



AL-AMEEN ENGINEERING COLLEGE

(Autonomous)

Accredited by NAAC with “A” Grade :: An ISO Certified Institution
(Affiliated to Anna University, Chennai & Approved by AICTE, New Delhi)
Karundevanpalayam, NanjaiUthukkuli Post, Erode – 638 104, Tamilnadu, INDIA.

CURRICULUM & SYLLABI

SEMESTERS – I to IV

(Regulations2023)

CHOICE BASED CREDIT SYSTEM

M.E.Industrial Safety Engineering

Applicable to the Students admitted from the AY 2024-25 onwards

KNOWLEDGE LEVELS (BLOOM'S TAXONOMY)

Notation	Knowledge Levels
K1	Remembering
K2	Understanding
K3	Applying
K4	Analysing
K5	Evaluating
K6	Creating

VISION	
	To be a centre of excellence focusing on inventiveness for uplifting rural and the underprivileged with values, culture and high degree of trans-disciplinary expertise.

MISSION	
M1	To groom confident, wholesome mechanical engineers with good communication and entrepreneurial skills to transform the world of work in holism.
M2	To develop diverse experiences in students for enriching rural and under-privileged communities.
M3	To develop students focused on career in industries, engineering start-ups and management with awareness of social, economic and ethical impacts.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)	
PEO 1	Enhance the skills and knowledge on safety, health and environment with respect to industry and research, for executing safe methods in complex engineering problems.
PEO 2	Understand the impact of safety, health and environmental solutions on productivity, quality and societal at large.
PEO 3	To comply with legal safety, ethical and contractual requirements, professional practices to contribute the community for the sustainable development of society.

PROGRAM OUTCOMES (POs)	
PO 1	An ability to independently carry out research / investigation and development work to solve practical problems.
PO 2	An ability to write and present a substantial technical report / document.
PO 3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be a level higher than the requirements in the appropriate bachelor program.

PROGRAM SPECIFIC OUTCOMES (PSOs)	
PSO 1	An ability to attain, identify and apply knowledge of mathematics, soft computing & soft skill and management for various academic and industrial needs.
PSO 2	Students should be able to use techniques and modern engineering tools for engineering practices in their immediate employment and/or entrepreneurial activities.
PSO 3	Contribute to the core universal human values and social good to community with respect to industrial safety, health and environment

CURRICULUM

SEMESTER I

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	23MC1T1	Research Methodology and IPR	PC	40	60	3	0	0	3
2	23IS1T2	Environmental Safety	PC	40	60	3	0	0	3
3	23IS1T3	Applied Statistics	BS	40	60	3	1	0	4
4	23IS1T4	Industrial Safety, Health and Environment (SHE) Acts	PC	40	60	3	0	0	3
5	23IS1T5	Principles of Safety Management	RMC	40	60	3	0	0	3
6	23IS1T6	Universal Human Value and Ethics	MC	100	-	2	0	0	0
7	23IS1E_	Professional Elective – I	PE	40	60	3	0	0	3
8	23ISCA_	Audit Course – I	AC	100	-	2	0	0	0
LABORATORY COURSE									
9	23IS1L1	Technical Presentation – I	EEC	100	-	0	2	0	2
Total						22	3	0	21

SEMESTER II

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	23IS2T1	Fire Engineering and Explosion Control	PC	40	60	3	0	0	3
2	23IS2T2	Reliability Engineering	PC	40	60	3	0	0	3
3	23IS2T3	Safety in Chemical Industries	PC	40	60	3	0	0	3
4	23IS2T4	Safety in Engineering Industry	PC	40	60	3	0	0	3
5	23IS2E_	Professional Elective – II	PE	40	60	3	0	0	3
6	23IS2E_	Professional Elective – III	PE	40	60	3	0	0	3
7	23ISCA_	Audit course – II	AC	100	-	2	0	0	0
LABORATORY COURSES									
8	23IS2L1	Industrial Safety Laboratory	PC	60	40	0	0	4	2
9	23IS2L2	Technical Presentation – II	EEC	100	-	0	2	0	2
Total						20	2	4	22

SEMESTER III

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	23IS3T1	Computer Aided Hazard Analysis	PC	40	60	3	0	0	3
2	23IS3T2	Occupational Health and Industrial Hygiene	PC	40	60	3	0	0	3
3	23IS3E_	Professional Elective – IV	PE	40	60	3	0	0	3
4	23IS3O_	Open Elective / Swayam	OE	40	60	3	0	0	3
LABORATORY COURSE									
5	23IS3L1	Industrial Safety Assessment – Internship	EEC	100	-	0	0	4	2
6	23IS3L2	Project Phase – I	EEC	40	60	0	0	12	6
Total						12	0	16	20

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
LABORATORY COURSE									
1	23IS4L1	Project Phase – II	EEC	40	60	0	0	24	12
Total						0	0	24	12

Total Credits: 75

BASIC SCIENCES (BS)

Sl.No.	Course Code	Course Title	L	T	P	C
1	23IS1T3	Applied Statistics	3	1	0	4

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

Sl.No.	Course Code	Course Title	L	T	P	C
1	23MC1T1	Research Methodology and IPR	3	0	0	3

PROFESSIONAL CORE (PC)

Sl.No.	Course Code	Course Title	L	T	P	C
1	23IS1T2	Environmental Safety	3	0	0	3
2	23IS1T4	Industrial Safety, Health and Environment (SHE) Acts	3	0	0	3
3	23IS1T5	Principles of Safety Management	3	0	0	3
4	23IS2T1	Fire Engineering and Explosion Control	3	0	0	3
5	23IS2T2	Reliability Engineering	3	0	0	3
6	23IS2T3	Safety in Chemical Industries	3	0	0	3
7	23IS2T4	Safety in Engineering Industry	3	0	0	3
8	23IS2L1	Industrial Safety Laboratory	0	0	4	2
9	23IS3T1	Computer Aided Hazard Analysis	3	0	0	3
10	23IS3T2	Occupational Health and Industrial Hygiene	3	0	0	3

PROFESSIONAL ELECTIVES (PE)**PROFESSIONAL ELECTIVE – I**

Sl. No.	Course Code	Course Title	L	T	P	C
1	23IS1E1	Work Study and Ergonomics	3	0	0	3
2	23IS1E2	Quality Engineering	3	0	0	3
3	23IS1E3	Plant Layout and Materials Handling	3	0	0	3
4	23IS1E4	OHSAS18000 and ISO14000	3	0	0	3

PROFESSIONAL ELECTIVE – II

Sl. No.	Course Code	Course Title	L	T	P	C
1	23IS2E1	Safety in Mines	3	0	0	3
2	23IS2E2	Transport Safety	3	0	0	3
3	23IS2E3	Dock Safety	3	0	0	3
4	23IS2E4	Aviation Safety	3	0	0	3

PROFESSIONAL ELECTIVE – III

Sl. No.	Course Code	Course Title	L	T	P	C
1	23IS2E5	Safety in Construction	3	0	0	3
2	23IS2E6	Safety in Powder Handling	3	0	0	3
3	23IS2E7	Safety in Textile Industry	3	0	0	3
4	23IS2E8	Safety in Waste Management	3	0	0	3

PROFESSIONAL ELECTIVE – IV

Sl. No.	Course Code	Course Title	L	T	P	C
1	23IS3E1	Nuclear Engineering and Safety	3	0	0	3
2	23IS3E2	Electrical Safety	3	0	0	3
3	23IS3E3	Fireworks safety	3	0	0	3
4	23IS3E4	Safety in Petroleum Refining Industry	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Course Code	Course Title	L	T	P	C
1	23IS1L1	Technical Presentation – I	0	2	0	2
2	23IS2L2	Technical Presentation – II	0	2	0	2
3	23IS3L1	Industrial Safety Assessment – Internship	0	0	4	2
4	23IS3L2	Project Phase – I	0	0	12	6
5	23IS4L1	Project Phase – II	0	0	24	12

Mandatory Course

Sl. No.	Course Code	Course Title	L	T	P	C
1	23IS1T6	Universal Human Value and Ethics	2	0	0	0

Audit Courses

Sl. No.	Course Code	Course Title	L	T	P	C
1	23ISCA1	English for Research Paper Writing	2	0	0	0
2	23ISCA2	Constitution of India	2	0	0	0
3	23ISCA3	Principles of Sustainable Development	2	0	0	0
4	23ISCA4	□□□□□□□□□□□□□□□□	2	0	0	0
5	23ISCA5	Disaster Management	2	0	0	0

List of Open Electives for P.G. Industrial Safety Engineering

Sl. No.	Course Code	Course Title	L	T	P	C
1	23IS3O1	Integrated Water Resources Management	3	0	0	3
2	23IS3O2	Water, Sanitation and Health	3	0	0	3
3	23IS3O3	Principles of Sustainable Development	3	0	0	3
4	23IS3O4	Environmental Impact Assessment	3	0	0	3
5	23IS3O5	Deep Learning	3	0	0	3
6	23IS3O6	Sustainable Management	3	0	0	3
7	23IS3O7	Micro and Small Business Management	3	0	0	3
8	23IS3O8	Ethical Management	3	0	0	3
9	23IS3O9	IoT for Smart Systems	3	0	0	3
10	23IS3O10	Machine Learning and Deep Learning	3	0	0	3
11	23IS3O11	Smart Grid	3	0	0	3
12	23IS3O12	Security Practices	3	0	0	3
13	23IS3O13	Cloud Computing Technologies	3	0	0	3
14	23IS3O14	Big Data Analytics	3	0	0	3
15	23IS3O15	Internet of Things and Cloud	3	0	0	3
16	23IS3O16	Embedded Automation	3	0	0	3
17	23IS3O17	Artificial Intelligence and Expert Systems	3	0	0	3

CREDIT SUMMARY

S. No.	Course Area	Credits per Semester				Total Credits	Curriculum Content (% of total number of credits of the program)
		I	II	III	IV		
1	Basic Sciences	4	-	-	-	4	5.33%
2	Research Methodology And IPR Courses	3	-	-	-	3	4.00%
3	Professional Core	9	14	6	-	29	38.67%
4	Professional Electives	3	6	3	-	12	16.00%
5	Open Electives	-	-	3	-	3	4.00%
6	Employability Enhancement Courses	2	2	8	12	24	32.00%
TOTAL		21	22	20	12	75	100.00%

BS – Basic Sciences

RMC - Research Methodology and IPR Course

PC – Professional Core

PE – Professional Elective

OE – Open Elective

EEC – Employability Enhancement Course

**SYLLABUS
SEMESTER I**

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	23MC1T1	Research Methodology and IPR	PC	40	60	3	0	0	3
2	23IS1T2	Environmental Safety	PC	40	60	3	0	0	3
3	23IS1T3	Applied Statistics	BS	40	60	3	1	0	4
4	23IS1T4	Industrial Safety, Health and Environment (SHE) Acts	PC	40	60	3	0	0	3
5	23IS1T5	Principles of Safety Management	RMC	40	60	3	0	0	3
6	23IS1T6	Universal Human Value and Ethics	MC	100	-	2	0	0	0
7	23IS1E_	Professional Elective – I	PE	40	60	3	0	0	3
8	23ISCA_	Audit Course – I	AC	100	-	2	0	0	0
LABORATORY COURSE									
9	23IS1L1	Technical Presentation – I	EEC	100	-	0	2	0	2
Total						22	3	0	21

Semester	Programme	Course Code	Course Name	L	T	P	C
I	M.E. ISE	20MC1TL	Research Methodology and IPR	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Understanding of research process and design.	K2	1
CO2	Utilizing secondary and exploratory data.	K2	2
CO3	Proficiency in qualitative research methods.	K2	3
CO4	Competence in observation studies, experiments, and surveys.	K2	4
CO5	Data collection and sources management.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	-
CO2	-	2	3	-	-	-
CO3	-	2	-	-	2	-
CO4	-	2	-	-	-	-
CO5	-	2	-	-	-	-

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	RESEARCH DESIGN									8
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.										
Topic – 2	DATA COLLECTION AND SOURCES									8
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.										
Topic – 3	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.										
Topic – 4	INTELLECTUAL PROPERTY RIGHTS									10
Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.										
Topic – 5	PATENTS									10
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, Licences, Licensing of related patents, patent agents, Registration of patent agents.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2	David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
3	The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.
4	C.R. Kothari, "Research Methodology: Methods and Techniques", New Age International, 2009
5	Ranjit Kumar, "Research Methodology: A Step-by-Step Guide for Beginners", SAGE Publications Ltd, 2019
6	K. Shyamala, "Intellectual Property Rights", New Age International, 2003

Semester	Programme	Course Code	Course Name	L	T	P	C
I	M.E. ISE	23IS1T2	Environmental Safety	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Gain about the air pollution effects and its control.	K2	1
CO2	Analyze about the water pollutants and its health hazards.	K4	2
CO3	Apply the health and safety concepts with respect to hazardous waste management.	K3	3
CO4	Acquire knowledge on environmental measurement and its control.	K2	4
CO5	Demonstrate the health and safety practices in controlling risks for different engineering activities.	K3	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	2	-	-	3
CO2	2	-	2	-	-	3
CO3	2	-	2	-	-	3
CO4	2	-	2	-	-	3
CO5	2	-	2	-	-	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		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.										
Topic – 2		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.										
Topic – 3		HAZARDOUS WASTE MANAGEMENT							10	
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.										
Topic – 4		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.										
Topic – 5		POLLUTION CONTROL IN PROCESS INDUSTRIES							8	
Pollution control in process industries like cement, paper and petroleum - petroleum products - textile - tanneries thermal power plants - dying and pigment industries - eco-friendly energy										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK 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	Environmental Pollution Control (4th Edition) - Wayne C. Strock, 2020
5	Pollution Control Handbook (2nd Edition) - Larry K. Wang, et al. ,2019
6	Water Quality Engineering: Systems, Processes, and Design (2nd Edition) - H. David Jenkins & Marcus T. Mannheimer, 2015

