Selvam College of Technology
An Autonomous Institution
Accredited by NAAC with "A" Grade, UGC Recognized 2(f) Status,
An ISO 9001:2015 Certified Institution, Approved by AICTE New Delhi, Affiliated to Anna University-Chennai
Salem Road (NH 44), Namakkal – 637 003. TAMIL NADU.
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M.E

INDUSTRIAL SAFETY ENGINEERING

Curriculum and Syllabi

(Regulation 2024)

Choice Based Credit System

For the Students Admitted from the Academic Year 2024-25 Onwards

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M.E. INDUSTRIAL SAFETY ENGINEERING

Vision of the Institution

- ✓ To be a world class institute in technical education through innovations and research in various fields of engineering and technology by creating highly competent technocrats with moral qualities.

Mission of the Institution

SCT will endeavor to:

- ✓ Be a focal point in engineering education for emerging technologies in accordance with societal contexts.
- ✓ Be an engineering institute fostering research and development, evolving innovative applications of technology, encouraging entrepreneurship of students with moral qualities.
- ✓ Empower the students from various socio economic strata.

Vision of the Department

- ✓ Attempt to Succeed Total Quality in Education and Research in the Branch of Mechanical Engineering by Providing Excellent Academic Ambience.

Mission of the Department

- ✓ To create excellent facilities and equipments with quality teaching learning process in the department of mechanical engineering to realize desired outcomes.
- ✓ To build Industry-Institute Collaboration by team up with pioneer industries for training, internships, and industry expert conferences.
- ✓ To promote academic, research, consultancy and innovation leading to research publications and patents team up with pioneer industries.
- ✓ To teach Ethical, Moral, Political, Social Values and Environment Awareness by participation in Co- curricular and Extra-curricular activities.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1	Possess a mastery of Health safety and environment awareness and safety management skills, to reach higher levels in their profession.
PEO2	Proficient safety Engineer rendering professional expertise to the industrial and societal needs at national and global level subject to legal requirements.
PEO3	Well communicate the information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities.
PEO4	Demonstrate professional and ethical attitude with awareness of current legal issues by rendering expertise to wide range of industries.

PROGRAMME OUTCOMES (POs)	
Engineering Graduates will be able to:	
PO1	An ability to independently carry out research/investigation and development work to solve practical problems.
PO2	An ability to write and present a substantial technical report/document.
PO3	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.
PO4	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.
PO5	Demonstrate the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to occupational health and safety practices.
PO6	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.

Courses of Study (Regulations 2024)

M.E. Industrial Safety Engineering

S. No.	Course Code	Course Title	L	T	P	C	CAT	Total Contact Periods
SEMESTER I								
THEORY COURSES								
1	P24IS101	Principles of Safety Management	3	0	0	3	PCC	45
2	P24IS102	Environmental Safety	3	0	0	3	PCC	45
3	P24IS103	Occupational Health and Industrial Hygiene	3	0	0	3	PCC	45
4	P24IS104	Industrial Safety, Health and Environment Acts	3	0	0	3	PCC	45
5	P24RM101	Research Methodology and IPR	2	0	0	2	RMC	30
6		Professional Elective - I	3	0	0	3	PEC	45
7		Audit Course – I*	2	0	0	0	AC	30
PRACTICAL COURSES								
8	P24IS111	Safety Audit	0	0	2	1	EEC	30
9	P24IS112	Industrial Safety and Simulation Laboratory	0	0	4	2	PCC	60
					Total Credits	**20**		

L - Lecture Hours, T - Tutorial Hours, P - Practical, C - Credits, CAT - Category of Course

PCC Program Core Courses

RMC Research Methodology and IPR Courses

PEC Professional Elective Courses

EEC Employability Enhancement Courses

AC Audit Course

Approved By

Chairperson - BoS MECHANICAL	Member Secretary Academic Council	Dean - Academics	Chairperson - Academic Council & Principal
Dr.G.Selvaraj	Dr.G.Selvaraj	Dr.S.Prakash	Dr.A.Jegan

Courses of Study (Regulations 2024)

M.E. Industrial Safety Engineering

S. No.	Course Code	Course Title	L	T	P	C	CAT	Total Contact Periods
SEMESTER II								
THEORY COURSES								
1	P24IS201	System Simulation and Hazard Analysis	4	0	0	4	PCC	60
2	P24IS202	Electrical Safety	3	0	0	3	PCC	45
3	P24IS203	Safety in Process Industries	3	0	0	3	PCC	45
4	P24IS204	Fire Engineering and Explosion Control	3	0	0	3	PCC	45
5		Professional Elective - II	3	0	0	3	PEC	45
6		Professional Elective- III	3	0	0	3	PEC	45
7		Audit Course - II*	2	0	0	0	AC	30
PRACTICAL COURSES								
8	P24IS211	Industrial Safety Assessment – Internship	0	0	4	2	EEC	60
9	P24IS212	Technical Seminar	0	0	2	1	EEC	30
					Total Credits	**22**		

L - Lecture Hours, T - Tutorial Hours, P - Practical, C - Credits, CAT - Category of Course

PCC Program Core Courses

PEC Professional Elective Courses

EEC Employability Enhancement Courses

AC Audit Course

Approved By

Chairperson - BoS MECHANICAL	Member Secretary Academic Council	Dean - Academics	Chairperson - Academic Council & Principal
Dr.G.Selvaraj	Dr.G.Selvaraj	Dr.S.Prakash	Dr.A.Jegan

Courses of Study (Regulations 2024)

M.E. Industrial Safety Engineering

S. No.	Course Code	Course Title	L	T	P	C	CAT	Total Contact Periods
SEMESTER III								
THEORY COURSES								
1	P24IS301	Reliability Engineering	3	0	0	3	PCC	45
2		Professional Elective - IV	3	0	0	3	PEC	45
3		Professional Elective - V	3	0	0	3	PEC	45
4		Open Elective	3	0	0	3	OEC	45
PRACTICAL COURSES								
5	P24IS311	Project Work I	0	0	12	6	EEC	180
					Total Credits	**18**		

L - Lecture Hours, T - Tutorial Hours, P - Practical, C - Credits, CAT - Category of Course

