1=2	3/1=3	2/1=2

1 - low, 2-medium, 3-high, ‘-‘ - no correlation

IS4202

SYSTEM SIMULATION AND HAZARD ANALYSIS

L T P C

4 0 0 4

### OBJECTIVES:

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

### UNIT I HAZARD, RISK ISSUES AND HAZARD ASSESSMENT

12

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

### UNIT II COMPUTER AIDED INSTRUMENTS

12

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

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

### UNIT III RISK ANALYSIS QUANTIFICATION AND SOFTWARES

12

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

**UNIT IV CONSEQUENCES ANALYSIS****12**

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

**UNIT V CREDIBILITY OF RISK ASSESSMENT TECHNIQUES****12**

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

**TOTAL: 60 PERIODS****OUTCOMES:**

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

**REFERENCES**

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

**CO-PO MAPPING**

CO	PO					
	1	2	3	4	5	6
1	-	3	-	-	-	2
2	-	-	-	-	-	3
3	-	-	-	2	-	-
4	-	-	-	-	3	-
5	-	-	2	-	-	-
AVg.	-	3/1=3	2/1=2	2/1=2	3/1=3	(2+3)/2=2.5

1 - low, 2-medium, 3-high, '-'- no correlation

**OBJECTIVES:**

- To provide knowledge on basics of electrical fire and statutory requirements for electrical safety
- To understand the causes of accidents due to electrical hazards
- To know the various protection systems in Industries from electrical hazards
- To know the importance of earthing
- 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 equipments-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 equipments.

**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:**

- This course would make familiar of basic concepts in electrical circuit and hazards involved in it.
- Course would be helpful to understand the electrical hazards in Industries.
- Students would be able to understand the operation of various protection systems from electrical hazards
- 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.
5. Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1986.

## CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	3	-	-		2
2	-	-	2	-	-	-
3	-	-	-	2	-	3
4	-	-	-	-	3	-
5	-	-	-	-	-	-
AVg.	-	3/1=3	2/1=2	2/1=2	3/1=3	(2+3)/2=2.5

1 - low, 2-medium, 3-high, ‘-’ - no correlation

IS4204

SAFETY IN PROCESS INDUSTRIES

L T P C  
3 0 0 3

### OBJECTIVES:

- To provide knowledge on design features for a process industry and safety in the operation of various equipment in industry.
- To understand the various hazards and prevention in commissioning stage of industry.
- To recognise and identify the safe operation of equipment in process industry.
- To plan and trained for emergency planning in a process industry.
- 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 equipments, 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 STORAGEES****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:**

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

**REFERENCES**

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

**CO-PO MAPPING:**

CO	PO					
	1	2	3	4	5	6
1	-	-	-	-	3	-
2	-	-	2	-	-	-
3	-	-	-	2	-	-
4	-	3	-	-	1	-
5	-	-	-	-	-	2
<b>AVg.</b>	-	3/1=3	2/1=2	2/1=2	3/1=3	2/1=2

1 - low, 2-medium, 3-high, '-'- no correlation



**OBJECTIVES:**

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

**FIRST AID CONCEPTS**

Study of Emergency Kits ,First – aid, road safety signs and signals -Safety Software Demo

**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 Co<sub>2</sub>

Foam

Carbon dioxide (Co<sub>2</sub>)

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  
SOFTWARE USAGE - Accident Analysis, Safety Audit Packages, Consequence Analysis (CISCON), Fire, Explosion and Toxicity Index (FETI), Reliability Analysis for Mechanical system and Electrical System, Failure Mode Analysis

### Experiments on simulation to be added

#### Discrete and continuous

#### 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
12. Extend SIM
13. System : 12 No.

**TOTAL: 30 PERIODS**

### OUTCOMES:

- This course would make students to know and run the various equipments to bring out the safety environment in the industry.
- Course would be helpful for the students to measure the particulate matter and assess the impact of air pollution.
- Students would be trained to conduct experiments to find out various environmental parameters. Students would be able to use personal protective equipment in-dependently.
- Students can recognise the various problems with the use of software and hence to predict the real situations on major accidents.

### CO-PO MAPPING:

CO	PO					
	1	2	3	4	5	6
1	-	2	-	-	-	-
2	-	-	3	-	-	-
3	-	-	-	3	-	-
4	-	-	-	-	3	-
5	-	-	-	-	-	2
AVg.	-	2/1=2	3/1=3	3/1=3	3/1=3	2/1=2

1 - low, 2-medium, 3-high, '-'- no correlation

**OBJECTIVES:**

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

**OUTCOME:**

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, quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.