Semester	Programme	Course Code	Course Name	L	T	P	C
I	M.E. ISE	23IS1T3	Applied Statistics	3	1	0	4

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Develop the skills in random variable and its Distributions.	K2	1
CO2	Develop the skills in Estimation theory and interpretation of correlation and regression analysis	K2	2
CO3	Extend knowledge in testing the significance between the samples.	K2	3
CO4	Interpret the variances and finding the significance by using Design of Experiments.	K3	4
CO5	Compute the control charts and finding various types of inferences.	K4	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
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	-

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	RANDOM VARIABLES								9	
One dimensional and Two-dimensional Random variables – Moments – Moment generating function – Standard distributions - Binomial, Poisson, Normal and Exponential distributions.										
Topic – 2	CORRELATION, REGRESSION AND ESTIMATION THEORY								9	
Correlation and Regression - Multiple and Partial correlations - Principle of least squares- Fitting straight line trends. Estimation of Parameters – Maximum likelihood estimates – Method of moments.										
Topic – 3	TESTING OF HYPOTHESIS								9	
Sampling distributions - Type I and Type II errors – Test of significance for small sample (Student’s t-test) - Test of significance for large samples (z-test) – Test of significance of variance (F- test) – Chi-Square test for Independence of attributes.										
Topic – 4	DESIGN OF EXPERIMENTS								9	
Analysis of variance – One-way and two-way classifications – Completely randomized design - Randomized block design –Latin square design.										
Topic – 5	QUALITY CONTROL								9	
Introduction – Types of control Charts – X chart – R chart – Control chart for the standard deviations s-chart – Control chart for C (Number of defects per unit) – Advantage and limitation of Statistical Quality Control.										
THEORY	45		TUTORIAL	15		PRACTICAL	0		TOTAL	60

BOOK REFERENCES	
1	S.P. Gupta, Statistical Methods, Sultan Chand & sons, New Delhi, Thirty first edition, 2014.
2	Freund John, E and Miller, Irvin, Probability and Statistics for Engineering, Prentice Hall, New Delhi, Fifth Edition, 2013.
3	Gupta, S.C and Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, Fourteenth edition, 2014.
4	Eugene L. Grant and Richard S. Leavenworth, Statistical Quality Control, McGraw-Hill Publications, New York, Seventh edition, 2013.
5	Douglas C. Montgomery, "Introduction to Statistical Quality Control", John Wiley & Sons, 2012
6	David S. Moore, George P. McCabe, and Bruce A. Craig, "Introduction to the Practice of Statistics", W. H. Freeman, 2017

Semester	Programme	Course Code	Course Name	L	T	P	C
I	M.E. ISE	23IS1T4	Industrial Safety, Health and Environment (SHE) Acts	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Gain the health and welfare provisions as given in factories act.	K2	1
CO2	Acquire knowledge on environment act with respect to air and water pollution.	K2	2
CO3	Analyze the responsibilities of occupier according to manufacture, storage and import of chemical rules.	K4	3
CO4	Evaluate the other legislation acts pertaining to health and safety.	K4	4
CO5	List out the various international acts and rules.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	3	2	-	-	3
CO2	2	2	2	-	-	3
CO3	3	3	2	-	-	3
CO4	3	3	2	-	-	3
CO5	1	2	2	-	-	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	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.										
Topic – 2	ENVIRONMENT ACT - 1986								10	
General powers of the central government, prevention, control and abatement of environmental pollution - Biomedical waste (Management and Handling) Rules, 1989 - The Noise Pollution (Regulation and control) Rules, 2000 - The Batteries (Management and Handling) Rules, 2001 - No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974:Central and state boards for the prevention and control of air pollution - powers and functions of boards - prevention and control of air pollution and water pollution – fund - accounts and audit, penalties and procedures.										
Topic – 3	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.										
Topic – 4	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.										
Topic – 5	INTERNATIONAL ACTS AND STANDARDS								8	
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).										
THEORY	45		TUTORIAL		0	PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	The Factories Act 1948, Madras Book Agency, Chennai, 2000.
2	The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt. Ltd., New Delhi, Second Edition, 2019.
3	The Indian boilers act 1923, Commercial Law Publishers (India) Pvt. Ltd., Allahabad, Second Edition, 2011.
4	The Mines Act 1952, Commercial Law Publishers (India) Pvt. Ltd., Allahabad, Second Edition, 2019.
5	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.
6	David L. Goetsch, "Occupational Safety and Health for Technologists, Engineers, and Managers", Pearson, 2019.

Semester	Programme	Course Code	Course Name	L	T	P	C
I	M.E. ISE	23IS1T5	Principles of Safety Management	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Understand the concepts and techniques of safety management functions.	K2	1
CO2	Recall about safety audit and to prepare a report for the audit.	K2	2
CO3	Acquire knowledge on the principles of accident and its control methods.	K2	3
CO4	Evaluate the accident cost using supervisors report and data.	K2	4
CO5	Recall the role of various agencies in safety education and training.	K2	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	-
CO2	2	3	2	-	2	-
CO3	3	3	2	-	2	3
CO4	2	3	2	-	2	-
CO5	2	2	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		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.										
Topic – 2		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.										
Topic – 3		SAFETY AUDIT - INTRODUCTION							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.										
Topic – 4		SAFETY AUDIT - INTRODUCTION							8	
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.										
Topic – 5		SAFETY EDUCATION AND TRAINING							10	
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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Relevant India Acts and Rules, Government of India.
2	Blake, R.B., Industrial Safety, Prentice Hall Inc, Delhi, Third Edition, 2009.
3	Heinrich, H.W., Industrial Accident Prevention, McGraw-Hill Company, New York, Fifth Edition, 2019.
4	Krishnan, N.V., Safety Management in Industry, Jaico Publishing House, Bombay, Second Edition, 2017.
5	Lees, F.P., Loss Prevention in Process Industries, Butterworth publications, London, Second edition, 2001.
6	John Ridley., Safety at Work, Butterworth and Co, London, Seventh Edition, 2003.

Semester	Programme	Course Code	Course Name	L	T	P	C
I	M.E. ISE	23IS1L1	Technical Presentation - I	0	2	0	2

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	Able to identify the problems in general area of interest by the student.	K2
CO2	Incorporate the area / problem by referring journals, conference proceedings etc.	K2
CO3	Enhance the collective skills between theoretical knowledge and real time problems.	K2
CO4	Gain knowledge on the problem by presentation and review.	K2
CO5	Acquire idea on report writing and presentation.	K2

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	3	-	2	-	-
CO2	1	3	-	2	-	-
CO3	1	3	-	2	-	-
CO4	1	3	-	2	-	-
CO5	1	3	-	2	-	-

COURSE ASSESSMENT METHODS		
DIRECT	1	Presentation
	2	Report
INDIRECT	1	Course End Survey

COURSE CONTENT										
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 Power Point, the student has to make presentation for 20 minutes followed by 10 minutes discussion. 5. The student has to make three 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.										
THEORY	0		TUTORIAL		30	PRACTICAL	0		TOTAL	30

SEMESTER II

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	23IS2T1	Fire Engineering and Explosion Control	PC	40	60	3	0	0	3
2	23IS2T2	Reliability Engineering	PC	40	60	3	0	0	3
3	23IS2T3	Safety in Chemical Industries	PC	40	60	3	0	0	3
4	23IS2T4	Safety in Engineering Industry	PC	40	60	3	0	0	3
5	23IS2E_	Professional Elective – II	PE	40	60	3	0	0	3
6	23IS2E_	Professional Elective – III	PE	40	60	3	0	0	3
7	23ISCA_	Audit course – II	AC	100	-	2	0	0	0
LABORATORY COURSES									
8	23IS2L1	Industrial Safety Laboratory	PC	60	40	0	0	4	2
9	23IS2L2	Technical Presentation – II	EEC	100	-	0	2	0	2
Total						20	2	4	22

Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2T1	Fire Engineering and Explosion Control	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Recall about the fire properties of solid, liquid and gases and understand the principle of fire and combustion Theory.	RBT Level	1
CO2	Gain knowledge about the fire prevention and fire protection systems.	K2	2
CO3	Acquire knowledge on different sources of ignition, classes of fires and their extinguishing Medium.	K2	3
CO4	Ability to know the objective of building fire safety and relevant standards.	K2	4
CO5	Apply the principles of explosion and understand about their protecting systems.	K3	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-
CO2	3	3	3	-	3	-
CO3	3	3	3	-	-	-
CO4	3	2	3	-	1	-
CO5	3	2	3	-	2	-

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		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.										
Topic – 2		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.										
Topic – 3		INDUSTRIAL FIRE PROTECTION SYSTEMS							10	
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.										
Topic – 4		BUILDING FIRE SAFETY							8	
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.										
Topic – 5		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 ₂), chlorine (Cl ₂) etc.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Derek, James, Fire Prevention Hand Book, Butter Worths and Company, London, Ninth edition, 2016
2	Gregory E. Gorbett and James L. Pharr, "Introduction to Fire Protection and Emergency Services", Jones & Bartlett Learning, 2014.
3	Philip J. DiNenno, Joseph F. McAllister, and David D. Evans, "SFPE Handbook of Fire Protection Engineering", Springer, 2015
4	Dinko Tuhtar, Fire and explosion Protection, E. Horwood, Second Edition, 1989
5	Davis Daniel et al, Hand Book of fire technology.
6	Fire fighters hazardous materials reference book for Fire Prevention in Factories, Van Nostrand Rein Hold, Second Edition, New York, 1991.

Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2T2	Reliability Engineering	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Gain knowledge about the priori and post priori concepts, mortality curve and ability to calculate the system effectiveness.	K2	1
CO2	Acquire knowledge on failure data analysis and their limitations.	K2	2
CO3	Apply the principles of reliability prediction models and its applications.	K3	3
CO4	Analyze about the improvement of components and their computational procedures.	K4	4
CO5	Determine the objectives of reliability and quality management approaches.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-
CO2	3	-	2	-	-	-
CO3	3	-	2	3	-	-
CO4	3	-	2	3	2	-
CO5	3	-	2	2	-	-

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		RELIABILITY CONCEPT							10	
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.										
Topic – 2		FAILURE DATA ANALYSIS							8	
Time to failure distributions - Exponential, Normal, Gamma, Weibull - ranking of data - probability plotting techniques - Hazard plotting.										
Topic – 3		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.										
Topic – 4		RELIABILITY IMPROVEMENT							8	
Introduction - Improvement of components - Element, Unit, Standby Redundancies - Redundancy Optimization - Computational Procedures.										
Topic – 5		RELIABILITY MANAGEMENT							10	
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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK 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.
4	Dimitri Kececioglu, "Reliability Engineering Handbook", Prentice Hall, 1999
5	David J. Smith,"Reliability, Maintainability and Risk: Practical Methods for Engineers", Butterworth-Heinemann, 2005
6	Anthony J. McCallum, "Reliability-Centered Maintenance", Industrial Press, Inc., 2016

Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2T3	Safety in Chemical Industries	3	0	0	3

COURSE LEARNING OUTCOMES (COs)				
After Successful completion of the course, the students should be able to			RBT Level	Topics Covered
CO1	Acquire knowledge on Chemical plant design, process, facilities and inherent safe design.		K2	1
CO2	Explore the commissioning phases and their documentation.		K2	2
CO3	Analyze the operating procedures and emergency procedures during plant operations.		K4	3
CO4	Apply the concepts of plant maintenance, modification and emergency planning.		K3	4
CO5	Classify the different types of chemical storages and their safety measures.		K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	3
CO2	3	2	2	-	-	-
CO3	3	2	2	2	-	3
CO4	3	3	2	2	-	2
CO5	3	2	2	-	-	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		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.										
Topic – 2		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.										
Topic – 3		PLANT OPERATIONS							8	
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.										
Topic – 4		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.										
Topic – 5		STORAGES							10	
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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Lees, F.P., Loss Prevention in Process Industries, Butterworths and Company, U.S., Fourth Edition, 2012.
2	Mannan, S., Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment, and Control, Butterworth-Heinemann, 2018.
3	Fawcett, H.H. and Wood, Safety and Accident Prevention in Chemical Operations, Wiley inters, U.S., Second Edition, 2008.
4	Accident Prevention Manual for Industrial Operations, NSC, Chicago, Third edition, 2008.
5	GREEN, A.E., High Risk Safety Technology, John Wiley and Sons, U.K., Second Edition, 2003.
6	Petroleum Act and Rules, Government of India.

Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2T4	Safety in Engineering Industry	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Determine the General safety rules, principles, maintenance, Inspections of metal and wood working machinery.	K2	1
CO2	Apply the concepts of safety in design, use and maintenance of machines.	K3	2
CO3	Recall about welding, common hazards in welding, personal protective equipment and safety precautions in welding.	K2	3
CO4	Analyze the safety in cold working and hot working of metals.	K4	4
CO5	Acquire knowledge on safety in finishing, inspection and testing of machines.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	2	3	1	-	3
CO2	2	2	3	1	-	3
CO3	2	2	3	1	-	3
CO4	2	2	3	1	-	3
CO5	2	2	3	1	-	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic – 1	SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES	10
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.		
Topic – 2	SAFETY IN DESIGN, USE & MAINTENANCE OF MACHINES	10
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.		
Topic – 3	SAFETY IN WELDING AND GAS CUTTING	8
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.		
Topic – 4	SAFETY IN COLD FARMING AND HOT WORKING OF METALS	10
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.		
Topic – 5	SAFETY IN FINISHING, INSPECTION AND TESTING	7
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.		

THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45
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BOOK REFERENCES	
1	David Goetsch, Occupational Safety and Health for Technologists, Engineers, and Managers, Pearson, 2016
2	Accident Prevention Manual, NSC, Chicago, Third Edition, 2008.
3	Krishnan, N.V., Safety in Industry, Jaico Publishers House, London, Fourth Edition, 1996.
4	Safety in the use of wood working machines, HSE, UK, Second Edition, 2005.
5	Health and Safety in Welding and Allied Processes, Welding Institute, UK, High Tech. Publishing Ltd., London, Fifth Edition, 1989
6	Fred A. Manuele, "On the Practice of Safety", Wiley, 2003

Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2L1	Industrial Safety Laboratory	0	0	4	2

COURSE LEARNING OUTCOMES (COs)							
After Successful completion of the course, the students should be able to							RBT Level
CO1	Analyze about the various equipments to bring out the safety environment in the industry.						K4
CO2	Gain knowledge about the various sources of particular matter and assess the impact of air pollution.						K2
CO3	Learn about the usage of fire extinguishers and its operation.						K2
CO4	Acquire knowledge on insulation and earth resistance.						K2
CO5	Demonstrate the use of software and hence to predict the real situations on major accidents.						K4

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	3
CO2	3	2	3	2	2	3
CO3	3	-	3	2	2	3
CO4	3	-	3	2	2	3
CO5	3	-	3	2	2	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Lab Record
	2	End Semester Examinations
INDIRECT	1	Course End Survey

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 CO₂, CO, SO₂ and O₂ 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.
11. Investigate the effectiveness of different types of personal protective equipment (PPE) in reducing exposure to hazards.
12. Simulate emergency situations and train workers on how to respond.
13. Assess worker fatigue and its impact on safety.
14. Investigate the effect of workplace design on safety.
15. Study the psychological factors that influence safety behaviour.

THEORY	0		TUTORIAL		0	PRACTICAL	60		TOTAL	60
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Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2L2	Technical Presentation - II	0	2	0	2

COURSE LEARNING OUTCOMES (COs)							
After Successful completion of the course, the students should be able to							RBT Level
CO1	Identify the problems in general area of interest by the student.						K2
CO2	Explore the area / problem by referring journals, conference proceedings etc.						K2
CO3	Enhance the collective skills between theoretical knowledge and real time problems.						K2
CO4	Gain knowledge on the area by presentation and review.						K2
CO5	Acquire idea on report writing and presentation related to the area.						K2

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	3	-	2	-	-
CO2	1	3	-	2	-	-
CO3	1	3	-	2	-	-
CO4	1	3	-	2	-	-
CO5	1	3	-	2	-	-

COURSE ASSESSMENT METHODS		
DIRECT	1	Presentation
	2	Report
INDIRECT	1	Course End Survey

COURSE CONTENT

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 three 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.

THEORY	0		TUTORIAL		30	PRACTICAL	0		TOTAL	30
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SEMESTER III

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
THEORY COURSES									
1	23IS3T1	Computer Aided Hazard Analysis	PC	40	60	3	0	0	3
2	23IS3T2	Occupational Health and Industrial Hygiene	PC	40	60	3	0	0	3
3	23IS3E_	Professional Elective – IV	PE	40	60	3	0	0	3
4	23IS3O_	Open Elective / Swayam	OE	40	60	3	0	0	3
LABORATORY COURSE									
5	23IS3L1	Industrial Safety Assessment – Internship	EEC	100	-	0	0	4	2
6	23IS3L2	Project Phase – I	EEC	40	60	0	0	12	6
Total						12	0	16	20

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3T1	Computer Aided Hazard Analysis	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Explore the basic concepts in risk and hazard assessment.	K2	1
CO2	Analyze the use of different types of instruments for various testing.	K4	2
CO3	Apply the risk assessment technique to quantify the risk using different software.	K3	3
CO4	Determine the consequence analysis for plotting the damages towards hazardous situations.	K2	4
CO5	Demonstrate the various types of disasters based on past accident analysis.	K4	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	3	3	3	2
CO2	3	-	3	3	3	-
CO3	3	-	3	3	3	-
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	-

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic – 1	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.		
Topic – 2	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.		
Topic – 3	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.		
Topic – 4	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.		
Topic – 5	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.		

THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45
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BOOK REFERENCES	
1	Frank P. Less, Loss Prevention in Process Industries, Butterworth -Hein UK 1990 (Vol.I, II & III), UK,Third edition, 2005
2	Nigel Hyatt, "Guidelines for Process Hazards Analysis (PHA, HAZOP), Hazards Identification, and Risk Analysis", CRC Press, 2015.
3	Course Material – Intensive Training Programme on Consequence Analysis, Process Safety Centre, Indian Institute of Chemical Technology, Tarnaka& CLRI, Chennai, Second Edition, 1987.
4	Major Hazard control- A practical Manual, ILO, Geneva, Third Edition, 1993.
5	Edward M. Marszal,"Computer-Aided Risk Management: Applications and Solutions",CRC Press, 2012.
6	Clifton A. Ericson II, "Hazard Analysis Techniques for System Safety", Wiley, 2005.

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3T2	Occupational Health and Industrial Hygiene	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Acquire knowledge on the various physiological functions of our body, their effects and control.	RBT Level	1
CO2	Recall the various types of chemical hazards and their control methods.	K2	2
CO3	Analyze the various types of occupational diseases arising out of biological agents.	K4	3
CO4	Demonstrate effectively about the occupational health and toxic nature among the employees and with society at large.	K3	4
CO5	Recall about the physiology of work with the working environment.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	-	2	1	-	-	3
CO2	-	2	1	-	-	3
CO3	-	2	1	-	-	3
CO4	-	2	1	-	-	3
CO5	-	2	1	-	-	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT		
Topic – 1	PHYSICAL HAZARDS	10
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.		
Topic – 2	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		
Topic – 3	BIOLOGICAL AND ERGONOMICAL HAZARDS	8
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.		
Topic – 4	OCCUPATIONAL HEALTH AND TOXICOLOGY	10
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.		
Topic – 5	OCCUPATIONAL PHYSIOLOGY	8
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

THEORY	9		TUTORIAL	0		PRACTICAL	0		TOTAL	45
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BOOK 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, 1985.
3	Barry R. Ashman, "Occupational Health and Safety Management: A Practical Approach",CRC Press, 2015
4	Thomas P. Fuller, "Industrial Hygiene Evaluation Methods", Wiley, 2006
5	Peter O'Shaughnessy, "Principles of Occupational Health and Hygiene: An Introduction",Routledge, 2007
6	Mark A. Friend, James P. Kohn, "Fundamentals of Occupational Safety and Health",Government Institutes, 2018

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3L2	Project Phase – I	0	0	12	6

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Identify real time problems.	K3	1
CO2	Acquire knowledge on the industrial oriented projects.	K2	2
CO3	Collect the data from the literature surveys and able to find out the solutions.	K4	3
CO4	Select the topic based on the critical problems and hazards identified.	K4	4
CO5	Apply the solutions for the problems identified.	K3	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	3	-	3	3
CO2	3	3	3	2	3	3
CO3	3	3	3	2	2	3
CO4	3	3	3	-	2	3
CO5	3	3	3	2	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Project Review
	2	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
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.										
THEORY	0		TUTORIAL	0		PRACTICAL	180		TOTAL	180

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	CIA	ESE	L	T	P	C
LABORATORY COURSE									
1	23IS4L1	Project Phase – II	EEC	40	60	0	0	24	12
Total						0	0	24	12

Semester	Programme	Course Code	Course Name	L	T	P	C
IV	M.E. ISE	23IS4L1	Project Phase – II	0	0	24	12

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Identify real time problems.	K3	1
CO2	Extend knowledge on the industrial oriented projects.	K2	2
CO3	Collect the data from the literature surveys and able to find out the solutions.	K4	3
CO4	Classify the topic based on the critical problems and hazards identified.	K4	4
CO5	Justify the solutions for the problems identified.	K4	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	3	-	3	3
CO2	3	3	3	2	3	3
CO3	3	3	3	2	2	3
CO4	3	3	3	-	2	3
CO5	3	3	3	2	3	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Project Review
	2	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
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.										
THEORY	0		TUTORIAL	0		PRACTICAL	360		TOTAL	360

Semester	Programme	Course Code	Course Name	L	T	P	C
I	M.E. ISE	23IS1E1	Work Study and Ergonomics	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Familiarize on work study and study of operation and its application.	K2	1
CO2	Analyze about applications of ergonomic principle in the shop floor and physiology of workers.	K4	2
CO3	Explore the concepts of PPE's and its ergonomic considerations.	K3	3
CO4	Recall about various machine tools, process and equipment design.	K2	4
CO5	Acquire knowledge on man-machine systems.	K3	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	2
CO2	3	3	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	2	2
CO5	3	3	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		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).										
Topic – 2		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.										
Topic – 3		PERSONAL PROTECTION							8	
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.										
Topic – 4		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.										
Topic – 5		MAN MACHINE SYSTEMS							10	
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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Lakhwinder Pal Singh, Work Study and Ergonomics, 2018.
2	Introduction to Work Study, ILO, Oxford and IBH Publishing company, Bombay, Fourth Revised Edition, 1991.
3	McCormick, E.J., and M.S.Sanders, Human Factors in Engineering and Design, TMH, New Delhi, Seventh Edition, 1982.

4	George Kanawaty, "Introduction to Work Study", International Labour Organization (ILO), 1992
5	David Osborne, "Work Study, 4th Edition"CRC Press, 2017
6	Stephan Konz, S. Cammarata, "Occupational Ergonomics: Principles and Applications",CRC Press, 2003

Semester	Programme	Course Code	Course Name	L	T	P	C
I	M.E. ISE	23IS1E2	Quality Engineering	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Acquire knowledge on quality objectives, quality control and knows the importance of quality assurance.	K3	1
CO2	Analyze about the online quality control and its measurement.	K4	2
CO3	Determine about the online quality control attributes and methods for process improvement.	K3	3
CO4	Apply the concept of preventive maintenance schedule and TPM.	K3	4
CO5	Gain knowledge on six sigma and its implementation.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	2
CO2	3	3	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	2	2
CO5	3	3	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey
COURSE CONTENT		

Topic – 1	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.										
Topic – 2	ON-LINE QUALITY CONTROL								9	
On-line feedback quality control variable characteristics - control with measurement interval –oneunit, multiple units –control systems for lot and batch production. On-line process parameter controlvariable characteristics - process parameter tolerances feedback control systems - measurement error and process control parameters.										
Topic – 3	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.										
Topic – 4	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.										
Topic – 5	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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
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.
3	Brue, G., Six Sigma for Managers, Tata-McGraw Hill, New Delhi, Second Reprint, 2002.
4	Douglas C. Montgomery, "Introduction to Statistical Quality Control", John Wiley & Sons, 2012
5	Dale H. Besterfield, Glen Besterfield, Leroy C. Johnson, "Quality Control", Pearson 2011
6	Dale H. Besterfield, Carol Besterfield-Michna, "Total Quality Management", Pearson, 2018

Semester	Programme	Course Code	Course Name	L	T	P	C
I	M.E. ISE	23IS1E3	Plant Layout and Materials Handling	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Acquire knowledge on plant locations and the safe storage of chemicals.	K2	1
CO2	Analyze the plant layout and their safety for various types of process industry.	K2	2
CO3	Determine the principles of good ventilation and illumination.	K2	3
CO4	Gain knowledge on the benefits of an efficient material handling system and lifting tackles.	K3	4
CO5	Classify the various types of mechanical material handling devices.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	2
CO2	3	3	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	2	2
CO5	3	3	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		PLANT LOCATION							8	
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.										
Topic – 2		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.										
Topic – 3		WORKING CONDITIONS							8	
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.										
Topic – 4		MANUAL MATERIAL HANDLING AND LIFTING TACKLES							10	
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.										
Topic – 5		MECHANICAL MATERIAL HANDLING							10	
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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	C. Ray Asfahl, David W. Rieske., Industrial Safety and Health Management , Prentice Hall, U.K., seventh edition,2018.
2	Encyclopedia of occupational safety and health, ILO Publication, Francis, Fourth Edition, 1998
3	Apple M. James., Plant layout and material handling, John Wiley & sons, New York, Third edition, 1977
4	Reymond, A.Kulwice., Material Handling Hand Book - II, John Wiley and Sons, New York, 1985. Safety and good housekeeping, N.P.C. New Delhi, 1985.
5	Industrial ventilation (A manual for recommended practice), American conference of government industrial Hygiene, Thirty Edition, USA, 1984.
6	Theodore T. Allen, "Introduction to Engineering Statistics and Lean Sigma: Statistical Quality Control and Design of Experiments and Systems", Springer, 2007