PCC Program Core Courses
PEC Professional Elective Courses
EEC Employability Enhancement Courses
OEC Open Elective Courses

Approved By

Chairperson - BoS MECHANICAL	Member Secretary Academic Council	Dean - Academics	Chairperson - Academic Council & Principal
Dr.G.Selvaraj	Dr.G.Selvaraj	Dr.S.Prakash	Dr.A.Jegan

Courses of Study (Regulations 2024)								
M.E. Industrial Safety Engineering								
S. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**CAT**	**Total Contact Periods**
SEMESTER IV								
PRACTICAL COURSES								
1	P24IS411	Project Work II	0	0	24	12	EEC	360
						Total Credits	**12**	

L - Lecture Hours, T - Tutorial Hours, P - Practical, C - Credits, CAT - Category of Course

EEC Employability Enhancement Courses

Approved By

Chairperson - BoS MECHANICAL	Member Secretary Academic Council	Dean - Academics	Chairperson - Academic Council & Principal
Dr.G.Selvaraj	Dr.G.Selvaraj	Dr.S.Prakash	Dr.A.Jegan

Credits Distribution

(For the candidates admitted from 2024-2025 onwards)

M.E. – Industrial Safety Engineering - R 2024

S. No.	Course Category	Credit per Semester				Total Credits	Credit %
		I	II	III	IV		
1	PCC	14	13	3	-	30	41.66
2	PEC	3	6	6	-	15	20.83
3	RMC	2	-	-	-	2	2.77
4	OEC	-	-	3	-	3	4.16
5	EEC	1	3	6	12	22	30.55
6	AC	-	-	-	-	-	-
Total		**20**	**22**	**18**	**12**	**72**	**100**

PCC	Professional Core Courses	**EEC**	Employability Enhancement Courses
RMC	Research Methodology And IPR	**OEC**	Open Elective Courses
AC	Audit Course	**PEC**	Professional Elective Courses

PROGRAM CORE COURSES (PCC)

S. No.	Course Code	Course Title	L	T	P	C	CAT	Total Contact Periods
1	P24IS101	Principles of Safety Management	3	0	0	3	PCC	45
2	P24IS102	Environmental Safety	3	0	0	3	PCC	45
3	P24IS103	Occupational Health and Industrial Hygiene	3	0	0	3	PCC	45
4	P24IS104	Industrial Safety, Health and Environment Acts	3	0	0	3	PCC	45
5	P24IS112	Industrial Safety and simulation Laboratory	0	0	4	2	PCC	60
6	P24IS201	SystemSimulation and Hazard Analysis	4	0	0	4	PCC	60
7	P24IS202	Electrical Safety	3	0	0	3	PCC	45
8	P24IS203	Safety in Process Industries	3	0	0	3	PCC	45
9	P24IS204	Fire Engineering and Explosion Control	3	0	0	3	PCC	45
10	P24IS301	Reliability Engineering	3	0	0	3	PCC	45
					TOTAL CREDITS	30		

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. No.	Course Code	Course Title	L	T	P	C	CAT	Total Contact Periods
1	P24RM101	Research Methodology and IPR	2	0	0	2	RMC	30
					TOTAL CREDITS	2		

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	Course Code	Course Title	L	T	P	C	CAT	Total Contact Periods
1	P24IS111	Safety Audit	0	0	2	1	EEC	30
2	P24IS211	Industrial Safety Assessment – Internship	0	0	4	2	EEC	60
3	P24IS212	Technical Seminars	0	0	2	1	EEC	30
4	P24IS311	Project Work I	0	0	12	6	EEC	180
5	P24IS411	Project Work II	0	0	24	12	EEC	360
					TOTAL CREDITS	22		

AUDIT, MANDATORY COURSES

S. No.	Course Code	Course Title	L	T	P	C	CAT	Total Contact Periods
1	P24AC101	English for Research Paper Writing	2	0	0	0	AC	30
2	P24AC102	Disaster Management	2	0	0	0	AC	30
3	P24AC201	Constitution of India	2	0	0	0	AC	30
4	P24AC202		2	0	0	0	AC	30

PROFESSIONAL ELECTIVES COURSES (PEC)

SEMESTER I, ELECTIVE I

S. No.	Course Code	Course Title	L	T	P	C	CAT	Total Contact Periods
1	P24ISP11	Plant Layout and Material Handling	3	0	0	3	PEC	45
2	P24ISP12	Work Study and Ergonomics	3	0	0	3	PEC	45
3	P24ISP13	Human Factors in Engineering	3	0	0	3	PEC	45
4	P24ISP14	Maintainability Engineering	3	0	0	3	PEC	45
5	P24ISP15	Optimization Techniques	3	0	0	3	PEC	45

PROFESSIONAL ELECTIVES COURSES (PEC)

SEMESTER II, ELECTIVE II & III

S. No.	Course Code	Course Title	L	T	P	C	CAT	Total Contact Periods
1	P24ISP21	Transport Safety	3	0	0	3	PEC	45
2	P24ISP22	Fireworks Safety	3	0	0	3	PEC	45
3	P24ISP23	Safety in Construction	3	0	0	3	PEC	45
4	P24ISP24	Nuclear Engineering and Safety	3	0	0	3	PEC	45
5	P24ISP25	Safety in Textile Industry	3	0	0	3	PEC	45
6	P24ISP26	Safety in Mines	3	0	0	3	PEC	45
7	P24ISP27	Dock Safety	3	0	0	3	PEC	45
8	P24ISP28	Universal Human Values and Ethics	3	0	0	3	PEC	45

PROFESSIONAL ELECTIVES COURSES (PEC)

SEMESTER III, ELECTIVE IV & V

S. No.	Course Code	Course Title	L	T	P	C	CAT	Total Contact Periods
1	P24ISP31	Safety in Engineering Industry	3	0	0	3	PEC	45
2	P24ISP32	Quality Engineering in Production Systems	3	0	0	3	PEC	45
3	P24ISP33	ISO 45001 and ISO 14000	3	0	0	3	PEC	45
4	P24ISP34	Artificial Intelligence and Expert Systems	3	0	0	3	PEC	45
5	P24ISP35	Design of Experiments	3	0	0	3	PEC	45
6	P24ISP36	Data Analytics	3	0	0	3	PEC	45

