KSR College of Engineering

NAAC ACCREDITED A++ | NBA ACCREDITED PROGRAMMES

AN AUTONOMOUS INSTITUTION

M.E. - INDUSTRIAL SAFETY AND ENGINEERING

Curriculum &
Syllabus for Semester I and II

REGULATIONS 2024

(Academic Year 2024-25 Onwards)

	K.S.R. COLLEGE OF ENGINEERING: TIRUCHENGODE - 637 215 **(Autonomous)** **M.E(INDUSTRIAL SAFETY ENGINEERING)** **(REGULATIONS 2024)**

Vision of the Institution

IV	To become a globally renowned institution in Engineering and Management, committed to providing holistic education that fosters research, innovation and sustainable development.

Mission of the Institution

IM1	Deliver value-based quality education through modern pedagogy and experiential learning.
IM2	Enrich Engineering and Managerial Skills through cutting-edge laboratories to meet evolving global demands.
IM3	Empower research and innovation by integrating collaboration, social responsibility, and commitment to sustainable development.

Vision of the Department / Programme:

DV	To produce recognized Safety and Fire Engineers with pioneering innovative solutions to enhance safety and promote sustainable development.

Mission of the Department / Programme:

DM 1	Impart quality education through student-centered teaching approaches.
DM 2	Equip students with the cutting-edge knowledge and skills to address the emerging safety challenges.
DM 3	Enhance research and innovation in Safety and Fire Engineering, fostering a culture of safety and sustainability.

Programme Educational Objectives (PEOs) :(Industrial Safety Engineering)

The graduates of the programme will be able to	
PEO 1	**Core Competency**: Graduates will have the ability to apply advanced knowledge in engineering, science, and technology to identify, analyze, and solve complex industrial safety issues using modern tools and techniques.
PEO 2	**Professional Excellence:** Graduates will establish themselves as professionals in safety engineering, capable of designing and implementing effective safety protocols, health management systems, and risk mitigation strategies in diverse industrial environments.
PEO 3	**Leadership and Teamwork:** Graduates will demonstrate leadership, communication, and teamwork skills to effectively manage multidisciplinary teams in achieving safe and sustainable industrial operations.

K.S.R. COLLEGE OF ENGINEERING: TIRUCHENGODE - 637 215
(Autonomous)

M.E(INDUSTRIAL SAFETY ENGINEERING)
(REGULATIONS 2024)

PROGRAMME OUTCOMES (POs) OF M.E(INDUSTRIAL SAFETY ENGINEERING)

Programme Outcomes (POs)	
PO1	**Conduct Investigations of complex Problems:** An ability to independently carry out research / investigation and development work to solve practical problems.
PO2	**Presentation Skill:** An ability to write and present a substantial technical report / document.
PO3	**Scholarship of Knowledge:** Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be a level higher than the requirements in the appropriate bachelor program.
PO4	**Research and Investigation:** Conduct independent research and investigations to address emerging safety issues and contribute to knowledge development in safety engineering.
PO5	**Core values:** Contribute to the core universal human values and social good to community with respect to industrial safety, health and environment.

	K. S. R COLLEGE OF ENGINEERING **An Autonomous Institution** **Approved by AICTE and Affiliated to Anna University, Chennai** **Accredited by NBA,NAAC ('A++' Grade)**	**Curriculum PG R - 2024**
Department	**Department of Mechanical Engineering**	
Programme	**M.E. Industrial Safety Engineering**	

SEMESTER I

S. No.	Course Code	Course Title	Category	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot		CA	ES	Tot
Induction Programme			-	-	-	-	-	-	-	-	-	-
THEORY COURSES												
1	MA24T13	Applied Statistics	FC	45	0	0	45	90	**3**	40	60	100
2	IS24T11	Principles of Safety Management	PCC	45	0	0	45	90	**3**	40	60	100
3	IS24T12	Environmental Safety	PCC	45	0	0	45	90	**3**	40	60	100
4	IS24T13	Industrial Safety, Health and Environment (SHE) Acts	PCC	45	0	0	45	90	**3**	40	60	100
5		Professional Elective – I	PEC	45	0	0	45	90	**3**	40	60	100
6		Professional Elective – II	PEC	45	0	0	45	90	**3**	40	60	100
EMPLOYABILITY ENHANCEMENT COURSES												
7	IS24P11	Technical Presentation - I	EEC	0	0	30	30	60	**2**	60	40	100
			TOTAL	**270**	**0**	**30**	**300**	**600**	**20**	**700**		

SEMESTER II

S. No	Course Code	Course Title	Category	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot		CA	ES	Tot
THEORY COURSES												
1	RM24T09	Research Methodology and IPR	RMC	45	0	0	45	90	**3**	40	60	100
2	IS24T21	Fire Engineering and Explosion Control	PCC	45	0	0	45	90	**3**	40	60	100
3	IS24T22	Electrical Safety	PCC	45	0	0	45	90	**3**	40	60	100
4	IS24T23	Occupational Health and Industrial Hygiene	PCC	45	0	0	45	90	**3**	40	60	100
5		Professional Elective – III	PEC	45	0	0	45	90	**3**	40	60	100
6		Professional Elective – IV	PEC	45	0	0	45	90	**3**	40	60	100
LABORATORY COURSES												
7	IS24P21	Industrial Safety Laboratory	PCC	0	0	30	30	60	**2**	60	40	100
EMPLOYABILITY ENHANCEMENT COURSES												
8	IS24P22	Technical Presentation - II	EEC	0	0	30	30	60	**2**	60	40	100
			TOTAL	**270**	**0**	**60**	**330**	**660**	**22**	**800**		

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Department	**Department of Mechanical Engineering**	
Programme	**M.E. Industrial Safety Engineering**	

SEMESTER III

S. No	Course Code	Course Title	Category	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot		CA	ES	Tot
THEORY COURSES												
1	IS24T31	Human Factors Engineering	PCC	45	0	0	45	90	**3**	40	60	100
2		Professional Elective – V	PEC	45	0	0	45	90	**3**	40	60	100
3		Professional Elective – VI	PEC	45	0	0	45	90	**3**	40	60	100
EMPLOYABILITY ENHANCEMENT COURSES												
4	IS24P31	Project work Phase - I	EEC	0	0	90	90	180	**6**	60	40	100
5	IS24P32	Internship *	EEC	0	0	90	90	180	**6**	100	-	100
AUDIT COURSES												
6		Audit course	AC	30	0	0	30	60	**0**	100	-	100
TOTAL				**165**	**0**	**180**	**345**	**690**	**21**	**600**		

* **- Students should undergo internship during the II semester summer vacation**

SEMESTER IV

S. No	Course Code	Course Title	Category	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot		CA	ES	Tot
EMPLOYABILITY ENHANCEMENT COURSES												
1	IS24P41	Project work Phase - II	EEC	0	0	180	180	360	**12**	60	40	100
TOTAL				**0**	**0**	**180**	**180**	**360**	**12**	**100**		
TOTAL CREDITS									**75**			

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 75
Note:FC - Foundation Courses, PCC - Professional core courses, PEC- Professional Elective courses, EEC - Employability Enhancement Coursesand AC- Audit courses.

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Department	**Department of Mechanical Engineering**	
Programme	**M.E. Industrial Safety Engineering**	

FOUNDATION COURSES (FC)

S. No.	Course Code	Course Title	Sem	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot		CA	ES	Tot
1	MA24T13	Applied Statistics	I	45	0	0	45	90	**3**	40	60	100
		TOTAL		**45**	**0**	**0**	**45**	**90**	**3**	**100**		

PROFESSIONAL CORE COURSES (PCC)

S. No.	Course Code	Course Title	Sem	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot		CA	ES	Tot
1	IS24T11	Principles of Safety Management	I	45	0	0	45	90	**3**	40	60	100
2	IS24T12	Environmental Safety	I	45	0	0	45	90	**3**	40	60	100
3	IS24T13	Industrial Safety, Health and Environment (SHE) Acts	I	45	0	0	45	90	**3**	40	60	100
4	IS24T21	Fire Engineering and Explosion Control	II	45	0	0	45	90	**3**	40	60	100
5	IS24T22	Electrical Safety	II	45	0	0	45	90	**3**	40	60	100
6	IS24T23	Occupational Health and Industrial Hygiene	II	45	0	0	45	90	**3**	40	60	100
7	IS24P21	Industrial Safety Laboratory	II	0	0	30	30	60	**2**	60	40	100
8	IS24T31	Human Factors Engineering	III	45	0	0	45	90	**3**	40	60	100
		TOTAL		**315**	**0**	**30**	**345**	**690**	**23**	**800**		

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	Course Code	Course Title	Sem	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot		CA	ES	Tot
1	IS24P11	Technical Presentation - I	I	0	0	30	30	60	**2**	60	40	100
2	IS24P22	Technical Presentation - II	II	0	0	30	30	60	**2**	60	40	100
3	IS24P31	Project work Phase - I	III	0	0	90	90	180	**6**	60	40	100
4	IS24P32	Internship	III	0	0	90	90	180	**6**	100	-	100
5	IS24P41	Project work Phase - II	IV	0	0	180	180	360	**12**	60	40	100
		TOTAL		**0**	**0**	**420**	**420**	**840**	**28**	**500**		

PROFESSIONAL ELECTIVE COURSES (PEC)												
PROFESSIONAL ELECTIVES – I and II (SEMESTER – I)												
S. No.	**Course Code**	**Course Title**	**Sem**	**Periods / Semester**					**Credit**	**Max. Marks**		
				L	**T**	**P**	**SL**	**Tot**		**CA**	**ES**	**Tot**
1	IS24E01	Safety in Construction	I	45	0	0	45	90	**3**	40	60	100
2	IS24E02	Dock Safety	I	45	0	0	45	90	**3**	40	60	100
3	IS24E03	Artificial Intelligence and Expert systems	I	45	0	0	45	90	**3**	40	60	100
4	IS24E04	Plant Layout and Materials Handling	I	45	0	0	45	90	**3**	40	60	100
5	IS24E05	Additive Manufacturing	I	45	0	0	45	90	**3**	40	60	100
6	IS24E06	Advanced Materials	I	45	0	0	45	90	**3**	40	60	100
7	IS24E07	Safety in Mines	I	45	0	0	45	90	**3**	40	60	100
8	IS24E08	Fireworks safety	I	45	0	0	45	90	**3**	40	60	100
9	IS24E09	Welding Economics, Management and Safety	I	45	0	0	45	90	**3**	40	60	100
10	IS24E10	Food Processing, Preservation and Transport	I	45	0	0	45	90	**3**	40	60	100
PROFESSIONAL ELECTIVES – III and IV (SEMESTER – II)												
S. No.	**Course Code**	**Course Title**	**Sem**	**Periods / Semester**					**Credit**	**Max. Marks**		
				L	**T**	**P**	**SL**	**Tot**		**CA**	**ES**	**Tot**
1	IS24E11	OHSAS18001 and ISO14001	II	45	0	0	45	90	**3**	40	60	100
2	IS24E12	Safety in Chemical Industries	II	45	0	0	45	90	**3**	40	60	100
3	IS24E13	Non Destructive Testing and Evaluation	II	45	0	0	45	90	**3**	40	60	100
4	IS24E14	Reliability Engineering	II	45	0	0	45	90	**3**	40	60	100
5	IS24E15	Optimization Techniques in Manufacturing	II	45	0	0	45	90	**3**	40	60	100
6	IS24E16	Quality Engineering	II	45	0	0	45	90	**3**	40	60	100
7	IS24E17	Computer Aided Hazard Analysis	II	45	0	0	45	90	**3**	40	60	100
8	IS24E18	Advanced Metrology and Non Destructive Testing	II	45	0	0	45	90	**3**	40	60	100
9	IS24E19	Safety in Engineering Industry	II	45	0	0	45	90	**3**	40	60	100
10	IS24E20	Materials Testing and Characterization Techniques	II	45	0	0	45	90	**3**	40	60	100

PROFESSIONAL ELECTIVES – V and VI (SEMESTER – III)												
S. No	**Course Code**	**Course Title**	**Sem**	**Periods / Semester**					**Credit**	**Max. Marks**		
				L	**T**	**P**	**SL**	**Tot**		**CA**	**ES**	**Tot**
1	IS24E21	Work Study and Ergonomics	III	45	0	0	45	90	**3**	40	60	100
2	IS24E22	Safety in Powder Handling	III	45	0	0	45	90	**3**	40	60	100
3	IS24E23	Nuclear Engineering and Safety	III	45	0	0	45	90	**3**	40	60	100
4	IS24E24	Safety in Textile Industry	III	45	0	0	45	90	**3**	40	60	100
5	IS24E25	Transport Safety	III	45	0	0	45	90	**3**	40	60	100
6	IS24E26	Energy Conservation and Management	III	45	0	0	45	90	**3**	40	60	100
7	IS24E27	Plastics and Composite Materials	III	45	0	0	45	90	**3**	40	60	100
8	IS24E28	Industrial Safety Engineering	III	45	0	0	45	90	**3**	40	60	100
9	IS24E29	Fire Engineering and Protection	III	45	0	0	45	90	**3**	40	60	100
10	IS24E30	Food and Bio-safety	III	45	0	0	45	90	**3**	40	60	100
AUDIT COURSES (SEMESTER – III)												
S. No	**Course Code**	**Course Title**	**Sem**	**Periods / Semester**					**Credit**	**Max. Marks**		
				L	**T**	**P**	**SL**	**Tot**		**CA**	**ES**	**Tot**
1	AX24A01	Disaster Management	III	30	0	0	0	30	**0**	100	-	100
2	AX24A02	Value Education	III	30	0	0	0	30	**0**	100	-	100
3	AX24A03	Constitution of India	III	30	0	0	0	30	**0**	100	-	100
4	AX24A04	Indian Knowledge System	III	30	0	0	0	30	**0**	100	-	100
RESEARCH METHODOLOGY COURSE (RMC)												
S. No	**Course Code**	**Course Title**	**Sem**	**Periods / Semester**					**Credit**	**Max. Marks**		
				L	**T**	**P**	**SL**	**Tot**		**CA**	**ES**	**Tot**
1	RM24T09	Research Methodology and IPR	II	45	0	0	45	90	**3**	40	60	100

Summary						
Name of the Programme: M.E Industrial Safety Engineering						
CATEGORY	**I**	**II**	**III**	**IV**	**TOTAL CREDITS**	**%**
FC	3				**3**	**04.00**
PCC	9	11	3		**23**	**30.66**
PEC	6	6	6		**18**	**24.00**
EEC	2	2	12	12	**28**	**37.33**
AC			✓			**-**
RMC		3			**3**	**04.00**
Total	**20**	**22**	**21**	**12**	**75**	**100**

MA24T13	APPLIED STATISTICS	Category	L	T	P	SL	C
		FC	45	0	0	45	3

PREREQUISITE

The students should have basic knowledge in data collection, data analysis, data interpretation and research design.

OBJECTIVES:

- Understand the concept of hypothesis testing.
- Learn to select and apply the appropriate statistical test.
- Develop the skills in design of experiments.
- Experience the concepts of correlation, regression, and time series.
- Use various charts to represent the quality of the process.

UNIT – I	PARAMETRIC TESTS	9

Sampling distributions - Test for significance of small samples: Student's t- test for testing single sample mean - two sample mean - Fiducial limits for population mean - Testing Significance of large samples (Z- test) for mean of a random sample - testing difference between means of two samples (Independent and dependent samples) - Chi square distribution - Independent of Attributes - F-Ratio test for equality of variances.

UNIT - II	NON-PARAMETRIC TESTS	9

Advantages of Non-Parametric tests – The Sign test, A rank sum test: The Mann-Whitney U test, The Kruskal - Wallis or H-test, One sample Run test.

UNIT - III	DESIGN OF EXPERIMENTS	9

Analysis of variance – One-way and two-way classifications – Completely randomized design – Randomized block design –Latin square design.