Semester	Programme	Course Code	Course Name	L	T	P	C
I	M.E. ISE	23IS1E4	OHSAS18000 and ISO14000	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Acquire knowledge on the basic concepts of OSHA standard	RBT Level	1
CO2	Explore the details of OHSAS 18000 policy and planning with their guidelines and methods.	K2	2
CO3	Apply the concepts of implementation, review and improvement plan.	K3	3
CO4	Analyze about ISO 14000 and 45001 policies with its planning.	K4	4
CO5	Acquire knowledge on environmental impact assessment, types & control.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	-	-	3	2	1	1
CO2	-	-	3	2	1	-
CO3	-	-	3	2	1	-
CO4	-	-	3	2	1	2
CO5	-	-	3	2	1	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	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.										
Topic – 2	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.										
Topic – 3	IMPLEMENTATION, REVIEW AND IMPROVEMENT PLAN								9	
Guidelines for structure and Responsibilities, Top level management, middle level management, co-ordinator 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.										
Topic – 4	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.										
Topic – 5	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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK 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.
3	B. Siyanbola, A. Siyanbola, "ISO 14001 Environmental Certification Step by Step: Revised edition", Routledge, 2011
4	Syed Imtiaz Haider, "Occupational Health and Safety Management: A Comprehensive Understanding", CRC Press, 2011
5	Charles D. Reese, "Occupational Health and Safety Management: A Practical Approach", CRC Press, 2018
6	Christopher A. Janicak, Asfahl C. Ray, "Safety Management Systems in Aviation", Ashgate Publishing Limited, 2014

Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2E1	Safety in Mines	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Acquire knowledge on open cast mines and safe handling of explosives.	K2	1
CO2	Gain knowledge on underground mines and their working conditions.	K2	2
CO3	Demonstrate about the hazards and safety measures in tunneling.	K2	3
CO4	Analyze about the concept of risk assessment techniques.	K4	4
CO5	Learn about accident analysis and its management systems.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	2
CO2	3	3	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	2	2
CO5	3	3	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	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.										
Topic – 2	UNDERGROUND MINES									8
Fall of roof and sides - effect of gases-fire and explosions - water flooding - warning sensors - gas detectors - occupational hazards - working conditions - winding and transportation.										
Topic – 3	TUNNELLING									8
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.										
Topic – 4	RISK ASSESSMENT									10
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.										
Topic – 5	ACCIDENT ANALYSIS AND MANAGEMENT									10
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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Dhillon, S Balbir Mine., Safety- A modern Approach, Springer Publication, 2010.
2	Jan M. Mutmanský, Raja V. Ramani, Mine Ventilation and Air Conditioning, Wiley , 2019
3	Fred G. Bell, J. Laurance, Mining and its impact on environment, Taylor and Francis, 2006.
4	B.S. Chauhan, "Underground Mine Environment", New Age International, 2009
5	B.R. Nateriya, "Mine Safety: A Modern Approach" Springer, 2010
6	K.C. Mishra, "Mine Environment and Ventilation", Wiley, 2014

Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2E2	Transport Safety	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Acquire knowledge on causes of accidents due to drivers and pedestrians.	K2	1
CO2	Gain knowledge on inspection and maintenance of vehicles.	K2	2
CO3	Recall about the safety in road and rail transportation.	K2	3
CO4	Demonstrate about the safety in air transportation and shipping.	K4	4
CO5	Familiarize on shop floor and repair shop safety.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	2
CO2	3	3	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	2	2
CO5	3	3	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		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 - tachograph - 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.										
Topic – 2		TRANSPORTATION OF HAZARDOUS GOODS							8	
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.										
Topic – 3		SAFETY IN ROAD AND RAIL TRANSPORTATION							10	
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.										
Topic – 4		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.										
Topic – 5		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 charginggasoline handling - other safe practices - off the road motorized equipment. Plant railway: Clearance - track - warning methods - loading and unloading - moving cars - safety practices.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Popkes, C.A., Traffic Control and Road Accident Prevention, Chapman and Hall Limited, New Delhi, Second Edition, 1986.
2	Babkov, V.F., Road Conditions and Traffic Safety, MIC Publications, Moscow, First Edition, 1986.
3	Kadiyali, Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, Third Edition, 1983.
4	Fred A. Manuele, "On the Practice of Safety", Wiley, 2003
5	V. S. Ramachandran, "Safety Aspects of Transportation in an Aging Society", CRC Press, 2013
6	Grigore Havarneanu, "Transportation Safety in an Age of Deregulation", CRC Press, 2012

Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2E3	Dock Safety	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Determine the history of legislation towards dock safety.	K2	1
CO2	Recall about the cargo ships and the safety precautions in the use of transport equipment.	K2	2
CO3	Classify the different types of lifting appliances and its construction and maintenance.	K3	3
CO4	Acquire knowledge on various types of transport equipment and their handling of cargos.	K2	4
CO5	Apply the emergency action plan for fire and explosions and understand about the dock regulations.	K3	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	2
CO2	3	3	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	2	2
CO5	3	3	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		HISTORY OF SAFETY LEGISLATION							10	
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.										
Topic – 2		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.										
Topic – 3		LIFTING APPLIANCES							8	
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.										
Topic – 4		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.										
Topic – 5		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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Bindra SR, Course in Dock and Harbour Engineering, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.
2	Srinivasan, Harbour, Dock and Tunnel Engineering, Charotar Publishing House Pvt. Limited, New Delhi, 29th Edition, 2011.
3	International Labour Organization, Safety and Health in Dock Work, New York, second edition, 1997.
4	Safety and Health in Dock work, ILO, Third edition, 1992.
5	Indian Dock Labourers Act 1934 with rules 1948, Law Publishers (India) Pvt. Ltd., Allahabad, Second Edition, 1932.
6	John M. White, "Safety and Health in Ports: ILO Code of Practice", International Labour Office, 2005

Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2E4	Aviation Safety	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Explain the fundamental principles of aviation safety.	K2	1
CO2	Identify the key components of SMS and their integration into organizational culture.	K2	2
CO3	Identify and categorize hazards in aviation operations.	K2	3
CO4	Apply strategies for managing and mitigating fatigue in aviation personnel.	K3	4
CO5	Demonstrate effective crisis communication strategies in the context of aviation emergencies.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	-	-	3	-	-	3
CO2	-	-	3	-	-	3
CO3	-	-	3	-	-	3
CO4	-	-	3	-	-	3
CO5	-	-	3	-	-	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	Introduction									8
Overview of Aviation Safety -Historical Perspectives and Milestones - Importance of Safety Culture in Aviation - Regulatory Bodies in Aviation Safety (ICAO, FAA, EASA).										
Topic – 2	Safety Management Systems(SMS) in Aviation									9
Basics of Safety Management Systems - Key Components of SMS - Integration of SMS into Organizational Culture - Benefits and Challenges of Implementing SMS.										
Topic – 3	Risk Management in Aviation									8
Hazard Identification - Risk Assessment and Analysis - Risk Mitigation Strategies - Case Studies on Effective Risk Management.										
Topic – 4	Human Factors in Aviation Safety									10
Understanding Human Factors - Crew Resource Management (CRM) - Fatigue Management - Human Error Prevention Techniques.										
Topic – 5	Emergency Response and Crisis Management									10
Emergency Response Planning - Crisis Communication - Conducting Emergency Drills and Simulations - Case Studies of Successful Crisis Management.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Clarence C. Rodrigues, "Introduction to Aviation Insurance and Risk Management", CRC Press, 2014
2	Alan J. Stolzer, Carl D. Halford, John J. Goglia, "Safety Management Systems in Aviation", Ashgate, 2008
3	Tom C. Jones, "Aviation Safety Programs: A Management Handbook", McGraw-Hill Education, 2009
4	Jeffrey C. Price, Forrest S. Young, Alexander T. Wells, "Introduction to Aviation Management", Routledge, 2018
5	Shari Stamford Krause, "Aviation Safety: A Balanced Industry Approach", Wiley, 2017
6	Carl D. Halford, John J. Goglia, Alan J. Stolzer, "Implementing Safety Management Systems in Aviation", Ashgate, 2011

Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2E5	Safety in Construction	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Demonstrate about the accident causes and the management systems.	K3	1
CO2	Familiarize about the hazards in construction and their prevention.	K2	2
CO3	Analyze the safety procedure for working at heights during construction.	K4	3
CO4	Apply knowledge selecting, operations, inspection and testing of construction machinery.	K3	4
CO5	List out construction regulations and Indian standards for construction and demolition work.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	2
CO2	3	3	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	2	2
CO5	3	3	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		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.										
Topic – 2		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 highrise buildings.										
Topic – 3		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.										
Topic – 4		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.										
Topic – 5		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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Rita Yi Man Li, Sun Wah Poon, 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.
3	Charles D. Reese and James V. Edison, Handbook of OSHA Construction safety and health, CRC press, UK, Second Edition, 2006.
4	Jnathea D.Sime, Safety in the Build Environment, London, Second Edition, 1988.
5	Davies, V.J., and Thomas, K., Construction Safety Hand Book, Thomas Telford Ltd., London, 1990.
6	David V. MacCollum, "Construction Safety Planning", McGraw-Hill Education, 2005

Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2E6	Safety in Powder Handling	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Acquire knowledge on powder classification, its physical, chemical and other properties.	K2	1
CO2	Demonstrate about the metal powders and their characterization.	K2	2
CO3	Familiarize about Industrial dust and their explosion.	K2	3
CO4	Gain knowledge on dust handling plants and electro static hazards.	K2	4
CO5	Analyze about the dust evaluation methods and their control.	K4	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	2
CO2	3	3	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	2	2
CO5	3	3	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		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.										
Topic – 2		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.										
Topic – 3		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 - dustexplosion venting, vent coefficient, various methods of design - venting of ducts and pipes - dust fire.										
Topic – 4		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.										
Topic – 5		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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Vahid Ebadat, Dust Explosion Prevention and Protection: A Practical Guide, Elsevier, 2019
2	Paul Amyotte, Introduction to Dust Explosions, Gulf Professional Publishing, 2014
3	Seminar on Hazard recognition and prevention in the work place - airborne dust, Vol.I and 2, SRMC, Chennai, SecondEdition, 4/5, Sept.2000.
4	ASM Metals hand book, Ninth edition, Vol.7, Powder Metallurgy.
5	Tony Fishwick, "Handling Powdered Products",Elsevier, 1991
6	Nigel Hyatt, "Guidelines for Safe Handling of Powders and Bulk Solids"IChemE, 2007.

Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2E7	Safety in Textile Industry	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Familiarize about the basic concepts of textile process and its safety.	K2	1
CO2	Acquire knowledge on hazards in sizing processes, looms and knitting machines.	K2	2
CO3	Demonstrate on various types of mechanical finishing operations.	K2	3
CO4	Analyze about the health and welfare measures in textile industry.	K4	4
CO5	Apply the relevant provisions of factories act and rules applicable to textile industry.	K3	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	2
CO2	3	3	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	2	2
CO5	3	3	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	INTRODUCTION									10
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.										
Topic – 2	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.										
Topic – 3	TEXTILE HAZARDS – II									8
Scouring, bleaching, dyeing, punting, mechanical finishing operations and effluents in textile processes.										
Topic – 4	HEALTH AND WELFARE									10
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.										
Topic – 5	SAFETY STATUS									8
Relevant provision of factories act and rules and other statues applicable to textile industry - effluent treatment and waste disposal in textile industry.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	"Occupational Safety and Health for Technologists, Engineers, and Managers" by David L. Goetsch and Stanley D. Davis, Pearson, 2015
2	Groover and Henry, D.S., Hand book of textile testing and quality control, New Delhi, Ninth Edition, 1960.
3	Quality tolerances for water for textile industry, BIS, Second Revision, 1982.
4	Shenai, V.A., A technology of textile processing, Vol. I, Textile Fibers, Third Edition, 1972.
5	David G. Broadbent, "Occupational Health and Safety in the Textile Industry", Woodhead Publishing, 1998
6	F. Salameh, "Safety and Health in the Textile Industry", Routledge, 2004

Semester	Programme	Course Code	Course Name	L	T	P	C
II	M.E. ISE	23IS2E8	Safety in Waste Management	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
RBT Level			
CO1	Differentiate between various types of waste, including hazardous, non-hazardous, and biomedical waste.		
CO2	Apply identification methods and criteria to classify hazardous waste.		
CO3	Understand storage requirements for different types of waste.		
CO4	Apply relevant safety measures during waste transport.		
CO5	Analyze case studies and apply best practices for environmentally responsible waste management.		

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	2
CO2	3	3	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	2	2
CO5	3	3	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	Introduction to Waste Management and Safety									8
Overview of waste management - Types of waste (like hazardous, non-hazardous, biomedical) - Importance of safety in waste handling - Legal and regulatory frameworks.										
Topic – 2	Hazardous Waste Identification and Classification									9
Characteristics of hazardous waste - Identification methods and criteria - Regulatory requirements for hazardous waste handling - Labelling and marking of hazardous waste containers.										
Topic – 3	Safe Handling and Storage Practices									8
Personal protective equipment (PPE) for waste handlers - Proper lifting techniques - Storage requirements for different types of waste - Emergency response procedures.										
Topic – 4	Transportation and Logistics in Waste Management									10
Safe loading and unloading of waste materials - Transportation regulations and compliance - Vehicle safety for waste transport - Documentation and record-keeping.										
Topic – 5	Environmental Impact and Sustainability									10
Environmental effects of improper waste handling - Sustainable waste management practices - Waste reduction, reuse, and recycling - Case studies and best practices.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Frank R. Spellman,"Introduction to Environmental Engineering and Science", Wiley, 2014.
2	T. H. Y. Tebbutt,"Principles of Water Quality Control", Butterworth-Heinemann, 2005.
3	Baral, S., Das, S., and Rath, P., "Waste Management: An Integrated Vision", Springer, 2014.
4	Michael D. LaGrega, Phillip L. Buckingham, Jeffrey C. Evans, "Hazardous Waste Management", McGraw-Hill Education, 2000
5	Ronald J. Baker, "Waste Treatment and Disposal", Wiley, 2005.
6	George Tchobanoglous, Hilary Theisen, Samuel Vigil,"Integrated Solid Waste Management: Engineering Principles and Management Issues",McGraw-Hill Education, 1993.