**TOTAL: 30 PERIODS****CO-PO MAPPING:**

CO	PO					
	1	2	3	4	5	6
1	3	-	3		2	-
2	-	-	-	-	-	3
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
AVg.	3/1=3	-	-	3/1=3	2/1=2	3/1=3

1 - low, 2-medium, 3-high, '-' - no correlation

**OBJECTIVES:**

- Impart knowledge in reliability concepts.
- Facilitate students in filling the life data into theoretical distribution.
- Educate the students in reliability evaluation of various configuration.
- Impart knowledge in reliability monitoring methods.
- Analyze effectively various techniques to improve reliability of the system.

**UNIT I RELIABILITY CONCEPTS****9**

Reliability definition – Quality and Reliability– Reliability mathematics – Reliability functions – Hazard rate – Measures of Reliability – Design life –A priori and posteriori probabilities – Mortality of a component –Mortality curve – Useful life.

**UNIT II LIFE DATA ANALYSIS****9**

Data collection –Non Parametric methods: Ungrouped/Grouped, Complete/Censored data – Time to failure distributions: Exponential, Weibull – Probability plotting – Goodness of fit tests.

**UNIT III RELIABILITY ASSESSMENT****9**

Different configurations – Redundancy – k out of n system – Complex systems: RBD – Baye's approach – Cut and tie sets – Fault Trees – Standby systems.

**UNIT IV RELIABILITY MONITORING****9**

Life testing methods: Failure terminated – Time terminated – Sequential Testing –Reliability growth monitoring – Reliability allocation – Software reliability-Human reliability.

**UNIT V RELIABILITY IMPROVEMENT****9**

Analysis of downtime – Repair time distribution – System repair time – Maintainability prediction – Measures of maintainability – Inspection decisions –System Availability.

**TOTAL: 45 PERIODS****OUTCOMES:**

**CO1** : Understand the basic concepts of reliability engineering

**CO2** : Effectively analyze various non parametric methods and failure distributions

**CO3** : Conduct reliability assessment and failure analysis on any complex systems

**CO4** : Effectively design and analyze reliability monitoring techniques

**CO5** : Analyze various techniques to improve reliability of the system

	PO1	PO2	PO3	PO4	PO5	PO6
<b>CO1</b>		3				
<b>CO2</b>				3		
<b>CO3</b>	3					
<b>CO4</b>						
<b>CO5</b>						2
<b>AVg.</b>	3/1=3	3/1=3		3/1=3	-	2/1=2

**REFERENCES:**

1. Charles E. Ebeling, "An introduction to Reliability and Maintainability engineering", TMH, 2000.
2. Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2007.

**IS4312****INDUSTRIAL SAFETY ASSESSMENT – INTERNSHIP**

**L T P C**  
**0 0 4 2**

**OBJECTIVES:**

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

**GUIDELINES:**

- The students are expected to undergo meaningful, practical and hands-on-work experiences related to safety measures through industrial training.
- 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.
- Minimum duration of internships period is 3-4 weeks.
- 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.

- Internship should be evaluated through final presentation with viva-voce exam.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

The students will be able to

1. Select and analysis the effective industry safety methods for the given field applications.

**CO-PO MAPPING**

CO	PO					
	1	2	3	4	5	6
1	-	2	3	-	3	2
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
<b>AVg.</b>	-	2/1=2	3/1=3	-	3/1=3	2/1=2

1 - low, 2-medium, 3-high, ‘-‘- no correlation

IL4076

**PLANT LAYOUT AND MATERIAL HANDLING**

**L T P C  
3 0 0 3**

**COURSE OBJECTIVES:**

- To provide provided with the knowledge of the process of analyzing and developing information to produce a plant layout based on the locations and working conditions.
- To educate the students about the basic things of work conditions which includes ventilation, comfort, lighting and its effect based on various nature of work.
- To provide knowledge on effective and safe layout design of an industry.

**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

### **UNIT 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:**

CO 1: The students will be able to Identify equipment requirements for a specific process and for various locations and working conditions.

CO 2: The students will be able to Design an efficient material handling system.

CO 3: Understand the difficulties during the design and implementation of the plant layout.

CO 4: Know about material handling requirements and methods

CO 5: Understand the inspection and maintenance techniques.