OPEN ELECTIVE COURSES (OEC)

S. No.	Course Code	Course Title	L	T	P	C	CAT	Total Contact Periods
1	P24CEO11	Integrated Water Resources Management	3	0	0	3	OEC	45
2	P24CEO12	Water, Sanitation and Health	3	0	0	3	OEC	45
3	P24CEO13	Principles of Sustainable Development	3	0	0	3	OEC	45
4	P24CEO14	Environmental Impact Assessment	3	0	0	3	OEC	45
5	P24CSO11	Block chain Technologies	3	0	0	3	OEC	45
6	P24MGO11	Sustainable Management	3	0	0	3	OEC	45
7	P24MGO12	Micro and Small Business Management	3	0	0	3	OEC	45
8	P24MGO13	Intellectual Property Rights	3	0	0	3	OEC	45
9	P24MGO14	Ethical Management	3	0	0	3	OEC	45
10	P24ECO11	IoT for Smart Systems	3	0	0	3	OEC	45
11	P24CSO12	Machine Learning and Deep Learning	3	0	0	3	OEC	45
12	P24MEO11	Renewable Energy Technology	3	0	0	3	OEC	45
13	P24EEO11	Smart Grid	3	0	0	3	OEC	45
14	P24CSO13	Security Practices	3	0	0	3	OEC	45
15	P24CSO14	Cloud Computing Technologies	3	0	0	3	OEC	45
16	P24MEO12	Design Thinking	3	0	0	3	OEC	45
17	P24CSO15	Big Data Analytics	3	0	0	3	OEC	45
18	P24CSO16	Internet of Things and Cloud	3	0	0	3	OEC	45
19	P24BMO11	Medical Robotics	3	0	0	3	OEC	45
20	P24ECO12	Embedded Automation	3	0	0	3	OEC	45
21	P24CEO15	Environmental Sustainability	3	0	0	3	OEC	45
22	P24MEO13	Nano composite Materials	3	0	0	3	OEC	45
23	P24BTO11	IPR, Bio safety and Entrepreneurship	3	0	0	3	OEC	45

P24IS101	PRINCIPLES OF SAFETY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Summarize the various concepts and Techniques in the safety management.
CO2	Organize a safety audit and prepare a report for the audit.
CO3	Develop an accident investigation report.
CO4	Examine the safety performance monitoring activities.
CO5	Explain the safety education and training.

UNIT I	CONCEPTS AND TECHNIQUES	9

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

UNIT II	SAFETY AUDIT	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

REFERENCES:	
1.	E. C Wolfe, Race to Save to Save Planet, Wadsworth Publishing Co., Belmont, CA 2006.
2.	G. T Miller, Environmental Science: Working with the Earth, 11th Edition, Wadsworth Publishing Co., Belmont, CA, 2006.
3.	M.J Hammer,., and M.J Hammer,., Jr., Water and Wastewater Technology, Pearson Prentice Hall, 2006.
4.	Rao, CS, "Environmental pollution engineering:, Wiley Eastern Limited, New Delhi, 1st 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.
7.	Lees, F.P., "Loss Prevention in Process Industries" Butterworth publications, London, 2 nd edition, 1990.
8.	Relevant Indian Standards and Specifications, BIS, New Delhi. 8. "Safety and Good House Keeping", N.P.C., New Delhi, 1985.
9.	https://www.osha.gov/safety-management/additional-resources-by-topic.
10.	https://www.assp.org/education.
11.	https://onlinecourses.nptel.ac.in/noc22_mg55/preview.
12.	https://onlinecourses.nptel.ac.in/noc20_mg43/preview.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	1	-	2	2	-
CO2	-	-	-	2	3	-
CO3	3	3	2	2	1	1
CO4	2	3	2	3	3	-
CO5	-	-	3	3	-	2
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24IS102	ENVIRONMENTAL SAFETY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Illustrate and familiarize the basic concepts scope of environmental safety.
CO2	Interpret the standards of professional conduct that are published by professional safety organizations and/or certification bodies.
CO3	Explain the ways in which environmental health problems have arisen due to air and water pollution.
CO4	Examine the role of hazardous waste management and use of critical thinking to identify and assess environmental health risks.
CO5	Apply concepts of emission measurement and 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 – dying and pigment industries - eco-friendly energy.

TOTAL : 45 PERIODS

REFERENCES:	
1	E. C Wolfe, Race to Save to Save Planet, Wadsworth Publishing Co., Belmont, CA 2006.
2	G. T Miller, Environmental Science: Working with the Earth, 11th Edition, Wadsworth Publishing Co., Belmont, CA, 2006.
3	M.J Hammer,., and M.J Hammer,., Jr., Water and Wastewater Technology, Pearson Prentice Hall, 2006.
4	Rao, CS, "Environmental pollution engineering:, Wiley Eastern Limited, New Delhi, 1st 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.
7.	https://tifac.org.in/index.php/programmes/activities/8-publication/145-industrial-air-pollution-control echnologies? show all=1.
8.	https://www.unep.org/beatpollution/global-response-pollution.
9.	https://onlinecourses.nptel.ac.in/noc23_ce14/preview.
10.	https://onlinecourses.nptel.ac.in/noc23_ch72/preview.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	1	2	-	-	1
CO2	-	1	3	1	-	1
CO3	-	2	2	-	1	2
CO4	1	3	3	1	3	-
CO5	1	1	3	3	-	-
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24IS103	OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Apply the knowledge of physical hazards and its control measures in an Industrial Environment.
CO2	Explain the types of chemicals for its health hazard and provide suitable control methods.
CO3	Interpret various types of hazards arising out of biological and ergonomically aspects in a process and able to provide suitable corrective actions.
CO4	Outline the functions and activities of Occupational health services.
CO5	Evaluate the various physiological functions of our body and the test methods for periodical monitoring of health.