UNIT - IV	CORRELATION, REGRESSION & TIME SERIES ANALYSIS	9

Karl Pearson's Co efficient of Correlation - Spearman's rank correlation - Regression analysis - Principle of least squares- Fitting straight line trends.

UNIT - V	QUALITY CONTROL	9

Introduction – Types of control Charts – Advantage and limitation of Statistical Quality Control - $\bar{X}$ and R charts – Control charts for P and nP charts - Control chart for the standard deviations σ-chart.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Formulate and test hypotheses using appropriate statistical tests.	Understand
CO2	Apply non-parametric tests to real world data to understand the advantages of them.	Apply
CO3	Design and analyze the experiments using various designs such as CRD, RBD, and LSD.	Analyze
CO4	Assess relationships between variables using correlation, regression and time series.	Apply
CO5	Construct and interpret control charts for process monitoring to improve the quality control.	Analyze

TEXT BOOKS:

1. Freund John, E and Miller, Irvin, "Probability and Statistics for Engineering", Prentice Hall, 5th

Edition 2013.
2. S.P. Gupta , "Statistical Methods ", Sultan Chand & sons, New Delhi, 19th Edition 2022.

REFERENCES:

1.Gupta S.C., Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 12th Edition 2022.
2.Devore, J. L., "Probability and Statistics for Engineering and the Sciences",Cengage Learning, 9th Edition 2020.
3. Eugene L. Grant, Richard S. Leavenworth, "Statistical Quality Control", McGraw-Hill Publications, 7th Edition 2017.
4.Richard A. Johnson, Dean W. Wichern, "Applied Multivariate Statistical Analysis", Pearson Education, Asia, 6th Edition 2012.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-
Avg.	3	-	-	-	-	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24T11	PRINCIPLES OF SAFETY MANAGEMENT	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE:
Courses in industrial safety often require foundational knowledge of engineering disciplines such as mechanical, civil, or electrical engineering.

OBJECTIVE(S):
To impart foundational knowledge and understanding of safety management principles, enabling students or professionals to identify, evaluate, and control workplace hazards. The course aims to develop competencies in implementing effective safety systems, ensuring regulatory compliance, promoting a proactive safety culture, and minimizing risks across industrial operations.

UNIT - I	CONCEPTS AND TECHNIQUES	(9)

Content Evolution of modern safety concept - Safety Management functions - planning for safety for optimization of productivity -productivity, quality and safety - line and staff functions for safety - safety committee - budgeting for safety - safety policy - Statutory Provisions for safety management. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

UNIT - II	SAFETY AUDIT - INTRODUCTION	(9)

Components of safety audit, types of audit, audit methodology, 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 PREVENTION	(9)

Basic Principle of Accident & Prevention concept of an accident, reportable and non reportable accidents, reporting to statutory authorities - principles of accident prevention - accident investigation and reporting - Accident analysis - based on causes & injury - records for accidents, departmental accident reports, documentation of accidents - unsafe act and condition - Accident causation theories - 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 such as hands on training and tabletop exercise - Programme, seminars, conferences, competitions - method of promoting safe practice – motivation - communication -safety attitude and culture - 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.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Analyze the concepts and techniques of safety management functions.	Analyze
CO2	Recall about safety audit and to prepare a report for the audit.	Understand
CO3	Acquire knowledge on the principles of accident and its control	Understand

	methods.	
CO4	Evaluate the accident cost using supervisors report and data.	Understand
CO5	Recall the role of various agencies in safety education and training.	Understand

TEXT BOOKS:

1. Blake, R.B., Industrial Safety, Prentice Hall Inc, Delhi, Third Edition, 2009.
2. Heinrich, H.W., Industrial Accident Prevention, McGraw-Hill Company, New York, Fifth Edition, 2019.

REFERENCES:

1. Relevant India Acts and Rules, Government of India.
2. Krishnan, N.V., Safety Management in Industry, Jaico Publishing House, Bombay, Second Edition, 2017.
3. Lees, F.P., Loss Prevention in Process Industries, Butterworth publications, London, Second edition, 2001.
4. John Ridley., Safety at Work, Butterworth and Co, London, Seventh Edition, 2003.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	1	2	3	2	-	-	-	-	-	-	-	-
CO2	-	1	2	3	2	-	-	-	-	-	-	-	-
CO3	-	1	2	3	2	-	-	-	-	-	-	-	-
CO4	-	1	2	3	2	-	-	-	-	-	-	-	-
CO5	-	1	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24T12	ENVIRONMENTAL SAFETY	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE

Understanding of ecological systems, pollution, and environmental regulations.

OBJECTIVE(S):

The main emphasis is given on the topics relevant to air and water pollution, the origin of various pollutants, the effects on man and on the environment and the methods available to control them. The fundamental aspects stressed and due importance is given to their application to the design of pollution control equipment.

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 Statutory provisions related to air pollution.

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 - Statutory provisions related to water pollution.

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 vitrification - hazards due to bio-process - dilution standards and restrictions - recycling and reuse - statutory provisions related to hazardous waste management & handling.

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 like cement, paper and petroleum - petroleum products - textile - tanneries thermal power plants - dying and pigment industries - eco-friendly energy.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Gain about the air pollution effects and its control.	Remember
CO2	Analyze about the water pollutants and its health hazards.	Analyze
CO3	Apply the health and safety concepts with respect to hazardous waste management.	Apply
CO4	Acquire knowledge on environmental measurement and its control.	Understand
CO5	Demonstrate the health and safety practices in controlling risks for	Understand

	different engineering activities.	

TEXT BOOKS:

1. Rao, C.S. ,Environmental Pollution Engineering, Wiley Eastern Limited,New Delhi, Third Edition, 2020.
2. Mahajan, S.P., Pollution Control in Process Industries, Tata McGraw Hill Publishing Company,New Delhi, Fifth Edition, 2001.

REFERENCES:

1. Rao, C.S., Environmental Pollution Engineering, Wiley Eastern Limited, New Delhi, Third Edition, 2020.
2. Mahajan, S.P. ,Pollution Control in Process Industries, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition, 2001.
3. Varma and Braner, Air Pollution Equipment, Springer Publishers, New Delhi, Second Edition,2017.
4. Rao, C.S., Environmental Pollution Engineering, Wiley Eastern Limited, New Delhi, Third Edition, 2020.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	1	2	3	2	-	-	-	-	-	-	-	-
CO2	-	1	2	3	2	-	-	-	-	-	-	-	-
CO3	-	1	2	3	2	-	-	-	-	-	-	-	-
CO4	-	1	2	3	2	-	-	-	-	-	-	-	-
CO5	-	1	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24T13	INDUSTRIAL SAFETY, HEALTH AND ENVIRONMENT (SHE) ACTS	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE

Familiarity with workplace health and safety regulations, including risk assessments and health management practices.

OBJECTIVE(S):

To provide comprehensive knowledge of statutory provisions and legal frameworks related to industrial safety, occupational health, and environmental protection, enabling students to understand, interpret, and apply SHE-related acts, rules, and regulations for ensuring compliance and promoting safe and sustainable industrial practices.

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 - 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 CHEMICAL RULES 1989	(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.

UNIT - IV	OTHER ACTS AND RULES	(9)

Indian Boiler Act 1923, Static and Mobile Pressure Vessel Rules (SMPV), Motor Vehicle Rules, Mines Act 1952, Workman Compensation Act, Rules - Electricity Act and Rules - Hazardous Wastes (Management and Handling) Rules, 1989, with amendments in 2000 - The Building and Other Construction Workers Act 1996., Petroleum rules, Gas cylinder rules - Explosives Act 1983 - Pesticides Act.

UNIT - V	INTERNATIONAL ACTS AND STANDARDS	(9)

Occupational Safety and Health Act of USA (The Williams - Steiger Act of 1970) - Health and Safety Work Act (HASAWA) 1974, UK - SHAS 18001 - ISO 45001 - American National Standards Institute (ANSI).

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Gain the health and welfare provisions as given in factories act	Understand
CO2	Acquire knowledge on environment act with respect to air and water pollution.	Understand

CO3	Analyze the responsibilities of occupier according to manufacture, storage and import of chemical rules	Analyze
CO4	Apply the other legislation acts pertaining to health and safety.	Apply
CO5	List out the various international acts and rules.	Remember

TEXT BOOKS:

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000.
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt. Ltd., New Delhi, Second Edition, 2019.

REFERENCES:

1. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt. Ltd., Allahabad, Second Edition, 2011
2. The Mines Act 1952, Commercial Law Publishers (India) Pvt. Ltd., Allahabad, Second Edition, 2019.
3. National seminar on hazardous waste management ,National Safety council, Ministry of environment and forests, Government of India, United State - Asia environmental partnership, Tamilnadu pollution control board and Indian chemical manufacturers association, April 2009.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	2	2	3	2	-	-	-	-	-	-	-	-
CO2	-	2	2	3	2	-	-	-	-	-	-	-	-
CO3	-	2	2	3	2	-	-	-	-	-	-	-	-
CO4	-	2	2	3	2	-	-	-	-	-	-	-	-
CO5	-	2	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24P11	TECHNICAL PRESENTATION - I	Category	L	T	P	SL	C
		EEC	0	0	30	30	2

PREREQUISITE

Familiarity with presentation software such as Microsoft PowerPoint, Google Slides, or other tools used to create technical presentations.

OBJECTIVE(S):

To develop students' ability to effectively communicate technical information through structured oral and visual presentations, enhancing their skills in research, organization, delivery, and the use of modern presentation tools for professional and academic settings.

1. The students have to refer the journals and conference proceedings and collect the published literature.
2. By mutual discussions with the faculty in-charge the student can decide a topic in general.
3. The student is expected to collect at least 20 such research papers published in the last 5 years.
4. Using OHP / Power Point, the student has to make presentation for 20 minutes followed by 10 minutes discussion.
5. The student has to make five presentations in the semester.
6. The student has to write a technical report for about 30 - 50 pages (Title page, One page Abstract, Review of Research paper under various sub - headings, concluding remarks and list of references). The technical report has to be submitted to the course coordinator one week before the final presentation.

L=0,P=30, SL=30,TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Identify the problems in general area of interest by the student.	Understand
CO2	Incorporate the area / problem by referring journals, conference proceedings etc.	Remember
CO3	Enhance the collective skills between theoretical knowledge and real time problems.	Understand
CO4	Gain knowledge on the problem by presentation and review.	Remember
CO5	Acquire idea on report writing and presentation.	Understand

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	1	2	2	-	-	-	-	-	-	-	-
CO2	2	3	1	2	2	-	-	-	-	-	-	-	-
CO3	2	3	1	2	2	-	-	-	-	-	-	-	-
CO4	2	3	1	2	2	-	-	-	-	-	-	-	-
CO5	2	3	1	2	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

RM24T09	RESEARCH METHODOLOGY AND IPR	Category	L	T	P	SL	C
		RMC	45	0	0	45	3

(Common to PED, EST,CAD/CAM,ISE and CS)

PREREQUISITE: A basic understanding of academic writing and critical thinking skills to analyze research literature, familiarity with fundamental statistical concepts for data analysis, and a strong grasp of core subject knowledge relevant to the student's field. Additionally, a general awareness of legal principles related to intellectual property, ethical research practices, and innovation trends will enhance the student's ability to engage with both research methodologies and IPR concepts.

OBJECTIVES:

- To equip students with the ability to design and conduct rigorous research, employing appropriate methodologies, and critically analyzing results.
- To foster the ability to critically evaluate academic literature, identify research gaps, and formulate research questions.
- To enable students to effectively communicate research findings and legal arguments, both in written form and through presentations, to academic and professional audiences.
- To instill an understanding of ethical issues in research, including responsible conduct, data integrity, and the ethical use of intellectual property.
- To provide a comprehensive understanding of intellectual property rights, including patents, trademarks, copyrights, and their application in various industries.

UNIT - I	RESEARCH DESIGN	(9)

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

UNIT - II	DATA COLLECTION AND SOURCES	(9)

Measurements: Measurement Scales – Questionnaires and Instruments – Sampling and Methods. Data - Preparing, Exploring, Examining and displaying.

UNIT - III	DATA ANALYSIS AND REPORTING	(9)

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

UNIT - IV	INTELLECTUAL PROPERTY RIGHTS	(9)

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

UNIT - V	PATENTS	(9)

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

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1:	Develop a suitable research process to solve real-time problems.	Apply
CO2:	Apply appropriate methods to collect qualitative and quantitative data for analysis.	Apply
CO3:	Apply appropriate statistical tools to analyze data and solve research problems.	Apply
CO4:	Describe the types and features of intellectual property and its role in IPR establishment.	Apply
CO5:	Illustrate the patent procedures, E-filling, register of patents, and licensing of patents.	Apply

TEXT BOOKS:

1	Cooper Donald, R., Schindler Pamela, S., and Sharma, J.K., "Business Research Methods", Tata McGraw Hill Education, Eleventh Edition, 2012.
2	Catherine J. Holland, Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets, Entrepreneur Press, 2007.

REFERENCES:

1	David Hunt, Long Nguyen, Matthew Rodgers, Patent Searching: Tools & Techniques, Wiley, 2007.
2	The Institute of Company Secretaries of India, Statutory body under an Act of Parliament, Professional Programme Intellectual Property Rights, Law and Practice, September 2013.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PSO1	PSO2
CO1	3	3	1	1	-	-
CO2	3	3	1	1	-	-
CO3	3	3	1	1	-	-
CO4	3	3	1	1	-	-
CO5	3	3	1	1	-	-

1 - Low, 2 - Medium, 3 - High

IS24T21	FIRE ENGINEERING AND EXPLOSION CONTROL	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE

A basic understanding of safety protocols, hazard management, and risk assessment in industrial environments.

OBJECTIVE(S):

To provide students with comprehensive knowledge of fire science, fire behavior, and explosion mechanisms, and to equip them with the skills necessary to analyze, design, and implement effective fire prevention, protection, and explosion control systems in industrial and built environments, in accordance with safety standards and regulations.

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, Pasadena Texas, Piper Alpha, Peterborough & 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 - 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 - CO_2 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

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 - exits - width calculations - fire certificates - fire safety requirements for high rise buildings - snookers

UNIT - V	EXPLOSION PROTECTING SYSTEMS	(9)

Principles of explosion - detonation and blast waves - explosion parameters - Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure - explosion venting - inert gases, plant for generation of inert gas - rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO 2) and halons - hazards in LPG, ammonia (NH_3), sulphur dioxide (SO_3), chlorine (Cl_2) etc.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Recall about the fire properties of solid, liquid and gases and understand the principle of fire and combustion Theory.	Understand

CO2	Gain knowledge about the fire prevention and fire protection systems.	Understand
CO3	Acquire knowledge on different sources of ignition, classes of fires and their extinguishing medium	Understand
CO4	Ability to know the objective of building fire safety and relevant standards.	Understand
CO5	Apply the principles of explosion and understand about their protecting systems.	Apply

TEXT BOOKS:

1. Derek, James, Fire Prevention Hand Book, Butter Worths and Company,London, Ninth edition, 2016 .
2. Gupta, R.S., Hand Book of Fire Technology, Orient Longman, Bombay, Second Edition, 1993.

REFERENCES:

1. Accident Prevention manual for industrial operations, N.S.C., Chicago,Second Edition,1982.
2. DinkoTuhtar, Fire and explosion Protection,E.Horwood, Second Edition, 1989
3. Davis Daniel et al, Hand Book of fire technology.
4. Fire fighters hazardous materials reference book for Fire Prevention in Factories, Van Nostrand Rein Hold, Second Edition, New York, 1991.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1-low, 2-medium, 3-high

IS24T22	ELECTRICAL SAFETY	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE

Basic understanding of physical principles related to electricity and electromagnetism.

OBJECTIVE(S):

To enable participants to identify electrical hazards, apply safe work practices—including PPE use and comply with relevant standards in order to prevent electrical accidents, injuries, fires, and equipment damage.

