# K.S. Rangasamy College of Technology (Autonomous Institution affiliated to Anna University, Chennai)



#### **CURRICULUM & SYLLABI**

FOR

**M.E.** Industrial Safety Engineering (For the batch admitted in 2023– 2025)

## R 2022

Accredited by NAAC with A++ Grade, Approved by AICTE, Affiliated to Anna University, Chennai.

> KSR Kalvi Nagar, Tiruchengode – 637 215. Namakkal District, Tamil Nadu, India.

#### **M.E.Industrial Safety Engineering**

#### Vision of Industrial Safety Engineering

To create industrial safety professionals and make them lead the safety team for achieving the goals of zero accident and excellence in the field of industrial safety management for the benefit of all the stake holders.

#### **Mission of Industrial Safety Engineering**

To enrich the industrial safety knowledge, safety statues and effective safety management skills and techniques in the minds of young engineering professionals by imparting training, workshops, role play, seminars, group discussions, guest lectures, case studies, industrial visits and in-plant training by undertaking live industrial projects.

#### **PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

- **PEO 1 : Fundamental :** Graduates of the programme will become professionally competent in the field of Safety, Health and Environment issues, expertise in all sorts of hazard evaluation, risk assessment and safety management systems.
- **PEO 2 : Employability:** Graduates of the programme will become principal auditors in pinpointing vulnerable areas, therefore suggesting corrective/preventive actions to industries. They are also highly proficient enough in handling emergency scenario, disaster mitigation and extremely knowledgeable in developing emergency preparedness plan.
- **PEO 3 : Technical Competence:** Graduates of the programme will have adequate skill in investigating accidents thereby preventing accident in proactive and reactive approach. They will adhere to Indian and International standards in handling Safety, Health and Environment aspects enhancing lifelong learning and engineering ethical behaviour.

#### PROGRAMME OUTCOMES (POs)

#### Engineering Graduates will be able to:

- **PO1:** Ability to individually carryout the STEM based (Science, Technology, Engineering, and Mathematics) research project.
- **PO2:** Ability to write, present and publish technical articles in reputed international/national conferences and journals.
- **PO3:** The skill developed by the student should be at a level of higher than the requirements in the appropriate bachelor program.
- **PO4:** Ability to acquire in depth knowledge of engineering design concepts and application of the same to solve complex engineering problems.
- **PO5:** Ability to find optimum safe and cost effective solutions in the development of mechanical systems taking into consideration sustainability, societal, environmental and public health aspects.
- **PO6:** Ability to support professional ethics and social responsibilities consistent with their roles as design engineers.

#### PROGRAMME SPECIFIC OUTCOMES (PSOs):

Engineering Graduates will be able to:

- **PSO1:** Design and implement safety measures and practices pertaining to industrial activities for enhancing safety culture.
- **PSO2:** Apply modern techniques, tools and devices to provide effective solutions for issues concerning safety in industries.

## MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) WITH PROGRAMMEOUTCOMES (POs) Programme Educational Objectives Programme Outcomes

Programme Educational Objectives		Prog	gramme	Oulco	mes	
	P01	PO2	PO3	PO4	PO5	PO6
PEO 1	3	2	3	2	2	1
PEO 2	3	3	3	2	2	1
PEO 3	3	2	3	2	2	1

Contributions: 1- low, 2- medium, 3- high

Veer	Com	Course Name			Ρ	0		
Year	Sem	Course Name	1	2	3	4	5	6
		Probability and Statistical Methods	3	3	2	1	2	1
		Safety Management	3	3	3	2	3	3
	I	Industrial Safety, Health and Environment Acts	2	2	3	2	2	3
		Research Methodology and IPR	3	3	2	2	2	2
		Design and fabrication of Safety Device	3	3	3	3	3	3
		Technical Seminar	3	3	3	2	2	2
I		Fire Engineering and Explosion Control	3	3	3	3	3	3
		Computer Aided Hazard Analysis	3	3	3	3	2	2
		Environment Safety	3	3	3	3	2	2
	II	Industrial Safety ,Environment and Simulation Laboratory	3	2	3	2	2	2
		Fire Engineering Laboratory	3	3	2	2	2	2
II		Project Work - Phase I	3	3	3	2	3	2
	111	Inplant Training	3	3	3	2	3	2
	IV	Project Work - Phase	3	3	3	2	3	2

## K.S. RANGASAMY COLLEGE OF TECHNOLOGY Credit Distribution for M.E (ISE)Programme-2022 -2023 Batch

S. No.	Cotogom	Cı	edits Pe	r Semes	ter	Total	Percentage
S. No.	Category	I	II	III	IV	Credits	%
1	PC	17	16	-	-	33	43.26
2	PE	3	6	6	-	15	20.56
3	CG	1	-	10	16	27	36.98
4	AC	-	-	-	-	-	-
٦	otal	21	22	16	16	75	100

PC – PROFESSIONAL CORE PE – PROFESSIONAL ELECTIVES CG - CAREER GUIDANCE COURSES

AC- AUDIT COURSES

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#### CONCEIVE DEVELOP IMPLEMENT EXECUTE(CDIE)

#### Course Contact Course Title т Ρ С S.No. Category L Pre-requisite Code Periods Probability and Statistical 1. 60 PIS 101 PC 5 3 1 0 4 Nil Methods 2. 60 PIS 102 Safety Management PC 5 3 1 0 4 Nil Industrial Safety, Health 3. 60 PIS 103 PC 5 3 1 0 4 Nil and Environment Acts 60 PED 001\ Research Methodology 4. PC 3 3 0 0 3 Nil 60 PDB E26 and IPR 60PIS1P1 Design and Nil 5. PC fabrication of Safety 4 0 0 4 2 Device Fire Engineering and 6. 60 PIS 201 PC 5 1 0 4 Nil 3 **Explosion Control** Computer Aided Hazard 7. 60 PIS 202 PC 5 3 1 0 4 Probability Analysis 8. PC 60 PIS 203 **Environment Safety** 5 3 1 0 4 Nil Nil Industrial Safety, 9. 60 PIS 2P1 Environment and PC 0 0 4 2 4 Simulation Laboratory Fire Engineering Nil 10. 60 PIS 2P2 PC 4 0 4 2 0 Laboratory

#### **PROFESSIONAL CORE (PC)**

#### PROGRAMME ELECTIVE (PE)

#### SEMESTER I, PROGRAMME ELECTIVE I

S.No.	Course Code	Course Title	Category	Contact Periods	L	т	Ρ	С	Pre- req
1.	60 PIS E11	Industrial Health and Hygiene	PE	3	3	0	0	3	Ν
2.		Industrial Noise and Vibration Control	PE	3	3	0	0	3	Nil
3.	60 PIS E13	Plant Layout and Material Handling	PE	3	3	0	0	3	Nil
4.	60 PIS E14	Personal Protective Equipment	PE	3	3	0	0	3	Nil
5.	60 PIS E15	Explosion technology and safety	PE	3	3	0	0	3	Nil
6.	60 PIS E16	Fire Risk Calculations	PE	3	3	0	0	3	Nil

#### SEMESTER II, PROGRAMME ELECTIVE II

S.No.	Course Code	Course Title	Category	Contact Periods	L	Т	Ρ	С	Pre -
1.	60 PIS E21	Safety in Chemical Industries	PE	3	3	0	0	3	Ν
2.	60 PIS E22	Safety in Engineering Industries	PE	3	3	0	0	3	Nil
3.	60 PIS E23	Mechanical Integrity Assessment	PE	3	3	0	0	3	Nil
4.	60 PIS E24	Maintainablility Engineering	PE	3	3	0	0	3	Nil
5.	60 PIS E25	Design and Analysis of Experiments	PE	3	3	0	0	3	Nil
6.	60 PIS E26	Safety in Food package and Preservation	PE	3	3	0	0	3	Nil

## SEMESTER II, PROGRAMME ELECTIVE III

S.No.	Course Code	Course Title	Category	Contact Periods	L	т	Ρ	С	Pre -
1.	60 PIS E31	Safety and Risk Analytics	PE	3	3	0	0	3	Ν
2.	60 PIS E32	Bio Safety	PE	3	3	0	0	3	Nil
3.	60 PIS E33	Safety in Textile Industry	PE	3	3	0	0	3	Nil
4.	60 PIS E34	Environmental Impact Assessment	PE	3	3	0	0	3	Nil
5.	60 PIS E35	Integrated Management System	PE	3	3	0	0	3	Nil
6.	60 PIS E36	Fundamentals of Sustainable Development	PE	3	3	0	0	3	Nil

SEMESTER III, PROGRAMME ELECTIVE IV

S.No.	Course Code	Course Title	Category	Contact Periods	L	т	Ρ	С	Pre- requi
1.	60 PIS E41	Human Factors Engineering	PE	3	3	0	0	3	Nil
2.	60 PIS E42	Cognitive Ergonomics	PE	3	3	0	0	3	Nil
3.	60 PIS E43	Behaviour Based Safety and Safety Culture	PE	3	3	0	0	3	Nil
4.	60 PIS E44	Ergonomic tools and Techniques	PE	3	3	0	0	3	Nil
5.	60 PIS E45	Ergonomics in Automotive Design	PE	3	3	0	0	3	Nil
6.	60 PIS E46	Applied Ergonomics	PE	3	3	0	0	3	Nil

## SEMESTER III, PROGRAMME ELECTIVE V

S.No.	Course Code	Course Title	Category	Contact Periods	L	Т	Ρ	С	Pre- reauisite
1.	60 PIS E51	Safety in Construction	PE	3	3	0	0	3	Nil
2.	60 PIS E52	Dock Safety	PE	3	3	0	0	3	Nil
3.	60 PIS E53	Hazardous Goods Transportation	PE	3	3	0	0	3	Nil
4.	60 PIS E54	Electrical Safety	PE	3	3	0	0	3	Nil
5.	60 PIS E55	Relaibility Engineering	PE	3	3	0	0	3	Probaility and Statistics
6.	60 PIS E56	Safety in Energy Sector	PE	3	3	0	0	3	Nil

## AUDIT COURSES (AC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	Т	Ρ	С	Pre-requisite
1.	60 PAC 001	English for Research Paper Writing	AC	2	2	0	0	0	Nil
2.	60 PAC 002	Disaster Management	AC	2	2	0	0	0	Nil
3.	60 PAC 003	Constitution of India	AC	2	2	0	0	0	nil

## CAREER GUIDANCE COURSES (CG)

S.No.	Course Code	Course Title	Category	Contact Periods		т	D	6	Pre- Requisit
	Coue	Course ritie		Fellous			Г	C	Requisit
1.	60 PIS1P2	Technical Seminar	CG	2	0	0	2	1	Nil
2.	60 PIS 3P1	Industrial Safety Assessment – Internship	CG	4	0	0	4	2	Nil
3.	60 PIS 3P2	Project Work I	CG	16	0	0	16	8	Nil
4.	60 PIS 4P1	Project Work II	CG	32	0	0	32	16	Project

#### K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE -637215

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#### COURSES OF STUDY

#### (For the candidates admitted from 2022-2023 onwards)

#### SEMESTER I

S.No.	Course Code	Course Title	Category	Contact Periods	L	Т	Ρ	С
		Induction Programme	-	-	-	-	-	0
		THEORY						
1.	60 PIS 101	Probability and Statistical Methods	PC	5	3	2	0	4
2.	60 PIS 102	Safety Management	PC	5	3	2	0	4
3.	60 PIS 103	Industrial Safety, Health and Environment Acts	PC	5	3	2	0	4
4.	60 PED 001\ 60 PDB E26	Research Methodology and IPR	PC	3	3	0	0	3
5.	60 PIS E1*	Professional Elective – I	PE	3	3	0	0	3
6.	60 PAC 001	English for Research Paper Writing	AC	2	2	0	0	0
		PRACTICAL	_S					
7.	00015101	Design and fabrication of Safety Device	CG	4	0	0	4	2
8.	60 PIS1P2	Technical Seminar	CG	2	0	0	2	1
		TOTAL		29	17	6	6	21

S.No.	Course Code	Course Title	Category	Contact Periods	L	т	Р	С
		THEORY						
1.	60 PIS 201	Fire Engineering and Explosion Control	PC	5	3	2	0	4
2.	60 PIS 202	Computer Aided Hazard Analysis	PC	5	3	2	0	4
3.	60 PIS 203	Environment Safety	PC	5	3	2	0	4
4.	60 PIS E2*	Professional Elective – II	PE	3	3	0	0	3
5.	60 PIS E3*	Professional Elective- III	PE	3	3	0	0	3
6.	60 PAC 002	Disaster Management	AC	2	2	0	0	0
		PRACTICAL	S					
7.	60 PIS 2P1	Industrial Safety ,Environment and Simulation Laboratory	PC	4	0	0	4	2
8.	60 PIS 2P2	Fire Engineering Laboratory	PC	4	0	0	4	2
			TOTAL	31	17	6	8	22

#### SEMESTER III

S.No.	Course Code	Course Title	Category	Contact Periods	L	т	Ρ	С
	THEORY							
1.	60 PIS E4*	Professional Elective – IV	PE	3	3	0	0	3
2.	60 PIS E5*	Professional Elective – V	PE	3	3	0	0	3
		PRACTICALS						
3.	60 PIS 3P1	Project Work I	CG	16	0	0	16	8
4.	60 PIS 3P2	Industrial Safety Assessment – Internship	CG	4	0	0	0	2
			TOTAL	22	6	0	16	16

#### **SEMESTER IV**

S.No.	Course Code	Course Title	Category	Contact Periods	L	Т	Ρ	С
		PRACTICALS						
1.	60 PIS 4P1	Project Work II	CG	32	0	0	32	16
			TOTAL	32	0	0	32	16

#### TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE: 75

#### Note:

PC- Professional Core Courses; PE- Professional Elective Courses; CG-Career Guidance Courses; AC- Audit Courses.

L: Lecture;

- T: Tutorial;
- P: Practical;

C: Credit

1 Hour Lecture = 1 credit

2 Hours tutorial = 1 credit

2 Hours practical = 1 credit

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#### M.E. / M.Tech. Degree Programme SCHEME OF EXAMINATIONS (For the candidates admitted from 2022-2023 onwards) FIRSTSEMESTER

S.	Course Code	Name of the Course	Duration of	Weight	age of Marks	Minimum Marks for Pass in End Semester Exam		
No.			Internal Exam	Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
		•	TI	HEORY				•
1	60 PIS 101	Probability and Statistical Methods	2	40	60	100	45	100
2	60 PIS 102	Safety Management	2	40	60	100	45	100
3	60 PIS 103	Industrial Safety, Health and Environment Acts	2	40	60	100	45	100
4	60 PED 001\ 60 PDB E26	Research Methodology and IPR	2	40	60	100	45	100
5	60 PIS E1*	Professional Elective	2	40	60	100	45	100
6	60 PAC 001	English for Research Paper Writing	2	100	-	100	-	-
			PR	ACTICAL				
7	60PIS1P1	Design and fabrication of Safety Device	3	60	40	100	45	100
8	60 PIS1P2	Technical Seminar	3	100	-	100	45	100

\* CA evaluation pattern will differ from course to course and for different tests. This willhave to be declared in advance to students. The department will put process in place toensure that the actual test paperfollow the declared pattern.

\*\* End Semester Examination will be conducted for maximum marks of 100 and subsequently bereduced to60marksfortheawardofterminalexaminationmarks

		Category	L	Т	Ρ	Credit	
60 PIS 101	Probability and Statistical Methods	РС	3	2	0	4	

#### Objective

- To understand the basic concepts of statistics.
- To familiarize with distributions.
- To get exposed to various testing techniques.
- To design and analyze the statistical experiments.
- To introduce a variety of statistical models for time series.

#### Prerequisite

NIL

#### CourseOutcomes

#### On the successful completion of the course, students will be able to

CO1	Comprehend the concepts of probability.	Remember,Understand,Apply				
CO2	Interpret different discrete and continuous distributions.	Remember,Understand, Apply				
CO3	Analyze various hypothesis testing methods.	Remember,Understand,Analyze				
CO4	Design and analysis the experiments	Remember,Understand,Analyze				
	Apply suitable methods for measuring trend values and seasonal variations in time series.	Remember,Understand,Apply				

#### Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	
CO1	3	3	3	2	2	2	
CO2	3	3	3	2	2	2	
CO3	3	3	3	2	2	2	
CO4	3	3	2	2	2	2	
CO5	3	3	2	3	2	2	
	3- Strong; 2-Medium; 1-Low						

#### Assessment Pattern

Bloom'sCategory		AssessmentTests Marks)	End Sem Examination
Bicom seategory	1	2	(Marks)
Remember (Re)	10	10	10
Understand (Un)	20	20	30
Apply (Ap)	30	0	30
Analyze (An)	0	30	30
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

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					101-Probabil				
					-Industrial Safe				lea.
-			Hours/Wee T	Р		Credit C	CA	MaximumMar	rs Total
Se	mester	L	I	'	Totalhrs	0	0A	LU	Total
		3	2	0	60	4	40	60	100
<b>Probability and Random Variable</b> Probability – Random variables – Moments – Moment generating function — Two-dimensional Random Variables– Correlation and Regression.									m [9]
Conc (MTT	epts of R F)-Stand	ard distribu	ilure rate-⊢ tions-Binon	nial, Poisso	- Mean time bel n, Normal, Exp n and Variance	onential, Un	. ,		ure [9]
Test	based on			•	and F-distribut al-Wallis test (H			-	1 1 1 1
Analy Rand	ysis of vai Iomized b		-way classi		ompletely rando n – 2 <sup>2</sup> Factorial		gn – Two-wa	y classification	- [9]
Com –Exp	onential t	rend – Para	abolic trend	– Seasona	squares – Movi al variations: Me k relative methe	ethod of sim			
							Total Ho	urs [45 +15(T	utorial))=6
	Book(s):								
1.	P.N.Aro	ra, S.Arora	, "Statistics	s for Manag	ement", S.Chai	nd and Com	pany Limited,	,5th edition,20	09
2	Anderso	on, O.D, "Ti	me Series /	Analysis: Tł	neory and Prac	tice," North	– Holland, Ar	nsterdam, 198	2.
Refe	erence(s)	:							
1.		n,R.A., Mille Education			iller and Freund	d's Probabilit	y and Statisti	ics for Enginee	ers",
<ol> <li>Trivedi K.S, "Probability and Statistics with Reliability, Queuing and Computer Science Applications", John Wiley &amp; Sons, New Delhi, 2008</li> </ol>							ons",		
3. Probability and Statistics –Dr.Somesh Kumar, NPTEL online video courses.									

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Course	Contents	and I	Lecture	Schedule
Course	Contents			Scheune

S.No	Торіс	No.of
		Hours
1	Probability and Random Variable	
1.1	Probability and Random variables	2
1.2	Moments , Moment generating function	1
1.3	Two-dimensional RandomVariables.	3
1.4	Correlation	1
1.5	Regression.	2
1.6	Tutorial	3
2	Reliability and Distributions	
2.1	Concepts of Reliability	1
2.2	Failure rate-Hazard rate	1
2.3	Mean time between failures (MTBF)	1
2.4	Mean time to failure(MTTF)	1
2.5	Standard distributions-Binomial, Poisson	2
2.6	Exponential, Uniform	2
2.7	Geometric distributions	1
2.8	Tutorial	3
3	Test of hypothesis	
3.1	Test based on Normal, t-distribution	1
3.2	chi-square test	2
3.3	F-distributions	1
3.4	Non-Parametric Methods: The sign test for paired data Mann	2
3.5	Whitney U test	1
3.6	Kruskal-Wallis test (H-test)	1
3.7	Sampling distribution of statistic	1
3.8	Tutorial	3
4	Design of Experiments	
4.1	Analysis of variance	1
4.2	One-way classification	1
4.3	Completely randomized design	1
4.4	Two-way classification	1
4.5	Randomized block design	1
4.6	Latin square Design	2

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**BoS Chairman** 

4.7	2 <sup>2</sup> Factorial designs.	2
4.8	Tutorial	3
5	Time series	
5.1	Components of Time series	1
5.2	Method of Least squares	1
5.3	Moving averages method (3 years and 5 years)	1
5.4	Exponential trend	1
5.5	Parabolic trend	1
5.6	Seasonal variations: Method of simple averages	1
5.7	Ratio to trend method	1
5.8	Ratio to moving average method	1
5.9	Link relative method	1
6.0	Tutorial	3
	Total	60

#### CourseDesigners

1. K.Kavitha- <u>kavithak@ksrct.ac.in</u>

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**BoS** Chairman

	SAFETY MANAGEMENT	Category	L	Т	Ρ	Credit
60 PIS 102		PC	3	0	0	4

#### Objective

- To describe the general principles and objectives of safety.
- To give exposure on safety management and safe operating practices within the industry.
- To explain the basic practices in industries in regard with industrial process.
- To provide guidance on accident investigation and reporting.
- To know the statutory requirements pertaining to safety management.

