KNOWLEDGE INSTITUTE OF TECHNOLOGY, SALEM

(An Autonomous Institution)

Approved by AICTE, Affiliated to Anna University, Chennai.
Accredited by NBA (CSE, ECE, EEE & MECH), Accredited by NAAC with 'A' Grade

KIOT Campus, Kakapalayam – 637 504. Salem Dt., Tamil Nadu, India.

M.E. / M.Tech. Regulations 2023

M.E. – Industrial Safety Engineering

Curriculum and Syllabi

(For the Students Admitted from the Academic Year 2023 – 2024 onwards)

Version: 1.0 **Date:** 09.09.2023

	KNOWLEDGE INSTITUTE OF TECHNOLOGY (AUTONOMOUS), SALEM -637504
	Approved by AICTE, Affiliated to Anna University, Accredited by NAAC and NBA (B.E.:Mech., ECE, EEE & CSE)
	Website: www.kiot.ac.in

S.NO.	CONTENTS	PAGE NO.
1	INSTITUTE AND DEPARTMENT VISION & MISSION	1
2	PEOs & POs	2
3	CURICULUM STRUCTURE FROM I TO IV SEMESTER	3 - 6
4	SEMESTER WISE CREDIT DISTRIBUTION & NOMENCLATURE	7
5	SEMESTER I – SYLLABUS	8 - 32
6	SEMESTER II – SYLLABUS	33-44
7	PROFESSIONAL ELECTIVE COURSES – SYLLABUS	45-70
8	OPEN ELECTIVE COURSES – SYLLABUS	71-125
9	AUDIT COURSES – SYLLABUS	126-136
10	SPECIAL ELECTIVES – SYLLABUS	137-154

	KNOWLEDGE INSTITUTE OF TECHNOLOGY(AUTONOMOUS), SALEM
	Approved by AICTE, Affiliated to Anna University, Accredited by NAAC and NBA (B.E.: Mech., ECE, EEE & CSE)
	website: www.kiot.ac.in

M.E. / M.Tech. REGULATIONS 2023 (R 2023)

CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION

M.E. – INDISTRIAL SAFETY ENGINEERING

VISION OF THE INSTITUTE
To be a world class institution to impart value and need based professional education to the aspiring youth and carving them into disciplined world class professional who have the quest for excellence, achievement orientation and social responsibilities.

MISSION OF THE INSTITUTE	
A	To promote academic growth by offering state-of-art undergraduate, postgraduate and doctoral programs and to generate new knowledge by engaging in cutting – edge research
B	To nurture talent, innovation, entrepreneurship, all-round personality and value system among the students and to foster competitiveness among students
C	To undertake collaborative projects which offer opportunities for long-term interaction with academia and industry
D	To pursue global standards of excellence in all our endeavors namely teaching, research, consultancy, continuing education and support functions

VISION OF THE DEPARTMENT
To create competent and industry relevant Mechanical Engineers with professional and social values to meet global challenges.

MISSION OF THE DEPARTMENT	
M1	Enabling environment for effective teaching - learning and research to meet global challenges.
M2	Motivating students to pursue higher education and to excel in competitive examinations and entrepreneurship.
M3	Establish a continuous Industry Institute Interaction to make the students employable.
M4	Inculcate the students leadership quality with ethical values and spirit of team work.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)	
PEO 1	Possess a mastery of Health safety and environment awareness and safety management skills, to reach higher levels in their profession.
PEO 2	Proficient safety Engineer rendering professional expertise to the industrial and societal needs at national and global level subject to legal requirements.
PEO 3	Well communicate the information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities.
PEO 4	Demonstrate professional and ethical attitude with awareness of current legal issues by rendering expertise to wide range of industries.

PROGRAM OUTCOMES (POs)	
Graduates Engineering will be able to:	
PO1	An ability to independently carry out research /investigation and development work to solve practical problems
PO2	An ability to write and present a substantial technical report/document
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
PO4	Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to safety, health and environmental engineering activities with an understanding of the limitations.
PO5	Demonstrate the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to occupational health and safety practices.
PO6	Recognise the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously

KNOWLEDGE INSTITUTE OF TECHNOLOGY (AUTONOMOUS), SALEM - 637504												
M.E. INDUSTRIAL SAFETY ENGINEERING											Version : 1.0	
Courses of Study and Scheme of Assessment (Regulations 2023)											Date : 09.09.23	
S. No.	Course Code	Course Title	Periods / Week						Maximum Marks			
			CAT	CP	L	T	P	C	IA	ESE	Total	
SEMESTER I												
-	-	Induction Programme	-	-	-	-	-	-	-	-	-	
	THEORY											
1	ME23MA101	Probability and Statistical Methods	FC	4	3	1	0	4	40	60	100	
2	ME23IS301	Principles of Safety Management	PC	3	3	0	0	3	40	60	100	
3	ME23IS302	Environmental Safety	PC	3	3	0	0	3	40	60	100	
4	ME23IS303	Occupational Health and Industrial Hygiene	PC	3	3	0	0	3	40	60	100	
5	ME23IS304	Industrial Safety, Health and Environment Acts	PC	3	3	0	0	3	40	60	100	
6	ME23IS305	Fire Engineering and Explosion Control	PC	3	3	0	0	3	40	60	100	
7	ME23RM201	Research Methodology and IPR	RM	3	2	1	0	3	40	60	100	
8	ME23AC7XX	Audit Course-I*	AC	2	2	0	0	0	100	-	100	
	PRACTICAL											
9	ME23IS306	Industrial Safety and Simulation Laboratory	PC	2	0	0	2	1	60	40	100	
	EMPLOYABILITY ENHANCEMENT											
10	ME23PT801	Technical Seminar/Case Study Presentation	EEC	2	0	0	2	0	100	-	100	
Total				28	22	2	4	23	540	460	1000	
SEMESTER II												
	THEORY											
1	ME23IS307	System Simulation and Hazard Analysis	PC	4	4	0	0	4	40	60	100	
2	ME23IS308	Safety in Process Industries	PC	3	3	0	0	3	40	60	100	
3	ME23IS4XX	Professional Elective-I	PE	3	3	0	0	3	40	60	100	
4	ME23IS4XX	Professional Elective-II	PE	3	3	0	0	3	40	60	100	
5	ME23XX5XX	Open Elective-I	OE	3	3	0	0	3	40	60	100	
6	ME23MC701	Universal Human Values and Ethics	MC	3	2	1	0	3	40	60	100	
7	ME23AC7XX	Audit Course-II*	AC	2	2	0	0	0	100	-	100	
	EMPLOYABILITY ENHANCEMENT											
8.	ME23PT802	Research Paper Review and Presentation	EEC	2	0	0	2	1	100	-	100	
9.	ME23PT803	Industrial Safety Assessment – Internship	EEC	4	0	0	4	2	100	-	100	
Total				27	20	1	6	22	540	360	900	

*indicates the course is optional

KNOWLEDGE INSTITUTE OF TECHNOLOGY (AUTONOMOUS), SALEM - 637504												
M.E. INDUSTRIAL SAFETY ENGINEERING											Version : 1.0	
Courses of Study and Scheme of Assessment (Regulations 2023)											Date : 09.09.23	
S. No.	Course Code	Course Title	Periods / Week						Maximum Marks			
			CAT	CP	L	T	P	C	IA	ESE	Total	
SEMESTER III												
	THEORY											
1	ME23IS309	Electrical Safety	PC	3	3	0	0	3	40	60	100	
2	ME23IS4XX	Professional Elective-III	PE	3	3	0	0	3	40	60	100	
3	ME23IS4XX	Professional Elective- IV	PE	3	3	0	0	3	40	60	100	
4	ME23XX5XX	Open Elective-II	OE	3	3	0	0	3	40	60	100	
	PRACTICAL											
5	ME23IS601	Project Work – Phase I	PW	12	0	0	12	6	60	40	100	
		Total		24	12	0	12	18	220	280	500	
SEMESTER IV												
	PRACTICAL											
1	ME23IS602	Project Work – Phase II	PW	24	0	0	24	12	60	40	100	
		Total		24	0	0	24	12	60	40	100	
Total Number of Credits: 75												

PROFESSIONAL ELECTIVES											
SEMESTER II (Professional Electives - I & II)											
S. No.	Course Code	Course Title	Periods / Week						Maximum Marks		
			CAT	CP	L	T	P	C	IA	ESE	Total
1.	ME23IS401	Plant Layout and Material Handling	PE	3	3	0	0	3	40	60	100
2.	ME23IS402	Work Study and Ergonomics	PE	3	3	0	0	3	40	60	100
3.	ME23IS403	Human Factors in Engineering	PE	3	3	0	0	3	40	60	100
4.	ME23IS404	Maintenance Engineering	PE	3	3	0	0	3	40	60	100
5.	ME23IS405	Optimization Techniques	PE	3	3	0	0	3	40	60	100
6.	ME23IS406	Transport Safety	PE	3	3	0	0	3	40	60	100
7.	ME23IS407	Fireworks Safety	PE	3	3	0	0	3	40	60	100
8.	ME23IS408	Nuclear Engineering and Safety	PE	3	3	0	0	3	40	60	100
9.	ME23IS409	Safety in construction	PE	3	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVES											
SEMESTER III (Professional Electives - III & IV)											
1	ME23IS410	Safety in Textile Industry	PE	3	3	0	0	3	40	60	100
2	ME23IS411	Safety in Mines	PE	3	3	0	0	3	40	60	100
3	ME23IS412	Dock Safety	PE	3	3	0	0	3	40	60	100
4	ME23IS413	Safety in Engineering Industry	PE	3	3	0	0	3	40	60	100
5	ME23IS414	Quality Engineering in Production Systems	PE	3	3	0	0	3	40	60	100
6	ME23IS415	ISO 45001 and ISO 14000	PE	3	3	0	0	3	40	60	100
7	ME23IS416	Artificial Intelligence and Data Analytics	PE	3	3	0	0	3	40	60	100
8	ME23IS417	Design of Experiments	PE	3	3	0	0	3	40	60	100
9	ME23IS418	Reliability Engineering	PE	3	3	0	0	3	40	60	100
10	ME23IS419	Logistics and Distribution Management	PE	3	3	0	0	3	40	60	100

OPEN ELECTIVES											
S. No.	Course Code	Course Title	Periods / Week						Maximum Marks		
			CAT	CP	L	T	P	C	IA	ESE	Total
Except M.E. Computer Science and Engineering											
1.	ME23CP501 / ME23CP310	Security Practices	OE	3	3	0	0	3	40	60	100
2.	ME23CP502 / ME23CP401	Cloud Computing Technologies	OE	3	3	0	0	3	40	60	100
3.	ME23CP503 / ME23CP415	Block chain Technologies	OE	3	3	0	0	3	40	60	100
4.	ME23CP504 / ME23CP414	Deep Learning	OE	3	3	0	0	3	40	60	100
5.	ME23CP505	Design Thinking	OE	3	3	0	0	3	40	60	100
6.	ME23CP506	Principles of Multimedia	OE	3	3	0	0	3	40	60	100
Except M.E. Industrial Safety Engineering											
7.	ME23IS501 / ME23IS302	Environmental Safety	OE	3	3	0	0	3	40	60	100
8.	ME23IS502 / ME23IS309	Electrical safety	OE	3	3	0	0	3	40	60	100
9.	ME23IS503 / ME23IS413	Safety in Engineering Industry	OE	3	3	0	0	3	40	60	100
10.	ME23IS504	Design of Experiments	OE	3	3	0	0	3	40	60	100
11.	ME23IS505	Circular Economy	OE	3	3	0	0	3	40	60	100
Except M.E. Embedded System Technologies											
12.	ME23ET501 / ME23ET310	IoT for Smart Systems	OE	3	3	0	0	3	40	60	100
13.	ME23ET502 / ME23ET408	Machine Learning and Deep Learning	OE	3	3	0	0	3	40	60	100
14.	ME23ET503	Renewable Energy Technology	OE	3	3	0	0	3	40	60	100
15.	ME23ET504 / ME23ET423	Smart Grid	OE	3	3	0	0	3	40	60	100

Except M.E. VLSI Design											
16.	ME23VL501	Big Data Analytics	OE	3	3	0	0	3	40	60	100
17.	ME23VL502	Internet of Things and Cloud	OE	3	3	0	0	3	40	60	100
18.	ME23VL503	Medical Robotics	OE	3	3	0	0	3	40	60	100
19.	ME23VL504	Embedded Automation	OE	3	3	0	0	3	40	60	100

AUDIT COURSES/MANDATORY COURSES											
AUDIT COURSES (Optional Courses)											
S. No.	Course Code	Course Title	Periods / Week						Maximum Marks		
			CAT	CP	L	T	P	C	IA	ESE	Total
1	ME23AC701	English for Research Paper Writing	AC	2	2	0	0	0	100	-	100
2	ME23AC702	Disaster Management	AC	2	2	0	0	0	100	-	100
3	ME23AC703	Constitution of India	AC	2	2	0	0	0	100	-	100
4	ME23AC704	நற்றமிழ் இலக்கியம் / Classical Tamil literature	AC	2	2	0	0	0	100	-	100
MANDATORY COURSES											
1	ME23MC701	Universal Human Values and Ethics	MC	3	2	1	0	3	40	60	100

Special Electives (For Ph.D Scholars)											
S. No.	Course Code	Course Title	Periods / Week						Maximum Marks		
			CAT	CP	L	T	P	C	IA	ESE	Total
1	ME23IS901	Design of Heat Exchangers	SE	3	2	1	0	3	40	60	100
2	ME23IS902	Advanced Materials Technology	SE	3	2	1	0	3	40	60	100
3	ME23IS903	Energy Efficient Buildings	SE	3	2	1	0	3	40	60	100
4	ME23IS904	Advanced Energy Storage Technologies	SE	3	2	1	0	3	40	60	100
5	ME23IS905	Energy Conversion Techniques	SE	3	2	1	0	3	40	60	100
6	ME23IS906	Material Testing and Characterization Techniques	SE	3	2	1	0	3	40	60	100
7	ME23IS907	Tribology in Design	SE	3	2	1	0	3	40	60	100
8	ME23IS908	Measurement and Control for Energy Systems	SE	3	2	1	0	3	40	60	100
9	ME23IS909	Computational Fluid Dynamics	SE	3	2	1	0	3	40	60	100

Special electives for Ph.D. scholars are determined by the recommendations of the Doctoral Committee for each individual scholar. The syllabus for these electives is also provided by the Doctoral Committee members, subject to approval by the Internal Board of Studies (BOS), and subsequently ratified in the next BOS meeting.

SEMESTER WISE CREDITS DISTRIBUTION

SUMMARY							
S.No.	Course Category	Credits per Semester				Credits	Credit %
		I	II	III	IV		
1.	**FC**	4	-	-	-	4	5.32
2.	**RM**	3	-	-	-	3	4
3.	**PC**	16	7	3	-	26	34.68
4	**PE**	-	6	6	-	12	15
5.	**OE**	-	3	3	-	6	8
6.	**PW**	-	-	6	12	18	24
7.	**AC/MC**	✓	3	-	-	3	4
8.	**EEC**	-	3	-	-	3	4
	Total	**23**	**22**	**18**	**12**	**75**	**100**

NOMENCLATURE

CAT	Category of Course	**FC**	Foundation Courses	**AC/ MC**	Audit Courses / Mandatory Courses
CP	Contact Periods	**RM**	Research Methodology & IPR	**EEC**	Employability Enhancement Courses
L	Lecture Periods	**PC**	Professional Core Courses	**IA**	Internal Assessment
T	Tutorial Periods	**PE**	Professional Elective Courses	**ESE**	End Semester Examination
P	Laboratory Periods	**OE**	Open Elective Courses		
C	Credits	**PW**	Project Work Courses		

ME23MA101	PROBABILITY AND STATISTICAL METHODS	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		4	3	1	0	4

Use of F test, t test and Chi-square test tables are permitted

Course Objectives:

1	To introduce the basic concepts of probability and standard distributions.
2	To provide the most appropriate estimator of the parameter in statistical inference.
3	To decide whether to accept or reject a specific value of a parameters.
4	To introduce the fundamentals of classifications of design of experiments which plays very important roles in the field of agriculture and quality control.
5	To learn methods for analyzing time series data to extract meaningful statistical characteristic of data.

UNIT–I	PROBABILITY AND RANDOM VARIABLES	9+3

Probability(L1) – Axioms of probability(L2) – Conditional probability and problems(L3) – Baye's theorem and problems (L3) - Random variables(L1) – Probability function(L2) – Moments (L2) – Moment generating functions and their properties (L2) – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions and problems (L3) – Function of a random variable(L2).

UNIT–II	ESTIMATION THEORY	9+3

Principle of least squares (L2) – Regression and problems (L3)– Multiple and partial correlations and problems (L3) – Estimation of parameters and problems (L3)– Maximum likelihood estimates(L2) – Method of moments and problems(L3).

UNIT– III	TESTING OF HYPOTHESIS	9+3

Sampling distributions (L2) – Small and large samples and problems (L3) – Tests based on Normal, t -distribution, Chi - square, Goodness of fit and F – distributions (L3).

UNIT – IV	DESIGN OF EXPERIMENTS	9+3

Analysis of variance (L1) – Completely randomized design (L3) – Randomized block design (L3) – Latin square design (L3) – 2^2 Factorial designs (L3).

UNIT–V	TIME SERIES	9+3

Characteristics and representation (L1) – Moving averages and problems (L3) – Exponential smoothing (L2) – Auto Regressive Processes and problems (L3).

Total : 45+15=60 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS		
Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination		
COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Explain probability axioms , rules and the moments of discrete and continuous random variables.	L2 - Understand
CO2	Interpret the concepts of estimator and various methods to find Estimator.	L2 - Understand
CO3	Utilize statistical tests in testing hypotheses on data.	L3 - Apply
CO4	Apply the basic concepts of classifications of design of experiments in the field of agriculture and quality control.	L3 - Apply
CO5	Explain various time series models and application of these models appropriately to engineering problems.	L2 - Understand
REFERENCE BOOKS:		
1.	Anderson, O.D, "Time Series Analysis: Theory and Practice", North - Holland, Amsterdam, 1982.	
2.	Devore, J. L., "Probability and Statistics for Engineering and Sciences", 9th Edition, Cengage Learning, 2016.	
3.	Gupta S.C. and Kapoor V.K.," Fundamentals of Mathematical Statistics", 12th Edition, Sultan and Sons, New Delhi, 2020.	
4.	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers, 9th Edition, Pearson Education, Asia, 2016.	
VIDEO REFERENCES:		
1.	https://youtu.be/14PQawp_rjk	
2.	https://youtu.be/IEUTRhyoHNc	
WEB REFERENCES:		
1.	https://www.edanz.com/blog/anova-explained	
2.	http://stankova.net/book.pdf	
ONLINE COURSES:		
1.	https://nptel.ac.in/courses/110105087	
2.	https://onlinecourses.nptel.ac.in/noc23_ge25/preview	

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2		1			1
CO2	2		1			
CO3	2		1			
CO4	3		2			
CO5	1		1			1
Average	2.2		1.6			1
1–Low, 2 –Medium, 3–High.						

ME23IS301	PRINCIPLES OF SAFETY MANAGEMENT	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

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

UNIT–I	CONCEPTS AND TECHNIQUES	9

History of Safety Movement (L1)-Evolution of Modern Safety Concept (L2)-General Concepts of Management (L1)-Planning for Safety for Optimization of Productivity (L2)-Productivity, Quality, and Safety (L3)-Line and Staff Functions for Safety (L2)-Budgeting for Safety (L2)-Safety Policy (L2)-Incident Recall Technique (IRT) (L2)-Disaster Control (L2)-Job Safety Analysis (L2)-Safety Survey (L2)-Safety Inspection (L2)-Safety Sampling (L2)-Evaluation of Performance of Supervisors on Safety (L2).

UNIT–II	SAFETY EDUCATION AND TRAINING	9

Importance of Training (L1)- Assessing competency (L2)-Identification of Training Needs (L1)-Training Methods (L2)- Programmes, Seminars (L1)-, Conferences (L1)-, Competitions (L1)-Method of Promoting Safe Practice (L2)-Motivation (L1)-Communication (L1)-Role of Government Agencies and Private Consulting Agencies in Safety Training (L1)-Creating Awareness (L2)-, Awards, Celebrations, Safety Posters, Safety Displays, Safety Pledge, Safety Incentive Scheme, Safety Campaign (L2)-Domestic Safety and Training (L2).

UNIT–III	SAFETY AUDIT	9

Components of Safety Audit (L1)-Types of Audit (L2)-Audit Methodology (L2)-Non-Conformity Reporting (NCR) (L2)-Audit Checklist and Report (L2)-Review of Inspection (L2)-Remarks by Government Agencies, Consultants, Experts (L2)-Perusal of Accident and Safety Records, Formats (L2)-Implementation of Audit Indication (L2)-Liaison with Departments to Ensure Coordination (L2)-Checklist (L2)-Identification of Unsafe Acts of Workers and Unsafe Conditions in the Shop Floor (L2).

UNIT–IV	ACCIDENT INVESTIGATION AND REPORTING	9

Concept of an Accident (L1)-Reportable and Non-reportable Accidents (L1)-Reporting to Statutory Authorities (L2)-Principles of Accident Prevention (L2)-Accident Investigation and Analysis (L2)-Records for Accidents, Departmental Accident Reports, Documentation of Accidents (L2)-Unsafe Act

and Condition (L2)-Domino Sequence (L2)-Supervisory Role (L2)-Role of Safety Committee (L2)-Cost of Accident (L3).

UNIT – V	SAFETY PERFORMANCE MONITORING	9

ANSI (Z16.1) Recommended Practices for Compiling and Measuring Work Injury Experience (L1)-Permanent Total Disabilities(L2)-, Permanent Partial Disabilities(L2)-, Temporary Total Disabilities (L2)-Calculation of Accident Indices (L2)-Frequency Rate, Severity Rate, Frequency Severity Incidence, Incident Rate, Accident Rate, Safety "t" Score, Safety Activity Rate -Problems (L3) - Financial justification of hazard controls (L2).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: Upon completion of this course the students will be able to:		**BLOOM'S Taxonomy**
CO1	Summarize the various concepts and Techniques in the safety management.	L2 - Understand
CO2	Explain the safety education and training.	L2 - Understand
CO3	Organize a safety audit and prepare a report for the audit.	L3 - Apply
CO4	Develop an accident investigation report.	L3 - Apply
CO5	Examine the safety performance monitoring activities.	L4 - Analyze

REFERENCE BOOKS:

1.	"Accident Prevention Manual for Industrial Operations", N.S.C.Chicago, 13th Edition 2009.
2.	Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey,. 3 rd Edition 2000.
3.	Dan Petersen, "Techniques of Safety Management", McGraw-Hill Company, Tokyo, 1981.
4.	Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980
5.	John Ridley, "Safety at Work", Butterworth and Co., London, 1983
6.	Lees, F.P., "Loss Prevention in Process Industries" Butterworth publications, London, 2 nd edition, 1990.
7.	Relevant Indian Standards and Specifications, BIS, New Delhi. 8. "Safety and Good House Keeping", N.P.C., New Delhi, 1985.

VIDEO REFERENCES:

1.	https://www.youtube.com/watch?v=Pa0KfUwKIaU
2.	https://www.youtube.com/watch?v=VhOTDJVC8uM

WEB REFERENCES:

1.	https://www.osha.gov/safety-management/additional-resources-by-topic
2.	https://www.assp.org/education

ONLINE COURSES:

1.	https://onlinecourses.nptel.ac.in/noc22_mg55/preview
2.	https://onlinecourses.nptel.ac.in/noc20_mg43/preview

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		1		2	2	
CO2				2	3	
CO3	3	3	2	2	1	1
CO4	2	3	2	3	3	
CO5			3	3		2
Average	2.5	2.3	2.3	2.4	2.25	1.2
1–Low, 2 –Medium, 3–High.						

ME23IS302	ENVIRONMENTAL SAFETY	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

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

UNIT–I	AIR POLLUTION	9

Classification and properties of air pollutants (L1)-Pollution sources (L1)-Effects of air pollutants on human beings(L2), Animals, Plants, and Materials (L2)-Automobile pollution (L1)-Hazards of air pollution (L2)-Concept of clean coal combustion technology (L2)-Ultra violet radiation (L1), infrared radiation(L1), radiation from the sun (L1)-Hazards due to depletion of ozone (L2)-Deforestation (L2), ozone holes (L2), automobile exhausts, chemical factory stack emissions, CFC (L2).

UNIT–II	WATER POLLUTION	9

Classification of water pollutants (L1)-Health hazards (L2)-Sampling and analysis of water (L2)-Water treatment (L3)-Different industrial effluents and their treatment and disposal (L2)-Advanced wastewater treatment (L3)-Effluent quality standards and laws (L3)-Chemical industries, tannery, textile effluents (L2)-Common treatment (L2).

UNIT– III	HAZARDOUS WASTE MANAGEMENT	9

Hazardous waste management in India (L1)-Waste identification, characterization, and classification (L2)-Technological options for collection, treatment, and disposal of hazardous waste (L2)Selection charts for the treatment of different hazardous wastes (L2)-Methods of collection and disposal of solid wastes (L2)-Health hazards - (L2)-Toxic and radioactive wastes (L2)-Incineration and vitrification (L1)-Hazards due to bio-process(L1)-, dilution, standards, and restrictions (L1)-Recycling and reuse (L2).

UNIT – IV	ENVIRONMENTAL MEASUREMENT AND CONTROL	9

Sampling and analysis (L2)-Dust monitor (L2)-Gas analyzer(L1)-, particle size analyzer (L2)-Lux meter(L1)-, pH meter (L1)-Gas chromatograph (L1)-Atomic absorption spectrometer (L1)-Gravitational settling chambers(L1), cyclone separators(L1), scrubbers (L1)-Electrostatic precipitator(L1), bag filter(L1), maintenance (L2)-Control of gaseous emission by adsorption(L2), absorption(L2), and combustion methods (L2)-Pollution Control Board, laws (L1).

UNIT–V	POLLUTION CONTROL IN PROCESS INDUSTRIES	9
Pollution control in process industries (L2)-Cement, paper, petroleum, petroleum products, textile (L2)-Tanneries, thermal power plants (L2)-Dyeing and pigment industries (L2)-Eco-friendly energy (L2).		
Total : 45 PERIODS		

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: Upon completion of this course the students will be able to:		**BLOOM'S Taxonomy**
CO1	Illustrate and familiarize the basic concepts scope of environmental safety.	L2 - Understand
CO2	Interpret the standards of professional conduct that are published by professional safety organizations and/or certification bodies.	L2 - Understand
CO3	Explain the ways in which environmental health problems have arisen due to air and water pollution.	L2 - Understand
CO4	Examine the role of hazardous waste management and use of critical thinking to identify and assess environmental health risks.	L4 - Analyze
CO5	Apply concepts of emission measurement and design emission measurement devices.	L3 - Apply

REFERENCE BOOKS:

1.	E. C Wolfe, Race to Save to Save Planet, Wadsworth Publishing Co., Belmont, CA 2006.
2.	G. T Miller, Environmental Science: Working with the Earth, 11th Edition, Wadsworth Publishing Co., Belmont, CA, 2006
3.	M.J Hammer,., and M.J Hammer,., Jr., Water and Wastewater Technology, Pearson Prentice Hall, 2006
4.	Rao, CS, "Environmental pollution engineering:, Wiley Eastern Limited, New Delhi, 1 st January 2018.
5.	S. P. Mahajan, "Pollution control in process industries", Tata McGraw Hill Publishing Company, New Delhi, 2006.
6.	Varma and Braner, "Air pollution equipment", Springer Publishers, Second Edition.

VIDEO REFERENCES:

1.	https://www.youtube.com/watch?v=DAQapF-F4Vw&list=PL9108F6C4E154885A
2.	https://www.youtube.com/watch?v=5dukz1UOtkA&list=PLLy_2iUCG87BwOQUbS7WSdMVWHDXByk-w

WEB REFERENCES:

1.	https://tifac.org.in/index.php/programmes/activities/8-publication/145-industrial-air-pollution-control-technologies?showall=1
2.	https://www.unep.org/beatpollution/global-response-pollution

ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc23_ce14/preview
2.	https://onlinecourses.nptel.ac.in/noc23_ch72/preview

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		1	2			1
CO2		1	3	1		1
CO3		2	2		1	2
CO4	1	3	3	1	3	
CO5	1	1	3	3		
Average	1	1.6	2.75	1.66	2	1.33
1–Low, 2 –Medium, 3–High.						

ME23IS303	OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE	Version: 1.0				
Programme & Branch	M.E INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To apply the knowledge of physical hazards and its control measures in an Industrial Environment.
2	To distinguish the types of chemicals for its health hazard and provide suitable control methods
3	To categorize various types of hazards arising out of biological and ergonomical aspects in a process and able to provide suitable corrective actions
4	To implement the functions and activities of Occupational health services.
5	To illustrate the various physiological functions of our body and the test methods for periodical monitoring of health.

UNIT–I	PHYSICAL HAZARDS	9

General physics concepts (e.g., force, acceleration, velocity, momentum, and friction) (L1), Noise (L1), compensation aspects (L2), noise exposure regulation (L2), properties of sound (L3), occupational damage (L2), risk factors (L2), sound measuring instruments (L2), octave band analyzer (L3), noise networks (L3), noise surveys (L2), noise control program (L2), industrial audiometry (L2), hearing conservation programs (L2),Vibration (L3), types (L1), effects (L2), instruments (L1), surveying procedure (L2), permissible exposure limit (L2),Ionizing radiation (L3), types (L1), effects (L2), monitoring instruments (L1), control programs (L1), OSHA standard (L1),Non-ionizing radiations (L3), effects (L2), types (L1), radiation hazards (L2), microwaves and radio-waves (L2), lasers (L2), TLV (L3),Cold environments (L2), hypothermia (L2), wind chill index (L3), control measures (L2),Hot environments (L2), thermal comfort (L3), heat stress indices (L3), acclimatization (L2), estimation, and control (L2).