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- nonionizing 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, vapor, 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 Vapor 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

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.
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.
9.	https://www.who.int/india/health-topics/occupational-health.
10.	https://www.ilo.org/safework/countries/asia/india/lang--en/index.htm.
11.	https://onlinecourses.swayam2.ac.in/nou23_es01/preview.
12.	https://onlinecourses.swayam2.ac.in/aic20_ed03/preview.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	3	2	2	-
CO2	1	1	3	2	2	-
CO3	-	1	3	-	2	1
CO4	-	1	3	-	1	1
CO5	-		2	-	1	1
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24IS104	INDUSTRIAL SAFETY, HEALTH AND ENVIRONMENT ACTS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Interpret the requirements mentioned in factories act for the prevention of accidents.
CO2	List important legislations related to health, Safety and Environment act.
CO3	Infer the manufacturing storage and import of hazardous chemical rule.
CO4	Summarize the statutory requirements for an Industry on registration, license and its renewal.
CO5	Develop an system of international act and standard.

UNIT I	**FACTORIES ACT – 1948**	**9**

Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young person's – 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 Tran boundary 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 Williams - Stagier 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

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.
9.	https://www.indiacode.nic.in/handle/123456789/1530?sam_handle=123456789/1362.
10.	https://dgfasli.gov.in/factories-act-1948.
11.	https://onlinecourses.nptel.ac.in/noc23_mg98/preview.
12.	https://onlinecourses.swayam2.ac.in/nou23_ge81/preview.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	3	-	2	-
CO2	1	1	3	-	2	2
CO3	1	1	3	-	2	1
CO4	-	1	3	-	2	1
CO5	-	1	3	-	2	
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24IS105	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Illustrate the importance and objectives of research in contributing to knowledge and solving real-world problems.
CO2	Experiment with data collection techniques, choosing fitting approaches to ensure sound research framework and methodology.
CO3	Utilize research & analytic tools for enhancing the research publication.
CO4	Apply knowledge to produce presentations and technical reports that effectively communicate research findings.
CO5	Explain types of intellectual property and comprehend patenting as essential for safeguarding innovation and creativity.

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-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, 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.
5.	https://www.researchgate.net/.
6.	https://www.wipo.int/about-ip/en/.
7.	https://onlinecourses.nptel.ac.in/noc23_ge36/preview.
8.	https://onlinecourses.nptel.ac.in/noc22_hs59/preview.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1		-	1
CO2	3	3	-	2	-	-
CO3	3	-	-	3	1	-
CO4	3	3	-	-	-	-
CO5	2	2	-	2	-	1
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24IS111	SAFETY AUDIT	L	T	P	C
		0	0	2	1

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	To Minimize the Labor turnover by existence of Safety Measures of an Employee.
CO2	To Promote the Fatigue Study it will lead to good production.
CO3	To Implement the Human Resource Management Practices.
CO4	To impart the Health Consciousness to the Working Community.

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

Mapping of COs with POs						
COs	**Program Outcomes (Pos)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	3	-	-	-	-
CO2	-	2	2	-	-	-
CO3	-	-	-	3	-	-
CO4	-	-	-	-	-	-
CO5	-	-	-	-	-	-
1–Low, 2 –Medium, 3–High, -No correlation.						

P24IS112	INDUSTRIAL SAFETY AND SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	This course would make students to know and run the various equipments to bring out the safety environment in the industry.
CO2	Course would be helpful for the students to measure the particulate matter and assess the impact of air pollution.
CO3	Students would be trained to conduct experiments to find out various environmental parameters.
CO4	Students would be able to use personal protective equipment in-dependently.
CO5	Students can recognise the various problems with the use of software and hence to predict the real situations on 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 Co2
Foam
Carbon dioxide (Co2)
Dry chemical powder and
Currently amendment fire safety systems

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

Illumination testing - by lux meter and photo meter.

Electrical safety
Insulation resistance for motors and cables Estimation of earth resistance Earth continuity test Sensitivity test for MCB, ELCB, RCCB, MCCB
Software Usage
Dispersion modeling of various highly dangerous chemicals using ALOHA software 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 kid : 1 No 10. Lock out/Tag out : 1 No 11. Software: ALOHA, CAMEO 12. Extend SIM 13. System : 12 No.
TOTAL : 60 PERIODS

Mapping of COs with POs						
COs	**Program Outcomes (Pos)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	2	-	-	-	-
CO2	-	-	3	-	-	-
CO3	-	-	-	3	-	-
CO4	-	-	-	-	3	-
CO5	-	-	-	-	-	2
1–Low, 2 –Medium, 3–High, -No correlation.						

P24IS201	SYSTEM SIMULATION AND HAZARD ANALYSIS	L	T	P	C
		4	0	0	4

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	This course would make familiarizing of basic concepts in risk and hazard.
CO2	Course would be helpful to understand the various instruments to bring safety in Industries.
CO3	Students would be trained to find solution for risk assessment studies through the use of software.
CO4	Students would be able to make use of a risk assessment technique to quantify the risk.
CO5	Course would equip the students effectively to employ hazard analysis techniques in Industry and helpful to prevent the accidents in Industry.

UNIT I	HAZARD, RISK ISSUES AND HAZARD ASSESSMENT	12

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

UNIT II	COMPUTER AIDED INSTRUMENTS	12

Applications of Advanced Equipments and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter(DSC), Thermo Gravimetric Analyser(TGA), Accelerated Rate Calorimeter(ARC), Reactive Calorimeter(RC), Reaction System Screening Tool(RSST) - Principles of operations, Controlling parameters, Applications, advantages. Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitiveness Test, Impact Sensitiveness Test(BAM) and Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test.

UNIT III	RISK ANALYSIS QUANTIFICATION AND SOFTWARES	12

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

UNIT IV	CONSEQUENCES ANALYSIS	12

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

UNIT V	CREDIBILITY OF RISK ASSESSMENT TECHNIQUES	12

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

TOTAL:60 PERIODS

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.
9..	https://www.graphicproducts.com/articles/hazard-analysis-risk-assessment/.
10.	https://www.aiche.org/ccps/introduction-hazard-identification-and-risk-analysis.
11.	https://onlinecourses.nptel.ac.in/noc23_mg98/preview?user_email=tdmech@kiot.ac.in.
12.	https://onlinecourses.swayam2.ac.in/nou23_ge81/preview.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	3	3
CO2	3	3	-	3	-	-
CO3	3	-	3	-	2	2
CO4	3	3	3	3	1	3
CO5	3	3	3	2	2	3
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24IS202	ELECTRICAL SAFETY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Demonstrate understanding of electrical concepts and legal compliance for safe operation, within regulatory constraints.
CO2	Identify and mitigate electrical hazards, ensuring safety adherence to protocols and guidelines.
CO3	Utilize protection systems effectively, ensuring electrical safety within specified standards.
CO4	Apply a safe and efficient process for selecting, installing, operating, and maintaining electrical equipment, adhering to industry regulations.
CO5	Develop expertise in managing hazardous zones safely, within the constraints of applicable safety standards.

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

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.
6.	https://www.osha.gov/sites/default/files/2019-03/electrical_safety_manual.pdf .
7.	https://www.ilo.org/global/topics/labour-administration-inspection/resources library/publications/guide-for-labour-inspectors/electrical-safety/lang--en/index.htm .
8.	https://onlinecourses.swayam2.ac.in/nou20_cs08/preview.
9.	https://learning.tcsionhub.in/courses/ve/safety/siemens/electrical-safety-online-course-and-training/.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	3	-	1	1
CO2	-	1	3	1	2	2
CO3	-	2	3	2	2	2
CO4	1	1	3	1	1	1
CO5	-	2	3	-	2	-
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24IS203	SAFETY IN PROCESS INDUSTRIES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Apply knowledge of pressure system design principles to improve safety in a process industry.
CO2	Utilize pre-commissioning documents to verify the readiness of equipment and systems for operation.
CO3	Students would understand the problems and find innovative solutions while industries facing Problems in commissioning and maintenance stages.
CO4	Utilize knowledge of maintenance management to strategize and execute maintenance activities safely and efficiently.
CO5	Apply knowledge of storage layout and segregation principles to design safe storage facilities.

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	**STORAGES**	**9**

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

TOTAL:45 PERIODS

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.
8.	https://www.nsc.org/getmedia/238460ca-6df0-411d-914a-54d36282fc36/apm_et_answers_q_cs_ch25.pdf.
9.	https://www.osha.gov/sites/default/files/2019-03/sheetmetal.pdf.
10.	https://www.nfpa.org/for-professionals/training-for-me/industrial-hazards-training/hot-work-safety-certificate-online-training.
11.	https://www.nsc.org/safety-training/workplace/advanced-safety-certificate/safety-inspections.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	1	3	-	2	-
CO2	-	1	3	-	3	1
CO3	1	1	3	-	3	-
CO4	1	1	3	-	3	1
CO5	2	1	3	1	3	-
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24IS204	FIRE ENGINEERING AND EXPLOSION CONTROL	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Explain the basic concepts of fire and explosion science.
CO2	Demonstrate the different source of ignition and their prevention techniques.
CO3	Illustrate the operation of various types of fire fighting equipments. .
CO4	Summarize the causes and prevention of explosion.
CO5	Apply explosion protection techniques and their significances to suit the industrial requirement.

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 – layout of stand pipes – fire station-fire alarms and sirens – maintenance of fire trucks – foam generators – escape from fire rescue operations – fire drills– notice-first aid for burns.

UNIT III	INDUSTRIAL FIRE PROTECTION SYSTEMS	9

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

UNIT IV	BUILDING FIRE SAFETY	9

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

UNIT V	EXPLOSION PROTECTING SYSTEMS	9

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

TOTAL :45 PERIODS

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.	Relevant Indian Acts and rules, Government of India.
8.	https://www.graphicproducts.com/articles/hazard-analysis-risk-assessment/.
9.	https://www.aiche.org/ccps/introduction-hazard-identification-and-risk-analysis.
10.	https://onlinecourses.nptel.ac.in/noc23_mg98/preview.
11.	https://onlinecourses.swayam2.ac.in/nou23_ge81/preview.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	3	-	-	-	2
CO2	-	-	3	-	2	-
CO3	-	-	2	3		-
CO4	-	3	-	-	3	-
CO5	2	-	-	-	-	2
1–Low, 2–Medium, 3–High, "-"-No Correlation.						

P24IS211	INDUSTRIAL SAFETY ASSESSMENT – INTERNSHIP	L	T	P	C
		0	0	4	2

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Select and analysis the effective industry safety methods for the given field applications.

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 : 30 PERIODS

Mapping of COs with POs

COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	3	-	3	2
CO2	-	-	-	-	-	-
CO3	-	-	-	-	-	-
CO4	-	-	-	-	-	-
CO5	-	-	-	-	-	-

1–Low, 2 –Medium, 3–High, -No correlation.

P24ISP11	PLANT LAYOUT AND MATERIAL HANDLING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Identify suitable plant locations based on territorial parameters, land, water, electricity, and safety for hazardous materials.
CO2	Plan safe layouts for various industries, applying basic principles of plant layout.
CO3	Apply principles for adequate ventilation, lighting, and basic housekeeping to enhance working conditions in an industry.
CO4	Apply safe manual handling practices, including lifting techniques and team lifting, to prevent common injuries.
CO5	Demonstrate safety proficiency in mechanical material handling within an industrial setting.

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

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.
5.	https://link.springer.com/book/10.1007/978-1-349-01786-7.
6.	https://industri.fatek.unpatti.ac.id/wp-content/uploads/2019/03/139-Plant-Layout-and-Materials-Handling-A.W.-Pemberton-Edisi-1-1974.pdf.
7.	https://onlinecourses.nptel.ac.in/noc24_ce44/preview.
8.	https://www.coursera.org/learn/battery-comparison-manufacturing-and-packaging.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	1	2	-
CO2	2	1	2	-	1	-
CO3	1	2	1	-	2	-
CO4	2	-	1	2	-	-
CO5	2	1	-	-	-	-
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24ISP12	WORK STUDY AND ERGONOMICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Identify the standard time for doing a task and to improve the productivity.
CO2	Apply the basic principles of Ergonomics to increase the safety, comfort and performance of a product and solve practical problems.
CO3	Analyze and Use Personal Protective Equipment appropriate for the tasks and the environment.
CO4	Develop a holistic approach towards process and Equipment design for the production of high-quality, cost-effective products.
CO5	Examine Man-machine relationship and Suggest the measures to reduce fatigue.

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

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, 6th Edition, Allied Publishers, Madras, 1989.
7	W.Benjamin Neibal Motion and Time Study, 9th Edition 1993.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	1	2	-
CO2	2	1	2	-	1	-
CO3	1	2	1	-	2	-
CO4	2	-	1	2	-	-
CO5	2	1	-	-	-	-
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24ISP13	HUMAN FACTORS IN ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Apply ergonomic principles to optimize work systems in an Industrial Setting.
CO2	Interpret individual differences, factors contributing to personality, and their influence on safety in the workplace.
CO3	Apply an ergonomic approach to design workstations for standing and seated workers in an industrial environment.
CO4	Apply ergonomics interventions to prevent work-related musculoskeletal disorders.
CO5	Apply effective design strategies for virtual environments to ensure user-friendliness and efficient systems.

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 sprine 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

REFERENCES:	
1.	Ergonomic design for organizational effectiveness, Michael O'Neill 1st Edition 1998.
2.	Human factors in engineering and design, MARK S.SANDERS 1992.
3.	Introduction to Ergonomics, R.S. Bridger, Taylor and Francis 3rd Edition 2008.
4.	The Ergonomics manual, Dan Mc Leod, Philip Jacobs and Nancy Larson.
5.	https://ocw.mit.edu/courses/16-400-human-factors-engineering-fall-2011/ .
6.	https://www.emergobyul.com/resources/intro-human-factors-engineering-medical-devices .
7.	https://onlinecourses.nptel.ac.in/noc22_mg108/preview.
8.	https://on.abdn.ac.uk/courses/human-factors-engineering/.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	2	3	2	3
CO2	1	2	-	1	1	2
CO3	2	-	2	2	1	-
CO4	1	1	-	1	3	1
CO5	2	2	2	1	-	-
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24ISP14	MAINTAINABILITY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Apply principles to identify and address specific challenges in maintenance operations.
CO2	Apply maintenance strategies for efficient equipment performance and operational effectiveness in industrial contexts.
CO3	Utilize logistics for efficient resource management and spare parts availability, enhancing operational efficiency in industry.
CO4	Apply maintenance techniques effectively to enhance system reliability in industrial settings.
CO5	Develop strategies to address and rectify equipment defects, reducing downtime and enhancing overall operational efficiency.

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

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.
4.	https://www.the maintenance engineer.com/.
5.	https://maintenance engineering solutions.com/.
6.	https://online courses.swayam2.ac.in/nou21_me10/preview.
7.	https://www.futurelearn.com/courses/introduction-to-maintenance-engineering.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	1	2	2	1	1
CO2	1	1	2	1	1	1
CO3	-	1	-	1	1	1
CO4	2	2	2	1	1	-
CO5	-	1	-	1	1	1
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24ISP15	OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Apply optimization techniques to efficiently address real-world problems.
CO2	Apply optimization techniques to efficiently address real-world problems.
CO3	Solve non-linear optimization problems with appropriate methods.
CO4	Utilize non-traditional optimization techniques for complex problem-solving.
CO5	Implement nature-inspired algorithms for effective optimization in various applications.

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

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.
6.	https://www.researchgate.net/publication/271847368_Decision-Analysis_-_an_Overview.
7.	https://www.researchgate.net/publication/283344536_Traditional_vs_non-traditional_optimization_tools.
8.	https://onlinecourses.nptel.ac.in/noc21_me10/preview.
9.	https://www.coursera.org/learn/discrete-optimization.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	1	-	-
CO2	1	1	1	1	-	-
CO3	1	1		2	-	-
CO4	2	1	1	1	-	-
CO5	2	1	1	1	-	-
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24ISP21	TRANSPORT SAFETY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Apply emergency response techniques, including precise tanker parking and effective communication, in compliance with regulatory guidelines.
CO2	Apply road safety principles, including accident prevention, truck design, Motor Vehicles Act, insurance, and safety surveys to improve transport safety.
CO3	Develop driver safety initiatives, focusing on selection, training, and innovative monitoring for performance improvement.
CO4	Demonstrate proficiency in improving road safety by using various methods to prevent accidents in an industry.
CO5	Construct comprehensive safety measures, emphasizing transportation precautions, responsible equipment handling, and effective servicing.

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	10

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

UNIT IV	ROAD SAFETY	9

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

UNIT V	SHOP FLOOR AND REPAIR SHOP SAFETY	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

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.
8.	https://www.who.int/health-topics/road-safety.
9.	https://morth.nic.in/motor-vehicles-act-1988.
10	https://onlinecourses.nptel.ac.in/noc23_ce29/preview .
11.	https://www.nsc.org/safety-training/defensive-driving/nsc-defensive-driving-courses/online-defensive-driving-courses.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	-	3	1
CO2	1	2	3	1	3	2
CO3	2	2	3	-	3	2
CO4	-	2	3	1	3	2
CO5	1	2	3	-	2	-
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24ISP22	FIREWORKS SAFETY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Classify the Properties of Fire work chemicals and its reactions to improve safety in an Fire work Storage area.
CO2	Apply preventive measures to control static charge and dust explosion in fireworks factories.
CO3	Apply safety protocols in fireworks Industry, in adherence to regulations and minimizing risks in the industry.
CO4	Demonstrate proper techniques for manual handling emphasizing safety measures, in adherence to transport regulations.
CO5	Demonstrate knowledge of waste management concepts in fireworks industry to ensure safety.

UNIT I	PROPERTIES OF FIREWORKS CHEMICALS	9

Fire properties – potassium nitrate (KN03), potassium chlorate (KCl03), barium nitrate (BaNO3), calcium nitrate (CaNO3), Sulphur (S), Phosphorous (P), antimony (Sb), Pyro Aluminum (A1) powder- Reactions-metal powders, Borax, ammonia (NH3) – Strontium Nitrate, Sodium Nitrate, Potassium per chloride. Fire and explosion, impact and friction sensitivity.

UNIT II	STATIC CHARGE AND DUST	9

Concept-prevention-earthling-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-reparable-biological barriers-hazards-personal protective equipment-pollution prevention.

UNIT III	PROCESS SAFETY	8

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

UNIT IV	MATERIAL HANDLING AND TRANSPORTATION	10

Manual handling – wheel barrows-trucks-bullock carts-cycles-automobiles-fuse handling – paper caps handling-nitric acid handling in snake eggs manufacture-handling the mix in this factory-material movement-go down-waste pit. Packing-magazine-design of vehicles for explosive transports loading into automobiles-transport restrictions-case studies-overhead power lines-driver habits-intermediate parking-fire extinguishers-loose chemicals handling and transport.

UNIT V	WASTE CONTROL AND USER SAFETY	9

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

TOTAL : 45 PERIODS

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.
10.	https://nptel.ac.in/courses/104103019.
11.	https://www.brainkart.com/subject/Engineering-Chemistry_264/.
12.	https://nptel.ac.in/courses/103103206.
13	https://www.coursera.org/learn/battery-comparison-manufacturing-and-packaging.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	-
CO2	1	3	1	1	1	2
CO3	2	1	2	-	2	1
CO4	1	2	3	-	-	2
CO5	1	1	1	2	2	-
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24ISP23	SAFETY IN CONSTRUCTION	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Interpret the problems impeding safety, causes of accidents and designing aids for safe construction.
CO2	Identify and Solve the hazards during the construction of power plant, road works and high rise buildings.
CO3	Relate the safety procedure for working at heights during construction.
CO4	Demonstrate the selection, operation, inspection and testing of various construction machinery.
CO5	Relate the construction regulations and Indian standards for construction and 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

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.
5.	https://www.osha.gov/construction.
6.	https://www.assp.org/news-and-articles/five-important-issues-in-construction-safety.
7.	https://onlinecourses.nptel.ac.in/noc21_ce16/preview.
8.	https://alison.com/course/construction-safety-and-health.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	-	2	1
CO2	-	-	2	3	2	1
CO3	-	3	2	2	2	1
CO4	-	-	2	-	2	1
CO5	-	2	2	1	2	1
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24ISP24	NUCLEAR ENGINEERING AND SAFETY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Describe nuclear concepts, use reactor principles, and explain radiation effects and neutron interactions at a basic level.
CO2	Make use of reactor control strategies, operate rods, and employ online data processing to ensure efficient control.
CO3	Outline the types of nuclear reactor with its functionality to improve the safety in different types of reactors.
CO4	Utilize safety principles, engineer features, and critique case studies, emphasizing reactor design, assuring quality, and ensuring operational safety.
CO5	Apply radiation control techniques, design shielding solutions, and implement safety measures for effective control of plant personnel exposure.

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

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.
8.	https://www.iaea.org/topics/nuclear-safety-and-security.
9.	https://www.sciencedirect.com/topics/engineering/nuclear-safety.
10.	https://www.iaea.org/services/education-and-training/online-learning.
11.	https://www.mooc-list.com/tags/nuclear-safety.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	-
CO2	1	3	2	1	1	3
CO3	2	1	1	-	2	1
CO4	2	-	-	-		2
CO5	1	1	1	3	2	-
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24ISP25	SAFETY IN TEXTILE INDUSTRY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	The student will able to know about the overall picture about the textile industries and its operations.
CO2	The student could understand the various concepts underlying in the processes involved in processing of fibres to yarn.
CO3	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.
CO4	The student could have the capability to handle the various health and welfare activities as per the Factories act and could implement statutory requirements.
CO5	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.

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

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.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	-	-	2	-
CO2	-	-	-	3	-	2
CO3	-	-	2	-	-	-
CO4	-	-	-	2	-	-
CO5	-	-	-	-	2	-
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24ISP26	SAFETY IN MINES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	This course would make the student familiar with the concept of safety aspects in the mining industries.
CO2	Course would be helpful in understanding the various types of mining activities like open case mines, underground mines and tunnel ling.
CO3	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.
CO4	Students could able to implement the techniques like risk assessment Disaster management and emergency preparedness with the proper knowledge on accident prevention.
CO5	Course would equip the students to effectively employ their knowledge on accident prevention in mines.

UNIT I	OPEN CAST 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

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

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	3	-	-	-	-
CO2	-	-	-	-	-	-
CO3	-	2	-	-	2	-
CO4	-	-	-	-	-	3
CO5	-	-	-	-	-	-
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24ISP27	DOCK SAFETY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	This course would make the student to familiar of various operations carried out in a dock.
CO2	Students would know the different acts and rules for safe dock operations.
CO3	Students could be able to understand the operation of various types of material handling equipments.
CO4	Students would be prepared to response at the time of emergency in a dock.
CO5	Students can recognize the various problems associated with the use of lifting equipments and in the storage yards.

UNIT I	**HISTORY OF SAFETY LEGISLATION**	**9**

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

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

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

UNIT III	**LIFTING APPLIANCES**	**9**

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

UNIT IV	**TRANSPORT EQUIPMENT**	**9**

The different types of equipment for transporting containers and safety in their use-safety in the use of self loading container vehicles, container side lifter, fork lift truck, dock railways, conveyors and cranes.

Safe use of special lift trucks inside containers – Testing, examination and inspection of containers – carriage of dangerous goods in containers and maintenance and certification of containers for safe operation Handling of different types of cargo – stacking and unshackling both on board the ship and ashore – loading and unloading of cargo identification of berths/walking for transfer operation of specific chemical from ship to shore and vice versa – restriction of loading and unloading operations.

UNIT V	EMERGENCY ACTION PLAN AND DOCK WORKERS (SHW) REGULATIONS 1990	9
Emergency action Plans for fire and explosions - collapse of lifting appliances and buildings, sheds etc., - gas leakages and precautions concerning spillage of dangerous goods etc., - Preparation of on-site emergency plan and safety report. Dock workers (SHW) rules and regulations 1990-related to lifting appliances, Container handling, loading and unloading, handling of hatch coverings and beams, Cargo handling, conveyors, dock railways, forklift.		
		TOTAL : 45 PERIODS

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".

Mapping of COs with POs

COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	-	-	3	2
CO2	-	3	-	3	-	-
CO3	-	-	-	-	-	-
CO4	-	-	-	-	2	-
CO5	-	-	2	-	-	2

1–Low, 2 –Medium, 3–High, "-"-No Correlation.

P24ISP28	UNIVERSAL HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1	Interpret the concepts of Universal Human Values.
CO2	Summarize both theoretical and practical implications of Universal Human Values.
CO3	Build the harmony in family and society.
CO4	Practice harmony in all human existence.
CO5	Relate human values in both personal and professional life.

UNIT I	INTRODUCTION TO VALUE EDUCATION	9

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) - Understanding Value Education - Sharing about Oneself - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Exploring Human Consciousness - Happiness and Prosperity – Current Scenario - Method to Fulfil the Basic Human Aspirations - Exploring Natural Acceptance.

UNIT II	HARMONY IN THE HUMAN BEING	9

Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - Exploring the difference of Needs of Self and Body - The Body as an Instrument of the Self - Understanding Harmony in the Self - Exploring Sources of Imagination in the Self- Harmony of the Self with the Body - Programme to ensure self regulation and Health - Exploring Harmony of Self with the Body.

UNIT III	HARMONY IN THE FAMILY AND SOCIETY	9

Harmony in the Family – the Basic Unit of Human Interaction - 'Trust' – the Foundational Value in Relationship - Exploring the Feeling of Trust - 'Respect' – as the Right Evaluation - Exploring the Feeling of Respect - Other Feelings , Justice in Human-to-Human Relationship - Understanding Harmony in the Society - Vision for the Universal Human Order - Exploring Systems to fulfil Human Goal .

UNIT IV	HARMONY IN THE NATURE/EXISTENCE	9

Understanding Harmony in the Nature – Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature - Exploring the Four Orders of Nature - Realizing Existence as Co-existence at All Levels - The Holistic Perception of Harmony in Existence - Exploring Co-existence in Existence .

UNIT V	IMPLICATIONS OF THE HOLISTIC UNDERSTANDING - A LOOK AT PROFESSIONAL ETHICS	9

Natural Acceptance of Human Values - Definitiveness of (Ethical) Human Conduct - Exploring Ethical Human Conduct - A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order - Competence in Professional Ethics - Exploring Humanistic Models in Education - Holistic Technologies, Production Systems and Management Models -Typical Case Studies - Strategies for Transition towards Value-based Life and Profession - Exploring Steps of Transition towards Universal Human Order.

TOTAL : 45 PERIODS

REFERENCES:	
1	R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics – Teachers Manual, Excel books, New Delhi, 2010.
2	B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow, Reprinted 2008.
3	Frankl, Viktor E. Yes to Life In spite of Everything, Penguin Random House, London, 2019.
4	Van Zomeren, M., & Dovidio, J. F. The Oxford Handbook of the Human Essence (Eds.), New York Oxford University Press, 2018.
5	B P Banerjee, Foundations of Ethics and Management, Excel Books, 2005.

Mapping of COs with POs						
COs	Program Outcomes (Pos)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	-	-	-
CO2	-	-	-	-	2	-
CO3	2	-	-	-	2	-
CO4	-	-	-	-	2	3
CO5	-	-	-	-	1	-
1–Low, 2 –Medium, 3–High, "-"-No Correlation.						

P24AC101	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

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.

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

REFERENCES:

1	Adrian Wall work, 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's5.book 1998.

P24AC102	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

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.

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

REFERENCES:

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

P24AC201	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

COURSE OUTCOMES:

CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in India Qn politics.
CO2	Discuss the intellectual origins of the frame work of argument that informed the conceptualization of social reforms leading to revolution in India.
CO3	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.
CO4	Discuss the passage of the Hindu Code Bill of 1956.

UNIT I	HISTORY OF MAKING OF THE INDIAN CONSTITUTION	6

History, Drafting Committee, (Composition & Working).

UNIT II	PHILOSOPHY OF THE INDIAN CONSTITUTION	6

Preamble, Salient Features.

UNIT III	CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES	6

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

UNIT IV	ORGANS OF GOVERNANCE	6

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	6

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Panchayat. 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	6

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

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, Pradeep Et.Al.,"Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi, 2001.

P24AC202	நற்றமிழ் இலக்கியம்	L	T	P	C
		2	0	0	0

அலகு I	சங்க இலக்கியம்	6

1. தமிழின் துவக்க நூல் தொல்காப்பியம் – எழுத்து, சொல், பொருள்
2. அகநானூறு (82) - இயற்கை இன்னிசை அரங்கம்.
3. குறிஞ்சிப்பாட்டின் மலர் காட்சி.
4. புறநானூறு (95,195) -போரை நிறுத்திய ஔவையார்

அலகு II	அறநெறித் தமிழ்	6

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

அலகு III	இரட்டைக் காப்பியங்கள்	6

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

அலகு IV	அருள் நெறித் தமிழ்	6

1.சிறுபாணாற்றுப்படை - பாரி முல்லைக்கு தேர் கொடுத்தது பேகன் மயிலுக்கு போர்வை கொடுத்தது
அதியமான் அவ்வைக்கு நெல்லிக்கனி கொடுத்தது அரசர் பண்புகள்.
2.நற்றிணை - அன்னைக்கு உரிய புன்னை சிறப்பு.
3.திருமந்திரம்(61,618) - இயமம் நியமம் விதிகள்.
4.தர்ம சாலையை நிறுவிய வள்ளலார்.
5.புறநானூறு- சிறுவனே வள்ளலானான்.
6.அகநானூறு (4) - வண்டு
7.நற்றிணை(11) - நண்டு
8.கலித்தொகை (11) – யானை, புறா
ஐந்திணை 50(27) - மான் ஆகியவை பற்றிய செய்திகள்.

அலகு V	நவீன தமிழ் இலக்கியம்	6

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

TOTAL : 30 PERIODS

தமிழ் இலக்கிய வெளியீடுகள் புத்தகங்கள்:

1	தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University) - www.tamilvu.org
2	தமிழ் விக்கிபீடியா (Tamil Wikipedia) -https://ta.wikipedia.org
3	தருமபுரி ஆதீன வெளியீடு
4	வாழ்வியல் களஞ்சியம் தமிழ் பல்கலைக்கழகம் =தஞ்சாவூர் தமிழ்கலைக்களஞ்சியம் தமிழ்
5	கலைக் களஞ்சியம் தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6	அறிவியல் கலைக்களஞ்சியம்-தமிழ் பல்கலைக்கழகம் தஞ்சாவூர்.