### **REFERENCES:**

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

## CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	-	-	-	-
CO2	-	-	-	-	-	-
CO3	2	-	-	2	-	-
CO4	-	-	-	-	2	-
CO5	-	-	-	-	2	-
Avg.	$(2+2)/2=2$	-	-	$2/1=2$	$(2+2)/2=2$	-

1 - low, 2-medium, 3-high, ‘-‘- no correlation

**IS4001**

**WORK STUDY AND ERGONOMICS**

**L T P C**  
**3 0 0 3**

### OBJECTIVES:

- To study the applications of ergonomic principles and physiology of workers
- To know the concepts of personal protective equipment and its usages
- To create the knowledge in process and equipment design in safety aspects

### 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:**

The students will be able

1. To know in work procedure and applications in hazardous
2. Incorporate human factors in design of Personal protective equipment
3. Know the risk factors, guide lines for safe design of man machine systems considering human factors

**REFERENCES**

1. "Accident Prevention Manual for Industrial Operations", NSC Chicago, 1982.
2. "Work Study", National Productivity Council, New Delhi, 1995.
3. E.J.Mc Cormick and M.S.Sanders "Human Factors in Engineering and Design", TMH, New Delhi, 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, 6<sup>th</sup> Edition, Allied Publishers, Madras, 1989.
7. W.Benjamin Neibal Motion and Time Study, 9<sup>th</sup> Edition 1993.

**CO-PO MAPPING**

CO	PO					
	1	2	3	4	5	6
1	-	2	-	-	-	2
2	2	-	-	-	-	-
3	-	-	-	3	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
<b>AVg.</b>	2/1=2	2/1=2	-	3/1=3	-	2/1=2

1 - low, 2-medium, 3-high, '-'- no correlation

IL4074

HUMAN FACTORS IN ENGINEERING

L T P C  
3 0 0 3

**OBJECTIVES:**

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

**UNIT I ERGONOMICS AND ANATOMY**

9

Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, future directions for ergonomics

Anatomy, Posture and Body Mechanics: Some basic body mechanics, anatomy of the spine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioural aspects of posture, effectiveness and cost effectiveness, research directions



**UNIT II HUMAN BEHAVIOR****9**

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

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

Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness

Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design for standing workers, design for seated workers, work surface design, visual display units, guidelines for design of static work, effectiveness and cost effectiveness, research directions

**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:**

- Students can have the knowledge in work procedure and applications in hazardous workplaces.
- Students can design their own safety devices and equipment to reduce the accidents possibilities.
- Students will be able to incorporate human factors in design of Personal protective equipment.
- They know the risk factors, guide lines for safe design of man machine systems considering human factors.

**REFERENCES**

1. Ergonomic design for organizational effectiveness, Michael O'Neill 1<sup>st</sup> Edition 1998.
2. Human factors in engineering and design, MARK S.SANDERS 1992.
3. Introduction to Ergonomics, R.S. Bridger, Taylor and Francis 3<sup>rd</sup> Edition 2008.
4. The Ergonomics manual, Dan Mc Leod, Philip Jacobs and Nancy Larson

## CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	-	-	3	-	-
2	-	-	3	-	-	-
3	2	-	-	-	-	2
4	-	-	-	-	3	-
5	-	-	-	-	-	-
AVg.	2/1=2	-	3/1=3	3/1=3	3/1=3	2/1=2

1- low, 2-medium, 3-high, ‘-‘- no correlation

IS4002

MAINTAINABILITY ENGINEERING

L T P C  
3 0 0 3

### OBJECTIVES:

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

### UNIT I MAINTENANCE CONCEPT 6

Maintenance definition – Need for maintenance – Maintenance objectives and challenges – Tero technology – Maintenance costs - Scope of maintenance department.

### UNIT II MAINTENANCE MODELS 12

Proactive/Reactive maintenance – Imperfect maintenance – Maintenance policies – PM versus b/d maintenance – PM schedule and product characteristics – Inspection models-Optimizing profit/downtime – Replacement decisions.

### UNIT III MAINTENANCE LOGISTICS 11

Human factors – Maintenance staffing: Learning curves – Simulation – Maintenance resource requirements: Optimal size of service facility – Optimal repair effort – Maintenance planning and scheduling – Spare parts planning.

### UNIT IV MAINTENANCE QUALITY 8

Maintenance excellence – Five Zero concept –FMECA –Root cause analysis – System effectiveness – Design for maintainability – Reliability Centered Maintenance.

### UNIT V TOTAL PRODUCTIVE MAINTENANCE 8

TPM features – Chronic and sporadic losses – Equipment defects – Six major losses – Overall Equipment Effectiveness – TPM pillars – Autonomous maintenance – TPM implementation

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students will be able to

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

**REFERENCES**

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

**CO-PO MAPPING**

CO	PO					
	1	2	3	4	5	6
1	-	-	-	-	3	-
2	-	-	3	-	-	-
3	-	2	-	-	-	2
4	-	-	-	2	-	-
5	-	-	-	-	-	-
AVg.	-	2/1=2	3/1=3	2/1=2	3/1=3	2/1=2

1- low, 2-medium, 3-high, '-'- no correlation

IS4003

OPTIMIZATION TECHNIQUES

L T P C  
3 0 0 3

**COURSE OBJECTIVES:**

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

**UNIT I INTRODUCTION**

5

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

**UNIT II DECISION ANALYSIS**

10

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

**UNIT III NON-LINEAR OPTIMIZATION**

15

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

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

10

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

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

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

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

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

**REFERENCES**

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

**IS4004****TRANSPORT SAFETY****L T P C  
3 0 0 3****OBJECTIVES:**

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

**UNIT I TRANSPORTATION OF HAZARDOUS GOODS****9**

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

**UNIT II ROAD TRANSPORT****8**

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

**UNIT III DRIVER AND SAFETY****9**

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

**UNIT IV ROAD SAFETY****10**

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

Plant railway: Clearance-track-warning methods-loading and unloading-moving cars-safety practices.