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3E1	Nuclear Engineering and Safety	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Explore the basic concepts of fission process and activity.	K3	1
CO2	Analyze the control requirements in design considerations.	K4	2
CO3	Classify the reactor types and their role of power generation in India.	K3	3
CO4	Apply the safe design principles of nuclear reactors and their safety.	K3	4
CO5	Acquire knowledge on radiation control, its exposure and their disposal practices.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	2
CO2	3	3	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	2	2
CO5	3	3	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		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.										
Topic – 2		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.										
Topic – 3		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.										
Topic – 4		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.										
Topic – 5		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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Ronald A. Knief, "Nuclear Engineering: An Introduction" Springer, 1992
2	Robert E. Masterson, Nuclear Engineering Fundamentals, CRC Press, UK, First Edition, 2017.
3	James J. Duderstadt, Louis J. Hamilton "Nuclear Reactor Analysis" Wiley, 1976
4	Dr. G. Vardyanathan., Nuclear reactor Engineering, UK, Second Edition, 2013.
5	Charles D. Ferguson, Nuclear Energy, New York, Second Edition, 2011.
6	Todd E. Peterson, Paul D. Knauth, "Nuclear Power Plant Safety and Mechanical Integrity: Design and Operability of Mechanical Systems, Equipment and Supporting Structures", ASME Press, 2004

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3E2	Electrical Safety	3	0	0	3

COURSE LEARNING OUTCOMES (COs)				
After Successful completion of the course, the students should be able to			RBT Level	Topics Covered
CO1	Familiarize the basic concepts in electrical circuit and hazards involved in it.		K2	1
CO2	Analyze the different types of electrical hazards in industries.		K4	2
CO3	Acquire knowledge about the different types of protection systems.		K2	3
CO4	Apply the knowledge in the selection, installation, operation and maintenance of portable tools.		K3	4
CO5	Classify the different hazardous zones in Industries.		K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	3
CO2	3	-	2	-	-	-
CO3	2	-	2	-	-	-
CO4	2	2	2	-	3	-
CO5	2	-	2	-	-	-

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		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).										
Topic – 2		ELECTRICAL HAZARDS							10	
Primary and secondary hazards - shocks, burns, scalds, falls - human safety in the use of electricity.Energy leakage - clearances and insulation - classes of insulation - voltage classifications - excess energy - current surges - Safety in handling of war equipments - over current and short circuit current - heating effects of current - electromagnetic forces - corona effect - static electricity - definition, sources, hazardous conditions, control, electrical causes of fire and explosion - ionization, spark and arc-ignition energy - national electrical safety code ANSI.High voltage Hazards, Lightning, hazards, lightning arrestor, installation - earthing, specifications, earth resistance, earth pit maintenance.										
Topic – 3		PROTECTION SYSTEMS							10	
Fuse, circuit breakers and overload relays - protection against over voltage and under voltage - safe limits of amperage – voltage - safe distance from lines - capacity and protection of conductor - joints and connections, overload and short circuit protection - no load protection - earth fault protection. FRLS insulation - insulation and continuity test - system grounding - equipment grounding - earth leakage circuit breaker (ELCB) - cable wires - maintenance of ground - ground fault circuit interrupter - use of low voltage - electrical guards Personal protective equipment - safety in handling hand held electrical appliances tools and medical equipments.										
Topic – 4		SELECTION, INSTALLATION, OPERATION AND MAINTENANCE							8	
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.										
Topic – 5		HAZARDOUS ZONES							8	
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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Dr.Massim A.G. Mitolo., Electrical safety of Low voltage systems, Mc Graw Hill, Second Edition, 2009
2	Accident prevention manual for industrial operations, N.S.C., Chicago, Third edition,2008.
3	Fordham Cooper, W., Electrical Safety Engineering., Butterworth and Company, London, Third edition,2002
4	Accident prevention manual for industrial operations, N.S.C., Chicago, Third edition, 2008.
5	Indian Electricity Act and Rules, Government of India, 2003
6	Power Engineers – Handbook of TNEB, Chennai, 1989.
7	Martin Glove Electrostatic Hazards in powder handling, Research Studies Pvt Ltd., England, Second Edition,1988

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3E3	Fireworks Safety	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Acquire knowledge on the properties of the chemicals used in the fireworks.	K2	1
CO2	Familiarize about the static charge and dust in fireworks factories.	K2	2
CO3	Recall about the various types of process in risk related fireworks.	K2	3
CO4	Analyze the material handling techniques and transportation of explosives in fireworks.	K4	4
CO5	Determine the concepts of waste control and user safety in fireworks.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	2
CO2	3	3	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	2	2
CO5	3	3	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		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 (Al) powder - Reactions - metal powders, Borax, ammonia (NH ₃) - Strontium Nitrate, Sodium Nitrate, Potassium per chloride. Fire and explosion, impact and friction sensitivity.										
Topic – 2		STATIC CHARGE AND DUST							9	
Concept - prevention - earthing - copper plates - dress materials - static charge meter lightning, causes - effects - hazards in fireworks factories - lightning arrestor: concept - installation - earth pit – maintenance - resistance - legal requirements - case studies. Dust: size - respirable, non-respirable - biological barriers - hazards - personal protective equipment - pollution prevention.										
Topic – 3		PROCESS SAFETY							8	
Safe - quantity, mixing - filling - fuse cutting - fuse fixing – finishing - drying at various stages – packing - storage - hand tools - materials, layout: building - distances - factories act - explosive act and rules - fire prevention and control - risk related fireworks industries.										
Topic – 4		MATERIAL HANDLING							10	
Manual handling - wheel barrows - trucks - bullock carts - cycles - automobiles - fuse handling - paper caps handling -nitric acid handling in snake eggs manufacture - handling the mix in this factory - material movement - godown - waste pit.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.										
Topic – 5		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.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
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.
3	Purkiss, J.A., Fireworks - Fire Safety Engineering, UK, Third Edition, 1996
4	Jon A. Gritzo, James E. Hill, "Fireworks: Principles and Practice", American Chemical Society, 1998

5	P. Walton, J. A. Gritz, "Safety in the Use of Commercial Explosives", CRC Press, 2003
6	C. T. Wee, L. A. Medora, W. D. Brown, "Fireworks: Pyrotechnic Arts and Sciences in European History", Journal of Pyrotechnics, 2010

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3E4	Safety in Petroleum Refining Industry	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Understand the fundamental processes involved in petroleum refining.	K2	1
CO2	Understand the significance of Process Safety Management (PSM) in ensuring operational safety.	K2	2
CO3	Understand corrosion management strategies to ensure equipment longevity.	K2	3
CO4	Evaluate fire detection and suppression systems for their effectiveness.	K3	4
CO5	Apply behavioral safety principles to improve workplace safety.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	3
CO2	3	2	2	-	-	-
CO3	3	2	2	2	-	3
CO4	3	3	2	2	-	2
CO5	3	2	2	-	-	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Assignment
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	Introduction and Fundamentals									8
petroleum refining process - Types of refining units and their functions - Importance of safety in the petroleum refining industry - Regulatory frameworks and standards - Identification and classification of hazardous materials - Material Safety Data Sheets (MSDS).										
Topic – 2	Process Safety Management (PSM)									8
Major incidents and their impact on the industry - Hazard identification and risk assessment - Process safety information and documentation - Permit-to-work systems - Lockout/Tagout procedures - Hot work procedures.										
Topic – 3	Equipment Safety and Maintenance									9
Importance of maintaining equipment integrity - Inspection and testing procedures - Inspection and maintenance of pressure vessels and piping - Corrosion management - Design and functionality of emergency shutdown systems - Emergency response procedures.										
Topic – 4	Fire Safety and Emergency Response									10
Fire prevention measures - Fire detection and suppression systems - Development of emergency response plans - Emergency drills and training - Measures to prevent and respond to environmental incidents - Compliance with environmental regulations.										
Topic – 5	Human Factors and Safety Culture									10
Human errors and their impact - Behavioural safety principles- Competency assessment and development programs - Building a safety-conscious culture in the workplace - Reporting and investigating incidents.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Dennis P. Nolan, "Handbook of Fire and Explosion Protection Engineering Principles", William Andrew, 2010
2	Frank Lees, "Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control", Butterworth-Heinemann, 2013
3	Paul R. H. Black, Gary M. Considine, "Handbook of Industrial Chemistry and Biotechnology", Springer, 2012
4	Mannan S., "Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control", Butterworth-Heinemann, 2019
5	Dennis P. Nolan, "Safety and Security Review for the Process Industries: Application of HAZOP, PHA, What-IF and SVA Reviews", Elsevier, 2014
6	Center for Chemical Process Safety (CCPS), "Guidelines for Engineering Design for Process Safety", Wiley, 2012

Semester	Programme	Course Code	Course Name	L	T	P	C
	M.E. ISE	23ISCA1	English for Research Paper Writing	2	0	0	0

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Improve writing skills and level of readability.	K2	1
CO2	Recall about what to write in each section.	K2	2
CO3	Improve skills needed when writing a title, abstract and introduction.	K2	3
CO4	Improve skills needed when writing methods, results and discussion.	K2	4
CO5	Ensure the good quality of paper at very first time submission.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	-	3	-	-	2	-
CO2	-	3	-	-	2	-
CO3	-	3	-	-	2	-
CO4	-	3	-	-	2	-
CO5	-	3	-	-	2	-

COURSE ASSESSMENT METHODS		
DIRECT	1	Technical Paper
INDIRECT	1	Course End Survey

COURSE CONTENT										
1. Planning and Preparations, Word order, Breaking up long sentences, Structuring, Paragraphs and Sentences, Being concise and removing redundancy, Avoiding Ambiguity and vagueness. 2. Clarifying who did what, Highlighting Your Findings, Hedging and Criticizing Paraphrasing and plagiarism, Sections of a paper, abstracts, Introduction, Review of the Literature, methods, results, discussions, conclusions, the final check. 3. Key skills are needed when writing a title, key skills are needed when writing an abstract, key skills are needed when writing an introduction, skills needed when writing a review of literature. 4. Skills are needed when writing the methods, skills needed when writing the results, skills are needed when writing the discussion, skills are needed when writing the conclusions. 5. Useful phrases, how to ensure paper is as good as it could possibly be the first time submission.										
THEORY	30		TUTORIAL	0		PRACTICAL	0		TOTAL	30

BOOK REFERENCES	
1	Adrian Wallwork, English for Writing Research Papers, Springer New York, Dordrecht Heidelberg London, Second Edition, 2011.
2	Day R, How to write and publish a scientific paper, Cambridge University Press, US, Seventh Edition, 2006.
3	Goldbort R, Writing for Science, Yale University Press, New York, Third Edition, 2006.
4	Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book, UK, 1998.
5	John M. Swales, Christine B. Feak, "Academic Writing for Graduate Students: Essential Tasks and Skills", University of Michigan Press, 2012
6	Kate L. Turabian, Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, Joseph Bizup, William T. FitzGerald, "A Manual for Writers of Research Papers, Theses, and Dissertations", University of Chicago Press, 2018

Semester	Programme	Course Code	Course Name	L	T	P	C
	M.E. ISE	23ISCA2	Constitution of India	2	0	0	0

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics	K2
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.	K4
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru.	K3
CO4	Discuss the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.	K2
CO5	Discuss the passage of the Hindu Code Bill of 1956.	K3

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	3
CO2	2	-	-	-	-	3
CO3	-	-	-	-	-	3
CO4	-	-	-	-	-	3
CO5	-	-	-	-	-	3

COURSE ASSESSMENT METHODS		
DIRECT	1	Seminar
INDIRECT	1	Course End Survey

COURSE CONTENT										
- History of making of the Indian constitution: history, drafting committee, (composition & working) - Philosophy of the Indian constitution preamble, salient features parliament, composition, qualifications and disqualifications, powers and functions, executive, President, governor, council of ministers, judiciary, appointment and transfer of judges, qualifications, powers and functions. - District's administration head: role and importance, municipalities: introduction, mayor and role of elected representative, CEO, Municipal Corporation. Pachayati raj: introduction, Elected officials and their roles, CEO zila pachayat: position and role. Block level: organizational hierarchy(different departments), village level:role of elected and appointed officials, importance of grass root democracy. - Election commission: role and functioning. Chief election commissioner and election commissioners - institute and bodies for the welfare of SC/ST/OBC and women.										
THEORY	30		TUTORIAL	0		PRACTICAL	0		TOTAL	30

BOOK REFERENCES	
1	The Constitution of India,1950(Bare Act),Government Publication.
2	Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3	M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4	D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
5	M. Laxmikanth,"Indian Polity",McGraw-Hill Education, 2021
6	V. N. Shukla, "Constitution of India"Eastern Book Company, 2019