UNIT - I	CONCEPTS AND STATUTORY REQUIREMENTS	(9)

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

UNIT - II	ELECTRICAL HAZARDS	(9)

Primary and secondary hazards - shocks, burns, scalds, falls - human safety in the use of electricity. Energy leakage - clearances and insulation - classes of insulation - voltage classifications - excess energy - current surges - Safety in handling of war equipment's - 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. High voltage Hazards, Lightning, hazards, lightning arrestor, installation - earthing, specifications, earth resistance, earth pit maintenance

UNIT - III	PROTECTION SYSTEMS	(9)

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

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 zone - 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.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Familiarize the basic concepts in electrical circuit and hazards involved in it.	Remember
CO2	Analyze the different types of electrical hazards in industries	Analyze
CO3	Acquire knowledge about the different types of protection systems.	Understand
CO4	Apply the knowledge in the selection, installation, operation and maintenance of portable tools	Apply
CO5	Classify the different hazardous zones in Industries.	Understand

TEXT BOOKS:

1. Dr.Massim A.G. Mitolo., Electrical safety of Low voltage systems, McGraw Hill, Second Edition, 2009
2. Accident prevention manual for industrial operations, N.S.C., Chicago, Third edition,2008.

REFERENCES:

1. Fordham Cooper, W., Electrical Safety Engineering., Butterworth and Company, London, Third edition,2002
2. Accident prevention manual for industrial operations, N.S.C., Chicago, Third edition,2008.
3. Indian Electricity Act and Rules, Government of India,2003
4. Power Engineers – Handbook of TNEB, Chennai, 1989.
5. Martin Glove Electrostatic Hazards in powder handling, Research Studies Pvt Ltd., England, Second Edition,1988.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1-low, 2-medium, 3-high

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IS24T23	OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE

Familiarity with the basic concepts of industrial hygiene, including hazard identification and control measures.

OBJECTIVE(S):

To equip students with comprehensive expertise in identifying, evaluating, and controlling workplace hazards—spanning chemical, physical, biological, ergonomic, and psychosocial risks—and to instill effective practices in occupational health surveillance, industrial hygiene, regulatory compliance, and continuous improvement for protecting worker well-being and productivity.

UNIT - I	PHYSICAL HAZARDS	(9)

Noise, types, Industrial noise, compensation aspects, noise exposure regulation and control, properties of sound, occupational damage, risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, noise control programmes, industrial audiometry, hearing conservation programmes.

Vibration, types, effects, instruments, surveying procedure, permissible exposure limit and control.Ionizing radiation, types, effects, monitoring instruments, control programmes, OSHA standard - non-ionizing radiations, effects, types, radar hazards, microwaves and radio-waves, lasers TLV - cold environments, hypothermia, wind chill index, control measures - hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control.

UNIT - II	CHEMICAL HAZARDS	(9)

Recognition of chemical hazards - dust, fumes, mist, 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 Bio-hazardous agents - examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents and infectious diseases - biohazard control programmes, employee health programmes - laboratory safety programmes - 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

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Acquire knowledge on the various physiological functions of our body, their effects and control.	Understand
CO2	Recall the various types of chemical hazards and their control methods.	Understand
CO3	Analyze the various types of occupational diseases arising out of biological agents.	Analyze
CO4	Demonstrate effectively about the occupational health and toxic nature among the employees and with society at large.	Apply
CO5	Recall about the physiology of work with the working environment.	Understand

REFERENCES:

1. Hand book of Occupational Safety and Health, National Safety Council, Chicago,Second Edition, 2012.
2. Encyclopedia of Occupational Health and Safety, Vol - I and II, International Labour Office,Geneva, Fourth Edition, 2000.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**-**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**-**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**-**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**-**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**-**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1-low, 2-medium, 3-high

IS24P21	INDUSTRIAL SAFETY LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	30	30	2

PREREQUISITE

Knowledge of basic laboratory safety procedures and protocols, including the use of personal protective equipment (PPE) and safe handling of materials.

OBJECTIVE(S):

To expertise the students in selection and usage of safety equipment and monitor the various parameters that affect the environment.

LIST OF EXPERIMENTS

1. Carryout the Noise level Measurement for a given area and compare with the standards.
2. Find the illumination level of a given area using the Lux meter.
3. Find the percentage of CO_2, CO, SO_2 and O_2 present in the exhaust gas of a given diesel/petrol engine using Exhaust gas analyzer under different loading conditions.
4. Find the total mass of the suspended particulate matter in a given area using the respirable dust sampler.
5. Determine the earth resistance and resistivity by using the earth resistance for the given soil.
6. Find the insulation resistance for the given motor and cable using insulation tester.
7. Identify the given PPE's and explain in detail about its usage.
8. Identify the various types of fire extinguishers and elaborate in detail about its operation and method of extinguishing.
9. Find the toxic and flammable level of the given chemical using dispersion modeling (ALOHA) software.
10. What is meant by First-aid and what are the items to be kept in the first-aid box? Explain briefly.

LIST OF EQUIPMENTS

1. Noise level meter - 1 No.
2. Lux meter - 1 No.
3. Exhaust gas analyzer- 1 No.
4. Respirable dust sampler - 1 No.
5. Earth resistance tester - 1No.
6. Insulation tester - 1No.
7. PPE set – 1 No.
8. Fire extinguisher set – 1 No.
9. ALOHA Software (*on-line – trial version)- 1 No.
10. First-aid kit - 1 No.

L=0,P=30, SL=30,TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Analyze about the various equipments to bring out the safety environment in the industry.	Analyze
CO2	Gain knowledge about the various sources of particular matter and assess the impact of air pollution.	Understand
CO3	Learn about the usage of fire extinguishers and its operation.	Understand
CO4	Acquire knowledge on insulation and earth resistance.	Understand
CO5	Demonstrate the use of software and hence to predict the real situations on major accidents.	Apply

Mapping of COs with POs and PSOs													
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**1**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
1-low, 2-medium, 3-high													

IS24P22	TECHNICAL PRESENTATION - II	Category	L	T	P	SL	C
		EEC	0	0	30	30	2

PREREQUISITE

Familiarity with presentation software such as Microsoft PowerPoint, Google Slides, or other tools used to create technical presentations.

OBJECTIVE(S):

To equip participants with the essential skills to design and deliver structured, engaging, and audience-focused technical presentations—ensuring clarity, credibility, and impact through effective storytelling, visuals, and delivery techniques.

- The students have to refer the journals and conference proceedings and collect the published literature.
- By mutual discussions with the faculty in-charge the student can decide a topic related to area /subject.
- The student is expected to collect at least 20 such research papers published in the last 5 years.
- Using OHP / Power Point, the student has to make presentation for 20 minutes followed by 10 minutes discussion.
- The students should visit an industry, has to make five presentations and a report of the same in the semester.
- The student has to write a technical report for about 30 - 50 pages (Title page, One page Abstract, Review of Research paper under various sub - headings, concluding remarks and list of references). The technical report has to be submitted to the course coordinator one week before the final presentation, after the approval of the faculty in-charge.

L=0,P=30, SL=30,TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Identify the problems in general area of interest by the student.	Understand
CO2	Explore the area / problem by referring journals, conference proceedings etc.	Understand
CO3	Enhance the collective skills between theoretical knowledge and real time problems.	Understand
CO4	Gain knowledge on the area by presentation and review.	Understand
CO5	Acquire idea on report writing and presentation related to the area.	Understand

Mapping of COs with POs and PSOs													
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**2**	**3**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**2**	**3**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**3**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**3**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
1-low, 2-medium, 3-high													

IS24T31	HUMAN FACTORS ENGINEERING	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE

Knowledge of human anatomy and physiology is essential for understanding the physical limitations of the human body in various contexts.

OBJECTIVE(S):

To equip learners with the principles and techniques required to design systems, products, and work environments that enhance human performance, safety, usability, and well-being by systematically integrating human capabilities and limitations throughout the design and operational lifecycle.

UNIT - I	ERGONOMICS AND ANATOMY	(9)

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

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

UNIT - II	HUMAN BEHAVIOR	(9)

Individual differences, Factors contributing to personality, Fitting the man to the job, Influence of difference on safety, Method of measuring characteristics, Accident Proneness. Motivation, Complexity of Motivation, Job satisfaction. Management theories of motivation, Job enrichment theory. Frustration and Conflicts, Reaction to frustration, Emotion and Frustration. Attitudes, determination of attitudes, changing attitudes, learning, principles of learning, forgetting, motivational requirements.

UNIT - III	ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND SEATED WORKS	(9)

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

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

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

UNIT - V	HUMAN SKILL & 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.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Acquire knowledge on ergonomics and its area of application.	Understand
CO2	Gain about human behavior, behavior based system and ABC theory.	Understand
CO3	Apply the concept of anthropometry and work design for standing and seated works.	Apply
CO4	Relate the man machine system and manual handling task and its hazards	Understand
CO5	Recall the principles for the design of visual displays and design of controls	Remember

TEXT BOOKS:

1. Mark S Sanders, Ernest J Mc Cormick., Human Factors In Engineering & Design, McGraw - hill Book Company –Koga, Seventh Edition, 2019.
2. Dan Mc Leod, The Ergonomics Manual, Philip Jacobs & Nancy Larson, New Delhi, Second Edition, 2013.

REFERENCES:

1. Bridger, R.S.,Introduction to Ergonomics, Taylor & Francis, UK, second edition, 2018.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	2	3	2	-	-	-	-	-	-	-	-
CO2	2	1	2	3	2	-	-	-	-	-	-	-	-
CO3	2	1	2	3	2	-	-	-	-	-	-	-	-
CO4	2	1	2	3	2	-	-	-	-	-	-	-	-
CO5	2	1	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24P31	PROJECT WORK PHASE - I	Category	L	T	P	SL	C
		EEC	0	0	90	90	6

PREREQUISITE

Students should have completed most of their core departmental courses to ensure domain knowledge.

OBJECTIVES:

To enable learners to apply theoretical knowledge and develop practical skills by executing a structured, real-world project; this fosters critical thinking, problem-solving, teamwork, communication, time management, and reflective learning in alignment with defined objectives.

1. Every student shall have a supervisor who is the member of the faculty of the institution. Identification of student and his faculty supervisor has to be completed within the first two weeks from the day of beginning of third semester.
2. The students should make industrial visits, identify real time problems and submit reports.
3. In consultation with supervisor, the problem has to be selected.
4. Preferably it can be a collaborative project with industry.
5. A detailed study of the problem and its financial implications and physical and mental hazards can be studied.
6. The methodology to tackle this problem can be studied and analyzed.
7. A mini project report should be submitted at the end of the semester as per guidelines.
8. This project report should be evaluated jointly by external and internal examiners.

L=0,P=90, SL=90,TOTAL: 180 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Identify real time problems.	Applying
CO2	Acquire knowledge on the industrial oriented projects.	Understanding
CO3	Collect the data from the literature surveys and able to find out the solutions.	Creating
CO4	Select the topic based on the critical problems and hazards identified.	Analyzing
CO5	Apply the solutions for the problems identified.	Evaluating

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-	-
CO3	3	3	3	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24P32	INTERNSHIP	Category	L	T	P	SL	C
		EEC	0	0	90	90	6

PREREQUISITE

Students should have completed key foundational and departmental courses to ensure subject-matter understanding relevant to the internship domain.

OBJECTIVES:

To provide interns with structured, hands-on experience that bridges classroom learning and professional practice—enhancing field-specific skills, fostering professional networks, and preparing them for future career advancement through meaningful contributions and reflective development.

GUIDELINES:

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

L=0,P=90, SL=90,TOTAL: 180 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Apply academic knowledge to solve practical problems in a professional environment.	Applying
CO2	Demonstrate an understanding of industrial processes, workflows, and professional practices.	Understanding
CO3	Communicate effectively through technical reports, presentations, and workplace interactions.	Understanding
CO4	Exhibit professional behaviour, teamwork, ethical conduct, and adaptability in a real-world setting.	Applying
CO5	Develop career readiness by gaining hands-on experience in the chosen field of study.	Applying

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	3	2	-	-	-	-	-	-	-	-
CO2	3	3	2	3	2	-	-	-	-	-	-	-	-
CO3	3	3	2	3	2	-	-	-	-	-	-	-	-
CO4	3	3	2	3	2	-	-	-	-	-	-	-	-
CO5	3	3	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24P41	PROJECT WORK PHASE - II	Category	L	T	P	SL	C
		EEC	0	0	180	180	12

PREREQUISITE

Project Work Phase – II typically involves more advanced work, where students apply the knowledge and findings from Phase I to develop detailed solutions or prototypes.

OBJECTIVES:

To advance the project beyond initial concept by validating the problem definition, conducting in-depth planning—including methodology, resources, risk mitigation, and deliverables—and formalizing a structured action and development plan that transitions the project toward final execution and implementation.

1. The supervisor allotted for project phase I will continue to supervise project phase II.
2. As per methodology suggested in phase I, the project can be implemented.
3. Outcome of implementation can be studied and each student shall finally produce a comprehensive report covering back ground information, literature survey, problem statement, results and discussions with conclusion.
4. This final report shall be in type written form as specified in the guidelines.
5. The project report should be evaluated jointly by external and internal examiners.

L=0,P=180, SL=180,TOTAL: 360 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Identify real time problems.	Applying
CO2	Extend knowledge on the industrial oriented projects.	Understanding
CO3	Collect the data from the literature surveys and able to find out the solutions.	Creating
CO4	Classify the topic based on the critical problems and hazards identified.	Analyzing
CO5	Justify the solutions for the problems identified.	Evaluating

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	-	-	-	-	-
CO2	3	3	3	3	2	-	-	-	-	-	-	-	-
CO3	3	3	3	3	2	-	-	-	-	-	-	-	-
CO4	3	3	3	3	2	-	-	-	-	-	-	-	-
CO5	3	3	3	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E01	SAFETY IN CONSTRUCTION	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Understanding of construction processes, methods, and terminology.

OBJECTIVE(S):

To ensure the protection of workers, equipment, and infrastructure by identifying potential hazards, implementing effective safety measures, promoting a safety culture, and complying with statutory regulations, thereby minimizing accidents, injuries, and occupational illnesses at construction sites.

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	SAFETY IN 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.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Demonstrate about the accident causes and the management systems.	*Understand*
CO2	Familiarize about the hazards in construction and their prevention.	*Understand*

CO3	Analyze the safety procedure for working at heights during construction.	*Analyze*
CO4	Apply knowledge selecting, operations, inspection and testing of various construction machinery.	*Apply*
CO5	List out construction regulations and Indian standards for construction and demolition work.	*Remember*

TEXT BOOKS:

1. Rita Yi Man Li, Sun WahPoon, Construction Safety, Springer Heidelberg New York, Dordrecht London, First Edition, 2013.
2. Safety Handbook for the Building and Construction, Incolink (Australian construction association), Australia, First Edition, 2013.

REFERENCES:

1. Charles D. Reese and James V. Edison, Handbook of OSHA Construction safety and health, CRC press, UK, Second Edition, 2006.
2. Jnathea D.Sime, Safety in the Build Environment, London, Second Edition, 1988.
3. Davies, V.J., and Thomas, K., Construction Safety Hand Book, Thomas Telford Ltd., London, 1990.
4. Hudson, R.,Construction hazard and Safety Hand book, Butter Worth's, New Delhi, Second Edition, 1985.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**-**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO2	**1**	**-**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO3	**1**	**-**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO4	**1**	**-**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO5	**1**	**-**	**1**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-

1-low, 2-medium, 3-high

IS24E02	DOCK SAFETY	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Knowledge of basic maritime operations, including docking procedures and vessel handling.

OBJECTIVE(S):

To prevent accidents, injuries, and property damage at docks by enforcing safe practices in loading and unloading operations, ensuring proper use of personal protective equipment (PPE), maintaining equipment and dock structures, and complying with safety regulations to create a secure working environment for dock workers and transport personnel.

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 - storages - types, hazardous cargo.