UNIT–II	CHEMICAL HAZARDS	9

General chemistry concepts (e.g., nomenclature, balancing chemical equations, chemical reactions, ideal gas law, and pH) (L1) -Recognition of chemical hazards: dust (L1), fumes, mist (L1), Vapour (L1), fog, gases (L1), types (L1), concentration (L1).Exposure vs. dose (L2), TLV (L3)Methods of Evaluation: process or operation description (L2), Field Survey (L2), Sampling methodology (L2), Industrial Hygiene calculations (L3), Comparison with OSHAS Standard (L2), Air Sampling instruments (L2), Types (L1), Measurement Procedures (L2), Instruments Procedures (L2), Gas and Vapour monitors (L2), dust sample collection devices (L2), personal sampling (L2), Methods of Control: Engineering Control (L2), Design maintenance considerations (L2), design specifications (L2), General Control Methods (L2), training, and education (L1).

UNIT– III	BIOLOGICAL AND ERGONOMICAL HAZARDS	9

Classification of Biohazardous agents (L2): examples, bacterial agents(L1)-, rickettsial and chlamydial agents(L1)-, viral agents, fungal, parasitic agents, infectious diseases -Protocol for blood borne pathogen control – Covid,SARS (L1) - Protocol for Air borne pathogen control-Biohazard control program (L2), employee health program (L2), laboratory safety program (L2), animal care and handling (L1), biological safety cabinets (L2), building design (L1)-Work Related Musculoskeletal Disorders : carpal tunnel syndrome CTS(L2), Tendon pain, disorders of the neck(L2), back injuries(L2).

UNIT – IV	OCCUPATIONAL HEALTH AND TOXICOLOGY	9

Concept and spectrum of health (L2),Functional units and activities of occupational health services (L2), pre-employment, and post-employment medical examinations (L2),Occupational related diseases (L2), levels of prevention of diseases (L2), Notifiable occupational diseases: such as silicosis(L2), asbestosis(L2), pneumoconiosis(L2), siderosis (L2), anthracosis (L2), aluminosis (L2), and anthrax, Lead-nickel(L2), chromium(L2), and manganese toxicity (L2), gas poisoning (such as CO, ammonia, coal, and dust, etc.) (L2), their effects and prevention (L2),Cardio pulmonary resuscitation (L2), audiometric tests (L2), eye tests (L2), vital function tests (L2),Industrial toxicology (L2): local(L2), systemic(L2), and chronic effects(L2), temporary and cumulative effects(L2), Mutagens, teratogens, and carcinogens(L1),carcinogens entry into human systems(L2).

UNIT–V	OCCUPATIONAL PHYSIOLOGY	9

Man as a system component (L2), allocation of functions (L2), efficiency (L2), occupational work capacity (L1),Aerobic and anaerobic work (L2), evaluation of physiological requirements of jobs (L5), parameters of measurements (L2),Categorization of job heaviness (L2), work organization (L2), stress (L1), strain (L1), fatigue (L1), rest pauses (L1), shift work (L1), personal hygiene (L2).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Apply the knowledge of physical hazards and its control measures in an Industrial Environment	L3 - Apply
CO2	Explain the types of chemicals for its health hazard and provide suitable control methods	L2 - Understand
CO3	Interpret various types of hazards arising out of biological and ergonomical aspects in a process and able to provide suitable corrective actions	L2 - Understand

CO4	Outline the functions and activities of Occupational health services.	L2 - Understand
CO5	Evaluate the various physiological functions of our body and the test methods for periodical monitoring of health.	L5 - Evaluate

REFERENCE BOOKS:	
1.	Benjamin O.Alli, Fundamental Principles of Occupational Health and Safety ILO 2008.
2.	Danuta Koradecka, Handbook of Occupational Health and Safety, CRC, 2010.
3.	E.J. McCornick, and M. S Sanders, Human Factors in Engineering and Design, Tata McGraw-Hill, 1992.
4.	Encyclopedia of "Occupational Health and Safety", Vol.I and II, published by International Labour Office, Geneva, 1985
5.	Hand book of "Occupational Safety and Health", National Safety Council, Chicago, 2002.
6.	Lawrence Slote , Handbook of occupational safety and health, Wiley, 2001.
7.	Louis J. Di Berardinis, Handbook of occupational safety and health Wiley, 1999.
8.	Interim guidance "COVID-19: Occupational health and safety for health workers", WHO & ILO,2021
VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=n7oUOUCIblg
2.	https://www.youtube.com/watch?v=LcGDEKGiOOo
WEB REFERENCES:	
1.	https://www.who.int/india/health-topics/occupational-health
2.	https://www.ilo.org/safework/countries/asia/india/lang--en/index.htm
ONLINE COURSES:	
1.	https://onlinecourses.swayam2.ac.in/nou23_es01/preview
2.	https://onlinecourses.swayam2.ac.in/aic20_ed03/preview

Mapping of COs with POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	1	3	2	2	
CO2	1	1	3	2	2	
CO3		1	3		2	1
CO4		1	3		1	1
CO5			2		1	1
Average	1	1	2.8	2	1.6	1
1–Low, 2 –Medium, 3–High.						

ME23IS304	INDUSTRIAL SAFETY, HEALTH AND ENVIRONMENT ACTS	Version: 1.0				
Programme & Branch	M.E INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

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

UNIT–I	FACTORIES ACT – 1948	9

Statutory authorities (L2) – inspecting staff, health, safety, provisions relating to hazardous processes, welfare (L2), working hours, employment of young persons (L2) – special provisions – penalties and procedures (L2) -Tamilnadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948 (L2). Forms, Registers and notices (L2) – Tamilnadu Safety Officer Rules 2005 (L2) - with updated Amendments (L2).

UNIT–II	ENVIRONMENT ACT – 1986	9

General powers of the central government (L2), prevention, control and abatement of environmental pollution (L2) -Biomedical waste (Management and handling Rules, 1989 (L2) -The noise pollution (Regulation and control) Rules, 2000 (L2) -The Batteries (Management and Handling Rules) 2001 (L2) - No Objection certificate from statutory authorities like pollution control board(L2). Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution (L2) - powers and functions of boards (L2) – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures (L2).

UNIT– III	MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES 1989 AND MAJOR ACCIDENT HAZARD CONTROL RULES AND AMENDMENT	9

Definitions – duties of authorities (L1)– responsibilities of occupier (L2) – notification of major accidents (L2) – information to be furnished (L2) – preparation of offsite and onsite plans (L2) – list of hazardous and toxic chemicals (L2) – safety reports – safety data sheets (L2). Major Accident Hazard Control Rules (L2). Hazardous Wastes (management, handling and Transboundary Movement) Rules 2016 (L2).

UNIT – IV	OTHER ACTS AND RULES	9

Indian Boiler (Amendments) Act 2007 (L2), static and mobile pressure vessel rules (SMPV) (L2), motor vehicle rules, The Mines and Minerals (Development & Regulation) Amendment Act 2015 (L2), workman compensation act, rules (L2) – electricity act and rules (L2) – hazardous wastes (management, handling and transboundary) rules, 2008 (L2) - the building and other construction workers act 1996 (L2)., Petroleum rules, Gas cylinder rules 2016 (L2), Explosives Act 1884 (L2) - Pesticides Act (L2) – E waste (management) rules 2016 (L2).

UNIT–V	INTERNATIONAL ACTS AND STANDARDS	9

Occupational Safety and Health act of USA (The Williames - Steiger Act of 1970) (L2) – Health and safety work act (HASAWA 1974, UK) L2– ISO 14001 – ISO 45001 (L2), European Safety and Health Legislations (L2), American Petroleum Institute (API) Standards (L2), Oil Industry Safety Directorate (OISD) Standards (L2), National Fire Protection Association (NFPA) Standards (L2), Atomic Energy Regulatory Board (AERB) (L2), American National Standards Institute(ANSI) (L2).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Interpret the requirements mentioned in factories act for the prevention of accidents.	L2 - Understand
CO2	List important legislations related to health, Safety and Environment act.	L1- Remember
CO3	Infer the manufacturing storage and import of hazardous chemical rule.	L2 - Understand
CO4	Summarize the statutory requirements for an Industry on registration, license and its renewal.	L2 - Understand
CO5	Develop an system of international act and standard.	L3- Apply

REFERENCE BOOKS:

1.	The Factories Act 1948, Madras Book Agency, Chennai, 2000
2.	The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
3.	Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt.Ltd.,New Delhi.
4.	Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
5.	The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
6.	The Mines Act 1952, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
7.	The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.

8.	Srinivasan S , "The Tamil Nadu Safety Officers Rules 2005" Madras Book Agency, Chennai, 28th Edition, 2017
VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=Nc3WJf8Pyx0
2.	https://www.youtube.com/watch?v=G8l6bzhfIDg
WEB REFERENCES:	
1.	https://www.indiacode.nic.in/handle/123456789/1530?sam_handle=123456789/1362
2.	https://dgfasli.gov.in/factories-act-1948
ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc23_mg98/preview
2.	https://onlinecourses.swayam2.ac.in/nou23_ge81/preview

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		2	3		2	
CO2	1	1	3		2	2
CO3	1	1	3		2	1
CO4		1	3		2	1
CO5		1	3		2	
Average	1	1.2	3		2	1.33
1–Low, 2 –Medium, 3–High.						

ME23IS305	FIRE ENGINEERING AND EXPLOSION CONTROL	Version: 1.0				
Programme & Branch	M.E INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To provide an in depth knowledge about the science of fire.
2	To understand the causes and effects of fire.
3	To know the various fire prevention systems and protective equipment's.
4	To understand the science of explosion and its prevention techniques.
5	To understand the various fire prevention techniques to be followed in a building.

UNIT–I	PHYSICS AND CHEMISTRY OF FIRE	9

Fire properties of solid (L1), liquid and gases (L2) - fire spread (L3)- toxicity of products of combustion (L3) - theory of combustion and explosion (L3)– vapour clouds (L2) -Combustible dust (L2)– flash fire (L2)– jet fires L3– pool fires (L1)– unconfined vapour cloud explosion (L3), shock waves (L3)- auto-ignition (L3)– boiling liquid expanding vapour explosion (L3) – case studies – Flixborough (L2), Mexico disaster (L2), Pasedena Texas (L2), Piper Alpha (L2), Peterborough (L2) and Bombay Victoria dock ship explosions (L2).

UNIT–II	FIRE PREVENTION AND PROTECTION	9

Sources of ignition (L2) – fire triangle (L2)– principles of fire extinguishing (L2)– active and passive fire protection systems (L2) – various classes of fires (L1) – A, B, C, D, E – types of fire extinguishers (L2) – fire stoppers (L2)– hydrant pipes (L2) – hoses – monitors (L2) – fire watchers (L2)– lay out of stand pipes (L2) – fire station (L2)-fire alarms and sirens (L2) – maintenance of fire trucks (L2)– foam generators (L2) – escape from fire rescue operations (L2) – fire drills (L3)– notice-first aid for burns (L3).

UNIT– III	INDUSTRIAL FIRE PROTECTION SYSTEMS	9

Sprinkler (L2)-hydrants (L2)-stand pipes (L2) – special fire suppression systems like deluge and emulsifier (L3), selection criteria of the above installations (L2), reliability (L3), maintenance (L2), evaluation and standards (L2) – alarm and detection systems (L2). Other suppression systems (L2) – CO2 system (L2), foam system (L2), dry chemical powder (DCP) system (L2), Halon system (L2)– need for halon replacement (L2) – smoke venting (L2). Portable extinguishers (L2) – flammable liquids (L2) – tank farms (L2)– indices of in flammability (L2)-firefighting systems (L3).

UNIT – IV	BUILDING FIRE SAFETY	9

Objectives of fire safe building design (L3), Fire load (L3), fire resistant material and fire testing (L3) – structural fire protection (L2) – structural integrity (L2)– concept of egress design (L3)- exists (L2)– width calculations (L4)- fire certificates (L4) – fire safety requirements for high rise buildings (L4)– snookers (L2).

UNIT–V	EXPLOSION PROTECTING SYSTEMS	9

Principles of explosion (L1)-detonation and blast waves (L3)-explosion parameters (L2) – Explosion Protection (L2), Containment (L2), Flame Arrestors (L2), isolation (L3), suppression (L2), venting (L2), explosion relief of large enclosure (L2)-explosion venting (L2)-inert gases (L2), plant for generation of inert gas (L2)-rupture disc in process vessels and lines explosion (L2), suppression system based on carbon dioxide (CO2) and halons (L3)-hazards in LPG L2, ammonia (NH3) (L3), sulphur dioxide (SO3) (L2), chlorine (CL2) (L2) etc.

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Explain the basic concepts of fire and explosion science.	L2 - Understand
CO2	Demonstrate the different source of ignition and their prevention techniques.	L2 - Understand
CO3	Illustrate the operation of various types of firefighting equipments.	L2 - Understand
CO4	Summarize the causes and prevention of explosion.	L2 - Understand
CO5	Apply explosion protection techniques and their significances to suit the industrial requirement.	L3 - Apply

REFERENCE BOOKS:

1.	"Accident Prevention manual for industrial operations" N.S.C., Chicago, 1982.
2.	"Davis Daniel et al, "Hand Book of fire technology"
3.	"Fire Prevention and firefighting", Loss prevention Association, India.
4.	Derek, James, "Fire Prevention Hand Book", Butter Worths and Company, London, 1986.
5.	Dinko Tuhtar, "Fire and explosion protection"
6.	Fire fighters hazardous materials reference book Fire Prevention in Factories", an Nostrand Rein Hold, New York, 1991.
7.	Gupta, R.S., "Hand Book of Fire Technology" Orient Longman, Bombay 1977.
8.	Relevant Indian Acts and rules, Government of India.

VIDEO REFERENCES:

1.	https://www.youtube.com/watch?v=j-XNzBUKOoE
2.	https://www.youtube.com/watch?v=XADuwFDOyz0&pp=ygUPaGF6YXJkIGFuYWx5c2lz

WEB REFERENCES:

1.	https://www.graphicproducts.com/articles/hazard-analysis-risk-assessment/
2.	https://www.aiche.org/ccps/introduction-hazard-identification-and-risk-analysis

ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc23_mg98/preview
2.	https://onlinecourses.swayam2.ac.in/nou23_ge81/preview

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		3				2
CO2			3		2	
CO3			2	3		
CO4		3			3	
CO5	2					2
Average	2	3	2.5	3	2.5	2
1–Low, 2 –Medium, 3–High.						

ME23RM201	RESEARCH METHODOLOGY AND IPR	Version: 1.0
(COMMON TO ALL BRANCHES)		

Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	2	1	0	3

Course Objectives:

1	Analyze the significance of research and formulate well-defined research questions.
2	Apply appropriate research methods and critically evaluate research articles.
3	Create well-structured research papers and utilize research tools proficiently.
4	Produce effective technical reports and deliver impactful presentations.
5	Understand forms of intellectual property and analyze their implications on technological research and international cooperation.

UNIT–I	CONCEPT OF RESEARCH	6+3

Meaning and Significance of Research(L2)-Skills, Habits and Attitudes for Research (L1)-Time Management (L3) -Status of Research in India (L2)-Why, How, and What a Research is? (L2)-Types and Process of Research (L2)-Outcome of Research (L2)-Sources of Research Problem (L2)-Characteristics of a Good Research Problem (L2)-Errors in Selecting a Research Problem (L2)-Importance of Keywords (L1)-Literature Collection - Analysis (L2)-Citation Study - Gap Analysis (L2)-Problem Formulation Techniques (L2).

UNIT–II	RESEARCH METHODS AND JOURNALS	6+3

Interdisciplinary Research (L2)-Need for Experimental Investigations (L2)-Data Collection Methods (L3)-Appropriate Choice of Algorithms / Methodologies / Methods (L2)-Measurement and Result Analysis (L3)-Investigation of Solutions for Research Problem (L2)-Interpretation (L2)-Research Limitations (L2)-Journals in Science/Engineering (L2)-Indexing and Impact factor of Journals (L3)-Citations(L2)- h Index (L2)- i10 Index (L2)-Journal Policies (L4)How to Read a Published Paper (L2)-Ethical Issues Related to Publishing(L3)- Plagiarism and Self-Plagiarism (L2).

UNIT– III	PAPER WRITING AND RESEARCH TOOLS	6+3

Types of Research Papers (L2)- Original Article/Review Paper/Short Communication/Case Study(L2)-When and Where to Publish? (L2) - Journal Selection Methods (L2)-Layout of a Research Paper (L2)-Guidelines for Submitting the Research Paper (L2)-Review Process - Addressing Reviewer Comments (L3)-Use of tools / Techniques for Research (L3)-Hands-on Training related to Reference Management Software - EndNote (L3)- Introduction to Origin, SPSS,etc (L2)-Software for Detection of Plagiarism (L2)

UNIT – IV	EFFECTIVE TECHNICAL THESIS WRITING/PRESENTATION	6+3

How to Write a Report(L1)- - Language and Style (L1)-Format of Project Report (L1) - Use of Quotations (L2)-Method of Transcription Special Elements (L3)-Title Page - Abstract - Table of Contents - Headings and Sub-Headings (L2)-Footnotes - Tables and Figures - Appendix - Bibliography etc. (L3)-Different Reference Formats (L2)-Presentation using PPTs (L2).

UNIT–V	NATURE OF INTELLECTUAL PROPERTY	6+3

Patents(L1) - Designs(L2) - Trade and Copyright (L2)- Process of Patenting and Development (L2)- Technological research(L2)- innovation(L2)- - patenting(L2)-Development International Scenario (L2)-International Cooperation on Intellectual Property (L2)-Procedure for Grants of Patents (L2).

Total : 30+15=45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Illustrate the importance and objectives of research in contributing to knowledge and solving real-world problems.	L2 - Understand
CO2	Experiment with data collection techniques, choosing fitting approaches to ensure sound research framework and methodology.	L3 - Apply
CO3	Utilize research & analytic tools for enhancing the research publication	L2 - Understand
CO4	Apply knowledge to produce presentations and technical reports that effectively communicate research findings.	L3 - Apply
CO5	Explain types of intellectual property and comprehend patenting as essential for safeguarding innovation and creativity.	L2 - Understand

REFERENCE BOOKS:

1.	Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2.	DePoy, Elizabeth, and Laura N. Gitlin, "Introduction to Research-E-Book: Understanding and Applying Multiple Strategies", Elsevier Health Sciences, 2015.
3.	Walliman, Nicholas, "Research Methods: The basics", Routledge, 2017
4.	Bettig Ronald V., "Copyrighting culture: The political economy of intellectual property", Routledge, 2018.
5.	The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

VIDEO REFERENCES:

1.	https://www.youtube.com/watch?v=1vf8ZvADxfY&list=PLLhSIFfDZcUWRlgiXMkd1rNeLSz1You4O
2.	https://www.youtube.com/watch?v=eIUaS51U05M&list=PLIEVEMAFhG4_JmLtWGr6G0PRGB13xapyC

WEB REFERENCES:	
1.	https://www.researchgate.net/
2.	https://www.wipo.int/about-ip/en/
ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc23_ge36/preview
2.	https://onlinecourses.nptel.ac.in/noc22_hs59/preview

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1			1
CO2	3	3		2		
CO3	3			3	1	
CO4	3	3				
CO5	2	2		2		1
Average	2.8	2.5	1	2.33	1	1
1–Low, 2 –Medium, 3–High.						

ME23IS306	INDUSTRIAL SAFETY AND SIMIULATION LABORATORY	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		2	0	0	2	1

Course Objectives:

1.	To provide opportunity to operate the equipment to acquire practical knowledge.
2.	To know the various PPEs and software.
3.	To carry out experiments to find out the environmental parameters.
4.	To assess the impact of sensitivity of chemicals on explosivity.
5.	To run the software to assess the consequence effects of major accidents. To learn the proper use of various kinds of physics laboratory equipment.

List of Experiments/Exercises and Skills ,

1.	**First aid concepts:** Study of Emergency Kits ,First – aid, road safety signs and signals -Safety Software Demo
2.	**Noise level measurement and analysis:** Measurement of sound pressure level in dB for impact, continuous and intermittent sources at various networks, peak and average values
3.	**Friction test:** Explosive materials like barium nitrate, gun powder, white powder, amorces composition etc.
4.	**Impact test:** Explosive materials like gun powder, white powder, amerce composition etc. Burst strength test of packaging materials like paper bags, corrugated cartoons, wood etc. Auto ignition temperature test.
5.	**Exhaust gas measurement and analysis:** Measurement of sox, nox, cox, hydrocarbons.
6.	**Environmental parameter measurement:** Dry bulb temperature, wet bulb temperature, determination of relative humidity, wind flow and effective corrective effective. Particle size measurement, Air sampling analysis.
7.	**Personal protective equipment:** Respiratory and non-respiratory-demonstration-self contained breathing apparatus. Safety helmet,Belt, hand gloves, goggles, safety shoe, gum boots, ankle shoes, face shield, nose mask, ear plug, ear muff, anti-static and conducting plastics/rubber materials, apron and leg guard.
8.	**Fire extinguishers and its operations:** Water Co_2,Foam,Carbon dioxide (Co_2),Dry chemical powder and, Currently amendment fire safety systems
9.	**Static charge testing:** on plastic, rubber, ferrous and non-ferrous materials

10.	**Illumination testing:** - by lux meter and photo meter.
11.	**Electrical safety:** Insulation resistance for motors and cables, Estimation of earth resistance Earth continuity test, Sensitivity test for MCB, ELCB, RCCB, MCCB
12.	**Software usage:** Dispersion modeling of various highly dangerous chemicals using aloha software Software usage - accident analysis ,safety audit packages, consequence analysis (CISCON), fire, explosion and toxicity index (FETI), reliability analysis for mechanical system and electrical System, failure mode analysis
13.	**Experiments on simulation to be added Discrete and continuous**

List of Equipment Required:

1.	Noise level meter	:	1 Number
2.	Friction tester	:	1 Number
3.	Impact tester	:	1 Number
4.	Exhaust gas analyzer	:	1 Number
5.	High volume sampler	:	1 Number
6.	PPE Set	:	1 Number
7.	Fire extinguisher set	:	1 Number
8.	Static charge tester	:	1 Number
9.	First aid kid	:	1 Number
10.	Lock out/Tag out	:	1 Number
11.	Software	:	ALOHA, CAMEO
12.	Extend SIM		
13.	System	:	12 Number

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
1.	Make use of various equipment's to bring out the safety environment in the industry.	L3 - Apply
2.	Measure the particulate matter and assess the impact of air pollution.	L5 - Evaluate
3.	Experiment with equipment's to find out various environmental parameters.	L3 - Apply
4.	Utilize the personal protective equipment in-dependently.	L3 - Apply
5.	Identify the various problems with the use of software and hence to predict the real situations on major accidents.	L3 - Apply
		TOTAL: 30 PERIODS

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		3				2
CO2			3		2	
CO3			2	3		
CO4		3			3	
CO5	2					2
Average	2	3	2.5	3	2.5	2
1–Low, 2 –Medium, 3–High.						

ME23PT801	TECHNICAL SEMINAR / CASE STUDY PRESENTATION	Version : 1.0
(COMMON TO ALL BRANCHES)		

Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		2	0	0	2	0

Course Objectives:

1	To encourage the students to study advanced engineering developments.
2	To prepare and present the technical and case study reports.

Method of Evaluation:

The students need to identify an area of interest or topic in their programme of study or case study and prepare a 5-10 page report and a presentation. Based on the report and presentation, the course is evaluated for 100 marks. Minimum 50 marks is essential to pass. In case a student fails, he has to make such presentation in the subsequent semesters. The evaluation guidelines will be issued by the Head of the Department before the commencements of the course. The objectives are improving literature searching capabilities, comprehension and ability to write reports and to make presentations. It is assessed in Internal Assessment mode only and no End Semester Examination.

Total : 30 PERIODS

C**ourse Outcomes:** At the end of this course, the students will demonstrate the ability to		**BLOOM'S Taxonomy**
CO1	Perform the review and present technological developments in their field.	L3 - Apply
CO2	Interpret the case study report and make a decision.	L3 - Apply

Mapping of COs with POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1		3				
CO2		3				
Average		3				
1–Low, 2 –Medium, 3–High.						

ME23IS307	SYSTEM SIMULATION AND HAZARD ANALYSIS	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		4	4	0	0	4

Course Objectives:

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

UNIT–I	SYSTEM SIMULATION AND HAZARD ANALYSIS	12

Introduction (L2), hazard (L2), hazard monitoring (L2)-risk issue (L2), group or societal risk (L2), individual risk (L2), voluntary and involuntary risk (L2), social benefits Vs technological risk (L2), approaches for establishing risk acceptance levels (L2), Risk estimation (L4). Hazard assessment (L3), procedure (L2), methodology; safety audit (L2), (checklist analysis L3), what-if analysis (L3), safety review (L3), preliminary hazard analysis(PHA) (L3), human error analysis (L3), hazard operability studies(HAZOP) L3), safety warning systems (L2).

UNIT–II	COMPUTER AIDED INSTRUMENTS	12

Applications of Advanced Equipments and Instruments (L1), Thermo Calorimetry (L1), Differential Scanning Calorimeter(DSC) (L1), Thermo Gravimetric Analyser(TGA) (L1), Accelerated Rate Calorimeter(ARC) (L1), Reactive Calorimeter(RC) (L1), Reaction System Screening Tool(RSST) (L1) - Principles of operations (L2), Controlling parameters (L2), Applications (L2), advantages (L1).

Explosive Testing (L2), Deflagration TestV (L2), Detonation Test (L2), Ignition Test (L2), Minimum ignition energy Test (L2), Sensitiveness Test (L2) , Impact Sensitiveness Test(BAM) (L2) and Friction Sensitiveness Test (BAM) (L2), Shock Sensitiveness Test (L2), Card Gap Test (L2).

UNIT– III	RISK ANALYSIS QUANTIFICATION AND SOFTWARES	12

Introduction to Discrete and Continuous Systems Simulation (L2)- Fault Tree Analysis and Event Tree Analysis (L2), Logic symbols (L1), methodology (L2), minimal cut set ranking (L2) - fire explosion and toxicity index (FETI) (L2) , various indices (L2) - Hazard analysis(HAZAN) (L2)- Failure Mode and Effect Analysis(FMEA) (L3)- Basic concepts of Reliability (L2)- Software on Risk analysis (L2), CISCON, FETI, HAMGARS modules on Heat radiation, Pool fire, Jet, Explosion (L1). Reliability softwares on FMEA for mechanical and electrical systems (L2).

UNIT – IV	EFFECTIVE TECHNICAL THESIS WRITING/PRESENTATION	12

Logics of consequences analysis (L1)- Estimation- Hazard identification based on the properties of chemicals (L2)- Chemical inventory analysis(L2)- identification of hazardous processes (L2)- Estimation of source term (L2), Gas or vapour release (L2), liquid release (L2), two phase release (L2)- Heat radiation effects (L1), BLEVE (L2), Pool fires and Jet fire (L1)- Gas/vapour dispersion (L2)- Explosion L1), UVCE and Flash fire (L1), Explosion effects and confined explosion L2)- Toxic effects (L1)- Plotting the damage distances on plot plant/layout (L2).

UNIT–V	CREDIBILITY OF RISK ASSESSMENT TECHNIQUES	12

Past accident analysis as information sources for Hazard analysis (L2) and consequences analysis of chemical accident, Mexico disaster, Flixborough, Bhopal , Seveso , Pasadena, Feyzin disaster (1966) , Port Hudson disaster (L2)- convey report (L2), hazard assessment of non-nuclear installation (L2)- Rijnmond report (L2), risk analysis of size potentially Hazardous Industrial objects (L2)- Rasmussen masses report L1), Reactor safety study of Nuclear power plant (L1).

Total : 60 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Identify risks in industrial setup using hazard monitoring and safety analysis techniques to enhance workplace safety.	L3 - Apply
CO2	Demonstrate proficiency with advanced instruments like DSC and TGA to control hazards ensure safe industrial processes.	L2- Understand
CO3	Apply risk quantification techniques to prioritizing and managing risks in an Industry.	L3 - Apply
CO4	Analyze and communicate consequences, hazards, and risks effectively to control those in an industrial setting.	L4- Analyze
CO5	Apply past accident insights and employ risk assessment techniques to strengthen current assessments.	L3 - Apply

REFERENCE BOOKS:

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

7	Methodologies for Risk and Safety Assessment in Chemical Process Industries, Common wealth Science Council, UK
8	Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety.
VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=j-XNzBUKOoE
2.	https://www.youtube.com/watch?v=XADuwFDOyz0&pp=ygUPaGF6YXJkIGFuYWx5c2lz
WEB REFERENCES:	
1.	https://www.graphicproducts.com/articles/hazard-analysis-risk-assessment/
2.	https://www.aiche.org/ccps/introduction-hazard-identification-and-risk-analysis
ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc23_mg98/preview?user_email=tdmech@kiot.ac.in
2.	https://onlinecourses.swayam2.ac.in/nou23_ge81/preview

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	2	2	3	3
CO2	3	3		3		
CO3	3		3		2	2
CO4	3	3	3	3	1	3
CO5	3	3	3	2	2	3
Average	3	3	2.75	2.5	2	2.75
1–Low, 2 –Medium, 3–High.						

ME23IS308	SAFETY IN PROCESS INDUSTRY	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1.	To provide knowledge on design features for a process industry and safety in the operation of various equipment in industry.
2.	To understand the various hazards and prevention in commissioning stage of industry.
3.	To recognize and identify the safe operation of equipment in process industry.
4.	To plan and trained for emergency planning in a process industry.
5.	To get fundamental knowledge on safe storage of chemicals.