Semester	Programme	Course Code	Course Name	L	T	P	C
	M.E. ISE	23ISCA3	Principles of Sustainable Development	2	0	0	0

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Understanding the foundations of sustainable development.	K2	1
CO2	Analyzing interconnected systems.	K4	2
CO3	Applying sustainable development principles to real-world issues.	K3	3
CO4	Ethical decision-making in sustainable development.	K2	4
CO5	Communication and collaboration for sustainable solutions.	K2	5

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	2	-	-	1
CO2	2	-	2	-	-	1
CO3	2	-	2	-	-	1
CO4	2	-	2	-	-	1
CO5	2	3	2	-	-	1

COURSE ASSESSMENT METHODS		
DIRECT	1	Seminar
INDIRECT	1	Course End Survey

COURSE CONTENT										
1. Definition, historical context, and evolution of sustainable development - Key principles, such as intergenerational equity, social justice, and environmental stewardship. 2. Introduction to systems thinking and its application in analyzing complex issues - Tools and methodologies for mapping and understanding interconnected systems – 3. Understanding the role of biodiversity and ecosystem services in sustainable development - the impact of human activities on ecosystems and the consequences for interconnected systems- Comprehensive study of climate change science, impacts, and mitigation strategies – 4. Introduction to ethical theories relevant to sustainable development - Exploration of environmental justice issues and their ethical implications. 5. Developing skills for communicating complex sustainability concepts to diverse audiences - Use of storytelling, visual aids, and other communication tools.										
THEORY	30		TUTORIAL	0		PRACTICAL	0		TOTAL	30

BOOK REFERENCES	
1	Jeffrey D. Sachs, "The Age of Sustainable Development", Columbia University Press, 2015
2	Lester R. Brown, "Plan B 4.0: Mobilizing to Save Civilization", W. W. Norton & Company, 2009
3	Donella H. Meadows, Jorgen Randers, Dennis L. Meadows, "The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind", v, 1972
4	John Elkington, "Cannibals with Forks: The Triple Bottom Line of 21st Century Business", Capstone, 1999
5	Paul Hawken, Amory B. Lovins, L. Hunter Lovins, "Natural Capitalism: Creating the Next Industrial Revolution", Back Bay Books, 2000
6	Jeffrey D. Sachs, "Common Wealth: Economics for a Crowded Planet", Penguin Press, 2008

CO5	-	2	-	-	-	2
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COURSE ASSESSMENT METHODS		
DIRECT	1	Seminar
INDIRECT	1	Course End Survey

COURSE CONTENT									
சங்க இலக்கியம் 1. தமிழின் துவக்க நூல் தொல்காப்பியம் - எழுத்து, சொல், பொருள் 2. அகநானூறு (82) - இயற்கை இன்னிசை அரங்கம் 3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி 4. புறநானூறு (95,195) - போரை நிறுத்திய ஓளவையார் அறநெறித் தமிழ் 1. அறநெறி வகுத்த திருவள்ளுவர் - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புரவறிதல், ஈகை, புகழ் 2. பிற அறநூல்கள் - இலக்கிய மருந்து - ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்)									
THEORY	30		TUTORIAL	0		PRACTICAL	0		TOTAL
									30

REFERENCES
1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University) - www.tamilvu.org 2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia) - https://ta.wikipedia.org 3. தர்மபுர ஆதீன வெளியீடு 4. வாழ்வியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர் 5. தமிழ்கலைக் களஞ்சியம் - தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com) 6. அறிவியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்

Semester	Programme	Course Code	Course Name	L	T	P	C
	M.E. ISE	23ISCA5	Disaster Management	2	0	0	0

COURSE LEARNING OUTCOMES (COs)		
After Successful completion of the course, the students should be able to		RBT Level
CO1	Recall about the concepts of disaster management and meteorological phenomena.	K2
CO2	Familiarize about the technological disasters and its case study.	K2
CO3	Acquire knowledge on environmental pollution and its impact assessment.	K2
CO4	Apply the concepts of marine pollution and its control with global environmental issues.	K3
CO5	Analyze environmental education with risk assessment process for different disaster types.	K4

PRE-REQUISITE	-
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	2
CO2	3	3	2	-	2	2
CO3	3	3	2	-	2	2
CO4	3	3	2	-	2	2
CO5	3	3	2	-	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Seminar

INDIRECT	1	Course End Survey
COURSE CONTENT		
1. Philosophy of disaster management - Introduction to disaster mitigation - hydrological, coastal and marine disasters -atmospheric disasters - geological, meteorological phenomena - mass movement and land disasters - forest related disasters - wind and water related disasters - deforestation - use of space technology for control of geological disasters Master thesis. 2. Technological Disasters - Case studies of Technology disasters with statistical details Emergencies and control measures - APELL - Onsite and Offsite emergencies - Crisis management groups - Emergency centers and their functions throughout the country - Software's on emergency controls - Monitoring devices for detection of gases in the atmosphere - Right to know act. 3. Environmental education - population and community ecology - natural resources conservation - environmental protection and law - Research methodology and systems analysis - Policy initiatives and future prospects - Risk assessment process, assessment for different disaster - types - assessment data use, destructive capacity - risk adjustment - choice - loss acceptance - disaster aid - public liability insurance - stock taking and vulnerability analysis - disaster profile of the country - national policies - objectives and standards - physical event modification - preparedness, forecasting and warning, land use planning.		

BOOK REFERENCES	
1	R. Subramanian, Disaster Management, Vikas Publishing House, Second Edition ,2018.
2	Bagad Vilas, Principles of Environmental Science and Engineering, Technical Publication, Fourth Edition, 2012.
3	Sivakumar R., Principles of Environmental Science and Engineering, Vijay Nicole Imprints, Second Edition, 2005.
4	Gilbert, M. Masters, Introduction to Environmental Engineering and Science, Pearson New International Edition, Wendell P. Ela, 2013.
5	George Haddow, Jane Bullock, and Damon P. Coppola, "Introduction to Emergency Management", Butterworth-Heinemann, 2017
6	Damon P. Coppola, "Introduction to International Disaster Management",Butterworth-Heinemann, 2015

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3O1	Integrated Water Resources Management	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			RBT Level
COs	Learning Outcomes	RBT Level	Topics Covered
CO1	Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.	K2	1
CO2	Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.	K2	2
CO3	Apply law and governance in the context of IWRM.	K3	3
CO4	Discuss the linkages between water-health; develop a HIA framework.	K2	4
CO5	Analyse how the virtual water concept pave way to alternate policy options.	K4	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	2
CO2	2	3	2	2	-	2
CO3	2	2	2	2	-	-
CO4	2	2	2	2	-	2
CO5	2	2	2	-	-	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		CONTEXT FOR IWRM							9	
Water as a global issue: key challenges – Definition of IWRM within the broader context of development – Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment - SDGs.										
Topic – 2		WATER ECONOMICS							9	
Economic view of water issues: economic characteristics of water good and services – Non-market monetary valuation methods – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.										
Topic – 3		LEGAL AND REGULATORY SETTINGS							9	
Basic notion of law and governance: principles of international and national law in the area of water management - Understanding UN law on non-navigable uses of international water courses – International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.										
Topic – 4		WATER AND HEALTH WITHIN THE IWRM CONTEXT							9	
Links between water and health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies.										
Topic – 5		AGRICULTURE IN THE CONCEPT OF IWRM							9	
Water for food production: ‘blue’ versus ‘green’ water debate – Water foot print - Virtual water trade for achieving global water and food security — Irrigation efficiencies, irrigation methods - current water pricing policy– scope to relook pricing.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Larry W. Mays, Water Resources Engineering, John Wiley & Sons, 2010
2	Mollinga .P. etal “ Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.
3	Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
4	Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002.
5	Technical Advisory Committee, Effective Water Governance”. Technical Advisory Committee Background paper No: 7. Global water partnership, Stockholm, Sweden, 2003.
6	Asit K. Biswas and Cecilia Tortajada, Integrated Water Resources Management in South and Southeast Asia, Oxford University Press, 2005.

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3O2	Water, Sanitation and Health	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Capture to fundamental concepts and terms which are to be applied and understood all through the study.	K2	1
CO2	Comprehend the various factors affecting water sanitation and health through the lens of third world scenario.	K2	2
CO3	Critically analyse and articulate the underlying common challenges in water, sanitation and health.	K3	3
CO4	Acquire knowledge on the attributes of governance and its say on water sanitation and health.	K2	4
CO5	Gain an overarching insight in to the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects.	K2	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	2
CO2	1	2	-	-	-	2
CO3	1	2	2	2	-	2
CO4	2	2	1	2	-	2
CO5	1	2	2	-	-	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	FUNDAMENTALS WASH									9
Meanings and Definition: Safe Water- Health, Nexus: Water- Sanitation - Health and Hygiene – Equity issues-Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH.										
Topic – 2	MANAGERIAL IMPLICATIONS AND IMPACT									9
Third World Scenario – Poor and Multidimensional Deprivation--Health Burden in Developing Scenario -Factors contribute to water, sanitation and hygiene related diseases-Social: Social Stratification and Literacy Demography: Population and Migration- Fertility - Mortality-Environment: Water Borne-Water Washed and Water Based Diseases – Economics.										
Topic – 3	CHALLENGES IN MANAGEMENT AND DEVELOPMENT									9
Common Challenges in WASH - Bureaucracy and Users- Water Utilities -Sectoral Allocation:- Infrastructure- Service Delivery: Health services: Macro and Micro- level: Community and Gender Issues- Equity Issues - Paradigm Shift: Democratization of Reforms and Initiatives.										
Topic – 4	GOVERNANCE									9
Public health -Community Health Assessment and Improvement Planning (CHA/CHIP)-Infrastructure and Investments on Water, (WASH) - Cost Benefit Analysis – Institutional Intervention-Public Private Partnership - Policy Directives - Social Insurance -Political Will vs Participatory Governance.										
Topic – 5	INITIATIVES									9
Management vs Development -Accelerating Development- Development Indicators -Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Bonitha R., Beaglehole R., Kjellstorm, 2006, “Basic Epidemiology”, 2nd Edition, World Health Organization.
2	Van Note Chism, N. and Bickford, D. J. (2002), Improving the environment for learning: An expanded agenda. New Directions for Teaching and Learning, 2002: 91–98. doi: 10.1002/tl.83Improving the Environment for learning: An Expanded Agenda.
3	National Research Council. Global Issues in Water, Sanitation, and Health: Workshop Summary. Washington, DC: The National Academies Press, 2009.
4	Sen, Amartya 1997. On Economic Inequality. Enlarged edition, with annex by James Foster and Amartya Sen, Oxford: Clarendon Press, 1997.
5	Intersectoral Water Allocation Planning and Management, 2000,
6	Third World Network.org (www.twn.org).

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3O3	Principles Of Sustainable Development	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			RBT Level
COs	Topics Covered		
CO1	Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises.	K2	1
CO2	Identify and critically analyze the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals.	K2	2
CO3	Develop a fair understanding of the social, economic and ecological linkage of Human well poi;’being, production and consumption.	K3	3
CO4	Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems.	K3	4
CO5	Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability.	K3	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	-	3	-	2	-	2
CO2	-	3	-	2	-	2
CO3	-	-	-	2	-	2
CO4	-	-	3	-	-	2
CO5	-	-	3	-	-	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		SUSTAINABILITY AND DEVELOPMENT CHALLENGES							9	
Definition of sustainability – environmental, economical and social dimensions of sustainability - sustainable development models – strong and weak sustainability – defining development- millennium development goals – mindsets for sustainability: earthly, analytical, precautionary, action and collaborative– syndromes of global change: utilisation syndromes, development syndromes, and sink syndromes – core problems and cross cutting Issues of the 21 century - global, regional and local environmental issues – social insecurity - resource degradation –climate change – desertification.										
Topic – 2		PRINCIPLES AND FRAME WORK							9	
History and emergence of the concept of sustainable development - our common future - Stockholm to Rio plus 20– Rio Principles of sustainable development – Agenda 21 natural step- peoples earth charter – business charter for sustainable development –UN Global Compact - Role of civil society, business and government – United Nations’ 2030 Agenda for sustainable development – 17 sustainable development goals and targets, indicators and intervention areas.										
Topic – 3		SUSTAINABLE DEVELOPMENT AND WELLBEING							9	
The Unjust World and inequities - Quality of Life - Poverty, Population and Pollution - Combating Poverty - - Demographic dynamics of sustainability - Strategies to end Rural and Urban Poverty and Hunger – Sustainable Livelihood Framework- Health, Education and Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities and Industry for Prevention, Precaution , Preservation and Public participation.										
Topic – 4		SUSTAINABLE SOCIO-ECONOMIC SYSTEMS							9	
Sustainable Development Goals and Linkage to Sustainable Consumption and Production – Investing in Natural Capital- Agriculture, Forests, Fisheries - Food security and nutrition and sustainable agriculture- Water and sanitation - Biodiversity conservation and Ecosystem integrity –Ecotourism Sustainable Cities – Sustainable Habitats- Green Buildings - Sustainable Transportation — Sustainable Mining - Sustainable Energy– Climate Change –Mitigation and Adaptation - Safeguarding Marine Resources - Financial Resources and Mechanisms.										
Topic – 5		ASSESSING PROGRESS AND WAY FORWARD							9	
Nature of sustainable development strategies and current practice- Sustainability in global, regional and national context –Approaches to measuring and analysing sustainability– limitations of GDPEcological Footprint- Human Development Index- Human Development Report – National initiatives for Sustainable Development - Hurdles to Sustainability - Science and Technology for sustainable development –Performance indicators of sustainability and Assessment mechanism – Inclusive Green 67 Growth and Green Economy – National Sustainable Development Strategy Planning and National Status of Sustainable Development Goals.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Tom Theis and Jonathan Tomkin, Sustainability: A Comprehensive Foundation, Rice University, Houston, Texas, 2012
2	A guide to SDG interactions from science to implementation, International Council for Science, Paris, 2017
3	Karel Mulder, Sustainable Development for Engineers - A Handbook and Resource Guide, Roulledge Taylor and Francis, 2017.
4	The New Global Frontier - Urbanization, Poverty and Environment in the 21st Century - George Martine, Gordon McGranahan, Mark Montgomery and Rogelio Fernández-Castilla, IIED and UNFPA, Earthscan, UK, 2008
5	Nolberto Munier, Introduction to Sustainability: Road to a Better Future, Springer, 2006
6	Barry Dalal Clayton and Stephen Bass, Sustainable Development Strategies- a resource book", Earthscan Publications Ltd, London, 2002.