UNIT - III	LIFTING APPLIANCES	(9)

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

UNIT - IV	TRANSPORT EQUIPMENT	(9)

The different types of equipment for transporting containers and safety in their use safety in the use of self-loading container vehicles, container side lifter and 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 un stacking 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.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Determine the history of legislation towards dock safety.	Understand
CO2	Recall about the cargo ships and the safety precautions in the use of transport equipment.	Understand
CO3	Classify the different types of lifting appliances and its construction and maintenance.	Understand
CO4	Acquire knowledge on various types of transport equipment and their handling of cargos.	Understand
CO5	Apply the emergency action plan for fire and explosions and understand about the dock regulations.	Apply

TEXT BOOKS:

1. Bindra S R ,Course in Dock and Harbour Engineering, DhanpatRai Publications (P) Ltd., New Delhi, 2013.
2. Srinivasan ,Harbour, Dock and Tunnel Engineering, Charotar Publishing House Pvt. Limited, New Delhi, 29th Edition, 2011.

REFERENCES:

1. International Labour Organization, Safety and Health in Dock Work, New York,second edition, 1997.
2. Safety and Health in Dock work, ILO, Third edition, 1992
3. Indian Dock Labourers Act 1934 with rules 1948, Law Publishers (India) Pvt. Ltd., Allahabad, Second Edition, 1932.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO2	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO3	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO4	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO5	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-

1-low, 2-medium, 3-high

IS24E03	ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Familiarity with foundational concepts in machine learning can be beneficial for understanding more advanced AI techniques.

OBJECTIVE(S):

To understand the principles, techniques, and applications of Artificial Intelligence (AI) and Expert Systems in solving complex real-world problems by simulating human reasoning, learning, and decision-making, and to develop intelligent systems that enhance automation, efficiency, and decision support across various domains.

UNIT - I	INTRODUCTION	(9)

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

UNIT - II	COGNITIVE PSYCHOLOGY	(9)

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

UNIT - III	KNOWLEDGE ENGINEERING	(9)

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

UNIT - IV	EXPERT SYSTEMS	(9)

Introduction, knowledge acquisition for expert system, features of expert systems - system structure, inference engines, uncertainties, memory mechanisms, range of applications, actual expert systems - VP expert. Assignment - development of a simple expert system.

UNIT - V	INTRODUCTION TO NEURAL NETWORKS	(9)

Neural Network Architecture - Learning methods - Architecture of a Back Propagation Network - Selection of parameters - Simple variation of BPN.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explore about the measuring intelligence, historical back ground and its applications.	Understand
CO2	Recall the cognitive psychology for identifying real objects and factory vision systems	Understand
CO3	Acquire knowledge engineering based on fuzzy logic and sematic networks.	Remember
CO4	Apply the concept of expert system for knowledge acquisition, system structure and its applications.	Apply
CO5	Familiarize about the neural network architecture and its learning methods.	Understand

TEXT BOOKS:

1. Elaine, R., Kevin and Shivashankar B Nair., Artificial Intelligence 3E (Sie), Tata McGraw Hill, US, Third Edition, 2019.
2. Rajasekaran, S and VijayalakshmiPai., G.A, Neural Networks, Fuzzy Logic and Evolutionary Algorithms - Synthesis and Applications, PHI, Second Edition, 2017.

REFERENCES:

1. Rajendra Akerkar., Introduction to Artificial Intelligence., PHI Learning , Second Edition, 2014.
2. Dan W.Patterson., Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India, New Delhi,Third revision, 1992.
3. Winston, P.H., Artificial Intelligence, Addison Wesley, UK, Third Edition, 1990.
4. Nilsson, N.J., Principles of AI, Narosa Publishing House, UK, Reprint, 1990.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	-	2	3	2	-	-	-	-	-	-	-	-
CO2	1	-	2	3	2	-	-	-	-	-	-	-	-
CO3	1	-	2	3	2	-	-	-	-	-	-	-	-
CO4	1	-	2	3	2	-	-	-	-	-	-	-	-
CO5	1	-	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E04	PLANT LAYOUT AND MATERIALS HANDLING	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Knowledge of logistics, inventory management, and supply chain principles can be beneficial for understanding the broader context of materials handling.

OBJECTIVES:

To design efficient plant layouts and implement effective materials handling systems that optimize the use of space, minimize material movement, reduce production costs, improve workflow, and ensure safety and productivity in manufacturing and service operations.

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.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Acquire knowledge on plant locations and the safe storage of chemicals.	Understand
CO2	Analyze the plant layout and their safety for various types of process industry.	Analyze
CO3	Determine the principles of good ventilation and illumination	Understand
CO4	Gain knowledge on the benefits of an efficient material handling system and lifting tackles.	Understand
CO5	Classify the various types of mechanical material handling devices.	Understand

TEXT BOOKS:

1. Apple M. James., Plant layout and material handling, John Wiley & sons, New York,Third edition, 1977
2. Reymond, A.Kulwice.,Material Handling Hand Book - II, John Wiley and Sons, New York, 1985.

REFERENCES:

1. Safety and good housekeeping, N.P.C. New Delhi, 1985.
2. Industrial ventilation (A manual for recommended practice), American conference of government industrial Hygiene, Thirty Edition, USA, 1984.
3. Rudenko, N., Material handling Equipments, Mir Publishers, Fifth Edition, 1981.
4. Accident prevention manual for industrial operations, N.S.C., Fourth Edition, Chicago, 1982.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO2	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO3	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO4	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO5	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-

1-low, 2-medium, 3-high

IS24E05	ADDITIVE MANUFACTURING	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Proficiency in creating and interpreting engineering drawings or using computer-aided design (CAD) software, essential for designing 3D models.

OBJECTIVE(S):

To understand the principles, processes, and applications of additive manufacturing technologies for producing complex and customized components with high precision, reduced material waste, and faster prototyping, enabling innovation in product design and advanced manufacturing.

UNIT - I	INTRODUCTION TO ADDITIVE MANUFACTURING	(9)

Introduction to Additive Manufacturing: Evolution, fundamental fabrication processes, CAD for RPT, product design and rapid product development - Need for time compression in product development - Conceptual design - Detail design, Prototype fundamentals - Fundamentals of RP systems – RP process chain - 3D modelling -3D solid modeling software and their role in RPT - Data format - STL files- History of RP systems - Classification of RP systems - Benefits of RPT.

UNIT - II	LIQUID BASED RP SYSTEMS	(9)

Liquid based RP systems: Stereo Lithography Apparatus (SLA): Principle, Photo polymers, Post processes, Process parameters, Machine details, Advantages. Solid Ground Curing (SGC): Principle, Process parameters, Process details, Machine details, Limitations. Solid Creation System (SCS): Principle, Process parameters, Process details, Machine details, Applications.

UNIT - III	SOLID BASED RP SYSTEMS	(9)

Solid based RP systems: Fusion Deposition Modeling (FDM): Principle, Raw materials, BASS, Water soluble support system, Process parameters, Machine details, Advantages and limitations. Laminated Object Manufacturing (LOM): Principle, Process parameters, Process details, Advantages and limitations. Solid Deposition Manufacturing (SDM): Principle, Process parameters, Process details, Machine details, Applications.

UNIT - IV	POWDER BASED RP SYSTEMS	(9)

Powder based RP systems: Selective Laser Sintering (SLS): Principle, Process parameters, Process details, Machine details, Advantages and applications. 3-Dimensional Printers (3DP): Principle, Process parameters, Process details, Machine details, Advantages and limitations. Laser Engineered Net Shaping (LENS): Principle, Process details, Advantages and applications.

UNIT - V	RAPID TOOLING AND APPLICATIONS OF RP	(9)

Rapid Tooling and Applications of RP-Different input data types- Direct Rapid Tooling, Indirect Rapid Tooling: Soft tooling and Hard tooling. Applications of RP in Product design, Automotive industry, and Medical field – Conversion of CT/MRI scan data - Customized implant - Case studies -Reverse engineering.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Apply the concepts of rapid prototyping in product design and development	*Apply*
CO2	Select the suitable liquid based rapid prototyping system for a specific application.	*Apply*
CO3	Select the suitable solid based rapid prototyping system for a specific application.	*Apply*

CO4	Select the suitable powder based rapid prototyping system for a specific application	*Apply*
CO5	Apply the concepts of rapid prototyping in product design and development.	*Apply*

TEXT BOOKS:

1. Chua.C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and Applications", World scientific, Newjersy, 2010.
2. Pham D.T. and Dimov S.S, "Rapid Manufacturing", Springer -Verlag, London, 2011.

REFERENCES:

1. Amitabha Ghosh, "Rapid Manufacturing a brief Introduction", Affiliated East West Press, New Delhi, 2011.
2. Gibson, I., Rosen, D.W. and Stucker, B., Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
3. Liou, L.W. and Liou, F.W., Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, Second Edition, 2011

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**2**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO2	**2**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO3	**2**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO4	**2**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO5	**2**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-

1-low, 2-medium, 3-high

IS24E06	ADVANCED MATERIALS	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Knowledge of mechanical behavior of materials, including stress, strain, and deformation.

OBJECTIVES:

To explore the structure, properties, processing, and applications of advanced materials such as composites, polymers, ceramics, biomaterials, and nano materials, with the aim of developing innovative solutions for high-performance, sustainable, and specialized engineering applications.

UNIT - I	INTRODUCTION	(9)

INTRODUCTION TO COMPOSITE MATERIALS: Introduction, classification: polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon–carbon composites, fiber reinforced composites and nature-made composites, and applications.

REINFORCEMENTS: Fibres- glass, silica, kevlar, carbon, boron, silicon carbide, and born carbide fibres.

UNIT - II	POLYMER MATRIX COMPOSITE	(9)

Polymer composites, thermoplastics, thermosetting plastics, manufacturing of PMC, MMC & CCC and their applications.

UNIT - III	MANUFACTURING METHODS	(9)

Autoclave, tape production, moulding methods, filament winding, hand layup, pultrusion, RTM.

UNIT - IV	SHAPE MEMORY ALLOYS	(9)

FUNCTIONALLY GRADED MATERIALS: Types of functionally graded materials-classification different systems-preparation-properties and applications of functionally graded materials.

SHAPE MEMORY ALLOYS: Introduction-shape memory effect-classification of shape memory alloys composition-properties and applications of shape memory alloys.

UNIT - V	NANO MATERIALS	(9)

Introduction-properties at nano scales-advantages & disadvantages-applications in comparison with bulk materials (nano – structure, wires, tubes, composites). State of art nano advanced- topic delivered by student.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Comprehend the construction of composite materials	Understand
CO2	Develop the production process of polymer matrix composites.	Analyze
CO3	Acquire to build the different manufacturing methods.	Understand
CO4	Explore the shape memory alloys and applications.	Understand
CO5	Discover the nano materials and applications.	Analyze

TEXT BOOKS:

1. Mechanics of Composite Materials / R. M. Jones/ McGraw Hill Company, New York, 1975.
2. Analysis of Laminated Composite Structures / L. R. Calcote/Van NostrandRainfold,NY 1969

REFERENCES:

1. Analysis and performance of fibre Composites /B. D. Agarwal and L. J. Broutman /Wiley-Interscience, New York, 1980

2. Mechanics of Composite Materials – Second Edition (Mechanical Engineering) /AutarK.Kaw / CRC Press
3. Nano material /A.K. Bandyopadyay, New age Publishers.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**2**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO2	**2**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO3	**2**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO4	**2**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO5	**2**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-

1-low, 2-medium, 3-high

IS24E07	SAFETY IN MINES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Basic understanding of geological formations and mining geology, as it relates to identifying and managing geological hazards.

OBJECTIVE(S):

To ensure the health and safety of mine workers by identifying and controlling hazards associated with mining operations, enforcing statutory safety regulations, implementing preventive and protective measures, and promoting a culture of safety to minimize accidents, occupational diseases, and environmental risks in mining environments.

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 and 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.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Acquire knowledge on open cast mines and safe handling of explosives.	Understand
CO2	Gain knowledge on underground mines and their working conditions.	Understand
CO3	Demonstrate about the hazards and safety measures in tunneling.	Understand
CO4	Analyze about the concept of risk assessment techniques	Analyze
CO5	Learn about accident analysis and its management systems.	Understand

TEXT BOOKS:

1. D**h**illon, S Balbir *Mine., safety- A modern Approach,* Springer Publication,2010.
2. Hartmann, *Introduction to mining engineering*, Wiley Publications, 2007.

REFERENCES:

1. Fred G. Bell, J. Laurance, *Mining and its impact on environment*, Taylor andFrancis,2006.
2. DGMS Circulars-Ministry of Labour, Government of India press, OR Lovely Prakashan-DHANBAD, 2002.
3. Kejiriwal, B.K., Safety in Mines, GyanPrakashan, Dhanbad, 2001.
4. Michael Karmis ed., Mine Health and Safety Management, SME, Littleton, Co.2001.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	2	3	2	-	-	-	-	-	-	-	-
CO2	2	1	2	3	2	-	-	-	-	-	-	-	-
CO3	2	1	2	3	2	-	-	-	-	-	-	-	-
CO4	2	1	2	3	2	-	-	-	-	-	-	-	-
CO5	2	1	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E08	FIREWORKS SAFETY	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Basic knowledge of the principles and safety considerations of explosives and pyrotechnic materials.

OBJECTIVE(S):

To prevent accidents, injuries, and environmental hazards associated with the manufacturing, storage, handling, transportation, and usage of fireworks by enforcing strict safety protocols, ensuring regulatory compliance, and promoting awareness and safe practices among workers and the public.

UNIT - I	PROPERTIES OF FIREWORKS CHEMICALS	(9)

Fire properties - potassium nitrate (KNO_3), potassium chlorate ($KClO_3$), barium nitrate ($BaNO_3$), calcium nitrate ($CaNO_3$), Sulphur (S), Phosphorous (P), Antimony (Sb), Pyro Aluminum (A1) powder - Reactions - metal powders, Borax, ammonia (NH_3) - 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 - respirable, non-respirable - biological barriers - hazards - personal protective equipment - pollution prevention.

UNIT - III	PROCESS SAFETY	(9)

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	(9)

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

Transportation: 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.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Acquire knowledge on the properties of the chemicals used in the fireworks.	Understand
CO2	Familiarize about the static charge and dust in fireworks factories.	Understand
CO3	Recall about the various types of process in risk related	Understand

	fireworks.	
CO4	Analyze the material handling techniques and transportation of explosives in fireworks	Analyze
CO5	Determine the concepts of waste control and user safety in fireworks	Understand

TEXT BOOKS:

1. Morgan J. Hurley, Daniel T. Gottuk, John R. Hall Jr., SFPE Handbook of Fire Protection Engineering , First Edition, 2015
2. John A. Purkiss, Long-Yuan Li , Fire Safety Engineering Design of Structures, CRC press, UK, Third Edition, 2013.

REFERENCES:

1. Proceedings of National seminar on Fireworks Safety - 1999, MSEC -1999.
2. Purkiss, J.A., Fireworks - Fire Safety Engineering,UK, Third Edition, 1996
3. Bill of Ofca, Fireworks Safety manual,1991
4. Ghosh, K.N., Principles of fireworks, Khatsuria, H., Sivakasi, Second Edition, 1987.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO2	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO3	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO4	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-
CO5	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	-	-

1-low, 2-medium, 3-high

IS24E09	WELDING ECONOMICS, MANAGEMENT AND SAFETY	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:
Understanding of fundamental welding processes, techniques, and equipment.

OBJECTIVES:
To develop an in-depth understanding of cost-effective welding practices, efficient management of welding operations, and implementation of safety standards by analyzing welding economics, optimizing resource utilization, planning workflows, and minimizing risks to ensure productivity, quality, and a safe working environment.

UNIT - I	FACTORS INFLUENCING WELDING ECONOMICS	(9)

Welding design- selection of electrodes, size, type and metal recovery – electrode efficiency, sub, thrown away electrodes – over welding and joint fit – up welding position - operation factor – jigs, fixtures, positioners, Operator efficiency.