UNIT–I	SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM DESIGN	9

Design process, conceptual design, and detail design (L2)-Assessment and inherently safer design (L3)-Chemical reactor types and batch reactors (L2)-Reaction hazard evaluation and assessment (L3)-Reactor safety and operating conditions (L2)-Unit operations and equipment(L2)-, utilities (L2)-Pressure system and pressure vessel design (L2)-Standards and codes(L1)-, pipe works(L2)-, and valves (L2)-Heat exchangers and process machinery (L2)-Overpressure protection and pressure relief devices (L2)-Fire relief, vacuum, and thermal relief (L2)-Flare and vent systems(L2)-, failures in pressure system (L2).

UNIT–II	PLANT COMMISSIONING AND INSPECTION	9

Commissioning phases and organization (L2)-Pre-commissioning documents (L2)-Process commissioning and problems (L3)-Post-commissioning documentation (L2)-Plant inspection(L2), pressure vessel(L2)-, pressure piping system (L2),-Non-destructive testing(L2)-, pressure testing(L2)-, leak testing(L2)-, and monitoring (L2)-Plant monitoring(L2)-, performance monitoring(L2)-, condition, vibration, corrosion, acoustic emission (L2)-Pipeline inspection (L2).

UNIT– III	PLANT OPERATIONS	9

Operating discipline and procedures (L2), -Emergency procedures and handover system (L2)--Start-up and shut down operation (L2)-Operation of fired heaters, driers (L2)-, and storage (L2), -Operating activities and hazards (L2)-Trip systems and exposure of personnel (L2).

UNIT – IV	PLANT MAINTENANCE, MODIFICATION, AND EMERGENCY PLANNING	9

Management of maintenance and hazards (L2)-Preparation for maintenance, isolation, purging, cleaning(L5)-Confined spaces and permit system (L2) Maintenance equipment and hot works (L2)-Tank cleaning(L2)-, repair(L2)-, demolition(L2)-, and online repairs (L2)-Maintenance of protective devices and controls of modifications (L2)-Emergency planning and disaster planning (L2), Onsite emergency and offsite emergency (L2).

UNIT–V	STORAGES	9

General consideration and petroleum product storages (L2)-Storage tanks and vessel (L2)-Storages layout(L2), segregation(L2)-, and separating distance (L2)-Secondary containment and venting and relief (L2)-Fire prevention and protection (L2)-LPG storages(L2)-, pressure storages(L2)-, and refrigerated storages (L2)-LNG storages(L2)-, hydrogen storages(L2)-, toxic storages (L2)-Chlorine storages(L2), ammonia storages(L2), other chemical storages (L2)-Underground storages and loading and unloading facilities (L2)-Drum and cylinder storage(L1)-, warehouse(L1)-, storage hazard assessment of LPG and LNG (L2).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Apply knowledge of pressure system design principles to improve safety in a process industry	Apply (L3)
CO2	Utilize pre-commissioning documents to verify the readiness of equipment and systems for operation.	Apply (L3)
CO3	Interpret the operating activities and potential hazards associated with various processes and equipment.	Understand(L2)
CO4	Utilize knowledge of maintenance management to strategize and execute maintenance activities safely and efficiently.	Apply (L3)
CO5	Apply knowledge of storage layout and segregation principles to design safe storage facilities.	Apply (L3)

REFERENCE BOOKS:

1.	"Accident Prevention Manual for Industrial Operations" NSC, Chicago, 1982.
2.	"Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety.
3.	Carbide of Calcium Rules, Government of India.
4.	Fawcett, H.h. and Wood, "Safety and Accident Prevention in Chemical Operations" Wiley inters, Second Edition.
5.	GREEN, A.E., "High Risk Safety Technology", John Wiley and Sons,. 1984.
6.	Lees, F.P. "Loss Prevention in Process Industries" Butterworths and Company, 1996.
7.	Petroleum Act and Rules, Government of India.

VIDEO REFERENCES:

1.	https://www.youtube.com/watch?v=Bq4hVTJpvKk&list=PLLy_2iUCG87D-DD3bgR-MT-k5MsYfkeTR
2.	https://www.youtube.com/watch?v=mA-zFdw_Hn8

WEB REFERENCES:	
1.	https://www.thechemicalsafetyassociation.org/
2.	https://www.ilo.org/global/topics/safety-and-health-at-work/areasofwork/chemical-safety-and-the-environment/lang--en/index.htm
ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc23_ch60/preview
2.	https://onlinecourses.nptel.ac.in/noc23_ch71/preview

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			3	1	2	
CO2		2	3		2	
CO3			3		2	
CO4		1	3		2	1
CO5		1	3		2	1
Average		1.33	3	1	2	1
1–Low, 2 –Medium, 3–High.						

ME23MC701	UNIVERSAL HUMAN VALUES AND ETHICS	Version: 1.0
(COMMON to ALL BRANCHES)		

Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	2	1	0	3

Course Objectives:

1.	To understand the concept of Universal Human Values.
2.	To discuss theoretical and practical implications of UHV.
3.	To relate the use of harmony in the family and society.
4.	To classify the harmony in the nature methods.
5.	To construct effective human values in personal and professional in life.

UNIT–I	INTRODUCTION TO VALUE EDUCATION	9

Right Understanding (L2), Relationship and Physical Facility (L2) (Holistic Development and the Role of Education) (L2) - Understanding Value Education (L2) - Sharing about Oneself (L2) - Self-exploration as the Process for Value Education (L2) - Continuous Happiness and Prosperity (L2) – the Basic Human Aspirations (L1) - Exploring Human Consciousness (L2) - Happiness and Prosperity (L2) – Current Scenario (L2) - Method to Fulfil the Basic Human Aspirations (L2) - Exploring Natural Acceptance (L2).

UNIT–II	HARMONY IN THE HUMAN BEING	9

Understanding Human being as the Co-existence of the Self and the Body (L2) - Distinguishing between the Needs of the Self and the Body (L2)- Exploring the difference of Needs of Self and Body (L2) - The Body as an Instrument of the Self (L2)- Understanding Harmony in the Self (L2)- Exploring Sources of Imagination in the Self(L2) - Harmony of the Self with the Body (L2)- Programme to ensure self-regulation and Health (L2)- Exploring Harmony of Self with the Body (L2).

UNIT– III	HARMONY IN THE FAMILY AND SOCIETY	9

Harmony in the Family (L2) – the Basic Unit of Human Interaction (L2) - 'Trust' – the Foundational Value in Relationship (L2) - Exploring the Feeling of Trust (L2) - 'Respect' – as the Right Evaluation (L3) - Exploring the Feeling of Respect (L2) - Other Feelings (L2), Justice in Human-to-Human Relationship (L2) - Understanding Harmony in the Society (L2)- Vision for the Universal Human Order (L3) - Exploring Systems to fulfil Human Goal (L2).

UNIT – IV	HARMONY IN THE NATURE/EXISTENCE	9

Understanding Harmony in the Nature (L2) – Interconnectedness (L2), self-regulation and Mutual Fulfilment among the Four Orders of Nature (L3) - Exploring the Four Orders of Nature (L2) - Realizing Existence as Co-existence at All Levels (L2) - The Holistic Perception of Harmony in Existence (L2) - Exploring Co-existence in Existence (L2).

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

Natural Acceptance of Human Values (L2) - Definitiveness of (Ethical) Human Conduct (L2) - Exploring Ethical Human Conduct (L2) - A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order (L2) - Competence in Professional Ethics (L2) - Exploring Humanistic Models in Education (L2) - Holistic Technologies, Production Systems and Management Models (L2) -Typical Case Studies (L2)- Strategies for Transition towards Value-based Life and Profession (L2) - Exploring Steps of Transition towards Universal Human Order (L2).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific Open Ended Problems will be solved during the class room teaching. Such problems can be given as Assignments and evaluated as IA only and not for the End semester Examinations.

	COURSE OUTCOMES: Upon completion of this course the students will be able to:	**BLOOM'S Taxonomy**
1.	Interpret the concepts of Universal Human Values.	L2 - Understand
2.	Summarize both theoretical and practical implications of Universal Human Values.	L2 - Understand
3.	Build the harmony in family and society.	L3 - Apply
4.	Practice harmony in all human existence.	L3 - Apply
5.	Relate human values in both personal and professional life.	L2- Understand

REFERENCE BOOKS:

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

VIDEO REFERENCES:	
1.	https://www.youtube.com/c/UniversalHumanValues
2.	https://www.youtube.com/watch?v=OgdNx0X923I
WEB REFERENCES:	
1.	Story of Stuff, http://www.storyofstuff.com
2.	https://fdp-si.aicte-india.org/UHVII.php
ONLINE COURSES:	
1.	https://nptel.ac.in/courses/109104068
2.	https://uhv.org.in/course

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1						
CO2					2	
CO3					2	
CO4					2	
CO5					1	
Average					1.75	
1–Low, 2 –Medium, 3–High.						

ME23PT802	RESEARCH PAPER REVIEW AND PRESENTATION	Version : 1.0				
(COMMON TO ALL BRANCHES)						
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		2	0	0	2	1

Course Objectives:

1.	To Learn scientific paper reading and wiring skills.
2.	To Learn the literature review and report wiring skills.
3.	To understand the research gap and formulation of the research problem.

The work involves the following steps:

1 Assigning the faculty supervisor
2 Selecting a subject, narrowing the subject into a topic
3 Stating an objective.
4 Collecting the relevant bibliography (atleast 20 research papers)
5 Studying the papers understanding the authors contributions and critically analysing each paper.
6 Preparing a 20-25 page literature review report
7 Preparing conclusions based on the literature review report.
8 Writing the Final Review Paper
9 Final Presentation to the review committee

Evaluation method:

A faculty supervisors will be assigned to each student. The supervisor will assign a topic to the student. The student has to review the literature pertaining to the topic, prepare a 20-25 page report and make a presentation. Minimum 20 research papers have to be reviewed out of which 60% have to be in the recent 05 years. The format for the research paper report and guidelines for assessment will be issued by the Head of the Department before the commencement of the course. The evaluation will be carried out based on the research paper report and presentation, and is evaluated for 100 marks. Minimum 50 marks is essential to pass. In case a student fails, he or she has to redo the course in the forthcoming semesters. Assessment is by Internal Assessment mode only no End Semester Examination.

Total : 30 PERIODS

COURSE OUTCOMES: Upon completion of this course the students will be able to:		BLOOM'S Taxonomy
CO1	Write a scientific review paper in their field	L3 - Apply
CO2	Identify the research gap and formulate the research problem	L3 - Apply

Mapping of COs with POs						
COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1		3				
CO2		3				
Average		3				
1–Low, 2 –Medium, 3–High.						

ME23PT803	INDUSTRIAL SAFETY ASSESSMENT – INTERNSHIP	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		4	0	0	4	2

Course Objectives:

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

GUIDELINES:

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

Total: 60 PERIODS

COURSE OUTCOMES: Upon completion of this course the students will be able to:		**BLOOM'S Taxonomy**
CO1	Demonstrate the application of safety protocols and measures in real industrial scenarios	L2 - Understand
CO2	Assess potential hazards , demonstrating proficiency in risk management within the workplace.	L5 - Evaluate

Mapping of COs with POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		3		2	1
CO2	2	3	3	1	2	1
Average	1.5	3	3	1	2	1
1–Low, 2 –Medium, 3–High.						

ME23IS401	PLANT LAYOUT AND MATERIAL HANDLING	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1.	To illustrate the boiler feed water requirements, related problems and water treatment techniques.
2.	To impart knowledge on the Preparation, properties and applications of engineering materials.
3.	To elaborate the Principles of electrochemical reactions, redox reactions in corrosion of materials and basics of polymers.
4.	To outline the principles and generation of energy in batteries and fuel cells.
5.	To introduce the concepts of industry safety precautions and its standards.

UNIT–I	PLANT LOCATION	9

Selection of plant locations (L3), territorial parameters(L2), considerations of land, water(L2), electricity(L2), location for waste treatment and disposal(L2), further expansions Safe location of chemical storages, LPG (L3), LNG, CNG, acetylene, ammonia, chlorine, explosives and propellants (L2).

UNIT–II	PLANT LAYOUT	9

Safe layout, equipment layout, safety system (L2), fire hydrant locations (L2), fire service rooms (L2), facilities for safe effluent disposal and treatment tanks (L3), site considerations (L2), approach roads, plant railway lines, security towers (L2).

Safe layout for process industries (L3), engineering industry (L2), construction sites (L2), pharmaceuticals (L2), pesticides, fertilizers(L2), refineries, food processing (L2), nuclear power stations, thermal power stations(L2), metal powders manufacturing(L3), fireworks and match works. (L2)

UNIT– III	WORKING CONDITIONS	9

Principles of good ventilation (L2), purpose, physiological and comfort level types (L2), local and exhaust ventilation(L3), hood and duct design(L3), air conditioning (L2), ventilation standards, application (L2).

Purpose of lighting, types (L2), advantages of good illumination (L2), glare and its effect (L2), lighting requirements for various work (L2), standards- Housekeeping (L2), principles of 5S (L2)).

UNIT – IV	MANUAL MATERIAL HANDLING AND LIFTING TACKLES	9

Preventing common injuries (L2), lifting by hand (L2), team lifting and carrying (L2), handling specific shape machines and other heavy objects – accessories for manual handling (L2), hand tools, jacks, hand trucks (L2), dollies and wheel barrows – storage of specific materials (L3) - problems with hazardous materials (L2), liquids, solids – storage and handling of cryogenic liquids (L2) - shipping and receiving (L2), stock picking (L2), dock boards, machine and tools (L2), steel strapping and sacking(L2), glass and nails (L2), pitch and glue (L2), boxes and cartons and car loading (L2) – personal protection (L2) – ergonomic considerations (L3).

Fiber rope, types, strength and working load inspection (L2), rope in use (L2), rope in storage (L2)- wire rope, construction (L2), design factors (L3), deterioration causes (L2), sheaves and drums, lubrication (L2), overloading (L2), rope fitting (L2), inspection and replacement (L2) – slings, types, method of attachment (L2), rated capacities (L2), alloy chain slings (L2), hooks and attachment (L2), inspection (L2).

UNIT–V	MECHANICAL MATERIAL HANDLING	9

Hoisting apparatus (L2), types - cranes, types, design and construction (L2), guards and limit devices (L2), signals, operating rules (L2), maintenance safety rules (L2), inspection and inspection checklist (L2)– conveyors, precautions, types (L2), applications (L2).

Powered industrial trucks (L2), requirements, operating principles (L2), operators selection and training and performance test (L2), inspection and maintenance (L2), electric trucks, gasoline operated trucks, LPG trucks (L2)– power elevators, types of drives, hoist way and machine room emergency procedure (L2), requirements for the handicapped, types (L2)- Escalator, safety devices and brakes, moving walks (L2)– man lifts, construction, brakes, inspection (L2).

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

Total : 45 PERIODS

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Identify suitable plant locations based on territorial parameters, land, water, electricity, and safety for hazardous materials.	L3 - Apply
CO2	Plan safe layouts for various industries, applying basic principles of plant layout.	L3 - Apply

CO3	Apply principles for adequate ventilation, lighting, and basic housekeeping to enhance working conditions in an industry	L3 - Apply
CO4	Apply safe manual handling practices, including lifting techniques and team lifting, to prevent common injuries.	L3 - Apply
CO5	Demonstrate safety proficiency in mechanical material handling within an industrial setting.	L2 – Understand

REFERENCE BOOKS:	
1.	"Accident prevention manual for industrial operations" N.S.C., Chicago, 1982.
2.	Alexandrov. M.P. "Material handling equipment" Mir Publishers, Moscow, 1981
3.	APPLE M. JAMES "Plant layout and material handling", 3rd edition, John Wiley and sons.
4.	"Encyclopedia of occupational safety and health", ILO Publication, 1985
VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=v-eltsixu4I
2.	https://www.youtube.com/watch?v=NDTyxwU7rXs
WEB REFERENCES:	
1.	https://industri.fatek.unpatti.ac.id/wp-content/uploads/2019/03/139-Plant-Layout-and-Materials-Handling-A.W.-Pemberton-Edisi-1-1974.pdf
2.	https://link.springer.com/book/10.1007/978-1-349-01786-7
ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc24_ce44/preview
2.	https://www.coursera.org/learn/battery-comparison-manufacturing-and-packaging

Mapping of COs with POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	2	1	2	
CO2	2	1	2		1	
CO3	1	2	1		2	
CO4	2		1	2		
CO5	2	1			1	
Average	1.8	1.25	1.5	1.5	1.5	
1–Low, 2 –Medium, 3–High.						

ME23IS402	WORK STUDY AND ERGONOMICS	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To enable students to recognize and interpret work procedures using safety and method study techniques.
2	To enable students to Understand the impact of ergonomics on machine foundations and work platforms from a perceptual standpoint.
3	To provide knowledge to students in selecting appropriate PPE based on workplace hazards with consideration to ergonomics
4	To impart knowledge on process and equipment design to reduce ergonomic hazards
5	To impart knowledge on factors influencing man-machine systems and recognize safety standards.

UNIT–I	WORK STUDY	9

Study of operations(L1) – work content(L1) – work procedure(L2) – breakdown(L1) – human factors(L2) – safety and method study(L3) – methods and movements at the workplace(L2) – substitution with latest devices(L2) – robotic concepts(L1) – applications in hazardous workplaces(L2) – productivity, quality and safety (PQS) (L3).

UNIT–II	ERGONOMICS	9

Definition(L1) – applications of ergonomic principles in the shop floor(L2) – work benches(L1) – seating arrangements (L2) – layout of electrical panels(L3).- switch gears (L1) – principles of motion economy(L2) – location of controls(L2) – display locations (L2) – machine foundations(L1) – work platforms(L1) , fatigue(L1) , physical and mental strain(L2) – incidents of accident (L2) – physiology of workers (L3).

UNIT– III	PERSONAL PROTECTION	9

Concepts of personal protective equipment(L2) – types(L1) – selection of PPE (L3).– invisible protective barriers (L2) – procurement, storage, inspection and testing(L2) – quality(L1) – standards(L1) – ergonomic considerations in personal protective equipment design(L2). .

UNIT – IV	PROCESS AND EQUIPMENT DESIGN	9

Process design (L2) – equipment (L1) – instrument(L1) – selection (L2) – concept modules(L2) – various machine tools(L1) - in- built safety(L2) – machine layout(L2) - machine guarding(L2) -safety devices and methods (L2) – selection, inspection, maintenance and safe usage(L3) – statutory provisions(L1) , operator training and supervision(L1) – hazards and prevention(L2). .

UNIT–V	MAN MACHINE SYSTEMS	9

Job and personal risk factors(L2) – standards(L1) -selection and training(L2) -body size and posture(L2) -body dimension (static/dynamic) (L2) – adjustment range (L2) – penalties (L2) – guide lines for safe design and postures (L1) – evaluation and methods of reducing posture strain. (L4)

Man-machine interface(L2) -controls (L1) -types of control(L1) -identification and selection(L2) -types of displays(L1) - compatibility and stereotypes of important operations(L2) -fatigue and vigilance(L2) -measurement characteristics and strategies for enhanced performance(L3).

Total : 45+15=60 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Identify the standard time for doing a task and to improve the productivity	L3
CO2	Apply the basic principles of Ergonomics to increase the safety, comfort and performance of a product and solve practical problems	L3
CO3	Analyze and Use Personal Protective Equipment appropriate for the tasks and the environment	L4
CO4	Develop a holistic approach towards process and Equipment design for the production of high-quality, cost-effective products	L3
CO5	Examine Man-machine relationship and Suggest the measures to reduce fatigue	L4

REFERENCE BOOKS:

1.	"Accident Prevention Manual for Industrial Operations", NSC Chicago, 1982.
2.	"Work Study", National Productivity Council, New Delhi, 1995.
3.	E.J.Mc Cormick and M.S.Sanders "Human Factors in Engineering and Design", TMH, New Delhi, 1982.
4.	Hunter, Gomas, "Engineering Design for Safety", Mc Graw Hill Inc., 1992.
5	Introduction to Work Study", ILO, Oxford and IBH Publishing company, Bombay, 1991".
6	Mundel, Motion and Time Study, 6th Edition, Allied Publishers, Madras, 1989.
7	W.Benjamin Neibal Motion and Time Study, 9th Edition 1993.

VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=KNFZXNWYVno
2.	https://www.youtube.com/watch?v=a6nfhQyMFUs&list=PLwdnzlV3ogoVIAGZ-hGh1JS0gHbHhclls
WEB REFERENCES:	
1.	https://www.physio-pedia.com/Ergonomics
2.	https://www.osha.gov/ergonomics
ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc20_de12/preview
2.	https://onlinecourses.nptel.ac.in/noc23_me124/preview

Mapping of COs with POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	3		2	1
CO2	1	2	3	1	3	1
CO3	1	2	3		2	2
CO4	2	2	3	2	3	
CO5	2	2	3	1	2	1
Average	1.4	2	3	1.33	2.4	1.2
1–Low, 2 –Medium, 3–High.						

ME23IS403	HUMAN FACTORS IN ENGINEERING	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1.	To learn the work procedure and understanding the relationships between the workers and working environments.
2.	To Study and understand personality differences, motivation, and the impact of job satisfaction on workplace behavior and safety.
3.	To study the applications of ergonomic principles and physiology of workers.
4.	To know the concepts of personal protective equipment and its usages.
5.	To create the knowledge in process and equipment design in safety aspects.

UNIT–I	ERGONOMICS AND ANATOMY	9

Introduction to ergonomics: The focus of ergonomics (L2)**,** ergonomics and its areas of application in the work system (L2), a brief history of ergonomics (L2), attempts to humanize work (L2), modern ergonomics (L2), future directions for ergonomics (L2)

Anatomy, Posture and Body Mechanics: Some basic body mechanics (L2), anatomy of the spine and pelvis related to posture (L2), posture stability and posture adaptation (L2), low back pain, risk factors for musculoskeletal disorders in the workplace (L2), behavioral aspects of posture (L2), effectiveness and cost effectiveness(L2), research directions (L2).

UNIT–II	HUMAN BEHAVIOR	9

Individual differences (L2), Factors contributing to personality (L2), Fitting the man to the job (L2), Influence of difference on safety (L2), Method of measuring characteristics, Accident Proneness (L2). Motivation, Complexity of Motivation(L2), Job satisfaction. Management theories of motivation (L2), Job enrichment theory (L2). Frustration and (L2) Conflicts, Reaction to frustration (L2), Emotion and Frustration. Attitudes (L2)- Determination of attitudes (L2), Changing attitudes Learning (L2), Principles of Learning, Forgetting, Motivational requirements (L2).

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

Designing for a population of users (L2), percentile, sources of human variability (L2), anthropometry and its uses in ergonomics (L2), principals of applied anthropometry in ergonomics (L2), application of anthropometry in design (L2), design for everyone (L2), anthropometry and personal space (L2), effectiveness and cost effectiveness (L2)

Fundamental aspects of standing and sitting (L2), an ergonomics approach to work station design (L2), design for standing workers (L2), design for seated workers (L2), work surface design (L2), visual display units (L2), guidelines for design of static work (L2)**,** effectiveness and cost effectiveness, research directions(L2).

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

Applications of human factors engineering (L2), man as a sensor (L2), man as information processor (L2), man as controller (L2) – Man vs Machine (L2).

Ergonomics interventions in Repetitive works (L2), handle design, key board design (L2)- measures for preventing in work related musculoskeletal disorders (WMSDs) (L2), reduction and controlling (L2), training Anatomy and biomechanics of manual handling (L2), prevention of manual handling injuries in the work place (L2), design of manual handling tasks (L2), carrying, postural stability (L2).

UNIT–V	**HUMAN SKILL AND PERFORMANCE AND DISPLAY, CONTROLS AND VIRTUAL ENVIRONMENTS**	**9**

A general information-processing model of the users (L2), cognitive system (L2), problem solving, effectiveness(L2).

Principles for the design of visual displays (L2)- auditory displays (L2)- design of controls (L2)- combining displays and controls (L2)- virtual (synthetic) environments (L2), research issues (L2).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific Open Ended Problems will be solved during the class room teaching. Such problems can be given as Assignments and evaluated as IA only and not for the End semester Examinations.

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Apply ergonomic principles to optimize work systems in an Industrial Setting	L3 – Apply
CO2	Interpret individual differences, factors contributing to personality, and their influence on safety in the workplace.	L2 – Understand
CO3	Apply an ergonomic approach to design workstations for standing and seated workers in an industrial environment	L3 – Apply
CO4	Apply ergonomics interventions to prevent work-related musculoskeletal disorders	L3 – Apply
CO5	Apply effective design strategies for virtual environments to ensure user-friendliness and efficient systems.	L3 – Apply

REFERENCE BOOKS:	
1.	Ergonomic design for organizational effectiveness, Michael O'Neill 1st Edition 1998.
2.	Human factors in engineering and design, MARK S.SANDERS 1992.
3.	Introduction to Ergonomics, R.S. Bridger, Taylor and Francis 3rd Edition 2008.
4.	The Ergonomics manual, Dan Mc Leod, Philip Jacobs and Nancy Larson
VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=G5PxuOEUWA8&list=PLFkR6k-V2SSr_J7OSXn_kyp6WSnyh9JP2
2.	https://www.youtube.com/watch?v=v19hAbLAWyk
WEB REFERENCES:	
1.	https://ocw.mit.edu/courses/16-400-human-factors-engineering-fall-2011/
2.	https://www.emergobyul.com/resources/intro-human-factors-engineering-medical-devices
ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc22_mg108/preview
2.	https://on.abdn.ac.uk/courses/human-factors-engineering/

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	2	3	2	3
CO2	1	2		1	1	2
CO3	2		2	2	1	
CO4	1	1		1	3	1
CO5	2	2	2	1		
Average	1.6	2	2	1.8	1.75	2
1–Low, 2 –Medium, 3–High.						

ME23IS404	MAINTENANCE ENGINEERING	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To enable the students with the basic concept of maintainability engineering.
2	To impart knowledge on various maintenance models, maintenance policies and replacement model of various equipment.
3	To provide knowledge on logistics for the effective utilization of existing resources and facilities availability of spares parts.
4	To impart knowledge on strategies on tools which improve maintenance quality
5	To provide of the six major losses and Overall Equipment Effectiveness (OEE) metrics to assess and improve equipment performance.

UNIT–I	MAINTENANCE CONCEPT	9

Maintenance definition(L1) – Need for maintenance (L2) – Maintenance objectives and challenges (L2) – Tero technology (L2) – Maintenance costs(L3) - Scope of maintenance department(L2).

UNIT–II	MAINTENANCE MODELS	9

Proactive/Reactive maintenance(L2) – Imperfect maintenance(L2) – Maintenance policies(L1) – PM versus b/d maintenance(L2) – PM schedule and product characteristics(L3) – Inspection models(L2) -Optimizing profit/downtime(L3) – Replacement decisions(L2).

UNIT– III	MAINTENANCE LOGISTICS	9

Human factors(L2) – Maintenance staffing: Learning curves(L2) – Simulation (L2) – Maintenance resource requirements: Optimal size of service facility (L2) – Optimal repair effort (L2) – Maintenance planning and scheduling (L3) – Spare parts planning(L3).

UNIT – IV	MAINTENANCE QUALITY	9

Maintenance excellence(L1) – Five Zero concept(L2) –FMECA(L3) –Root cause analysis (L3) – System effectiveness(L3) – Design for maintainability (L2) – Reliability Centered Maintenance(L2).

UNIT–V	TOTAL PRODUCTIVE MAINTENANCE	9

TPM features (L2) – Chronic and sporadic losses (L2) – Equipment defects(L1) – Six major losses (L2) – Overall Equipment Effectiveness(L3) – TPM pillars(L2) – Autonomous maintenance(L2) – TPM implementation(L2)

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS		
Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination		
COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Apply principles to identify and address specific challenges in maintenance operations.	L3 - Apply
CO2	Apply maintenance strategies for efficient equipment performance and operational effectiveness in industrial contexts.	L3 - Apply
CO3	Utilize logistics for efficient resource management and spare parts availability, enhancing operational efficiency in industry.	L3 - Apply
CO4	Apply maintenance techniques effectively to enhance system reliability in industrial settings.	L3 - Apply
CO5	Develop strategies to address and rectify equipment defects, reducing downtime and enhancing overall operational efficiency.	L3 - Apply
REFERENCE BOOKS:		
1.	Andrew K.S.Jardine & Albert H.C.Tsang, "Maintenance, Replacement and Reliability", Taylor and Francis, 2021.	
2.	Bikas Badhury & S.K.Basu, "Tero Technology: Reliability Engineering and Maintenance Management", Asian Books, 2003.	
3.	Seichi Nakajima, "Total Productive Maintenance", Productivity Press, 1998.	
VIDEO REFERENCES:		
1.	https://www.youtube.com/playlist?list=PLY6t1DVWyHmhlKQUctN-gG6Hd9h_3xi1W	
2.	https://www.youtube.com/watch?v=f58SW0Hwcf0	
WEB REFERENCES:		
1.	https://www.themaintenanceengineer.com/	
2.	https://maintenanceengineeringsolutions.com/	
ONLINE COURSES:		
1.	https://onlinecourses.swayam2.ac.in/nou21_me10/preview	
2.	https://www.futurelearn.com/courses/introduction-to-maintenance-engineering	

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		1	2	2	1	1
CO2	1	1	2	1	1	1
CO3		1		1	1	1
CO4	2	2	2	1	1	
CO5		1		1	1	1
Average	1.5	1.2	2	1.2	1	1
1–Low, 2 –Medium, 3–High.						