#### Prerequisite

#### Nil

#### **Course Outcomes**

#### On the successful completion of the course, students will be able to,

CO1	Advise legal functions and techniques for effective management of safety practices.	Analyse
CO2	Conduct safety audit for identifying strength and weakness of safety practices.	Apply
CO3	Investigate accidents and notify potential causes of accidents in the report.	Analyse
CO4	Monitor and measure safety performance of the industry as per Indian standards	Apply
CO5	Inculcate safety through Behaviour Based Safety among workers for promoting	Understand
	safety culture	

#### Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	1		3
CO2	1	2	2	1	1	3
CO3	1	3	1	2	2	2
CO4	1	2	2	1	1	3
CO5	1	2	1	1		3
	3	- Strong;	2-Mediu	m; 1-Low	/	

#### Assessment Pattern

	Continuous Asse	Continuous Assessment Tests (Marks)		
Bloom's Category	1	2	End Sem Examination (Marks)	
Remember(Re)	10	10	10	
Understand (Un)	10	10	30	
Apply (Ap)	20	20	30	
Analyze (An)	10	10	20	
Evaluate (Ev)	10	10	10	
Create (Cr)	-	-	-	

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**BoS Chairman** 

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					afety Manage				
Some	patar	Hours	Week		Total hrs	Credit	Ν	1aximumMarks	
Seme	ester	L	Т	Р	TOLATINS	С	CA	ES	Total
	I	3	2	0	60	4	40	60	100
as a polic Incid	n integ y- Statu ent Red	nd Techniques Ever ral part of business itory Provisions for s call Technique (IRT) ction, safety samplir	s- Safety ( afety mana )- Job Safe	Drganizatio agement. ety analysi	on- Safety Cor s(JSA)/Job Ha	nmittee-bud zard Analys	lgeting for is (JHA),	safety-safety	[10]
Occu non rema forma list.	ipationa conform irks by ats – in	it – Introduction A al Safety and health hity reporting (NCR) government agenc pplementation of auc	audit- Co - Electrica cies, consu dit indicatio	mponents Il Safety <i>A</i> Iltants, ex n - liaison	of safety audit Audit - checklis perts – perusa with departme	, types of an t and report al of accide ents to ensur	udit, audit – review ent and sa re co-ordir	methodology, of inspection, afety records, nation – check	[08]
corre accic Beha inves caus accic domi Studi	ective a lent, re aviour A stigatior es & i lent rep no seq ies.	nvestigation & Rep and preventive action portable and non analysis - reporting and reporting – F njury-Problem solvi ports, documentation uence – supervisor	on-(CAPA). reportable to statutor Response t ng tools fo of accider y role – ro	Basic Pri accidents y authoriti o Accider or accider nts – unsa	nciple of Acci s, Near Miss F es – principles nts -4P's Evide nt analysis -re fe act and conc	dent & Pre Reporting a of acciden ences- Accie cords for a dition – Accie	evention c nd Analys It prevention dent analys accidents, dent cause	oncept of an sis, At- Risk on – accident /sis-based on departmental ation theories-	[10]
ANS Reac temp frequ	l (Z16.1 ctive P orary to lency se is incid	ormance Monitorin ) Recommended pr erformance Monito otal disabilities – IS 3 everity incidence, ind ence rate ,lost wo	actice for c ring – pe 3786:1984 cident rate,	ermanent Calculatio accident	total disabilitie n of accident in rate, safety "t" s	es, perman ndices, frequ score, safety	ent partia lency rate activity ra	al disabilities, , severity rate, ate,Total injury	[08]
Safe such meth priva awar sche Safe and	ty Educ as han od of p te cons eness, me, sat ty(BBS) feedba	cation and Training ds on training and to promoting safe pract ulting agencies in sa awards, celebratio fety campaign – Eth and safety culture ck. Evolution of S nical responsibility fo	able top ex tice - motiv afety trainir ns, safety nical Respo : Pinpointin afety cultu	ercise – F vation – co ng DGFAS posters, posibilities ng of uns ire, Trans	Programme, ser ommunication - SLI, NSC, ASSE safety display -Domestic Saf afe behaviour-l formation requ	minars, conf – role of go E, HSE, OSH s, safety p fety and Tra Positive reir	erences, c vernment HA, NEBO ledge, sa lining. Beh nforcemen	competitions – agencies and SH – creating fety incentive naviour Based t- observation	[09]
		. ,	<b>/</b> 1			Total H	ours [45 +	15(Tutorial)]	60
Text	book(s	5):							
1.	Ray As	fahl C "Industrial Sa	fety and H	ealth Man	agement" ,Pear	rson Prentic	e Hall, 200	)3.	
2. John V Grimaldi and Rollin H Simonds, "Safety Management", All India Travellers Book Seller, New							w Delł		
		ion, 2001.							
Refe	rence(s								

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**BoS Chairman** 

2.	Philip Hagan, "Accident Prevention Manual for Business and Industry", N.S.C.Chicago, 13th Edition, 2009
3.	Roger L Brauer, "Safety and Health for Engineers", Wiley, 3 <sup>rd</sup> Edition, 2016
4.	"Accident Prevention Manual" – National Safety Council, Chicago, 1982.

#### **Course Contents and Lecture Schedule**

S.No	Торіс	No.of Hours
1	Concepts and Techniques	
1.1	Evolution of modern safety concept	1
1.2	Safety Management functions- Safety as an integral part of business	1
1.3	Safety Organization- Safety Committee	1
1.4	budgeting for safety	1
1.5	safety policy	1
1.6	Statutory Provisions for safety management. Incident Recall Technique (IRT)	1
1.7	Job Safety analysis(JSA)/Job Hazard Analysis (JHA),	1
1.8	safety survey, safety inspection	1
1.9	safety sampling	1
1.10	Evaluation of performance of supervisors on safety	1
2	Safety Audit – Introduction	
2.1	Audit Standards ILO- OSH – 2001,	1
2.2	IS 14489 1998 code of practice on Occupational Safety and health audit	1
2.3	Components of safety audit, types of audit,	1
2.4	audit methodology, non conformity reporting (NCR) -	1
2.5	Electrical Safety Audit - checklist and report	1
2.6	review of inspection, remarks by government agencies, consultants, experts	1
2.7	perusal of accident and safety records, formats – implementation of audit indication	1
2.8	liaison with departments to ensure co-ordination – check list.	1
3	Accident, Investigation & Reporting	
3.1	Root cause analysis-RCA process-tools	1
3.2	cause effect diagram- corrective and preventive action-(CAPA).	1
3.3	Basic Principle of Accident & Prevention concept of an accident, reportable and non reportable accidents, Near Miss Reporting and Analysis	1
3.4	At- Risk Behaviour Analysis - reporting to statutory authorities -	1

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	principles of accident prevention	
3.5	accident investigation and reporting – Response to Accidents -4P's Evidences	1
3.6	Accident analysis-based on causes & injury-Problem solving tools for accident analysis -records for accidents,	2
3.7	departmental accident reports, documentation of accidents – unsafe act and condition	1
3.8	Accident causation theories- domino sequence – supervisory role – role of safety committee –cost of accident - Accident Case Studies.	2
4	Safety Performance Monitoring	
4.1	ANSI (Z16.1) Recommended practice for compiling and measuring work injury experience	1
4.2	Proactive & Reactive Performance Monitoring	1
4.3	permanent total disabilities, permanent partial disabilities, temporary total disabilities	2
4.4	IS 3786:1984 Calculation of accident indices, frequency rate, severity rate, frequency severity incidence	2
4.5	incident rate, accident rate, safety "t" score, safety activity rate,	1
4.6	Total injury illness incidence rate ,lost workday cases incidence rate(LWDI),Number of lost workdays rate – problems	1
5	Safety Education and Training	
5.1	Importance of training-identification of training needs-training methods such as hands on training and table top exercise	2
5.2	Programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication –	2
5.3	role of government agencies and private consulting agencies in safety training DGFASLI, NSC, ASSE, HSE, OSHA, NEBOSH – creating awareness, awards, celebrations,	2
5.4	safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign –	2
5.5	Ethical Responsibilities -Domestic Safety and Training. Behaviour Based Safety(BBS) and safety culture:	1
5.6	Pinpointing of unsafe behaviour-Positive reinforcement- observation and feedback.	1
5.7	Evolution of Safety culture, Transformation requirement from reactive to proactive culture – Ethical responsibility for safety professional.	2
	Total	60

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#### **Course Designers**

1. Mrs.S.Chandralekha

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	Industrial Safety, Health and Environment(SHE)	Category	L	Т	Р	Credit
60 PIS 103	Acts	PC	3	2	0	4

#### Objective

- To lay the foundation for industrial safety engineers.
- To provide indispensable guidance regarding statutory requirements of SHE Acts.
- To familiarize the powers of Directorate of Industrial Safety and Health.
- To know the significance of regulations pertaining to Factories and Environment.
- To offer assistance for processing Indian and International certification.

#### Prerequisite

#### Nil

#### Course Outcomes

#### On the successful completion of the course, students will be able to,

CO1	Exercise legal provisions of factories act, Tamil Nadu factories rules and Tamil Nadu safety officer's rule and its amendments.			
CO2	Execute legal provisions of Environment act and allied rules.	Apolyzo		
002	Execute legal provisions of Environment act and alled rules.	Analyze		
CO3	B Devise and execute Offsite and Onsite emergency preparedness.			
CO4	Practise legal provisions pertaining to transport and handling of hazardous materials,	Apply		
	boilers, explosive, motor, mines electricity and other acts.			
CO5	Apply for Indian and International Certification standards based on industrial requirement.	Apply		

#### Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6		
CO1	3	1	2	2	3	2		
CO2	3	2	1	2	2	2		
CO3	3	2	1	2	2	2		
CO4	2	2	1	2	3	2		
CO5	2	2	1	2	3	2		
	3- Strong;2-Medium;1-Some							

#### Assessment Pattern

	Continuous Asse	essment Tests (Marks)	End Sem Examination
Bloom's Category	1	2	(Marks)
Remember(Re)	20	20	20
Understand (Un)	10	10	40
Apply (Ap)	10	10	20
Analyze (An)	10	10	10
Evaluate (Ev)	10	10	10
Create (Cr)	-	-	-

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				Technology–A Health and Er			S	
Semester Hours/Week Total hrs Credit MaximumMarks								
Semester	L	Т	Р	I otal hrs	С	CA	ES	Tota
1	3	2	0	60	4	40	60	100
authorities working ho Familnadu	Act – 1948 Constitu – inspecting staff, urs, employment of Factories Rules 195 nd notices – Tamilna	health, sat young po 50 under S	fety, prov ersons – Safety and	isions relating special provis d health chapt	to hazardo ions – pen ers of Facto	us proces alties and pries Act	sses, welfare, d procedures- 1948- Forms,	[11]
the central Waste Mar Batteries (M Consent ord Pollution co prevention a	nt Act (protection) government, preven nagement Rules, 20 Aanagement and Ha der from pollution cor pontrol boards -Centra and control of air poll	ntion, cont 016-The N ndling Rule ntrol board. al and sta ution and v	rol and a loise Poll es) 2001 Air Act 1 te boards vater pollu	batement of e ution (Regulati – E-waste regu 981 and Water for the preve tion–penalties a	environmenta ion and co ulations- Cla r Act 1974: <sub>I</sub> ntion and c and procedu	al pollutio ntrol) Rul ssification powers ar ontrol of res.	n- Biomedical es, 2000-The of industries, id functions of air pollution	[12]
<b>Control Ru</b> notification ist of haza	re, Storage and Imp Iles and Amendme of major accidents – rdous and toxic che es. Hazardous Waste	nt Definition information micals – s	ons – dut n to be fu afety repo	ties of authoriti Irnished – prep orts – safety d	ies – respo aration of of ata sheets,	nsibilities fsite and Major Ac	of occupier – onsite plans – cident Hazard	[10]
Vehicle Rul Petroleum I workers (Sa ndustrial R	and Rules Indian B es, Mines Act 1952, Rules 2002, Gas cyl afety Health and welfa Relations Code, Cod Code -Disaster Mana	Workman linder rules are) Act 19 le on Soci	Compens 2010-Ex 86 and re al Securi	ation Act, Rule plosives Act a gulations 1990, ty and Occupa	s – Electricit nd rules 200 Introduction tional Safet	y Act and )8-Pesticio to Labou	rules 2003 des Act, Dock r codes 2020 ,	[15]
Internation Recommen Elements a Legislations Standards,	al Acts and Star dations, OSHA Reg and benefits of OSH s, American Petrole National Fire Protect nerican National Star	ndards In ulations – AS 18001 um Institu tion Assoc	ternationa Health a – ISO 14 te (API) \$ tiation (NF	I Labour Org Ind Safety At 4001 – ISO 45 Standards, Oil FPA) Standards	anisation (l Work Act (l 5001- Europ Industry Sa	HAŚAWA ean Safe fety Direc	1974, UK) – ty and Health torate (OISD)	[12]
					Total H	lours [45	+15(Tutorial)]	60
Chenna 2. The En Reference 1. The Inc 2. The Mi	san S,"The Factorie ai, 28 <sup>th</sup> Edition, 2017. wironment Act (Prote	ction) 1986 Commerc	δ, Comme ial Law Ρι Publisher	rcial Law Publis ublishers (India) s (India) Pvt. Lt	shers (India) ) Pvt. Ltd., A :d., Allahaba	Pvt. Ltd., llahabad.		Ageno
	san S, "The Tamil I					k Agency	Chennai 28 <sup>th</sup>	Editi

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#### Course Contents and Lecture Schedule

S.No	Торіс	No.of Hours			
1	Factories Act – 1948	11			
1.1	Constitutional Background	1			
1.2	Chapters-Sections-Schedules, Powers Of Statutory Authorities	1			
1.3	Inspecting Staff, Health, Safety	1			
1.4	Provisions Relating To Hazardous Processes, Welfare	1			
1.5	Working Hours, Employment Of Young Persons	1			
1.6	Special Provisions	1			
1.7	Penalties And Procedures-Tamilnadu Factories Rules 1950	1			
1.8	Under Safety And Health Chapters Of Factories Act 1948	1			
1.9	Forms, Registers And Notices Tamilnadu	1			
1.10	Safety Officer Rules 2005 - With Updated Amendments.	2			
2	Environment Act (protection) 1986 with allied rules	12			
2.1	Constitutional Background, General powers of the central government	1			
2.2	prevention, control and abatement of environmental pollution	1			
2.3	Biomedical Waste Management Rules, 2016	1			
2.4	The Noise Pollution (Regulation and control) Rules, 2000	1			
2.5	The Batteries (Management and Handling Rules) 2001	1			
2.6	E-waste regulations	1			
2.7	Classification of industries, consent order from pollution control board. Air Act 1981 and Water Act 1974	2			
2.8	powers and functions of Pollution control boards	1			
2.9	Central and state boards for the prevention and control of air pollution	1			
2.10	prevention and control of air pollution and water pollution	1			
2.11	penalties and procedures	1			
3	Manufacture, Storage and Import of Hazardous Chemical Rules 1989 and Major Accident Hazard Control Rules and Amendment	10			
3.1	Definitions	1			
3.2	duties of authorities	1			
3.3	responsibilities of occupier	1			
3.4	notification of major accidents	1			
3.5	information to be furnished	1			
3.6	preparation of offsite and onsite plans	1			
3.7	list of hazardous and toxic chemicals	1			
3.8	safety reports	1			
3.9	safety data sheets, Major Accident Hazard Control Rules	1			

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3.10	Hazardous Wastes (management, handling and Transboundary Movement) Rules 2016.	1				
4	Other Acts and Rules	15				
4.1	Indian Boiler Act 2007	1				
4.2	Static and Mobile Pressure Vessel Rules (SMPV)	1				
4.3	Motor Vehicle Rules, Mines Act 1952, Workman Compensation Act, Rules	2				
4.4	Electricity Act and rules 2003	1				
4.5	Petroleum Rules 2002, Gas cylinder rules 2010-Explosives Act and rules 2008					
4.6	Pesticides Act, Dock workers (Safety Health and welfare) Act 1986 and regulations 1990	2				
4.7	Introduction to Labour codes 2020, Industrial Relations Code					
4.8	Code on Social Security					
4.9	Occupational Safety Health and Working Conditions Code					
4.10	Disaster Management Act 2005Ammoniumnitraterules.					
5	International Acts and Standards	12				
5.1	International LabourOrganisation (ILO) Conventions and Recommendations, OSHA Regulations	2				
5.2	Health and Safety At Work Act (HASAWA 1974, UK) – Elements and benefits of OSHAS 18001 – ISO 14001	2				
5.3	ISO 45001- European Safety and Health Legislations,	2				
5.4	American Petroleum Institute (API) Standards,					
5.5	Oil Industry Safety Directorate (OISD) Standards					
5.6	National Fire Protection Association (NFPA) Standards	1				
5.7	Atomic Energy Regulatory Board (AERB), American National Standards Institute(ANSI).	2				
	Total	60				

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## 1. Course Designers

Dr.V.Sundararaju

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60 PED 001\	Research Methodology and IPR	Category	L	Т	Ρ	Credit
60 PDB E26	Research Methodology and IFR	PC	3	0	0	3

#### **Objective(s)**

- To understand the principles of research process.
- To develop knowledge in analytical skills for collection of research data.
- To understand the procedure in the preparation of reports.
- To accomplish basic idea about the process involved in intellectual property rights.
- To enlighten the process of patent filing.

#### Pre-requisite

Nil

#### Course Outcomes

On the successful completion of the course, students will be able

CO1	To understand the research process and design.	Remember, Understand,
001	To understand the research process and design.	Apply
CO2	To gain the knowledge about sources and collection of research data	Remember, Understand, Aanalyze
CO3	To understand the procedure of data analysis, preparation of reports and checking plagiarism	Remember, Understand, Analyze
CO4	To gain the knowledge on Trade mark and functions of UNESCO in IPR	Remember, Understand, Apply
CO5	To enlighten the benefits, E-filing and Examinations related to patents	Remember, Understand, Apply

#### Mapping with Programme Outcomes

COURSE NAME	со	PO P						PSO		
COURSE NAME	CO	1	2	3	4	5	6	1	2	3
	CO1	3	3	2	2	2	2	3	1	3
	CO2	3	3	2	2	2	2	3	1	3
Research Methodology and IPR	CO3	3	3	2	2	2	2	3	1	3
	CO4	3	3	2	2	2	2	3	1	3
	CO5	3	3	2	2	2	2	3	1	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

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#### AssessmentPattern

Bloom'sCategory	Continuous Ass (Mar		Model	End Semester Examination (Marks)
	1	2	Exam (Marks)	
Remember	10	10	20	30
Understand	20	20	40	30
Apply	30	30	40	30
Analyse	0	0	0	10
Evaluate	0	0	0	0
Create	0	0	0	0

#### Syllabus

L       T       P       C       CA       ES       Total         3       0       0       30       3       40       60       100         ch Design       w of research process and design- Use of Secondary and exploratory data to answer the h question, Qualitative research, Observation studies, Experiments and Surveys, Selection       [09]         ight Medium and Journal for publication, Translation of Research       Image: Secondary and exploratory data to answer the follocition and Sources       [09]         ements, Measurement Scales, Questionnaires and Instruments, Sampling and methods.       [09]         Preparing, Exploring, examining and displaying.       Image: Secondary and Properting       [09]         and findings using written reports and oral presentation. Checks for Plagiarism, ation, Fabrication, and Misrepresentation       [09]         tual Property Rights       Image: Secondary Rights       [09]         ual Property – The concept of IPR, Evolution and development of concept of IPR, IPR, ment process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in ablishments, Right of Property, Common rules of IPR practices, Types and Features of IPR, evolution in PR maintenance.       [09]         — objectives and benefits of patent, Concept, features of patent, Inventive step,       [09]	ynabus								
Common to all Branches           Easter         Hours/Week         Total hrs         Credit         Maximum Marks           L         T         P         C         CA         ES         Total           3         0         0         30         3         40         60         100           ch Design         w of research process and design- Use of Secondary and exploratory data to answer the h question, Qualitative research, Observation studies, Experiments and Surveys, Selection         [09]           bight Medium and Journal for publication, Translation of Research         Dilection and Sources         [09]           ements, Measurement Scales, Questionnaires and Instruments, Sampling and methods.         [09]           Dreparing, Exploring, examining and displaying.         [09]           and findings using written reports and oral presentation. Checks for Plagiarism, ation, Fabrication, and Misrepresentation         [09]           tual Property Rights         ual Property Rights         [09]           ual Property – The concept of IPR, Evolution and development of concept of IPR, IPR ment process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in ablishments, Right of Property, Common rules of IPR practices, Types and Features of IPR ent, Trademark, Functions of UNESCO in IPR maintenance.         [09]           a         objectives and benefits of patent, Concept, features of patent, Inventive step,         [09]<									
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w of Multivariate Analysis, Hypotheses testing and Measures of Association. Presenting and findings using written reports and oral presentation. Checks for Plagiarism, ation, Fabrication, and Misrepresentation[09]tual Property Rights ual Property – The concept of IPR, Evolution and development of concept of IPR, IPR ment process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in ablishments, Right of Property, Common rules of IPR practices, Types and Features of IPR ent, Trademark, Functions of UNESCO in IPR maintenance.[09]• • • • • • • • • • 	Measureme	nts, Measu	rement Sca			Instruments	, Sampling a	and methods.	[09]
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	<b>Patents</b> Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.							[09]	
Total Hours 45	-		-					Total Hours	45
ook(s):	Text Book(	s):							
vid I. Bainbridge, "Intellectual Property", Longman, 9th Edition, 2012.	1. David I.	Bainbridge	, "Intellectua	al Property"	, Longman, 9th	Edition, 201	2.		