**UNIT V SHOP FLOOR AND REPAIR SHOP SAFETY****9**

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

**TOTAL: 45 PERIODS****OUTCOMES:**

The students will be able to

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

**REFERENCES:**

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

**CO-PO MAPPING**

CO	PO					
	1	2	3	4	5	6
1	-	-	-	3	-	-
2	-	-	3	-	2	-
3	2	-	-	-	-	3
4	-	-	-	-	-	-
5	-	-	-	-	-	-
<b>AVg.</b>	2/1=2	-	3/1=3	3/1=3	2/1=2	3/1=3

1- low, 2-medium, 3-high, '-'- no correlation

**IS4005****FIREWORKS SAFETY****L T P C  
3 0 0 3****OBJECTIVES:**

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

<b>UNIT I</b>	<b>PROPERTIES OF FIREWORKS CHEMICALS</b>	<b>9</b>
Fire properties – potassium nitrate (KNO <sub>3</sub> ), potassium chlorate (KClO <sub>3</sub> ), barium nitrate (BaNO <sub>3</sub> ), calcium nitrate (CaNO <sub>3</sub> ), Sulphur (S), Phosphorous (P), antimony (Sb), Pyro Aluminum (Al) powder- Reactions-metal powders, Borax, ammonia (NH <sub>3</sub> ) – Strontium Nitrate, Sodium Nitrate, Potassium per chloride. Fire and explosion, impact and friction sensitivity.		
<b>UNIT II</b>	<b>STATIC CHARGE AND DUST</b>	<b>9</b>
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-biologicalbarriers-hazards-personal protective equipment-pollution prevention.		
<b>UNIT III</b>	<b>PROCESS SAFETY</b>	<b>8</b>
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.		
<b>UNIT IV</b>	<b>MATERIAL HANDLING AND TRANSPORTATION:</b>	<b>10</b>
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.		
<b>UNIT V</b>	<b>WASTE CONTROL AND USER SAFETY</b>	<b>9</b>
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 the course the students will be able

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

#### **REFERENCES:**

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

## CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	-	3	-	-	-	-
2	-	-	-	3	-	2
3	-	-	2	-	-	-
4	-	-	-	3	2	-
5	-	-	2	-	-	3
<b>AVg.</b>	-	3/1=3	(2+2)/2=2	(3+3)/2=3	2/1=2	(3+2)/2=2.5

1- low, 2-medium, 3-high, ‘-‘- no correlation

IS4006

SAFETY IN CONSTRUCTION

L T P C

3 0 0 3

### OBJECTIVES:

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

### UNIT I ACCIDENTS CAUSES AND MANAGEMENT SYSTEMS 9

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

### UNIT II HAZARDS OF CONSTRUCTION AND PREVENTION 9

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

### UNIT III WORKING AT HEIGHTS 9

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

### UNIT IV CONSTRUCTION MACHINERY 9

Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist - builder's hoist, winches, chain pulley blocks – use of conveyors - concrete mixers, concrete vibrators – safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps, welding machines, use of portable electrical tools, drills, grinding tools, manual handling scaffolding, hoisting cranes – use of conveyors and mobile cranes – manual handling.

**UNIT V SAFETY IN DEMOLITION WORK****9**

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

**TOTAL: 45 PERIODS****OUTCOMES:**

Upon completion of the course the students will be able

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

**REFERENCES**

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

**CO-PO MAPPING**

CO	PO					
	1	2	3	4	5	6
1	2	-	-	-	-	-
2	-	-	-	3	-	2
3	-	3	-	-	-	-
4	-	-	-	2	2	-
5	-	-	2	-	-	-
<b>AVg.</b>	2/1=2	3/1=3	2/1=2	(3+2)/2=2.5	2/1=2	2/1=2

1- low, 2-medium, 3-high, '-'- no correlation

**IS4007****NUCLEAR ENGINEERING AND SAFETY****L T P C  
3 0 0 3****OBJECTIVES:**

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

**UNIT I INTRODUCTION****9**

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



**UNIT II REACTOR CONTROL 9**

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

**UNIT III REACTOR TYPES 9**

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

**UNIT IV SAFETY OF NUCLEAR REACTORS 9**

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

**UNIT V RADIATION CONTROL 9**

Radiation shielding – radiation dose – dose measurements – units of exposure – exposure limits – barriers for control of radioactivity release – control of radiation exposure to plant personnel – health physics surveillance – waste management and disposal practices – environmental releases.