ME23IS405	OPTIMIZATION TECHNIQUES	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To provide knowledge on basics of optimization problems, design vectors, and parametric linear programming.
2	To enable students with decision analysis techniques, including decision trees and multi-objective optimization.
3	To provide knowledge on non-linear optimization, covering unconstrained and constrained optimization, KKT conditions, and quadratic programming.
4	To impart knowledge on non-traditional optimization, including classes P and NP, genetic algorithms, simulated annealing, and neural network-based optimization.
5	To impart knowledge on non-traditional optimization like particle swarm optimization, ant colony optimization, and optimization of fuzzy systems.

UNIT–I	INTRODUCTION TO OPTIMIZATION TECHNIQUES	9

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

UNIT–II	DECISION ANALYSIS	9

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

UNIT– III	NON-LINEAR OPTIMIZATION	9

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

UNIT – IV	NON-TRADITIONAL OPTIMIZATION -1	9

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

UNIT–V	NON-TRADITIONAL OPTIMIZATION -2	9

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

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: Upon completion of this course the students will be able to:		BLOOM'S Taxonomy
CO1	Apply optimization techniques to efficiently address real-world problems.	L3 - Apply
CO2	Apply optimization techniques to efficiently address real-world problems.	L3 - Apply
CO3	Solve non-linear optimization problems with appropriate methods.	L2 - Understand
CO4	Utilize non-traditional optimization techniques for complex problem-solving.	L2 - Understand
CO5	Implement nature-inspired algorithms for effective optimization in various applications.	L5 - Evaluate

REFERENCE BOOKS:	
1.	Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006
2.	Fredrick S.Hillier and G.J.Liberman, "Introduction to Operations Research", McGraw Hill Inc. 1995.
3.	Kalymanoy Deb, "Optimization for Engineering Design",PHI,2003
4.	Ravindran – Phillips –Solberg, "Operations Research – Principles and Practice", John Wiley India, 2006.
5.	Singiresu S.Rao, "Engineering optimization – Theory and practices", John Wiley and Sons, 1996.
VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=RYqBnxL8Lbg&list=PLq-Gm0yRYwTipntZ17qTnGYAkyOPuhNEf
2.	https://www.youtube.com/watch?v=wEdZLKMMZ8o&list=PLwdnzlV3ogoXKKb9nABDWYltTDgi37lYD
WEB REFERENCES:	
1.	https://www.researchgate.net/publication/271847368_Decision-Analysis_-_an_Overview
2.	https://www.researchgate.net/publication/283344536_Traditional_vs_non-traditional_optimization_tools
ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc21_me10/preview
2.	https://www.coursera.org/learn/discrete-optimization

Mapping of COs with POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	1		
CO2	1	1	1	1		
CO3	1	1		2		
CO4	2	1	1	1		
CO5	2	1	1	1		
Average	1.6	1.2	1	1.2		
1–Low, 2 –Medium, 3–High.						

ME23IS406	TRANSPORT SAFETY	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To impart knowledge on safe transportation of hazardous goods in every phase of the transportation.
2	To familiarize students with the safety on road in comprehension with motor vehicle act.
3	To enable students to have knowledge on improving road safety in relation with the driver.
4	To provide an in depth knowledge on External factures with influence the road safety
5	To enable student to have knowledge on vehicles operation and guidelines with relevance to an industrial environment

UNIT–I	TRANSPORTATION OF HAZARDOUS GOODS	9

Transport emergency card (TREM) (L1) – driver training-parking of tankers on the highways (L3) -speed of the vehicle (L2) – warning symbols (L2) – design of the tanker lorries (L2) -static electricity(L1) -responsibilities of driver (L2) – inspection and maintenance of vehicles(L3)-check list(L3)- loading and decanting procedures (L2)– communication(L3).

UNIT–II	ROAD TRANSPORT	9

Introduction (L1)– factors for improving safety on roads (L2) – causes of accidents due to drivers and pedestrians(L2) -design, selection, operation and maintenance of motor trucks(L3) -preventive maintenance(L2) - check lists(L3) -motor vehicles act (L1) – motor vehicle insurance (L2) and surveys(L3).

UNIT– III	DRIVER AND SAFETY	9

Driver safety programme (L2) – selection of drivers(L3) – driver training(L2) -tacho-graph(L2) -driving test(L2) -driver's responsibility(L2) -accident reporting and investigation procedures(L3) -fleet accident frequency(L2) -safe driving incentives(L2) -slogans in driver cabin(L1) -motor vehicle transport workers act(L1) - driver relaxation and rest pauses (L2) – speed and fuel conservation(L2) – emergency planning and Haz mat codes(L2).

UNIT – IV	ROAD SAFETY	9

Road alignment and gradient(L1) -reconnaissance(L2) -ruling gradient(L1) -maximum rise per k.m (L2).- factors influencing alignment like tractive resistance(L2), tractive force(L2), direct alignment(L2), vertical curves(L2) -breaking characteristics of vehicle(L2) -skidding-restriction of speeds(L2) -significance of speeds(L2) - Pavement conditions(L2) – Sight distance(L2) – Safety at intersections(L2) – Traffic control lines and guide posts(L2) -guard rails and barriers (L2) –

street lighting and illumination overloading(L2) -concentration of driver(L1).

Plant railway: Clearance(L2) -track(L2) -warning methods(L2) -loading and unloading(L2) -moving cars(L2) -safety practices(L3).

UNIT–V	SHOP FLOOR AND REPAIR SHOP SAFETY	9

Transport precautions (L2) -safety on manual(L2), mechanical handling equipment operations(L2) -safe driving(L3) - movement of cranes(L2) -conveyors etc (L2)., servicing and maintenance equipment(L2) -grease rack operation(L2) - wash rack operation(L2) -battery charging(L2) -gasoline handling(L2) -other safe practices(L3) -off the road motorized equipment(L2).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Apply emergency response techniques, including precise tanker parking and effective communication, in compliance with regulatory guidelines	L3 - Apply
CO2	Apply road safety principles, including accident prevention, truck design, Motor Vehicles Act, insurance, and safety surveys to improver transport safety	L3 - Apply
CO3	Develop an driver safety initiatives, focusing on selection, training, and innovative monitoring for performance improvement.	L2 - Understand
CO4	Demonstrate proficiency in improving road safety by using various methods to prevent accidents in an industry	L2 - Understand
CO5	Construct comprehensive safety measures, emphasizing transportation precautions, responsible equipment handling, and effective servicing	L3 - Apply

REFERENCE BOOKS:

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

VIDEO REFERENCES:

1.	https://www.nhtsa.gov/road-safety
2.	https://www.osha.gov/motor-vehicle-safety

WEB REFERENCES:	
1.	https://www.who.int/health-topics/road-safety
2.	https://morth.nic.in/motor-vehicles-act-1988
ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc23_ce29/preview
2.	https://www.nsc.org/safety-training/defensive-driving/nsc-defensive-driving-courses/online-defensive-driving-courses

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	2		3	1
CO2	1	2	3	1	3	2
CO3	2	2	3		3	2
CO4		2	3	1	3	2
CO5	1	2	3		2	
Average	1.5	2	2.8	1	2.8	1.75
1–Low, 2 –Medium, 3–High.						

ME23IS407	FIREWORKS SAFETY	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

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

UNIT–I	PROPERTIES OF FIREWORKS CHEMICALS	9

Fire properties (L2) – potassium nitrate (KN03) (L2), potassium chlorate (KCl03) (L2), barium nitrate (BaNO3) (L2), calcium nitrate (CaNO3) (L2), Sulphur (S) (L2), Phosphorous (P) (L2), antimony (Sb) (L2), Pyro Aluminum (A1) powder (L2) - Reactions-metal powders, Borax (L2), ammonia (NH3) (L2) – Strontium Nitrate(L2), Sodium Nitrate, Potassium per chloride (L2). Fire and explosion (L2), impact and friction sensitivity (L2).

UNIT–II	STATIC CHARGE AND DUST	9

Concept-prevention (L2) -earthing-copper plates-dress materials-static charge meter lightning, Causes (L2) - effects-hazards in fireworks factories-lightning arrestor: concept-installation (L2) - earth pit-maintenance (L2) - resistance-legal requirements-case studies (L2).

Dust: size-desirable (L2), non-respirable (L2) -biological barriers-hazards (L2) -personal protective equipment (L2) - pollution prevention (L2).

UNIT– III	PROCESS SAFETY	9

Safe-quantity L2, mixing-filling-fuse cutting L2– fuse fixing L2– finishing L2– drying at various stages-packing L2- storage-hand tools-materials, layout: building L2-distances- factories act L2 – explosive act and rules L2 – fire prevention and control L2 – risk related fireworks industries L2.

UNIT – IV	MATERIAL HANDLING AND TRANSPORTATION	9

Manual handling (L2) – wheel barrows-trucks-bullock carts (L2) -cycles-automobiles-fuse handling (L2) – paper caps handling (L2) -nitric acid handling in snake eggs manufacture (L2) -handling the mix in this factory (L2) -material movement(L2) –godown (L2) -waste pit(L2) .

Packing-magazine (L2) -design of vehicles for explosive transports loading into automobiles (L2) -

transport restrictions-case studies-overhead power lines (L2) -driver habits-intermediate parking (L2) -fire extinguishers (L2) - loose chemicals handling and transport (L2).

UNIT–V	WASTE CONTROL AND USER SAFETY	9

Concepts of wastes (L2) – Wastes in fireworks(L2) -Disposal-Spillages (L2) -storage of residues. Consumer anxiety(L2) - hazards in display (L1) -methods in other countries(L1) -fires (L2), burns and scalds(L2) -sales outlets (L2) -restrictions-role of fire service (L2).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific Open Ended Problems will be solved during the class room teaching. Such problems can be given as Assignments and evaluated as IA only and not for the End semester Examinations.

COURSE OUTCOMES: Upon completion of this course the students will be able to:		**BLOOM'S Taxonomy**
CO1	Classify the Properties of Fire work chemicals and its reactions to improve safety in an Fire work Storage area	L2 – Understand
CO2	Apply preventive measures to control static charge and dust explosion in fireworks factories.	L3 – Apply
CO3	Apply safety protocols in fireworks Industry, in adherence to regulations and minimizing risks in the industry.	L3 – Apply
CO4	Demonstrate proper techniques for manual handling emphasizing safety measures, in adherence to transport regulations.	L2 – Understand
CO5	Demonstrate knowledge of waste management concepts in fireworks industry to ensure safety.	L2 – Understand

REFERENCE BOOKS:

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

VIDEO REFERENCES:

1.	https://www.youtube.com/watch?v=v-eltsixu4I
2.	https://www.youtube.com/watch?v=2bDf7JSRvf8

WEB REFERENCES:	
1.	https://nptel.ac.in/courses/104103019
2.	https://www.brainkart.com/subject/Engineering-Chemistry_264/
ONLINE COURSES:	
1.	https://nptel.ac.in/courses/103103206
2.	https://www.coursera.org/learn/battery-comparison-manufacturing-and-packaging

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	2	2	
CO2	1	3	1	1	1	2
CO3	2	1	2		2	1
CO4	1	2	3			2
CO5	1	1	1	2	2	
Average	1.6	1.8	2	1.66	1.75	1.66
1–Low, 2 –Medium, 3–High.						

ME23IS408	NUCLEAR ENGINEERING AND SAFETY	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1.	To Understand about the nuclear energy and fission fusion process.
2.	To gain knowledge in reactor types, design considerations and their operational problems
3.	To know the current status of India in nuclear energy.
4.	To study about the nuclear reactors operational safety and their emergency preparedness.
5.	To understand the concepts in nuclear waste treatments and disposal practices.

UNIT–I	INTRODUCTION	9

Binding energy (L2) – fission process (L2) – radio activity (L2) – alpha, beta and gamma rays radioactive decay (L2) – decay schemes (L2) – effects of radiation (L2) – neutron interaction – cross section – reaction rate (L2) – neutron moderation (L2) – multiplication – scattering (L2) – collision – fast fission – resonance escape (L2) – thermal utilization (L2) – criticality(L2).

UNIT–II	REACTOR CONTROL	9

Control requirements in design considerations (L2) – means of control (L2) – control and shut down rods (L2) – their operation and operational problems (L2) – control rod worth (L2) – control instrumentation and monitoring (L2) – online central data processing system (L2).

UNIT–III	REACTOR TYPES	9

Boiling water reactors (L2) – radioactivity of steam system (L2) – direct cycle and dual cycle power plants (L2) - pressurized water reactors and pressurized heavy water reactors (L2) – fast breeder reactors and their role in power generation in the Indian context (L2) – conversion and breeding (L2) – doubling time (L2) – liquid metal coolants (L2) – nuclear power plants in India (L2).

UNIT–IV	SAFETY OF NUCLEAR REACTORS	9

Safety design principles (L2) – engineered safety features (L2) – site related factors (L2) – safety related systems (L2) – heat transport systems (L2) – reactor control and protection system (L2) – fire protection system (L2) – quality assurance in plant components (L2) – operational safety (L2) – safety regulation process (L2) – public awareness and emergency preparedness. Accident Case studies (L2) - Three Mile island and Chernobyl accident (L2).

UNIT–V	RADIATION CONTROL	9
Radiation shielding (L2) – radiation dose (L2) – dose measurements (L2) – units of exposure (L2) – exposure limits (L2) – barriers for control of radioactivity release (L2) – control of radiation exposure to plant personnel (L2) – health physics surveillance (L2) – waste management and disposal practices (L2) – environmental releases (L2).		
Total : 45 PERIODS		

OPEN ENDED PROBLEMS / QUESTIONS

Course specific Open Ended Problems will be solved during the class room teaching. Such problems can be given as Assignments and evaluated as IA only and not for the End semester Examinations.

Total : 45 PERIODS

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Describe nuclear concepts, use reactor principles, and explain radiation effects and neutron interactions at a basic level.	L2 – Understand
CO2	Make use of reactor control strategies, operate rods, and employ online data processing to ensure efficient control.	L3 – Apply
CO3	Outline the types of nuclear reactor with its functionality to improve the safety in different types of reactors	L2 – Understand
CO4	Utilize safety principles, engineer features, and critique case studies, emphasizing reactor design, assuring quality, and ensuring operational safety.	L3 – Apply
CO5	Apply radiation control techniques, design shielding solutions, and implement safety measures for effective control of plant personnel exposure.	L3 – Apply

REFERENCE BOOKS:

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

VIDEO REFERENCES:

Any relevant videos like

1.	https://www.youtube.com/watch?v=VEB7qnzOsv0
2.	https://www.youtube.com/watch?v=ciStnd9Y2ak

WEB REFERENCES:

1.	https://www.iaea.org/topics/nuclear-safety-and-security
2.	https://www.sciencedirect.com/topics/engineering/nuclear-safety

ONLINE COURSES:	
1.	https://www.iaea.org/services/education-and-training/online-learning
2.	https://www.mooc-list.com/tags/nuclear-safety

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	2	2	
CO2	1	3	2	1	1	3
CO3	2	1	1		2	1
CO4	2					2
CO5	1	1	1	3	2	
Average	1.8	1.75	1.75	2	2.25	2
1-Low, 2 -Medium, 3-High.						

ME23IS409	SAFETY IN CONSTRUCTION	Version: 1.0				
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

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

UNIT–I	ACCIDENTS CAUSES AND MANAGEMENT SYSTEMS	9

Problems impeding safety in construction industry (L2)- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accident (L2) – construction regulations, contractual clauses (L2) – Pre contract activates, preconstruction meeting (L3) - design aids for safe construction (L2) – permits to work (L2) – quality assurance in construction (L2) – compensation (L2) – Recording of accidents and safety measures (L3) – Education and training (L2).

UNIT–II	HAZARDS OF CONSTRUCTION AND PREVENTION	9

Excavations, basement and wide excavation, trenches, shafts (L2) – scaffolding , types, causes of accidents, scaffold inspection checklist (L3) – false work (L2) – erection of structural frame work, dismantling (L2) – tunneling (L2) – blasting, pre blast and post blast inspection (L3) – confined spaces (L3)– working on contaminated sites (L3) – work over water (L2) - road works (L2) – power plant constructions (L2) – construction of high rise buildings (L2).

UNIT– III	WORKING AT HEIGHTS	9

Fall protection in construction OSHA 3146 (L2) – OSHA requirement for working at heights, Safe access and egress (L2) – safe use of ladders (L2) - Scaffoldings , requirement for safe work platforms, stairways, gangways and ramps (L2) – fall prevention and fall protection , safety belts, safety nets, fall arrestors, controlled access zones, safety monitoring systems (L2) – working on fragile roofs, work permit systems, height pass (L2) – accident case studies (L3)

UNIT – IV	CONSTRUCTION MACHINERY	9

Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist (L2) - builder's hoist, winches, chain pulley blocks (L2) – use of conveyors (L2) - concrete mixers, concrete vibrators (L2) – 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 (L2) – use of conveyors and mobile cranes (L2) – manual handling (L2).

UNIT–V	SAFETY IN DEMOLITION WORK	9

Safety in demolition work, manual, mechanical, using explosive (L2) - keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition (L3) - Indian standard - trusses, girders and beams (L2) – first aid (L2) – fire hazards and preventing methods (L2) – interesting experiences at the construction site against the fire accidents (L3).

Total : 45 PERIODS

OPEN ENDED PROBLEMS /QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Interpret the problems impeding safety, causes of accidents and designing aids for safe construction.	L2- Understand
CO2	Identify and Solve the hazards during the construction of power plant, road works and high rise buildings.	L3- Apply
CO3	Relate the safety procedure for working at heights during construction.	L2- Understand
CO4	Demonstrate the selection, operation, inspection and testing of various construction machinery.	L2- Understand
CO5	Relate the construction regulations and Indian standards for construction and demolition work.	L2- Understand

REFERENCE BOOKS:

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

VIDEO REFERENCES:

1.	https://www.youtube.com/watch?v=7OWCat6bnUs
2.	https://www.youtube.com/watch?v=WSj4f_yqLy4

WEB REFERENCES:	
1.	https://www.osha.gov/construction
2.	https://www.assp.org/news-and-articles/five-important-issues-in-construction-safety
ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc21_ce16/preview
2.	https://alison.com/course/construction-safety-and-health

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	2	-	2	1
CO2	-	-	2	3	2	1
CO3	-	3	2	2	2	1
CO4	-	-	2	-	2	1
CO5	-	2	2	1	2	1
Average	2	2	2	2	2	1
1–Low, 2 –Medium, 3–High.						

ME23CP501 / ME23CP310	SECURITY PRACTICES	Version: 1.0

EXCEPT FOR M.E. COMPUTER SCIENCE AND ENGINEERING

Programme & Branch	M.E. COMPUTER SCIENCE AND ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1.	To learn the core fundamentals of system and web security concepts
2.	To have through understanding in the security concepts related to networks
3.	To deploy the security essentials in IT Sector
4.	To be exposed to the concepts of Cyber Security and cloud security
5.	To perform a detailed study of Privacy and Storage security and related Issues

UNIT -I	SYSTEM SECURITY	9

Model of network security (L1)– Security attacks, services and mechanisms(L1) – OSI security architecture A Cryptography primer- Intrusion detection system(L1)- Intrusion Prevention system (L1)- Security web applications- Case study: OWASP(L3) - Top 10 Web Application Security Risks(L2)

UNIT -II	NETWORK SECURITY	9

Internet Security - Intranet security(L2)- Local Area Network Security - Wireless Network Security(L2) - Wireless Sensor Network Security(L1)- Cellular Network Security - Mobile security(L2) - IOT security - Case Study - Kali Linux(L3).

UNIT –III	SECURITY MANAGEMENT	9

Information security essentials for IT Managers- Security Management System (L2)- Policy Driven System Management- IT Security(L3) - Online Identity and User Management System. Case study: Metasploit(L3)

UNIT –IV	CYBER SECURITY AND CLOUD SECURITY	9

Cyber Forensics- Disk Forensics – Network Forensics (L2)– Wireless Forensics – Database Forensics(L2) – Malware Forensics – Mobile Forensics (L2)– Email Forensics(L3)- Best security practices for automate Cloud infrastructure management (L2)– Establishing trust in IaaS, PaaS, and SaaS Cloud types. Case study: DVWA(L2)

UNIT –V	PRIVACY AND STORAGE SECURITY	9

Privacy on the Internet(L2) - Privacy Enhancing Technologies (L3)- Personal privacy Policies - Detection of Conflicts in security policies(L2)- privacy and security in environment monitoring systems(L2). Storage Area Network Security(L3) - Storage Area Network Security Devices (L2)- Risk management - Physical Security Essentials(L3)

Total: 45 PERIODS

OPEN ENDED PROBLEMS /QUESTIONS		
Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination		
COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOMS Taxonomy**
CO1	Understand the core fundamentals of system security	L3 – Apply
CO2	Apply the security concepts to wired and wireless networks	L3 – Apply
CO3	Implement and Manage the security essentials in IT Sector	L2 – Understand
CO4	Explain the concepts of Cyber Security and Cyber forensics	L3 – Apply
CO5	Be aware of Privacy and Storage security Issues	L3 – Apply
REFERENCEBOOKS:		
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.	Siani Pearson, George Yee "Privacy and Security for Cloud Computing" Computer Communications and Networks, Springer, 2013.	

Mapping of COs with POs						
Cos	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	2	1	1	2	1
CO2	2	1	3	1	1	2
CO3	-		2	3	3	3
CO4	2	2	1	2	1	3
CO5	1	-	1	1	2	3
Average	1.5	1.67	1.6	8	1.4	2.4
1–Low, 2 –Medium, 3–High.						

ME23CP502 / ME23CP401	CLOUD COMPUTING TECHNOLOGIES	Version: 1.0

EXCEPT FOR M.E. COMPUTER SCIENCE AND ENGINEERING

Programme & Branch	M.E. COMPUTER SCIENCE AND ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1.	To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
2.	To understand the architecture, infrastructure and delivery models of cloud computing
3.	To explore the roster of AWS services and illustrate the way to make applications in AWS
4.	To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
5.	To develop the cloud application using various programming model of Hadoop and Aneka

UNIT -I	VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE	9

Basics of Virtual Machines(L1) - Process Virtual Machines (L1)– System Virtual Machines (L1)– Emulation (L1)– Interpretation(L1) – Binary Translation - Taxonomy of Virtual Machines. Virtualization (L1)– Management Virtualization – Hardware Maximization – Architectures (L1)– Virtualization Management – Storage Virtualization (L1)– Network Virtualization- Implementation levels of virtualization(L1) – virtualization structure(L1) – virtualization of CPU, Memory and I/O devices (L1)– virtual clusters and Resource Management (L1)– Virtualization for data center automation(L1).

UNIT -II	CLOUD PLATFORM ARCHITECTURE	9

Cloud Computing: Definition, Characteristics (L1)- Cloud deployment models: public, private, hybrid, community(L1) – Categories of cloud computing(L1): Everything as a service: Infrastructure(L1), platform, software- A Generic Cloud Architecture Design(L1) – Layered cloud Architectural Development(L1) – Architectural Design Challenges(L1).

UNIT –III	AWS CLOUD PLATFORM - IAAS	9

Amazon Web Services: AWS Infrastructure(L1)- AWS API- AWS Management Console - Setting up AWS Storage (L1)- Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes(L1)- AWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy(L1), AWS Code Pipeline(L1), AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling(L1), AWS control Tower, Cloud Formation(L1), Cloud Trail, AWS License Manager(L1).

UNIT –IV	PAAS CLOUD PLATFORM	9

Windows Azure: Origin of Windows Azure(L1), Features, The Fabric Controller – First Cloud APP in Windows Azure(L1)- Service Model and Managing Services: Definition and Configuration(L1), Service runtime API(L1)- Windows Azure Developer Portal(L1)- Service Management API(L1)- Windows Azure Storage Characteristics-Storage Services(L1)- REST API(L1)- Blops(L1).

UNIT –V	PROGRAMMING MODEL	9

Introduction to Hadoop Framework - Map reduce, Input splitting, map and reduce functions, specifying input and output parameters(L1), configuring and running a job(L1) –Developing Map Reduce Applications(L1)- Design of Hadoop file system(L1) –Setting up Hadoop Cluster(L1)- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map(L1)-Reduce Programming in Aneka(L1).

Total:- 45 PERIODS

OPEN ENDED PROBLEMS /QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOMS Taxonomy**
CO1	Employ the concepts of virtualization in the cloud computing	L3 – Apply
CO2	Identify the architecture, infrastructure and delivery models of cloud computing	L3 – Apply
CO3	Develop the Cloud Application in AWS platform	L2 – Understand
CO4	Apply the concepts of Windows Azure to design Cloud Application	L3 – Apply
CO5	Develop services using various Cloud computing programming models	L3 – Apply

REFERENCEBOOKS:

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.	Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner"s Guide‖, McGraw-Hill Osborne Media, 2009.
6.	Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	-	-	2	2	1
CO2	2	3	1	-	-	1
CO3	3	-	3	-	1	3
CO4	-	-	-	2	-	3
CO5	3	2	-	-	-	-
Average	2.67	2.5	2	2	1.5	2
1–Low, 2 –Medium, 3–High.						

ME23CP503 / ME23CP415	BLOCKCHAIN TECHNOLOGIES	Version: 1.0

EXCEPT FOR M.E. COMPUTER SCIENCE AND ENGINEERING

Programme & Branch	M.E. COMPUTER SCIENCE AND ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1.	This course is intended to study the basics of Blockchain technology.
2.	During this course the learner will explore various aspects of Blockchain technology like application in various domains
3.	By implementing, learners will have idea about private and public Blockchain, and smart contract.

UNIT -I	INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN	9

Introduction to Blockchain(L1), Blockchain Technology Mechanisms & Networks (L1), Blockchain Origins, Objective of Blockchain, Blockchain Challenges(L1), Transactions and Blocks, P2P Systems(L1), Keys as Identity, Digital Signatures(L1), Hashing, and public key cryptosystems(L1), private vs. public Blockchain(L1).

UNIT -II	BITCOIN AND CRYPTOCURRENCY	9

Introduction to Bitcoin(L1), The Bitcoin Network, The Bitcoin Mining Process(L1), Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks(L1), Ethereum Virtual Machine (EVM), Merkle Tree(L2), Double-Spend Problem(L1), Blockchain and Digital Currency, Transactional Blocks(L1), Impact of Block chain Technology on Cryptocurrency(L1)

UNIT –III	INTRODUCTION TO ETHEREUM	9

Introduction to Ethereum(L1), Consensus Mechanisms(L1), Metamask Setup(L1), Ethereum Accounts(L1) , Transactions, Receiving Ethers, Smart Contracts(L1).

UNIT –IV	INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING	9

Introduction to Hyperledger(L1), Distributed Ledger Technology & its Challenges(L1), Hyperledger & Distributed Ledger Technology(L2), Hyperledger Fabric(L2), Hyperledger Composer(L2). Solidity (L2)-Language of Smart Contracts(L1), Installing Solidity & Ethereum Wallet(L1), Basics of Solidity(L1), Layout of a Solidity Source File & Structure of Smart Contracts(L2), General Value Types(L2).

UNIT –V	BLOCKCHAIN APPLICATIONS	9

Internet of Things(L2), Medical Record Management System(L3), Domain Name Service and Future of Blockchain(L3), Alt Coins(L2)

Total:- 45 PERIODS

OPEN ENDED PROBLEMS /QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: Upon completion of this course the students will be able to:		**BLOOMS Taxonomy**
CO1	Understand and explore the working of Block chain technology	L3 – Apply
CO2	Analyze the working of Smart Contracts	L3 – Apply
CO3	Understand and analyze the working of Hyper ledger	L2 – Understand
CO4	Apply the learning of solidity to build de-centralized apps on Ethereum	L3 – Apply
CO5	Develop applications on Block chain	L3 – Apply

REFERENCEBOOKS:

1.	Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018
2.	Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University Press, 2016
3.	Antonopoulos, Mastering Bitcoin, O'Reilly Publishing, 2014. .
4.	Antonopoulos and G. Wood, "Mastering Ethereum: Building Smart Contracts and Dapps", O'Reilly Publishing, 2018.
5.	D. Drescher, Blockchain Basics. Apress, 2017.

Mapping of COs with POs						
Cos	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	3	2	2	3
CO2	2	1	2	3	2	2
CO3	2	1	3	1	2	1
CO4	2	1	2	3	2	2
CO5		1		2		
Average	2	1	2.5	2.2	2	2
1–Low, 2 –Medium, 3–High.						

ME23CP504 / ME23CP414	DEEP LEARNING	Version: 1.0

EXCEPT FOR M.E. COMPUTER SCIENCE AND ENGINEERING

Programme & Branch	M.E. COMPUTER SCIENCE AND ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1.	Develop and Train Deep Neural Networks
2.	Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
3.	Build and train RNNs, work with NLP and Word Embeddings
4.	The internal structure of LSTM and GRU and the differences between them
5.	The Auto Encoders for Image Processing

UNIT–I	DEEP LEARNING CONCEPTS	6

Fundamentals about Deep Learning (L2) Perception Learning Algorithms (L2) Probabilistic modelling (L2) Early Neural Networks (L2) How Deep Learning different from Machine Learning (L2) Scalars (L2) Vectors (L2) Matrixes(L2) Higher Dimensional Tensor (L2). Manipulating Tensors (L2) Vector Data (L2) Time Series Data (L2) Image Data (L2) Video Data (L2)

UNIT–II	NEURAL NETWORKS	9

About Neural Networ (l2) Building Blocks of Neural Network (L2) Optimizers (L2) Activation Functions (L3) Loss Functions (L3) Data Pre-processing for neural networks()L3 Feature Engineering (L2) Overfitting and Underfitting(L2) Hyperparameters(L2)

UNIT– III	CONVOLUTIONAL NEURAL NETWORK	10

About CNN (L2) Linear Time Invariant (L2) Image Processing Filtering (L2) Building a convolutional neural network (L2) Input Layers (L2) Convolution Layers (L2) Pooling Layers (L2) Dense Layers(L2) Backpropagation Through the Convolutional Layer(L2) Filters and Feature Map (L2). Backpropagation Through the Pooling Layers(L3) Dropout Layers and Regularization(L3) Batch Normalization (L3) Various Activation Functions (L2) Various Optimizers(L2) LeNet (L2), AlexNet(L2), VGG16 (L2), ResNet (L2) Transfer Learning with Image Data(L3) Transfer Learning using Inception Oxford VGG Model(L3), Google Inception Model(L3), Microsoft ResNet Model(L2). R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO(L2)

UNIT – IV	NATURAL LANGUAGE PROCESSING USING RNN	10

About NLP & its Toolkits(L2) Language Modeling(L2) Vector Space Model (VSM)(L2) Continuous Bag of Words (CBOW) (L2) Skip-Gram Model for Word Embedding(L3) Part of Speech (PoS) Global Co-occurrence Statistics–based Word Vectors (L3). Transfer Learning (L2) Word2Vec(L2) Global Vectors for Word Representation GloVe (L3) Backpropagation Through Time (L2) Bidirectional RNNs (BRNN)(L2) . Long Short Term Memory (LSTM)(L2) Bi-directional LSTM(L2) Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU(L2)

UNIT–V	DEEP REINFORCEMENT & UNSUPERVISED LEARNING	10

About Deep Reinforcement Learning(L2) Q-Learning(L2) Deep Q-Network (DQN)(L2). Policy Gradient Methods(L2). Actor-Critic Algorithm(L3) About Autoencoding(L2) Convolutional Auto Encoding(L2) Variational Auto Encoding(L3) Generative Adversarial Networks (L2) Autoencoders for Feature Extraction(L2) Auto Encoders for Classification (L3). Denoising Autoencoders(L2) Sparse Autoencoders(L2)

TOTAL : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific Open Ended Problems will be solved during the classroom teaching. Such problems can be given as Assignments and evaluated as Internal Assessment (IA) only and not for the End semester Examinations.

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Feature Extraction from Image and Video Data	L2 - Understand
CO2	Implement Image Segmentation and Instance Segmentation in Images	L3 - Apply
CO3	Implement image recognition and image classification using a pretrained network (Transfer Learning)	L3 - Apply
CO4	Traffic Information analysis using Twitter Data.	L3 - Apply
CO5	Autoencoder for Classification & Feature Extraction.	L3 - Apply

REFERENCE BOOKS:

1.	Josh Patterson and Adam Gibson," Deep Learning A Practitioner's Approach", O'Reilly Media, Inc.2017
2.	Jojo Moolayil," Learn Keras for Deep Neural Networks", Apress,2018
3.	Vinita Silaparasetty," Deep Learning Projects Using TensorFlow 2", Apress, 2020
4.	François Chollet," Deep Learning with Python", Manning Shelter Island,2017
5.	Santanu Pattanayak," Pro Deep Learning with TensorFlow", Apress,2017

VIDEO REFERENCES:	
1.	https://onlinecourses.nptel.ac.in/noc20_cs62/preview
2.	https://onlinecourses.nptel.ac.in/noc20_cs50/preview
WEB REFERENCES:	
1.	https://www.kaggle.com/learn/intro-to-deep-learning
2.	https://www.datacamp.com/tutorial/tutorial-deep-learning-tutorial
ONLINE COURSES:	
1.	https://www.udemy.com/course/deeplearning
2.	https://in.mathworks.com/solutions/deep-learning

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2		3	3	3
CO2	2	2	2	3	3	2
CO3	2	2	2	3	2	3
CO4	2	2	1	3	3	3
CO5	2	2		3	2	2
Average	2	2	1.67	3	2.6	2.6
1–Low, 2 –Medium, 3–High.						

ME23CP505	DESIGN THINKING	Version: 1.0
EXCEPT FOR M.E. COMPUTER SCIENCE AND ENGINEERING		

Programme & Branch	M.E. COMPUTER SCIENCE AND ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1.	To provide a sound knowledge in UI & UX
2.	To understand the need for UI and UX
3.	Research Methods used in Design
4.	Tools used in UI & UX
5.	Creating a wireframe and prototype

UNIT–I	UX LIFECYCLE TEMPLATE	8

Introduction(L1) A UX process lifecycle template (L2) Choosing a process instance for your project (L2). The system complexity space (L2) Meet the user interface team (L2) Scope of UX presence within the team (L2) More about UX lifecycles(L2) Business Strategy (L2) Value Innovation (L2) Validated User Research (L2) Killer UX Design (L2) The Blockbuster Value Proposition(L2) What Is a Value Proposition? (L2)

UNIT–II	CONTEXTUAL INQUIRY	10

The system concept statement (L2) User work activity data gathering (L3) Look for emotional aspects of work practice (L3) Abridged contextual inquiry process (L3) Data-driven vs. model-driven inquiry(L2) Organizing concepts: work roles and flow model(L2) Creating and managing work activity notes (L3) Constructing your work activity affinity diagram (WAAD) (L3). Abridged contextual analysis process (L3) History of affinity diagrams(L2)

UNIT– III	DESIGN THINKING, IDEATION, AND SKETCHING	9

Design-informing models: second span of the bridge(L2) Some general "how to" suggestions(L2) A New example domain: slideshow presentations (L3) User models (L2) Usage models(L2) Work environment models(L2) Barrier summaries(L2) Model consolidation(L3) Protecting your sources(L2) Abridged methods for design-informing models extraction(L3) Design paradigms(L2) Design thinking(L2) Design perspectives(L2) User personas(L3) Ideation(L3) Sketching(L3).

UNIT – IV	UX GOALS, METRICS, AND TARGETS	8

Introduction (L1) UX goals (L2) UX target tables(L2) Work roles (L2) user classes(L2) and UX goals(L2) UX measures (L2) Measuring instruments. UX metric(L3) Baseline level(L3) Target level(L3) Setting levels(L3) Observed results(L2) Practical tips and cautions for creating UX targets(L3) How UX targets help manage the user experience engineering process(L2).

UNIT–V	ANALYSING USER EXPERIENCE	10

Sharpening Your Thinking Tools (L2) UX Research and Strength of Evidence (L2) Agile Personas(L2) How to Prioritize Usability Problems(L2). Creating Insights(L2), Hypotheses and Testable Design Ideas(L2). How to Manage Design Projects with User Experience Metrics(L2) Two Measures that Will Justify Any Design Change(L2). Evangelizing UX Research(L2). How to Create a User Journey Map(L3). Generating Solutions to Usability Problems(L3). Building UX Research into the Design Studio Methodology(L3). Dealing with Common objections to UX Research(L3). The User Experience Debrief Meeting(L3). Creating a User Experience Dashboard(L3).

TOTAL : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific Open Ended Problems will be solved during the classroom teaching. Such problems can be given as Assignments and evaluated as Internal Assessment (IA) only and not for the End semester Examinations.

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Build UI for user Applications.	L2 - Understand
CO2	Use the UI Interaction behaviors and principles	L3 - Apply
CO3	Evaluate UX design of any product or application.	L3 - Apply
CO4	Demonstrate UX Skills in product development.	L3 - Apply
CO5	Implement Sketching principles.	L3 - Apply

REFERENCE BOOKS:

1.	Westley Knight," UX for Developers: How to Integrate User-Centered Design Principles Into Your Day-toDay Development Work", Apress, 2018
2.	Rex Hartson, Pardha Pyla. Morgan Kaufmann," The UX Book: Process and Guidelines for Ensuring a Quality User Experience", 2012
3.	Edward Stull," UX Fundamentals for Non-UX Professionals: User Experience Principles for Managers, Writers, Designers, and Developers". Apress, 2018
4.	Gothelf, Jeff, Seiden, and Josh," Lean UX: Designing Great Products with Agile Team", O'Reilly Media, 2016
5.	Ben Coleman, and Dan Goodwin," Designing UX: Prototyping: Because Modern Design is Never Static", SitePoint, 2017

VIDEO REFERENCES:	
1.	https://onlinecourses.nptel.ac.in/noc22_mg32/preview
2.	https://elearn.nptel.ac.in/shop/iit-workshops/completed/introduction-to-design-thinking-its-creative-tools/
WEB REFERENCES:	
1.	https://www.ibm.com/design/thinking/
2.	https://designthinking.ideo.com/
ONLINE COURSES:	
1.	https://www.edx.org/learn/design-thinking
2.	https://www.udemy.com/topic/design-thinking/

Mapping of COs with POs						
COs	**Pos**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	1	1		
CO2	2	2	1	1		
CO3	2	2	1	1		
CO4	2	2	1	1		
CO5	2	2	1	1		
Average	2	2	1	1		
1–Low, 2 –Medium, 3–High.						

ME23CP506	PRINCIPLES OF MULTIMEDIA	Version: 1.0

EXCEPT FOR M.E. COMPUTER SCIENCE AND ENGINEERING

Programme & Branch	M.E. COMPUTER SCIENCE AND ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To get familiarity with gamut of multimedia and its significance
2	To acquire knowledge in multimedia components
3	To acquire knowledge about multimedia tools and authoring
4	To acquire knowledge in the development of multimedia applications
5	To explore the latest trends and technologies in multimedia

UNIT–I	INTRODUCTION	9

Introduction to Multimedia (L2) – Characteristics of Multimedia Presentation (L2) – Multimedia Components (L2) – Promotion of Multimedia Based Components (L2) – Digital Representation (L2) – Media and Data Streams (L2) – Multimedia Architecture (L2) – Multimedia Documents (L2) , Multimedia Tasks and Concerns (L2), Production (L2), sharing and distribution (L2), Hypermedia (L2), WWW and Internet (L2), Authoring (L2), Multimedia over wireless and mobile networks(L2)

Suggested Activities:

1. Flipped classroom on media Components (L3).
2. External learning – Interactive presentation (L3).

Suggested Evaluation Methods:

1. Tutorial – Handling media components
2. Quizzes on different types of data presentation.

UNIT–II	ELEMENTS OF MULTIMEDIA	9

Text-Types (L2), Font, Unicode Standard, File Formats (L2), Graphics and Image data representations (L2) – data types, file formats, color models(L2); video – color models in video (L2), analog video (L2), digital video, file formats, video display interfaces (L2), 3D video and TV: Audio – Digitization (L2), SNR, SQNR, quantization, audio quality, file formats, MIDI (L2); Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation (L2)

Suggested Activities:

1. Flipped classroom on different file formats of various media elements (L3).
2. External learning – Adobe after effects, Adobe Media Encoder, Adobe Audition(L3).

Suggested Evaluation Methods:

1. Demonstration on after effects animations.
2. Quizzes on file formats and color models

UNIT– III	MULTIMEDIA TOOLS	9

Authoring Tools (L2) – Features and Types (L2) – Card and Page Based Tools(L2) – Icon and Object Based Tools (L2) – Time Based Tools (L2) – Cross Platform Authoring To(L2)ols – Editing Tools (L2)– Painting and Drawing Tools (L2) – 3D Modeling and Animation Tools (L2) – Image Editing Tools (L2)– Sound Editing Tools (L2)– Digital Movie Tools (L2).

Suggested Activities:

1. Flipped classroom on multimedia tools (L3).
2. External learning – Comparison of various authoring tools (L3).

Suggested Evaluation Methods:

1. Tutorial – Audio editing tool.
2. Quizzes on animation tools.

UNIT – IV	MULTIMEDIA SYSTEMS	9

Compression Types and Techniques: CODEC (L2), Text Compression: GIF Coding Standards, JPEG standard (L2) – JPEG 2000 (L2), basic audio compression (L2) – ADPCM, MPEG Psychoacoustics (L2), basic Video compression techniques (L2) – MPEG, H.26X – Multimedia Database System (L2) – User Interfaces – OS Multimedia Support (L2) – Hardware Support (L2)– Real Time Protocols (L2) – Play Back Architectures (L2) – Synchronization (L2) – Document Architecture (L2) – Hypermedia Concepts: Hypermedia Design – Digital Copyrights, Content analysis(L2).

Suggested Activities:

1. Flipped classroom on concepts of multimedia hardware architectures(L3).
2. External learning – Digital repositories and hypermedia design (L3).

Suggested Evaluation Methods:

1. Quizzes on multimedia hardware and compression techniques.
2. Tutorial – Hypermedia design.

UNIT–V	MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS	9

ADDIE Model (L2)– Conceptualization – Content Collection – Storyboard–Script Authoring Metaphors (L2) – Testing – Report Writing – Documentation (L2). Multimedia for the web and mobile platforms(L2) Virtual Reality, Internet multimedia content distribution (L2), Multimedia Information sharing (L2) – social media sharing, cloud computing for multimedia services,

interactive cloud gaming(L2). Multimedia information retrieval (L2).

Suggested Activities:

1. External learning – Game consoles (L3).
2. External learning – VRML scripting languages (L3).

Suggested Evaluation Methods:

1. Demonstration of simple interactive games.
2. Tutorial – Simple VRML program.

TOTAL : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific Open Ended Problems will be solved during the classroom teaching. Such problems can be given as Assignments and evaluated as Internal Assessment (IA) only and not for the End semester Examinations.

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Handle the multimedia elements effectively.	L3 - Apply
CO2	Articulate the concepts and techniques used in multimedia applications	L3 - Apply
CO3	Develop effective strategies to deliver Quality of Experience in multimedia applications	L3 - Apply
CO4	Design and implement algorithms and techniques applied to multimedia objects.	L3 - Apply
CO5	Design and develop multimedia applications following software engineering models.	L3 - Apply

REFERENCE BOOKS:

1.	Li, Ze-Nian, Drew, Mark, Liu, Jiangchuan, "Fundamentals of Multimedia", Springer, Third Edition, 2021
2.	Prabhat K.Andleigh, Kiran Thakrar, "MULTIMEDIA SYSTEMS DESIGN", Pearson Education, 2015
3.	Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press, 2018. (digital book)
4.	Ranjan Parekh, "Principles of Multimedia", Second Edition, McGraw-Hill Education, 2017
5.	Santanu Pattanayak," Pro Deep Learning with TensorFlow", Apress,2017

VIDEO REFERENCES:	
1.	https://nptel.ac.in/courses/117105083
2.	https://www.classcentral.com/course/swayam-cit-003-web-based-technologies-and-multimedia-applications-20229
WEB REFERENCES:	
1.	https://ctl.wiley.com/principles-of-multimedia-learning/
2.	https://pressbooks.pub/elearning2020/chapter/a-quick-overview-of-the-multimedia-principle/
ONLINE COURSES:	
1.	https://www.skillshare.com/browse/multimedia
2.	https://leverageedu.com/blog/multimedia-courses/

Mapping of COs with POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1				1	3	2
CO2				1	3	2
CO3				1	3	2
CO4				1	3	2
CO5				1	3	2
Average				1	3	2

1–Low, 2 –Medium, 3–High.

ME23IS501 / ME23IS302	ENVIRONMENTAL SAFETY	Version: 1.0
(EXCEPT FOR M.E. INDUSTRIAL SAFETY ENGINEERING)		

Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

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

UNIT–I	AIR POLLUTION	9

Classification and properties of air pollutants (L1)-Pollution sources (L1)-Effects of air pollutants on human beings(L2), Animals, Plants, and Materials (L2)-Automobile pollution (L1)-Hazards of air pollution (L2)-Concept of clean coal combustion technology (L2)-Ultra violet radiation (L1), infrared radiation(L1), radiation from the sun (L1)-Hazards due to depletion of ozone (L2)-Deforestation (L2), ozone holes (L2), automobile exhausts, chemical factory stack emissions, CFC (L2).

UNIT–II	WATER POLLUTION	9

Classification of water pollutants (L1)-Health hazards (L2)-Sampling and analysis of water (L2)-Water treatment (L3)-Different industrial effluents and their treatment and disposal (L2)-Advanced wastewater treatment (L3)-Effluent quality standards and laws (L3)-Chemical industries, tannery, textile effluents (L2)-Common treatment (L2).

UNIT– III	HAZARDOUS WASTE MANAGEMENT	9

Hazardous waste management in India (L1)-Waste identification, characterization, and classification (L2)-Technological options for collection, treatment, and disposal of hazardous waste (L2)Selection charts for the treatment of different hazardous wastes (L2)-Methods of collection and disposal of solid wastes (L2)-Health hazards - (L2)-Toxic and radioactive wastes (L2)-Incineration and vitrification (L1)-Hazards due to bio-process(L1)-, dilution, standards, and restrictions (L1)-Recycling and reuse (L2).

UNIT – IV	ENVIRONMENTAL MEASUREMENT AND CONTROL	9

Sampling and analysis (L2)-Dust monitor (L2)-Gas analyzer(L1)-, particle size analyzer (L2)-Lux meter(L1)-, pH meter (L1)-Gas chromatograph (L1)-Atomic absorption spectrometer (L1)-Gravitational settling chambers(L1), cyclone separators(L1), scrubbers (L1)-Electrostatic

precipitator(L1), bag filter(L1), maintenance (L2)-Control of gaseous emission by adsorption(L2), absorption(L2), and combustion methods (L2)-Pollution Control Board, laws (L1).		
UNIT–V	**POLLUTION CONTROL IN PROCESS INDUSTRIES**	**9**
Pollution control in process industries (L2)-Cement, paper, petroleum, petroleum products, textile (L2)-Tanneries, thermal power plants (L2)-Dyeing and pigment industries (L2)-Eco-friendly energy (L2).		
		Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: Upon completion of this course the students will be able to:		**BLOOM'S Taxonomy**
CO1	Illustrate and familiarize the basic concepts scope of environmental safety.	L2 - Understand
CO2	Interpret the standards of professional conduct that are published by professional safety organizations and/or certification bodies.	L2 - Understand
CO3	Explain the ways in which environmental health problems have arisen due to air and water pollution.	L2 - Understand
CO4	Examine the role of hazardous waste management and use of critical thinking to identify and assess environmental health risks.	L4 - Analyze
CO5	Apply concepts of emission measurement and design emission measurement devices.	L3 - Apply

REFERENCE BOOKS:

1.	E. C Wolfe, Race to Save to Save Planet, Wadsworth Publishing Co., Belmont, CA 2006.
2.	G. T Miller, Environmental Science: Working with the Earth, 11th Edition, Wadsworth Publishing Co., Belmont, CA, 2006
3.	M.J Hammer,., and M.J Hammer,., Jr., Water and Wastewater Technology, Pearson Prentice Hall, 2006
4.	Rao, CS, "Environmental pollution engineering:, Wiley Eastern Limited, New Delhi, 1 st January 2018.
5.	S. P. Mahajan, "Pollution control in process industries", Tata McGraw Hill Publishing Company, New Delhi, 2006.
6.	Varma and Braner, "Air pollution equipment", Springer Publishers, Second Edition.

VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=DAQapF-F4Vw&list=PL9108F6C4E154885A
2.	https://www.youtube.com/watch?v=5dukz1UOtkA&list=PLLy_2iUCG87BwOQUbS7WSdMVWHDXByk-w
WEB REFERENCES:	
1.	https://tifac.org.in/index.php/programmes/activities/8-publication/145-industrial-air-pollution-control-technologies?showall=1
2.	https://www.unep.org/beatpollution/global-response-pollution
ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc23_ce14/preview
2.	https://onlinecourses.nptel.ac.in/noc23_ch72/preview

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		1	2			1
CO2		1	3	1		1
CO3		2	2		1	2
CO4	1	3	3	1	3	
CO5	1	1	3	3		
Average	1	1.6	2.75	1.66	2	1.33
1–Low, 2 –Medium, 3–High.						

ME23IS502 / ME23IS309	ELECTRICAL SAFETY	Version: 1.0
(EXCEPT FOR M.E. INDUSTRIAL SAFETY ENGINEERING)		

Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1.	To impart knowledge on fundamental electrical concepts, equipment principles, and comply with safety regulations, including basic first aid.
2.	To familiarize students with primary electrical hazards, insulation, and lightning protection measures.
3.	To provide an in depth knowledge on functioning of fuses, circuit breakers, and safety measures against electrical faults.
4.	To provide knowledge on equipment selection, safety features, and maintenance for electrical tools.
5.	To familiarize students with hazardous zone classification, safe equipment, and safety measures in different environments.

UNIT–I	CONCEPTS AND STATUTORY REQUIREMENTS	9

Introduction – electrostatics (L1), electro magnetism(L1), stored energy(L1), energy radiation and electromagnetic interference(L1) – Working principles of electrical equipment(L2)-Indian electricity act and rules(L1)-statutory requirements from electrical inspectorate(L1)-international standards on electrical safety (L1)– first aid-cardio pulmonary resuscitation(CPR) (L1).

UNIT–II	ELECTRICAL HAZARDS	9

Primary and secondary hazards (L2)-shocks(L1), burns(L1), scalds(L1), falls-human safety in the use of electricity(L1).

Energy leakage(L2)-clearances and insulation(L2)-classes of insulation(L2)-voltage classifications(L2)-excess energycurrent surges(L2)-Safety in handling of war equipments(L2)-over current and short circuit current(L2)-heating effects of current(L2)-electromagnetic forces(L1)-corona effect(L2)-static electricity(L1) –definition, sources, hazardous conditions(L2), control(L2), electrical causes of fire and explosion(L2)-ionization, spark and arcignition energy(L2)-national electrical safety code ANSI(L2). Lightning (L2), hazards (L2), lightning arrestor (L2), installation – earthing(L2), specifications(L2), earth resistance(L2), earth pit maintenance(L2).

UNIT– III	PROTECTION SYSTEMS	9

Fuse(L1), circuit breakers and overload relays(L1) – protection against over voltage and under voltage (L2)– safe limits of amperage – voltage –safe distance from lines(L2)-capacity and protection of conductor-joints-and connections(L2), overload and short circuit protection(L2)-no load protection(L2)-earth fault protection(L2).

FRLS insulation(L2)-insulation and continuity test(L2)-system grounding(L2)-equipment grounding(L2)-

earth leakage circuit breaker (ELCB) (L2)-cable wires(L2)-maintenance of ground-ground fault circuit interrupter(L2)-use of low voltage(L2)-electrical guards(L2)-Personal protective equipment(L2) – safety in handling hand held electrical appliances tools and medical equipments(L2).

UNIT – IV	SELECTION, INSTALLATION, OPERATION AND MAINTENANCE	9

Role of environment in selection(L2)-safety aspects in application(L2) - protection and interlock(L2)-self diagnostic features and fail safe concepts(L2)-lock out and work permit system(L2)-discharge rod and earthing devices safety in the use of portable tools(L2)-cabling and cable joints(L2)-preventive maintenance(L2).

UNIT–V	HAZARDOUS ZONES	9

Classification of hazardous zones(L2)-intrinsically safe and explosion proof electrical apparatus(L2)-increase safe equipment(L2)-their selection for different zones(L2)-temperature classification(L2)-grouping of gases(L2)-use of barriers and isolators(L2)-equipment certifying agencies(L2).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Demonstrate understanding of electrical concepts and legal compliance for safe operation, within regulatory constraints.	L2 - Understand
CO2	Identify and mitigate electrical hazards, ensuring safety adherence to protocols and guidelines.	L3 - Apply
CO3	Utilize protection systems effectively, ensuring electrical safety within specified standards.	L3 - Apply
CO4	Apply a safe and efficient process for selecting, installing, operating, and maintaining electrical equipment, adhering to industry regulations.	L3 - Apply
CO5	Develop expertise in managing hazardous zones safely, within the constraints of applicable safety standards.	L3 - Apply

REFERENCE BOOKS:

1.	"Accident prevention manual for industrial operations", N.S.C., Chicago, 1982.
2.	Indian Electricity Act and Rules, Government of India.
3.	Power Engineers – Handbook of TNEB, Chennai, 1989.
4.	Martin Glov Electrostatic Hazards in powder handling, Research Studies Pvt. Ltd., England, 1988.
5.	Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1986.

VIDEO REFERENCES:

1.	https://www.youtube.com/watch?v=zRHtJLFJf78
2.	https://www.youtube.com/watch?v=7N9chOXO8TU

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

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	1	3		1	1
CO2		1	3	1	2	2
CO3		2	3	2	2	2
CO4	1	1	3	1	1	1
CO5		2	3		2	
Average	1	1.4	3	1.33	1.6	1.5
1–Low, 2 –Medium, 3–High.						

ME23IS503/ ME23IS 413	SAFETY IN ENGINEERING INDUSTRY	Version: 1.0
(EXCEPT FOR M.E. INDUSTRIAL SAFETY ENGINEERING)		

Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To know the safety rules and regulations, standards and codes
2	To study various mechanical machines and their safety importance
3	To understand the principles of machine guarding and operation of protective devices.
4	To know the working principle of mechanical engineering processes such as metal forming and joining process and their safety risks.
5	To impart knowledge on finishing, inspection and testing operations in engineering industry

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

General safety rules(L1), principles(L1), maintenance(L1), Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines (L3), CNC machines(L1), Wood working machinery(L1), types(L1),, safety principles(L1),, electrical guards(L2),, work area(L1), material handling(L1), inspection(L3),, standards and codes(L1),- saws(L1), types(L1),hazards(L2).

UNIT–II	PRINCIPLES OF MACHINE GUARDING	9

Guarding during maintenance(L2),, Zero Mechanical State (ZMS) (L2),, Definition(L1),, Policy for ZMS(L1), – guarding of hazards(L2), - point of operation protective devices(L2), machine guarding(L2), types, fixed guard(L2), interlock guard(L2), automatic guard(L2), trip guard(L2), electron eye(L2), positional control guard(L2), fixed guard fencing(L2), - guard construction(L2), - guard opening(L1).

Selection and suitability: lathe-drilling-boring-milling-grinding-shaping-sawing-shearing-presses-forge hammer(L1) -flywheels(L1) -shafts(L1)-couplings(L1)-gears(L1)-sprockets wheels and chains(L1)-pulleys and belts(L1)-authorized entry to hazardous installations(L3)-benefits of good guarding systems(L1).

UNIT– III	SAFETY IN WELDING AND GAS CUTTING	9

Gas welding and oxygen cutting(L2), resistances welding(L2), arc welding and cutting(L2), common hazards(L1), personal protective equipment(L1), training(L1), safety precautions in brazing, soldering and metalizing(L2) – explosive welding(L1), selection, care and maintenance of the associated equipment and instruments(L2) – safety in generation, distribution and handling of industrial gases(L2) -colour coding(L2) – flashback arrestor (L2)– leak detection(L1)-pipe line safety(L1)-storage and handling of gas cylinders(L2).

UNIT – IV	SAFETY IN COLD FARMING AND HOT WORKING OF METALS	9

Cold working(L1), power presses(L1), point of operation safe guarding(L2), auxiliary mechanisms(L1), feeding and cutting mechanism(L1),, hand or foot-operated presses(L1),, power press electric controls(L1),, power press set up and die removal(L2), inspection and maintenance(L3), -metal sheers-press brakes(L2).

Hot working safety in forging(L2),, hot rolling mill operation(L2), safe guards in hot rolling mills(L2), – hot bending of pipes(L2), hazards and control measures(L1).

Safety in gas furnace operation, cupola, crucibles, ovens (L2)- foundry health hazards(L2), work environment(L1), material handling in foundries(L1), foundry production cleaning and finishing foundry processes(L2).

UNIT–V	SAFETY IN FINISHING, INSPECTION AND TESTING	9

Heat treatment operations(L2), electro plating(L2), paint shops(L1), sand and shot blasting(L1), safety in inspection and testing(L3), dynamic balancing(L2), hydro testing(L2), valves(L1), boiler drums and headers(L1), pressure vessels(L1), air leak test(L2), steam testing(L2), safety in radiography(L2), personal monitoring devices(L2), radiation hazards(L2), engineering and administrative controls(L2), Indian Boilers Regulation(L1).

Health and welfare measures in engineering industry(L2),-pollution control in engineering industry(L2) - industrial waste disposal(L2) .

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Apply safety rules for maintaining and inspecting metal and wood working machines, ensuring industry standards.	L3 - Apply
CO2	Apply effective design strategies for machine guarding systems, emphasizing zero mechanical state (ZMS) during maintenance.	L3 - Apply
CO3	Demonstrate proficiency in safe welding and cutting, ensuring proper equipment selection, care, and maintenance.	L2 - Understand
CO4	Make use of safety measures in cold and hot metalworking, ensuring proper equipment setup, inspection, and maintenance.	L3 - Apply
CO5	Apply safety protocols in finishing, inspection, and testing, adhering to regulations and considering health and pollution control in engineering.	L3 - Apply

REFERENCE BOOKS:

1.	"Accident Prevention Manual" – NSC, Chicago, 1982.
2.	"Occupational safety Manual" BHEL, Trichy, 1988.

3.	"Safety Management by John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, 1989.
4.	"Safety in Industry" N.V. Krishnan Jaico Publishery House, 1996.
5.	Indian Boiler acts and Regulations, Government of India.
6.	Safety in the use of wood working machines, HMSO, UK 1992.
7.	Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London, 1989.
VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=7ZjDk92zE1Y
2.	https://www.youtube.com/watch?v=3VReVbsmjKI
WEB REFERENCES:	
1.	https://www.nsc.org/getmedia/238460ca-6df0-411d-914a-54d36282fc36/apm_et_answers_q_cs_ch25.pdf
2.	https://www.osha.gov/sites/default/files/2019-03/sheetmetal.pdf
ONLINE COURSES:	
1.	https://www.nfpa.org/for-professionals/training-for-me/industrial-hazards-training/hot-work-safety-certificate-online-training
2.	https://www.nsc.org/safety-training/workplace/advanced-safety-certificate/safety-inspections

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		1	3		2	
CO2		1	3		3	1
CO3	1	1	3		3	
CO4	1	1	3		3	1
CO5	2	1	3	1	3	
Average	1.33	1	3	1	2.8	1
1–Low, 2 –Medium, 3–High.						

ME23IS504	DESIGN OF EXPERIMENTS	Version: 1.0
(EXCEPT FOR M.E. INDUSTRIAL SAFETY ENGINEERING)		

Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To impart knowledge on principles and steps in designing a statistically designed experiment.
2	To build foundation in analysing the data in single factor experiments and to perform post hoc tests.
3	To provide knowledge on analysing the data in factorial experiments.
4	To educate on analysing the data analysis in special experimental designs and Response Surface Methods.
5	To impart knowledge in designing and analysing the data in Taguchi's Design of Experiments to improve Process/Product quality.

UNIT–I	EXPERIMENTAL DESIGN FUNDAMENTALS	9

Importance of experiments(L2), experimental strategies(L2), basic principles of design(L2), terminology, ANOVA(L3), steps in experimentation(L2), sample size(L3), normal probability plot(L3), linear regression models(L3).

UNIT–II	SINGLE FACTOR EXPERIMENTS	9

Completely randomized design(L2), Randomized block design(L2), Latin square design(L2). Statistical analysis(L3), estimation of model parameters(L3), model adequacy checking(L3), pair wise comparison tests(L4).

UNIT– III	MULTIFACTOR EXPERIMENTS	9

Two and three factor full factorial experiments(L2), Randomized block factorial design(L3), Experiments with random factors(L3), rules for expected mean squares(L3), approximate F-tests(L4). 2^K factorial Experiments(L4).

UNIT – IV	SPECIAL EXPERIMENTAL DESIGNS	9

Blocking and confounding in 2^K designs(L2). Two level Fractional factorial design(L3), nested designs(L3), Split plot design(L3), Introduction to Response Surface Methods(L3).

UNIT–V	TAGUCHI METHODS	9

Steps in experimentation(L2), design using Orthogonal Arrays(L3), data analysis(L3), Robust design(L2),- control and noise factors(L3), S/N ratios(L3), parameter design(L3), Multi-level experiments(L2), Multi-response optimization(L2), Introduction to Shainin DOE(L2).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS		
Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination		
COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Interpret the Design of Experiments principles, strategizing experiment design within practical resource considerations and goals.	L2 - Understand
CO2	Analyze single-factor experiment data, focusing on randomization and pair-wise comparison tests.	L4 - Analyze
CO3	Analyze multifactor experiment data, applying rules for expected mean squares and approximate F-tests.	L4 - Analyze
CO4	Apply special experimental designs, minimize confounding effects, optimize data collection, and introduce Response Surface Methods with practical considerations.	L3 - Apply
CO5	Apply Taguchi-based approaches for quality evaluation, emphasizing practical experimentation with orthogonal arrays and multi-response optimization.	L3 - Apply
REFERENCE BOOKS:		
1.	Krishnaiah, K. and Shahabudeen, P. Applied Design of Experiments and Taguchi Methods, PHI learning private Ltd., 2012.	
2.	Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons, Eighth edition, 2012.	
3.	NicoloBelavendram, Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.	
4.	Phillip J.Rose, Taguchi techniques for quality engineering, McGraw Hill, 1996.	
5.	Montgomery, D.C., Design and Analysis of Experiment, Minitab Manual, John Wiley and Sons, Seventh edition, 2010.	
VIDEO REFERENCES:		
1.	https://www.youtube.com/watch?v=k3lUo0XYG3E	
2.	https://www.youtube.com/watch?v=IEUTRhyoHNc&list=PLPjSqITyvDeWS9Lxp4jreGJ7eNsxHxJA8	
WEB REFERENCES:		
1.	https://www.itl.nist.gov/div898/handbook/pmd/section3/pmd31.htm	
2.	https://www.sartorius.com/en/knowledge/science-snippets/what-is-doe-design-of-experiments-basics-for-beginners-507170	
ONLINE COURSES:		
1.	https://onlinecourses.nptel.ac.in/noc21_mg48/preview	
2.	https://www.coursera.org/specializations/design-experiments	

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	2	1			
CO2	2	2	1		1	
CO3	2	2	1		1	
CO4	3	2	1		1	
CO5	3	2	1	3	1	
Average	2.2	2	1	3	1	
1–Low, 2 –Medium, 3–High.						

ME23IS505	CIRCULAR ECONOMY	Version: 1.0
(EXCEPT FOR M.E. INDUSTRIAL SAFETY ENGINEERING)		

Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To equip graduates with circularity expertise for diverse national and international job opportunities.
2	To develop skilled manpower and foster entrepreneurship in Circular Economy.
3	To facilitate student-professional interactions for real-world exposure in technology, research, innovation, and circular business models.
4	To inspire students to address circularity business needs and pursue Research and Development (R&D) and entrepreneurship.
5	To cultivate environmentally conscious entrepreneurs through core competencies in environmental education and collaborative university-industry partnerships.

UNIT–I	INTRODUCTION TO CIRCULAR ECONOMY	9

Linear Economy and its emergence(L2), Economic and Ecological disadvantages of linear economy(L3), Replacing Linear economy by Circular Economy(L3), Development of Concept of Circular Economy(L2), A differential - Linear Vs Circular Economy(L2).

UNIT–II	CHARACTERISTICS OF CIRCULAR ECONOMY	9

Material recovery(L2), Waste Reduction(L2), reducing negative externalities(L3), Explaining Butterfly diagram(L2), Concept of Loops(L2).

UNIT– III	CIRCULAR DESIGN, INNOVATION AND ASSESSMENT	9

Zero waste: Waste Management in context of Circular Economy(L3), Circular design(L3), Research and innovation(L4), LCA(L2), Circular Business(L2)

UNIT – IV	CASE STUDIES	9

Business models(L2), Solid Waste Management / Wastewater, Plastics: A case study(L4), EPR: polluters pay principle(L3), Industrial symbiosis/ Eco-parks(L2)

UNIT–V	LEGAL AND POLICY FRAMEWORK	9

Role of governments and networks(L2), Sharing best practices(L2), Universal circular economy policy goals(L2), India and CE strategy(L2), ESG(L2).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: Upon completion of this course the students will be able to:		BLOOM'S Taxonomy
CO1	Differentiate Circular Economy from Linear Economy and showcase its practical application.	L2 - Understand
CO2	Apply Circular Economy principles, incorporating material recovery and waste reduction to illustrate the Butterfly diagram and emphasize the loops within the circular system.	L3 - Apply
CO3	Apply circular design and innovation principles, assess sustainability in Circular Economy, and examine circular business models	L3 - Apply
CO4	Analyze case studies on circular economy from different fields and connect these cases to Circular Economy concepts professionally.	L4 - Analyze
CO5	Infer government roles, share best practices, and articulate Circular Economy policy goals, demonstrating expertise in legal frameworks with an ESG focus, especially in India.	L2 - Understand
REFERENCE BOOKS:		
1.	Towards Zero Waste: Circular Economy Boost, Waste to Resources María-Laura Franco-García, Jorge Carlos Carpio-Aguilar, Hans Bressers. Springer International Publishing 2019	
2.	Strategic Management and the Circular Economy Marcello Tonelli, Nicolo Cristoni, Routledge 2018.	
3.	Circular Economy: Global Perspective Sadhan Kumar Ghosh, Springer, 2020	
4.	The Circular Economy: A User's Guide Stahel, Walter R. Routledge 2019	
5.	An Introduction to Circular Economy Lerwen Liu, Seeram Ramakrishna, Springer Singapore 2021	
VIDEO REFERENCES:		
1.	https://www.youtube.com/watch?v=ETxYCzS7xlg	
2.	https://www.youtube.com/watch?v=2KdTYaCSBCs	
WEB REFERENCES:		
1.	https://www.oecd.org/cfe/regionaldevelopment/Ekins-2019-Circular-Economy-What-Why-How-Where.pdf	
2.	https://ic-ce.com/product/principles-of-circular-economy/	
ONLINE COURSES:		
1.	https://online-learning.harvard.edu/course/introduction-circular-economy?delta=0	
2.	https://www.coursera.org/learn/circular-economy	

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1						
CO2	1					
CO3	1	2			1	
CO4	2					
CO5						
Average	1.33	2			1	
1–Low, 2 –Medium, 3–High.						

ME23ET501 / ME23ET310	IOT FOR SMART SYSTEMS	Version : 1.0

EXCEPT FOR M.E. EMBEDDED SYSTEM TECHNOLOGIES

Programme &Branch	M.E. EMBEDDED SYSTEM TECHNOLOGIES	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To study about Internet of Things technologies and its role in real time applications.
2	To introduce the infrastructure required for IoT
3	To familiarize the accessories and communication techniques for IoT.
4	To provide insight about the embedded processor and sensors required for IoT
5	To familiarize the different platforms and Attributes for IoT

UNIT–I	INTRODUCTION TO INTERNET OF THINGS	9

Overview(L2), Hardware and software requirements for IOT(L2), Sensor and actuators, Technology driver(L2)s, Business drivers(L2), Typical IoT applications(L3), Trends and implications(L3).

UNIT–II	IOT ARCHITECTURE	9

IoT reference model and architecture (L2)-Node Structure(L2) - Sensing, Processing, Communication, Powering, Networking(L2) - Topologies(L2), Layer/Stack architecture(L2)**,** IoT standards(L2), Cloud computing for IoT(L2), Bluetooth(L2), Bluetooth Low Energy beacons(L2).

UNIT– III	PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT PROTOCOLS	9

NFC, SCADA and RFID, Zigbee, MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe, GSM, CDMA, LTE, GPRS, small cell(L2). **Wireless technologies for IoT:** WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends. (L2).

UNIT – IV	IOT PROCESSORS	9

Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability (L2).

Embedded processors for IOT :Introduction to Python programming(L2) -Building IOT with RASPERRY PI and Arduino (L3).

UNIT–V	CASE STUDIES	9

Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense(L3).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: Upon completion of this course the students will be able to:		**BLOOM'S Taxonomy**
CO1	Analyze the concepts of IoT and its present developments.	L3 - Apply
CO2	Compare and contrast different platforms and infrastructures available for IoT	L2 - Understand
CO3	Explain different protocols and communication technologies used in IoT	L2 - Understand
CO4	Analyze the big data analytic and programming of IoT	L3 - Apply
CO5	Implement IoT solutions for smart applications	L3 - Apply

REFERENCE BOOKS:

1.	ArshdeepBahga and VijaiMadisetti : 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.	Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and sons, 2014.
7.	Lingyang Song/DusitNiyato/ Zhu Han/Ekram Hossain,"Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015.
8.	OvidiuVermesan and Peter Friess (Editors), "Internet of Things: Converging Technologies for Smart Environments and I ntegrated Ecosystems", River Publishers Series in Communication, 2013.
9.	Vijay Madisetti , ArshdeepBahga, "Internet of Things (A Hands on-Approach)", 2014.
10.	Lars T.Berger and Krzysztof Iniewski, "Smart Grid applications, communications and security", Wiley, 2015.
11.	JanakaEkanayake, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, " Smart Grid Technology and Applications", Wiley, 2015.
12.	UpenaDalal,"Wireless Communications & Networks,Oxford,2015.

WEB REFERENCES:

1.	https://archive.nptel.ac.in/courses/106/105/106105166/
2.	https://www.geeksforgeeks.org/architecture-of-internet-of-things-iot/

ONLINE COURSES:

1.	https://onlinecourses.nptel.ac.in/noc22_cs53/
2.	https://www.udemy.com/course/internet-of-things-iot-fundamentals

VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=WUYAjxnwjU4&list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE
2.	https://www.youtube.com/watch?v=urUBLmXFKI0&list=PLgMDNELGJ1CaBrefq-0eYatfOnoncW0y-
3.	https://www.youtube.com/watch?v=hdZzNOQV5vU

Mapping of COs with POs						
COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2	1			
CO2		2				
CO3	1	2		1	3	
CO4	2		3	3	3	
CO5	3	2	3	3	3	
Average	1.75	2	2.33	2.33	3	
1–Low, 2 –Medium, 3–High.						

ME23ET502 / ME23ET408	MACHINE LEARNING AND DEEP LEARNING	Version : 1.0

EXCEPT FOR M.E. EMBEDDED SYSTEM TECHNOLOGIES

Programme & Branch	M.E. EMBEDDED SYSTEM TECHNOLOGIES	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	Understanding about the learning problem and algorithms
2	Providing insight about neural networks
3	Introducing the machine learning fundamentals and significance
4	Enabling the students to acquire knowledge about pattern recognition
5	Motivating the students to apply deep learning algorithms for solving real life problems. metering infrastructure.

UNIT–I	LEARNING PROBLEMS AND ALGORITHMS	9

Various paradigms of learning problems(L2), Supervised, Semi-supervised and Unsupervised algorithms(L2).

UNIT–II	NEURAL NETWORKS	9

Differences between Biological and Artificial Neural Networks(L2) - Typical Architecture, Common Activation Functions, Multi-layer neural network, Linear Separability, Hebb Net, Perceptron, Adaline, Standard Back propagation Training Algorithms for Pattern Association (L2)- 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 (L2).

UNIT– III	MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS	9

Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1(L2)- 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 (L2).

UNIT – IV	DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS	9

Feed forward networks(L2), Activation functions(L2), back propagation in CNN(L2), optimizers(L2), batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs(L2).

UNIT–V	DEEP LEARNING: RNNS, AUTOENCODERS AND GANS	9
State, Structure of RNN Cell, LSTM and GRU(L2), Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders(L2), GANs: The discriminator, generator, DCGANs(L2).		
Total : 45 PERIODS		
OPEN ENDED PROBLEMS / QUESTIONS		
Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination		

COURSE OUTCOMES: Upon completion of this course the students will be able to:		**BLOOM'S Taxonomy**
CO1	Illustrate the categorization of machine learning algorithms.	L2 – Understand
CO2	Compare and contrast the types of neural network architectures, activation functions	L2 – Understand
CO3	Acquaint with the pattern association using neural networks	L2 – Understand
CO4	Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks	L2 – Understand
CO5	Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs	L2 – Understand

REFERENCE BOOKS:

1.	J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro Fuzzy and Soft Computing - A Computational Approach to Learning and Machine Intelligence, 2015, 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. 2019.
4.	Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2016
5.	Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.

WEB REFERENCES:

1.	https://archive.nptel.ac.in/courses/106/106/106106139/
2.	https://archive.nptel.ac.in/courses/106/106/106106202/

ONLINE COURSES:

1.	https://nptel.ac.in/courses/117105084
2.	https://onlinecourses.nptel.ac.in/noc23_ee87/

VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=KshIEHQn5ZM
2.	https://www.youtube.com/watch?v=TIFFfLejkcA
3.	https://www.youtube.com/watch?v=4TC5s_xNKSs&list=PLyqSpQzTE6M9gCgajvQbc68Hk_JKGBAYT&index=2

Mapping of COs with POs						
COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	3	1			
CO2	2	3	2			
CO3	3		3		3	
CO4	2	3	3			
CO5	3	3	3		3	
Average	2.42	3	2.57		3	
1–Low, 2 –Medium, 3–High.						

ME23ET503	RENEWABLE ENERGY TECHNOLOGY	Version : 1.0
EXCEPT FOR M.E. EMBEDDED SYSTEM TECHNOLOGIES		

Programme & Branch	M.E. EMBEDDED SYSTEM TECHNOLOGIES	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1.	To provide knowledge about the different types of renewable energy technologies
2.	To provide knowledge on standalone operation of solar energy systems
3.	To provide knowledge on grid connected operation of solar energy systems
4.	To analyze the various operating modes of wind energy generating systems
5.	To provide knowledge about other renewable energy systems.

UNIT–I	INTRODUCTION	9

Classification of energy sources(L2) – Co2 Emission (L2)- Features of Renewable energy(L2) - Renewable energy scenario in India(L2) -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO2 Emission(L2) - importance of renewable energy sources, Potentials – Achievements– Applications(L2)

UNIT–II	SOLAR PHOTOVOLTAICS	9

Solar Energy: Sun and Earth(L1)-Basic Characteristics of solar radiation(L2)- angle of sunrays on solar collector(L2)-Estimating Solar Radiation Empirically (L2)- Equivalent circuit of PV Cell(L2)-Photovoltaic cell characteristics: P-V and I-V curve of cell-Impact of Temperature and Insolation on I-V characteristics(L2), Shading Impacts on I-V characteristics(L2)-Bypass diode -Blocking diode(L2).

UNIT– III	PHOTOVOLTAIC SYSTEM DESIGN	9

Block diagram of solar photo voltaic system: Line commutated converters (inversion mode) - Boost and buck-boost converters(L2) - selection of inverter, battery sizing, array sizing (L2)- PV systems classification(L2)- standalone PV systems(L2) - Grid tied and grid interactive inverters(L2)- grid connection issues(L2).

UNIT – IV	WIND ENERGY CONVERSION SYSTEMS	9

Origin of Winds: Global and Local Winds(L2)- Aerodynamics of Wind turbine(L3)-Derivation of Betz's limit Power available in wind(L2)-Classification of wind turbine: Horizontal Axis wind turbine and Vertical axis wind turbine(L2)- Aerodynamic Efficiency(L3)-Tip Speed(L2)-Tip Speed

Ratio(L3)-Solidity-Blade Count-Power curve of wind turbine (L2)- Configurations of wind energy conversion systems: Type A, Type B, Type C and Type D Configurations(L2)- Grid connection Issues(L2) - Grid integrated SCIG and PMSG based WECS(L3).

UNIT–V	OTHER RENEWABLE ENERGY SOURCES	9

Qualitative study of different renewable energy resources: ocean(L2), Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC)(L2), Tidal and wave energy, Geothermal Energy Resources(L2).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: Upon completion of this course the students will be able to:		**BLOOM'S Taxonomy**
CO1	Demonstrate the need for renewable energy sources.	L2 – Understand
CO2	Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system	L2 – Understand
CO3	Design a stand-alone and Grid connected PV system	L2 – Understand
CO4	Analyze the different configurations of the wind energy conversion systems.	L3 - Apply
CO5	Realize the basic of various available renewable energy sources	L2 – Understand

REFERENCE BOOKS:

1.	S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford UniversityPress, 2019.
3.	Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
4.	Rai. G.D," Solar energy utilization", Khanna publishes, 1993.
5.	Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, 2012
6.	John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2016.

WEB REFERENCES:

1.	https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA-ETSAP_Tech_Brief_Power_Grid_Integration_2015.pdf
2.	https://www.nrel.gov/docs/fy15osti/63033.pdf

ONLINE COURSES:

1.	https://www.coursera.org/learn/renewable-power-electricity-systems
2.	https://nptel.ac.in/courses/103103206

VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=mh51mAUexK4&list=PLwdnzlV3ogoXUifhvYB65lLJCZ74o_fAk
2.	https://www.youtube.com/watch?v=cGHlV0EavaQ

Mapping of COs with POs						
COs	**POs**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3		2			
CO2	3		2			
CO3	3		2			
CO4	3		2			
CO5	3		2			
Average	3		2			
1–Low, 2 –Medium, 3–High.						

ME23ET504 / ME23ET423	SMART GRID	Version : 1.0
EXCEPT FOR M.E. EMBEDDED SYSTEM TECHNOLOGIES		

Programme & Branch	M.E. EMBEDDED SYSTEM TECHNOLOGIES	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1.	To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
2.	To know about the function of smart grid
3.	To familiarize the power quality management issues in Smart Grid
4.	To familiarize the high performance computing for Smart Grid applications
5.	To get familiarized with the communication networks for Smart Grid applications

UNIT–I	INTRODUCTION TO SMART GRID	9

Evolution of Electric Grid(l2), Concept, Definitions and Need for Smart Grid(l2), Smart grid drivers, functions, opportunities, challenges and benefits(l2), Difference between conventional & Smart Grid(L2), Comparison of Micro grid and Smart grid(l2), Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India(l2) – Case Study(L2).

UNIT–II	SMART GRID TECHNOLOGIES	9

Technology Drivers, Smart Integration of energy resources(L2), Smart substations(L2), Substation Automation(L2), Feeder Automation(L2), Transmission systems: EMS, FACTS and HVDC(L2), Wide area monitoring(L2), Protection and control, Distribution systems: DMS(L2), Volt/Var control, Fault Detection(L2), Isolation and service restoration(L2), Outage management(L2), High-Efficiency Distribution Transformers(L2), Phase Shifting Transformers(L2), Plug in Hybrid Electric Vehicles (PHEV(L2)) (L2) – Grid to Vehicle and Vehicle to Grid charging concepts(L2).

UNIT– III	SMART METERS AND ADVANCED METERING INFRASTRUCTURE	9

Introduction to Smart Meters(L1), Advanced Metering infrastructure (AMI) drivers and benefits(L2), AMI protocols, standards and initiatives(L2), AMI needs in the smart grid(L2), Phasor Measurement Unit(PMU) & their application for monitoring & protection(L2). Demand side management and demand response programs(L2), Demand pricing and Time of Use, Real Time Pricing(L2), Peak Time Pricing(L2).

UNIT – IV	POWER QUALITY MANAGEMENT IN SMART GRID	9

Power Quality & EMC in Smart Grid(L2), Power Quality issues of Grid connected Renewable Energy Sources(L2), Power Quality Conditioners for Smart Grid(L2), Web based Power Quality monitoring(L2), Power Quality Audit (L2).

UNIT–V	HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS	9

Architecture and Standards(L2) -Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols(L2), Basics of Web Service and CLOUD Computing(L2), Cyber Security for Smart Grid(L2).

Total : 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: Upon completion of this course the students will be able to:		**BLOOM'S Taxonomy**
CO1	Relate with the smart resources, smart meters and other smart devices.	L2 – Understand
CO2	Explain the function of Smart Grid	L2 – Understand
CO3	Experiment the issues of Power Quality in Smart Grid.	L2 – Understand
CO4	Analyze the performance of Smart Grid	L2 – Understand
CO5	Recommend suitable communication networks for smart grid applications	L2 – Understand

REFERENCE BOOKS:

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. 2018

WEB REFERENCES:

1.	https://www.researchgate.net/publication/224078022_Power_Quality_and_EMC_in_Smart_Grid
2.	https://amity.edu/icactm/Proceeding/Paper%20Index%20Content/24%20T4%20P9%20ID%209.pdf

ONLINE COURSES:

1.	https://onlinecourses.nptel.ac.in/noc21_ee68
2.	https://onlinecourses.nptel.ac.in/noc23_ee124/

VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=KgVFJnmJvKk&list=PLSJzHGpGe6lP5biCvZrtQdHf80tnSXRBr
2.	https://archive.nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee65/

Mapping of COs with POs						
COs	POs					
	1	2	3	4	5	6
CO1	3	2		2	2	2
CO2	3		2	2		2
CO3	2		1			2
CO4	1			3	3	1
CO5		2	2	2	2	3
Average	2.25	2	1.66	2.25	2.3	2
1–Low, 2 –Medium, 3–High.						

ME23VL501	BIG DATA ANALYTICS	Version: 1.0
EXCEPT FOR M.E. VLSI DESIGN		

Programme & Branch	M.E. VLSI DESIGN	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To understand the basics of big data analytics
2	To understand the search methods and visualization
3	To learn mining data streams
4	To learn frameworks
5	To gain knowledge on R language

UNIT–I	INTRODUCTION TO BIG DATA	9

Introduction to Big Data Platform (L2)– Challenges of Conventional Systems (L2)- Intelligent data analysis –Nature of Data (L2)- Analytic Processes and Tools (L2)- Analysis Vs Reporting (L2)- Modern Data Analytic Tools (L2)- Statistical Concepts: Sampling Distributions (L2)- Re-Sampling (L2)– Statistical Inference - Prediction Error (L2).

UNIT–II	SEARCH METHODS AND VISUALIZATION	9

Search by simulated Annealing (L2)– Stochastic, Adaptive search by Evaluation (L2)– Evaluation Strategies (L3) – Genetic Algorithm – Genetic Programming (L2) – Visualization – Classification of Visual Data Analysis Techniques (L3) – Data Types – Visualization Techniques (L3) – Interaction techniques – Specific Visual data analysis Techniques (L3)

UNIT– III	MINING DATA STREAMS	9

Introduction To Streams Concepts (L2)– Stream Data Model and Architecture (L2)- Stream Computing - Sampling Data in a Stream (L2)– Filtering Streams – Counting Distinct Elements in a Stream (L3)– Estimating Moments – Counting Oneness in a Window (L3)– Decaying Window (L3) - Real time Analytics Platform(RTAP) Applications (L3) - Case Studies - Real Time Sentiment Analysis (L3), Stock Market Predictions (L3)

UNIT – IV	FRAMEWORKS	9

MapReduce – Hadoop (L2) , Hive, MapR – Sharding – NoSQL Databases (L2) - S3 - Hadoop Distributed File Systems (L2) – Case Study- Preventing Private Information Inference Attacks on Social Networks (L2) - Grand Challenge: Applying Regulatory Science (L2) and Big Data to Improve Medical Device Innovation(L2)

UNIT–V	R LANGUAGE	9
Overview, Programming structures: Control statements (L3) - Operators – Functions (L3) – Environment and scope issues (L3)- Recursion - Replacement functions (L3), R data structures: Vectors -Matrices and arrays (L3)- Lists -Data frames -Classes, Input/output, String manipulations (L3)		
		Total: 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Understand the basics of big data analytics	L2 – Understand
CO2	Ability to use Hadoop, Map Reduce Framework	L3 – Apply
CO3	Apply big data analytics for increasing the business outcome	L3 – Apply
CO4	Understand the concepts of R language	L2 – Understand
CO5	Use R language to integrate and analyse large amounts of information	L3 – Apply

REFERENCE BOOKS:

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

VIDEO REFERENCES:

1.	https://onlinecourses.nptel.ac.in/noc20_cs92/preview
2.	https://onlinecourses.swayam2.ac.in/arp19_ap60/preview

WEB REFERENCES:

1.	https://www.ibm.com/analytics/big-data-analytics
2.	https://www.tableau.com/learn/articles/big-data-analytics

ONLINE COURSES:

1.	https://www.edx.org/learn/big-data/university-of-adelaide-big-data-analytics
2.	http://moocs.anuonline.ac.in/advance-diploma-in-big-data-analytics.html

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2		2	3	3	1
CO2	2		2	2	3	1
CO3	1		2	2	3	1
CO4	1		2	3	2	1
CO5	2		2	2	1	1
Average	1.6		2	2.4	2.4	1
1–Low, 2 –Medium, 3–High.						

ME23VL502	INTERNET OF THINGS AND CLOUD	Version: 1.0
EXCEPT FOR M.E. VLSI DESIGN		

Programme & Branch	M.E. VLSI DESIGN	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To understand Smart Objects and IoT Architectures
2	To learn about various IOT-related protocols
3	To build simple IoT Systems using Arduino and Raspberry Pi.
4	To understand data analytics and cloud in the context of IoT
5	To develop IoT infrastructure for popular applications

UNIT–I	FUNDAMENTALS OF IoT	9

Introduction to IoT (L2)– IoT definition – Characteristics (L2)– IoT Complete Architectural Stack (L2)– IoT enabling Technologies – IoT Challenges (L2). Sensors and Hardware for IoT (L2)– Hardware Platforms – Arduino, Raspberry Pi, Node MCU (L2). A Case study with any one of the boards and data acquisition from sensors (L3).

UNIT–II	PROTOCOLS FOR IoT	9

Infrastructure protocol (IPV4/V6/RPL) (L2), Identification (URIs) (L2), Transport (Wifi, Lifi, BLE), Discovery (L3), Data Protocols, Device Management Protocols (L3). – A Case Study with MQTT/CoAP usage-IoT privacy (L3), security and vulnerability solutions (L3).

UNIT– III	CASE STUDIES/INDUSTRIAL APPLICATIONS	9

Case studies with architectural analysis (L2): IoT applications – Smart City – Smart Water (L3)– Smart Agriculture (L2)– Smart Energy – Smart Healthcare (L3)– Smart Transportation – Smart Retail (L3)– Smart waste management (L3).

UNIT – IV	CLOUD COMPUTING INTRODUCTION	9

Introduction to Cloud Computing (L2)- Service Model (L2)– Deployment Model (L2)- Virtualization Concepts – Cloud Platforms (L2)– Amazon AWS (L2)– Microsoft Azure – Google APIs (L2).

UNIT–V	IoT AND CLOUD	9

IoT and the Cloud (L2)- Role of Cloud Computing in IoT (L2)- AWS Components (L2)- S3 – Lambda – AWS IoT Core (L2)- Connecting a web application to AWS IoT using MQTT (L3)- AWS IoT Examples (L3). Security Concerns, Risk Issues (L2), and Legal Aspects of Cloud Computing (L2)- Cloud Data Security (L2).

Total: 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS		
Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination		
COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Understand the various concept of the IoT and their technologies.	L2 – Understand
CO2	Develop IoT application using different hardware platforms.	L3 – Apply
CO3	Implement the various IoT Protocols.	L3 – Apply
CO4	Understand the basic principles of cloud computing.	L2 – Understand
CO5	Develop and deploy the IoT application into cloud environment.	L2 – Understand
REFERENCE BOOKS:		
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.	
VIDEO REFERENCES:		
1.	https://onlinecourses.nptel.ac.in/noc22_cs53/preview	
2.	https://www.oracle.com/in/internet-of-things/what-is-iot/	
WEB REFERENCES:		
1.	https://innovationatwork.ieee.org/internet-of-things/	
2.	https://www.ibm.com/topics/internet-of-things	
ONLINE COURSES:		
1.	https://onlinecourses.nptel.ac.in/noc23_cs82/preview	
2.	https://onlinecourses.nptel.ac.in/noc22_cs53/preview	

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2		2	3	3	1
CO2	2		2	2	3	1
CO3	1			2	3	1
CO4			2	3	2	1
CO5	2		2	2	1	1
Average	1.7		2	2.4	2.4	1
1–Low, 2 –Medium, 3–High.						