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	Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, erence(s):
	Chawla H S., "Introduction to Intellectual Property Rights", CBS PUB & DIST PVT Limited, INDIA, 2019.
	Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007
3.	David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007
	Arun K. Narasani, Kankanala K.C., Radhakrishnan V., "Indian Patent Law and Practice", Oxford University Press, 2010.
	Richard Stim, "Patent, Copyright & Trademark - An Intellectual Property Desk Reference", NOLO Publishers, 2020.
	The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

#### Course Content and Lecture Schedule

S.No.	Topics				
1.0	Research Design				
1.1	Overview of research process and design	1			
1.2	Use of Secondary and exploratory data to answer the research question	2			
1.3	Qualitative research	1			
1.4	Observation studies	1			
1.5	Experiments and Surveys	1			
1.6	Selection of the Right Medium and Journal for publication	2			
1.7	Translation of Research	1			
2.0	Data Collection and Sources				
2.1	Measurements, Measurement Scales	2			
2.2	Questionnaires and Instruments	2			
2.3	Sampling and methods	2			
2.4	Data - Preparing, Exploring, examining and displaying	3			
3.0	Data Analysis and Reporting				
3.1	Overview of Multivariate analysis	1			
3.2	Hypotheses testing and Measures of Association	2			
3.3	Presenting Insights	1			

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3.4	Findings using written reports and oral presentation	2
3.5	Checks for Plagiarism	1
3.6	Falsification	1
3.7	Fabrication, and Misrepresentation	1
4.0	Intellectual Property Rights	
4.1	Intellectual Property – The concept of IPR	1
4.2	Evolution and development of concept of IPR, IPR development process	2
4.3	Trade secrets, utility Models, IPR & Bio diversity	2
4.4	Role of WIPO and WTO in IPR establishments	1
4.5	Right of Property, Common rules of IPR practices	1
4.6	Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance	2
5.0	Patents	
5.1	Patents – objectives and benefits of patent, Concept, features of patent	2
5.2	Inventive step, Specification, Types of patent application	2
5.3	Process E-filling, Examination of patent	1
5.4	Grant of patent, Revocation	1
5.5	Equitable Assignments, Licences, Licensing of related patents	2
5.6	Patent agents, Registration of patent agents	1
	Total Hrs	45

#### Course Designer

Dr.A.Murugesan – murugesana@ksrct.ac.in

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**BoS Chairman** 

Design and Fabrication of Safety Device

Category	L	Т	Ρ	Credit
PC	0	0	4	2

#### Objective

To impart knowledge on

- To develop the skill of students for building a safety device to control the hazard.
- To impart the knowledge of designing a safety device

#### Prerequisite

Nil

#### **Course Outcomes**

#### On the successful completion of the course, students will be able to,

CO1	To understand and explain the working principle of the safety device	Apply
CO2		Analyze
	To design and fabricate a working model of a safety device	
CO3	To demonstrate a working model of a safety device	Evaluate
CO4	To file patent for the working model	Apply
CO5	To write a journal paper on model fabricated	Apply

#### Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6				
CO1	3	2	2	1	3	2				
CO2	3	1	1	2	2	2				
CO3	3	1	3	2	2	2				
CO4	2	2	2	2	3	2				
CO5	3	2								
	3- Strong;2-Medium;1-Some									

Mul

. BoS Chairman

	K.S.Ran	gasamy C	ollege of	Technology–A	utonomous	R2022		
	60 P	IS 1P1 – C	esign an	d Fabrication of	of Safety De	vice		
Semester	Hours	Hours/Week			Credit	Ma	aximumMarks	
Semesler	L	Т	Р	Total hrs	С	CA	ES	Tota
I	0	0	4	30	2	60	40	100
safety de fabricatio Every pr possible The item signal ar The stud working drawings The prog may be o compreh work det This fina	active of this project is evice and to control to roject work shall have with an industry guid a chosen may be a sr and a control system e lents are required to apart from submitting and process charts gress of the project is constituted by the He pensive report coverin ails and conclusion. I report shall be type made as prescribed	he hazard. e a guide v de also. mall safety etc.) design and g the projec relating to s evaluated ad of the I ng backgro	The stude who is the device (E fabricate t report. 1 fabricatio based on Departmer ound inform	ents have to tak member of the xample– Machi the chosen iter The report shou n. a minimum of nt. Each student nation, literature	te one small faculty of the ne guard, trip m in the colle ld contain as three review t shall finally e survey, pro	item for de institution o systems, ege and de ssembly dra s. The revi produce a oblem state	esign and and if an alarm monstrate its awing,parts ew committee ement, project	30

## Course Designers

1. Dr.V.Sundararaju

- sundararaju@ksrct.ac.in chandralekha@ksrct.ac.in

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2. Mrs.S.Chandralekha

60	PIS	1P2

Category	L	Т	Ρ	Credit
CG	0	0	2	1

#### Objective

- To offer a platform where a learner can carry out
- To make the learner, to take up a real time scenario and suggest suitable solution.
- To build up the confidence of the learner to indulge themselves in the industrial environment.
- To bring out the learner's creativity and solution for the problem identified.
- To enhance the learner's presenting and report writing skill.

#### Prerequisite

Nil

#### Course Outcomes

#### On the successful completion of the course, students will be able to,

CO1	Get an opportunity to work in actual industrial environment.	Understand
CO2	Understand live problem using software/ analytical /computational tools.	Understand
CO3	Learn to write technical reports and give suggestions and recommendations to the problem.	Apply
CO4	Develop the skill to present their work	Analyze
CO5	Defend their work in front of technically qualified audience	Evaluate

#### Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6			
CO1	3	3	2	3	2	3			
CO2	3	3	3	2	2	2			
CO3	3	3	2	3	2	2			
CO4	3	3	2	2	2	2			
CO5 3 3 2 3 3									
	3- Strong;2-Medium;1-Some								

	K.S.Rangasamy College of Technology–Autonomous R2022									
	60 PIS 1P2 – Technical Seminar									
Semester	Semester Hours/Week Total brs Credit MaximumMarks									
Semester	L T P Totalms C CA ES To									
I	0 0 4 45 1 100 0 100									
	udent should presen issues pertaining to s			opic relevant to	the area of	industrial s	safety engin	eering or		
Three reviews have to be conducted by the committee of minimum of three members one of which should be the technical Seminar Coordinator										
<ul> <li>Final rev</li> </ul>	iew will be done by t	the commit	tee that c	onsists of minir	num of three	e members	include one	external		

 Final review will be done by the committee that consists of minimum of three members include one external expert examiner – can be chosen from inter department of the institution

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#### **Course Designers**

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- 2. Mrs.S.Chandralekha
- chandralekha@ksrct.ac.in

#### K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215 (An Autonomous Institution affiliated to Anna University) M.E. / M.Tech. Degree Programme SCHEME OF EXAMINATIONS (For the candidates admitted from 2022-2023 onwards) SECOND SEMESTER

S.No.	Course		Name of the	Duration Interna		Wei	ghta	ige of N			Minim for Pa Ser		n End
	Code		Course	Exam	1	Continuous End Assessment Semester		Max. Marks	End Semester Exam		Total		
					TH	IEORY					·		
1	60 PIS 201	ano Ex	gineering d plosion	2		40	6	0	100	4	5	1	00
2	60 PIS 202	Aic	mputer led zard	2		40	6	0	100	4	5	1	00
3	60 PIS 203		vironment fety	2		40	6	0	100	4	5	1	00
4	60 PIS E2*		ofessional ective – II	2		40	6	0	100	4	.5	1	00
5	60 PIS E3*		ofessional ective- III	2		40		60	100	) 45	5		100
6	60 PAC 002		aster nagement	2		100	-	-	100		-		-
					PRA	CTICAL							
7	60 PIS 2P1		Industrial Safety Environment and	3		60		40		100	45		100
8	60 PIS 2P2		Fire Engineering Lab	3		60		40		100	45		100

\*CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department wills put a process in place to ensure that the actual test paper follow the declared pattern.

\*\*End Semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for the award of terminal examination marks.

60 PIS 201	Fire Engineering and Explosion Control	Category	L	Т	Ρ	Credit
		PC	3	2	0	4

Objective

- To provide a clear illustration with principles of fire management systems.
- To provides an overview of fire accidents and accident analysis as a means of improving performance in order to have a fire hazard free environment.
- To determine the hazards of fire and control measures.
- To determine the fire load of industrial as well as domestic occupancy.
- To understand about the Industrial Fire protection System

#### Prerequisite

Nil

#### Course Outcomes

#### On the successful completion of the course, students will be able to

CO1	Understand the basic science behind fire.	Remember, Understand,
		Apply
CO2	Devise methodology for fire prevention and protection	Remember, Understand, Apply
CO3		Remember, Understand, Analyze
	Devise installation and maintenance fire safety systems as per statues.	Remember, Understand, Analyze
CO5	Associate basic principles of fire and explosion protection systems	Remember,Understand, Apply

#### Mapping with Programme Outcomes

COs	P01	PO2	PO3	PO4	PO5	PO6				
CO1	3	3	3	2	2	2				
CO2	3	3	3	2	2	2				
CO3	3	3	3	2	2	2				
CO4	3	3	2	2	2	2				
CO5 3 3 2 3 2										
	3- Strong;2-Medium;1-Some									

#### Assessment Pattern

Bloom'sCategory	ContinuousA (N	End Sem Examination		
Dioonii Soutegory	1	2	(Marks)	
Remember (Re)	10	10	10	
Understand (Un)	20	20	30	
Apply (Ap)	30	0	30	
Analyze (An)	0	30	30	
Evaluate (Ev)	0	0	0	
Create (Cr)	0	0	0	

			K.S.Rangas		ege of Techno			022	
					01 Fire Engine				
				M.E-	Industrial Safe	ety Enginee	ring		
Sem	nester	F	lours/Week	(		Credit	I	MaximumMarks	;
		L	Т	Р	Total hrs	С	CA	ES	Total
		3	2	0	60	4	40	60	100
Fire pro of comb cloud e (BLEVE	perties of s pustion - th explosion, E)– case st	neory of com shock wave udies – Flixl	and gases – F bustion and s – auto igi	explosion – nition and s kico disaster	vapour clouds – spontaneous ignit , BP Texas, Pipe	flash fire – jet tion – Boiling	fires – pool fi Liquid Expar	ead - toxicity of pr res – unconfined nding Vapour Exp mbay Victoria doo	vapour .[ plosion
Fire Pre Sources systems - desigr	evention a s of ignitio s – various	n <b>d Protectio</b> n – fire trian classes of fi e station– ma	on ngle – fire te ires – A, B, C	trahedron -	principles of fire	rs – fire stopp	ers – hydrant p	d passive fire pro bipes – hoses – m operations – fire	onitors [
nstallati CO <sub>2</sub> sys Portable - Releva <b>Nationa</b> ntroduc naterial	ions, reliat stem, foam e extinguis ant standa al Building ction to Na I and fire to	bility, mainter a system, dry hers – flamn rds - Oil Indu <b>j Code</b> tional Buildin esting – fire	nance, evalua chemical po nable liquids - ustry Safety D ng Codes (Ni water require	ation and sta wder (DCP) – server roor Directorate(O BC)-Objectiv ements-struc	andards – alarm a system, halon sy m and tank farms vISD),American Pe res of fire safe bu ctural fire protection	Ind detection s stem – need f safety – indic etroleum Instit uilding design, on – structural	systems. Othe or halon replaces of inflamma ute & other sta fire load and integrity – cor	calculation, fire re ncept of egress de	tems – enting. ystems [ŕ esistant esign – [{
Explosi Principle Contain gases, p carbon	ion Protect es of exp ment, Flau plant for g dioxide (C	ting System losion-Explo me Arrestors eneration of CO <sub>2</sub> ) and ha	<b>is</b> sion Pentago s, isolation, s inert gas-rup	on- detonati suppression, oture disc in on protectio	on and blast wa , venting, explosi process vessels	aves-explosion ion relief of la	n parameters arge enclosure plosion, suppre	<ul> <li>National Fire Pro</li> <li>Explosion Protection</li> <li>Explosion ventinection</li> <li>Explosion system basis</li> <li>Ses and liquid store</li> </ul>	ection, ig-inert sed on I
							Total H	lours [45 +15(T	utorial)):
	Book(s):								
1. J	lain V K, "F	Fire Safety in	Buildings", N	lew Age Inte	ernational (P) Limi	ted Publishers	,New Delhi, 2 <sup>n</sup>	dEdition,2015.	
2 C	Derek Jam	es, "Fire Pre	vention Hand	Book", Butte	erworth-Heinemar	nn,London,198	36.		
	ence(s):								
Refer									
	Gupta R S,	"Hand Book	of Fire Tech	nology", Orie	ent Longman, Bon	nbay,2 <sup>nd</sup> Editic	on, 2010.		

## **Course Contents and Lecture Schedule**

S.No	Торіс	No.of Hours		
1	Physics and Chemistry of Fire			
1.1	Fire properties of solid, liquid and gases – Flammability limits-Minimum Ignition energy (MIE)- fire spread - toxicity of products of combustion - theory of combustion and explosion			
1.2	<ul> <li>vapour clouds – flash fire – jet fires – pool fires – unconfined vapour cloud explosion, shock waves – auto ignition and spontaneous ignition –</li> </ul>	2		
1.3	Boiling Liquid Expanding Vapour Explosion (BLEVE)–	2		
1.4	case studies – Flixborough, Mexico disaster, BP Texas, Piper Alpha	2		
1.5	Peterborough & Bombay Victoria dock ship explosions - Buncefield fire – Jaipur oil fire 2009- Bombay high-vizag	2		
1.6	Tutorial	3		
2	Fire Prevention and Protection			
2.1	Sources of ignition – fire triangle – fire tetrahedron - principles of fire extinguishing –	1		
2.2	active and passive fire protection systems – various classes of fires – A, B, C, $D -$	2		
2.3	types of fire extinguishers – fire stoppers –	2		
2.4	hydrant pipes – hoses – monitors – designing of fire station– maintenance of fire trucks – foam generators	2		
2.5	– escape from fire rescue operations – fire drills – notice-first aid for burns			
2.6	Tutorial			
3	Industrial Fire Protection Systems			
3.1	Sprinkler-hydrants-stand pipes – special fire suppression systems like deluge and emulsifier, selection criteria of the above installations, reliability, maintenance, evaluation and standards –	3		
3.2	alarm and detection systems. Other suppression systems – CO <sub>2</sub> system, foam system, dry chemical powder (DCP) system,	2		
3.3	halon system – need for halon replacement – smoke venting.	1		
3.4	Portable extinguishers – flammable liquids – server room and tank farms safety – indices of inflammability-	2		
3.5	firefighting systems – Relevant standards - Oil Industry Safety Directorate(OISD),American Petroleum Institute & other standards.	2		
3.6	Tutorial	3		
4	National Building Code			
4.1	Introduction to National Building Codes (NBC)-Objectives of fire safe building design, fire load and calculation	2		
4.2	fire resistant material and fire testing – fire water requirements-structural fire protection – structural integrity –	1		
4.3	concept of egress design – exits width calculations - fire certificates	2		
4.4	fire safety requirements for high rise buildings – snookers	1		
4.5	National Fire Protection Administration (NFPA) -Life code.	2		
4.6	Tutorial	3		
5	Explosion Protecting Systems.			
5.1	Principles of explosion-Explosion Pentagon- detonation and blast waves- explosion parameters – Explosion Protection, Containment,	2		

5.2	Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure-explosion venting-inert gases	2
5.3	, plant for generation of inert gas-rupture disc in process vessels and lines explosion,	2
5.4	suppression system based on carbon dioxide (CO <sub>2</sub> ) and halonsExplosion protection for flammable, toxic and compressed gases and liquid storages- Qualifying Standards and approving agencies	
5.5	Tutorial	3
	Total	60

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## CourseDesigners

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60 PIS 202	Computer Aided Hazard Analysis	Category	L	Т	Ρ	Credit
		PC	3	2	0	4

#### Objective

- To impart the learner an amount of qualitative and quantitative methods for risk analysis.
- To familiarize the learner with hazard identification and risk analysis methods.
- To give an overview on safety softwares currently used in industries.
- To give insight on micro calorimetric methods.
- To elaborate on consequence analysis and dispersion modelling.

#### Prerequisite

Nil

#### **Course Outcomes**

#### On the successful completion of the course, students will be able to

CO1	Selection and suitability of hazard evaluation techniques for industrial	Remember, Understand,
	issues.	Apply
	Understand and apply hazard analysis techniques for scenario and non- scenario based.	Remember, Understand, Apply
	Utilize software aids for hazard evaluation and estimate heat radiation effect and damage distance using gas/Vapour dispersion	Remember, Understand, Analyze
CO4	Analyze the causes of runaway reaction using micro calorimetric techniques	Remember, Understand, Analyze
CO5		Remember,Understand, Apply

#### Mapping with Programme Outcomes

COs	P01	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	2	2
3- Strong;2-Medium;1-Some						

#### Assessment Pattern

Bloom'sCategory		ssessmentTests Iarks)	End Sem Examination		
Bioom sourcegory	1	2	(Marks)		
Remember (Re)	10	10	10		
Understand (Un)	20	20	30		
Apply (Ap)	30	0	30		
Analyze (An)	0	30	30		
Evaluate (Ev)	0	0	0		
Create (Cr)	0	0	0		

		En DIE 202			logy-Auton	iomous R2	2022			
		60 PIS 202		er Aided Hazar		rina				
M.E-Industrial Safety Engineering           Semester         Hours/Week         Total hrs         Credit         MaximumMarks										
Comester			P	rotarms	C	CA ES Tot				
11	3	2	0	60	4	40	60	10		
afety review S	election of ha	zard evaluatio	on techniques	es of process life s - Factors influe nt changes -comb	ncing the sele	ction of hazar	d evaluation te	chniques-		
oxicity index (F	ased:- Checkl ETI) Scenaric arious indices re Mode and I	ist analysis, s b Based:- Fau b – what-if ar Effect Analysi	lt Tree Analy nalysis/checkl s (FMEA) .	relative ranking, /sis & Event Tree list analysis - ha	Analysis, Lo	gic symbols, n	nethodology, m	inimal cut		
Scenarios from of Safeguards- .evel (SIL). Haz	scenario-base Risk Estimatio	ed Hazard Ev on using Risk	aluations- Se Matrix or Dir	everity of consequences of consequences of the sector of t	Layer of Prote	ction Analysis	(LOPA), Safet	y Integrity	r	
	bench), PHA ı			PHAPro,FEME-P			COP manager,		[9]	
<b>nstrumentatio</b> Applications of Fhermo Gravim Applications, ac	bench), PHA ı n Advanced E etric Analyzer vantages. Exț	manager, LOF quipments ar (TGA), Acce plosive Testin	PA manager, nd Instrumer lerated Rate g, Deflagratio		Pro,ALOHA. orimetry, Diffe C), Principles on Test, Ignitio	erential Scanr of operations on Test, Minim	ning Calorimete , Controlling pa num ignition end	er (DSC), trameters, ergy Test,	[9] [9]	
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# **Course Contents and Lecture Schedule**

S.No	Торіс	No.of
		Hours
1	Introduction	
1.1	Introduction, hazard, hazard monitoring, different stages of process life time – Hazard reduction approaches and inherent safety review	2
1.2	Selection of hazard evaluation techniques - Factors influencing the selection of hazard evaluation techniques	2
1.3	decision making process	1
1.4	hazard review for management changes	2
1.5	combined hazard review- hazard evaluation - Risk issues	2
1.6	Tutorial	3
2	Hazard Evaluation Techniques	
2.1	Non Scenario Based:- Checklist analysis, safety review, relative ranking, preliminary hazard analysis (PHA),	1
2.2	fire explosion and toxicity index (FETI)	1
2.3	Scenario Based:- Fault Tree Analysis & Event Tree Analysis, Logic symbols, methodology, minimal cut set ranking	2
2.4	-various indices – what-if analysis/checklist analysis	1
2.5	Hazard operability studies (HAZOP) -Hazard analysis (HAZAN) -	2
2.6	Failure Mode and Effect Analysis (FMEA) .	2
2.6	Tutorial	3
3	Risk-Based Determination of The Adequacy of Safeguard .	
3.1	Scenarios from scenario-based Hazard Evaluations- Severity of consequence- Frequency of Initiating Causes- Effectiveness of Safeguards-	2
3.2	Risk Estimation using Risk Matrix or Direct Calculation,	1
3.3	Layer of Protection Analysis (LOPA), Safety Integrity Level (SIL).	2
3.4	Hazard evaluation software aids – Risk Phast V 6.6 (DNV), HazardReview LEADER, HAZOP manager	2
3.5	HAZOP+ (Reliability workbench), PHA manager, LOPA manager, PHAPro,FEME-Pro,ALOHA	2
3.6	Tutorial	3
4	Instrumentation	
4.1	Applications of Advanced Equipments and Instruments, Principles of operations, Controlling parameters, Applications, advantages. Thermo Calorimetry, Differential Scanning Calorimeter (DSC),	1
4.2	Principles of operations, Controlling parameters, Applications, advantages Thermo Gravimetric Analyzer (TGA), Accelerated Rate Calorimeter (ARC),	2
4.3	Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test,	2
4.4	Sensitiveness Test, Impact Sensitiveness Test(BAM) and Friction Sensitiveness Test (BAM	2
4.5	Shock Sensitiveness Test, Card Test	2
4.6	Tutorial	3

5	Consequences Analysis	
5.1	Logics of consequences analysis- Estimation- Hazard identification based on the properties of chemicals-	2
5.2	Chemical inventory analysis- identification of hazardous processes-	2
5.3	Estimation of source term, Gas or vapour release, liquid release, two phase release-	2
5.4	Heat radiation effects, BLEVE, Pool fires and Jet fire- Gas/vapour dispersion- Explosion, UVCE and Flash fire,	2
5.5	Explosion effects and confined explosion- Toxic effects- Plotting thedamage distances on plot plant/layout.	1
5.6	Tutorial	3
	Total	60

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# CourseDesigners

1. Dr.V.Sundararaju

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- 2. Mrs.S.Chandralekha
- <u>chandralekha@ksrct.ac.in</u>

60 PIS 203	Environmental Safety	Category	L	Т	Ρ	Credit
		PC	3	2	0	4

- To give insight on Environment pollution.
- To impart the causes and consequences of air pollution.
- To educate the causes and ill effects of water pollution.
- To describe the causes and effects of hazardous wastes.