**TOTAL: 45 PERIODS****OUTCOMES:**

The students will be able to

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

**REFERENCES**

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

**CO-PO MAPPING**

CO	PO					
	1	2	3	4	5	6
1	-	-	-	2	-	-
2	-	-	-	-	2	-
3	-	-	-	-	-	3
4	-	-	-	-	-	-
5	-	-	-	-	-	-
AVg.	-	-	-	2/1=2	2/1=2	3/1=3

1- low, 2-medium, 3-high, '-'- no correlation

**OBJECTIVES:**

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

**UNIT I INTRODUCTION 9**

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

**UNIT II TEXTILE HAZARDS I 9**

Accident hazards i) sizing processes- cooking vessels, transports of size, hazards due to steam ii) Loom shed – shuttle looms and 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:**

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

**REFERENCES:**

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

**CO-PO MAPPING**

CO	PO					
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3	-	-	2	-	-	-
4	-	-	-	2	-	-
5	-	-	-	-	2	-
AVg.	-	-	2/1=2	(3+2)/2=2.5	(2+2)/2=2	2/1=2

1- low, 2-medium, 3-high, ‘-‘- no correlation

IS4009

SAFETY IN MINES

L T P C  
3 0 0 3

**OBJECTIVES:**

- To provide in depth knowledge on Safety of mine s of various types.
- To study, know and understand about the types of mines and various risk involved in the mining operations.
- To get exposed to various types of accidents happened in mines and how to manage during accidents.
- To analyse the nature of mining activities and developing a safety system to reduce the risk and also to implement the Emergency preparedness in the working environment of mines and to plan for 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:**

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

**REFERENCES:**

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

**CO-PO MAPPING**

CO	PO					
	1	2	3	4	5	6
1	-	3	-	-	-	-
2	-	-	-	-	-	-
3	-	2	-	-	2	-
4	-	-	-	-	-	3
5	-	-	-	-	-	-
<b>AVg.</b>	-	$(3+2)/2=2.5$	$3/1=3$	-	$2/1=2$	$3/1=3$

1- low, 2-medium, 3-high, '-'- no correlation

**IS4010****DOCK SAFETY****L T P C****3 0 0 3****OBJECTIVES:**

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

<b>UNIT I</b>	<b>HISTORY OF SAFETY LEGISLATION</b>	<b>9</b>
<p>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.</p> <p>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.</p>		
<b>UNIT II</b>	<b>WORKING ON BOARD THE SHIP</b>	<b>9</b>
<p>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 combustible engines like forklift trucks-pay loaders etc. Working with electricity and electrical management – Storage – types, hazardous cargo.</p>		
<b>UNIT III</b>	<b>LIFTING APPLIANCES</b>	<b>9</b>
<p>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 – toplift trucks – derricks in different rigging etc.</p> <p>Use and care of synthetic and natural fiber ropes – wire rope chains, different types of slings and loose gears.</p>		
<b>UNIT IV</b>	<b>TRANSPORT EQUIPMENT</b>	<b>9</b>
<p>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.</p> <p>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</p> <p>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.</p>		
<b>UNIT V</b>	<b>EMERGENCY ACTION PLAN AND DOCK WORKERS (SHW) REGULATIONS 1990</b>	<b>9</b>
<p>Emergency action Plans for fire and explosions - collapse of lifting appliances and buildings, sheds etc., - gas leakages and precautions concerning spillage of dangerous goods etc., - Preparation of on-site emergency plan and safety report.</p> <p>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.</p>		

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**REFERENCES**

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

**CO-PO MAPPING**

CO	PO					
	1	2	3	4	5	6
1	-	-	-	-	3	-
2	-	3	-	3	-	-
3	-	-	-	-	-	-
4	-	-	-	-	2	-
5	-	-	2	-	-	2
AVg.	-	3/1=3	2/1=2	3/1=3	(3+2)/2=2.5	2/1=2

1- low, 2-medium, 3-high, '-'- no correlation

IS4011

SAFETY IN ENGINEERING INDUSTRY

L T P C  
3 0 0 3**OBJECTIVES:**

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

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

General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines,

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-forge hammer-flywheels-shafts-couplings-gears-sprockets wheels and chains-pulleys and belts-authorized entry to hazardous installations-benefits of good guarding systems.

**UNIT III SAFETY IN WELDING AND GAS CUTTING 9**

Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.

**UNIT IV SAFETY IN COLD FORMING AND HOT WORKING OF METALS 9**

Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes.

Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures.

Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, 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:**

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

**REFERENCES**

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

**CO-PO MAPPING:**

CO	PO					
	1	2	3	4	5	6
1	-	3	-		3	-
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3	-	3	-		-	-
4	-	-	-	-	2	-
5	-	-	-	-	-	3
<b>AVg.</b>	-	$(3+3)/2=3$	-	$3/1=3$	$(3+2)/2=2.5$	$(3+3)/2=3$

1- low, 2-medium, 3-high, '-'- no correlation

IS4012

QUALITY ENGINEERING IN PRODUCTION SYSTEMS

L T P C  
3 0 0 3

**OBJECTIVES:**

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

**UNIT I INTRODUCTION TO QUALITY ENGINEERING AND LOSS FUNCTION 9**

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

**UNIT II ON-LINE QUALITY CONTROL 9**

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



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

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

**UNIT IV QUALITY ENGINEERING AND TPM 9**

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

**UNIT V SIX SIGMA AND ITS IMPLEMENTATION 9**

Introduction- definition-methodology- impact of implementation of six sigma-DMAIC method-roles and responsibilities –leaders, champion, black belt, green belts. Do’s and dont’s - readiness of organization – planning-management role- six sigma tools – sustaining six sigma.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**REFERENCES:**

1. Brue G, “Six Sigma for Managers”, Tata-McGraw Hill, New Delhi, Second reprint, 2002.
2. De Feo J A and Barnard W W, “Six Sigma: Breakthrough and Beyond”, Tata McGraw-Hill, 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

**CO-PO MAPPING**

CO	PO					
	1	2	3	4	5	6
1	3	-	2	-	-	-
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3	-	3	-	-	-	-
4	-	2	-	-	-	-
5	-	-	-	2	-	-
<b>AVg.</b>	$(3+2)/2=2.5$	$(3+2)/2=2.5$	$(2+3)/2=2.5$	$3/1=3$	$3/1=3$	-

1- low, 2-medium, 3-high, ‘-‘- no correlation

**OBJECTIVES:**

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

**UNIT I OH & S MANAGEMENT SYSTEM STANDARD 9**

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

**UNIT II PLANNING 9**

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

**UNIT III PERFORMANCE EVALUATION 9**

Monitoring , measurement , analysis and performance evaluation -evaluation of compliance- Internal audit-management review- Improvement- Incident, nonconformity and corrective action – continual improvement- guidance of the use of the document ISO 45001 - benefits of certification- certification procedure.

**UNIT IV ISO 14001& ISO 19011 9**

EMS, ISO 14001, specifications, objectives, Environmental Policy, Guidelines and Principles (ISO 14004), clauses 4.1 to 4.5. Documentation requirements, 3 levels of documentation for a ISO 14000 based EMS, steps in ISO 14001.

Implementation plan, Registration, Importance of ISO 14000 to the Management. Auditing ISO14000- General principles of Environmental Audit, Auditor, steps in audit, Audit plan.

ISO 19011- Guidelines for auditing management Systems-General principles, managing audit programme- audit activities, steps in audit, audit plan-competence of auditors.

**UNIT V ENVIRONMENT IMPACT ASSESSMENT 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:**

- The student would be able to remember the various standards which is meant mainly for maintaining the Health of the employee and for the maintenance of the Environment.
- The student could be able to understand the basic difference between the ISO 9000 series and ISO 45001 and ISO 14000 standards and the various clauses which governs the system in maintaining the standard.
- The course could provide the sufficient knowledge on various clauses and subsequent preparation of procedures and related documents and could be able to apply their knowledge in preparing the ISO manual for getting the certification from the external certifying agencies.
- Course could help the students in acquiring the knowledge on various standards and provide the skill in analysing the various clauses and its suitability and applicability on the nature of organization.

**REFERENCES:**

1. ISO 45001: 2018 –Occupational Health and safety management systems Requirements with guidance for use
2. ISO14001:2004, Environmental Management Systems Requirements with Guidance for Use” ,ISO,2004.
3. “Guidelines on Occupational Health and Safety Management Systems (OSH-MS)” International Labour Organization, 2001.
4. “BS 8800: 2004 Occupational Health and Safety Management Systems-Guide” BSI, UK, 2004.
5. “ISO 19011:2011 Guidelines for Auditing Management Systems”, ISO, 2011.
6. “ISO 14040:2006 Environmental Management- Life Cycle Assessment - Principles and Framework” ISO,2006.
7. “ISO 14025:2006 Environmental Labels and Declarations -Type III Environmental Declarations - Principles andProcedures”, ISO,2006.
8. “ISO 14021:1999 Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II environmental labelling)”, ISO, 1999.
9. “ISO 14020:2000 Environmental Labels and Declarations-General Principles”, ISO, 2000.