UNIT - II	ESTIMATION OF WELDING TIME	(9)

Need for time standard – definition of standard time- various methods of computing standard time – analytical calculation – computerisation of time standards

UNIT - III	ESTIMATION ANDCOSTING FOR WELDING	(9)

Definition of terms – composition of welding costs, cost of consumables – labour cost – cost over heads - formulae for total cost – cost curves for different processes like GMAW, SAW, ESW, Mechanization in welding – job shop operation.

UNIT - IV	PROCESS AND PLANT LAY OUT	(9)

Process vs product lay out – construction – service consideration – employees- services, welding shop equipment, oxy acetylene stations- resistance welding stations – inert gas welding stations – arc welding stations – crane forges - jigs and fixtures; power tools - blast cleaning supplies- welding equipment repair shop - proper arrangement of the above in the welding shop for maximum convenience and ease of production.

UNIT - V	SAFE PRACTICES IN WELDING	(9)

Selection and installation of equipments, safe handling equipment - fire prevention- eye and face protection - respiratory protection - ventilation -protective extra clothing -electric shock- safety analysis.

Planning for welding operations, production control planning for welding processes- pre- production planning- routing - scheduling. Activating, monitoring, materials management in welding-Inventory control- Basic aspects of financial management and man-power planning.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Gain knowledge on various factors influencing the welding cost.	Understand
CO2	Estimate the standard welding time using various methods for the welding processes.	Analyze
CO3	Calculate the welding cost for the different welding process.	Apply
CO4	Gain knowledge on various requirements on setting up a welding plant layout.	Understand
CO5	Gain knowledge on safety measures during welding processes	Understand

	and planning operations.	

TEXT BOOKS:

1. ASM Metals Handbook, Vol.6, "Welding, Brazing and Soldering", ASM, New York, 1998.
2. AWS Welding Handbook, vol.5, "Engineering Costs, Quality and Safety", 9th edition, AWS,2015.

REFERENCES:

1. John Norrish, "Arc Welding Processes - Technologies and process control", Woodhead Publishing and Maney Publishing on behalf of The Institute of Materials, Minerals & Mining, 2006.
2. standard Data for Arc Welding – The Welding Institute, U.K., 1994.
3. Bathy. J., "Industrial Administration and Management", 1984.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	-	2	3	2	-	-	-	-	-	-	-	-
CO2	1	-	2	3	2	-	-	-	-	-	-	-	-
CO3	1	-	2	3	2	-	-	-	-	-	-	-	-
CO4	1	-	2	3	2	-	-	-	-	-	-	-	-
CO5	1	-	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E10	FOOD PROCESSING, PRESERVATION AND TRANSPORT	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Understanding of microbial growth, control, and the impact of microorganisms on food safety and preservation.

OBJECTIVE(S):

To understand and apply the principles of food processing, preservation, and transportation to ensure food safety, extend shelf life, maintain nutritional value, and deliver high-quality food products efficiently from farm to consumer while adhering to regulatory and environmental standards.

UNIT - I	INTRODUCTION	(9)

Microbiology of Food Products, Mechanism of food spoilage critical microbial growth requirements, Design for control of micro organisms, The role of HACCP, Sanitation, Regulation and standards.

UNIT - II	PROCESSING & PRESERVATION	(9)

Thermodynamic properties and Transfer properties, Water content, Initial freezing temperature, Ice fraction, Transpiration of fresh fruits & vegetables, Food processing techniques for Dairy products, Poultry, Meat, Fruits & Vegetables.

UNIT - III	FREEZING & DRYING	(9)

Precooling, Freeze drying principles, Cold storage & freezers, Freezing drying limitations, Irradiation techniques, Cryofreezing, Numerical and analytical methods in estimating Freezing, Thawing times, Energy conservation in food industry.

UNIT - IV	COLD STORAGE DESIGN & INSTRUMENTATION	(9)

Initial building consideration, Building design, Specialized storage facility, Construction methods, Refrigeration systems, Insulation techniques, Control & instrumentation, Fire protection, Inspection & maintenance

UNIT - V	PACKAGING AND TRANSPORT	(9)

Refrigerated transportation, Refrigerated containers & trucks, Design features, Piping & Role of cryogenics in freezing & transport. Basic packaging materials, types of packaging, Packaging design. Packaging for different types of foods.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Recall the methods of food processing.	*Understand*
CO2	Analysis of food processing and preservation methods.	Analyze
CO3	Analyze the freezing and drying processes.	Analyze
CO4	Design the cold storage and instrumentation.	*Understand*
CO5	Analysis of packing and transporting the food products.	Analyze

TEXT BOOKS:

1. DS Warris., Food Processing and Preservation, CBS, New York, Second Edition, 2020.
2. Srivastava., Fruit and Vegetable Preservation, CBS, New York, Third Edition, 2019.

REFERENCES:

1. G. Subbulakshmi., Food Processing and Preservation, New Age Publishers, New Delhi, Second Edition, 2006.
2. IbrahamDincer., Heat Transfer in Food Cooling Applications, Tailor & Francis Pub., UK, Fourth Edition, 1997.
3. Clive V.I. Dellino, Cold and Chilled Storage Technology, VanNostrand Reinhold Pub. New York, Second Edition, 1991.
4. Stanley E. Charm, Fundamentals of Food Engineering,AVI Pub. Company Inc., New Delhi, Third Edition, 1989.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	-	2	3	2	-	-	-	-	-	-	-	-
CO2	1	-	2	3	2	-	-	-	-	-	-	-	-
CO3	1	-	2	3	2	-	-	-	-	-	-	-	-
CO4	1	-	2	3	2	-	-	-	-	-	-	-	-
CO5	1	-	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E11	OHSAS18001 AND ISO14001	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Familiarity with general concepts of quality management systems, as they provide a framework relevant to both OHSAS 18001 and ISO 14001.

OBJECTIVES:

To implement and maintain effective Occupational Health and Safety (OHSAS 18001) and Environmental Management Systems (ISO 14001) that help organizations systematically manage health, safety, and environmental risks, ensure regulatory compliance, promote continuous improvement, and enhance overall organizational sustainability and stakeholder confidence.

UNIT - I	OHSAS STANDARD	(9)

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

UNIT - II	OHSAS 18000 POLICY & PLANNING	(9)

Developing OH & S policy – guidelines - developments - procedure - content of OH & S policy – General principle, strategy and planning, specific goals, compliance - methodology.

Planning - guidelines, methodology steps developing action plan - analysis and identification of priorities, objective & targets, short term action plan, benefits and cost of each option, Development of action plan.

UNIT - III	IMPLEMENTATION, REVIEW AND IMPROVEMENT PLAN	(9)

Guidelines for structure and Responsibilities, Top level management, middle level management, coordinator and employees - developing procedures, identifying training needs, providing training, documentation of training, Training methodology consultation and communications.

Checking & Review; performance measurement and monitoring, proactive and reactive monitoring, measurement techniques, inspections, measuring equipment - accidents reports, Process & procedures, recording, investigation corrective action and follow up - records and records management. Handling documentation, information, records.

UNIT - IV	ISO 14000 POLICY, ISO 45001 POLICY & PLANNING	(9)

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

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

ISO 45001 – Scope, Terms and definitions, OH&S Policy, Planning, Objectives, Documentation, Importance, Evaluation, Management Review.

UNIT - V	ENVIRONMENT IMPACT ASSESSMENT	(9)

ISO 14040 (LCA), General principles of LCA, Stages of LCA, Report and Review. ISO 14020 (Eco labeling) - history, 14021, 14024, Type I labels, Type II labels, ISO 14024, principles, rules for eco labeling before company attempts for it, advantages, EIA in EMS, types of EIA, EIA methodology - EIS, Scope, Benefits. Audit - methodology, auditors audit results, management review - Continual improvement.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Acquire knowledge on the basic concepts of OSHA standard	Understand
CO2	Explore the details of OHSAS 18000 policy and planning with their guidelines and methods.	Understand
CO3	Apply the concepts of implementation, review and improvement plan.	Apply
CO4	Analyze about ISO 14000 and 45001 policies with its planning.	Analyze
CO5	Acquire knowledge on environmental impact assessment, types & control.	Understand

REFERENCES:

1. ISO 9000 to OHSAS 18001, Dr. K.C. Arora, S.K. Kataria& Sons, Delhi, First Edition, 2003.
2. NQA-ISO-45001-Implementation-Guide.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1-low, 2-medium, 3-high

IS24E12	SAFETY IN CHEMICAL INDUSTRIES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Familiarity with chemical processes, equipment, and operations used in the chemical industry.

OBJECTIVE(S):

To identify, assess, and control the risks associated with hazardous chemicals and processes in chemical industries by implementing robust safety practices, adhering to regulatory standards, promoting a safety culture, and ensuring the protection of personnel, property, and the environment.

UNIT - I	SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM	(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 and 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, vaporizer, 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.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Acquire knowledge on Chemical plant design, process, facilities	Understand

	and inherent safe design.	
CO2	Explore the commissioning phases and their documentation	Understand
CO3	Analyze the operating procedures and emergency procedures during plant operations.	Analyze
CO4	Apply the concepts of plant maintenance, modification and emergency planning.	Apply
CO5	Classify the different types of chemical storages and their safety measures.	Remember

TEXT BOOKS:

1. Lees, F.P., Loss Prevention in Process Industries, Butterworths and Company, U.S., Fourth Edition, 2012.
2. Quantitative Risk Assessment in Chemical Process Industries, American Institute of Chemical Industries, Centre for Chemical Process safety, U.S., Second Edition,1999.

REFERENCES:

1. Fawcett, H.H. and Wood, Safety and Accident Prevention in Chemical Operations, Wiley inters, U.S., Second Edition, 2008.
2. Accident Prevention Manual for Industrial Operations, NSC, Chicago, Third edition, 2008.
3. GREEN, A.E., High Risk Safety Technology, John Wiley and Sons, U.K., Second Edition, 2003.
4. Petroleum Act and Rules, Government of India.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1-low, 2-medium, 3-high

IS24E13	NON DESTRUCTIVE TESTING AND EVALUATION	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Familiarity with general testing and inspection concepts used in engineering and manufacturing.

OBJECTIVE(S):

To understand and apply various non-destructive testing methods for evaluating the integrity, properties, and defects of materials and components without causing damage, ensuring reliability, safety, and quality in manufacturing, maintenance, and service operations.

UNIT - I	OVERVIEW OF NDT	(9)

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided

UNIT - II	SURFACE NDE METHODS	(9)

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT - III	THERMOGRAPHY AND EDDY CURRENT TESTING (ET)	(9)

Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications.Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation

UNIT - IV	ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)	(9)

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique – Principle, AE parameters, Applications

UNIT - V	RADIOGRAPHY (RT)	(9)

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explore the working principle, types and characteristics of various NDT processes.	Understand
CO2	Recognize different surface NDT methods and its applications	Understand
CO3	Analyze the application of Thermography and Eddy current testing.	Analyze
CO4	Comprehend the Ultrasonic Testing and Acoustic Emission process.	Understand
CO5	Apply the working principle and applications of Radiography techniques.	Apply

TEXT BOOKS:

1. ASM Metals Handbook,Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17
2. Dr.V.Jayakumar,Dr.K.Elangovan, Non-Destructive Testing of Materials, Lakshmi Publications,Chennai,2017.

REFERENCES:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu ,Practical Non-Destructive Testing, Narosa Publishing House, 2009 .
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.
3. Charles, J. Hellier, Handbook of Nondestructive evaluation, McGraw Hill, New York , Second Edition,2001 .
4. Paul E Mix, Introduction to Non-destructive testing: a training guide, Wiley, New Jersey, Second Edition,2005

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	-	2	3	2	-	-	-	-	-	-	-	-
CO2	2	-	2	3	2	-	-	-	-	-	-	-	-
CO3	2	-	2	3	2	-	-	-	-	-	-	-	-
CO4	2	-	2	3	2	-	-	-	-	-	-	-	-
CO5	2	-	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E14		Category	L	T	P	SL	C

	RELIABILITY ENGINEERING	PEC	45	0	0	45	3

PREREQUISITE

Reliability engineering is a key part of the engineering field, and involves assessing and evaluating product reliability throughout its lifecycle.

OBJECTIVE(S):

To analyze, design, and implement systems and components with high reliability by applying probabilistic and statistical methods to predict, evaluate, and enhance performance, minimize failures, and ensure consistent operation over the product lifecycle in engineering and industrial applications.

UNIT - I	**RELIABILITY CONCEPT**	**(9)**

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

UNIT - II	**FAILURE DATA ANALYSIS**	**(9)**

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

UNIT - III	**RELIABILITY PREDICTION MODELS**	**(9)**

Series and parallel systems - RBD approach - Standby systems - Application of Bayes' theorem - cut and tie set method - Markov analysis - Fault Tree Analysis - limitations.

UNIT - IV	**RELIABILITY IMPROVEMENT**	**(9)**

Introduction - Improvement of components - Element, Unit, Standby Redundancies - Redundancy Optimization - Computational Procedures.

UNIT - V	**RELIABILITY MANAGEMENT**	**(9)**

Integrated reliability programs - Management policies and decisions - Reliability Management by objectives - Managing people for reliability - Managing lower level suppliers - Customer management - Quality management approaches -Reliability data acquisition and analysis - Life cycle costs - Reliability allocation.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Gain knowledge about the priori and post priori concepts, mortality curve and ability to calculate the system effectiveness.	Understand
CO2	Acquire knowledge on failure data analysis and their limitations.	Understand
CO3	Apply the principles of reliability prediction models and its applications.	Understand
CO4	Analyze about the improvement of components and their computational procedures.	Apply
CO5	Determine the objectives of reliability and quality management approaches.	Analyze

REFERENCES:

1. Srinath L.S, Reliability Engineering, Affiliated East-West Press Pvt Ltd, New Delhi, Fourth Edition, 2005.

2. Patrick O Connor, Reliability Engineering John Wiley & Sons, Ltd, New Delhi, Fifth Edition, 2006.
3. Balagurusamy. E., Reliability Engineering, Tata McGraw Hill Education Pvt Ltd, Ninth Edition, New Delhi, Second Edition, 1984.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1-low, 2-medium, 3-high

IS24E15	OPTIMIZATION TECHNIQUES IN MANUFACTURING	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Knowledge of fundamental operations research concepts, including linear programming, integer programming**.**

OBJECTIVE(S):

To apply mathematical modeling, analytical methods, and computational tools to optimize manufacturing processes, resource utilization, and production systems, with the goal of improving efficiency, reducing costs, enhancing product quality, and supporting data-driven decision-making in industrial operations.

UNIT - I	INTRODUCTION	(9)

Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems.

UNIT - II	CLASSIC OPTIMIZATION TECHNIQUES	(9)

Linear programming - Graphical method – simplex method – dual simplex method – revised simplex method – duality in LP – Parametric Linear programming – Goal Programming.

UNIT - III	NON-LINEAR PROGRAMMING	(9)

Introduction – Lagrangeon Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming.

UNIT - IV	INTEGER PROGRAMMING AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES	(9)

Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem.

UNIT - V	ADVANCES IN SIMULATION	(9)

Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Introduce the various optimization techniques.	Understand
CO2	Develop the classic optimization techniques	Apply
CO3	Apply the non linear programming methods in optimum design	Apply
CO4	Construct the dynamic programming and network techniques.	Apply
CO5	Apply the algorithms and simulation.	Apply

TEXT BOOKS:

1. R. Panneerselvam, “Operations Research”, Prentice Hall of India Private Limited, New Delhi 1 – 2005
2. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, Singapore, 1992

REFERENCES:

1. Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997
2. J.K.Sharma, Operations Research – Theory and Applications – Macmillan India Ltd., 1997
3. P.K. Guptha and Man-Mohan, Problems in Operations Research – Sultan chand & Sons, 1994

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1-low, 2-medium, 3-high

IS24E16	QUALITY ENGINEERING	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Familiarity with general principles of industrial processes and operations management to understand quality within the broader production system.

OBJECTIVE(S):

To apply scientific and engineering principles, statistical methods, and quality management tools to design, monitor, and improve processes and products, ensuring conformance to standards, enhancing customer satisfaction, and achieving continuous improvement in manufacturing and service industries.