#### Prerequisite

Nil

### **Course Outcomes**

### On the successful completion of the course, students will be able to

C	Associate air pollutants, causes and effects and execute controls measures for air pollution at domestic and industrial level pertaining to air pollution statues	
C	Associate water pollutants, causes and effects and execute controls measures for water pollution at domestic and industrial level pertaining to water pollution statues	
C	Understand the characteristics of hazardous waste and execute controls measures for land pollution at domestic and industrial level pertaining to hazardous waste management statues.	
C	Experiment sampling techniques to measure the level of gaseous pollutants and particulate matters in industrial sector and environment.	Remember, Understand, Analyze
C	Investigate hazards and implement Pollution control measures at Major hazardous industries.	Remember,Understand, Apply

# Mapping with Programme Outcomes

COs	P01	PO2	PO3	PO4	PO5	PO6			
CO1	3	3	3	2	2	2			
CO2	3	3	3	2	2	2			
CO3	3	3	3	2	2	2			
CO4	3	3	2	2	2	2			
CO5	3	3	2	3	2	2			
	3- Strong;2-Medium;1-Some								

### Assessment Pattern

Bloom'sCategory		ssessmentTests Iarks)	End Sem Examination
Bicom coatogory	1	2	(Marks)
Remember (Re)	10	10	10
Understand (Un)	20	20	30
Apply (Ap)	30	0	30
Analyze (An)	0	30	30
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

			K.S.Rand	asa	mv Co	llege of Techn	oloav-Au	tonomous	R2022		
						203- Environn					
						ndustrial Safe					
Ser	nester		Hours/We	ek			Credit		MaximumMark	s	
		L	Т		Р	Total hrs	С	CA	ES		tal
		3	2		0	60	4	40	60	10	0
Air Pol	lution								•		
Plants violet ra automo	and Mater adiation, i obile exha	ials - autom nfrared radia usts- stack	obile pollut ation, radiat emissions	ion-ha tion fi - CF	azards o rom sur <sup>:</sup> C- Stat	ition sources – Ef of air pollution-cor n-hazards due to tutory Provisions	ncept of clea depletion of related to A	n coal combus ozone - defo Air Pollution -	stion technology restation-ozone Emission stand	- ultra holes- lards :	.[9]
<b>Water</b> I Classifi effluent chemic	Pollution ication of ts and the al industrie	water polluta eir treatmen es, tannery, t	ants-health t and disp textile efflue	haza osal ents-c	ards-san -advanc common	npling and analys ed wastewater to treatment - Statu statutory norms.	sis of water- reatment - e	water treatme offluent quality	nt - different ind standards and	lustrial laws-	
Hazard collectio selectic health I standar	ous waste on, transp on charts hazards-to rds and re	oort ,storage for the treat oxic ,E-waste estrictions –	nt in India- , treatment ment of d and radioa recycling	t and ifferer active and	dispos nt haza wastes	ication, characteri al of hazardous rdous wastes-met -incineration and Statutory Provisio	waste- Disp hods of coll vitrification -	osal Facilities ection and dis hazards due t	- Secured Lan posal of solid w o bio-process-di	dfills - /astes- ilution-	[9]
Samplii absorpt Gravita control	ng and an tion spectr tional set	ometer- Indu tling chaml	t monitor – uctive Coup pers-cyclon	gas a oled S on ab	pectrop parators	s-scrubbers-electro	ostatic preci	pitator - bag i	filter – maintena	ance -	[10
<b>Polluti</b> Enviror petrole	on Contro nmental Ir um produc	ol in Major h npact_Asses	<b>azardous (</b> ssment (El nneries-ther	( <b>MAH</b> A) – mal p	Indust) Pollutic ower pl	<b>ries</b> on control in pro lants -dying and p	cess industi	ies like ceme	ent, paper, petro	oleum-	[8]
								Total Ho	urs [45 +15(Tu	utoria	))=6(
Text	Book(s):										
	Sam Man Edition 20		Loss Prev	ventic	on in P	rocess Industries	", Vol1,Vol2,	Vol3,Butterwo	rth-Heinemann,,	Londo	on, 4
<u> </u>	'Methodolo UK.2004.	ogies for Ris	ok and Sat	fety A	ssessm	ont in Chomical	Process Inc	lustries" Com	monwoolth Soio	nce C	
	01.2004.		sk and Sai								ounci
Refe	rence(s):	-		-							
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1.	r <b>ence(s):</b> Course Ma Chemical	aterial – "Inte Technology,	ensive Trair Tarnaka& (	ning F CLRI,	Program Chenna	me on Conseque	nce Analysis	", Process Saf	ety Centre, India		

r formed Bos Chairman

# **Course Contents and Lecture Schedule**

S.No	Торіс	No.of Hours
1	Air Pollution	
1.1	Classification and properties of air pollutants – Pollution sources – Effects of air pollutants on human beings, Animals, Plants and Materials -	2
1.2		
1.3	deforestation-ozone holes-automobile exhausts- stack emissions - CFC- Statutory Provisions related to Air Pollution	1
1.4	- Emission standards : Permissible Limits –National Ambient Air Quality Standards(NAAQS) -MINAS	2
1.5	– EURO Norms – Legal Compliance to statutory Norms.	2
1.6	Tutorial	3
2	Water Pollution	
2.1	Classification of water pollutants-health hazards-sampling and analysis of water-water treatment	1
2.2	different industrial effluents and their treatment and disposal -advanced wastewater treatment - effluent quality standards and laws	1
2.3	- chemical industries, tannery, textile effluents-common treatment -	2
2.4	Statutory Provisions related to Water Pollution- Effluent standards: Permissible Limits	1
2.5	<ul> <li>Legal Compliance to statutory norms</li> </ul>	2
2.6	Tutorial	3
3	Hazardous Waste Management	
3.1	Hazardous waste management in India-waste identification, characterization and classification-	2
3.2	technological options for collection, transport ,storage, treatment and disposal of hazardous waste	1
3.3	- Disposal Facilities - Secured Landfills -selection charts for the treatment of different hazardous wastes-methods of collection and disposal of solid wastes-	2
3.4	health hazards-toxic ,E-waste and radioactive wastes-incineration and vitrification - hazards due to bio-process-dilution-standards and restrictions – recycling and reuse-	2
3.5	Statutory Provisions related to Hazardous waste management & handling	2
3.6	Tutorial	3
4	Environmental Measurement and Control	
4.1	Sampling and analysis – dust monitor – gas analyzer, particle size analyzer – pH meter – gas chromatograph – atomic absorption spectrometer- Inductive Coupled Spectrophotometer.	1
4.2	Gravitational settling chambers-cyclone separators-scrubbers-electrostatic precipitator - bag filter – maintenance - control of gaseous emission by adsorption, absorption and combustion methods- Pollution Control Board-laws –	2
4.3	National Forest Policy – National Water Policy – National Agriculture Policy – National Environment Policy –	2
4.4	Ministry of Environment and Forest (MoEF) – CPCB, TNPCB- online monitoring, Corporate Social Responsibility (CSR) - Corporate Responsibility	2

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	for environmental protection (CREP) – UNFCC –	
4.5	Stockholm convention on Persistent organic pollutants 2001.	2
4.6	Tutorial	3
5	Pollution Control in Major hazardous (MAH)Industries	
5.1	Environmental Impact Assessment (EIA) – Pollution control in process industries like cement, paper,	2
5.2	petroleum-petroleum products-	2
5.3	textile-tanneries-thermal power plants -	2
5.4	dying and pigment industries -	2
5.5	eco-friendly energy - National Environment Assessment and Monitoring Authority (NEAMA).	1
5.6	Tutorial	3
	Total	60

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# CourseDesigners

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00 DIO 0D4	Industrial Safety ,Environment and	Category	L	Т	Ρ	Credit
60 PIS 2P1	Simulation Laboratory	PC	0	0	4	2

To provide opportunity to operate the equipment to acquire practical knowledge.

- To know the various PPEs.
- To carry out experiments to find out the environmental parameters.
- To assess the impact of sensitivity of chemicals on explosivity.
- To run the software to assess the consequence effects of major accidents

#### Prerequisite

Nil

# Course Outcomes

# On the successful completion of the course, students will be able to

	know and run the various equipments to bring out the safety environment in the industry.	Remember, Understand, Apply
CO2	measure the particulate matter and assess the impact of air pollution.	Remember, Understand, Apply
CO3	conduct experiments to find out various environmental parameters.	Remember, Understand, Apply,Analyze
CO4	use personal protective equipment independently.	Remember, Understand, Analyze
CO5	recognise the various problems with the use of software and hence to predict the real situations on major accidents.	Remember, Understand, Apply

### Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6			
CO1	3	3	3	2	2	2			
CO2	3	3	3	2	2	2			
CO3	3	3	3	2	2	2			
CO4	3	3	2	2	2	2			
CO5	3	3	2	3	2	2			
	3- Strong;2-Medium;1-Some								

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BoS Chairman

	K.S.Rangasamy C						R2022		
	60 PIS 2P1 - Inc			vironment an rial Safety Eng		on Labor	atory		
	Hours/		. maust		Credit	N	<i>A</i> aximum	Marks	
Semester	L	T	Р	Total Hrs	C	CA	ES	Tota	al
II	0	0	4	60	2	60	40	100	)
Measurement and intermitter BURST STREI EXHAUST GA hydrocarbons. metals). ENVIRONMEN Determination TRAINING IN I Respiratory an hand gloves, g	MEASUREMENT A of sound pressure le t sources at various NGTH TEST of pack S MEASUREMENT Waste water analys ITAL PARAMETER of relative humidity, USAGE AND SKILL d nonrespiratory de oggles, safety shoe conducting plastics/r	evel in dB a networks kaging ma AND ANA sis, Sampli MEASUR wind Flow DEVELO monstratic , gum boo	for Impac , peak an terials like ALYSIS O ing and A EMENT: v, Particle PMENT ( on-self con ts, ankle	d average value e paper bags, o F WATER: Me nalysis of wate Dry Bulb Temp size Measure OF PERSONA ntained breath shoes, face sh	corrugated o easurement er (pH, COD perature, W ment & Air s L PROTEC <sup>-</sup> ing apparato ield, nose m	of SOx, N ), DO, Su et Bulb T sampling TIVE EQU us. Safety	NOx, COx Iphate and emperatur analysis. JIPMENT y helmet, l	, d heavy re, : : belt,	
STATIC CHAR lux meter.	GE TESTING on pl	astic, rubt	ber, ferrou	is and non-ferr	ous materia	als. Illumir	nation test	ting - by	
	SAFETY - Insulation Sensitivity test for E				s, Estimatic	on of eart	h resistan	ce, Earth	
SOFTWARE L (CISCON), Fire Electrical Syste	ARDING AND INTE JSAGE – ALOHA, A e, Explosion and To em, Failure Mode Ai RST-AID, Road safe	ccident Ar xicity Inde nalysis.	nalysis ,Sa x (FETI),	afety Audit Pao Reliability Ana					
							Tota	l Hours	60
Reference(s)									
1. Indust	rial Safety Laborato	ry Manual							

# **Course Designers**

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r formed Bos Chairman

		Category	L	Т	Ρ	Credit
60 PIS 2P2	Fire Engineering Laboratory	PC	0	0	4	2

- The Course is framed to make the student aware about the Fire fighting systems.
- The course will enable the student about the functioning of fire extinguishers.
- The course will make the student to organize a fire mock drill.

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# Prerequisite

Nil

# Course Outcomes

### On the successful completion of the course, students will be able to

CO1	Understand the principles of Fire Extinguishing	Remember, Understand, Apply
CO2	Operate Class A,B,C type Fire Extinguishers	Remember, Understand, Apply
CO3	Conduct fire mock drill	Remember, Understand, Apply,Analyze
CO4	Understand the function of fire hose reel , fire hydrant and fire tender used by Fire Station	Remember, Understand, Analyze
CO5	Understand the utility of fire fighters PPE	Remember, Understand, Apply

### Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	2	2
	3- St	rong;2-l	Vedium	;1-Som	e	

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**BoS Chairman** 

	K.S.Rangasamy C	ollege of	Technol	ogy–Autonom	nous		R2022		
				Engineering L					
		PIS: M.	E. Indust	rial Safety Eng	gineering				
Semester	Hours	Week		Total Hrs	Credit	Credit Ma		Marks	
Semester	L	Т	Р	TOLATTIS	С	CA	ES	Tota	al
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	-						Tota	Hours	60
Reference(s	):								
1. Fire E	ingineering Laborato	ory Manua	Ι.						

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# **Course Designers**

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**BoS Chairman** 

# K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215

(An Autonomous Institution affiliated to Anna University)

### M.E. / M.Tech. Degree Programme SCHEME OF EXAMINATIONS (For the candidates admitted from 2022-2023 onwards) THIRD SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal	Weighta	ige of Marks	5	Minimum Marks for Pass in End Semester Exam					
	Code	Course	Exam	Continuous Assessment *	End Semester Exam	Max. Marks	End Semester Exam	Total				
	THEORY											
1	60 PIS E4*	Professional Elective IV	2	40	60	100	45	100				
2	60 PIS E5*	Professional Elective V	2	40	60	100	45	100				
			PRA	CTICAL								
7	60 PIS3P1	Project Work - Phase I	3	100	-	100	45	100				
8	60 PIS3P2	Industrial Safety Assessment – Internship	3	100	-	100	45	100				

\*CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department wills put a process in place to ensure that the actual test paper follow the declared pattern.

\*\*End Semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for the award of terminal examination marks.

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		60 P	IS 3P1 PROJE	CT WORK PHA	ASE I				
		M.E. IN	IDUSTRIAL SA	AFETY ENGINE	ERING				
Semester		Hours / Wee	k	Total hrs	Credit	М	aximum l	Marks	
Semester	L	Т	Р	Total IIIs	С	CA ES Tota			
III	0	0	20	60	10	100	0	100	
Objective(s)	•	To emphasize to by industries. To provide an e journals and con To relate the pro	the current sat xposure to the nference proce oject work with	dge to the stude rety practices ar students to refe edings. the collected re ing and critical t	nd risk as er, read an search art	sessment id review icle.	procedu	res adopte	
Course Outcomes	1. 2. 3. 4.	Understands the Explain and pre	prevailing in in E Literature rev pare a project tify the work do	ndustries/ societ riew process and report for the sta one for the ident	d technical ated proble	writing. em.	d confirm	the title.	
<ul> <li>should inv and must</li> <li>Three rev should be</li> <li>Each revie</li> <li>The candidecided by</li> <li>Attendance two chance</li> <li>Problem s</li> </ul>	t Work w olve scier preferably ews have the guide w has to date has t he guid e is comp e may be hould be	ill start in semes offic research, d offic research, d offic research, d offic research, d offic research, d be evaluated fo to be in regular e and student. oulsory for all re- given. selected througl	ster III and sho esign, generat dividual contrib ted by the co r 100 marks. contact with h views. If a stud	uld preferably be ion/collection an	nd analysis mum of the topic of o nd review the ndustries.	of data, of hree men dissertation for some	determini nbers on on must b	ng solution e of which be mutually	

• Report has to be prepared by the students as per the then format by the institution. Preliminary implementation can be done if possible.

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**BoS Chairman** 

	ŀ	K.S.Rangasam	y College of T	echnology – A	utonomou	us R2022	2	
		60 PIS 3P2 II	ndustrial Safe	ty Assessment	– Interns	ship		
	r			AFETY ENGINE	ERING			
Semester		Hours / Wee		Total hrs	Credit	М	aximum	Marks
	L	Т	Р		С	CA	ES	Total
III	0	0	4	4	2	100	0	100
Objective(s)	know • Provi perm • To de • Enha	ledge de students th anent commitm evelop skills in t nce the ability t	ne opportunity ients are made he application io improve stud	to actual wo to test their i of theory to prac dent's creativity s bility and respor	nterest in ctical work skills and s	a partic situation: sharing id	cular car s eas	eer before
Course Outcomes	1. U 2. F 3. U 4. F	o problems alou Familiarized with cations along with Jnderstand the organization nterpreting the projects	psychology ng with the pra h various Desi ith relevant as scope, functio theoretical kn	of the workers, ctices followed e gn, Manufacturin bects of industry ns and job respo owledge with re complete project	either at fa ng, Analysi managem onsibilities al time sit	ctory or a s, Autom nent in various e conditio	t site ation and s departn ons while	I their appli nents of an
of one <ul> <li>Report <ul> <li>comme</li> </ul> </li> <li>A technic</li> </ul>	Month) s contain ents/sugge nical prese	ing the obse stion are to be	rvation of th prepared and s	ng during secor ne students at submitted in the udents immediat	fter the beginning	training of third s	with the emester	èir personal

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**BoS Chairman** 

# K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE - 637215

(An Autonomous Institution affiliated to Anna University)

### M.E. / M.Tech. Degree Programme SCHEME OF EXAMINATIONS (For the candidates admitted from 2022-2023 onwards) FOURTH SEMESTER

S.No.	Course Name of the		Duration of Internal	Weightage of Marks			Minimum I for Pass i Semes Exam	n End ter
	Code	Course	Exam	Continuous Assessment *	End Semester Exam	Max. Marks	End Semester Exam	Total
			PRA	CTICAL				
1	60 PIS 4P1	Project Work - Phase II	3	60	40	100	45	100

\*CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department wills put a process in place to ensure that the actual test paper follow the declared pattern.

\*\*End Semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for the award of terminal examination marks.

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	K.S	.Rangasa	my Colle	ege of Techr	nology – A	utonomous	s R 20	22
				Project Wo				
		M.E. IN	IDUSTRI	AL SAFETY		RING		
Semester	Hour	s / Week		Total hrs	Credit	I	Maximum Mark	s
	L	TP03260platform to the learner to check nent their innovative ideas to for e the hazards by adopting suita problems in global context and ce their decision making and cri- of the course, the student will problems prevailing in industries cands the Literature review proc explain and prepare a project re- present and justify the conso		C	CA	ES	Total	
IV	0	•	-		16	60	40	100
Objective(s)	<ul> <li>To implement</li> <li>To retrieve the to relate procession</li> <li>To enhance</li> </ul>	nt their inn he hazard oblems in g their decis	ovative ic s by adop global con sion maki	deas to forefing suitable ntext and sug ng and critic	ront the ris assessme ggest reco al thinking	k issues. ent methodo mmendation	logies.	al safety.
Course Outcomes	<ol> <li>Select pro</li> <li>Understan</li> <li>Able to ex</li> <li>Able to pr forum.</li> <li>Acquire co</li> </ol>	blems pre ds the Lite plain and p resent and competence	vailing in erature re prepare a d justify t e in sugg	industries or view process project repo he consolida	<sup>-</sup> societal b s and tech ort for the s ated work odology to	nical writing. stated proble done for th minimize ar	m. e identified pro id eliminate the	blem in the
Methodology	of which si Each revie Attendanc reason, or The projec pose threa They shou Final revie of which si Report has	hould be t ew has to l e is comp ne or two c ct carried at to life, pu ild publish ew will be o hould be t s to be pre	he guide be evalua ulsory for chance m out must roperty ar the pape done by t he guide epared by	ated for 100 r r all reviews ay be given. address ind address ind en preferably he committe (if possible in the students	marks. If a stude lustrial safe ent in the journ e that cons nclude one s as per the	ent fails to a ety issues/so nals/confere sists of minir e external ex e then forma	num of three m ttend review for ocietal issues w nces. num of three m pert examiner). to by the instituti	<sup>-</sup> some valid /hich mainly embers one on

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60	PIS	E11	

Industrial Health and Hygiene

Category	L	Т	Ρ	Credit
ES	3	0	0	3

## Objective

- To impart basic anatomy and functions of human body.
- To understand the significance of various hazards and its ill effects.
- To give an overview of ergonomics and ergonomics tools.
- To emphasize the practical means of achieving industrial health compliance with the current regulations.
- To provide knowledge on the assessment of industrial health and hygiene.

### Prerequisite

Nil

### Course Outcomes

### On the successful completion of the course, students will be able to,

CO1	Understand the anatomy and physiology of human organs and analyze the effect of various hazards on human organs	Understand
CO2	Determine the physical hazard at workplace and suggest control measures.	Apply
CO3	Compute the chemical hazards at workplace with adequate mitigating actions.	Apply
CO4	Evaluate the biological and ergonomical hazards at workplace and associated risk factors.	Evaluate
CO5	Practice the occupational health strategies at workplace. Regulate the man machine interface in the organization	Analyze

### Mapping with Programme Outcomes

COs	P01	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	3	2
CO2	3	2	1	2	2	2
CO3	3	2	1	2	2	2
CO4	2	2	1	2	3	2
CO5	2	2	1	2	3	2
	3- 3	Strong;2	2-Mediur	n;1-Son	ne	

#### Assessment Pattern

	Continuous Asse	End Sem Examinatior	
Bloom's Category	1	2	(Marks)
Remember(Re)	10	10	10
Understand (Un)	10	20	40
Apply (Ap)	10	10	20
Analyze (An)	20	10	20
Evaluate (Ev)	10	10	10
Create (Cr)			

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	K.S.Ra			Technology–A trial Health an		R2U22		
	Hours	Week	TT- maus	trial Health an	Credit		laximumMarks	
Semester			Р	Total hrs	Credit	CA	ES	Toto
1	L3	Т 0	P 0	45	3			Tota
l Anotomy/Db	ہ ysiology ,Hazard ar	-	-	45	3	40	60	100
Definition- Aı organs – Imj audiometric mechanisms	natomy and Physiolo pairment of organs – tests, eye tests, vi , Recognition of healt	gy of huma - Effects of tal function	n organs - various h al tests.	azards on orga Exposure rout	ans - Cardio p es of toxic	oulmonary materials	resuscitation - and protective	
Induced Hea networks, no hearing cons effects, instru- lonizing radia radiations, e environments stress indices	ensation aspects, no aring Loss (NIHL), r bise surveys, Noise a ervation programmes uments, surveying pro ation, types, effects, f ffects, types, radar s, hypothermia, wind s, acclimatization, est	isk factors, and Vibratio s- vibration poedure, per monitoring i hazards, r I chill index	sound m on Mappir - Standarc rmissible e nstrument nicrowave <, control	neasuring instri ng, noise contri ls, whole body exposure limit. s, control prog s and radio-w	uments, octav ol programme vibration, Hau rammes, OSH vaves, lasers,	ve band a es, industri nd - Arm v IA standar Permissil	nalyzer, noise al audiometry, /ibration types, d- non-ionizing ble level- cold	[10]
dose - India operation de OSHAS Stan and Vapour Control, Des Hygiene Aud	of chemical hazards- n standards (IS), TL scription, field survey idard. Air Sampling ir monitors, dust sampl ign maintenance cou it - training and educa	V, IDLH, L y, sampling hstruments, le collection hsiderations ation.	D <sub>50</sub> , LC <sub>50</sub> , methodolo Types, Me devices,	STEL,PEL,RE ogy, Industrial easurement Pro personal samp	EL Methods of hygiene calcu ocedures, Instr ling. Methods	of Evaluations, Co ruments Pr of Contro	on, process or omparison with ocedures, Gas I - Engineering	[09]
Classificatior agents, funga Covid-19-Bio animal care Disorders –co back injuries	nd Ergonomical Haz of Bio hazardous ag al, parasitic agents, ir hazard control Prog and handling-biolog arpal tunnel syndrom – Posture Assessme ination and Ventilatio	gents – exa nfectious dis grammes, e gical safety e (CTS) - R nt - Rapid L	eases - E employee cabinets epetitive S Jpper Limb	pidemic -Pande health Progra - building de Strain Injury (RS Assessment (	emic -Covid-19 mmes-laborat esign. Work SI) - Tendon p RULA), Rapid	9 and WHC ory safety Related M ain-disorde	) guidelines for programmes- lusculoskeletal ers of the neck-	[09]
Concept and employment diseases, no asbestosis, p manganese t Routes of e Surveillance resuscitation	al Health, Physiolog d spectrum of healt and Periodical medi- potifiable occupational pneumoconiosis, sid toxicity, gas poisonin entry - Probit Analy and records – Occ , audiometric tests, cute and chronic eff	h - function cal examina diseases erosis, anth g (such as sis – Chen cupational h eye tests,	nal units ations – co as per S nracosis, a CO, ammo mical Exp Health Ce vital funct	occupational re chedule III of aluminosis and onia, coal and osure Assessintre – Factory tion tests - Fit	lated disease Factories Act anthrax, lea dust etc) their ment – Lega / Medical Off ness test .Inc	s, levels o t 1948 suo ad-nickel, <sup>c</sup> effects an l requirem ficer - car dustrial tox	f prevention of ch as silicosis, chromium and d prevention – nents -Medical dio pulmonary kicology, local,	[10]
Man as a sys anaerobic w	stem component – all ork – evaluation of n of job heaviness – iene	physiologi	cal requir	ements of job	s – paramet	ers of me	asurements -	[07]
1 33								
extbook(s):							Total Hours	45

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2.	"Hand book of Occupational Safety and Health", National Safety Council, Chicago, 1982.						
Refer	Reference(s):						
1.	"Encyclopaedia of Occupational Health and Safety", Vol.I and II, International Labour Office, Geneva, 2011.						
	Barbara A Plog, Patricia J Quinlan, MPH, CIH and Jennifer Villareal "Fundamentals of Industrial Hygiene", National Safety Council , 6 <sup>th</sup> Edition, 2012.						
	Charles D Reese, "Occupational Health and Safety Management: A Practical Approach", CRC Press, 3 <sup>rd</sup> Edition,2018.						
4.	Fulekar M H , "Industrial Hygiene and Chemical Safety", I.K. International Publishing House, 2016.						