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3O4	Environmental Impact Assessment	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles.	K2	1
CO2	Understand various impact identification methodologies, prediction techniques and model of impacts on various environments.	K2	2
CO3	Understand relationship between social impacts and change in community due to development activities and rehabilitation methods.	K2	3
CO4	Document the EIA findings and prepare environmental management and monitoring plan.	K3	4
CO5	Identify, predict and assess impacts of similar projects based on case studies.	K2	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	-	-	-	2	-	2
CO2	3	2	3	2	-	2
CO3	-	2	3	2	-	2
CO4	-	-	3	-	-	2
CO5	3	-	-	-	-	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		INTRODUCTION							9	
Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. Legal and regulatory aspects in India – types and limitations of EIA –EIA processscreening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation.										
Topic – 2		IMPACT INDENTIFICATION AND PREDICTION							9	
Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modeling for impact prediction – assessment of impacts – air – water – soil – noise – biological — cumulative impact assessment.										
Topic – 3		SOCIO-ECONOMIC IMPACT ASSESSMENT							9	
Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. Factors and methodologies- individual and family level impacts. communities in transition-rehabilitation.										
Topic – 4		EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN							9	
Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment.										
Topic – 5		CASE STUDIES							9	
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India
2	Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India
3	Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996
4	Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003
5	Lee N. and George C. 2000. Environmental Assessment in Developing and Transitional Countries. Chichester: Willey
6	World Bank –Source book on EIA ,1999

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3O5	Deep Learning	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Feature Extraction from Image and Video Data.		1
CO2	Implement Image Segmentation and Instance Segmentation in Images C.		2
CO3	Implement image recognition and image classification using a pretrained network (Transfer Learning).		3
CO4	Traffic Information analysis using Twitter Data.		4
CO5	Auto encoder for Classification & Feature Extraction.		5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	-	2	3	1
CO2	2	-	-	-	3	1
CO3	2	-	-	2	3	1
CO4	2	2	-	2	3	1
CO5	2	2	-	2	3	1

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	DEEP LEARNING CONCEPTS									9
Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.										
Topic – 2	NEURAL NETWORKS									9
About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters.										
Topic – 3	CONVOLUTIONAL NEURAL NETWORK									10
About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. RCNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO Model, Microsoft ResNet Model. RCNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO.										
Topic – 4	NATURAL LANGUAGE PROCESSING USING RNN									9
About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Cooccurrence Statistics-based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.										
Topic – 5	DEEP REINFORCEMENT & UNSUPERVISED LEARNING									8
About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017

2	Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
3	Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
4	Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
5	Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017
6	Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS306	Sustainable Management	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.	K2	1
CO2	An understanding of corporate sustainability and responsible Business Practices.	K2	2
CO3	Knowledge and skills to understand, to measure and interpret sustainability performances.	K2	3
CO4	Knowledge of innovative practices in sustainable business and community management.	K3	4
CO5	Deep understanding of sustainable management of resources and commodities.	K2	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	2
CO2	3	2	2	2	-	2
CO3	3	3	1	2	-	2
CO4	3	3	2	2	-	2
CO5	3	3	2	2	-	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	MANAGEMENT OF SUSTAINABILITY									9
Management of sustainability -rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.										
Topic – 2	CORPORATE SUSTAINABILITY AND RESPONSIBILITY									9
Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.										
Topic – 3	SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES									10
Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.										
Topic – 4	SUSTAINABILITY AND INNOVATION									9
Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.										
Topic – 5	SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS									8
Energy management, Water management, Waste management, Wild Life Conservation, Emerging trends in sustainable management, Case Studies.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Daddi, T, Iraldo, F., Testa, Environmental Certification for Organizations and Products: Management, 2015
2	Christian N. Madu, Handbook of Sustainability Management 2012
3	Petra Molthan-Hill, The Business Student's Guide to Sustainable Management: Principles and Practice, 2014
4	Margaret Robertson, Sustainability Principles and Practice, 2014
5	Peter Rogers, An Introduction to Sustainable Development, 2006
6	Jeffrey D. Sachs, The Age of Sustainable Development, Columbia University Press, 2015

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3O7	Micro and Small Business Management	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Familiarise the students with the concept of small business.	K2	1
CO2	In depth knowledge on small business opportunities and challenges.	K2	2
CO3	Ability to devise plans for small business by building the right skills and marketing strategies.	K2	3
CO4	Identify the funding source for small start ups.	K2	4
CO5	Business evaluation for buying and selling of small firms.	K2	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	2	1	2	-	2
CO2	3	3	3	2	-	2
CO3	3	3	2	2	2	2
CO4	3	2	2	2	-	2
CO5	3	2	2	2	2	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	INTRODUCTION TO SMALL BUSINESS									9
Creation, Innovation, entrepreneurship and small business - Defining Small Business –Role of Owner – Manager – government policy towards small business sector –elements of entrepreneurship – evolution of entrepreneurship –Types of Entrepreneurship – social, civic, corporate - Business life cycle - barriers and triggers to new venture creation – process to assist start ups – small business and family business.										
Topic – 2	SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN									9
Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.										
Topic – 3	BUILDING THE RIGHT TEAM AND MARKETING STRATEGY									9
Management and Leadership – employee assessments – Tuckman’s stages of group development The entrepreneurial process model - Delegation and team building - Comparison of HR management in small and large firms - Importance of coaching and how to apply a coaching model. Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems, - market research, - assessing market performance- sales management and strategy - the marketing mix and marketing strategy.										
Topic – 4	FINANCING SMALL BUSINESS									9
Main sources of entrepreneurial capital; Nature of ‘bootstrap’ financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.										
Topic – 5	VALUING SMALL BUSINESS AND CRISIS MANAGEMENT									9
Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Hankinson,A.(2000). “The key factors in the profile of small firm owner-managers that influence business performance. The South Coast Small Firms Survey, 1997-2000.” Industrial and Commercial Training 32(3):94-98
2	Parker,R.(2000). “Small is not necessarily beautiful: An evaluation of policy support for small and medium-sized enterprise in Australia.” Australian Journal of Political Science 35(2):239-253.

3	C. B. Gupta, Small Business Management, Sultan Chand & Sons, 2015
4	R. V. Kulkarni, Entrepreneurship Development and Small Business Enterprises, Pearson Education, 2014
5	S. S. Khanka, Entrepreneurial Development, S. Chand & Company Ltd., 2013
6	K. A. Swami, Small Business Management: Principles and Practice, Prentice Hall India, 2012

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3O8	Ethical Management	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Role modeling and influencing the ethical and cultural context.	K2	1
CO2	Respond to ethical crises and proactively address potential crises situations.	K2	2
CO3	Understand and implement stakeholder management decisions.	K2	3
CO4	Develop the ability, knowledge, and skills for ethical management.	K3	4
CO5	Develop practical skills to navigate, resolve and thrive in management situations.	K3	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	2
CO2	-	3	2	2	-	2
CO3	3	3	3	2	-	2
CO4	3	3	3	2	-	2
CO5	3	3	3	2	-	2

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		ETHICS AND SOCIETY							9	
Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society’s expectations- Individual and organizational responsibility to society and the community.										
Topic – 2		ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS							9	
Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.										
Topic – 3		STAKEHOLDERS IN ETHICAL MANAGEMENT							9	
Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).										
Topic – 4		INDIVIDUAL VARIABLES IN ETHICAL MANAGEMENT							9	
Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology-ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.										
Topic – 5		PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS							9	
Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Brad Agle, Aaron Miller, Bill O' Rourke, The Business Ethics Field Guide: the essential companion to leading your career and your company, 2016
2	Steiner & Steiner, Business, Government & Society: A managerial Perspective, 2011.
3	Lawrence & Weber, Business and Society: Stakeholders, Ethics, Public Policy, 2020.
4	W. Michael Hoffman, Robert E. Frederick, and Mark S. Schwartz, Business Ethics: Readings and Cases in Corporate Morality, McGraw-Hill Education, 2014
5	R. Edward Freeman and Patricia H. Werhane, Business Ethics: A Stakeholder and Issues Management Approach, Wiley, 2019
6	Denis Collins, Essentials of Business Ethics: Creating an Organization of High Integrity and Superior Performance, John Wiley & Sons, 2009

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3O9	IOT for Smart Systems	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1		RBT Level	
CO1	Understand the concepts of IOT and its present developments.	K2	1
CO2	Compare and contrast different platforms and infrastructures available for IOT .	K2	2
CO3	Explain different protocols and communication technologies used in IOT.	K2	3
CO4	Analyze the big data analytic and programming of IOT.	K4	4
CO5	Implement IOT solutions for smart applications.	K3	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	-	2	3	1
CO2	2	-	-	-	3	1
CO3	2	-	-	2	3	1
CO4	2	2	-	2	3	1
CO5	2	2	-	2	3	1

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	INTRODUCTION TO INTERNET OF THINGS									9
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.										
Topic – 2	IOT ARCHITECTURE									9
IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture, IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy beacons.										
Topic – 3	PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT									9
PROTOCOLS: NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell. Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.										
Topic – 4	IOT PROCESSORS									9
Services/Attributes: Big-Data Analytics for IOT, Dependability,Interoperability, Security, Maintainability. Embedded processors for IOT :Introduction to Python programming -Building IOT with RASPERRY PI and Arduino.										
Topic – 5	CASE STUDIES									9
Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	ArshdeepBahga and VijaiMadiseti : A Hands-on Approach “Internet of Things”,Universities Press 2015.
2	Oliver Hersent , David Boswarthick and Omar Elloumi “ The Internet of Things”, Wiley,2016.
3	Samuel Greengard, “The Internet of Things”, The MIT press, 2015.
4	Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things “Wiley,2014.
5	Jean- Philippe Vasseur, Adam Dunkels, “Interconnecting Smart Objects with IP: The Next Internet” Morgan Kuffmann Publishers, 2010.
6	Arshdeep Bahga, Vijay Madiseti,IoT and Edge Computing for Architects, Apress, 2019

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3O10	Machine Learning and Deep Learning	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Illustrate the categorization of machine learning algorithms.	K3	1
CO2	Compare and contrast the types of neural network architectures, activation functions.	K3	2
CO3	Acquaint with the pattern association using neural networks.	K3	3
CO4	Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks.	K3	4
CO5	Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.	K3	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	-	2	3	1
CO2	2	-	-	-	3	1
CO3	2	-	-	2	3	1
CO4	2	2	-	2	3	1
CO5	2	2	-	2	3	1

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	LEARNING PROBLEMS AND ALGORITHMS								7	
Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms										
Topic – 2	NEURAL NETWORKS								10	
Differences between Biological and Artificial Neural Networks - Typical Architecture, Common Activation Functions, Multi-layer neural network, Linear Separability, Hebb Net, Perceptron, Adaline, Standard Back propagation Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero associative, Auto associative, Kohonen Self Organising Maps, Examples of Feature Maps, Learning Vector Quantization, Gradient descent, Boltzmann Machine Learning										
Topic – 3	MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS								10	
Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.										
Topic – 4	DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS								9	
Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.										
Topic – 5	DEEP LEARNING: RNNs, AUTOENCODERS AND GANS								9	
State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, 80 Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro Fuzzy and Soft Computing - A Computational Approach to Learning and Machine Intelligence, 2012, PHI learning
2	Deep Learning, Ian Good fellow, YoshuaBengio and Aaron Courville, MIT Press, ISBN: 9780262035613, 2016.
3	The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009.
4	Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2006.
5	Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.
6	Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3011	Smart Grid	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	RBT Level		
CO1	Relate with the smart resources, smart meters and other smart devices.		1
CO2	Explain the function of Smart Grid.		2
CO3	Experiment the issues of Power Quality in Smart Grid.		3
CO4	Analyze the performance of Smart Grid.		4
CO5	Recommend suitable communication networks for smart grid applications.		5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	-	2	3	1
CO2	2	-	-	-	3	1
CO3	2	-	-	2	3	1
CO4	2	2	-	2	3	1
CO5	2	2	-	2	3	1