UNIT - I	INTRODUCTION TO QUALITY ENGINEERING AND LOSS FUNCTION	(9)

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

UNIT - II	ON-LINE QUALITY CONTROL	(9)

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

UNIT - III	ON-LINE QUALITY CONTROL ATTRIBUTES AND METHODS FOR PROCESS IMPROVEMENT	(9)

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

UNIT - IV	QUALITY ENGINEERING AND TPM	(9)

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

UNIT - V	SIX SIGMA AND ITS IMPLEMENTATION	(9)

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

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Acquire knowledge on quality objectives, quality control and knows the importance of quality assurance.	Understand
CO2	Analyze about the online quality control and its measurement.	Analyze
CO3	Determine about the online quality control attributes and methods for process improvement.	Understand
CO4	Apply the concept of preventive maintenance schedule and TPM.	Apply
CO5	Gain knowledge on six sigma and its implementation.	Understand

TEXT BOOKS:

1. De Feo, J A and Barnard, W., Six Sigma: Breakthrough and Beyond, Tata McGraw- Hill, New Delhi, Second Edition, 2005.
2. Rachel Silvestrini, Sarah E. Burke, The Certified Quality Engineering Handbook, ASQ Quality Press, New Delhi, 2017.

REFERENCES:

1. Brue, G., Six Sigma for Managers, Tata-McGraw Hill, New Delhi, Second Reprint, 2002.
2. Pyzdek, T and Berger, R.W., Quality Engineering Handbook, Tata-McGraw Hill, New Delhi, Second Edition, 1996.
3. Taguchi, G, Elsayed, E.A and Hsiang, T.C., Quality Engineering in Production Systems, Mc-Graw Hill Book company, Singapore, International Edition, 1989.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	-	2	3	2	-	-	-	-	-	-	-	-
CO2	1	-	2	3	2	-	-	-	-	-	-	-	-
CO3	1	-	2	3	2	-	-	-	-	-	-	-	-
CO4	1	-	2	3	2	-	-	-	-	-	-	-	-
CO5	1	-	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E17	COMPUTER AIDED HAZARD ANALYSIS	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Understanding the basic concepts of workplace hazards, safety regulations, and preventive measures.

OBJECTIVE(S):

To utilize computer-based tools and simulation techniques for identifying, assessing, and mitigating potential hazards in industrial processes, thereby enhancing risk management, improving safety performance, and supporting compliance with health, safety, and environmental regulations..

UNIT - I	HAZARD, RISK ISSUES AND HAZARD ASSESSMENT	(9)

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 (Pre HA), human error analysis, Hazard Operability studies (HAZOP), safety warning systems.

UNIT - II	COMPUTER AIDED INSTRUMENTS	(9)

Applications of Advanced Equipments and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter(DSC), Thermo Gravimetric Analyzer(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	(9)

Fault Tree Analysis & 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), Layer of Protection Analysis(LOPA) and Safety integrity level(SIL) - Software on Risk analysis, ALOHA, Hamsagars modules on Heat radiation, Pool fire, Jet, Explosion. Reliability software on FMEA for mechanical and electrical systems.

UNIT - IV	CONSEQUENCES ANALYSIS	(9)

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	(9)

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,Vizag HPCL 1997 incident,LG Polymer Vizag incident 2020- 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.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Explore the basic concepts in risk and hazard assessment.	Understand
CO2	Analyze the use of different types of instruments for various testing.	Analyze
CO3	Apply the risk assessment technique to quantify the risk using different software.	Apply
CO4	Determine the consequence analysis for plotting the damages towards hazardous situations.	Apply
CO5	Demonstrate the various types of disasters based on past accident analysis.	Remember

TEXT BOOKS:

1. Frank P. Less, Loss Prevention in Process Industries, Butterworth -Hein UK 1990 (Vol.I, II & III), UK ,Third edition , 2005
2. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council, UK, 1990

REFERENCES:

1. Course Material – Intensive Training Programme on Consequence Analysis, Process Safety Centre, Indian Institute of Chemical Technology, Tarnaka& CLRI, Chennai, Second Edition, 1987.
2. Major Hazard control- A practical Manual, ILO, Geneva, Third Edition, 1993.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1-low, 2-medium, 3-high

IS24E18	ADVANCED METROLOGY AND NON DESTRUCTIVE TESTING	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Understanding material properties (mechanical, thermal, etc.), which is essential for analyzing and interpreting test results in NDT.

OBJECTIVES:

To develop proficiency in precision measurement techniques and non-destructive testing methods for evaluating the dimensional accuracy, surface integrity, and internal structure of materials and components, thereby ensuring quality control, reliability, and safety in advanced manufacturing and engineering applications.

UNIT - I	INTRODUCTION	(9)

Measuring Machines - Tool Maker's microscope - Co-ordinate measuring machines - Universal measuring machine - Laser viewers for production profile checks - Images shearing microscope- Use of computers- Machine vision technology - Microprocessors in metrology.

UNIT - II	STATISTIAL QUALITY CONTROL	(9)

Statistical Quality Control - Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - reliability and life testing

UNIT - III	BASIC NDT TESTS	(9)

Liquid penetrants and magnetic particle tests - characteristics of liquid penetrants - different washable systems - Developers - applications - method of production of magnetic fields - Principles of operation of magnetic particle test - applications -Advantages and limitations

UNIT - IV	RADIOGRAPY	(9)

Radiography - Sources of ray - x- ray production - properties of d and x rays - film characteristics – exposure charts-contrasts-operational characteristics of x ray equipment - applications.

UNIT - V	ULTRASONIC TESTING METHODS	(9)

Ultrasonic and acoustic emission techniques - Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method -A, B, C scans -Principles of acoustics emission technique - Advantage and limitations - Instrumentation – applications.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Demonstrate techniques used to quantify and comparison of products to required standards.	Understand
CO2	Conversant with the newer technologies used in metrology.	Understand
CO3	Design procedures which will incorporate quality in the product as per the customer's needs.	Apply
CO4	Demonstrate his or her knowledge in developing control mechanism to check variation in attributes and variables.	Understand
CO5	Select suitable ND testing method for the contemporary issues.	Remember

TEXT BOOKS:

1. Jain,R.K."Engineering Metrology ", Khanna Publishers, 2009
2. Barry Hull and Vernon John ," Non Destructive Testing ", Mac Millan, 2009

REFERENCES:

1. American Society for Metals ,"Metals Hand Book ", Vol II ,1976.
2. Progress in Acoustics Emission, " Proceedings of 10th International Acoustics Emission Symposium ", Japanese Society for NDI,1990.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	-	2	3	2	-	-	-	-	-	-	-	-
CO2	1	-	2	3	2	-	-	-	-	-	-	-	-
CO3	1	-	2	3	2	-	-	-	-	-	-	-	-
CO4	1	-	2	3	2	-	-	-	-	-	-	-	-
CO5	1	-	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E19	SAFETY IN ENGINEERING INDUSTRY	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Understanding of industrial processes, systems, and environments where safety measures are needed.

OBJECTIVE(S):

To identify, evaluate, and control workplace hazards in engineering industries by implementing effective safety management systems, promoting a culture of safety, complying with legal and regulatory requirements, and ensuring the protection of personnel, equipment, and the environment.

UNIT - I	SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES	(9)

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

UNIT - II	SAFETY IN DESIGN, USE & MAINTENANCE OF MACHINES	(9)

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

UNIT - III	SAFETY IN WELDING AND GAS CUTTING	(9)

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

UNIT - IV	SAFETY IN COLD FARMING AND HOT WORKING OF METALS	(9)

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

UNIT - V	SAFETY IN FINISHING, INSPECTION AND TESTING	(9)

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

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Determine the General safety rules, principles, maintenance, Inspections of metal and wood working machinery	Understand
CO2	Apply the concepts of safety in design, use and maintenance of machines.	Apply
CO3	Recall about welding, common hazards in welding, personal protective equipment and safety precautions in welding.	Understand
CO4	Analyze the safety in cold working and hot working of metals.	Analyze
CO5	Acquire knowledge on safety in finishing, inspection and testing of machines.	Understand

TEXT BOOKS:

1. Occupational Safety Manual, BHEL, Trichy, Second Edition, 1988.
2. Accident Prevention Manual, NSC, Chicago, Third Edition, 2008.

REFERENCES:

1. Krishnan, N.V., Safety in Industry, Jaico Publishers House, London, Fourth Edition, 1996.
2. Safety in the use of wood working machines, HSE, UK, Second Edition, 2005
3. Health and Safety in Welding and Allied Processes, Welding Institute, UK, High Tech. Publishing Ltd., London, Fifth Edition, 1989

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	-	2	3	2	-	-	-	-	-	-	-	-
CO2	1	-	2	3	2	-	-	-	-	-	-	-	-
CO3	1	-	2	3	2	-	-	-	-	-	-	-	-
CO4	1	-	2	3	2	-	-	-	-	-	-	-	-
CO5	1	-	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E20	MATERIALS TESTING AND CHARACTERIZATION TECHNIQUES	Category	L	T	P	C	C
		PEC	45	0	0	45	3

PREREQUISITE

Background in engineering principles relevant to testing and characterization.

OBJECTIVES:

To understand and apply various mechanical, thermal, chemical, and structural testing and characterization methods to evaluate the properties, behavior, and performance of engineering materials, thereby supporting material selection, quality assurance, failure analysis, and research and development activities.

UNIT - I	MICRO AND CRYSTAL STRUCTURE ANALYSIS	(9)

Principles of Optical Microscopy – Specimen Preparation Techniques – Polishing and Etching – Polarization Techniques – Quantitative Metallography – Estimation of grain size – ASTM grain size numbers – Microstructure of Engineering Materials - Elements of Crystallography – X- ray Diffraction – Bragg's law – Techniques of X-ray Crystallography – Debye – Scherer camera – Geiger Diffractometer – analysis of Diffraction patterns – Inter planer spacing – Identification of Crystal Structure, Elements of Electron Diffraction.

UNIT - II	ELECTRON MICROSCOPY	(9)

Interaction of Electron Beam with Materials – Transmission Electron Microscopy – Specimen Preparation – Imaging Techniques – BF & DF – SAD – Electron Probe Microanalysis – Scanning Electron Microscopy – Construction & working of SEM – various Imaging Techniques – Applications- Atomic Force Microscopy- Construction & working of AFM - Applications

UNIT - III	CHEMICAL AND THERMAL ANALYSIS	(9)

Basic Principles, Practice and Applications of X-Ray Spectrometry, Wave Dispersive X-Ray Spectrometry, Auger Spectroscopy, Secondary Ion Mass Spectroscopy, Fourier Transform Infra Red Spectroscopy (FTIR)- Proton Induced X-Ray Emission Spectroscopy, Differential Thermal Analysis, Differential Scanning Calorimetry (DSC) And Thermo Gravitymetric Analysis (TGA).

UNIT - IV	MECHANICAL TESTING – STATIC TESTS	(9)

Hardness – Brinell, Vickers, Rockwell and Micro Hardness Test – Tensile Test – Stress – Strain plot – Proof Stress – Torsion Test - Ductility Measurement – Impact Test – Charpy & Izod – DWTT - Fracture Toughness Test, Codes and standards for testing metallic and composite materials.

UNIT - V	MECHANICAL TESTING – DYNAMIC TESTS	(9)

Fatigue – Low & High Cycle Fatigues – Rotating Beam & Plate Bending HCF tests – S-N curve – LCF tests – Crack Growth studies – Creep Tests – LM parameters – AE Tests-modal analysis - Applications of Dynamic Tests.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Knowledgeable in microstructure evaluation & crystal structure analysis.	*Understand*
CO2	Gain knowledge in electron microscopy.	*Understand*
CO3	Discover the Chemical and Thermal Analysis.	*Analyze*
CO4	Examine the static mechanical testing methods.	*Analyze*
CO5	Inspect the dynamic mechanical testing methods.	*Analyze*

TEXT BOOKS:

1. Culity B.D., Stock S.R& Stock S., Elements of X ray Diffraction, (3rd Edition). Prentice Hall, 2001.
2. Davis J. R., Tensile Testing, 2nd Edition, ASM International, 2004.

REFERENCES:

1. ASM Hand book-Materials characterization, Vol – 10, 2004.
2. Davis, H.E., Hauck G. & Troxell G.E., The Testing of engineering Materials, (4th Edition), McGraw Hill, College Divn., 1982.
3. Grundy P.J. and Jones G.A., Electron Microscopy in the Study of Materials, Edward Arnold Limited, 1976.
4. Morita.S, Wiesendanger.R, and Meyer.E, "Non-contact Atomic Force Microscopy" Springer, 2002.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Avg.	**1**	**-**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**		

1-low, 2-medium, 3-high

IS24E21	WORK STUDY AND ERGONOMICS	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Understanding body posture, movement, physical limits, and health risks related to manual work.

OBJECTIVES:

To enhance productivity, efficiency, and worker well-being by systematically analyzing work processes and designing tasks, workplaces, and equipment that match human capabilities and limitations.

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.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Familiarize on work study and study of operation and its application.	Understand
CO2	Construct the applications of ergonomic principle in the shop floor and physiology of workers.	Apply
CO3	Explore the concepts of PPE's and its ergonomic considerations.	Understand
CO4	Recall about various machine tools, process and equipment design.	Understand
CO5	Acquire knowledge on man-machine systems.	Understand

TEXT BOOKS:

1. Lakhwinder Pal Singh, Work Study and Ergonomics, 2018.

2. Benjamin Neibal, W., Motion and Time Study, Seventh Edition, 1992.

REFERENCES:

1. McCormick, E.J., and M.S.Sanders, Human Factors in Engineering and Design, TMH, New Delhi, Seventh Edition, 1982.
2. Work Study, National Productivity Council, New Delhi, 1995.
3. Introduction to Work Study, ILO, Oxford and IBH Publishing company, Bombay, Fourth Revised Edition, 1991.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	2	3	2	-	-	-	-	-	-	-	-
CO2	2	1	2	3	2	-	-	-	-	-	-	-	-
CO3	2	1	2	3	2	-	-	-	-	-	-	-	-
CO4	2	1	2	3	2	-	-	-	-	-	-	-	-
CO5	2	1	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E22	SAFETY IN POWDER HANDLING	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Prior exposure to safety standards, hazard identification, and risk assessment methods. Basic understanding of powder properties: particle size, shape, flowability, and hygroscopicity.

OBJECTIVES:

To equip learners with the knowledge and skills necessary to identify, evaluate, and control hazards associated with the handling, processing, and storage of powders and bulk solids. The course focuses on preventing fire, explosion, contamination, and health hazards by understanding material properties, proper equipment use, and safety regulations, thereby ensuring a safe working environment in industries dealing with powders.

UNIT - I	INTRODUCTION	(9)

Powder classification - physical, chemical and other properties - metal powders - other non-metallic powders, Safety in cement, fly ash, quarry, sawdust, paint - handling methods - manual, mechanical, automatic - charges on powders -charge distribution - charging of powders.

UNIT - II	METAL POWDERS AND CHARACTERIZATION	(9)

Atomization, types - milling - electro deposition - spray drying, Production of iron powder, Aluminum powder, Titanium - screening & cleaning of metals - explosivity and pyrophoricity - toxicity.

Particle size and size distribution - measurement, types and significance - particle shape analysis, methods, surface area, density, porosity, flow rate - testing.

Metal powders, applications as fuel, solid propellants, explosives, pyrotechnics. Hazards in metal powder industries and safety principles.

UNIT - III	DUST EXPLOSION	(9)

Industrial dust, dust explosion accidents - explosibility characteristics, minimum explosive concentration, minimum ignition energy, explosion pressure characteristics, maximum permissible oxygen concentration - explosibility tests, Hartmann vertical tube apparatus, horizontal tube apparatus, inflammatory apparatus, Godbert and Green ward furnace. Explosibility classification - hybrid test - gas mixtures - dust ignition sources - dust explosion prevention - dust explosion protection - dust explosion venting, vent coefficient, various methods of design - venting of ducts and pipes - dust fire.