ME23VL503	MEDICAL ROBOTICS	Version: 1.0
EXCEPT FOR M.E. VLSI DESIGN		

Programme & Branch	M.E. VLSI DESIGN	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1.	To explain the basic concepts of robots and types of robots.
2.	To discuss the designing procedure of manipulators, actuators and grippers.
3.	To impart knowledge on various types of sensors and power sources.
4.	To explore various applications of Robots in Medicine.
5.	To impart knowledge on wearable robots.

UNIT–I	INTRODUCTION TO ROBOTICS	9

Introduction to Robotics (L2), Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization (L2).

Sensors and Actuators: Sensors and controllers (L2), Internal and external sensors, position, velocity and acceleration sensors (L2), Proximity sensors, force sensors Pneumatic and hydraulic actuators (L2), Stepper motor control circuits (L2), End effectors (L2), Various types of Grippers (L2), PD and PID feedback actuator models (L2).

UNIT–II	MANIPULATORS & BASIC KINEMATICS	9

Construction of Manipulators (L2), Manipulator Dynamic and Force Control (L2), Electronic and pneumatic manipulator (L2), Forward Kinematic Problems, Inverse Kinematic Problems (L2), Solutions of Inverse Kinematic problems (L2).

Navigation and Treatment Planning: Variable speed arrangements (L2), Path determination – Machinery vision (L2), Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor (L2).

UNIT– III	SURGICAL ROBOTS	9

Da Vinci Surgical System (L2), Image guided robotic systems for focal ultrasound based surgical applications (L2), System concept for robotic Tele-surgical system for off-pump (L2), CABG surgery, Urologic applications (L2), Cardiac surgery, Neuro-surgery (L2), Pediatric and General Surgery, Gynecologic Surgery (L2), General Surgery and Nanorobotics. Case Study (L2).

UNIT – IV	REHABILITATION AND ASSISTIVE ROBOTS	9

Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking (L2), Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking (L2), Motion Prediction, Motion Replication (L2). Portable Robot for Tele rehabilitation (L2), Robotic Exoskeletons – Design

considerations (L3), Hybrid assistive limb. Case Study (L3).

UNIT–V	WEARABLE ROBOTS	9

Augmented Reality (L2), Kinematics and Dynamics for Wearable Robots (L2), Wearable Robot technology, Sensors, Actuators, Portable Energy Storage (L2), Human–robot cognitive interaction (cHRI) (L2), Human– robot physical interaction (pHRI) (L2), Wearable Robotic Communication - Case Study (L3).

Total: 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Describe the configuration, applications of robots and the concept of grippers and actuators	L2 – Understand
CO2	Explain the functions of manipulators and basic kinematics	L2 – Understand
CO3	Describe the application of robots in various surgeries	L2 – Understand
CO4	Design and analyze the robotic systems for rehabilitation	L3 – Apply
CO5	Design the wearable robots	L3 – Apply

REFERENCE BOOKS:

1.	Nagrath and Mittal, "Robotics and Control", Tata McGraw Hill, First edition, 2003
2.	Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and Sons, First edition, 2008
4.	Fu.K.S, Gonzalez. R.C., Lee, C.S.G, "Robotics, control", sensing, Vision and Intelligence, Tata McGraw Hill International, First edition, 2008
5.	Bruno Siciliano, Oussama Khatib, Springer Handbook of Robotics, 1st Edition, Springer, 2008
6.	Shane (S.Q.) Xie, Advanced Robotics for Medical Rehabilitation - Current State of the Art and Recent Advances, Springer, 2016
7.	Sashi S Kommu, Rehabilitation Robotics, I-Tech Education and Publishing, 2007
8.	Jose L. Pons, Wearable Robots: Biomechatronic Exoskeletons, John Wiley & Sons Ltd, UK, 2008
9.	Howie Choset, Kevin Lynch, Seth Hutchinson, "Principles of Robot Motion: Theory, Algorithms, and Implementations", Prentice Hall of India, First edition, 2005
10.	Philippe Coiffet, Michel Chirouze, "An Introduction to Robot Technology", Tata McGraw Hill, First Edition, 1983
11.	Jacob Rosen, Blake Hannaford & Richard M Satava, "Surgical Robotics: System Applications & Visions", Springer 2011
12.	Jocelyn Troccaz, Medical Robotics, Wiley, 2012
13.	Achim Schweikard, Floris Ernst, Medical Robotics, Springer, 2015

VIDEO REFERENCES:	
1.	https://nptel.ac.in/courses/107106090
2.	https://onlinecourses.nptel.ac.in/noc22_me05/preview
WEB REFERENCES:	
1.	https://web.stanford.edu/class/me328/
2.	https://robotnik.eu/applications-of-robotics-in-medicine/
ONLINE COURSES:	
1.	https://web.stanford.edu/class/me328/#lectures
2.	https://nptel.ac.in/courses/112106298

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1				1		
CO2				2		
CO3	2		2	2	2	2
CO4	2		2	2	3	2
CO5	2		2	2	3	3
Average	2		2	1.8	2.6	2.3
1–Low, 2 –Medium, 3–High.						

ME23VL504	EMBEDDED AUTOMATION	Version: 1.0
EXCEPT FOR M.E. VLSI DESIGN		

Programme & Branch	M.E. VLSI DESIGN	CP	L	T	P	C
		3	3	0	0	3

Course Objectives:

1	To learn about the process involved in the design and development of real-time embedded system
2	To develop the embedded C programming skills on 8-bit microcontroller
3	To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
4	To learn about the tools, firmware related to microcontroller programming
5	To build a home automation system

UNIT–I	INTRODUCTION TO EMBEDDED C PROGRAMMING	9

C Overview and Program Structure (L2) - C Types, Operators and Expressions (L2) - C Control Flow – C Functions and Program Structures (L3) - C Pointers And Arrays (L3) - FIFO and LIFO (L3) - C Structures (L3) - Development Tools (L2).

UNIT–II	AVR MICROCONTROLLER	9

ATMEGA 16 Architecture (L2) - Nonvolatile and Data Memories (L2) - Port System (L2) - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation (L2), USART, SPI, Two Wire Serial Interface (L2) , ADC, Interrupts - Physical and Operating Parameters (L2).

UNIT– III	HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS	9

Lights and Switches (L3) - Stack Operation - Implementing Combinational Logic (L3) - Expanding I/O - Interfacing Analog To Digital Convertors (L3) - Interfacing Digital To Analog Convertors (L3) - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface (L3) - Serial EEPROM - Real Time Clock (L3) - Accessing Constants Table - Arbitrary Waveform Generation (L3) - Communication Links - System Development Tools (L3).

UNIT – IV	VISION SYSTEM	9

Fundamentals of Image Processing (L2) – Filtering (L2) - Morphological Operations (L3) - Feature Detection and Matching (L3) - Blurring and Sharpening (L3) - Segmentation - Thresholding (L3) - Contours - Advanced Contour Properties (L3) - Gradient - Canny Edge Detector (L3) - Object Detection (L3) - Background Subtraction (L3).

UNIT–V	HOME AUTOMATION	9

Home Automation (L2) - Requirements - Water Level Notifier (L2) - Electric Guard Dog (L2) - Tweeting Bird Feeder (L2) - Package Delivery Detector (L2) - Web Enabled Light Switch (L2) - Curtain Automation (L3) - Android Door Lock - Voice Controlled Home Automation (L3) - Smart Lighting - Smart Mailbox (L3) - Electricity Usage Monitor (L3) - Proximity Garage Door Opener (L3) - Vision Based Authentic Entry System (L3).

Total: 45 PERIODS

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Write embedded C programs for embedded system application	L2 – Understand
CO2	Describe internal subsystems of AVR microcontrollers	L2 – Understand
CO3	Analyze the 8-bit series microcontroller architecture, features and pin details	L3 – Apply
CO4	Develop the systems based on vision mechanism	L3 – Apply
CO5	Develop a real time home automation system	L3 – Apply

REFERENCE BOOKS:

1.	Dhananjay V. Gadre, "Programming and Customizing the AVR Microcontroller", McGraw-Hill, 2001
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

VIDEO REFERENCES:

1.	https://archive.nptel.ac.in/courses/106/105/106105193/
2.	https://archive.nptel.ac.in/courses/106/105/106105159/

WEB REFERENCES:

1.	https://community.arm.com/arm-community-blogs/b/embedded-blog
2.	https://www.embeddedrelated.com/blogs.php

ONLINE COURSES:

1.	https://nptel.ac.in/courses/106103182
2.	https://nptel.ac.in/courses/117106112

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1					
CO2	1	3	1			3
CO3	1	3	2	1	2	3
CO4	1	3	2	2	3	3
CO5	1	3	1	2	3	3
Average	1	3	1.5	1.6	2.6	3
1–Low, 2 –Medium, 3–High.						

ME23AC701	ENGLISH FOR RESEARCH PAPER WRITING	Version: 1.0
(COMMON TO ALL BRANCHES)		

Programme & Branch	M.E INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		2	2	0	0	0

Course Objectives:

1	To teach how to improve writing skills and level of readability
2	To tell about what to write in each section
3	To summarize the skills needed when writing a Title
4	To infer the skills needed when writing the Conclusion
5	To ensure the quality of paper at very first-time submission

UNIT–I	INTRODUCTION TO RESEARCH PAPER WRITING	6

Planning and Preparation (L2), Word Order (L1), Breaking up long sentences (L2), Structuring Paragraphs and Sentences (L1), Being Concise and Removing Redundancy (L1), Avoiding Ambiguity and Vagueness (L2).

UNIT–II	PRESENTATION SKILLS	6

Clarifying Who Did What (L2), Highlighting Your Findings (L1), Hedging and Criticizing (L1), Paraphrasing and Plagiarism (L1), Sections of a Paper (L1), Abstracts, Introduction (L1).

UNIT–III	TITLE WRITING SKILLS	6

Key skills are needed when writing a Title (L1), key skills are needed when writing an Abstract (L1), key skills are needed when writing an Introduction (L1), skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check (L1).

UNIT–IV	RESULT WRITING SKILLS	6

Skills are needed when writing the Methods (L1), skills needed when writing the Results (L2), skills are needed when writing the Discussion (L2), skills are needed when writing the Conclusions (L2).

UNIT–V	VERIFICATION SKILLS	6

Useful phrases (L1), checking Plagiarism (L1), how to ensure paper is as good as it could possibly be the first- time submission (L1).

TOTAL: 30 PERIODS

OPEN ENDED PROBLEMS /QUESTIONS		
Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination		
COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOMS Taxonomy**
CO1	Understand that how to improve your writing skills and level of readability	L2 – Understand
CO2	Learn about what to write in each section	L1 – Remember
CO3	Understand the skills needed when writing a Title	L2 – Understand
CO4	Understand the skills needed when writing the Conclusion	L2 – Understand
CO5	Ensure the good quality of paper at very first-time submission	L2 – Understand
TEXTBOOKS:		
1.	Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.	
2.	Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006.	
REFERENCE BOOKS:		
1.	Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006.	
2.	Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.	

ME23AC702	DISASTER MANAGEMENT	Version: 1.0
(COMMON TO ALL BRANCHES)		

Programme & Branch	M.E INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		2	2	0	0	0

Course Objectives:

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

UNIT–I	INTRODUCTION	6

Disaster: Definition(L1), Factors and Significance(L1); Difference between Hazard And Disaster(L2); Natural and Manmade Disasters: Difference, Nature, Types and Magnitude(L1).

UNIT–II	REPERCUSSIONS OF DISASTERS AND HAZARDS	6

Economic Damage (L1), Loss of Human and Animal Life (L1), Destruction Of Ecosystem (L1). Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches (L1), Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts (L1).

UNIT–III	DISASTER PRONE AREAS IN INDIA	6

Study of Seismic Zones (L1); Areas Prone To Floods and Droughts (L1), Landslides And Avalanches (L1); Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami (L1); Post-Disaster Diseases and Epidemics (L1)

UNIT–IV	DISASTER PREPAREDNESS AND MANAGEMENT	6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard (L2); Evaluation of Risk: Application of Remote Sensing (L1), Data from Meteorological And Other Agencies (L1), Media Reports: Governmental and Community Preparedness (L1).

UNIT–V	RISK ASSESSMENT	6

Disaster Risk: Concept and Elements (L1), Disaster Risk Reduction (L1), Global and National Disaster Risk Situation (L1). Techniques of Risk Assessment (L1), Global Co-Operation in Risk Assessment and Warning (L1), People's Participation in Risk Assessment. Strategies for Survival (L1)

TOTAL: 30 PERIODS

OPEN ENDED PROBLEMS /QUESTIONS		
Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination		
COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOMS Taxonomy**
CO1	Summarize basics of disaster	L1 – Remember
CO2	Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.	L2 – Understand
CO3	Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives	L2 – Understand
CO4	Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.	L2 – Understand
CO5	Develop the strengths and weaknesses of disaster management approaches	L2 – Understand
TEXTBOOKS:		
1.	Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.	
2.	NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company, 2007.	
REFERENCE BOOKS:		
1.	Sahni, Pradeep Et.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi, 2001.	

ME23AC703	CONSTITUTION OF INDIA	Version: 1.0
(COMMON TO ALL BRANCHES)		

Programme & Branch	M.E INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		2	2	0	0	0

Course Objectives:

1.	To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2.	To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
3.	To role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
4.	To address the role of socialism in India after the commencement of the Bolshevik Revolution 1917 And its impact on the initial drafting of the Indian Constitution

UNIT–I	HISTORY OF MAKING OF THE INDIAN CONSTITUTION	6

History(L1), Drafting Committee(L1), (Composition & Working)

UNIT–II	PHILOSOPHY OF THE INDIAN CONSTITUTION	6

Preamble (L1), Salient Features (L1).

UNIT–III	CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES	6

Fundamental Rights (L1), Right to Equality (L1), Right to Freedom (L1), Right against Exploitation (L1), Right to Freedom of Religion (L1), Cultural and Educational Rights (L1), Right to Constitutional Remedies (L1), Directive Principles of State Policy (L1), Fundamental Duties (L1).

UNIT–IV	ORGANS OF GOVERNANCE	6

Parliament (L1), Composition (L1), Qualifications and Disqualifications (L1), Powers and Functions (L1), Executive (L1), President (L1), Governor (L1), Council of Ministers (L1), Judiciary, Appointment and Transfer of Judges (L1), Qualifications, Powers and Functions (L1).

UNIT–V	LOCAL ADMINISTRATION	6

District's Administration head: Role and Importance (L1), Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation (L1). Pachayati raj: Introduction (L1), PRI: Zila Panchayat (L1). Elected officials and their roles (L1), CEO Zila Pachayat: Position and role (L1). Block level: Organizational Hierarchy(Different departments) (L1), Village level:Role of Elected and Appointed officials (L1), Importance of grass root democracy (L1).

UNIT–VI	ELECTION COMMISSION	6

Election Commission: Role and Functioning (L1). Chief Election Commissioner and Election Commissioners (L1) - Institute and Bodies for the welfare of SC/ST/OBC and women (L1).

Total: 30 PERIODS

OPEN ENDED PROBLEMS /QUESTIONS		
Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination		
COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOMS Taxonomy**
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.	L2 – Understand
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.	L2 – Understand
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.	L2 – Understand
CO4	Discuss the passage of the Hindu Code Bill of 1956.	L2 – Understand
TEXTBOOKS:		
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.	
REFERENCE BOOKS:		
1.	M.P. Jain, Indian Constitution Law, 7th Edn., LexisNexis,2014.	
2.	D.D. Basu, Introduction to the Constitution of India, LexisNexis, 2015.	

ME23AC704	நற்றமிழ் இலக்கியம் (TAMIL VERSION)	Version: 1.0
(COMMON TO ALL BRANCHES)		

Programme & Branch	M.E INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		2	2	0	0	0

Course Objectives:

1	சங்க இலக்கியம் பற்றி மாணவர்களுக்கு எடுத்துரைத்தல்
2	நீதி நூல்கள் வாயிலாக அறக்கருத்துகளை எடுத்து கூறுதல்.
3	சிலப்பதிகாரம், மணிமேகலை காப்பியங்களை எடுத்துரைத்தல்.
4	இலக்கியங்களில் காணப்படும் அருள்நெறிக் கதைகளைப் பற்றி விளக்குதல்.
5	தற்காலத் தமிழ் இலக்கியங்களை மாணவர்களுக்கு தெரியப்படுத்துதல்.

UNIT–I	சங்க இலக்கியம்	6

1. தமிழின் துவக்க நூல் தொல்காப்பியம் - எழுத்து, சொல், பொருள் (L1)
2. அகநானூறு (82) - இயற்கை இன்னிசை அரங்கம் (L1)
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி (L1)
4. புறநானூறு (95, 195) – போரை நிறுத்திய ஔவையார் (L1)

UNIT–II	அறநெறித்தமிழ்	6

1. அறநெறி வகுத்த திருவள்ளுவர் - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புறவு அறிதல், ஈகை, புகழ் (L2)
2. பிற அறநூல்கள் – இலக்கிய மருந்து - ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்) (L2)

UNIT–III	**இரட்டைக்காப்பியங்கள்**	6

1. கண்ணகியின் புரட்சி- சிலப்பதிகார வழக்குரை காதை (L1)
2. சமூக சேலை இலக்கியம் மணிமேகலை – சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை (L1)

UNIT–IV	**அருள்நெறித்தமிழ்**	6

1. சிறுபாணாற்றுப்படை – பாரி முல்லைக்கு தேர் கொடுத்தது, பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள். (L2)
2. நற்றிணை – அன்னைக்குரிய புன்னை சிறப்பு (L2)
3. திருமந்திரம் (617,618) இயமம் நியமம் விதிகள் (L2)
4. தர்மசாலையை நிறுவிய வள்ளலார் (L2)
5. புறநானூறு – சிறுவனே வள்ளலானான் (L2)
6. அகநானூறு (4) – வண்டு (L2)
7. நற்றிணை (11) – நண்டு (L2)

8. கலித்தொகை (11) – யானை, புறா (L2)
9. ஐந்திணை ஐம்பது (27) – மான் (L2)
    a. ஆகியவை பற்றிய செய்திகள் (L2)

UNIT–V	நவீன தமிழ் இலக்கியம்	6

1. உரைநடைத்தமிழ் (L1)
   – தமிழின் முதல் புதினம் (L1)
   – தமிழின் முதல் சிறுகதை (L1)
   – கட்டுரை இலக்கியம் (L1)
   – பயண இலக்கியம் (L1)
   – நாடகம் (L1)
2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும் (L1)
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும் (L1)
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும் (L1)
5. அறிவியல் தமிழ் (L1)
6. இணையத்தில் தமிழ் (L1)
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம் (L1)

Total: 30 PERIODS

COURSE OUTCOMES: **Upon completion of this course the students will be able to:**		**BLOOMS Taxonomy**
CO1	சங்க இலக்கியம் மாணவர்கள் முழுமையாக அறிந்து பயன்பெறுதல்.	L1 - நினைவில் கொள்ளுதல்
CO2	அறநெறி இலக்கியம் வாயிலாக வாழ்வியலுக்குத் தேவையான தூய்மைப் பணிகளை மேற்கொள்ளுதல்.	L2 - புரிந்து கொள்ளுதல்
CO3	சிலப்பதிகாரம், மணிமேகலை காப்பியங்களில் உள்ள நீதிக்கருத்துகளை மாணவர்கள் தெரிந்துகொள்ளுதல்.	L1 - நினைவில் கொள்ளுதல்
CO4	இலக்கியங்களில் காணப்படும் அருள்நெறிக் கதைகளைப் பற்றி விளக்குதல்.	L2 – புரிந்து கொள்ளுதல்
CO5	தற்காலத் தமிழ் இலக்கியங்களை மாணவர்கள் தெரிந்து அவற்றின் வாயிலாக பயன் அடைதல்.	L1 – நினைவில் கொள்ளுதல்

TEXTBOOKS: தமிழ் இலக்கிய வெளியீடுகள் புத்தகங்கள்	
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.	தமிழ்க்கலைக்களஞ்சியம் - தமிழ் வளர்ச்சித்துறை (thamilvalarchithurai.com).
6.	அறிவியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்.

ME23AC704	CLASSICAL TAMIL LITERATURE (ENGLISH VERSION)	Version: 1.0
(COMMON TO ALL BRANCHES)		

Programme & Branch	M.E INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		2	2	0	0	0

Course Objectives:

1.	Providing guidance to students about Sangam literature.
2.	Analyzing legal texts to articulate opinions on justice literature.
3.	Discussing about Silappathikaram & Manimekalai.
4.	Shedding light on narratives of grace found in literature.
5.	Familiarizing students with contemporary Tamil literature.

UNIT–I	SANGAM LITERATURE	6

1. Tolkappiyam - The Fundamental Text of Tamil - Writing, language, and meaning (L1)
2. Akananuru (82) - Natural Melodious Garden (L1)
3. Kurinchipattu's Flower Landscape (L1)
4. Purananuru (95, 195) - Avvaiyar Who Stopped the War (L1)

UNIT–II	JUSTICE & RIGHTEOUSNESS IN TAMIL	6

1. Thiruvalluvar who Expounded Virtue - Understanding justice, embracing love, avoiding falsehood, gratitude, and fame. (L2)
2. Other Legal Texts - Literary Medicine - Eladhi, Sirupanchamulam, Trigatukam, and Acharakkovai (A book emphasizing cleanliness). (L2)

UNIT–III	IRATTAI KAPPIYANKAL	6

1. Kannagi's Protest - Introduction to the Silappathikaram Legal Story (L1)
2. Social Structure Literature Manimekalai - Story of Siraikkottam turned into Arakkottam (L1)

UNIT–IV	SACRED TAMIL LITERATURE	6

1. Siruppanattrupadai - Pari Presented the chariot to Jasmine Creeper, Pegan Presented a blanket to Peacock, Gooseberry given to Avvai by Adhiyamaan, Royal honors. (L2)
2. Nattrinai - Special gift for Mother (L2)
3. Thirumandiram (617,618) - Rules of Conduct (L2)
4. Vallalar who founded Dharmasala (L2)
5. Purananuru - The young man becomes a warrior (L2)
6. Akananuru (4) - The Chariot (L2)
7. Nattrinai (11) - Bull (L2)
8. Kalittokai (11) - Elephant, Tiger (L2)

9. Aindiṉai Aimpatu (27) - Deer (L2)
   a. News about the above (L2)

UNIT–V	MODERN TAMIL LITERATURE	6

1. Literary Tamil (L1):
   - First Novel in Tamil (L1)
   - First Short Story in Tamil (L1)
   - Essay Literature (L1)
   - Travel Literature (L1)
   - Drama (L1)
2. National Liberation Struggle and Tamil Literature (L1)
3. Community Liberation and Tamil Literature (L1)
4. Women's Liberation and Tamil Literature in the Perspective of Feminist Criticism (L1)
5. Scientific Tamil (L1)
6. Tamil on the Internet (L1)
7. Tamil Literature in Environmental Conservation (L1)

Total: 30 PERIODS

COURSE OUTCOMES: Upon completion of this course the students will be able to:		**BLOOMS Taxonomy**
CO1	Students comprehensively understand and benefit from Sangam literature.	L1 – Remember
CO2	Emphasize cleanliness tasks needed for the vitality of literary life.	L2 – Understand
CO3	Familiarize students with ethical principles found in Silappathikaram and Manimekalai.	L1 – Remember
CO4	Illuminate stories of grace in literature.	L2 – Understand
CO5	Students acquire knowledge of contemporary Tamil literature and apply its insights.	L1 – Remember

TEXTBOOKS:

1.	Tamil Virtual University - www.tamilvu.org.
2.	Tamil Wikipedia - https://ta.wikipedia.org.
3.	Release of Dharmapuri Adheenam.
4.	Biotechnology Symposium - Tamil Nadu Agricultural University, Thanjavur.
5.	Tamil Arts Symposium - Department of Tamil Development (thamilvalarchithurai.com).
6.	Science Symposium - Tamil Nadu Agricultural University, Thanjavur.

ME23IS901	DESIGN OF HEAT EXCHANGERS	Version: 1.0				
Programme & Branch	M.E-INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	2	1	0	3

Course Objectives:

1.	To learn the various types of heat exchangers
2.	To explain the importance of thermal and stress analysis of heat exchangers
3.	To inculcate the thermal design aspects of tubular heat exchangers
4.	To provide the details of design aspects of compact heat exchangers
5.	To design of heat pipes for various application

UNIT–I	FUNDAMENTALS OF HEAT EXCHANGER	6+3

Temperature distribution (L2) - shell and tube heat exchangers(L2) – regenerators and recuperators – analysis of heat exchangers (L3) – LMTD and effectiveness method(L3).

UNIT–II	FLOW AND STRESS ANALYSIS	6+3

Effect of turbulence(L2) – friction factor– pressure loss(L2) – stress in tubes(L2) – header sheets and pressure vessels (L2) – thermal stresses, shear stresses (L2) - types of failures(L2).

UNIT–	DESIGN ASPECTS	6+3

Heat transfer and pressure loss (L3) – flow configuration – effect of baffles(L2) –design of double pipe (L3) - finned tube(L2) - shell and tube heat exchangers(L3) - limitations(L2).

UNIT –	COMPACT AND PLATE HEAT EXCHANGERS	6+3

Types – merits and demerits (L2) – design of compact heat exchangers, plate heat exchangers(L3) – performance influencing parameters (L3) - limitations(L2).

UNIT–V	HEAT PIPES	6+3

Basic concepts - types and applications - heat transfer rate(L2) - influencing factors - operating principles (L2) - working fluids - fluid selection(L2) -material selection- control techniques(L2) - wick structure - design of heat pipes(L3).

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.

Total : 45 PERIODS

Course Outcomes: Upon completion of this course the students will be able to:		BLOOM'S Taxonomy
CO1	Apply the classification of heat exchangers to illustrate their applications in various industrial contexts.	Apply (L3)
CO2	Interpret the significance of stress analysis of heat exchangers.	Apply (L3)
CO3	Apply the principles of tubular heat exchanger design to specific industrial applications.	Apply (L3)
CO4	Apply critical evaluation to the design of compact heat exchangers for meeting industrial requirements.	Apply (L3)
CO5	Design heat pipe to evaluate heat transfer rate.	Apply (L3)

REFERENCE BOOKS:

1.	SadikKakac, Hongtan Liu, Anchasa Pramuanjaroenkij, "Heat Exchangers Selection, Rating and Thermal Design", CRC Press,Third Edition,2012.
2.	Ramesh K.Shah, Dušan P.Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.
3.	Robert W. Serth, "Process heat transfer principles and applications", Academic press, Elesevier, 2010.
4.	T. Kuppan, "Heat exchanger design hand book",New York: Marcel Dekker,2009.
5.	Chi, S. W., A Source Book , "Heat Pipe Theory and Practice", McGraw-Hill, 1976.

VIDEO REFERENCES:

1.	https://www.youtube.com/watch?v=8rGLrhVeZvw
2.	https://www.youtube.com/watch?v=br3gkrXTmdY

WEB REFERENCES:

1.	http://www.thermex.co.uk/news/blog/160-what-is-a-heat-exchanger
2.	https://www.explainthatstuff.com/how-heat-exchangers-work.html

ONLINE COURSES:

1.	https://archive.nptel.ac.in/courses/112/105/112105248/
2.	https://www.udemy.com/course/heat-exchangers/

ME23IS902	ADVANCED MATERIALS TECHNOLOGY	Version: 1.0				
Programme & Branch	M.E-INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	2	1	0	3

Course Objectives:

1.	To understand the fundamental principles governing the behavior of advanced materials.
2.	To understand the mechanisms of material strengthening, including dislocation theories and grain size control.
3.	To identify the properties and applications of super alloys and refractory materials.
4.	To apply the material selection in engineering design.
5.	To understand heat treatment techniques to ferrous & non-ferrous metals.

UNIT–I	MATERIALS AND CLASSIFICATION	6+3

Solid materials (L1) – Classification (L2) - Ceramics and metal glasses (L2) - selection and Application of tool steel (L3) - Magnetic alloys, copper, aluminum and magnesium alloys, bearing Alloys (L3) - Super hard materials (L2) – Plastics (L2) - Thermal, mechanical and chemical methods (L2), Macro and micro analysis of materials (L3), Macro analysis of ferrous and nonferrous materials(L2).

UNIT–II	MECHANICAL PROPERTIES	6+3

Strengthening mechanism of materials (L2) - elements of dislocation theories (L2) - Strain hardening - Grain size control (L2) - Single crystal growth - Reinforcing fibers for polymers (L2) - determination of mechanical properties of materials(L2) - Dynamic tests (L3) - Fracture and toughness tests (L2) - Low temperature and high temperature tests (L2) - Creep characteristics (L3) - Hot hardness tests (L3).

UNIT– III	MODERN MATERIALS AND ALLOYS	6+3

Super alloys(L2) -refractory materials(L2), Ceramic and their applications(L3) - Low melting alloys(L2), Shape Memory alloys(L2) - Ti and Ni based alloys for gas turbine applications(L3) - managing and cryogenic steels(L2) - Newer materials and their treatment for automobile applications(L4) - materials for Naval and nuclear systems(L3).

UNIT – IV	SELECTION OF MATERIALS - CASE STUDY	6+3

Motivation for selection (L2) - cost basis and service requirements (L3) - Selection for mechanical Properties(L2) - strength(L2) – toughness (L2) - fatigue and creep - selection for surface durability corrosion and wear resistance(L3) – Relationship between materials selection and processing (L3) - Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear application (L3).

UNIT–V	HEAT TREATMENT OF FERROUS & NON-FERROUS METALS	6+3

Iron Carbon phase diagram(L2) - TTT diagram - different microstructures(L2) – Annealing(L2) –

Normalizing (L2) – Hardening (L2) – Tempering (L2) – Quenching (L2) - Surface hardening (L2) - Thermo-mechanical treatment (L2) - Tool steel and their heat treatment(L2) - cast Iron and their heat treatment(L2) - Heat treatment of Magnesium and its alloys(L3) - Heat treatment of Titanium and its alloys (L3) - Heat treatment of Copper and its alloys(L3) - Heat treatment of Nickel and its alloys(L3).

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.

Total : 45 PERIODS

Course Outcomes: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Understand the selection criteria for tool steel, magnetic alloys, copper, aluminum, magnesium alloys, and bearing alloys.	Understand (L2)
CO2	Explain the strengthening mechanisms of materials, including dislocation theories and grain size control.	Understand (L2)
CO3	Identify super alloys, refractory materials, ceramics, and their applications.	Apply (L3)
CO4	Apply the material selection based on cost considerations and service requirements.	Apply (L3)
CO5	Understand the heat treatment methods to tool steel and cast iron.	Understand (L2)

REFERENCE BOOKS:

1.	Introduction to Material Science for Engineers – James F.Shackleford.
2.	Advanced Materials for sustainable developments by Shafifullah andH.M.A.R.Subramaniam.
3.	"Magnesium Alloys and Their Applications" edited by K.U. Kainer
4.	"Introduction to Smart Materials" by J. Lekner
5	"Emerging Trends in Materials Science" edited by Sachin C. Jain

VIDEO REFERENCES:

1.	https://www.youtube.com/watch?v=MtqugJcsHZs&list=PLbRMhDVUMngdzwQyMgoUgdaGBqi_p4nVM&index=1
2.	https://www.youtube.com/watch?v=v1qw-ttBOdA&list=PL716BC63A7418B310

WEB REFERENCES:

1.	https://www.routledge.com/Advanced-Materials-Science-and-Technology/book-series/CRCADVMATSCI

ONLINE COURSES:

1.	Advanced Materials And Processes onlinecourses@nptel.iitm.ac.in

ME23IS903	ENERGY EFFICIENT BUILDINGS	Version: 1.0				
Programme & Branch	M.E-INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	2	1	0	3

Course Objectives:

1.	To analyze the significance of water, energy, and indoor air quality in building design and operation.
2.	To understand the significance of energy-efficient landscape design in reducing overall energy consumption.
3.	To study various passive cooling strategies that harness wind, water, and earth for reducing indoor temperatures.
4.	To explore various heat transfer mechanisms, including ventilation, infiltration, and internal heat transfer.
5.	To understand the importance of integrating renewable energy in buildings for sustainable energy generation.

UNIT–I	INTRODUCTION	6+3

Conventional versus Energy Efficient buildings (L2) – Historical perspective (L1) - Water – Energy (L2) – IAQ requirement analysis (L2) – Future building design aspects (L3) – Criticality of resources and needs of modern living (L2).

UNIT–II	LANDSCAPE AND BUILDING ENVELOPES	6+3

Energy efficient Landscape design (L2)- Micro-climates (L2)– various methods (L2) – Shading, water bodies-Building envelope (L2): Building materials (L3), Envelope heat loss and heat gain and its evaluation, paints, Insulation (L2), Design methods and tools (L3).

UNIT– III	HEATING, VENTILATION AND AIR-CONDITIONING	6+3

Natural Ventilation (L2), Passive cooling and heating (L2) - Application of wind, water and earth for cooling, evaporative cooling, radiant cooling (L3) – Hybrid Methods (L2) – Energy Conservation measures (L2), Thermal Storage integration in buildings (L3).

UNIT – IV	HEAT TRANSMISSION IN BUILDINGS	6+3

Surface co-efficient: air cavity, internal and external surfaces (L3), overall thermal transmittance (L2), wall and windows (L2) - Heat transfer due to ventilation/infiltration, internal heat transfer (L3); Sol-air temperature; Decrement factor (L2); Phase lag. Design of day lighting (L2); Estimation of building loads: Steady state method, network method, numerical method, correlations (L2); Computer packages for carrying out thermal design of buildings and predicting performance (L3).

UNIT–V	PASSIVE COOLING & RENEWABLE ENERGY IN BUILDINGS	6+3

Passive cooling concepts: Evaporative cooling (L2), radiative cooling; Application of wind, water and earth for cooling (L2); Shading, paints and cavity walls for cooling (L3); Roof radiation traps (L2); Earth air tunnel (L2). Introduction of renewable sources in buildings (L2), solar water heating, small

wind turbines, stand-alone PV systems, Hybrid system (L2) – Economics (L2).		
OPEN ENDED PROBLEMS / QUESTIONS		
Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.		
		Total : 45 PERIODS
Course Outcomes: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Understand the major components of energy consumption in buildings, including heating, cooling, lighting, and appliances.	Understand (L2)
CO2	Develop a building envelope design that optimizes energy performance through proper insulation, glazing selection, and shading devices.	Apply (L3)
CO3	Explain the mechanisms of heat transfer (conduction, convection, and radiation), and describe how they apply to various building components.	Understand (L2)
CO4	Analyze the effects of different fenestration types on heat gain and loss	Analyze (L4)
CO5	Design a building with integrated renewable energy systems, considering factors like orientation, energy demand, and available resources.	Apply (L3)
REFERENCE BOOKS:		
1.	"Advanced Building Technologies for Sustainability" by Asif Syed (2017)	
2.	Green Strategies for Design and Construction" by Albert Thumann, Eric Woodroof, and Paul Mehta (2010)	
3.	"Energy-Efficient Building Systems: Green Strategies for Operation and Maintenance" by Lal Jayamaha and Don McQuaker (2012)	
4.	"Energy Efficiency: Towards the End of Demand Growth" by Harry Lehmann (2017)	
5.	"Passive Solar Architecture: Heating, Cooling, Ventilation, Daylighting, and More Using Natural Flows" by David A. Bainbridge and Ken Haggard (2011)	
VIDEO REFERENCES:		
1.	https://www.youtube.com/watch?v=5VMXL3lEYTI	
2.	https://www.youtube.com/watch?v=kXmq-uICmTM	
WEB REFERENCES:		
1.	https://www.ashrae.org/	
2.	https://www.energy.gov/eere/buildings/building-technologies-office	
ONLINE COURSES:		
1.	https://onlinecourses.nptel.ac.in/noc23_me138/preview	
2.	https://onlinecourses.nptel.ac.in/noc23_ge41/preview	

ME23IS904	ADVANCED ENERGY STORAGE TECHNOLOGIES	Version: 1.0				
Programme & Branch	M.E-INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	2	1	0	3

Course Objectives:

1.	To understand the various types of energy storage technologies and its applications.
2.	To study the various modeling techniques of thermal energy storage systems
3.	To learn the concepts and types of batteries.
4.	To make the students to get understand the concepts lithium ion battery.
5.	To learn the concepts of different storage systems.

UNIT–I	INTRODUCTION	6+3

Introduction to energy storage for power systems (L2) - Necessity of energy storage (L2) - applications– types of energy storage (L2) – comparison of energy storage technologies(L2) - Overview of energy storage systems on Thermal, Mechanical, Chemical, Electrochemical, Electrical (L3).

UNIT–II	THERMAL STORAGE SYSTEM	6+3

Introduction of Thermal storage (L2) – Types – Modeling of thermal storage units(L2) – Simple water and rock bed storage system (L2) – pressurized water storage system (L3) – Simple units, packed bed storage units(L2).

UNIT– III	ELECTRICAL ENERGY STORAGE	6+3

Fundamental concept of batteries (L2) – measuring of battery performance, charging and discharging of a battery, Energy storage density, energy density, and safety issues(L3). Types of batteries (L2) – Lead Acid, Nickel – Cadmium, Zinc Manganese dioxide(L2).

UNIT – IV	LITHIUM ION BATTERY	6+3

Introduction - Components and their functions(L2) - types - working principle(L2) – manufacturing - safety mechanisms(L2) - Charging and Discharging characteristics(L2) – Overcharging , Cooling Systems(L2) - air cooling , liquid cooling , Phase-Change Materials and Hybrid Cooling Systems (L3).

UNIT–V	HYDROGEN STORAGE AND ALTERNATE ENERGY STORAGE	6+3

Hydrogen storage options (L2) –compressed gas–liquid hydrogen(L2) –Metal Hydrides, chemical Storage.Flywheel, Super capacitors, Principles & Methods (L2) –Applications(L2), Compressed air Energy storage (L2), Concept of Hybrid Storage(L3) – Applications(L2).

OPEN ENDED PROBLEMS / QUESTIONS		
Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.		
		Total : 45 PERIODS
Course Outcomes: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Identify the energy storage technologies for suitable applications.	Apply (L3)
CO2	Apply Skills to design thermal energy storage systems to propose a solution for optimizing energy utilization in a commercial building.	Apply (L3)
CO3	Skill to design the concepts and types of batteries	Apply (L3)
CO4	Apply Skills to design lithium-ion battery technology to design a battery pack for an electric vehicle.	Apply (L3)
CO5	Apply Skills to design energy storage technologies to propose a solution for integrating renewable energy sources into a microgrid.	Apply (L3)
REFERENCE BOOKS:		
1.	Ibrahim Dincer and Mark A. Rosen, "Thermal Energy Storage Systems and Applications", John Wiley & Sons 2002.	
2.	Robert Huggins, "Energy Storage: Fundamentals, Materials andApplications",2ndedition, Springer,2015	
3.	Lunardini.V.J, "Heat Transfer in Cold Climates", John Wiley and Sons 1981.	
4.	Ru-shiliu, Leizhang and Xueliang sun, "Electrochemical technologies for energy storage and conversion", Wiley publications, 2012.	
5.	Schmidt.F.W and Willmott.A.J, "Thermal Storage and Regeneration", Hemisphere Publishing Corporation, 1981.	
VIDEO REFERENCES:		
1.	https://www.youtube.com/watch?v=WBbefOjmiEQ	
2.	https://www.youtube.com/watch?v=VxMM4g2Sk8U	
WEB REFERENCES:		
1.	https://www.cei.washington.edu/research/energy-storage/lithium-ion-battery/	
2.	https://cfdflowengineering.com/battery-cooling-techniques-in-electric-vehicle/	
ONLINE COURSES:		
1.	https://nptel.ac.in/courses/113105102	
2.	https://www.udemy.com/course/li-ion-battery-technology-crash-course-2023/	

ME23IS905	ENERGY CONVERSION TECHNIQUES	Version: 1.0				
Programme & Branch	M.E-INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	2	1	0	3

Course Objectives:

1.	To understand the various types of conventional energy conversion techniques
2.	To study Direct energy conversion systems
3.	To learn chemical and electromagnetic energy conversion techniques
4.	To learn about Phase Change Materials
5.	To provide the insights on fuel cell.

UNIT–I	CONVENTIONAL ENERGY CONVERSION CYCLES	6+3

Reversible and irreversible cycles (L2) – Thermodynamics analysis of Carnot (L3) – Stirling – Ericsson - Otto – Diesel – Dual(L2) – Lenoir – Atkinson - Brayton - Rankine(L2).

UNIT–II	DIRECT CONVERSION OF THERMAL TO ELECTRICAL ENERGY	6+3

Thermoelectric Converters(L2) –Thermionic converters (L2) – Magnetohydrodynamic (MHD) convertor - Ferro electric converter(L3) – Nernst effect generator(L2) .

UNIT– III	CHEMICAL & ELECTROMAGNETIC ENERGY TO ELECTRICAL	6+3

Batteries – types – working (L2) – performance governing parameters (L3) – Hydrogen energy – Solar photovoltaic cells(L2).

UNIT – IV	PHASE CHANGE MATERIALS	6+3

Introduction - Characteristics and classification (L2) -properties (L2) -Techniques for heat transfer between PCM and the fluid cycle(L3) - advantages, disadvantages and Applications(L2) - Solar Energy Applications(L3**)** - Building Applications- Vehicle Applications(L2).

UNIT–V	FUEL CELL	6+3

Basics –Principles of Electrochemical storage(L2) – Types(L2) – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, advantage and drawback of each type(L3).

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.

Total : 45 PERIODS

Course Outcomes: Upon completion of this course the students will be able to:		BLOOM'S Taxonomy
CO1	Study types of conventional energy conversion techniques	Understand (L2)
CO2	Apply knowledge of thermal energy conversion systems to propose solution for improving efficiency	Apply (L3)
CO3	Apply knowledge of chemical energy conversion techniques to propose a solution for improving the efficiency of a biomass power plant.	Apply (L3)
CO4	Apply knowledge of phase change materials to propose solution for improving efficiency	Apply (L3)
CO5	Apply knowledge of propose solution for improving efficiency and Provide the insights on fuel cell.	Apply (L3)

REFERENCE BOOKS:	
1.	ArchieW.Culp, "Principles of Energy Conversion", McGraw-Hill Inc., Singapore, 1991
2.	Hart A.B. and Womack G.J., "Fuel Cells: Theory and Application", Prentice Hall Newyork Ltd., London 1989
3.	Kettari M.A., "Direct Energy Conversion", Addison-Wesley Pub. Co 1997.
4.	Kordesch K. and Simader G., "Fuel Cell and Their Applications", Wiley-Vch, Germany 1996
VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=J6GExOyMtRA
2.	https://www.youtube.com/watch?v=6KkQqTReEBk
WEB REFERENCES:	
1.	https://www.princeton.edu/~ota/disk1/1992/9217/921708.PDF
2.	https://home.engineering.iastate.edu/~jdm/wind/EnergyConversionTechnologies.pdf
ONLINE COURSES:	
1.	https://nptel.ac.in/courses/103107125
2.	https://www.classcentral.com/course/swayam-energy-conversion-technologies-biomass-and-coal-184131
3.	https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020

ME23IS906	MATERIAL TESTING AND CHARACTERIZATION TECHNIQUES	Version: 1.0				
Programme & Branch	M.E-INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	2	1	0	3

Course Objectives:

1	To apply material testing principles to determine the best testing approach for a given material.
2	To understand of the thermal properties of materials and the testing techniques used to characterize them.
3	To understand of non-destructive testing (NDT) principles and techniques.
4	To analyze advanced microstructural analysis techniques used in materials science and engineering.
5	To develop the skills in the emerging trends and future directions of material testing in the field of materials science and engineering.

UNIT–I	INTRODUCTION TO MATERIAL TESTING AND MECHANICAL TESTING TECHNIQUES	6+3

Introduction (L1) - Significance of material tests (L2) - mechanical properties and behavior of materials(L2) - Basic testing terminology and principles different types of material tests methods(L2) - Tensile, compression, hardness tests(L3) - Impact and fatigue testing(L3) -Advanced mechanical properties analysis (L3) - ASTM and ISO standards in material testing(L2).

UNIT–II	THERMAL PROPERTIES AND TESTING	6+3

Introduction - Heat transfer and thermal properties(L2) - thermal conductivity(L2), thermal diffusivity, specific heat capacity, thermal expansion(L2) – High temperature testing(L3) - High-strain-rate testing (L2) – Measurement techniques(L3) - guarded hot plate method, hot wire method(L3) - laser flash method- differential scanning calorimetry (DSC) (L3) - heat flux calorimetry (L3). Applications in engineering (L2).

UNIT– III	NON-DESTRUCTIVE TESTING TECHNIQUES	6+3

Ultrasonic, radiographic, eddy current testing(L3) - Application and advantages(L2) - Detecting flaws and defects(L2) - Visual inspection techniques(L2) - Optical aids and equipment(L2) - Radiographic and computed tomography (CT) inspection(L2) - Emerging NDT techniques(L3).

UNIT – IV	ADVANCED MICROSTRUCTURAL ANALYSIS	6+3

Optical microscopy (L3) - Scanning electron microscopy (SEM) (L3) - Energy-dispersive X-ray spectroscopy (EDS) (L3) -Transmission electron microscopy (TEM) (L3) - X-ray diffraction (XRD) (L3) - Electron backscatter diffraction (EBSD) (L2).

UNIT–V	EMERGING TRENDS AND FUTURE OF MATERIAL TESTING	6+3

Cutting-edge testing methods and technologies (L3) –Additive Manufacturing (L3) - In-situ and Real-Time Testing (L3) - Role of artificial intelligence and machine learning (L2) - Sustainable and green testing practices (L3).

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.

Total : 45 PERIODS

Course Outcomes: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Apply material testing principles to determine the best testing approach for a given material.	Apply (L3)
CO2	Understand of the thermal properties of materials and the testing techniques used to characterize them.	Understand (L2)
CO3	Understand of non-destructive testing (NDT) principles and techniques.	Understand (L2)
CO4	Analysis various microstructural techniques used in materials science and engineering.	Analyze (L4)
CO5	Develop the emerging trends and future directions of material testing in the field of materials science and engineering.	Apply (L3)

REFERENCE BOOKS:

1.	"Materials Science and Engineering: An Introduction" by William D. Callister and David G. Rethwisch
2.	"Mechanical Testing of Materials" by Stephen L. Kampe
3.	"Mechanical and Metal Trades Handbook" by Ulrich Fischer, Max Heinzler, Roland Kilgus, and Friedrich Linnemann
4.	"Materials Characterization: Introduction to Microscopic and Spectroscopic Methods" by Yang Leng
5.	"Nondestructive Testing Handbook: Volume 1, Leak Testing" by American Society for Nondestructive Testing (ASNT)

VIDEO REFERENCES:

1.	https://www.youtube.com/watch?v=MtqugJcsHZs&list=PLbRMhDVUMngdzwQyMgoUgdaGBqi_p4nVM&index=1
2.	https://www.youtube.com/watch?v=v1qw-ttBOdA&list=PL716BC63A7418B310
1.	https://onlinelibrary.wiley.com/journal/2365709x
2.	https://www.routledge.com/Advanced-Materials-Science-and-Technology/book-series/CRCADVMATSCI

ONLINE COURSES:

1.	Advanced Materials And Processes onlinecourses@nptel.iitm.ac.in

ME23IS907	TRIBOLOGY IN DESIGN	Version: 1.0				
Programme & Branch	M.E-INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	2	1	0	3

Course Objectives:

1.	To understand fundamental of tribological principles and their significance in engineering design.
2.	To develop the ability to analyze and predict friction and wear behavior in mechanical systems
3.	To Investigate various lubrication techniques and their application in reducing friction and
4.	To develop skills in the selection of materials and surface treatments for improved tribological performance
5.	To encourage critical thinking and problem-solving in the context of selection of bearings and seals.

UNIT–I	INTRODUCTION TO TRIBOLOGY	6+3

Define friction and wear, and discuss their significance in mechanical systems (L2) - Introduce the laws of friction and coefficients of friction (L2) - Explore different types of wear (abrasive, adhesive, etc.) and their mechanisms (L3).

UNIT–II	FRICTION AND WEAR	6+3

Factors influencing friction, such as surface roughness and lubrication (L2) - material properties and how they affect wear behavior (L2) - concept of wear testing methods (L3) - applications of the knowledge of factors affecting friction and wear (L3).

UNIT– III	LUBRICATION AND LUBRICATION REGIMES	6+3

Lubrication types (boundary, hydrodynamic, mixed) (L2) - role of lubricants and additives in reducing friction and wear - lubrication strategies for mechanical systems- Selection of lubrication method and lubrication regime - applications of lubrication.

UNIT – IV	SURFACE ENGINEERING FOR WEAR CONTROL	6+3

Surface treatments (coatings, plating) for wear control - surface texturing and its role in reducing friction and wear (L2) - material selection for improved tribological performance (L3) - techniques involve modifying the surface properties of materials (L3) - applications of surface engineering for wear control (L3).

UNIT–V	BEARINGS AND SEALS	6+3

Importance of bearings and seals in mechanical systems (L1) - Analyze bearing types (plain, roller, ball) (L2) - tribological characteristics (L3) - Discuss sealing mechanisms and materials-selection of bearings and seals (L2) - applications of bearings and seals(L3).

OPEN ENDED PROBLEMS / QUESTIONS		
Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.		
		Total : 45 PERIODS
Course Outcomes: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Explain the key concepts and terminology of tribology.	Understand (L2)
CO2	Apply the skills in friction and wear behavior of simple mechanical systems.	Apply (L3)
CO3	Investigating various lubrication techniques and their application in reducing friction and wear.	Analyze (L4)
CO4	Design surface engineering techniques to mitigate wear in mechanical systems.	Apply (L3)
CO5	Analyze the bearings and seals considering various factors.	Analyze (L4)
REFERENCE BOOKS:		
1.	"Engineering Tribology" by Gwidon Stachowiak and Andrew W. Batchelor.	
2.	"Friction and Wear of Materials" by Ioan D. Marinescu, Constantin Caruntu, and Heshmat Aglan.	
3.	"Mechanical and Metal Trades Handbook" by Ulrich Fischer, Max Heinzler, Roland Kilgus, and Friedrich Linnemann.	
4.	"Surface Engineering: Science and Technology II" edited by J. Paulo Davim.	
5.	"Applied Tribology: Bearing Design and Lubrication" by Michael M. Khonsari and E. Richard Booser.	
VIDEO REFERENCES:		
1.	https://www.youtube.com/watch?v=7XBeRGmpLrE	
2.	https://www.youtube.com/watch?v=Bmj85Ihfv7w&list=PLLy_2iUCG87Bhld-RXqBIAwKCLaLjOzX_	
WEB REFERENCES:		
1.	https://archive.nptel.ac.in/courses/112/102/112102014/	
2.	https://nptel.ac.in/courses/113108083	
ONLINE COURSES:		
1.	Introduction to tribology onlinecourses@nptel.iitm.ac.in	

ME23IS908	MEASUREMENT AND CONTROL FOR ENERGY SYSTEMS	Version: 1.0				
Programme & Branch	M.E-INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	2	1	0	3

Course Objectives:

1.	To explain the basic concepts of measurement, including precision, accuracy, and units of
2.	To understand the need for signal conditioning to enhance the quality and compatibility of measurement signals.
3.	To apply techniques to ensure proper calibration, instrument maintenance, and data validation.
4.	To describe the dynamic behavior of control systems, including transient and steady-state
5.	To understand the frequency response of control systems in the context of system dynamics and

UNIT–I	MEASUREMENT CHARACTERISTICS	6+3

Introduction to measurements (L1), Errors in measurements (L2), Statistical analysis of data (L2), Regression analysis (L2), Correlation (L2), Estimation of uncertainty and Presentation of data, Design of experiments (L2)– Experimental design factors and protocols (L3).

UNIT–II	MEASUREMENTS IN ENERGY SYSTEMS	6+3

Basic Electrical measurements (L2), Transducers and its types (L2), Signal conditioning and processing (L2) - Measurement of temperature (L2), pressure, velocity, flow rate, thermo (L3)-physical and transport properties of solids liquids and gases (L2), Radiation properties of surfaces (L1), Vibration and noise (L2) - Computer assisted data acquisition (L2), Data manipulation and data presentation (L2).

UNIT– III	IAQ MEASUREMENTS & CONTROL	6+3

Contaminants measurement (L2) - sampling methods (L2) -Quality assurance (L1)-calibration - data Interpretation (L2) – instruments specifications (L2) - source control (L2) – prevention (L2) - Dilution Ventilation (L2) - demand control volume method (L3).

UNIT – IV	CONTROL SYSTEMS	6+3

Introduction, Open and closed loop control systems (L3), Transfer function (L2). – Dynamic characteristics (L2) –Types of feedback and feedback control system characteristics (L3) – Effect of disturbances (L2).

UNIT–V	DESIGNING OF MEASUREMENT AND CONTROL SYSTEMS	6+3

Designing of temperature, pressure, flow and liquid level measurement and control system (L2) – Performance (L2) – Steady state accuracy (L2) – Transient response (L2) – Frequency response (L3) – Fault finding (L1) – Computer based controls (L2).

OPEN ENDED PROBLEMS / QUESTIONS		
Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.		
		Total : 45 PERIODS
Course Outcomes: **Upon completion of this course the students will be able to:**		**BLOOM'S Taxonomy**
CO1	Explain the fundamental concepts of measurement, including accuracy, precision, and units of measurement.	Understand (L2)
CO2	Explain the fundamental principles of electrical measurements, including voltage, current, resistance, and power.	Understand (L2)
CO3	Demonstrate proficiency in calibrating measurement instruments used for contaminant analysis.	Apply (L3)
CO4	Analyze the advantages and limitations of open and closed-loop control systems in engineering applications.	Analyze (L4)
CO5	Apply knowledge of sensor technologies to select appropriate sensors for temperature, pressure, flow, and liquid level measurements.	Apply (L3)
REFERENCE BOOKS:		
1.	"Measurement and Instrumentation: Theory and Application" by Alan S. Morris, Reza Langari (2019)	
2.	"Energy Systems Engineering: Evaluation and Implementation" by Francis Vanek, Louis D. Albright (2017)	
3.	"Process Control: A First Course with MATLAB" by Pao C. Chau (2013)	
4.	"Principles of Measurement Systems" by John P. Bentley (2005)	
5.	"Instrumentation, Control, and Automation in Wastewater Systems" by Panagiotis G. Michalakis (2017)	
VIDEO REFERENCES:		
1.	https://www.youtube.com/watch?v=3uLIrsUb4EA	
2.	https://www.youtube.com/watch?v=sraco1MnEDQ	
WEB REFERENCES:		
1.	https://www.nrel.gov	
2.	https:// www.iea.org	
ONLINE COURSES:		
1.	https://onlinecourses.nptel.ac.in/noc23_ee105/preview	
2.	https://onlinecourses.nptel.ac.in/noc23_ge47/preview	

ME23IS909`	COMPUTATIONAL FLUID DYNAMICS	Version: 1.0				
Programme & Branch	M.E-INDUSTRIAL SAFETY ENGINEERING	CP	L	T	P	C
		3	2	1	0	3

Course Objectives:

1.	To recognize the sources of numerical errors in numerical simulations of fluid flow and heat transfer.
2.	To develop a deep understanding of diffusion phenomena, including molecular diffusion, heat conduction, and mass transfer in various physical systems.
3.	To understand the interdisciplinary nature of convection-diffusion processes and their relevance in various engineering and scientific fields.
4.	To develop skills to visualize and interpret simulation results, including flow patterns, velocity profiles, pressure distributions, and energy transfer.
5.	To explore the principles of Direct Numerical Simulation (DNS) and its ability to resolve all turbulence scales.

UNIT–I	GOVERNING DIFFERENTIAL EQUATIONS AND	6+3

Basics of Heat Transfer (L1), Fluid flow (L2) – Mathematical description of fluid flow and heat transfer (L3) – Conservation of mass, momentum, energy and chemical species (L2)- Classification of partial differential equations (L2) – Initial and Boundary Conditions (L2) – Discretisation techniques using finite difference methods (L3)- Uniform and non-uniform Grids, Numerical Errors (L2).

UNIT–II	DIFFUSION PROCESSES : FINITE VOLUME METHOD	6+3

Steady one-dimensional diffusion (L2), Two and three dimensional steady state diffusion problems (L2), Discretisation of unsteady diffusion problems (L3) – Explicit, Implicit and Crank-Nicholson's schemes (L2), Stability of schemes (L2).

UNIT– III	CONVECTION-DIFFUSION PROCESSES : FINITE VOLUME METHOD	6+3

One dimensional convection (L2) – diffusion problem, Central difference scheme, upwind scheme (L3) – Hybrid and power law discretization techniques (L2)– QUICK scheme (L2).

UNIT – IV	FLOW PROCESSES : FINITE VOLUME METHOD	6+3

Discretisation of incompressible flow equations (L2) – Pressure based algorithms (L2).

UNIT–V	TURBULENCE MODELS	6+3

Turbulence (L1) – RANS equation (L2)- Algebraic Models, One equation model, Two equation models (L3) – k - ϵ model, Low Reynold number models of k- ϵ (L2), Direct Numerical Simulation (DNS) (L2).

OPEN ENDED PROBLEMS / QUESTIONS

Course specific open ended problems will be solved during the classroom teaching. Such problems can be given as assignments and evaluated as internal assessment only and not for the end semester examination.

Total : 45 PERIODS

Course Outcomes: Upon completion of this course the students will be able to:		BLOOM'S Taxonomy
CO1	Apply conservation laws (mass, momentum, energy, etc.) to formulate governing equations for specific physical processes.	Apply (L3)
CO2	Apply various discretization techniques for both steady and unsteady diffusion problems.	Apply (L3)
CO3	Apply validation techniques to compare simulation results against analytical solutions, experimental data, or benchmark cases.	Apply (L3)
CO4	Understand how to verify the accuracy of numerical implementations for convection-diffusion simulations.	Understand (L2)
CO5	Understand how to analyze flow patterns, turbulence intensities, and other relevant quantities.	Understand (L2)

REFERENCE BOOKS:	
1.	Versteeg and Malalasekera, N, "An Introduction to computational Fluid Dynamics The Finite Volume Method," Pearson Education, Ltd., Second Edition, 2014.
2.	Ghoshdastidar, P.S., "Computer Simulation of Flow and Heat Transfer", Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998.
3.	Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2003.
4.	Subas and V.Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation, 1980.
5	Jiyuan Tu, Guan Heng Yeoh, Chaogun Liu, "Computational Fluid Dynamics A Practical Approach" Butterworth – Heinemann An Imprint of Elsevier, Madison, U.S.A., 2008

VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=aShONtHloUk&list=PLbRMhDVUMngcFmWiK1YBhAbsYo8mYvPKJ
2.	https://www.youtube.com/watch?v=oQL4CFbHY_g&list=PLaDq_DX7U7V91gfLrGdx0Yg68KW1Xlq

WEB REFERENCES:	
1.	https://www.cfd-online.com/
2.	https://www.ansys.com/products/fluids/ansys-fluent

ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc23_me119/preview
2.	https://onlinecourses.nptel.ac.in/noc23_me94/preview