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		INTRODUCTION TO SMART GRID							9	
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.										
Topic – 2		SMART GRID TECHNOLOGIES							10	
Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.										
Topic – 3		SMART METERS AND ADVANCED METERING INFRASTRUCTURE							9	
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.										
Topic – 4		POWER QUALITY MANAGEMENT IN SMART GRID							8	
Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.										
Topic – 5		HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS							9	
Architecture and Standards -Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Stuart Borlase ‘Smart Grid: Infrastructure, Technology and Solutions’, CRC Press 2012.
2	JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, ‘Smart Grid: Technology and Applications’, Wiley, 2012.
3	Mini S. Thomas, John D McDonald, ‘Power System SCADA and Smart Grids’, CRC Press, 2015
4	Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan, ‘Communication Networks for Smart Grids’, Springer, 2014
5	SMART GRID Fundamentals of Design and Analysis, James Momoh, IEEE press, A John Wiley & Sons, Inc., Publication.
6	Clark W. Gellings and Rahmat Shoureshi, CRC Press, 2009

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3012	Security Practices	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Understand the core fundamentals of system security.	RBT Level	1
CO2	Apply the security concepts to wired and wireless networks.	K3	2
CO3	Implement and Manage the security essentials in IT Sector.	K3	3
CO4	Explain the concepts of Cyber Security and Cyber forensics.	K2	4
CO5	Be aware of Privacy and Storage security Issues.	K2	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	-	2	3	1
CO2	2	-	-	-	3	1
CO3	2	-	-	2	3	1
CO4	2	2	-	2	3	1
CO5	2	2	-	2	3	1

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	SYSTEM SECURITY									9
Model of network security – Security attacks, services and mechanisms – OSI security architecture -A Cryptography primer- Intrusion detection system- Intrusion Prevention system - Security web applications- Case study: OWASP - Top 10 Web Application Security Risks.										
Topic – 2	NETWORK SECURITY									9
Internet Security - Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security - Mobile security - IOT security - Case Study - Kali Linux.										
Topic – 3	SECURITY MANAGEMENT									9
Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System. Case study: Metasploit.										
Topic – 4	CYBER SECURITY AND CLOUD SECURITY									9
Cyber Forensics- Disk Forensics – Network Forensics – Wireless Forensics – Database Forensics – Malware Forensics – Mobile Forensics – Email Forensics- Best security practices for automate Cloud infrastructure management – Establishing trust in IaaS, PaaS, and SaaS Cloud types. Case study: DVWA.										
Topic – 5	PRIVACY AND STORAGE SECURITY									9
Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	John R. Vacca, Computer and Information Security Handbook, Third Edition, Elsevier 2017
2	Michael E. Whitman, Herbert J. Mattord, Principles of Information Security, Seventh Edition, Cengage Learning, 2022
3	Richard E. Smith, Elementary Information Security, Third Edition, Jones and Bartlett Learning, 2019
4	Mayor, K.K.Mookhey, Jacopo Cervini, Fairuzan Roslan, Kevin Beaver, Metasploit Toolkit for Penetration Testing, Exploit Development and Vulnerability Research, Syngress publications, Elsevier, 2007. ISBN : 978-1-59749-074-0
5	John Sammons, “The Basics of Digital Forensics- The Primer for Getting Started in Digital Forensics”, Syngress, 2012
6	Cory Altheide and Harlan Carvey, “Digital Forensics with OpenSource Tools”,2011 Syngress, ISBN: 9781597495875.

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3O13	Cloud Computing Technologies	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to		RBT Level	Topics Covered
CO1	Employ the concepts of virtualization in the cloud computing.	K2	1
CO2	Identify the architecture, infrastructure and delivery models of cloud computing.	K2	2
CO3	Develop the Cloud Application in AWS platform.	K3	3
CO4	Apply the concepts of Windows Azure to design Cloud Application.	K3	4
CO5	Develop services using various Cloud computing programming models.	K3	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	-	2	3	1
CO2	2	-	-	-	3	1
CO3	2	-	-	2	3	1
CO4	2	2	-	2	3	1
CO5	2	2	-	2	3	1

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE							9	
Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization- Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.										
Topic – 2		CLOUD PLATFORM ARCHITECTURE							9	
Cloud Computing: Definition, Characteristics - Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Architectural Design Challenges.										
Topic – 3		AWS CLOUD PLATFORM - IAAS							9	
Amazon Web Services: AWS Infrastructure- AWS API- AWS Management Console - Setting up AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for KubernetesAWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy, AWS Code Pipeline, AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling, AWS control Tower, Cloud Formation, Cloud Trail, AWS License Manager.										
Topic – 4		PAAS CLOUD PLATFORM							9	
Windows Azure: Origin of Windows Azure, Features, The Fabric Controller – First Cloud APP in Windows Azure- Service Model and Managing Services: Definition and Configuration, Service runtime API- Windows Azure Developer Portal- Service Management API- Windows Azure Storage Characteristics-Storage Services- REST API- Blops.										
Topic – 5		PROGRAMMING MODEL							9	
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
2	Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
3	Sriram Krishnan, Programming: Windows Azure, O'Reilly,2010.

4	Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, Mastering Cloud Computing , MCGraw Hill Education (India) Pvt. Ltd., 2013
5	Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005
6	Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3014	Big Data Analytics	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Understand the basics of big data analytics.	RBT Level	1
CO2	Ability to use Hadoop, Map Reduce Framework.	K2	2
CO3	Ability to identify the areas for applying big data analytics for increasing the business outcome.	K2	3
CO4	Gain knowledge on R language.	K2	4
CO5	Contextually integrate and correlate large amounts of information to gain faster insights.	K2	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	-	2	3	1
CO2	2	-	-	-	3	1
CO3	2	-	-	2	3	1
CO4	2	2	-	2	3	1
CO5	2	2	-	2	3	1

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		INTRODUCTION TO BIG DATA							9	
Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis Vs Reporting - Modern Data Analytic ToolsStatistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.										
Topic – 2		SEARCH METHODS AND VISUALIZATION							9	
Search by simulated Annealing – Stochastic, Adaptive search by Evaluation – Evaluation Strategies – Genetic Algorithm – Genetic Programming – Visualization – Classification of Visual Data Analysis Techniques – Data Types – Visualization Techniques – Interaction techniques – Specific Visual data analysis Techniques.										
Topic – 3		MINING DATA STREAMS							9	
Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.										
Topic – 4		FRAMEWORKS							9	
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation.										
Topic – 5		R LANGUAGE							9	
Overview, Programming structures: Control statements -Operators -Functions -Environment and scope issues -Recursion -Replacement functions, R data structures: Vectors -Matrices and arrays - Lists - Data frames -Classes, Input/output, String manipulations.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007
2	Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 3rd edition 2020.
3	Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, No Starch Press, USA, 2011.
4	Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & sons, 2012
5	Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007.
6	Jeffrey Aven, Building Big Data and Analytics Solutions in the Cloud, Apress, 2014

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3O15	Internet of Things and Cloud	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
RBT Level			
CO1	Understand the various concept of the IoT and their technologies.		
CO2	Develop IoT application using different hardware platforms.		
CO3	Implement the various IoT Protocols.		
CO4	Understand the basic principles of cloud computing.		
CO5	Develop and deploy the IoT application into cloud environment.		

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	-	2	3	1
CO2	2	-	-	-	3	1
CO3	2	-	-	2	3	1
CO4	2	2	-	2	3	1
CO5	2	2	-	2	3	1

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	FUNDAMENTALS OF IOT									9
Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges. Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors.										
Topic – 2	PROTOCOLS FOR IOT									9
Infrastructure protocol (IPV4/V6/RPL), Identification (URIs), Transport (Wifi, Lifi, BLE), Discovery, Data Protocols, Device Management Protocols. – A Case Study with MQTT/CoAP usage-IoT privacy, security and vulnerability solutions.										
Topic – 3	CASE STUDIES/INDUSTRIAL APPLICATIONS									9
Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.										
Topic – 4	CLOUD COMPUTING INTRODUCTION									9
Introduction to Cloud Computing - Service Model – Deployment Model- Virtualization Concepts – Cloud Platforms – Amazon AWS – Microsoft Azure – Google APIs.										
Topic – 5	IoT AND CLOUD									9
IoT and the Cloud - Role of Cloud Computing in IoT - AWS Components - S3 – Lambda - AWS IoT Core -Connecting a web application to AWS IoT using MQTT- AWS IoT Examples. Security Concerns, Risk Issues, and Legal Aspects of Cloud Computing- Cloud Data Security.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	"The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman,CRC Press, 2017
2	Adrian McEwen, Designing the Internet of Things, Wiley,2013.
3	EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley publishers, 2015.
4	Simon Walkowiak, “Big Data Analytics with R” PackT Publishers, 2016
5	Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publishers, 2015.
6	Arshdeep Bahga and Vijay Madisetti, Internet of Things (A Hands-on-Approach), VPT, 2014

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3016	Embedded Automation	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			Topics Covered
CO1	Analyze the 8-bit series microcontroller architecture, features and pin details.	K3	1
CO2	Write embedded C programs for embedded system application.	K2	2
CO3	Design and develop real time systems using AVR microcontrollers.	K3	3
CO4	Design and develop the systems based on vision mechanism.	K3	4
CO5	Design and develop a real time home automation system.	K3	5

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	-	-	2	3	1
CO2	2	-	-	-	3	1
CO3	2	-	-	2	3	1
CO4	2	2	-	2	3	1
CO5	2	2	-	2	3	1

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1	INTRODUCTION TO EMBEDDED C PROGRAMMING									9
C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools.										
Topic – 2	AVR MICROCONTROLLER									9
ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters.										
Topic – 3	HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS									9
Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools.										
Topic – 4	VISION SYSTEM									9
Fundamentals of Image Processing - Filtering - Morphological Operations - Feature Detection and Matching - Blurring and Sharpening - Segmentation - Thresholding - Contours - Advanced Contour Properties - Gradient - Canny Edge Detector - Object Detection - Background Subtraction.										
Topic – 5	HOME AUTOMATION									9
Home Automation - Requirements - Water Level Notifier - Electric Guard Dog - Tweeting Bird Feeder - Package Delivery Detector - Web Enabled Light Switch - Curtain Automation - Android Door Lock - Voice Controlled Home Automation - Smart Lighting - Smart Mailbox - Electricity Usage Monitor - Proximity Garage Door Opener - Vision Based Authentic Entry System.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Embedded Automation in Human-Agent Environment" by Federico Cabitza, Carla Simone, and Matteo Picozzi, Springer, 2018
2	Joe Pardue, "C Programming for Microcontrollers ", Smiley Micros, 2005.
3	Steven F. Barrett, Daniel J. Pack, "ATMEL AVR Microcontroller Primer: Programming and Interfacing", Morgan & Claypool Publishers, 2012
4	Mike Riley, "Programming Your Home - Automate With Arduino, Android and Your Computer", the Pragmatic Programmers, Llc, 2012.
5	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
6	Kevin P. Murphy, "Machine Learning - a Probabilistic Perspective", the MIT Press Cambridge, Massachusetts, London, 2012.

Semester	Programme	Course Code	Course Name	L	T	P	C
III	M.E. ISE	23IS3O17	Artificial Intelligence and Expert Systems	3	0	0	3

COURSE LEARNING OUTCOMES (COs)			
After Successful completion of the course, the students should be able to			RBT Level
			Topics Covered
CO1	Explore the Concepts of artificial Intelligence and applications.		K2
CO2	Explore different modes of perception, including visual, auditory, and other sensory systems.		K2
CO3	Examine knowledge representation techniques, including psychology, production rules, logic, and programming.		K2
CO4	Understand a range of applications for expert systems.		K2
CO5	Understand the architecture of neural networks.		K2

PRE-REQUISITE	
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CO / PO MAPPING (1 – Weak, 2 – Medium, 3 – Strong)						
COs	Programme Learning Outcomes (POs)			Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	-	2	-	2	-
CO2	3	3	3	-	2	-
CO3	-	2	-	-	2	-
CO4	-	-	-	-	2	-
CO5	-	-	-	-	2	-

COURSE ASSESSMENT METHODS		
DIRECT	1	Continuous Assessment Tests
	2	Seminar
	3	End Semester Examinations
INDIRECT	1	Course End Survey

COURSE CONTENT										
Topic – 1		INTRODUCTION							9	
Intelligence – Definition, types cognitive aspect approach, measuring intelligence – early efforts, IQ and AI: aspects of intelligence – learning, problem solving, creativity, behaviour and biology. Artificial intelligence: Historical background, applications of AI, objections and myths, AI languages: Introduction to PROLOG and LISP.										
Topic – 2		COGNITIVE PSYCHOLOGY							11	
The mind – informative and cybernetics, components for thought, modes of perception – visual, auditory and other systems: memory mechanisms, problem solving – planning, search, the GPS systems; types of learning – rote, parameter, method and concept: Game playing, reasoning, Artificial Vision – picture processing – identifying real objects; Vision programs, factory vision systems.										
Topic – 3		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.										
Topic – 4		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.										
Topic – 5		INTRODUCTION TO NEURAL NETWORKS							7	
Neural Network Architecture – Learning methods – Architecture of a Back Propagation Network – Selection of parameters – Simple variations of BPN.										
THEORY	45		TUTORIAL	0		PRACTICAL	0		TOTAL	45

BOOK REFERENCES	
1	Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson, 2021
2	Elaine Rich, Kevin Knight, and Shivashankar B. Nair, Artificial Intelligence, McGraw-Hill, 2009
3	Rajasekaran S and Vijayalakshmi Pai, G.A, “Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications”, PHI, 2003.
4	Elaine R., and Kevin, “Artificial Intelligence”, 2nd Edition, Tata McGraw Hill, 1994.
5	Schalkoff, R.J., “Artificial Intelligence” – An Engineering Approach”, McGraw Hill International Edition, Singapore, 1992.
6	Patrick Winston, Artificial Intelligence, Addison-Wesley, 1992