### Course Contents and Lecture Schedule

S.No	Торіс	No.of Hours
1	Anatomy, Physiology, Hazard and Pathology	
1.1	Definition- Anatomy and Physiology of human organs	1
1.2	The lungs, Skin, Ear , Eyes and skin	1
1.3	Functions of organs	1
1.4	Impairment of organs	2
1.5	Effects of various hazards on organs	1
1.6	Cardio pulmonary resuscitation	1
1.7	- audiometric tests, eye tests, vital functional tests.	1
1.8	Exposure routes of toxic materials and protective mechanisms,	1
1.9	Recognition of health hazards,	1
1.10	Methods for measuring and evaluating health hazards	2
2	Physical Hazards	10
2.1	Noise, Compensation Aspects, Noise Exposure Regulation, Properties Of Sound, Occupational Damage	1
2.2	Noise Induced Hearing Loss (NIHL), Risk Factors, Sound Measuring Instruments, Octave Band Analyzer, Noise Networks, Noise Surveys	2
2.3	Noise And Vibration Mapping, Noise Control Programmes, Industrial Audiometry, Hearing Conservation Programmes- Vibration.	1
2.4	Standards, Whole Body Vibration, Hand Arm Vibration Types, Effects, Instruments, Surveying Procedure, Permissible Exposure Limit.	1
2.5	Ionizing Radiation, Types, Effects, Monitoring Instruments, Control Programmes, OSHA Standard	1
2.6	Non-Ionizing Radiations, Effects, Types, Radar Hazards, Microwaves And Radio-Waves, Lasers, Permissible Level	1
2.7	Cold Environments, Hypothermia, Wind Chill Index	1
2.8	Control Measures- Hot Environments	1
2.9	Thermal Comfort, Heat Stress Indices, Acclimatization, Estimation And Control.	1
3	Chemical Hazards	09
3.1	Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases, types, concentration	1
3.2	Exposure Vs. dose - Indian standards (IS), TLV, IDLH, LD <sub>50</sub> , LC <sub>50</sub> , STEL,PEL, REL Methods of Evaluation	1
3.3	process or operation description, field survey, sampling methodology,	1
3.4	Industrial hygiene calculations, Comparison with OSHAS Standard.	1

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3.5	Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures	1
3.6	Gas and Vapour monitors, dust sample collection devices, personal sampling. Methods of Control	2
3.7	Engineering Control, Design maintenance considerations, design specifications	1
3.8	General Control Methods - Industrial Hygiene Audit - training and education.	1
4	Biological and Ergonomical Hazards	09
4.1	Classification Of Bio Hazardous Agents – Examples, Bacterial Agents, Rickettsial And Chlamydial Agents, Viral Agents, Fungal, Parasitic Agents, Infectious Diseases	1
4.2	Epidemic -Pandemic -Covid-19 And WHO Guidelines For Covid-19	1
4.3	Biohazard Control Programmes, Employee Health Programmes- Laboratory Safety Programmes-Animal Care And Handling-Biological Safety Cabinets	2
4.4	Building Design. Work Related Musculoskeletal Disorders	1
4.5	Carpal Tunnel Syndrome (CTS) - Repetitive Strain Injury (RSI)	1
4.6	Tendon Pain-Disorders Of The Neck- Back Injuries – Posture Assessment	1
4.7	Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA).Illumination And Ventilation	1
4.8	Hazards – Control And Measurements.	1
5	Occupational Health, Physiology and Toxicology	
5.1	Concept and spectrum of health - functional units and activities of occupational health services, pre-employment and Periodical medical examinations	2
5.2	occupational related diseases, levels of prevention of diseases,	1
5.3	notifiable occupational diseases as per Schedule III of Factories Act 1948 such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax, lead-nickel, chromium and manganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc) their effects and prevention –	2
5.4	Routes of entry - Probit Analysis – Chemical Exposure Assessment – Legal requirements -Medical Surveillance and records – Occupational Health Centre – Factory Medical Officer - cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests -	2
5.5	Fitness test .Industrial toxicology, local, systemic, acute and chronic effects, temporary and cumulative effects, carcinogens entry into human systems.	1
5.6	Man as a system component – allocation of functions – efficiency – occupational work capacity – aerobic and anaerobic work – evaluation of physiological requirements of jobs.	1
5.7	<ul> <li>parameters of measurements – categorization of job heaviness – work</li> <li>organization – stress – strain – fatigue – rest pauses – shift work –</li> <li>personal hygiene</li> </ul>	2
	Total	45

# Course Designers

- 1. Dr.V.Sundararaju
- 2. Mrs.S.Chandralekha

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Category	L	Т	Ρ	Credit
ES	3	3	3	3

- To understand the health impacts of industrial noise
- To know about noise level measurement and noise surveys.
- To understand the significance of noise control measures.
- To emphasize their knowledge over the ill-effects of vibration.
- To understand the significance of vibration control in industrial environment.

# Prerequisite

Nil

### Course Outcomes

### On the successful completion of the course, students will be able to,

CO1	Understand specifics about industrial noise and their effects.	Understand
CO2	Identify the existence of noise problem in industrial area through noise	Apply
	mapping.	
CO3	Execute noise control measures for the industrial noise problem.	Analyze
CO4	Understand specifics about industrial vibration and their effects.	Understand
CO5	Assess specifics about Hand- Arm vibration and recommends suitable	Analyze
	remedial measures	

### Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	3	2
CO2	3	1	1	1	2	2
CO3	3	1	1	2	2	2
CO4	2	4	1	1	3	2
CO5	2	3	1	1	3	2
	3- S	strong;2	-Mediu	m;1-So	me	

### **Assessment Pattern**

Bloom's Category		Assessment Tests Marks)	End Sem Examination
Dicom s category	1	2	(Marks)
Remember(Re)	10	10	20
Understand (Un)	20	20	40
Apply (Ap)	10	10	20
Analyze (An)	10	10	10
Evaluate (Ev)	10	10	10
Create (Cr)			

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				-	Technology–A				
				Industrial	Noise and Vib				
Semester	ster	Hours	s/Week	1	Total hrs	Credit			
		L	Т	Р		С	CA	ES	Tota
	I	3	0	0	45	3	40	60	100
Soun meas 1948	uremen and Ta	i <b>on</b> ts propagation - t - Decibel – Sou mil Nadu Factories neter and other me	ind level m s Rules 19	eter – Pe 50 – Occu	rmissible expo upational Deafn	sure levels	under the	Factories Act	[09]
ldenti health noise	n – Nois problen	of the existence c e source diagnosis n in Engineering In	s – summai	ry of Diagi	nostic approach				[09]
Techr existir – Atte Noise mater	niques i ng mach enuation e Contro rials —	DI Measures nvolving minimal n ninery – Technique levels of different ol Materials -Nois Material selection ng machine.	s requiring types of PP se absorpti	equipmen PE – Motiv on mater	t redesign – Us ation and comn ials – Transm	e of persona nunication m ission Loss	al protectiv ieasures. materials	ve equipments s – Damping	[12]
		vation - Industrial Vibration monitoring		Vhole bod	y Vibration – St	andards -Vi	bration iso	lating	[05]
vibrat from I Tool f	ion – D HAV – E for the J	sks And Their Co aily Vibration Dos Back pain Risks fr ob in the right way breaks – Job rotati	se – measu rom mobile r (Ergonomi	rement To machine o cs) – Tool	echnique – Har operations – Er design and ma	nd – Arm Vi gonomics of	bration (H. f Vibrating	AV) – Injuries Tools – Right	[10]
								<b>Total Hours</b>	45
Text	book(s)	:							
1. 2.	Paul N ( Arbor Se	Cheremisinoff, Pete cience Publishers, L G, "Mechanical	1977						
	ence(s)								
		ook of Industrial No	ise Control		ashiaton D C				
		G Peterson, "Har				dition 1000			
/		Harris Allan G Pie					. McGraw	Hill Publication	ns Ne
3.		Edition, 2002.				nanaboon,	,		10, 110

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Course Contents and Lecture Sche	dule
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S.No	Торіс	No.of Hours
1	Noise Pollution	09
1.1	Sound And Its Propagation- Noise	1
1.2	Industrial Noise - Workers Exposure Level	2
1.3	Noise Level Measurement - Decibel – Sound Level Meter	3
1.4	Permissible Exposure Levels Under The Factories Act 1948 And Tamil Nadu Factories Rules 1950	1
1.5	Occupational Deafness As Notifiable Disease	1
1.6	Use Of Sound Level Meter And Other Means To Determine Noise Exposure.	1
2	Noise mapping	09
2.1	Identification of the existence of noise problems	1
2.2	Severity of noise problems and their impacts over health	2
2.3	Noise source diagnosis- summary of Diagnostic approaches	3
2.4	Noise Mapping- Case study of noise problem in Engineering Industry	2
2.5	Noise survey procedure	1
3	Noise control Measures	12
3.1	Techniques involving minimal noise modification	1
3.2	Techniques requiring equipment to be added to the existing machinery	1
3.3	Techniques requiring equipment redesign – Use of personal protective equipments	1
3.4	Attenuation levels of different types of PPE – Motivation and communication measures.Noise Control Materials -Noise absorption materials – Transmission Loss materials – Damping materials — Material selection – Comparison of noise reduction methods as applied to a particular noise producing machine.	2
4	Vibration	05
4.1	Vibration - Industrial Vibration - Whole body Vibration – Standards - Vibration isolating materials – Vibration monitoring	1
5	Vibration Risks And Their Control	10
5.1	Potential Hazards of Industrial Tools and operations that produce vibration – Daily Vibration Dose	2
5.2	measurement Technique – Hand – Arm Vibration (HAV)	2
5.3	Injuries from HAV – Back pain Risks from mobile machine operations	2
5.4	Ergonomics of Vibrating Tools	2
5.5	Right Tool for the Job in the right way (Ergonomics)	1
5.6	<ul> <li>Tool design and maintenance – Keeping hands warm</li> </ul>	1
5.7	Multiple shift breaks – Job rotation and maintenance.	2
	Total	45

# **Course Designers**

1. Dr.V.Sundararaju

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Category	L	Т	Ρ	Credit
ES	3	0	0	3

- Students will be provided with the knowledge of the process of analyzing and developing information to produce a plant layout based on the locations and working conditions.
- To educate the students about the basic things of work conditions which include ventilation, lighting and its effect based on various nature of work.
- To provide the skill of handling the Manual material handling and lifting techniques of various shapes of machine and heavy objects. Also give an input of handling the hazardous materials of liquid, solids and cryogenic liquids with proper packing.
- The students will be provided with expert knowledge of arriving plant locations and creating the plant layout

# Prerequisite

### Nil

### **Course Outcomes**

### On the successful completion of the course, students will be able to,

CO1	To identify equipment requirements for a specific process and for various locations and	Understand
	working conditions.	
CO2	Understand the benefit of an efficient plant layout for various applications.	Understand
CO3	Understand hazards and prevention methods in mechanical material handling system.	Understand
CO4	Know different working conditions for effective productivity	Apply
CO5	Know the different manual material handling methods and lifting tackles	Apply

### Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	1	2	2
CO2	2	3	2		1	3
CO3	1	2	2	2		2
CO4	2	2	1	1	3	2
CO5	1	1	1			1
	3-	Strong;2	2-Mediu	n;1-Sor	ne	

#### Assessment Pattern

	Continuous Ass	End Sem Examination	
Bloom's Category	1	2	(Marks)
Remember(Re)	20	20	20
Understand (Un)	20	20	40
Apply (Ap)	10	10	20
Analyze (An)	10	10	20
Evaluate (Ev)			
Create (Cr)			

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				yout and Mate	utonomous rial Handlin			
•	Hours	/Week			Credit	1	/aximumMarks	
Semester	L	Т	Р	Total hrs	C	CA	ES	Tota
1	3	0	0	45	3	40	60	100
Plant Lo		-	-					
Selection waste tre bullets, s propellan	of plant locations, terr eatment and disposal, spheres, cylinders for its.	further exp	oansions	Safe location o	of chemical	storages i	in the form of	[9]
safe efflu security pharmac power sta	but, equipment layout, uent disposal and trea towers. Safe layout euticals, pesticides, fe ations, metal powders r	tment tank for proce rtilizers, re	s, site co ess indus fineries, f	nsiderations, a stries, enginee food processin	pproach roa ering indust g, nuclear	ads, plant try, const	railway lines, ruction sites,	[9]
Principles ventilatio Purpose for variou	Conditions s of good ventilation, n, hood and duct desig of lighting, types, adva is work, standards- Hor Material Handling and	n, air cond antages of usekeeping	itioning, ve good illun , principle	entilation standa nination, glare	ards, applica and its effe	ation.		[9]
machines dollies ar solids – s machine car loadii load insp causes, s types, ma	ng common injuries, s and other heavy object and wheel barrows – stor storage and handling o and tools, steel strapping – personal protection pection, rope in use, re sheaves and drums, lub ethod of attachment, ra	ects – acce orage of spo f cryogenic ong and sac on – ergono ope in stor brication, o ted capacit	ssories fo ecific mate liquids - s cking, glas omic cons rage - wir verloading	r manual hand erials - problem shipping and re ss and nails, pit iderations. Fibe e rope, constru g, rope fitting, ir	ling, hand to is with haza iceiving, stor ch and glue er rope, type uction, desig nspection ar	pols, jacks irdous mat ck picking, , boxes an es, strengtl gn factors nd replace	, hand trucks, terials, liquids, , dock boards, ad cartons and h and working , deterioration ment – slings,	[9]
Hoisting	cal Material Handling apparatus, types - cra g rules, maintenance ons, types, applications s selection and training	nes, types, safety ru ns.Powere	ules, insp d indust	pection and in rial trucks, re	nspection of	checklist , operatir	<ul> <li>conveyors,</li> </ul>	
precautio operators gasoline emergen	operated trucks, LPG cy procedure, requirem valks – man lifts, constr	trucks – po nents for th	ower eleva e handica	tors, types of c pped, types- E	lrives, hoist	way and r	electric trucks, machine room es and brakes,	[9]
precautic operators gasoline emergen moving w	operated trucks, LPG cy procedure, requirem valks – man lifts, constr	trucks – po nents for th	ower eleva e handica	tors, types of c pped, types- E	lrives, hoist	way and r	electric trucks, machine room	[9] 45
precautic operators gasoline emergen moving w Textboo	operated trucks, LPG cy procedure, requirem valks – man lifts, constr <b>k(s):</b>	trucks – po nents for th ruction, bra	ower eleva e handica kes, inspe	ators, types of c pped, types- E ection.	lrives, hoist	way and r	electric trucks, machine room es and brakes,	
precautic operators gasoline emergen moving w Textboo 1. Enc	operated trucks, LPG cy procedure, requirem valks – man lifts, constr <b>k(s):</b> yclopaedia of Occupati	trucks – pc nents for th uction, bra onal Safety	ower eleva e handica kes, inspe / and Hea	ators, types of c pped, types- Es ection. Ith"	lrives, hoist	way and r	electric trucks, machine room es and brakes,	
precautic operators gasoline emergen moving w Textboo 1. Enc	operated trucks, LPG cy procedure, requirem valks – man lifts, constr <b>k(s):</b>	trucks – pc nents for th uction, bra onal Safety	ower eleva e handica kes, inspe / and Hea	ators, types of c pped, types- Es ection. Ith"	lrives, hoist	way and r	electric trucks, machine room es and brakes,	
precautic operators gasoline emergen moving w Textboo 1. Enc 2. "Acc	operated trucks, LPG cy procedure, requirem valks – man lifts, constr <b>k(s):</b> yclopaedia of Occupati cident Prevention Manu	trucks – pc nents for th uction, bra onal Safety	ower eleva e handica kes, inspe / and Hea	ators, types of c pped, types- Es ection. Ith"	lrives, hoist	way and r	electric trucks, machine room es and brakes,	
precautic operators gasoline emergen moving w Textboo 1. Enc 2. "Acc Referenc	operated trucks, LPG cy procedure, requirem valks – man lifts, constr <b>k(s):</b> yclopaedia of Occupati cident Prevention Manu	trucks – po nents for th uction, bra onal Safety nal for Indus	ower eleva e handica kes, inspe / and Hea strial Oper	ators, types of c pped, types- Es ection. Ith" rations" N.S.C.	lrives, hoist scalator, saf	way and r	electric trucks, machine room es and brakes,	
recaution operators gasoline emergen moving w Textboo 1. Enc 2. "Acc Referenc 1. Alex	operated trucks, LPG cy procedure, requirem valks – man lifts, constr <b>k(s):</b> yclopaedia of Occupati cident Prevention Manu	nents for th uction, bra onal Safety al for Indus Handling E	ower eleva e handica kes, inspe / and Hea strial Oper Equipment	ators, types of c pped, types- Es ection. Ith" rations" N.S.C.	lrives, hoist scalator, saf	way and r	electric trucks, machine room es and brakes,	

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## **Course Contents and Lecture Schedule**

S.No	Торіс	No.of Hours
1	Plant Location	09
1.1	Selection Of Plant Locations, Territorial Parameters	1
1.2	Considerations Of Land, Water, Electricity,	1
1.3	Location For Waste Treatment And Disposal	1
1.4	Further Expansions	2
1.5	Safe Location Of Chemical Storages In The Form Of Bullets.	1
1.6	Spheres, Cylinders For LPG, LNG, CNG, Acetylene, Ammonia, Chlorine	2
1.7	Explosives And Propellants	1
2	Plant Layout	09
2.1	Safe Layout, Equipment Layout, Safety System, Fire Hydrant Locations, Fire Service Rooms	1
2.2	Facilities For Safe Effluent Disposal And Treatment Tanks	1
2.3	Site Considerations, Approach Roads, Plant Railway Lines, Security Towers.	1
2.4	Safe Layout For Process Industries, Engineering Industry, Construction Sites	1
2.5	Pharmaceuticals, Pesticides, Fertilizers	1
2.6	Refineries, Food Processing, Nuclear Power Stations,	1
2.7	Thermal Power Stations	1
2.8	Metal Powders Manufacturing	1
2.9	Fireworks And Match Works.	1
3	Working Conditions	09
3.1	Principles Of Good Ventilation, Purpose	1
3.2	Physiological And Comfort Level Types	1
3.3	Local And Exhaust Ventilation, Hood And Duct Design	1
3.4	Air Conditioning, Ventilation Standards, Application.	2
3.5	Purpose Of Lighting, Types, Advantages Of Good Illumination	1
3.6	Glare And Its Effect, Lighting Requirements For Various Work	1
3.7	Standards- Housekeeping	1
3.8	Principles Of 5S And 7S.	1
4	Manual Material Handling and Lifting Tackles	09
4.1	Preventing common injuries, lifting by hand, team lifting and carrying, handling specific shape machines and other heavy objects	1
4.2	Accessories for manual handling, hand tools, jacks, hand trucks, dollies and wheel barrows	1
4.3	Storage of specific materials - problems with hazardous materials, liquids, solids	1
4.4	Storage and handling of cryogenic liquids - shipping and receiving, stock picking, dock boards, machine and tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car	2

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	loading	
4.5	Personal protection – ergonomic considerations. Fiber rope, types, strength and working load inspection, rope in use, rope in storage	1
4.6	Wire rope, construction, design factors, deterioration causes, sheaves and drums, lubrication, overloading, rope fitting, inspection and replacement	1
4.7	Slings, types, method of attachment, rated capacities, alloy chain slings	1
4.8	Hooks and attachment, inspection.	1
5	Mechanical Material Handling	09
5.1	Hoisting apparatus, types - cranes, types, design and construction	1
5.2	Guards and limit devices, signals, operating rules, maintenance safety rules, inspection and inspection checklist	1
5.3	Conveyors, precautions, types, applications.	1
5.4	Powered industrial trucks, requirements, operating principles, operators selection and training and performance test, inspection and maintenance, electric trucks,	1
5.5	Gasoline operated trucks, LPG trucks	1
5.6	Power elevators, types of drives	1
5.7	Hoist way and machine room emergency procedure	1
5.8	Requirements for the handicapped, types- Escalator, safety devices and brakes, moving walks	1
5.9	Man lifts, construction, brakes, inspection.	1
	Total	45

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# **Course Designers**

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60	PIS	E14

Category	L	Т	Ρ	Credit
ES	3	0	0	3

To expertise the student in selecting the personal protective equipment for appropriate work and making him competent enough to impart how the personal protection equipment can be used.

### Prerequisite

Nil

## **Course Outcomes**

### On the successful completion of the course, students will be able to,

CO1	Capable to advise and revise Maintenance procedures for Respiratory and Non	Analyze
	respiratory protective equipment	
CO2	Acquires competence in selection and storage of PPE. Suggest measure on PPE	Apply
	matrix and work zone monitoring	
CO3	Conduct PPE audit and document the report	Evaluate
CO4	Learn facts about psychology and how it is related to work and ergonomic application	Understand
CO5	Knows specifics about IS standard and EU directives relevant to PPE	Understand

### Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	3	2
CO2	3	1	1	1	2	2
CO3	3	1	1	1	2	2
CO4	2	3	1	2	3	2
CO5	2	2	1	4	3	2
	3-	Strong;2	2-Mediu	m;1-Sor	ne	•

# Assessment Pattern

	Continuous Asse	End Sem Examinatior	
Bloom's Category	1	2	(Marks)
Remember(Re)	10	10	20
Understand (Un)	20	20	40
Apply (Ap)	20	20	20
Analyze (An)	10	10	20
Evaluate (Ev)			
Create (Cr)			

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**BoS Chairman** 

	K.S.Ran			Technology–A nal Protective				
	Hours	Week	4 - Perso		Credit	1	1aximumMarks	
Semester	L	Т	Р	Total hrs	C	CA	ES	Total
	3	0	0	45	3	40	60	100
	<b>n</b> of personal protecti sources of help-requi						nents-general	۵
Head prote spectacles, combination flotation de harness, la emergency protection: protection:	ratory Personal Pro ction-helmet, hoods, goggles ,types of go - Body Protection: c vices, puncture resi nyard, grabbing de showers- eye was gloves and its type safety shoes-instep g slip resistant shoes aining.	bump ca oggles and oats, apro istant and wice, lifeli sh fountain es, pads, guard, ste	ps, soft ca d face shions, full su cut resis ne, fall a ns- eye a finger gu el insole, i	aps, Hair net a elds-Hearing P its, proximity su tant clothing- rrestor, climbin and face wash ard, sleeves, rubber boots, r	rotection – e uits, high vis Fall Protect ng safety syn fountain- creams and non sparking	ear muff, e ibility cloth ion: safet ystem and Hand, fin I lotions-F	ear plugs and ning, personal y belt, safety d safety net- ger and arm oot and Leg on conductive	۵
Respiratory respiratory respirators,	y Personal Protection Protection, selection fit testing, SCBA, Ho canister mask, filter ment – Fitness test -	on of the ose mask, respirator	respirator Air-line re and others	spirator, air-su - maintenance	pplied suits procedures	and hoods - limitation	s, air-purifying s	0
Procureme Types – sel instruction a Audit –Qual	nt, Storage, Inspec ection of PPE: selec aids, safety reminder ity – work zone mon -human factors- ergo	<b>tion, Qual</b> tion, suital rs, special itoring	<b>ity Testin</b> pility, appr ized traini	<b>g And Ergono</b> oved lables, us ng- storage of	<b>mic Consid</b> age, training PPE -Inspec	erations g, monitori	ng, retraining,	۵
IS Standard Safety Heln goggles- IS 5852-1996/ Safety cloth		Eye Protec 79 ,IS 598 Iboots-IS 1 6; Caniste	ctors – IS 3:1980; W 2254:199 r type res	5983:1980;Ea elding Helmets 3 /IS 13695:199 pirator – IS 852	r protectors s – IS 1179-1 93 Hand Pro 23:1977 Car	1967; Safe otectors – I tridge type	ty Shoes – IŠ S 4770:1991; e respirator IS	۵
-							Total Hours	45
Textbook(s	/	1	<b>6</b> Jun al <b>6</b>	Deservit		0		
	trial Safety "National /. Grimaldi and Rollin						Book seller, Ne	w Delł
Reference(	s):							
1. "Indust	trial safety I & II ",Nat	tional safe	ty council,	Mumbai				

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# Course Contents and Lecture Schedule

S.No	Торіс	No.of Hours
1	Introduction	09
1.1	Concepts of personal protective equipment.	2
1.2	Need for Personal Protective Equipments	2
1.3	general Principles	2
1.4	sources of help-requirements	1
1.5	procurement procedures -	1
1.6	user involvement	1
2	Non Respiratory Personal Protective Equipments	09
2.1	Head protection-helmet, hoods, bump caps, soft caps, Hair net and caps	1
2.2	Eye and Face protection-spectacles, goggles ,types of goggles and face shields-Hearing Protection	1
2.3	ear muff, ear plugs and combination- Body Protection: coats, aprons, full suits, proximity suits, high visibility clothing, personal flotation devices.	1
2.4	puncture resistant and cut resistant clothing- Fall Protection: safety belt, safety harness, lanyard, grabbing device, lifeline, fall arrestor	1
2.5	climbing safety system and safety net- emergency showers- eye wash fountains- eye and face wash fountain	1
2.6	Hand, finger and arm protection: gloves and its types, pads, finger guard, sleeves, creams and lotions	1
2.7	Foot and Leg protection: safety shoes-instep guard, steel insole, rubber boots, non sparking shoes	1
2.8	Non conductive shoes and slip resistant shoes – maintenance procedures - limitations	1
2.9	relevant Indian standards - Personal Training	1
3	Respiratory Personal Protective Equipments	09
3.1	Respiratory Protection, selection of the respiratory protective equipment	1
3.2	Quality of breathing air, respiratory fit testing	1
3.3	SCBA, Hose mask, Air-line respirator	1
3.4	Air-supplied suits and hoods	1
3.5	Air-purifying respirators, canister mask	1
3.6	Filter respirator and others- maintenance procedures	1
3.7	Limitations Pre Employment	2
3.8	Fitness test - health surveillance relevant Indian standards – Personal Training.	1
4	Procurement, Storage, Inspection, Quality Testing And Ergonomic Considerations	09
4.1	Types – selection of PPE: selection, suitability, approved lables, usage	1
4.2	Training, monitoring, retraining, instruction aids, safety reminders	1
4.3	Specialized training- storage of PPE	1
4.4	Inspection: ppe matrix- ppe audit	1

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4.5	Quality – work zone monitoring	2
4.6	Psychology-human factors	1
4.7	Ergonomic application.	1
4.8	PPE design considerations	1
5	IS Standards	
5.1	Safety Helmet IS 2925:1984; Eye Protectors	1
5.2	IS 5983:1980;Ear protectors	1
5.3	IS 9167:1979;Safety goggles- IS 7524 (Part I & II):1979 ,IS 5983:1980; Welding Helmets	1
5.4	IS 1179-1967; Safety Shoes – IS 5852-1996/IS 11226:1993 ;Gumboots	1
5.5	IS 12254:1993 /IS 13695:1993 Hand Protectors	1
5.6	IS 4770:1991; Safety clothing – IS 2573 – 1986	1
5.7	Canister type respirator – IS 8523:1977 Cartridge type respirator IS 8522:1977; Dust Respirator	1
5.8	IS 9473:1980 and Introduction to EU Directive 89/686/EEC	2
	Total	45

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60	PIS	E15
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Category	L	Т	Ρ	Credit
ES	3	0	0	3

- The physical principles governing the various kinds of explosions are dealt with.
- Starting with simple modeling of blast waves derived from energy release in explosions, predictions for the damage caused by explosions and methods of ensuring safety are considered.
- The mechanisms of energy release in gaseous, liquid, dust and solid explosives are examined.
- Physical explosions and explosions of pressure vessels are also considered.
- The interaction of blast waves from explosions with objects is dealt with and the damages that occur are quantified

### Prerequisite

### Nil

### **Course Outcomes**

### On the successful completion of the course, students will be able to,

CO1	Understand the principles behind various kinds of explosion.	Understand
CO2	Identify the characteristics of Blast waves	Understand
CO3	Determine the energy release in explosion	Apply
CO4	Model the rate of energy release in explosion	Evaluate
CO5	Understand detonation and types of explosions	Understand

# Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	3	3
CO2	3	2	1	2	2	3
CO3	3	2	1	2	2	3
CO4	2		1	2	3	2
CO5	2		1		3	
	3- 3	Strong;2	2-Mediu	n;1-Son	ne	

#### Assessment Pattern

	Continuous Asse	End Sem Examination		
Bloom's Category	1	2	(Marks)	
Remember(Re)	20	20	20	
Understand (Un)	20	20	40	
Apply (Ap)	10	10	20	
Analyze (An)	10	10	20	
Evaluate (Ev)				
Create (Cr)				

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**BoS Chairman** 

				Technology–A				
			– Explos	ion Technology	-			
Semester	Hours	/Week		Total hrs	Credit		aximumMarks	
	L	Т	Р		С	CA	ES	Tota
	3	0	0	45	3	40	60	100
Typical Ex Rayleigh L	on and Disruption- Bla amples of Explosion ine -Properties behir w Plow Approximatior	s and Cla nd Constar	ssification	-Theory of B	last Waves	- Shock H	Hugoniot and	[9]
<b>Character</b> Decay of Missiles, F Reflection Spall, Dam	istics of Blast Waves a Blast Wave, Sach <sup>*</sup> Fragments and Shra and Transmission of age to Organs, Mush	<b>s</b> 's Scaling pnel, Crat Blast Wa room Cloud	ers - Inte ves, Impe	eraction of Bla edance - Amp	ast with Ob lification of	jects and Reflected	Structures - Blast waves,	[9]
Energy Re Ratio and I	elease in an Explosic lease in a Chemical R Heat Release in Fuel- I Lower Calorific Value	Reaction, St rich and Ox	kidizer-ricl	n Compounds -				[9]
Concentrat of Thermal Role of Ch	tergy Release tion, Activation Energy Theory and Inference ain carriers in an expl f explosions involving	es Modelin osion - Fire	g of Rate and Com	of Energy Rele	ase-	•		[9]
Detonation Introduction Dimension Detonation Explosion Condensed Phase exp		Structure nation-Cas Explosions ns-Rupture Conden	of Deton e Historie -Explosior of Cryo sed Phas	es of explosion ns in Confined genic Storage e Explosives ba	ns Involving and Unconfi Vessels ar ased on Hyd	Detonation ned Geom Nd Pressu drocarbons	on or Quasi- letries - Dust re Vessels - s -Condensed	[9]
J	I						Total Hours	45
Textbook	(s):							
	r, W.E., Explosions in		,					
	amurthi, K. Explosions	and Explo	sion Safe	ty, McGraw Hill	, New Delhi,	2011		
Reference								
	, D. A. and Louvar, J.							
2. Stull,	D.R., Fundamentals o	of Fire and	Explosion	, AIChE Monog	raph Series	, Vol. 73, N	lo. 10, 1977	
3. Kinne	y G. F. and Graham k	K. J., Explo	sive Shoc	ks in Air, Spring	ger, Berlin, 1	985		
4. Coop 1966	er P. W. and Kurowsk	i S.R., Intro	oduction to	o the Technolog	gy of Explosi	ives, Wiley	-VCH, New Yo	rk,

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S.No	Торіс	No.of Hours			
1	Introduction				
1.1	Loud Bang and Disruption	1			
1.2	Typical Examples of Explosions and Classification				
1.3	Theory of Blast Waves	1			
1.4	Shock Hugoniot and Rayleigh Line	1			
1.5	Blast Wave in an Explosion; Prediction from Dimensional Considerations	1			
1.6	Properties behind Constant Velocity Shock	1			
1.7	Blast waves	1			
1.8	Concentration of Mass at Front	1			
1.9	Snow Plow Approximation	1			
2	Characteristics of Blast Waves				
2.1	Decay of a Blast Wave	1			
2.2	Sach's Scaling	2			
2.3	Overpressure and Impulse in the near and Far Field				
2.4	Missiles, Fragments and Shrapnel, Craters - Interaction of Blast with Objects and Structures				
2.5	Reflection and Transmission of Blast Waves, Impedance				
2.6	Amplification of Reflected Blast waves	1			
2.7	Spall, Damage to Organs, Mushroom Cloud,Damage from Blast waves, Iso-damage Curve				
3	Energy Release in an Explosion				
3.1	Energy Release in a Chemical Reaction	1			
3.2	Stoichiometry, Equivalence Ratio	1			
3.3	Heat Release in Fuel-rich and Oxidizer-rich Compounds	1			
3.4	Energy release calculations	2			
3.5	Standard Heats of Formation	1			
3.6	Higher and Lower Calorific Values	2			
3.7	Internal Energy of Formation				
4	Rate of Energy Release				
4.1	Concentration, Activation Energy	1			
4.2	Energy Release Profile	1			
4.3	Thermal Theory of Explosions	2			
4.4	Application of Thermal Theory and Inferences Modeling of Rate of Energy Release				

# Course Contents and Lecture Schedule

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4.5	Role of Chain carriers in an explosion, Fire and Combustion - Combustion and Explosions	2		
4.6	Case Histories of explosions involving Volatile Liquids			
5	Detonations			
5.1	Introduction to Detonations, Structure of Detonation	2		
5.2	Realizable States in a Detonation-One Dimensional Model of a Detonation,Case Histories of explosions Involving Detonation or Quasi-Detonation	2		
5.3	Different Types of Explosions, Explosions in Confined and Unconfined Geometries, Dust Explosion	2		
5.4	Physical Explosions-Rupture of Cryogenic Storage Vessels and Pressure Vessels,Condensed Phase Explosions	2		
5.5	Condensed Phase Explosives based on Hydrocarbons -Condensed Phase explosives and their Properties,TNT Equivalence and Yield of an Explosion -Quantification of damages in an Explosion	1		
	Total	45		

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60 PIS E16		Category	L	Т	Р	Credit
	Fire Risk Calculations	PE	3	0	0	3

- To learn the basics of probability
- To describe the fundamental of fire cost and damage
- To enhance knowledge on fire safety and fire prevention.
- To educate the learners about the fire hazards.
- To familiarize with design ,installation, working and use of different fire protection systems,.

### Prerequisite

### Nil

# **Course Outcomes**

### On the successful completion of the course, students will be able to

CO1	To apply concept of probability theory in fire analysis	Remember, Understand,	
001		Apply	
CO2	<ul> <li>To apply concept of factor affecting fire damages</li> </ul>	Remember, Understand,	
002		Apply	
CO3	<ul> <li>To apply concept of Fire Protection Engineering</li> </ul>	Remember, Understand,	
003		Analyze	
CO4	<ul> <li>To apply concept of Fire Protection and Insurance</li> </ul>	Remember, Understand,	
004		Analyze	
	<ul> <li>To apply concept of simulation software in calculations</li> </ul>	Remember, Understand,	
CO5		Apply,Analyze	

Mapping with Program Outcomes

COs	P01	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	2	2
2 Strange Madium 1 Sama						

3- Strong;2-Medium;1-Some

### Assessment Pattern

Bloom's Category	Continuous Ass	End Sem Examination				
BIOOTT'S Category	1	2	(Marks)			
Remember (Re)	10	10	10			
Understand (Un)	20	20	30			
Apply (Ap)	30	0	30			
Analyze (An)	0	30	30			
Evaluate (Ev)	0	0	0			
Create (Cr)	0	0	0			

ronned **BoS Chairman** 

		K.S.F	Rangasam	ny Colleg	e of Technolo	gy-Autono	omous		R2	022
			60 PIS	6 E16 – F	ire Risk Calcu	lations				
			M.E.	Industria	I Safety Engir	eering				
50	Semester Hours/Week Total Hrs Credit Maximum Marks							Marks		
36	L T P Total Hrs C CA ES Total									
I 3 0 0 45 3 40 60 100										0
		I OF FIRE RISK A								
		c concept of Proba								[09]
		stributions, Key p	arameters	of pro	bability Distrib	utions, Co	ommonly	used Pr	obability	[00]
	butions.									
		& EXTREME VAL								
		descriptive statistic								
		stical Inference, Sa								
		Economic Value of		ection Me	asures, Factor	Affecting fi	re damag	jes, Analy	sis of tes	5
		everity and fire resis					<u> </u>		0 1	
		Component Life,								
		esian Methods. Pro								[09]
		Chains, Queuing	wodels of	r Fire Co	ompany Avalla	ibility, Stre	ss-Streng	th model	in Fire	
		ering Economics.		-ine Drete	ation and Inc.		aian Anal	vaia Car		
		<b>DRY</b> Utility, Utility F								
		tion Value of Hun	ian Liie.	methous						[00]
		ral Docisions					Applicati		t-Benefit	[09]
		ral Decisions			_					[09]
СОЙ	PUTER S	SIMULATION FOR	FIRE PR	OTECTI	<b>ON</b> Engineerin	g Compute	r Simulat	ion Metho	odology,	
COM Tools	PUTER S	<b>SIMULATION FOR</b> Ilation, Variance R	FIRE PR	OTECTI	<b>ON</b> Engineerin	g Compute	r Simulat	ion Metho	odology,	[09]
COM Tools	PUTER S	SIMULATION FOR	FIRE PR	OTECTI	<b>ON</b> Engineerin	g Compute	r Simulat	ion Metho Flexibility	odology, v versus	[09]
<b>COM</b> Tools Comp	PUTER \$ of Simu outation, \$	SIMULATION FOR Ilation, Variance R Simulation Languag	FIRE PR	OTECTI	<b>DN</b> Engineerin	g Compute	r Simulat	ion Metho Flexibility	odology,	
COM Tools Comp Text	PUTER \$ of Simu putation, \$ t book(s)	SIMULATION FOR Ilation, Variance R Simulation Languag	FIRE PR Reduction es.	OTECTIO Techniqu	<b>DN</b> Engineerin es, Statistical	g Compute Terminatio	r Simulat n Tests,	ion Metho Flexibility <b>Tota</b>	odology, versus I Hours	[09]
COM Tools Comp	PUTER \$ of Simu putation, \$ t book(s) Dougal	SIMULATION FOR Ilation, Variance R Simulation Languag : Drysdale , "An intro	FIRE PR leduction es.	OTECTIO Techniqu	<b>DN</b> Engineerin es, Statistical amics" ,Willey F	g Compute Terminatio Publications	r Simulat n Tests, , Thrid Ec	ion Metho Flexibility <b>Tota</b> lition,2011	odology, versus I Hours	[09]
COM Tools Comp Text	PUTER \$ of Simu putation, \$ t book(s) Dougal	SIMULATION FOR Ilation, Variance R Simulation Languag	FIRE PR leduction es.	OTECTIO Techniqu	<b>DN</b> Engineerin es, Statistical amics" ,Willey F	g Compute Terminatio Publications	r Simulat n Tests, , Thrid Ec	ion Metho Flexibility <b>Tota</b> lition,2011	odology, versus I Hours	[09]
COM Tools Comp Text 1 2	PUTER \$ of Simu putation, \$ t book(s) Dougal Bjorn k erence(s)	SIMULATION FOR Ilation, Variance R Simulation Languag : Drysdale , "An intro arlsson, Jammes G :	FIRE PR eduction es. oduction to Quintiere	OTECTIO Techniqu fire dyna "Enclosu	<b>DN</b> Engineerin es, Statistical amics" ,Willey F are Fire Dynam	g Compute Terminatio Publications ics" CRC p	r Simulat n Tests, , Thrid Ec	ion Metho Flexibility <b>Tota</b> lition,2011	odology, versus I Hours	[09]
COM Tools Comp Text 1 2	PUTER \$ of Simu putation, \$ t book(s) Dougal Bjorn k erence(s)	SIMULATION FOR Ilation, Variance R Simulation Languag : Drysdale , "An intro arlsson, Jammes G	FIRE PR eduction es. oduction to Quintiere	OTECTIO Techniqu fire dyna "Enclosu	<b>DN</b> Engineerin es, Statistical amics" ,Willey F are Fire Dynam	g Compute Terminatio Publications ics" CRC p	r Simulat n Tests, , Thrid Ec	ion Metho Flexibility <b>Tota</b> lition,2011	odology, versus I Hours	[09]
COM Tools Comp Text 1 2 Refe	PUTER \$ of Simu putation, \$ t book(s) Dougal Bjorn k erence(s) "Fundar	SIMULATION FOR Ilation, Variance R Simulation Languag : Drysdale , "An intro arlsson, Jammes G :	FIRE PR teduction es. oduction to Quintiere, er skills", 1	OTECTIO Techniqu fire dyna fire dyna ("Enclosu	<b>DN</b> Engineerin es, Statistical amics" ,Willey F are Fire Dynam B learning, 2013	g Compute Terminatio Publications ics" CRC p	r Simulat n Tests, , Thrid Ec	ion Metho Flexibility <b>Tota</b> lition,2011	odology, versus I Hours	[09]

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#### **Course Contents and Lecture Schedule**

S.No	Торіс	No.of Hours
1	APPLICATION OF FIRE RISK ANALYSIS	9
1.1	Basic field of application, Methods of application Probability Concept	2
1.2	Basic concept of Probability Theory, Independence and conditionality	2
1.3	Random Variables and Probability Distributions	2
1.4	Key parameters of probability Distributions	2
1.5	Commonly used Probability Distributions.	1
2	STATISTICS & EXTREME VALUE THEORY	9
2.1	Introduction, Basic concept of statistical analysis, Key parameters of descriptive statistics	2
2.2	Correlation, Regression and Analysis of Variance, Hypothesis Testing in Classical Statistical Inference, Sampling Theory	3
2.3	Extreme Order Distribution, Behaviour of Large Losses, Average Loss, Economic Value of Fire	2
2.4	Protection Measures, Factor Affecting fire damages, Analysis of test results, Fire Severity and fire resistance.	2
3	RELIABILITY	9
3.1	Component Life, Failure Rate, Estimating the parameters of a Distribution	2
3.2	System Reliability, Bayesian Methods. Probability Models in Fire Protection Engineering: Decision Trees.	2
3.3	, Fault Trees, Markov Chains, Queuing Models of Fire Company Availability	2
3.4	Stress-Strength model in Fire Safety	1
3.5	Engineering Economics	2
4	UTILITY THEORY	9
4.1	Utility, Utility Functions, Fire Protection and Insurance	2
4.2	Decision Analysis, Construction of Utility	2
4.3	Function Value of Human Life: Methods of Valuing Human Life	2
4.4	Applications, Cost-Benefit Analysis	2
4.5	General Decisions	1
5	COMPUTER SIMULATION FOR FIRE PROTECTION	9
5.1	Engineering Computer Simulation Methodology	1
5.2	Tools of Simulation, Variance Reduction Techniques	3
5.3	Statistical Termination Tests, Flexibility versus Computation,	3
5.4	Simulation Languages.	2
	Total	45

# Course Designers

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	Safety in Chemical Industries	Category	L	Т	Ρ	Credit
60 PIS E21		PC	3	0	0	3

#### Objective

- To know the process and machineries involved in chemical plant. •
  - To impart the systematic and safe operating procedures at chemical industries. •
  - To detect and eliminate the process of dangerous mishaps at process industries.
  - To tell learner, in practical terms to enhance safety in all means till the end process. •
  - To familiarize with the statutory requirements pertaining to chemical safety. •

#### Prerequisite

#### Nil

#### Course Outcomes

#### On the successful completion of the course, students will be able to

CO1	Understand the Chemical plant design, process, facilities, statues	Remember, Understand,
001	and inherent safe design	Apply
CO2	Conduct pre and post plant commissioning with HMIS labelling, and	Remember, Understand,
002	document inspection report.	Apply
CO3	Devise operating procedures and emergency procedures start up	Remember, Understand,
003	and shut down operation	Analyze
CO4	Approve Work permit for maintenance with recommended safety	Remember, Understand,
004	measures.	Analyze
CO5	Devise emergency preparedness and plan to mitigate emergency	Remember, Understand,
005	situations	Apply

#### Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6			
CO1	3	3	3	2	2	2			
CO2	3	3	3	2	2	2			
CO3	3	3	3	2	2	2			
CO4	3	3	2	2	2	2			
CO5	3	3	2	3	2	2			
	3- Strong;2-Medium;1-Some								

#### Assessment Pattern

Bloom's Category	Continuous Ass	End Sem Examination		
Bloom's Category	1	2	(Marks)	
Remember (Re)	10	10	10	
Understand (Un)	20	20	30	
Apply (Ap)	30	0	30	
Analyze (An)	0	30	30	
Evaluate (Ev)	0	0	0	
Create (Cr)	0	0	0	

ronned **BoS Chairman** 

	n.ə.kanç			Technology-		3		R2022	
				y in Chemical I Safety Engin					
M.E. Industrial Safety Engineering Hours/Weeks Total Ura Credit Maximum Marks									
Semester	10015/11	T	Р	Total Hrs	C	СА	ES	Tot	
	3	0	Р 0	45	3	40	60	10	
	cess Design and F		-		3	40	00	10	
Chemical Pla design and de reaction haze equipments, u division I, II, process mach thermal relief,	nt Location and La stail design, assess utilities. Pressure s III- pipe works and inery- over pressur special situations, thing and bonding.	ayout – Int sment, inh sessment, ystem, pre d valves- re protectio disposal-	ter Distar erently sa reactor essure ve IS 2379: on, pressu	nce between fa afer design- ch safety, operat essel design, s 1990 Colour co ure relief device	emical react ting conditio tandards an oding of pip es and desig	or, type ons, uni d codes elines- jn, fire r	s, batch r t operatio ,ASME s heat exch elief, vacu	eactors, ons and ection 8 nangers- uum and	[10]
Plant Comm nformation, F commissionin oressure pipi monitoring, pe Hazardous N	issioning and In 2&I, preliminary ha g problems, post ng system, non-de rformance monitori laterials Identificati	ispection izard analy commiss estructive t ing, conditi on System	ysis-pre-c ioning de esting, p ion, vibrat is (HMIS)	commissioning ocumentation. ressure testing tion, corrosion, Labelling.	documents, Plant inspo g, leak testin acoustic em	proces ection, ng and ission-p	s commis pressure monitorin ipe line ins	ssioning, vessel, g- plant spection	[09
procedures- h (DCS)and Pro storage- ope Equipments, t	tions Operating of and over and perm ogrammable Logic rating activities a rip systems- Safety ceactive Hazards.	it system- control (Pl nd hazaro	start up a LC)Syster ds- Safe	nd shut down o ms- refinery un ty Instrumente	operation- Di nits- operatio ed System	stributed n of fire (SIS)	d Control S ed heaters – Safety	Systems , driers, Critical	[09]
Vanagement ourging, clear epair and de	nance, Modificatio of maintenance, ning, confined space molition- online rep nodifications. Emer	hazards- ces, permit airs- maint	Corrosion t system- tenance o	n Effects- pre maintenance of protective de	equipment- vices- modif	hot wor ication c	ks- tank o of plant, pi	cleaning, roblems-	[08
Storage of ha vessel- storaç excess flow v flame arrestor Bullet - layout storages, chlo and Cross Co	izardous chemical jes layout- segrega alve ,RoV valve, en s, fire relief- fire p instrumentation, va instrumentation, va rine storages, amr untry Pipelines – T e hazard assessme	ation, sepa mergency revention a apourizer, monia stor rucks - loa	arating di shutdowr and prote refrigerat ages, oth ding and	stance, second valve, atmosp ection- LPG sto ed storages- Li ner chemical st unloading facil	dary contain pheric vent, p prages, pres NG storages corages- und	ment- v pressure sure sto , hydrog lergroun	venting an e, vacuum rages - M en storage d storage der storage	nd relief, valves, lounded es, toxic es- Plant ge- ware	[09]
							Tota	I Hours	45
	•								I
Text Book(s)		Drovertie	n in Dre-	ana Industria - "					
Text Book(s) 1. Sam Ma London	annan., "Lees 'Loss , 4 <sup>th</sup> Edition, 2012.								nann,
Text Book(s) 1. Sam Ma London 2. Fulekar	annan., "Lees 'Loss , 4 <sup>th</sup> Edition, 2012. M H, "Industrial Hy								nann,
Text Book(s) 1. Sam Ma London 2. Fulekar Reference(s) 1. "Quanti	annan., "Lees 'Loss , 4 <sup>th</sup> Edition, 2012. M H, "Industrial Hy : ative Risk Assessn	rgiene and nent in Che	Chemica emical Pro	l Safety", I.K. Ir ocess Industrie	nternational F	Publishir	ng House,	2016.	
Text Book(s)         1.       Sam Miteration         2.       Fulekar         Reference(s)         1.       "Quantiteration"         1.       Centre         2.       Fawcett         Wiley &       Wiley &	annan., "Lees 'Loss , 4 <sup>th</sup> Edition, 2012. M H, "Industrial Hy :	rgiene and nent in Che ss safety,2 S, "Safety 982.	Chemica emical Pro nd Edition and Acci	I Safety", I.K. Ir ocess Industrie 1,1999. dent preventior	nternational F s" American n in Chemica	Publishir Institute Il Opera	ng House, e of Chem tions", 2nd	2016. ical Indus d Edition,	stries

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# Vyas M N, "Safety and Hazards Management in Chemical Industries", Atlantic Publishers and Distributors PVt Ltd, 1<sup>st</sup> edition,2017.

#### **Course Contents and Lecture Schedule**

4.

S.No	Торіс	No.of Hours
1	Safety in Process Design and Pressure System Design	
1.1	Chemical Plant Location and Layout	1
1.2	Inter Distance between facilities - Design process, conceptual design and detail design, assessment, inherently safer design	1
1.3	Chemical reactor, types, batch reactors	1
1.4	Reaction hazard evaluation, assessment, reactor safety, operating conditions, unit	1
	operations and equipments, utilities.	
1.5	Pressure system, pressure vessel design, standards and codes,ASME section 8 division I, II, III- pipe works and valves- IS 2379:1990	1
	Colour coding of pipelines- heat exchangers- process machinery- over pressure protection, pressure relief devices and design, fire relief, vacuum and thermal relief, special situations	2
	Disposal- flare and vent systems- failures in pressure system - Static Electricity, Earthing and bonding.	2
2	Plant Commissioning and Inspection	
2.1	Commissioning phases and organization, process safety information, P&I, preliminary hazard analysis	1
2.2	Pre-commissioning documents, process commissioning, commissioning problems, post commissioning documentation	2
2.3	Plant inspection, pressure vessel, pressure piping system, non-destructive testing, pressure testing, leak testing and monitoring	2
2.4	Plant monitoring, performance monitoring,	2
2.5	Condition, vibration, corrosion, acoustic emission-pipe line inspection - Hazardous Materials Identification Systems (HMIS) Labelling	2
3	Plant Operations	
3.1	Operating discipline, operating procedure and inspection, format, emergency procedures-	1
3.2	Hand over and permit system- start up and shut down operation-	2
3.3	Distributed Control Systems (DCS)and Programmable Logic control (PLC)Systems-	2
3.4	Refinery units- operation of fired heaters, driers, storage- operating activities and hazards	2
3.5	Safety Instrumented System (SIS) – Safety Critical Equipments, trip systems- Safety Integrity Level (SIL), Safety Instrumented System (SIS) – Safety Critical Equipments, trip systems- Safety Integrity Level (SIL)	2
3.6	SOP - exposure of personnel – Safety in batch processes – Reactive Hazards	2
4	Plant Maintenance, Modification and Emergency Planning	
4.1	Management of maintenance, hazards- Corrosion Effects	1
4.2	Preparation for maintenance, isolation, purging, cleaning, confined spaces, permit	2

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	system- maintenance equipment-	
4.3	Hot works- tank cleaning, repair and demolition- online repairs-	2
4.4	Maintenance of protective devices- modification of plant, problems- controls of modifications.	2
4.5	Emergency preparedness, onsite emergency- offsite emergency, disaster planning -APELL	2
5	Storage of hazardous chemicals	
5.1	General consideration, petroleum product storages, storage tanks and vessel- storages layout- segregation, separating distance, secondary containment-	1
5.2	Venting and relief, excess flow valve ,RoV valve, emergency shutdown valve, atmospheric vent, pressure, vacuum valves, flame arrestors, fire relief	2
5.3	Fire prevention and protection- LPG storages, pressure storages - Mounded Bullet - layout, instrumentation, vapourizer, refrigerated storages	2
5.4	LNG storages, hydrogen storages, toxic storages, chlorine storages, ammonia storages, other chemical storages- underground storages	2
5.5	Plant and Cross Country Pipelines – Trucks - loading and unloading facilities- drum and cylinder storage- ware house, storage hazard assessment of LPG and LNG.	2
	Total	45

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# **Course Designers**

1. Dr.V.Sundararaju

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**BoS Chairman** 

60 PIS E22 Safety in Engineering Industries PC 3 0 0 3		Safety in Engineering Industries	Category	L	Т	Ρ	Credit
	60 PIS E22		PC	3	0	0	3

#### Objective

- To impart knowledge on industrial machineries, its operation and guarding system. ٠
- To know the industrial operations, hazards and safety precautions. •
- To impart relevant standards and codes pertaining to engineering industry. •
- To give overview on health and welfare measures in engineering industry. •
- To understand the significance of safe operating practices at industry level. •

#### Prerequisite

#### Nil

#### **Course Outcomes**

#### On the successful completion of the course, students will be able to

CO1	Understand the General safety rules, principles, maintenance, Inspections of metal and wood working machinery	Remember, Understand, Apply
CO2	Point out common hazards, safety precautions and PPE in industrial welding operations.	Remember, Understand, Apply
CO3	Formulate safety measures in cold working, inspection and maintenance of metal sheers, press brakes.	Remember, Understand, Analyze
CO4	Interpret safety in Heat treatment operations, electro plating, hydro testing and shot blasting.	Remember, Understand, Analyze
CO5	Draft Health and welfare measures in engineering industry and waste disposal	Remember, Understand, Apply

# **Mapping with Programme Outcomes**

COs	PO1	PO2	PO3	PO4	PO5	PO6				
CO1	3	2	3	2	2	2				
CO2	3	2	3	2	2	2				
CO3	3	3	2	2	2	2				
CO4	3	3	2	2	2	2				
CO5	3	3	2	3	2	2				
	3- Strong;2-Medium;1-Some									

#### **Assessment Pattern**

Bloom's Catagony	Continuous Ass	End Sem Examination	
Bloom's Category	1	1 2	
Remember (Re)	10	10	10
Understand (Un)	20	20	30
Apply (Ap)	30	0	30
Analyze (An)	0	30	30
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

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	K.S.Rangasamy C						R2022		
				Engineering					
	llaur		uustriai 5	afety Engir	-		Maxim		
Semest	er	s/Weeks		Total	Credit		Maximu		
	L	T	P	Hrs	C	CA	ES	Tot	
 	3	0	0	45	3	40	60	10	0
	Metal Working Machin					horing	machinas	milling	
machine,	afety rules, principles, r planning machine and nciples, electrical guards rards	grinding ma	achines, C	NC machin	nes. Wood w	vorking	machinery	, types,	[08]
	Guarding and ZMS.								
Basic Prii fixed gua guard fen machines Selection hammer-f entry to h	nciple of Machine guard rd, interlock guard, auto cing- guard construction	omatic guard n- guard ope le-drilling-boi gs-gears-spr enefits of go	l, trip gua ening.Desi ring-milling ockets wh	rd, electron gn of mach g-grinding-sl neels and	eye, positio ine guarding haping-sawir chains-pulley	onal con g –IS sta ng-sheai ys and	trol guard andards – ing-press belts- au	, - fixed Special es-forge thorized	[10]
	Welding and Gas Cutt								
personal explosive safety in	ling and oxygen cuttir protective equipment, welding, selection, ca generation, distribution ashback arrestor – leak	training, sa re and mair and handli	fety preca itenance o ng of indu	autions in of the asso ustrial gase	brazing, sol ociated equip s-colour cod	dering oment a ling – N	and meta nd instrur Ion Retur	llizing – ments – n Valve	[09]
Cold work mechanis removal, rolling mi measures foundry h	Cold Forming and Hot sing, power presses, poi m, hand or foot-operate inspection and mainter II operation, safe guard Safety in gas furnace ealth hazards, work en ing foundry processes.	nt of operationed presses, nance-metal ds in hot ro operation, F	on safe gu power pre sheers-pi illing mills errous and	ess electric ress brakes – hot ben d Non Ferro	controls, pov s. Hot worki ding of pipe ous Furnace,	wer pres ng safe es , haz cupola,	ss set up ty in forg ards and crucibles	and die ing, hot control , ovens,	[08]
Safety in	Finishing, Inspection	and Testing							
Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Health and welfare measures in engineering industry-, PPE - pollution control in engineering industry-industrial waste disposal.									
Total Hou	•								45
Text Boo									-
	ip Hagan, "Accident Preve	ntion Manual	for Busines	s and Industr	y", N.S.C.Chio	cago, 13 <sup>t</sup>	<sup>h</sup> Edition, 2	009	
	cupational Safety Manual"				-	- ·			
Reference									
	cident Prevention Manual",	National Safe	ty Council,	Chicago, 198	32.				
••	hnan N V, "Safety in Indus		<u>,</u>	0					
	ety in the use of wood work								
J. Joan	sty in the use of wood work			2005					
	alth and Safety in Weldin 9	-			stitute, UK, H	igh Tech	. Publishin	ig Ltd., Lo	ondon

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# **Course Contents and Lecture Schedule**

S.No	Торіс	No.of Hours
1	Safety in Metal Working Machinery and Wood Working Machines	
1.1	General safety rules ,Principles, maintenance, Inspections of turning machines, boring machines, milling machine,	3
1.2	Principles, maintenance, Inspections of planning machine and grinding machines, CNC machines	2
1.3	Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection,	3
1.4	Standards and codes- saws, types, hazards	1
2	Machine Guarding and ZMS.	
2.1	Basic Principle of Machine guarding- Machinery Hazards- protective devices,	1
2.2	machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, - fixed guard fencing-	2
2.3	guard construction- guard opening. Design of machine guarding –IS standards – Special machines	1
2.4	Selection and suitability: lathe-drilling-boring-milling-grinding-shaping-sawing-shearing- presses-forge hammer-flywheels-shafts-couplings-gears-sprockets wheels and chains- pulleys and belts	3
2.5	authorized entry to hazardous installations-benefits of good guarding systems. Maintenance-Types- Zero Mechanical State (ZMS), Definition, Policy for ZMS	2
3	Safety in Welding and Gas Cutting	
3.1	Gas welding and oxygen cutting, resistances welding, arc welding and cutting	1
3.2	Common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing	2
3.3	Explosive welding, selection, care and maintenance of the associated equipment and instruments	2
3.4	Safety in generation, distribution and handling of industrial gases-colour coding –	2
3.5	Non Return Valve (NRV) - flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.	2
4	Safety in Cold Forming and Hot Working of Metals	
4.1	Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls	2
4.2	Power press set up and die removal, inspection and maintenance-metal sheers-press brakes.	1
4.3	Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes , hazards and control measures.	2
4.4	Safety in gas furnace operation, Ferrous and Non Ferrous Furnace, cupola, crucibles, ovens	2
4.5	foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.	2
5	Safety in Finishing, Inspection and Testing	
5.1	Heat treatment operations, electro plating, paint shops, sand and shot blasting,	2
5.2	safety in inspection and testing, dynamic balancing, hydro testing,	2
5.3	safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls	2
5.4	Health and welfare measures in engineering industry-, PPE - pollution control in engineering industry-industrial waste disposal.	1
	Total	45

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		Category	L	Т	Ρ	Credit
60 PIS E23	Mechanical Integrity Assessment	PC	3	0	0	3
Objectives						

- To give exposure to the guidelines for mechanical integrity assessment. •
- To know about the test carried out pertaining to industrial practice. •
- To understand concept and practices of mechanical integrity.
- To know the significance of safety protocols and procedures practiced in industries. •
- To give overview on inspection, testing, examination and assessment for mechanical integrity. •

#### Prerequisite

#### Nil

#### **Course Outcomes**

On the successful completion of the course, students will be able to

CO1	Recognize the concepts and practices of mechanical integrity	Remember, Understand, Apply
CO2	Understands the risk based mechanical integrity programme.	Remember, Understand, Apply
CO3	Formulate SIS, SOP,LOTO and other safety systems for industries.	Remember, Understand, Analyze
CO4	Recommend corrosion prevention methods by assessing corrosion.	Remember, Understand, Analyze
CO5	Execute mechanical integrity audit and documentation.	Remember, Understand, Apply

### **Mapping with Programme Outcomes**

COs	P01	PO2	PO3	PO4	PO5	PO6		
CO1	3	3	3	2	2	2		
CO2	3	3	3	2	2	2		
CO3	3	3	3	2	2	2		
CO4	3	3	2	2	2	2		
CO5	3	3	2	3	2	2		
	3- Strong;2-Medium;1-Some							

# **Assessment Pattern**

Bloom's Category	Continuous Ass	End Sem Examination	
Bioonin's Category	1	2	(Marks)
Remember (Re)	10	10	10
Understand (Un)	20	20	30
Apply (Ap)	30	0	30
Analyze (An)	0	30	30
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

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	K.S.Rangasam					F	R2022		
				al Integrity A					
			. Industrial S	Safety Engine	ering				
Semester	Hou	rs/Week		Total Hrs	Credit		Maximun	-	
	L	T	Р		C	CA	ES	Tota	
<u> </u>	3	0	0	45	3	40	60	100	)
<b>Concepts and Practices of Mechanical Integrity</b> Definition – chemical manufacturers association approach – ongoing fitness for service – components of mechanical integrity – engineering design, documented standard operating procedures, Training, Inspection – Preventive / predictive maintenance – Equipment, covered by MI – pressure vessels, storage Tanks, piping system-valves & fittings-pressure Relief systems-controls such as sensors, Alarms and Interlocks-Emergency shutdown system-classification of equipments-critical consequence equipments(Class I) – serious consequence equipments (Class II) – Normal consequence equipments (Class III) – Requirements for inspection, testing, examination and assessment.							standard by MI – sensors, sequence ass III) –	[09]	
inspection te maintenance Electricity Ac pressure sys examination- examination deterioration	Testing, Examination chniques-deterioration periodical testing-legal t 2003, static and mob tem safety regulations external examination destructive testing su report and conclusion nechanism-thermograp	mechanism requiremen sile pressure 2000-dange and interna ch as pne ons-integrity hyapplicatio	ns, process ts-relevant p vessels Ru rous substar al examinati umatic test assessmer n-qualityassi	& operations rovisions of th les 1981-contu- nces and expl on-non-invasiv and hydraul nt-condition n urance	, design & e factories Ac rol of major a osive atmosp ve technique ic test-written nonitoring-ten	Technolo ot 1948, E accident I here reg s such n schem nperature	gy, Metallu Boilers Act 2 nazards rul- ulations 20 as non-de ne of exal , noise,	urgy and 2007, the es 1999- 02-visual estructive mination- vibration,	[09]
<b>Maintenance and Repair of Equipments</b> Objectives and Responsibilities for maintenance organization-types of maintenance-Repair complexities of machinery-preventive/predictive maintenance-Risk-based mechanical integrity programme-programme scope, Risk Ranking, acceptance criteria-individual inspection and test programme						[09]			
Corrosion P inter granular embrittlemen damages-ma equipment-sp corrosion co inhibitors-cor	revention and Contro corrosion, pitting corro t, Galvanic corrosion-E terials of construction-r pecial equipment or "b ntrol-organic coatings, rosion monitoring-vet	DI Corrosion osion, crevic lectrochemic metal alloyir oad actors" Electrocher rasonic thi	mechanism ce corrosion, cal potential g for corros requiring in nical method ickness me	-different form stress corrosi for different m ion preventior dividualized a ds-Anodic pro easurement-Ra	on cracking, etals and not i-inspection p ttention-inspe tection and c adiography	Erosion o ble metals programm ection str cathodic testing-p	corrosion, H s-potential e for each ategy and protection-o	Hydrogen corrosion piece of interval-	[08]
critical utility systems such as fire water, cooling water, absorption tank, exploding suppression, quenching-failure analysis of alarms, sensors and interlocks-voltage drop calculation-integrity of fire fightingequipments-their maintenance and up keeping-mechanical integrity audits-documentation						[09]			
Taxt Beald	١.						IOt	al Hours	45
1. "Guide	): lines for Mechanical In	tearity Svete	ms" Centre f	for Chemical P	Process Safety		Wiley 200	6	
	can Petroleum institute:								)0.
Reference(s					2511100.7411		doningtor	. 2.0., 200	
	Sanders, " Chemical P	rocess Safe	ty", Elsevier.	3 <sup>rd</sup> Edition,200	6				
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	erous Substances and		•		•			Edition 20	15
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### **Course Contents and Lecture Schedule**

S.No	Торіс	No.of Hours			
1	Concepts and Practices of Mechanical Integrity				
1.1	Definition – chemical manufacturers association approach – ongoing fitness for service – components of mechanical integrity – engineering design,	2			
1.2	Documented standard operating procedures, Training, Inspection – Preventive / predictive maintenance – Equipment, covered by MI –	1			
1.3	Pressure vessels, storage Tanks, piping system-valves & fittings-pressure Relief systems-controls such as sensors, Alarms and Interlocks-Emergency shutdown system-	3			
1.4	Classification of equipments-critical consequence equipments(Class I) –serious consequence equipments (Class II) – Normal consequence equipments (Class III) – Requirements for inspection, testing, examination and assessment.	3			
2	Inspection, Testing, Examination and Assessment Form				
2.1	Competency required for inspection-knowledge of inspection techniques- deterioration mechanisms, process & operations, design & Technology, Metallurgy and maintenance-periodical testing	1			
2.2	legal requirements-relevant provisions of the factories Act 1948, Boilers Act 2007, the Electricity Act 2003	2			
2.3	static and mobile pressure vessels Rules 1981-control of major accident hazards rules 1999-pressure system safety regulations 2000-dangerous substances and explosive atmosphere regulations 2002-	2			
2.4	visual examination-external examination and internal examination-non-invasive techniques such as non-destructive examination	1			
2.5	-destructive testing such as pneumatic test and hydraulic test-written scheme of examination-examination report and conclusions	1			
2.6	integrity assessment-condition monitoring-temperature, noise, vibration, deterioration mechanism-thermography application-quality assurance	1			
3	Maintenance and Repair of Equipments				
3.1	Objectives and Responsibilities for maintenance organization-types of maintenance-Repair complexities of machinery-preventive/predictive maintenance-	1			
3.2	Risk-based mechanical integrity programme- programme scope, Risk Ranking, acceptance criteria	2			
3.3	-individual inspection and test programme specifying inspection technique and frequency-safe system of work-safety integrity level-safety instrumented system-standard/safe operating procedures(SOP)	2			
3.4	Lockout/Tagout system(LOTO)-safe isolation procedures-blinding and blanking- double block and bleed valve(DBB)	2			
3.5	work permit system-hot work, confined space work, excavation work, working at heights-chimney cleaning work-silo cleaning work.	2			
4	Corrosion Prevention and Control				
4.1	Corrosion mechanism-different forms of corrosion-general/uniform corrosion, inter granular corrosion, pitting corrosion, crevice corrosion, stress corrosion cracking, Erosion corrosion, Hydrogen embrittlement, Galvanic corrosion	1			
4.2	Electrochemical potential for different metals and noble metals-potential corrosion damages-materials of construction-metal alloying for corrosion prevention	2			

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	Total	45
5.7	Mechanical integrity audits-documentation	1
5.6	Integrity of fire fighting equipments-their maintenance and up keeping-	1
5.5	Failure analysis of alarms, sensors and interlocks-voltage drop calculation-	1
5.4	Critical utility systems such as fire water, cooling water, absorption tank, exploding suppression, quenching-	1
5.3	Thermography examination-electrical/electronic equipments, requiring the hazardous Area classification-	1
5.2	Key utility service systems-electric power, electronic gadgets, electrical junctions, joints cable tray, electrical distribution system and connections	2
5.1	Stability of structural and civil system-foundations-anchor bolts-supports-pipe hangers, pipe bridges-assessment-repair work-	2
5	On-Going Fitness for Service of Buildings, Machines and Electrical Systems	
4.5	corrosion inhibitors-corrosion monitoring-vetrasonic thickness measurement- Radiography testing-pipeline inspection-Assessment of corrosion under insulation- corrosion rate estimation-Remaining Assessment	2
4.4	corrosion control-organic coatings, Electrochemical methods-Anodic protection and cathodic protection	
4.3	inspection programme for each piece of equipment-special equipment or "bad actors" requiring individualized attention-inspection strategy and interval	2

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# **Course Designers**

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**BoS Chairman** 

		Category	L	Т	Ρ	Credit			
60 PIS E24	Maintainability Engineering	PC	3	0	0	3			
Objectives	Obiectives								

- To provide the students about the basic concept of maintainability engineering.
- To provide knowledge on various maintenance models, maintenance policies and replacement model • of various equipment.
- To inculcate the knowledge on logistics for the effective utilization of existing resources and facilities availability of spares parts.
- The students will be provided with thorough knowledge on Total productive maintenance and its implementation which includes TPM pillars and autonomous maintenance.

#### Prerequisite

Nil

#### **Course Outcomes**

#### On the successful completion of the course, students will be able to

CO1	Recall various terms and terminologies about the maintenance	Remember, Understand,
	concept.	Apply
CO2	Understand and explain the various maintenance models to reduce	Remember, Understand,
002	downtime and maximize profit.	Apply
CO3	Illustrate the legistics meant for the execution of verious equipes	Remember, Understand,
003	Illustrate the logistics meant for the execution of various services.	Analyze
	Analyse the various reasons for the failures and the corrective and	Remember, Understand,
CO4	preventive measure for each problem by using the techniques of	Analyze
	root cause analysis and FMECA.	-
	Apply the concepts of total Productive maintenance and prepare	Remember, Understand,
CO5	plans for planned maintenance and annual maintenance so as	Apply
	make effective utilization of sources available.	

# Mapping with Programme Outcome

COs	P01	PO2	PO3	PO4	PO5	PO6		
CO1	3	3	3	2	2	2		
CO2	3	3	3	2	2	2		
CO3	3	3	3	2	2	2		
CO4	3	3	2	2	2	2		
CO5	3	3	2	3	2	2		
3- Strong:2-Medium:1-Some								

#### Assessment Pattern

Bloom's Category	Continuous Ass	End Sem Examination	
Bloom's Category	1	1 2	
Remember (Re)	10	10	10
Understand (Un)	20	20	30
Apply (Ap)	30	0	30
Analyze (An)	0	30	30
Evaluate (Ev)	0	0	0

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**BoS Chairman** 

Create (Cr) 0	0	0
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	K.S.R	angasamy	College o	f Technolog	gy–Autonom	ous		R20	22
				inability Er					
M.E. Industrial Safety Engineering									
Semester	Hour	s/Week		Total	Credit		Maximu	m Marks	
Semester	L	Т	Р	Hrs	С	CA	CA ES Tot		
II	3	0	0	45	3	40	60	10	)
<b>Maintenance Concept</b> Need for maintenance – Maintenance definition – Maintenance objectives – Challenges of Maintenance management – Tero technology – Scope of maintenance department – Maintenance costs.							[06]		
- PM versus	<ul> <li>Models Proactive/l break downmainte</li> <li>break maximizing</li> </ul>	nance – (	Optimal PM	schedule	and product (	characte			[12]
Maintenance planning – M	<ul> <li>LogisticsHuman resource requireme aintenance schedulir</li> </ul>	nts: Optim ng – Spare	al size of se parts contr	ervice facility ol – Capital	y – Optimal re spare.	pair effo	ort – Main	tenance	[11]
	<b>e Quality</b> Maintenand ctiveness – Design ntenance.								[08]
	<b>ctive Maintenance</b> T 5 – Overall Equipmo								[08]
							Tota	I Hours	45
Text Book(s	s):								
	v K.S.Jardine& Alber ion, 2013.	t H.C.Tsaı	ng, "Mainter	nance, Repl	acement and	Reliabili	ty",Taylor	and Frar	ncis,
Reference(s	s) :								
	adhury&S.K.Basu, "	Tero Tech	nology: Rel	iability Engir	neering and M	laintena	nce Mana	aement".	
Asiant	Books, 2003.			, ,	5			.g,	

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**BoS Chairman** 

#### **Course Contents and Lecture Schedule**

S.No	Торіс	No.of Hours
1	Maintenance Concept	
1.1	Need for maintenance – Maintenance definition	1
1.2	Maintenance objectives	1
1.3	Challenges of Maintenance management	1
1.4	Tero technology	1
1.5	Scope of maintenance department – Maintenance costs	2
2	Maintenance Models	
2.1	Proactive/Reactive maintenance – Imperfect maintenance	2
2.2	Maintenance policies – PM versus break down maintenance	3
2.3	Optimal PM schedule and product characteristics	2
2.4	Optimal Inspection frequency: Maximizing profit	2
2.5	Minimizing downtime – Replacement models	3
3	Maintenance Logistics	
3.1	Human factors – Crew size decisions:	2
3.2	Learning curves – Simulation	2
3.3	Maintenance resource requirements: Optimal size of service facility	2
3.4	Optimal repair effort – Maintenance planning	2
3.5	Maintenance scheduling – Spare parts control – Capital spare.	3
4	Maintenance Quality	
4.1	Maintenance excellence –Five Zero concept	1
4.2	FMECA –Root cause analysis	2
4.3	System effectiveness – Design for maintainability	2
4.4	Maintainability allocation – CMMS	2
4.5	Reliability Centred Maintenance.	1
5	Total Productive Maintenance	
5.1	TPM features – Chronic and sporadic losses –	1
5.2	Equipment defects – Six major losses –.	2
5.3	Overall Equipment Effectiveness –	2
5.4	TPM pillars	2
5.5	TPM implementation – Autonomous maintenance	1
	Total	45

# **Course Designers**

1. Dr.V.Sundararaju

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r formed Bos Chairman

		Category	L	Т	Ρ	Credit
60 PIS E25	Design and Analysis of Experiments	PC	3	0	0	3
<b>•</b> •••						

#### Objective

- Describe how to design experiments, carry them out and analyse the yield data. ٠
- Understand the process of designing an experiment including factorial and fractional factorial designs.
- Examine how a factorial design allows cost reduction, increases efficiency of experimentation, and reveals the essential nature of a process; and discuss its advantages to those who conduct the experiments as well as those to whom the results are reported.
- Investigate the logic of hypothesis testing, including analysis of variance and the detailed analysis of experimental data.
- Formulate understanding of the subject using real examples, including experimentation in the social and economic sciences.

#### Prerequisite

Nil

#### **Course Outcomes**

#### On the successful completion of the course, students will be able to

001	Students are able to design number of experiment that is needed to	Remember, Understand,
CO1	achieve required level of confidence.	Apply
CO2	The influencing parameters and influence level of individual factors easily can be identified.	Remember, Understand, Apply
CO3	The study of this course will help the student to optimize the given problem with selection of optimum parameter value.	Remember, Understand, Analyze
CO4	Students are able to list and discuss several possible reasons for deviations between predicted and measured results from an experiment, choose the most likely reason and justify the choice and formulate a method to validate the explanation.	Remember, Understand, Analyze
CO5	Understand the Taguchi methods to solve the problem.	Remember, Understand, Apply

#### **Mapping with Program Outcomes**

COs	P01	PO2	PO3	PO4	PO5	PO6		
CO1	3	3	3	2	2	2		
CO2	3	3	3	2	2	2		
CO3	3	3	3	2	2	2		
CO4	3	3	2	2	2	2		
CO5	3	3	2	3	2	2		
3 Strong:2 Medium:1 Some								

3- Strong;2-Medium;1-Some

#### Assessment Pattern

Bloom's Category	Continuous Ass	End Sem Examination	
Bloom's Category	1	2	(Marks)
Remember (Re)	10	10	10
Understand (Un)	20	20	30
Apply (Ap)	30	0	30
Analyze (An)	0	30	30
Evaluate (Ev)	0	0	0

Passed in BoS Meeting held on 18/05/23

Approved in Academic Council Meeting held on 03/06/2023

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**BoS Chairman** 

Create (Cr)	0	0	0
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				Technology-				R2022	
	60			nd Analysis o		ents			
		M.E.	Industria	I Safety Engir	neering				
Semester	Hours	Week		Total Hrs	Credit	Ν	/laximum l	Marks	
Semester	L	Т	Р		С	CA	ES	Tot	al
11	3	0	0	45	3	40	60	10	0
Importance of	Design Fundamental experiments, experi on, sample size, norm	mental stra				terminoloç	gy, ANOVA	A, steps	[06]
Single Factor Completely rar ofmodel param	Experiments ndomized design, Ra eters, model adequac	ndomized	block desi	ign, Latin squar	re design. S	tatistical a	analysis, es	stimation	[09]
	periments principles - Complex al experiments, Mode								[10]
Fractional fac	<b>mental Designs</b> ctorial design, nes xperiments with rando	0	· ·	plot design, pected mean so				Surface	[10]
	o <b>ds</b> rimentation, design ι os, parameter design,			rays, data ana	lysis, Robus	t design-	control ar	nd noise	[10]
							Tota	I Hours	45
Text Book(s)	):								
	nery, D.C., "Design an								
	ah K, Shanabudeen P	, "Applied c	lesign of e	xperiments and	Taguchi metl	nods", PHI	, 2012.		
Reference(s)									
1. NicoloBe	elavendram, "Quality b	y Design; 1	aguchi teo	chniques for indu	ustrial Experi	mentation"	, Prentice I	Hall,1995.	
2. Phillip J.	Rose, "Taguchi techni	ques for qu	ality engin	eering", McGrav	v Hill, 1996.				

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#### **Course Contents and Lecture Schedule**

S.No	Topics	No.of Hours
1	Experimental Design Fundamentals	06
1.1	Importance of experiments, experimental strategies	1
1.2	basic principles of design, terminology, ANOVA	2
1.3	steps in experimentation, sample size	2
1.4	normal probability plot, and linear regression model	1
2	Single Factor Experiments	09
2.1	Completely randomized design, Randomized block design	2
2.2	Latin square design	2
2.3	Statistical analysis, estimation of model parameters,	2
2.4	model adequacy checking	1
2.5	pair wise comparison tests.	2
3	Multifactor Experiments	10
3.1	Definition and principles - Complexity and Design -	2
3.2	Numbering System for Factorial Designs -	2
3.3	Two and three factor full factorial experiments,	2
3.4	Model for two factors - 2K factorial Experiments,	2
3.5	Confounding and blocking designs.	2
4	Special Experimental Designs	10
4.1	Fractional factorial design, nested designs, Split plot design,	2
4.2	Introduction to Response Surface Methodology,	2
4.3	Experiments with random factors	2
4.4	rules for expected mean squares,	2
4.5	approximate F- tests.	2
5	Taguchi Methods	10
5.1	Steps in experimentation, design using Orthogonal Arrays,	2
5.2	data analysis, Robust design-	2
5.3	control and noise factors,S/N ratios,	2
5.4	parameter design	2
5.5	case studies.	2
	Total	45

# **Course Designers**

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		Category	L	Т	Ρ	Credit
60 PIS E26	Safety In Food Package and Preservation	PC	3	0	0	3

# Objective

The course will make the candidates understand the format of food safety legislation as it relates to the ٠ management of food safety in a manufacturing business. this course also outlines the safety procedures and food quality testing

#### Prerequisite

#### Nil

#### **Course Outcomes**

#### On the successful completion of the course, students will be able to

CO1	Understand the application and key aspect of regulations.	Remember, Understand, Apply
CO2	Describe the role of industry guides and codes of practice.	Remember, Understand, Apply
CO3	State how legislation is applied, actions that may be taken by enforcement officers and the consequences of non-compliance ,quality testing and safety procedures	Remember, Understand, Analyze
CO4	State the responsibilities of proprietors, managers, supervisors and food handlers towards food safety.	Remember, Understand, Analyze
CO5	Explain the importance of communicating food safety to staff	Remember, Understand, Apply

# **Mapping with Program Outcomes**

COs	P01	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	2	2
3- Strong;2-Medium;1-Some						

# Assessment Pattern

Bloom's Category	Continuous Ass	End Sem Examination	
Bioonis Category	1	1 2	
Remember (Re)	10	10	10
Understand (Un)	20	20	30
Apply (Ap)	30	0	30
Analyze (An)	0	30	30
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

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					e of Technolo				R2	022
		60			ood Package a		lion			
				industria	I Safety Engir	· · · · ·	-			
Sei	mester	Hours	Week		Total Hrs	Credit	N	Maximum	Marks	
00	nootor	L	Т	Р	rotarrito	С	CA	ES	Tot	al
	II	3	0	0	45	3	40	60	10	C
Orga manu	ufacturing p	nd management; qu practices, safety, haza	<i>J</i> / 1	lity assur	ance, quality c	control, total	quality r	nanageme	nt; good	[09
	iples of HA	ACCP, overview of bi Al-grades and standa				rd in foods, c	designing s	safety into	food and	[09]
ISO:9		<b>ls</b> s and ISO:14000 serie itions, Food Safety Ac		I laws and	regulations: PF	A, FPO, BIS	and Agma	ark and inte	rnational	[09]
samp acce	oling; opera ptance san	testing – objective ational characteristic npling; adulteration of ames, uses, maximum	s, risks, at f food; iden	tributes s itification o	ampling plan, v	ariables san	pling plar	n, administ	ration of	[09
Safet gove clean meth	t <b>y Proced</b> rning sanif ing compo ods; waste	uresSanitation in food tation; establishment bunds; choosing of cl disposal; solid and ods, vegetables and co	d processin of SOPs; leaning cor liquid; was	ng facilities personal mpounds, te control;	hygiene and hy handling and st quality control	ygienic food oring of clea aspect of pro	handlings ning comp ocessing p	, employee bounds, sa blant for mi	e health, nitization	[09]
									l Hours	45
Refe	erence(s)	:								
1.	Ali, Food	Quality Assurance: F	rinciples a	nd Practice	es, CRC Press, 2	2003				
2.	M. Pears	on and T.R. Dutson, I	Kluwer HAC	CCP in Me	at, Poultry and F	- ish Processi	ng, Acade	mic Publish	ners, 1995	
3.	J. P. F. D	,			. ,		<u>.</u> ,		,	

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S.No	Торіс	No.of Hours
1	Introduction	9
1.1	Organization and management	1
1.2	quality, quality assurance, quality control	2
1.3	total quality management	2
1.4	good manufacturing practices	2
1.5	safety, hazards, risk	2
2	НАССР	9
2.1	Principles of HACCP	1
2.2	overview of biological, chemical and physical hazard in foods,	2
2.3	designing safety into food and processes;	2
2.4	FSSAI-grades and standard of identity	2
2.5	Codex Alimentarius	2
3	Other standards	9
3.1	ISO:9000 series and ISO:14000 series	2
3.2	national laws and regulations: PFA, FPO, BIS and Agmark	3
3.3	international laws and regulations	2
3.4	Food Safety Act	2
4	Testing	9
4.1	Quality testing – objective analysis, sensory assessment, rapid microbiological techniques;	1
4.2	acceptance sampling; operational characteristics, risks, attributes sampling plan, variables sampling plan,	2
4.3	administration of acceptance sampling; adulteration of food;	2
4.4	identification of adulterants both qualitative and quantitative;	2
4.5	additives in foods; types, names, uses, maximum permissible limits;	2
5	Safety Procedures	9
5.1	Sanitation in food processing facilities; definition, important and application; laws and regulation governing sanitation;	1
5.2	establishment of SOPs; personal hygiene and hygienic food handlings, employee health, cleaning compounds;	2
5.3	choosing of cleaning compounds, handling and storing of cleaning compounds, sanitization methods; waste disposal; solid and liquid; waste control;	2
5.4	quality control aspect of processing plant for milk, meat, fish, poultry, foods, vegetables and cereals;	2
5.5	customers service; complaint handling, product recall.	2
	Total	45

# **Course Designers**

- 1. Dr.V.Sundararaju
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r formed Bos Chairman

		Category	L	Т	Ρ	Credit
60 PIS E31	Safety and Risk Analytics	PC	3	0	0	3
Obiectives		•		-		

# • The concepts, methodologies, mathematics, techniques and algorithms needed for this course are

- drawn from engineering approaches, statistics, machine learning and data mining.The primary focuses of this course is to learn from data, predict the future and take data driven
- decision making

# Prerequisite

Nil

#### **Course Outcomes**

#### On the successful completion of the course, students will be able to

CO1	Understand The Types, Sources And Characteristics Of Safety Data And Their Integration For Organization-Wide Safety Centric Data Model,	Remember, Understand, Apply
CO2	Perform Safety Data Visualization And Exploration Along With Safety Performance Evaluation And Monitoring	Remember, Understand, Apply
CO3	Draw Safety Predictive Models And Behavioural Safety Analytics	Remember, Understand, Analyze
CO4	Understand Injury Epidemiology	Remember, Understand, Analyze
CO5	Recommend On Safety Related Decision Making.	Remember, Understand, Apply

# **Mapping with Program Outcomes**

COs	P01	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	2	2
3- Strong;2-Medium;1-Some						

# Assessment Pattern

Bloom's Category	Continuous Ass	End Sem Examination	
Bloom's Category	1	1 2	
Remember (Re)	10	10	10
Understand (Un)	20	20	30
Apply (Ap)	30	0	30
Analyze (An)	0	30	30
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

ronned **BoS Chairman** 

	K.S.Rangasamy (	College of	Technol	ogy-Autonon	nous		R2022		
				ety and Risk A					
		M.E.	Industria	I Safety Engir	neering				
Semes	Hours	/Week		Total Hrs	Credit	Ν	<i>M</i> aximum	Marks	
Semes	L	Т	Р	Totarris	С	CA	ES	Tot	al
II	II 3 0 0 45 3 40 60 100						)		
Basics of safety and risk Introduction to safety and risk management – Hazard triangle- safety ontology – qualitative Risk assessment – quantitative risk assessment							[09]		
Creation organization	ata quality assessmen of safety database -H tional safety data- Data nation – data reduction	lazard and	d risk da	ita- Incident Ir					[09]
Probabili Predictive analytics	tive safety analytics ty distribution – sample e safety analytics - Pro and injury epidemiology	edictive ris	sk analyt						[09]
Leading	erformance evaluation and lagging indicators fo uation and monitoring – =	or measurii	ng safety		- control cha	arts for sa	afety perfo	rmance	[09]
Analysis Safety re	of Safety Reports and port and use of text ana delling -Risk quantificati	Narrative	)S	-	– documen	t classific	ation usin	g KNN-	[09]
							Tota	I Hours	45
Text Boo	ok(s):								
	obabilistic Risk Assessm nley, IEEE Press.	ent and M	anageme	ent for Enginee	rs and Scie	ntists, by	H Kuman	noto and	ΕJ
2. An Introduction to Statistical Learning by James, G., Witten, D., Hastie, T., and Tibshirani, R., Springer.									
Referen	ce(s) :								
1. Pa	ttern Recognition and M	achine Lea	arning by	Christopher M	Bishop, Spi	ringer.			
2. Inti	roduction to data mining	by Tan, P.	N., Steir	nbach, M., & Ku	umar, V. (20	16). Pea	rson Educ	ation Ind	ia.
	Text mining, predictive methods for analysing unstructured information, by Weiss S.M. