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–637504.SalemDt.,TamilNadu,India.

Beyond Knowledge

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: 06.07.2024

CHAIRPERSON
Board of Studies
Faculty of Mechanical Engineering
Knowledge Institute of Technology
KIOT Campus, Kakapalayam.

	KNOWLEDGE INSTITUTE OF TECHNOLOGY(AUTONOMOUS),SALEM-637504
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	Website: www.kiot.ac.in

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M.E./M.Tech. REGULATIONS 2023 (R2023)

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 teamwork.

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

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 modeling 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

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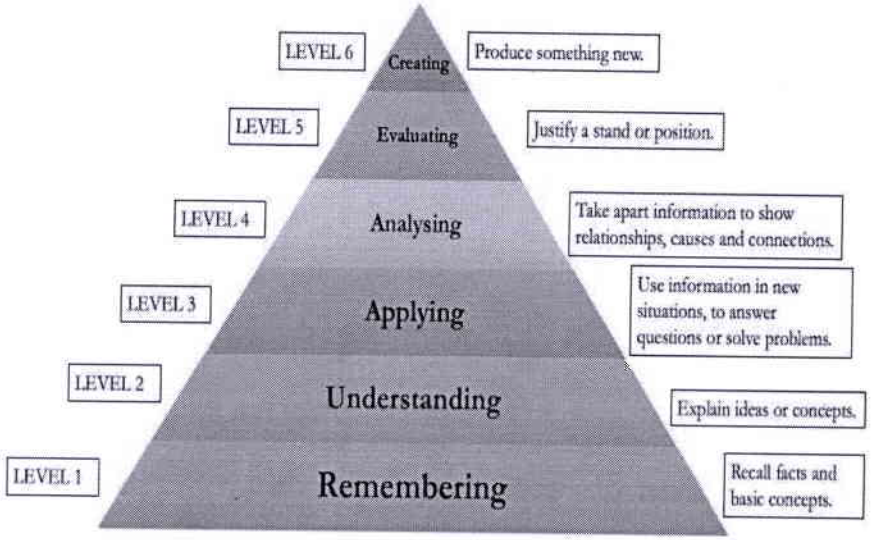
Bloom's Taxonomy Levels(BTL)

Bloom's Taxonomy(BT) is based on the belief that learners must begin by learning basic, foundational knowledge about a given subject before they can progress to more complex types of thinking such as analysis and evaluation. Bloom's Taxonomy can be useful for course design because the levels can help faculty to teach students through the process of learning, from the most fundamental remembering and understanding to the more complex evaluating and creating.



At KIOT, the Curriculum Design, Delivery and Assessment (CDDA) are carried out based on the Blooms' Taxonomy Levels (BTL). Its organized set of objectives helps teachers to plan and deliver appropriate instruction, design valid assessment tasks & schemes. It also helps to ensure that instruction

KNOWLEDGE INSTITUTE OF TECHNOLOGY(AUTONOMOUS),SALEM -637504												
M.E.INDUSTRIAL SAFETY ENGINEERING										Version:1.0		
Courses of Study and Scheme of Assessment(Regulations2023)										Date:06.07.2024		
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

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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

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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	ISO45001 and ISO14000	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

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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
10	ME23IS911	Polymers and Composite Materials	SE	3	2	1	0	3	40	60	100
11	ME23IS913	Advanced Internal Combustion Engines	SE	3	2	1	0	3	40	60	100
12	ME23IS915	Engine Pollution and Control	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.

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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		

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ME23IS309	ELECTRICAL SAFETY	CP	L	T	P	C
		3	3	0	0	3
Programme & Branch	M.E. INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

1	To provide knowledge on basics of electrical fire and statutory requirements for electrical safety.
2	To understand the causes of accidents due to electrical hazards.
3	To learn the various protection systems in Industries from electrical hazards.
4	To learn the importance of earthing.
5	To distinguish the various hazardous zones and applicable fire proof electrical devices.

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 energy current surges(L2)-Safety in handling of war equipment's (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 arc ignition 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 equipment's (L2).

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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	Summarize the basic concepts in electrical circuit and its operations.	L2-Understand
CO2	Outline the electrical hazards in an Industry.	L2-Understand
CO3	Choose various protection systems for different electrical operations.	L3- Apply
CO4	Apply knowledge for the safe selection, installation, operation, and maintenance of electrical systems.	L3- Apply
CO5	Identify hazardous zones in various industries.	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, 2003.
3.	"Power Engineers Handbook", 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 Heinemann Ltd, London, Third edition, 1998.

VIDEO REFERENCES:

1.	https://www.youtube.com/watch?v=tt80OiM1N9s
2.	https://www.youtube.com/watch?v=MEk68_veQYM

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WEB REFERENCES:	
1.	https://www.osha.gov/electrical#:~:text=Electricity%20has%20long%20been%20recognized,electrocution%2C%20fires%2C%20and%20explosions.
2.	https://www.ncbi.nlm.nih.gov/books/NBK580528/
ONLINE COURSES:	
1.	https://onlinecourses.swayam2.ac.in/nou20_cs08/preview
2.	https://www.tcsion.com/courses/ve/safety/siemens/electrical-safety-online-course-and-training/

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		2	3			2
CO2		2	3			
CO3		2	3	1		
CO4	1	2	3	1		1
CO5	2	2	3	1	1	1
Average	1.5	2	3	1	1	1.3
1–Low,2–Medium,3–High.						

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ME23IS601	PROJECT WORK–PHASE I	CP	L	T	P	C
		12	0	0	12	6
Programme & Branch	M.E.INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

1	To identify relevant research problems by searching academic databases and literature.
2	To design and conduct preliminary studies to explore identified problems.
3	To compile and present research findings effectively.

COURSE CONTENT:

The Student will identify and select a problem based on comprehensive literature survey. The student should submit a proposal and get it approved by the Head of the department.

Three reviews will be conducted by Project review committee. Students will be evaluated by the committee during the review and suggestions will be offered by members.

The report for PHASE-I should be submitted by the students at the end of course

Total: 180 Periods

Course Outcomes: Upon completion of this course the students will be able to:		**BLOOM'S Taxonomy**
CO1	Collect various literature articles to identify a research gap related to Environmental Health and Safety (EHS).	L3- Apply
CO2	Analyze the problem using suitable methodology to give solution	L4- Analyze
CO3	Prepare a project report and present the findings.	L3- Apply

Mapping of COs with POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	3	1	1	1
CO2	3	3	3	2	2	1
CO3	1	3	2	1	1	1
Average	2	3	2.7	1.3	1.3	1
1–Low,2–Medium,3–High.						

ME23IS602	PROJECT WORK–PHASE II	CP	L	T	P	C
		24	0	0	24	12
Programme& Branch	M.E.INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

1	To develop the skill of students for analyzing safety problems to control the hazard.
2	To expose the students to identify and evaluate the hazards in an industry under study.
3	To expose the students to assess the Compliance level of safety norms and procedures.

COURSE CONTENT:

It is the continuation of Phase I project. Three reviews will be conducted by Project review committee. Students' presentation will be evaluated by the committee during the reviews and suggestions will be offered by the committee members.

At least one paper should be published by the student in international/national conference and/or filing of the patent.

There port should be submitted by the students at the end of course.

Total: 360 Periods

Course Outcomes: Upon completion of this course the students will be able to:		**BLOOM'S Taxonomy**
CO1	Apply the appropriate methodology and find the solution for EHS related problems.	L4- Analyze
CO2	Create Safety procedures, and accident investigation reports relevant to the problem identified.	L6- Create
CO3	Prepare a project report and present the findings.	L3- Apply

Mapping of COs with POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	2	1
CO2	3	3	3	3	3	1
CO3	1	3	2	1	1	1
Average	2.3	2.7	2.7	2.3	2	1
1–Low,2–Medium,3–High.						

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ME23IS410	SAFETY IN TEXTILE INDUSTRY	CP	L	T	P	C
		3	3	0	0	3
Programme & Branch	M.E.INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

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

UNIT–I	INTRODUCTION	9

Introduction to process flow charts of i) short staple spinning, ii) long staple spinning, iii) viscose rayon and synthetic fiber, manufacturer, iv)spun and filament yarn to fabric manufacture, v)jute spinning and jute fabric manufacture-accident hazard, (L2)-guarding of machinery and safety precautions in opening,(L3)- carding, combing, drawing, flyer frames and ring frames, doubles, rotor spinning,(L2) winding, warping, softening/spinning specific to jute(L2).

UNIT–II	TEXTILE HAZARDS I	9

Accident hazards L2i)sizing processes-cooking vessels, transports of size, hazards due to steam(L3) ii)Loom shed–shuttle looms and shuttles looms(L2) iii)knitting machines iv)non-wovens(L2).

UNIT– III	TEXTILE HAZARDS II	9

Scouring, bleaching(L2),dyeing, punting, mechanical finishing operations(L2), and effluents in textile processes (L2).

UNIT–IV	HEALTH AND WELFARE	9

Health hazards in textile industry related to dust (L2), fly and noise generated-control measures-relevant occupational diseases (L2) personal protective equipment(L2)-health and welfare measures specific to textile industry(L2), Special precautions for specific hazardous work environments(L2).

UNIT–V	SAFETY STATUS	9

Relevant provision of factories act and rules and other statues applicable to textile industry (L2) – effluent treatment and waste disposal in textile industry(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.

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Course Outcomes: Upon completion of this course the students will be able to:		BLOOM'S Taxonomy
CO1	Identify potential accident hazards associated with various stages of textile manufacturing processes.	L3- Apply
CO2	Apply safety precautions in loom operations.	L3- Apply
CO3	Summarize specific accident hazards present in loom shed environments, including those associated with both shuttle and non-shuttle looms.	L2-Understand
CO4	Apply control measures to reduce health hazards in the textile industry and implement appropriate personal protective equipment (PPE) to ensure worker safety.	L3- Apply
CO5	Apply knowledge of waste disposal in the textile industry, including solid waste, hazardous waste, and wastewater sludge, in accordance with regulatory requirements.	L3- Apply

REFERENCE BOOKS:	
1.	"100 Textile fires analysis, findings and recommendations" LPA, 2008.
2.	Groover E.B. and Hamby D.S., "Hand book of textile testing and quality control", New York: Textile Book Publishers, 1960.
3.	"Quality tolerances for water for textile industry",BIS,1992.
4.	Shenai V.A., "A technology of textile processing", Vol. I, Textile Fibres, Sevak, 1975.
5.	Little A.H., Water supplies and the treatment and disposal of effluent, Manchester: Textile Institute, 1975.
6.	"Safety in Textile Industry", Thane Belapur Industries Association, Mumbai, 2007.
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		1	3		2	
CO2		2	3	3		2
CO3		1	3			
CO4	1	2	3	2		
CO5		1	2		2	
Average	1	1.4	2.8	2.5	2	2
1–Low,2–Medium,3–High.						

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ME23IS411	SAFETY IN MINES	CP	L	T	P	C
		3	3	0	0	3
Programme & Branch	M.E.INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

1	To provide in depth knowledge on Safety of mines of various types.
2	To understand the different types of mines and risks involved in the mining operations.
3	To gain knowledge on types of accidents in mines and how to manage during accidents.
4	To assess the Hazardous nature of mining activities and develop a safety system to reduce the risk
5	To implement the Emergency preparedness in the working environment of mines and to plan for the disaster management.

UNIT–I	OPEN CASTMINES	9

Causes and prevention of accident from : Heavy machinery, belt and bucket conveyors, drilling, hand tools(L2)-pneumatic systems, pumping, water, dust, electrical systems, fire prevention(L2). Garage safety(L2)–accident reporting system(L2)-working condition(L2)–safe Transportation(L2)–handling of explosives(L2).

UNIT–II	UNDER GROUND MINES	9

Fall of roof and sides-effect of gases(L2)- fire and explosions-water flooding(L2)-warning sensors(L2)-gas detectors- occupational hazards(L2)-working conditions(L2)-winding and transportation(L2).

UNIT–III	TUNNELLING	9

Hazards from: ground collapse(L2), inundation and collapse of tunnel face, falls from platforms and danger from falling bodies(L2). Atmospheric pollution (gases and dusts) (L2)– trapping (L2)–transport(L2)-noise(L2)- electrical hazards-noise and vibration from: pneumatic tools and other machines(L2)–ventilation and lighting(L2)–personal protective equipment(L2).

UNIT–IV	RISK ASSESSMENT	9

Basic concepts of risk(L2)-reliability and hazard potential(L2)-elements of risk assessment(L2) – statistical methods (L3)– control charts(L2)-appraisal of advanced techniques(L3) - fault tree analysis(L5) - failure mode and effect analysis(L5)–quantitative structure(L2) - activity relationship analysis(L2) - fuzzy model for risk assessment(L2).

UNIT–V	ACCIDENT ANALYSIS AND MANAGEMENT	9

Accidents classification and analysis(L2)–fatal(L2), serious, minor and reportable accidents (L2)– safety audits(L3)- recent development of safety engineering approaches for mines(L2) - frequency rates(L3) - accident occurrence(L2) - investigation -measures for improving safety in mines(L2) - cost of Accident(L3) - emergency preparedness(L2)–disaster management(L2).

Total:45 Periods

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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 concept of safety aspects in the mining industries.	L2-Understand
CO2	Summarize the hazards and control measure in an underground mining activity.	L2-Understand
CO3	Apply control measures to address the hazards encountered in tunneling activities to ensure worker safety	L3- Apply
CO4	Assess the severity of risk in mines to take the required remedial action.	L5-Evaluate
CO5	Utilize risk assessment techniques, disaster management, and emergency preparedness to prevent accidents.	L3- Apply
REFERENCE BOOKS:		
1.	"DGMS Circulars-Ministry of Labour", Government of India press, OR Lovely Prakashan-DHANBAD, 2002.	
2.	Kejiriwal B.K. "Safety in Mines", Gyan Prakashan, Dhanbad,2001.	
3.	Michael Karmis "Mine Health and Safety Management",SME,Littleton,Co.2001.	
4.	Dhillon, Balbir S "Mine safety- A modern Approach", Springer Publication,2010.	
VIDEO REFERENCES:		
1.	https://www.youtube.com/watch?v=fEFZw7bXSmk&list=PLB3JRydr2LBWmZ0n54wDrJHqzlsaf4bF0	
2.	https://www.youtube.com/watch?v=VE_xMqMp0k&list=PL8sSTcOtMi6a5saSaUnpQjlFtjQ3qw2lt	
WEB REFERENCES:		
1.	https://www.dgms.gov.in/	
2.	https://coal.gov.in/sites/default/files/2020-09/Chapter11-en.pdf	
ONLINE COURSES:		
1.	https://onlinecourses.nptel.ac.in/noc22_mm47/preview	
2.	https://www.classcentral.com/course/mining-the-university-of-queensland-health-safety-22045	

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

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ME23IS412	DOCK SAFETY	CP	L	T	P	C
		3	3	0	0	3
Programme & Branch	M.E.INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

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

UNIT–I	HISTORY OF SAFETY LEGISLATION	9

History of dock safety statues in India-background of present dock safety statues (L2)-dockworkers (safety, health and welfare) act 1986 (L2) and the rules and regulations framed there under, other statues like marking of heavy packages act 1951 (L2) and the rules framed there under (L2) –manufacture , storage and import of hazardous chemicals (L2). Rules 1989 framed under the environment (protection) act, (L2) 1989-fewcases laws to interpret the terms used in the dock safety statues(L2).

Responsibility of different agencies for safety, health and welfare involved in dock work (L2) –responsibilities of port authorities – dock labour board (L2) – owner of ship master, agent of ship(L2)–owner of lifting appliances and loose gear etc. (L2) – employers of dock workers like stevedores (L2) –clearing and forwarding agents (L2) – competent persons and dock worker. Forums for promoting safety and health in ports (L2)–Safe Committees and Advisory Committees. Their functions, training of dock workers(L2).

UNIT–II	WORKING ON BOARD THE SHIP	9

Types of cargo ships (L2) – working on board ships(L2) – Safety in handling of hatch beams (L2) – hatch covers including its marking, Mechanical operated hatch covers of different types and its safety features (L2) – safety in chipping and painting operations on board ships (L2) – safe means of accesses – safety in storage etc. (L2) – illumination of decks and in holds (L2) – hazards in working inside the hold of the ship and on decks – safety precautions needed (L2) – safety in use of transport equipment (L2) -internal combustible engines like fort-lift trucks-pay loaders, etc (L2). Working with electricity and electrical management (L2) – Storage – types, hazardous cargo(L2).

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UNIT–III	LIFTING APPLIANCES	9
Different types of lifting appliances (L2)– construction, maintenance and use, various methods of rigging of derricks(L2), safety in the use of container handling/lifting appliances like portainers, transtainer, top lift trucks and other containers (L2)–testing and examination of lifting appliances(L2) – portainers – transtainer stop lift trucks(L2)– derricks in different rigging etc(L2). Use and care of synthetic and natural fiber ropes (L2) – wire rope chains, different types of slings and loose gears(L2).		
UNIT– IV	**TRANSPORT EQUIPMENT**	**9**
The different types of equipment for transporting containers and safety in their use-safety in the use of self loading container vehicles(L2), container side lifter, fork lift truck, dock railways, conveyors and cranes(L2). Safe use of special lift trucks inside containers(L2) – Testing, examination and inspection of containers(L2) – carriage of dangerous goods in containers and maintenance and certification of containers for safe operation Handling of different types of cargo (L2) – stacking and unstacking both on board the ship and a shore(L2) – loading and unloading of cargo identification of berths/walking for transfer operation of specific chemical from ship to shore and vice versa (L2) – restriction of loading and unloading operations(L3).		
UNIT–V	**EMERGENCY ACTION PLAN AND DOCK WORKERS(SHW) REGULATIONS 1990**	**9**
Emergency action Plans for fire and explosions (L2) - collapse of lifting appliances and buildings, sheds etc., (L3) - gas leakages and precautions concerning spillage of dangerous goods etc(L2)., -Preparation of on-site emergency plan and safety report(L2). Dock workers(SHW) rules and regulations1990- related to lifting appliances(L2), Container handling, loading and unloading (L2), handling of hatch coverings and beams, Cargo handling, conveyors, dock railways, forklift(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.		

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Course Outcomes: Upon completion of this course the students will be able to:		BLOOM'S Taxonomy
CO1	Illustrate the background and evolution of present dock safety statutes, including the factors that contributed to their enactment.	L2-Understand
CO2	Summarize the importance of safety measures when handling hatch beams and hatch covers on cargo ships.	L2-Understand
CO3	Outline the principles of safe rigging practices, including the selection and placement of rigging equipment and the calculation of load capacities.	L2-Understand
CO4	Select safety measures to prevent accidents and ensure the safe handling of containers and cargo during transportation operations."	L3- Apply
CO5	Make use of protocols and procedures for responding to emergencies effectively, including evacuation plans and emergency response teams.	L3- Apply

REFERENCE BOOKS:	
1.	"Dock Safety" Thane Belapur Industries Association, Mumbai.
2.	Bindra S R "Course in Dock and Harbour Engineering", Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.
3.	"Safety and Health in Dock work", 2nd Edition, ILO,1992.
4.	Srinivasan "Harbour, Dock and Tunnel Engineering", Charotar Publishing House Pvt. Limited, 2011.
5.	Taylor D.A., "Introduction to Marine Engineering", 2nd Edition, Butterworth-Heinemann, 1996.
VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=b9cTL5JakVc
2.	https://www.youtube.com/channel/UC7j-KnWLS8at_Z0c0ZbunoA
WEB REFERENCES:	
1.	https://www.ehs.uci.edu/safety/_pdf/loading-dock-safety-reference-guide.pdf
2.	https://dgfasli.gov.in/dock-safety-view
ONLINE COURSES:	
1.	https://nptel.ac.in/courses/114105003
2.	https://archive.nptel.ac.in/courses/114/105/114105003/

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Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		1	3		3	
CO2		1	3	1		
CO3		1	3	1		
CO4	1	1	3	2	2	
CO5		1	2			2
Average	1	1	2.8	0.8	1	0.4
1–Low, 2–Medium, 3–High.						

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ME23IS413	SAFETY IN ENGINEERING INDUSTRY	CP	L	T	P	C
		3	3	0	0	3
Programme & Branch	M.E.INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

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 develop the knowledge related to health and welfare measures in engineering industry

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

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

UNIT–II	PRINCIPLES OF MACHINE GUARDING	9

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

Selection and suitability: lathe-drilling-boring-milling-grinding-shaping-sawing-shearing-presses (L3)-forgehammer-flywheels-shafts-couplings-gears-sprocketswheelsandchains (L3)-pulleys and belts (L3)-authorized entry to hazardous installations (L3)-benefits of good guarding systems (L2).

UNIT–III	SAFETY IN WELDING AND GASCUTTING	9

Gas welding and oxygen cutting(L2), resistances welding, arc welding and cutting, common hazards , personal protective equipment, training, safety precautions in brazing, soldering and metalizing(L2)–explosive welding, selection, care and maintenance of the associated equipment and instruments(L3)– safety in generation, distribution and handling of industrial gases(L2)-colour coding(L2)–flash back arrestor(L2)–leak detection(L2)-pipe line safety(L2)-storage and handling of gas cylinders(L2).

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

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

Safe tying as furnace operation, cupola, crucibles, ovens (L2),foundry health hazards (L2),work environment(L2), material handling in foundries(L2), 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(L2), sand and shot blasting(L2), safety in inspection and testing(L2), dynamic balancing(L2), hydro testing(L2), valves, boiler drums and headers(L2), pressure vessels(L2), 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(L2).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	Infer safety rules, standards and codes in various mechanical engineering processes.	L2-Understand
CO2	Choose suitable machine guarding systems for various machines such as lathes, drilling machines, boring machines, milling machines, etc.	L3 - Apply
CO3	Apply safety concepts to welding, gas cutting, storage and handling of gas cylinders, and metal forming processes.	L3 - Apply
CO4	Demonstrate knowledge in testing and inspection as per rules in boilers, heat treatment operations.	L2-Understand
CO5	Apply preventive measures to enhance the health and welfare of workers	L3 - Apply

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REFERENCE BOOKS:	
1.	Philip E. Hagan, John Franklin Montgomery, James T. O"Reilly, "Accident Prevention Manual" NSC, Chicago, 13th edition, 2009.
2.	"Occupational safety Manual" BHEL, Trichy, 1988.
3.	John V. Grimaldi and RollinH. Simonds "Safety Management", All India Travelers Bookseller, New Delhi,1989.
4.	Krishnan N.V. "Safety in Industry" Jaico Publishery House,1996.
5.	"Indian Boiler acts and Regulations", Government of India.
6.	"Safe use of wood working machinery", HSE, UK, 2005.
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=p9tJtV-SDXY
2.	https://www.youtube.com/watch?v=bAPMLwi0a88
WEB REFERENCES:	
1.	https://www.osha.gov/woodworking
2.	https://www.osha.gov/sites/default/files/publications/osha3157.pdf
ONLINE COURSES:	
1.	https://www.aws.org/Certification-and-Education/Education/Safety-in-Welding/
2.	https://www.classcentral.com/subject/woodworking

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

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ME23IS414	QUALITY ENGINEERING IN PRODUCTION SYSTEMS	CP	L	T	P	C
		3	3	0	0	3
Programme & Branch	M.E.INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

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

UNIT–I	INTRODUCTION TO QUALITY ENGINEERING AND LOSS FUNCTION	9

Quality value and engineering (L2) - overall quality system (L2) -quality engineering in product design (L2) -quality engineering in design of production processes (L2) - quality engineering in production (L2)-quality engineering in service. Loss function Derivation (L2) – use-loss function for products/system (L2)-justification of improvements- loss function and inspection(L2) -quality evaluations and tolerances -N type, S type, L type(L2).

UNIT–II	ON-LINE QUALITY CONTROL	9

On-line feedback quality control variable characteristics-control with measurement interval (L2) - one unit, multiple units-control systems for lot and batch production(L2). On-line process parameter control variable characteristics (L2)- process parameter tolerances(L2)-feedback control systems- measurement error and process control parameters(L2).

UNIT–III	ON-LINE QUALITYCONTROL ATTRIBUTES AND METHODS FOR PROCESS IMPROVEMENTS	9

Checking intervals (L2)- frequency of process diagnosis(L3). Production process improvement method (L2)- process diagnosis improvement method(L2)-process adjustment and recovery improvement methods(L2).

UNIT– IV	QUALITY ENGINEERING AND TPM	9

Preventive maintenance schedules(L2) -PM schedules for functional characteristics(L3) -PM schedules for large scale systems. Quality tools(L2)– fault tree analysis, event tree analysis, (L2)failure mode and effect analysis. (L2) ISO quality systems(L2).

UNIT–V	SIX SIGMA AND ITS IMPLEMENTATION	9

Introduction- definition-methodology (L2)- impact of implementation of six sigma-DMAIC method (L2)- roles and responsibilities–leaders ,champion, black belt, greenbelts (L2). Do's and don'ts - readiness of organization (L2)– planning - management role - six sigma tools(L2) – sustaining six sigma(L2).

TOTAL:45 Periods

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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 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	Outline the role of quality engineering in the design phase of products, emphasizing the integration of quality considerations from the outset.	L2-Understand
CO2	Summarize the role of process parameters in influencing product quality and explain how to adjust them in real-time to maintain quality standards.	L2-Understand
CO3	Utilize various methods and techniques to improve production processes, enhancing both product quality and efficiency.	L3- Apply
CO4	Apply fault tree analysis, event tree analysis, and failure mode and effect analysis(FMEA) to identify potential failure modes.	L3- Apply
CO5	Utilize strategic planning and change management to effectively prepare an organization for Six Sigma implementation.	L2-Understand
REFERENCE BOOKS:		
1.	Brue G, "Six Sigma or Managers", Tata-McGrawHill, New Delhi, Second reprint,2002.	
2.	De Feo J A and Barnard W W, "Six Sigma:Breaktrough and Beyond",Tata McGraw-Hill, New Delhi,2005.	
3.	Pyzdek T and Berger R W," Quality Engineering Handbook",Tata-McGrawHill, New Delhi, 1996.	
4.	Taguchi G, Elsayed E A and Hsiang, T.C.,"Quality Engineering in Production Systems", Mc-Graw-Hill Book company, Singapore, International Edition,1989.	
VIDEO REFERENCES:		
1.	https://www.youtube.com/watch?v=SoUjQpIO3YY&list=PLeGWvtOKhUv78mHlxeyPtqjhmaWZQNmyK	
2.	https://www.youtube.com/watch?v=H2z4pi0KZSs&list=PLeGWvtOKhUv78mHlxeyPtqjhmaWZQNmyK&index=4.	
WEB REFERENCES:		
1.	https://quality-one.com/qualityengineering/#:~:text=Quality%20Engineering%20consists%20of%20analysis,the%20customer's%20requirements%20and%20expectations.	
2.	http://www1.iitkgp.ac.in/downloads/sm_gian_1617_qe.pdf	
ONLINE COURSES:		
1.	https://onlinecourses.nptel.ac.in/noc20_mg18/preview	
2.	https://nptel.ac.in/courses/110105088	

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

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ME23IS415	ISO45001 AND ISO14000	CP	L	T	P	C
		3	3	0	0	3
Programme & Branch	M.E.INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

1	The course could provide the basic knowledge on Occupational Health and Safety Management System and Environmental Management System standards.
2	To inculcate the knowledge on various terms and terminologies which are used in the Occupational Health, Safety and Environmental Management system.
3	To inculcate the knowledge on performance evaluation methods based oniso45001.
4	To educate about the various steps to be taken for certification of ISO45001 (Occupational health and safety management systems) and ISO14001 (Environmental Management Systems) standards.
5	To impart knowledge on Environment Impact Assessment (EIA), Life Cycle Assessment of product and principles of Eco labeling.

UNIT–I	OH & S MANAGEMENT SYSTEM STANDARD	9

Introduction to ISO 45001 (L1)–Development of various OHSMS standards (L2)– aim of OH& S management system(L2)–success factors(L2)– plan do check act cycle(L2)-contents and scope of ISO45001(L2)- terms and definitions(L2) –leadership and worker participation (L2)– leadership and commitment(L2) -OH & S policy(L2)- organizational roles and responsibilities and authorities(L2) –consultation and participation of workers(L2).

UNIT–II	PLANNING	9

Actions to address risk and opportunities (L2) – hazard identification and assessment of risks and opportunities (L2) –determination of legal and other requirements(L2)-planning action(L2)-OH & S objectives and planning to achieve them(L2)-support (L2)– resources (L2)–competence (L2) –awareness (L2) –communication (L2) –documented information (L2) – operation planning & control(L2)–management of change(L2)–procurement(L2)–Emergency preparedness and response(L2).

UNIT–III	PERFORMANCE EVALUATION	9

Monitoring, measurement, analysis and performance evaluation(L3)-evaluation of compliance(L3)- Internal audit-management review(L2)- Improvement(L2)- Incident, non conformity and corrective action(L2)–continual improvement-guidance of the use of the document ISO 45001(L2)-benefits of certification(L2)-certification procedure(L2).

UNIT–IV	ISO14001 & ISO19011	9

EMS, ISO14001, specifications, objectives, Environmental Policy, Guidelines and Principles (ISO 14004) (L2), clauses 4.1 to 4.5. Documentation requirements (L2), 3 levels of documentation for a ISO14000 based EMS (L2), steps in ISO 14001 (L2).

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Implementation plan (L2),Registration (L2),Importance of ISO 14000 to the Management (L2).Auditing ISO14000(L3)- General principles of Environmental Audit(L2), Auditor(L2), steps in audit(L2),Audit plan(L2). ISO 19011(L2)- Guidelines for auditing management Systems (L2) -General principles, managing audit programme (L2) -audit activities (L3),steps in audit (L2),audit plan(L3)-competence of auditors(L2).		
UNIT–V	**ENVIRONMENT IMPACT ASSESSMENT**	**9**
ISO 14040(LCA), General principles of LCA, Stages of LCA, Report and Review(L2). ISO14020 (Eco labeling) – History, 14021, 14024, Type I labels, Type II labels, ISO 14024,principles, rules for eco labeling before company attempts for it (L2). Advantages. EIA in EMS, Types of EIA,EIA methodology EIS, Scope, Benefits(L2) .Audit- methodology (L2), Auditors Audit results management review (L2)-Continual improvement(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	Outline the various standards designed to maintain employee health and ensure environmental protection.	L2-Understand
CO2	Interpret the basic differences between the ISO 9000 series, ISO 45001, and ISO 14000 standards, including the various clauses that govern the maintenance of each standard.	L2-Understand
CO3	Apply various clauses of ISO 45001 and ISO 14000 to prepare procedures and related documents.	L3- Apply
CO4	Apply knowledge to prepare an ISO manual for obtaining certification from external certifying agencies.	L3- Apply
CO5	Select appropriate standards and clauses based on their relevance to various organizational types	L3- Apply

REFERENCE BOOKS:

1.	ISO 45001: 2018–Occupational Health and safety management systems requirements with guidance for use.
2.	ISO 14001:2004, Environmental Management Systems Requirements with Guidance for Use", ISO, 2004.
3.	"Guidelines on Occupational Health and safety Management Systems (OSH-MS)" International Labour Organization,2001.

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4.	"BS8800:2004 Occupational Health and Safety Management Systems Guide" BSI, UK, 2004.
5.	"ISO 19011:2011 Guidelines for Auditing Management Systems", ISO,2011.
6.	"ISO 14040:2006 Environmental Management- Life Cycle Assessment -Principles and Framework " ISO,2006.
7.	"ISO 14025:2006 Environmental Labels and Declarations -Type III Environmental Declarations - Principles and Procedures",ISO,2006.
8.	"ISO 14021:1999 Environmental Labels and Declarations-Self-Declared Environmental Claims (Type II environmental labeling)",ISO, 1999.
9.	"ISO 14020:2000 Environmental Labels and Declarations-General Principles", ISO, 2000.
VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=7utZfepa140&list=PLO8v5ESo95YMlWanVt2nw1S8ZhzlAchs-
2.	https://www.youtube.com/watch?v=_3dNjtuqbmY
WEB REFERENCES:	
1.	https://www.iso.org/iso-45001-occupational-health-and-safety.html
2.	https://www.iso.org/standards/popular/iso-14000-family
ONLINE COURSES:	
1.	https://www.bsigroup.com/en-IN/occupational-health-and-safety-iso-45001/iso-45001-training-courses/
2.	https://www.bsigroup.com/en-IN/ISO-14001-Environmental-Management/Training-courses-for-ISO-14001/

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

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ME23IS416	ARTIFICIAL INTELLIGENCE AND DATA ANALYTICS	CP	L	T	P	C
		3	3	0	0	3
Programme& Branch	M.E.INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

1	To understand data science fundamentals and its safety applications.
2	To learn data acquisition, cleaning, and exploratory analysis for safety.
3	To apply statistical concepts for safety evaluation and monitoring.
4	To explore machine learning algorithms for safety event prediction and anomaly detection.
5	To utilize visualization and communication techniques for safety data insights.

UNIT–I	DATA SCIENCE AND SAFETY	9

Introduction-Terminology in data science (L2) -.Application of data science (L2)-Overview of data science and its applications in safety-risk analysis (L2), anomaly detection and safety optimization (L2)-Introduction to safety analysis and risk assessment (L2).

UNIT–II	DATA COLLECTION AND PREPROCESSING	9

Data acquisition methods and sources relevant to Safety (L2)-Operators - Variables - data types -Conditional statements-Looping (L2) - Function -. Data structure (L2)- Lists, Dictionary and Tuple -Regular Expression (L2)-File Reading (CSV, Excel etc.) (L2)-Basics Class and Objects concepts (L2)-data cleaning handling missing values(L2)-dealing without liers-Exploratory data analysis techniques(L2).

UNIT–III	STATISTICAL ANALYSIS	9

Probability theory and statistical concepts relevant to safety analysis (L2) -statistical analysis, data visualization, and predictive modeling techniques(L2) - Descriptive and inferential statistics (L2) - Hypothesis testing and confidence intervals(L2)-Safety Program Evaluation, Comparative Analysis, Reliability Analysis(L2),Incident Investigation, Safety Performance Monitoring(L2).

UNIT–IV	MACHINE LEARNING	9

Introduction to supervised and unsupervised learning algorithms (L2)-Feature engineering and selection(L2)-Model evaluation and performance metrics (L2)-Regression models (L2)-Classification models(L2)-Ensemble methods and model optimization (L2)-Techniques for identifying anomalies and outlier detection(L2)-Time series analysis and forecasting for safety events (L2)-Event prediction using machine learning algorithms(L3).

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UNIT–V	VISUALIZATION AND COMMUNICATION OF SAFETY DATA	9
Data visualization techniques for safety insights - Story telling with data (L2) and effective communication of safety findings (L2)-Interactive dashboards and reporting tools for safety analysis(L2) - Ethical issues in working with safety data-Privacy and security concerns in data science for safety(L2)- Legal and regulatory frameworks related to safety data(L3)-Data science to safety problems(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 benefits of using data science to improve safety measures and prevent accidents in various industries.	L2-Understand
CO2	Summarize the significant impact of data analysis on quality and effectiveness.	L2-Understand
CO3	Illustrate the understanding of safety-related data and draw meaningful insights from it.	L2-Understand
CO4	Identify trends, patterns, and correlations in experimental data.	L3- Apply
CO5	Organize data into a more understandable form, highlighting trends and outliers.	L3- Apply

REFERENCE BOOKS:

1.	David J.Smith ,Kenneth GL Simpson "Safety Critical Systems Handbook: A Straight forward Guide to Functional Safety, IEC61508(2010 Edition) and Related Standards" 3rd Edition, Butterworth-Heinemann,2011.
2.	Tim Kelly "Safety Critical Systems: Problems, Process and Practice". Springer London, 2009.
3.	Nicholas J. Bahr "System Safety Engineering and Risk Assessment: A Practical Approach " 2nd edition, CRC Press, 2014.
4.	Mariy Yao, Adelyn Zhou, and Marlene Jia "Applied Artificial Intelligence :A Handbook For Business Leaders" Topbot, 2018.
5.	Charles D. Reese and James P. Nelson "Handbook of Safety and Health for the Service Industry" 1st edition, , CRC Press, 2008.
6.	Jose L. Munoz and Luis F. Miranda-Moreno "Data Science for Transport: A Self-Study Guide with Computer Exercises" 1st edition, Springer International Publishing AG, 2018.
7.	Avrim Blum, John Hopcroft, and Ravindran Kannan "Foundations of Data Science" Cambridge University Press, 2020.

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VIDEO REFERENCES:	
1.	https://www.youtube.com/watch?v=3K-vJlVMi5A
2.	https://www.youtube.com/watch?v=pKeVMlkFpRc&list=PLwdnzlV3ogoXaceHrrFVZCJKbm_laSHcH
WEB REFERENCES:	
1.	https://dl.acm.org/doi/pdf/10.1145/3550473
2.	https://www.coursera.org/articles/data-analytics
ONLINE COURSES:	
1.	https://onlinecourses.nptel.ac.in/noc22_cs56/preview
2.	https://onlinecourses.swayam2.ac.in/nou23_ge81/preview

Mapping of COs with POs						
COs	**POs**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1				1		1
CO2		1		2	2	
CO3		1	2	2	1	
CO4	1	1		2	1	
CO5	1	1		2	1	
Average	1	1	2	1.8	1.3	1
1–Low,2–Medium,3–High.						

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ME23IS417	DESIGN OF EXPERIMENTS	CP	L	T	P	C
		3	3	0	0	3
Programme & Branch	M.E.INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

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

UNIT–I	EXPERIMENTAL DESIGN FUNDAMENTALS	9

Importance of experiments(L1), experimental strategies(L2), basic principles of design, terminology(L2),ANOVA, steps in experimentation (L3), sample size, normal probability plot, linear regression models(L3).

UNIT–II	SINGLE FACTOR EXPERIMENTS	9

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

UNIT–III	MULTI FACTOR EXPERIMENTS	9

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

UNIT–IV	SPECIAL EXPERIMENTAL DESIGNS	9

Blocking and confounding in 2K designs(L4). Two level Fractional factorial design(L4), nested designs, Split plot design(L4),Introduction to Response Surface Methods(L4).

UNIT–V	TAGUCHI METHODS	9

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

Total:45 Periods

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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 ANOVA to determine if there are significant differences among treatment means and find sources of variation in data.	L3- Apply
CO2	Identify model parameters in various experimental designs using appropriate statistical methods, such as least squares estimation.	L3- Apply
CO3	Plan and conduct experiments with random factors, understanding how randomization helps estimate treatment effects and improve the generalizability of results.	L3- Apply
CO4	Develop and analyze nested experiments with hierarchical structures, understanding their implications for experimental setup and statistical analysis.	L4- Analyze
CO5	Develop skills in multi-response optimization to simultaneously optimize multiple response variables and achieve optimal process settings.	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.	Nicolo Belavendram, "Quality by Design; Taguchi techniques for industrial Experimentation", PrenticeHall,1995.	
4.	PhillipJ.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=IEUTRhyoHNc&list=PLPjSqITyvDeWS9Lxp4jreGJ7eNsxHxJA8	
2.	https://www.youtube.com/watch?v=pKeVMlkFpRc&list=PLwdnzlV3ogoXaceHrrFVZCJKbm_laSHcH	
WEB REFERENCES:		
1.	https://home.iitk.ac.in/~shalab/anova/chapter4-anova-experimental-design-analysis.pdf	
2.	https://www.itl.nist.gov/div898/handbook/pmd/section3/pmd31.htm	
ONLINE COURSES:		
1.	https://onlinecourses.nptel.ac.in/noc21_mg48/preview	
2.	https://onlinecourses.swayam2.ac.in/aic23_ge17/preview	

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

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ME23IS418	RELIABILITY ENGINEERING	CP	L	T	P	C
		3	3	0	0	3
Programme & Branch	M.E.INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

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

UNIT–I	RELIABILITY CONCEPTS	9

Reliability definition(L2)–Quality and Reliability(L2) – Reliability mathematics(L2) – Reliability functions(L2)–Hazard rate(L2)–Measures of Reliability(L2)–Design life(L2)– A priori and posteriori probabilities(L2) – Mortality of a component(L2) – Mortality curve (L2)– Useful life(L2).

UNIT–II	LIFE DATA ANALYSIS	9

Data collection (L2) –Non Parametric methods: Ungrouped/Grouped, Complete/Censored data(L3)–Time to failure distributions: Exponential, Weibull–Probability plotting(L3)– Goodness of fit tests(L3).

UNIT–III	PERFORMANCE EVALUATION	9

Different configurations(L2) – Redundancy (L3)– k out of n system (L3)– Complex systems: RBD(L3) – Baye's approach(L3) – Cut and tie sets(L3)–Fault Trees(L3)–Stand by systems(L3).

UNIT–IV	RELIABILITY MONITORING	9

Life testing methods: Failure terminated (L3)– Time terminated (L3) – Sequential Testing (L3) – Reliability growth monitoring (L3) – Reliability allocation (L3) – Software reliability(L2)-Human reliability(L2).

UNIT–V	RELIABILITY IMPROVEMENT	9

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

Total:45 Periods

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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 basic concepts of reliability engineering.	L2-Understand
CO2	Apply the different technique stopper form life data analysis on a system.	L3- Apply
CO3	Apply the knowledge to conduct reliability assessment and failure analysis on any complex systems.	L3- Apply
CO4	Apply techniques to monitor reliability of the system.	L3- Apply
CO5	Analyze various techniques to improve reliability of the system.	L4- Analyze
REFERENCE BOOKS:		
1.	Charles E.Ebeling, "An introduction to Reliability and Maintain ability engineering", TMH,2000.	
2.	Roy Billington and Ronald N.Allan, "Reliability Evaluation of Engineering Systems", Springer,2007.	
VIDEO REFERENCES:		
1.	https://www.youtube.com/watch?v=BQXnKpP2lrI&t=15s	
2.	https://www.youtube.com/watch?v=uutg8jKrL9w&t=30s	
WEB REFERENCES:		
1.	https://reliably.com/blog/what-is-reliability-engineering/	
2.	https://study.com/academy/lesson/reliability-engineering-definition-purpose.html	
ONLINE COURSES:		
1.	https://onlinecourses.nptel.ac.in/noc23_ge20/preview	
2.	https://reliability-academy.com/	

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

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ME23IS419	LOGISTICS AND DISTRIBUTION MANAGEMENT	CP	L	T	P	C
		3	3	0	0	3
Programme& Branch	M.E.INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

1	To provide knowledge on the fundamentals of logistics and warehouse safety.
2	To understand the principles and practices of safe material handling and storage.
3	To identify and mitigate risks associated with transportation safety.
4	To implement safety protocols for dock and yard operations.
5	To understand and apply fire safety measures in warehouses.

UNIT–I	INTRODUCTION TO LOGISTICS	9

Introduction to logistics (L1) – Definition and significance (L1)– Role of logistics in supply chain management (L2) – Key logistics functions: transportation, warehousing, inventory management, order fulfillment (L2) – Safety regulations and standards in logistics (e.g., ISO 45001 for Occupational Health and Safety Management Systems) (L2) – Overview of safety management systems (L2) – Risk assessment in logistics operations (L2) – Emergency preparedness and response planning(L2).

UNIT–II	MATERIAL HANDLING AND STORAGE	9

Principles of material handling (L2) – Types of material handling equipment (L1) – Safety in the use of conveyors, forklifts, cranes, and hoists (L2) – Ergonomics in material handling (L2) – Safe stacking and storage practices (L2) – Warehouse layout and design for safety (L3) – Palletizing and racking systems (L2) – Hazard identification and control in storage areas (L3) – Personal protective equipment (PPE) for material handling (L2) – Relevant standards: OSHA 1910 Subpart N (Materials Handling and Storage), ANSI/ITSDF B56.1 (Safety Standard for Low Lift and High Lift Trucks)(L2).

UNIT–III	TRANSPORTATION SAFETY	9

Transportation modes and their safety considerations (L2) – Road transport safety: vehicle maintenance, driver training, and route planning (L2) – Safety in rail transport: loading/unloading, signaling systems, and emergency procedures (L2) – Air transport safety: cargo handling, security, and regulatory compliance (L2) – Maritime transport safety: ship loading/unloading, container handling, and port safety (L2) – Risk management in transportation (L5) – Incident investigation and reporting (L5) – Relevant standards: DOT regulations, IATA Dangerous Goods Regulations, IMDG Code (International Maritime Dangerous Goods) (L2).

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UNIT–IV	DOCK AND YARD SAFETY	9

Safety procedures for dock and yard operations (L1) – Dock design and layout for safety(L2) – Safe loading and unloading practices (L2) – Equipment used in dock and yard operations (L2) – Traffic management in yards (L2) – Worker safety and PPE requirements(L2) – Preventive maintenance of dock and yard equipment (L2) – Hazardous material handling and storage in docks (L2) – Emergency procedures for dock and yard incidents(L3) – Relevant standards: OSHA 1910 Subpart D (Walking-Working Surfaces), ANSI MH30.1 (Safety Requirements for the Design, Testing, and Utilization of Portable Dock Leveling Devices)(L2).

UNIT–V	FIRE SAFETY IN WAREHOUSE.	9

Fire hazards in warehouses (L1) – Fire prevention strategies: housekeeping, storage practices, and electrical safety (L2) – Fire detection and alarm systems (L2) – Fire suppression systems: sprinklers, extinguishers, and fire doors (L2) – Emergency evacuation planning (L3) – Training and drills for fire safety (L3) – Compliance with fire safety regulations and standards (L2) – Case studies of warehouse fire incidents and lessons learned (L2) – Relevant standards: NFPA 13 (Standard for the Installation of Sprinkler Systems)(L2), NFPA 25 (Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems)(L2), NFPA 30 (Flammable and Combustible Liquids Code)(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 fo 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 and functions of logistics.	L2-Understand
CO2	Identify and implement safe practices for material handling and storage.	L3 - Apply
CO3	Assess and mitigate risks associated with transportation safety.	L5 - Evaluating
CO4	Apply safety protocols in dock and yard operations.	L3- Apply
CO5	Develop and implement fire safety measures for warehouse environments.	L3- Apply

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2.	Michael B. Spear, "Warehouse Safety: A Practical Guide to Preventing Warehouse Incidents and Injuries," CRC Press, 2014.
3.	Kenneth L. Arnold, "Introduction to Materials Handling," Prentice Hall, 1998.
4.	Ministry of Commerce & Industry, "e-Handbook on Warehousing Standards: PM GatiShakti," Government of India, 2022.
5.	Ministry of Commerce & Industry, "Warehousing Development and Regulation Act," Government of India, 2007.
6.	Bureau of Indian Standards (BIS), "IS 16145:2014 - Guidelines for Safety in Warehousing," BIS, 2014.
7.	NITI Aayog, "National Master Plan for Multi-Modal Connectivity: PM GatiShakti," Government of India, 2021.
8.	Daniel E. Della-Giustina, "Fire Safety Management Handbook," CRC Press, 2014.
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2.	https://www.youtube.com/watch?v=-XRu7BSouvY
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1.	https://www.osha.gov/warehousing
2.	https://www.india.gov.in/spotlight/pm-gati-shakti-national-master-plan-multi-modal-connectivity
ONLINE COURSES:	
1.	https://onlinecourses.swayam2.ac.in/ntr24_ed21/preview
2.	https://onlinecourses.nptel.ac.in/noc20_ce09/preview

Mapping of COs with POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1		1	2	1	2	
CO2		2	2	2	2	1
CO3		1	3	1	3	1
CO4	2	1	2	2	2	
CO5		1	3		3	1
Average	2	1.2	2.4	1.5	2.4	1

1–Low,2–Medium, 3–High.

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ME23IS911	POLYMERS AND COMPOSITE MATERIALS	CP	L	T	P	C
		3	2	1	0	3
Programme & Branch	M.E-INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

1	To Impart knowledge on various polymer processing techniques
2	To Learn about various fibre, Matrix materials and their properties
3	To Learn the methods by which Polymer matrix composites are made
4	To Study about the composites used for High temperature applications
5	To Study the behavior of reinforcements in MMC and PMC

UNIT–I	PROCESSING OF POLYMERS	6+3

Classification of Polymers (L2) – Properties of Thermo plastics (L2) – Properties of Thermosetting Plastics (L2) – Extrusion (L2) – Injection Moulding(L2) – Blow Moulding(L2) – Compression and Transfer Moulding (L2) – Casting (L2) – Thermo Forming (L2). General Machining properties of Plastics (L2) – Machining Parameters and their effect (L2) – Joining of Plastics (L2) – Thermal bonding (L2) – Applications (L2).

UNIT–II	FIBERS AND MATRIX MATERIALS	6+3

Fibers – Fabrication, Structure, properties and applications (L2) – Glass fiber (L2), Boron fiber (L2), Carbon Fiber (L2), Organic Fiber (L2), Ceramic and Metallic Fibres (L2) - Whiskers (L2) – Fabrication of Matrix Materials (L2) – Polymers, Metals and Ceramics and their properties (L2) – Interfaces (L2) – Wettability (L2) – Types of Bonding at the Interface (L2) – Tests for Measuring Interfacial Strength (L2) - Physical and Chemical properties (L2).

UNIT–III	PROCESSING OF POLYMER MATRIX COMPOSITES	6+3

Thermoset Matrix Composites: Hand Layup (L2), Spray (L2), Filament Winding (L2), Pultrusion (L2), Resin Transfer Moulding (L2), Autoclave Moulding(L2) - Bag Moulding (L2), Compression Moulding with Bulk Moulding Compound and SHEET Moulding Compound (L2) – Thermoplastic Matrix Composites (L2) – Film Stacking (L2), Diaphragm Forming (L2), Thermoplastic Tape Laying (L2), Injection Moulding(L2) – Interfaces in PMCs (L2) - Structure, Properties and Application of PMCs (L2) – Recycling of PMCs (L3).

UNIT–IV	PROCESSING OF METAL MATRIX COMPOSITES	6+3

Metallic Matrices: Aluminium (L2), Titanium (L2), Magnesium (L2), Copper Alloys (L2) – Processing of MMCs: Liquid State (L2), Solid State (L2), In Situ Fabrication Techniques (L2) – Diffusion Bonding (L2) – Powder Metallurgy Techniques (L2) - Interfaces in MMCs (L2) – Mechanical Properties (L2) – Machining of MMCs (L2) – Applications (L2).

UNIT–V	PROCESSING OF CERAMIC MATRIX COMPOSITES AND CARBON - CARBON COMPOSITES	6+3

Processing of CMCs: Cold Pressing (L2), Sintering (L2), Reaction Bonding (L2), Liquid Infiltration (L2), Lanxide Process (L2) – In Situ Chemical Reaction Techniques: Chemical Vapour Deposition (L2), Chemical Vapour Impregnation (L2), Sol-Gel (L2) – Interfaces In CMCs(L2) – Mechanical Properties and Applications Of CMCs(L2) – Carbon-Carbon Composites (L2) – Applications (L2).

Total:45PERIODS

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 polymer processing techniques.	L2-Understand
CO2	Understand about various fibre, matrix materials and their properties.	L2-Understand
CO3	Apply the methods by which polymer matrix composites are made.	L3-Apply
CO4	Analyze about the composites used for High temperature applications.	L4-Analyze
CO5	Understand the behavior of reinforcements in MMC and PMC.	L2-Understand

REFERENCE BOOKS:

1.	Harold Belofsky ,Plastics, Product Design and Process Engineering, Hanser Publishers,2002.
2.	Mallick,P.K. and Newman.S., Composite Materials Technology, Hanser Publishers,2003.
3.	Seamour, E.B.Modern Plastics Technology, Prentice Hall,2002.
4.	M.Balasubramanian , Composite Material and Processing, CRC Press,2014.
5.	K.K.Chawla, Composite Material: Science and Engineering, Springer, 3rd Edition,2012.

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1.	https://www.researchgate.net/publication/319400527_Recent_Advances_in_Metal_Matrix_Composites_MMCs_A_Review

ONLINE COURSES:

1.	https://onlinecourses.nptel.ac.in/noc20_me29/preview

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ME23IS913	ADVANCED INTERNAL COMBUSTION ENGINES	CP	L	T	P	C
		3	2	1	0	3
Programme & Branch	M.E-INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

1	To gain insight on the working principle of spark ignition engines.
2	To gain insight on the working principle of compression ignition engines.
3	To study the pollutant formation and its control in IC engines.
4	To Study the alternate fuels in IC Engines.
5	To study the recent technologies adopted in IC engine applications.

UNIT–I	SPARK IGNITION ENGINES	6+3

Spark ignition Engine mixture requirements (L2) – Fuel – Injection systems (L2) – Monopoint (L2), Multipoint injection (L2), Direct injection (L2) – Stages of combustion (L2) – Normal and abnormal combustion (L2) – factors affecting knock (L2) – Combustion chambers (L2).

UNIT–II	COMPRESSION IGNITION ENGINES	6+3

States of combustion in C.I. Engine (L2) – Direct and indirect injection systems (L2) – Combustion chambers (L2) – Fuel spray behaviour (L2) – spray structure (L2), spray penetration and evaporation (L2) – air motion (L2) – Introduction to Turbo charging (L2).

UNIT– III	POLLUTANT FORMATION AND CONTROL	6+3

Pollutant (L2) – Sources (L2) – Formation of carbon monoxide, Unburnt hydrocarbon, NOx, Smoke and Particulate matter (L2) – Methods of controlling Emissions (L2) – Catalytic converters and Particulate Traps (L2) – Methods of measurements and Introduction to emission norms and Driving cycles (L2).

UNIT–IV	ALTERNATIVE FUELS	6+3

Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas (L2)- Properties, Suitability, Merits and Demerits as fuels (L2), Engine Modifications (L2).

UNIT–V	RECENT TRENDS	6+3

Lean Burn Engines (L2) – Stratified charge Engines (L2) – homogeneous charge compression ignition engines (L2) – Plasma Ignition (L2) – Measurement techniques (L2) – laser Doppler (L2), Anemometry (L2). Use of Nano technology in IC Engines (L2).

Total:45 PERIODS

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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 working principle of spark ignition engine, fuel injections and combustion chambers.	L2-Understand
CO2	Understand the working principle of compression ignition engines, direct and indirect injection systems and turbo charging.	L2-Understand
CO3	Summarize the pollution formation and its control.	L2-Understand
CO4	Understand the alternate fuels in IC Engines.	L2-Understand
CO5	Apply the knowledge about recent technologies adopted in IC engine applications.	L3-Apply
REFERENCE BOOKS:		
1.	Duffy Smith, Auto fuel Systems, The Good Heart Willox Company,Inc.,1989	
2.	Heywood,J.B., Internal Combustion Engine Fundamentals ,McGraw-Hill,1988.	
3.	K.K.Ramalingam, Internal Combustion Engine fundamentals, Scitech Publications,2002	
4.	R.B.MathurandR. P.Sharma, Internal Combustion Engines, Dhanapat Rai Publications,1993.	
VIDEO REFERENCES:		
1.	https://www.youtube.com/watch?v=xTtiBmguhFQ	
WEB REFERENCES:		
1.	https://www.routledge.com/Advances-in-Combustion-Technology/Mishra/p/book/9780367501525	
ONLINE COURSES:		
1.	https://nptel.ac.in/courses/112104033	

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ME23IS915	ENGINE POLLUTION AND CONTROL	CP	L	T	P	C
		3	2	1	0	3
Programme & Branch	M.E-INDUSTRIAL SAFETY ENGINEERING	Version:1.0				

Course Objectives:

1	To provide an insight about effect of engine out emissions on human health and environment.
2	To impart the knowledge on various pollutant species formations in SI and CI engine.
3	To divulge about various emission measurement techniques in engines and its significance.
4	To provide a discernment about various emission control methods.
5	To impart the knowledge about international and national driving cycles and emission standards.

UNIT–I	AIR POLLUTION–ENGINES	6+3

Atmospheric pollution from automotive (L2), stationary engines and gas turbines (L2), Global warming (L2) – Greenhouse effect (L2), Effects of engine pollution on human health and environment (L2).

UNIT–II	POLLUTANT FORMATION	6+3

Formation of Oxides of nitrogen, Carbon monoxide, Hydrocarbon, Aldehydes, Smoke and Particulate matter emissions (L2). Effects of Engine design and operating variables on emission formation (L2), Noise pollution (L2).

UNIT–III	EMISSION MEASUREMENT TECHNIQUES	6+3

CO, CO2 (L2) - Non dispersive infrared gas analyzer (L2), NOx(L2) - Chemiluminescent analyzer (L2), HC (L2) - Flame ionization detector (L2), Smoke (L2) – Opacity and filter paper measurements (L2), Particulate Matter (L2) – Full flow and Partial flow dilution tunnel (L2), Gas chromatography (L2), Noise measurement (L2).

UNIT–IV	EMISSION CONTROL TECHNIQUES	6+3

Engine design modifications (L2), Fuel modification (L2), Evaporative emission control (L2), EGR (L2), Air injection (L2), Thermal reactors (L2), Water injection (L2), Common rail direct injection (L2) and Gasoline direct injection system (L2), After. treatment systems (L2) - Catalytic converters (L2), Diesel oxidation catalyst (L2), Particulate traps (L2), De-NOx catalysts (L2), SCR systems (L2). Low temperature combustion concepts (L2).

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UNIT–V	DRIVING CYCLES AND EMISSION STANDARDS	6+3
Transient dynamometer (L2), Test cells (L2), Driving cycles for emission measurement (L2), chassis dynamometer (L2), CVS system (L2), National and International emission standards (L2).		
		Total:45PERIODS

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 about atmospheric pollution from engines and its impact on human health and environment.	L2-Understand
CO2	Understand the formation of emissions in both SI and CI engines.	L2-Understand
CO3	Understand the various measurement techniques used globally for the measurement of automotive and stationary.	L2-Understand
CO4	Apply the various control methods / techniques used in IC engine to control the engine out emissions.	L3- Apply
CO5	Apply the transient and steady state driving cycles performed on automotive and stationary engines and emission standards that are followed in the national and international level.	L3- Apply

REFERENCE BOOKS:

1.	GanesanV.,"Internal Combustion Engines",V Edition,Tata McGraw Hill,2012.
2.	John.B.Heywood,"Internal Combustion engine fundamentals"McGraw-Hill,1988.
3.	George Springer and Donald JPatterson, Enginee missions, Pollutant Formation and Measurement, Plenumpress,2013.
4.	PundirB.P.,"IC Engines Combustion and Emission" Narosapublishinghouse,2010.

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1.	https://www.youtube.com/watch?v=WZb9Bx1cekI

WEB REFERENCES:

1.	https://www.routledge.com/Engine-Emission-Control-Technologies-Design-Modifications-and-pollution-Mitigation-Techniques/PrasadRaoKarthikeyaSharma/p/book/9781774634868

ONLINE COURSES:

1.	https://nptel.ac.in/courses/112104033

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