**CO-PO MAPPING**

CO	PO					
	1	2	3	4	5	6
1	-	3	2	-	-	2
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3	-	3	-	3	-	-
4	-	-	-	-	2	-
5	-	-	-	-	-	-
<b>AVg.</b>	-	(3+3)/2=3	(2+3)/2=2.5	3/1=3	2/1=2	2/1=2

1- low, 2-medium, 3-high, ‘-‘- no correlation

**OBJECTIVES:**

- To know the fundamental concepts and applications of Artificial intelligence.
- To familiarize with AI languages like PROLOG and LISP.
- To understand the various features of expert system
- 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:**

- To apply various aspects of intelligence to diverse industrial situations
- To list out the applications of expert system To develop a simple expert system related to industrial safety Engineering.
- To apply 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", 2<sup>nd</sup> 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 Edition, Singapore, 1992.
7. Winston, P.H., "Artificial Intelligence", Addison Wesley, 1990.

## CO-PO MAPPING

CO	PO					
	1	2	3	4	5	6
1	3	-	2	-	-	-
2	3	3	3	-	-	-
3	-	2	-	-	-	3
4	-	-	-	-	-	-
5	-	-	-	-	-	-
<b>AVg.</b>	$(3+3)/2=3$	$(3+2)/2=2.5$	$(2+3)/2=2.5$	-	-	$3/1=3$

1- low, 2-medium, 3-high, ‘-‘- no correlation

IL4072

DESIGN OF EXPERIMENTS

L T P C  
3 0 0 3

### OBJECTIVES:

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

**UNIT I EXPERIMENTAL DESIGN FUNDAMENTALS 9**  
Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression models.

**UNIT II SINGLE FACTOR EXPERIMENTS 9**  
Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests.

**UNIT III MULTIFACTOR EXPERIMENTS 9**  
Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F- tests.  $2^k$  factorial Experiments.

**UNIT IV SPECIAL EXPERIMENTAL DESIGNS: 9**  
Blocking and confounding in  $2^k$  designs. Two level Fractional factorial design, nested designs, Split plot design, Introduction to Response Surface Methods.

**UNIT V TAGUCHI METHODS 9**  
Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, Multi-level experiments, Multi-response optimization, Introduction to Shainin DOE.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

CO1: Understand the fundamental principles of Design of Experiments.

CO2: Analyze data in the single factor experiments.

CO3: Analyze data in the multifactor experiments.

CO4: Understand the special experimental designs & Response Surface Methods.

CO5: Apply Taguchi based approach to evaluate quality.

**REFERENCES:**

1. Krishnaiah, K. and Shahabudeen, P. Applied Design of Experiments and Taguchi Methods, PHI learning private Ltd., 2012.
2. Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons, Eighth edition, 2012.
3. NicoloBelavendram, Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.
4. Phillip J.Rose, Taguchi techniques for quality engineering, McGraw Hill, 1996.
5. Montgomery, D.C., Design and Analysis of Experiment, Minitab Manual, John Wiley and Sons, Seventh edition, 2010.

**CO-PO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	-	-	-	-
CO2	-	-	1	1	-	-
CO3	-	-	1	1	-	-
CO4	-	-	1	1	1	-
CO5	2	1	1	-	-	-
Avg.	$(1+2)/2=1.5$	$(1+1)/2=1$	$(1+1+1+1)/4=1$	$(1+1+1)/3=1$	$1/1=1$	-

1- low, 2-medium, 3-high, '-'- no correlation

IS4071

DATA ANALYTICS

L T P C  
3 0 0 3

**COURSE OBJECTIVES:**

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

**UNIT I****INTRODUCTION**

9

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

**UNIT II****MULTIPLE REGRESSION**

9

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

**UNIT III LOGISTIC REGRESSION 9**  
 Regression with binary dependent variable -Simple Discriminant Analysis Multiple Discriminant analysis-Assessing classification accuracy- Conjoint analysis (Full profile method).

**UNIT IV PRINCIPAL COMPONENT ANALYSIS 9**  
 Principal Component Analysis -Factor Analysis- Orthogonal and Oblique Rotation-Factor Score Estimation-Multidimensional Scaling-Perceptual Map-Cluster Analysis (Hierarchical Vs Nonhierarchical Clustering).

**UNIT V LATENT VARIABLE MODELS 9**  
 Latent Variable Models an Introduction to Factor, Path, and Structural Equation Analysis- Time series data analysis (ARIMA model) – Decision tree analysis (CHAID, CART) - Introduction to Big Data Management.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

On completion of the course, the student will be able to:

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

**REFERENCES:**

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

CO	PO					
	1	2	3	4	5	6
1	1	1	1	1	1	1
2	1	1	1	1	1	1
3	1	1	1	1	1	1
<b>AVG</b>	1	1	1	1	1	1

**1-low, 2-medium, 3-high, '-'- no correlation**

## AUDIT COURSES

**AX4091**

**ENGLISH FOR RESEARCH PAPER WRITING**

**L T P C**  
**2 0 0 0**

### **OBJECTIVES**

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

### **UNIT I INTRODUCTION TO RESEARCH PAPER WRITING**

**6**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

### **UNIT II PRESENTATION SKILLS**

**6**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

### **UNIT III TITLE WRITING SKILLS**

**6**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

### **UNIT IV RESULT WRITING SKILLS**

**6**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

### **UNIT V VERIFICATION SKILLS**

**6**

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

**TOTAL: 30 PERIODS**

### **COURSE OUTCOMES**

CO1 – Understand that how to improve your writing skills and level of readability

CO2 – Learn about what to write in each section

CO3 – Understand the skills needed when writing a Title

CO4 – Understand the skills needed when writing the Conclusion

CO5 – Ensure the good quality of paper at very first-time submission

### **REFERENCES**

1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.



**OBJECTIVES**

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

**UNIT I INTRODUCTION 6**

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

**UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6**

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

**UNIT III DISASTER PRONE AREAS IN INDIA 6**

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

**UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6**

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

**UNIT V RISK ASSESSMENT 6**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

**TOTAL : 30 PERIODS****COURSE OUTCOMES**

CO1: Ability to summarize basics of disaster

CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5: Ability to develop the strengths and weaknesses of disaster management approaches

## REFERENCES:

1. Goel S. L., Disaster Administration And Management Text And Case Studies”, Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
2. Nishitha Rai, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “New Royal book Company, 2007.
3. Sahni, Pardeep Et. Al. ,” Disaster Mitigation Experiences And Reflections”, Prentice Hall of India, New Delhi, 2001.

**AX4093**

**CONSTITUTION OF INDIA**

**L T P C**  
**2 0 0 0**

## OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

## UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

## UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

## UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

## UNIT IV ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

## UNIT V LOCAL ADMINISTRATION

District’s Administration head: Role and Importance, □ Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

## UNIT VI ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

**TOTAL: 30 PERIODS**

## OUTCOMES:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

## SUGGESTED READING

- The Constitution of India,1950(Bare Act),Government Publication.
- Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
- M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX4094

நற்றமிழ் இலக்கியம்

L T P C  
2 0 0 0

UNIT I

சங்க இலக்கியம்

6

1. தமிழின் துவக்க நூல் தொல்காப்பியம்  
- எழுத்து, சொல், பொருள்
2. அகநானூறு (82)  
- இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர் ச்காட்சி
4. புறநானூறு (95,195)  
- போரை நிறுத்திய ஓளவையார்

UNIT II

அறநெறித் தமிழ்

6

1. அறநெறி வகுத்த திருவள்ளுவர்  
- அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புரவறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து  
- ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல் )

UNIT III

இரட்டைக் காப்பியங்கள்

6

1. கண்ணகியின் புரட்சி  
- சிலப்பதிகார வழக்குரை காதை  
சமூகசேவை இலக்கியம் மணிமேகலை  
- சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

UNIT IV

அருள்நெறித் தமிழ்

6

1. சிறுபாணாற்றுப்படை

- பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குத் போர்வை கொடுத்தது, அதியமான் ஓளவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
- 2. நற்றிணை
  - அன்னைக்குரிய புன்னை சிறப்பு
- 3. திருமந்திரம் (617, 618)
  - இயமம் நியமம் விதிகள்
- 4. தர் மச்சாலையை நிறுவிய வள்ளலார்
- 5. புறநானூறு
  - சிறுவனே வள்ளலானான்
- 6. அகநானூறு (4) - வண்டு  
 நற்றிணை (11) - நண்டு  
 கலித்தொகை (11) - யானை, புறா  
 ஐந்திணை 50 (27) - மான்  
 ஆகியவை பற்றிய செய்திகள்

## UNIT V

### நவீன தமிழ் இலக்கியம்

6

1. உரைநடைத் தமிழ்,
  - தமிழின் முதல் புதினம்,
  - தமிழின் முதல் சிறுகதை,
  - கட்டுரை இலக்கியம்,
  - பயண இலக்கியம்,
  - நாடகம்,
2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. இணையத்தில் தமிழ்,
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

TOTAL: 30 PERIODS

### தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University) - [www.tamilvu.org](http://www.tamilvu.org)
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia) - <https://ta.wikipedia.org>
3. தர் மபுர ஆதீன வெளியீடு
4. வாழ்வியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம் - தமிழ் வளர்ச்சித்துறை ([thamilvalarchithurai.com](http://thamilvalarchithurai.com))
6. அறிவியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்