UNIT - IV	DUST HANDLING PLANTS AND ELECTRO STATIC HAZARDS	(9)

Grinding mills, conveyors, bucket elevators, dust separators, dust filters, cyclones, driers, spray driers, silos, grain elevators, typical applications, hazards and safety practices.

Electrostatic charges-energy released - type of discharge - spark - carona - insulating powders - propagating brush discharge - discharge in bulk lightning hazards in powder coating - electroplating.

UNIT - V	DUST EVALUATION AND CONTROL	(9)

Dust Evaluation, methodology, Quantitative, sampling, measurements - control approaches and strategies - control of dust sources, dust transmission - role of workers, PPE and work practice – housekeeping - storage - labeling - warning sign - restricted areas - Environmental protections.

Evaluation procedures and control measures for particulates (Respirable), Asbestos and other fibers, silica in coal mine - NIOSH guide to the selection and use of particulate respirators - case studies.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Acquire knowledge on powder classification, its physical, chemical and other properties.	Understand
CO2	Demonstrate about the metal powders and their characterization.	Understand
CO3	Familiarize about Industrial dust and their explosion.	Understand
CO4	Gain knowledge on dust handling plants and electro static hazards.	Understand
CO5	Identify about the dust evaluation methods and their control.	Apply

TEXT BOOKS:

1. Martin Glor, Electro Static Hazard in Powder Handling, Research studies Press Ltd., England, Fourth Edition, 1988.
2. Major hazard control - ILO Geneva, 1987.

REFERENCES:

1. Seminar on Hazard recognition and prevention in the work place - airborne dust, Vol.I and 2, SRMC, Chennai, Second Edition, 4/5, Sept.2000.

2. ASM Metals hand book, Ninth edition, Vol.7, Powder Metallurgy.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	1	2	3	2	-	-	-	-	-	-	-	-
CO2	-	1	2	3	2	-	-	-	-	-	-	-	-
CO3	-	1	2	3	2	-	-	-	-	-	-	-	-
CO4	-	1	2	3	2	-	-	-	-	-	-	-	-
CO5	-	1	2	3	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E23	NUCLEAR ENGINEERING AND SAFETY	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Foundations in **industrial safety**, **hazard analysis**, or **probabilistic risk assessment (PRA)** will enhance understanding of nuclear safety culture and regulation.

OBJECTIVE(S):

To provide students with a comprehensive understanding of nuclear energy systems, reactor technologies, radiation principles, and the implementation of safety measures to prevent accidents and protect personnel and the environment.

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.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explore the basic concepts of fission process and activity	Understand
CO2	identify the control requirements in design considerations	Apply
CO3	Classify the reactor types and their role of power generation in India.	Understand
CO4	Apply the safe design principles of nuclear reactors and their safety	Apply
CO5	Acquire knowledge on radiation control, its exposure and their disposal practices.	Understand

TEXT BOOKS:

1. Robert E. Masterson, Nuclear Engineering Fundamentals, CRC Press,UK,First Edition, 2017.
2. Dr. G. Vardyanathan., Nuclear reactor Engineering, UK, Second Edition, 2013.

REFERENCES:

1. Jhon R. Lamarsh, Anthony J. Baratta ,Introduction to Nuclear Engineering , CRC Press , New York, Third Edition, 2014.
2. Charles D. Ferguson, Nuclear Energy, New York, Second Edition, 2011.
3. Regulatory control of nuclear power plants Part A, International Atomic Energy Agency, Vienna, Austria, First Edition, 2002

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	1	2	3	-	-	-	-	-	-	-	-	-
CO2	1	1	2	3	-	-	-	-	-	-	-	-	-
CO3	1	1	2	3	-	-	-	-	-	-	-	-	-
CO4	1	1	2	3	-	-	-	-	-	-	-	-	-
CO5	1	1	2	3	-	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E24	SAFETY IN TEXTILE INDUSTRY	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Knowledge of textile machinery to understand mechanical hazards, lockout/tagout (LOTO), and equipment safety.

OBJECTIVE(S):

To familiarize learners with the specific hazards and risks associated with textile manufacturing processes and to develop effective safety strategies to minimize accidents, health hazards, and environmental impacts.

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 shuttles looms iii) knitting machines iv) non-woven's.

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 generation - 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.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Familiarize about the basic concepts of textile process and its safety	Understand
CO2	Acquire knowledge on hazards in sizing processes, looms and knitting machines.	Understand
CO3	Demonstrate on various types of mechanical finishing operations.	Understand
CO4	Identify the health and welfare measures in textile industry.	Apply
CO5	Apply the relevant provisions of factories act and rules applicable to textile industry	Apply

TEXT BOOKS:

1. Groover and Henry, D.S., Hand book of textile testing and quality control, New Delhi, Ninth Edition, 1960.

2. Shenai, V.A., A technology of textile processing, Vol. I, Textile Fibers, Third Edition, 1972.

REFERENCES:

1. Safety in Textile Industry, Thane Belapur Industries Association, Mumbai, Second Edition, 1978.
2. 100 Textile fibres - analysis, findings and recommendations LPA, 1989.
3. Quality tolerances for water for textile industry, BIS, Second Revision, 1982.
4. Little, A.H., Water supplies and the treatment and disposal of effluent.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1-low, 2-medium, 3-high

IS24E25	TRANSPORT SAFETY	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Understanding how urban layout, zoning, and transport infrastructure impact safety.

OBJECTIVE(S):

To provide a comprehensive understanding of safety principles, risk assessment, and regulatory requirements in various modes of transportation—road, rail, air, and maritime. The course aims to equip learners with the knowledge to identify potential hazards, implement accident prevention strategies, and promote the safe movement of people and goods through effective safety management systems and adherence to national and international transport safety standards.

UNIT - I	OVERVIEW OF TRANSPORT SAFETY	(9)

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

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 - II	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 - III	SAFETY IN ROAD AND RAIL TRANSPORTATION	(9)

Road alignment and gradient - reconnaissance - ruling gradient - maximum rise per k.m. - factors influencing alignment like attractive resistance, attractive 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.

Introduction to Rail Transportation - Rail Road Track - Materials and Cross section - Locomotives, Rail Car and Types - Rail road Worker Safety - Safety Performance, Gate Crossings and Trespassers - Signals and Communications, Types of rail road traffic control, other communication features - High Speed Rail Systems - Rail Road Construction and Maintenance methods, Construction and maintenance Equipment - Track Maintenance.

UNIT - IV	SAFETY IN OTHER TRANSPORT SYSTEMS	(9)

Introduction to Air Transportation - Trends in Air Transportation - Safety in Runway - Air Transportation System - Flight Maintenance, Construction and Safety - Storage and Handling of Fuels - Environmental Aspects of Air Transportation.

Types of cargo ships - working on board ships marking, safety in Shipping 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.

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.

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

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Acquire knowledge on causes of accidents due to drivers and pedestrians.	Understand
CO2	Gain knowledge on inspection and maintenance of vehicles.	Understand
CO3	Recall about the safety in road and rail transportation.	Understand
CO4	Demonstrate about the safety in air transportation and shipping.	Understand
CO5	Familiarize on shop floor and repair shop safety.	Understand

TEXT BOOKS:

1.Kadiyali, Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, Third Edition, 1983.
2.Babkov, V.F., Road Conditions and Traffic Safety, MIC Publications, Moscow, First Edition, 1986.

REFERENCES:

1. Popkes, C.A. ,Traffic Control and Road Accident Prevention, Chapman and Hall Limited, New Delhi, Second Edition, 1986.
2. Ogden, K.W., Safer Roads – A guide to Road Safety Engineering.
3. Pasricha,, Road Safety guide for drivers of heavy vehicle, Nasha Publications, Mumbai, Second Edition, 1999.
4. Motor Vehicles Act, 1988, Government of India.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	2	2	2	1	-	-	-	-	-	-	-	-
CO2	-	2	2	2	1	-	-	-	-	-	-	-	-
CO3	-	2	2	2	1	-	-	-	-	-	-	-	-
CO4	-	2	2	2	1	-	-	-	-	-	-	-	-
CO5	-	2	2	2	1	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E26	ENERGY CONSERVATION AND MANAGEMENT	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Basic concepts related to **sustainability**, **climate change**, and the environmental impact of energy production and consumption.

OBJECTIVES:

To develop an in-depth understanding of energy sources, usage patterns, and conservation techniques across industrial, commercial, and domestic sectors.

UNIT - I	INTRODUCTION	(9)

Indian Energy Scenario Basics of Energy and its various forms - Primary / Secondary Energy Sources Energy Conservation Energy Intensive Industries Barriers - EC Act 2003: Salient Features - Schemes of Bureau of Energy Efficiency (BEE) including Designated consumers, State Designated Agencies - Integrated energy policy - National action plan on climate change.

UNIT - II	ENERGY MANAGEMENT	(9)

Energy management approach - understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy metering, precautions, smart metering.

UNIT - III	ENERGY ECONOMICS	(9)

Roles and responsibilities of energy manager, accountability. energy consumption, production, cumulative sum of differences (CUSUM) Cost / Energy Share Diagram Break Even Analysis Depreciation Financial Analysis Techniques CUSUM Technique Energy Management Information Systems (EMIS) ESCO Concept

UNIT - IV	THERMAL UTILITIES: OPERATION AND ENERGY CONSERVARTION	(9)

i) Boilers (ii) Thermic Fluid Heaters (iii) Furnaces (iv) Waste Heat Recovery Systems (v) Thermal Storage

UNIT - V	PERFORMANCE STUDY OF THERMAL UTILITIES	(9)

Basics of R & A/C COP / EER / SEC Evaluation Psychometric Chart Analysis Types & Applications of Cooling Towers Basics Performance Analysis - Cost of Power Generation Scope for Energy Thermal systems

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Describe the present energy scenario of India and standards and EC act.	Understand
CO2	Optimize the energy requirement and identify the suitable system for energy management	Apply
CO3	Compare the cost vs. energy and identify suitable technique for cost analysis.	Understand
CO4	Construct the operation and energy conservation	Apply
CO5	Study of thermal utilities.	Understand

TEXT BOOKS:

1. K.V.Sharma, P.Venkataseshaiah., Energy Management and Conservation, Wiley, New Delhi, First

Edition, 2020.

2. Trivedi , PR, Jolka KR, Energy Management, Commonwealth Publication, New Delhi, Fourth Edition, 2000.

REFERENCES:

1. Witte, Larry C, Industrial Energy Management & Utilization, Hemisphere Publishers, Washington, Seventh Edition, 2000.

2. Frank Kreith, D. Yogi Goswami, Energy Management and Conservation, CRC press, UK, Second Edition, 2016.

3. S.S. Thipse, Energy Conservation and Management, Alpha Science, New Delhi, First Edition, 2014.

4. Barun Kumar De., Energy Management, Vrinda Publications , UK, Second Revised, 2014.

5. CB Smith, Energy Management Principles, Pergamon Press, New York, Second Edition, 1995.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1-low, 2-medium, 3-high

IS24E27	PLASTICS AND COMPOSITE MATERIALS	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Familiarity with molding techniques, including injection molding, compression molding, and extrusion, which are common in the production of plastic materials.

OBJECTIVES:

To provide learners with fundamental and applied knowledge of polymeric materials and composites, including their classification, properties, processing techniques, and applications.

UNIT - I	INTRODUCTION	(9)

Introduction – Chemistry and classification of Polymers – Properties of Thermo plastics Properties of Thermosetting plastics – Applications –Merits and Demerits.

UNIT - II	PLASTICS PROCESS	(9)

Processing of plastics – Extrusion – Injection Moulding -Blow Moulding – Compression And transfer Moulding – casting – Thermo Forming. Machining and joining of plastics – General Machining Properties of Plastics – Machining Parameters and their effect – joining of Plastics- Mechanical Fasteners – Thermal bonding – Press Fitting.

UNIT - III	COMPOSITE MATERIALS	(9)

Introduction to Composite Materials – Fibers – Glass, Boron , Carbon , Organic , Ceramic and Metallic Fibers – Matrix Materials – Polymers, Metals and Ceramics.

UNIT - IV	POLYMER MATRIX COMPOSITES	(9)

Processing of Polymer Matrix Composites – Open Mould Processes, Bag Moulding, Compression Moulding With BMS and SMS - Filament winding – Pultrusion - Centrifugal Casting – Injection Moulding – Application of PMC`s

UNIT - V	METAL MATRIX COMPOSITES	(9)

Processing of metal matrix composites – Solid State Fabrication Techniques – Diffusion Bonding – Powder Metallurgy Techniques – Plasma Spray, Chemical and Physical Vapour Deposition of Matrix on Fiber – Liquid State Fabrication Method – Infiltration – Squeeze Casting – Rheo Casting – Compocasting – Application of MMC`s.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Select suitable plastics and composite materials for the required applications and its corresponding fabrication method.	Apply
CO2	Identify the various process of involved in making plastics.	Apply
CO3	Identify service requirements and how to relate materials to those requirements.	Apply
CO4	Develop various production process of polymer matrix composite.	Apply
CO5	Explore the characteristics of metal matrix composite alloys.	Understand

TEXT BOOKS:

1. Hensen.F, "Plastics Extrusion Technology", Hanser Publishers, 1988.
2. Rauwendaal, C, "Polymer Extrusion", Hanser Publishers, 1990.

REFERENCES:

1. Harold Belofsky, "Plastics: Product Design and Process Engineering", Hanser Publishers, 1995.
2. Johnnaber F, "Injection Moulding Machines", Hanser Publishesr, 1983.
3. A.K.B hargava, "Engineering Materials: Polymers, Ceramics and Composites", Prentice-Hall of India Limited, New Delhi, 2005.
4.Bera, E and Moet, A, "High Performance Polymers", Hanser Publisners ,1991

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	2	2	3	1	-	-	-	-	-	-	-	-
CO2	1	2	2	3	1	-	-	-	-	-	-	-	-
CO3	1	2	2	3	1	-	-	-	-	-	-	-	-
CO4	1	2	2	3	1	-	-	-	-	-	-	-	-
CO5	1	2	2	3	1	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E28	INDUSTRIAL SAFETY ENGINEERING	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE

Introductory understanding of workplace hazards and general safety regulations.

OBJECTIVE(S):

To equip students with the knowledge and skills required to identify, evaluate, and control workplace hazards in industrial environments.

UNIT - I	SAFETY INTRODUCTION	(9)

Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation. Safety organization-objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Safety Officer-responsibilities, authority. Safety committee-need, types, advantages.

UNIT - II	PERSONAL PROTECTION IN WORK ENVIRONMENT	(9)

Personal protection in the work environment, Types of PPEs, Personal protective equipment respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5s of housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

UNIT - III	SAFETY ISSUES IN CONSTRUCTION	(9)

Introduction to construction industry and safety issues in construction Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds – Tunnelling – Blasting – Demolition – Confined space – Temporary Structures. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety. Relevance of ergonomics in construction safety. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders.

UNIT - IV	SAFETY HAZARDS IN MACHINES	(9)

Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas 4 welding and Arc Welding. Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance. Maintenance of common elements-wire rope, chains slings, hooks, clamps. Hearing Conservation Program in Production industries.

UNIT - V	HAZARD IDENTIFICATION AND ANALYSIS	(9)

Hazard and risk, Types of hazards –Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release, Structure of hazard identification and risk assessment. Identification of hazards: Inventory analysis, Fire and explosion hazard rating of process plants - The Dow Fire and Explosion Hazard Index, Preliminary hazard analysis, Hazard and Operability study (HAZOP)) – methodology, criticality analysis, corrective action and follow-up. Control of Chemical Hazards, Hazardous properties of chemicals, Material Safety Data Sheets (MSDS).

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Describe the theories of accident causation and preventive measures of industrial accidents.	Understand
CO2	Explain about personal protective equipment, its selection, safety performance & indicators and importance of housekeeping.	Understand
CO3	Explain different issues in construction industries.	Understand
CO4	Describe various hazards associated with different machines and mechanical material handling.	Understand
CO5	Utilize different hazard identification tools in different industries with the knowledge of different types of chemical hazards.	Understand

TEXT BOOKS:

1. R.K Jain (2000) Industrial Safety, Health and Environment management systems, Khanna Publications
2. Paul S V (2000), Safety management System and Documentation training Programme handbook, CBS Publication.

REFERENCES:

1. John V. Grimaldi and Rollin H.Simonds. (1989) Safety management. All India Traveller Book Seller, Delhi
2. Krishnan, N.V. (1997). Safety management in Industry. Jaico Publishing House, New Delhi
3. Ronald P. Blake. (1973). Industrial safety. Prentice Hall, New Delhi
4. Vaid, K.N., (1988). Construction safety management. National Institute of Construction Management and Research, Mumbai.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	2	2	2	2	-	-	-	-	-	-	-	-
CO2	1	2	2	2	2	-	-	-	-	-	-	-	-
CO3	1	2	2	2	2	-	-	-	-	-	-	-	-
CO4	1	2	2	2	2	-	-	-	-	-	-	-	-
CO5	1	2	2	2	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E29	FIRE ENGINEERING AND PROTECTION	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE
Basic exposure to safety practices and environmental controls.

OBJECTIVE(S):
To provide comprehensive knowledge of fire behaviour, fire prevention strategies, protection systems, and emergency response planning.

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, Pasadena Texas, Piper Alpha, Peterborough & 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 - 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 - CO_2 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

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 - exits - width calculations - fire certificates - fire safety requirements for high rise buildings - snookers.

UNIT - V	EXPLOSION PROTECTING SYSTEMS	(9)

Principles of explosion - detonation and blast waves - explosion parameters - Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure - explosion venting - inert gases, plant for generation of inert gas - rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO 2) and halons - hazards in LPG, ammonia (NH_3), sulphur dioxide (SO_3), chlorine (Cl_2) etc.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Recall about the fire properties of solid, liquid and gases and understand the principle of fire and combustion Theory.	Understand
CO2	Gain knowledge about the fire prevention and fire protection systems.	Understand
CO3	Acquire knowledge on different sources of ignition, classes of fires	Understand

	and their extinguishing medium	
CO4	Ability to know the objective of building fire safety and relevant standards.	Understand
CO5	Gain the principles of explosion and understand about their protecting systems.	Understand

REFERENCES:

1. Derek, James, Fire Prevention Hand Book, Butter Worths and Company, London, Ninth edition, 2016 .
2. Gupta, R.S., Hand Book of Fire Technology, Orient Longman, Bombay, Second Edition, 1993.
3. Accident Prevention manual for industrial operations, N.S.C., Chicago, Second Edition,1982.
4. DinkoTuhtar, Fire and explosion Protection, E. Horwood, Second Edition, 1989

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	1	2	2	2	-	-	-	-	-	-	-	-
CO2	1	1	2	2	2	-	-	-	-	-	-	-	-
CO3	1	1	2	2	2	-	-	-	-	-	-	-	-
CO4	1	1	2	2	2	-	-	-	-	-	-	-	-
CO5	1	1	2	2	2	-	-	-	-	-	-	-	-

1-low, 2-medium, 3-high

IS24E30	FOOD AND BIO-SAFETY	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE

Basic knowledge of **health risks and toxicology.**

OBJECTIVES:

To provide learners with a thorough understanding of the principles and practices that ensure the safety and quality of food and biological products.

UNIT - I	INTRODUCTION TO FOOD AND BIO SAFETY	(9)

Definitions: Food safety, bio safety, food security- Importance and scope in public health- Foodborne illnesses: causes and statistics- Historical outbreaks and lessons learned.

UNIT - II	FOOD HAZARDS AND CONTAMINATION	(9)

Biological hazards: bacteria, viruses, parasites, fungi- Chemical **hazards**: pesticides, food additives, allergens, heavy metals- Physical **hazards**: glass, metal fragments, plastic- Sources and routes of contamination.

UNIT - III	FOOD SAFETY MANAGEMENT SYSTEMS	(9)

HACCP (Hazard Analysis and Critical Control Points)- GMP (Good Manufacturing Practices) - GHP (Good Hygiene Practices)- ISO 22000 and FSSC 22000- Traceability and recall systems.

UNIT - IV	REGULATORY AND LEGAL FRAMEWORK AND BIOSAFETY PRINCIPLES	(9)

Codex Alimentarius- WHO, FAO food safety standards- FSSAI (India) / FDA (USA) guidelines- WTO-SPS Agreement- Risk analysis: risk assessment, risk management, risk communication

Biosafety levels (BSL 1–4)- Laboratory safety protocols and PPE- Handling of GMOs and recombinant organisms- Containment strategies (primary and secondary)- Biosafety in food biotech labs.

UNIT - V	EMERGING ISSUES AND TECHNOLOGIES	(9)

New food technologies and safety concerns (e.g., nanotech, lab-grown meat)- Antimicrobial resistance- Rapid detection methods (PCR, ELISA, biosensors)- Food safety in climate change context.

L=45,P=0, SL=45,TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand the principles of food safety and biological hazards.	Understand
CO2	Identify and classify biological, chemical, and physical hazards in food systems and describe appropriate control measures.	Understand
CO3	Understand national and international food safety standards, regulations, and risk assessment methods to evaluate food safety systems.	Understand
CO4	Learn regulatory frameworks and risk assessment methods.	Understand
CO5	Gain emerging food safety issues and modern technologies (e.g., rapid detection methods, biotechnology applications) in the context of consumer health and safety.	Understand

REFERENCES:

1. Food Safety – B. Lund, T.C. Baird-Parker & G.W. Gould
2. Principles of Food Sanitation – Norman Marriott
3. Biosafety in Microbiological and Biomedical Laboratories (BMBL) – CDC/NIH
4. FSSAI Manuals & Codex Guidelines (for region-specific)

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**1**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**1**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**1**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**1**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**1**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1-low, 2-medium, 3-high

AX24A01	DISASTER MANAGEMENT	Category	L	T	P	C
		AC	30	0	0	0

(Common to All Branches)

PREREQUISITE:

A basic understanding of geography, environmental science, and public health is a prerequisite for studying disaster management.

OBJECTIVES:

To enable students to understand the nature, causes, and impacts of natural and manmade disasters, identify disaster prone areas with special reference to India, and develop knowledge on disaster preparedness, management strategies, risk assessment techniques, and sustainable approaches for effective disaster mitigation and community resilience.

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, Green economy, Blue economy, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment, Strategies for Survival

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand the definitions, differences, and classifications of disasters and hazards	Understand
CO2	Discuss the destruction of ecosystems and the loss of human and animal life resulting from different disaster events.	Understand
CO3	Compare the vulnerability of different regions in India to various natural disasters.	Understand

CO4	Summarize the methods and technologies used in assessing and monitoring disaster risks.	Understand
CO5	Describe the concept, elements, and current global and national scenarios of disaster risk.	Understand

TEXT BOOKS:

1. Gupta, Harsh K., "Disaster Management", Universities Press, Hyderabad, 2nd Edition, 2013.

2. Satendra, "Disaster Management in India: Perspectives, Issues and Strategies", National Institute of Disaster Management, New Delhi, 1st Edition, 2018.

REFERENCES:

1. Goel S. L., “Disaster Administration and Management Text and Case Studies”, Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
2. Nishitha Rai, Singh AK, “Disaster Management in India: Perspectives, issues and strategies” New Royal book Company, 2007.
3. Sahni, Pardeep et.al., “Disaster Mitigation Experiences and Reflections”, Prentice Hall of India, New Delhi, 2001.
4. Sharma, R.K. and Sharma, G. “Natural Disaster Management: Causes, Effects and Mitigation”, Deep & Deep Publications, New Delhi, 2005.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	1	1	1	2	3
CO2	1	1	1	2	3
CO3	1	1	1	2	3
CO4	1	1	1	2	3
CO5	1	1	1	2	3
Avg.	1	1	1	2	3

1-low, 2-medium, 3-high

AX24A02	VALUE EDUCATION	Category	L	T	P	C
		AC	30	0	0	0

(Common to All Branches)

PREREQUISITE:

Basic understanding of moral principles, social responsibilities, and a willingness to engage in self-reflection and personal growth.

OBJECTIVES:

To foster self-development, strengthen human values, and promote overall personality growth and social empowerment through value-based education.

UNIT - I	INTRODUCTION TO VALUE EDUCATION	(6)

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgements.

UNIT - II	IMPORTANCE OF VALUES	(6)

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

UNIT - III	INFLUENCE OF VALUE EDUCATION	(6)

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth.

UNIT - IV	REINCARNATION THROUGH VALUE EDUCATION	(6)

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation

UNIT - V	VALUE EDUCATION IN SOCIAL EMPOWERMENT	(6)

Equality, Nonviolence, Humility, Role of Women, all religions and same message, mind your Mind, Self-control, Honesty, Studying effectively

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Gain knowledge of self-development	Understand
CO2	Learn the importance of Human values	Understand
CO3	Develop the overall personality through value education	Understand
CO4	Overcome the self-destructive habits with value education	Understand
CO5	Interpret social empowerment with value education	Understand

TEXT BOOKS:

1. Chakravarthy.S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi, 1999.

2. M.G. Chitakra, "Education and Human Values", A.P.H. Publishing Corporation, New Delhi, 2003.

REFERENCES:

1. Satchidananda, M.K, "Ethics, Education, Indian Unity and Culture", Ajantha Publications, Delhi, 1991.

2. Das, M.S., Gupta, V.K. "Social Values among Young adults: A changing Scenario", M.D. Publications, New Delhi, 1995.

3. Bandiste, D.D., "Humanist Values: A Source Book", B.R. Publishing Corporation, Delhi, 1999

4. Ruhela, S.P., "Human Values and education", Sterling Publications, New Delhi, 1986

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	1	1	1	2	3
CO2	1	1	1	2	3
CO3	1	1	1	2	3
CO4	1	1	1	2	3
CO5	1	1	1	2	3
Avg.	1	1	1	2	3

1-low, 2-medium, 3-high

AX24A03	CONSTITUTION OF INDIA	Category	L	T	P	C
		AC	30	0	0	0

(Common to All Branches)

PREREQUISITE:

Basic awareness of Indian history, civics, and political system at the school level, along with an Interest in understanding the democratic framework and governance of India.

OBJECTIVES:

To provide a comprehensive understanding of the India Constitution, including its basic structure, fundamental rights and duties, directive principles, the functioning of the Union and State governments, and the electoral system.

UNIT - I	INTRODUCTION TO INDIAN CONSTITUTION	(6)

Indian Constitution: Necessity of the Constitution, Societies before and after the Constitution adoption. Introduction to the Indian constitution, Making of the Constitution, Role of the Constituent Assembly.

UNIT - II	FUNDAMENTAL RIGHTS AND DUTIES	(6)

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

UNIT - III	UNION GOVERNMENT	(6)

Parliamentary System, Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism.

UNIT - IV	STATE GOVERNMENT	(6)

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT - V	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

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand the basic structure of Indian Constitution	Understand
CO2	Remember their Fundamental Rights, DPSP's and Fundamental Duties (FD's) of our constitution	Understand
CO3	Know about our Union Government, political structure & codes, procedures	Understand
CO4	Understand our State Executive of India	Understand
CO5	Understand our Elections system of India	Understand

TEXT BOOKS:

1. Durga Das Basu, "Introduction to the Constitution of India", Lexis Nexis Publisher, New Delhi, 23rd edition, 2018.

2. P.M. Bakshi, "The Constitution of India", Universal law Publishing, New Delhi, Fifteenth Edition, 2018.

REFERENCES:

1. Brij Kishore sharma, "Introduction to the constitution india", PHI Learning Pvt. Ltd, New Delhi, Seventh Edition, 2015.

2. M. Laxmikanth, "Indian Polity", Tata McGraw Hill, New Delhi, Sixth Edition, 2017.

3. P. K. Agarwal, "Constitution of India", Prabhat Publishers, New Delhi, Second Edition, 2015**.**

4. M.P. Jain, "Indian Constitution Law", Lexis Nexis Publisher, New Delhi, 7th Edition, 2014.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	1	1	1	2	3
CO2	1	1	1	2	3
CO3	1	1	1	2	3
CO4	1	1	1	2	3
CO5	1	1	1	2	3
Avg.	1	1	1	2	3

1-low, 2-medium, 3-high

AX24A04	INDIAN KNOWLEDGE SYSTEM	Category	L	T	P	C
		AC	30	0	0	0

(Common to All Branches)

PREREQUISITE:

Basic knowledge of Indian history and culture, and an interest in exploring traditional systems of knowledge across disciplines such as science, technology, humanities, and philosophy.

OBJECTIVES:

To provide an understanding of the historical evolution, key features, and multidisciplinary applications of the Indian Knowledge System, encompassing its contributions to humanities, science, engineering, socio-religious practices, and the need for its protection and preservation.

UNIT - I	INTRODUCTION TO INDIAN KNOWLEDGE SYSTEM	(6)

Importance of Ancient Knowledge System, Definition, concept, and scope of Indian Knowledge System (IKS), IKS based approaches on knowledge paradigms, IKS in modern India, Some unique Aspects of IKS.

UNIT - II	TRADITIONAL KNOWLEDGE IN HUMANITIES AND SCIENCES	(6)

Linguistics, Number and measurements - Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.

UNIT - III	TRADITIONAL KNOWLEDGE IN PROFESSIONAL DOMAIN	(6)

Town planning and architecture Construction, Health, wellness and Psychology - Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.

UNIT - IV	APPLIED TRADITIONAL KNOWLEDGE	(6)

Myths, Rituals, Spirituals, Taboos and Belief System, Folk Stories, Songs, Proverbs, Dance, Play, Acts and Traditional Narratives, Agriculture, animal husbandry, Forest, Sacred Groves, Water Mills, Sacred Water Bodies, Land, water and Soil Conservation and management Practices, Indigenous Bio-resource Conservation, Utilization Practices and Food Preservation Methods, Handicrafts, Wood Processing and Carving, -Fiber Extraction and Costumes

UNIT - V	PROTECTION OF INDIAN KNOWLEDGE SYSTEM	(6)

Documentation and Preservation of IKS, approaches for conservation and Management of nature and bio-resources, Approaches and strategies to protection and conservation of IKS.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explain the historicity of Indian Knowledge System	Understand
CO2	Explain the features of traditional knowledge in humanities and sciences	Understand
CO3	Develop familiarity with science, engineering and technology of IKS	Understand
CO4	Understand the importance of functional, aesthetic, and socio-religious concept of IKS.	Understand
CO5	Understand the concepts of protection of IKS	Understand

TEXT BOOKS:

1. B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, "Introduction to Indian Knowledge System Concepts and Applications", PHI Learning Private Ltd, 2022, ISBN-978-93-91818-21-0.

2. Amit Jha, "Traditional Knowledge System in India", Atlantic Publishers and Distributors (P) Ltd., 2009, ISBN-13: 978-8126912230

REFERENCES:

1. Kapil Kapoor, Avadesh Kumar Singh, "Knowledge Traditions and Practices of India", Vol. 1, DK Print World (P) Ltd., 2005, ISBN 81-246-0334.

2. D.N. Bose, S.N. Sen, B. V. Subbarayappa, "A Concise History of Science in India", Indian National Science Academy, New Delhi, 2009.

3. S. N. Sen, K. S. Shukla, "History of Astronomy in India", Indian National Science Academy, 2nd edition, New Delhi, 2000**.**

4. Dr. Ravindra Singh Rana, Indian Knowledge System of Materials in Science and Technology, Walnut Publication, 2023

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	1	1	1	2	3
CO2	1	1	1	2	3
CO3	1	1	1	2	3
CO4	1	1	1	2	3
CO5	1	1	1	2	3
Avg.	1	1	1	2	3

1-low, 2-medium, 3-high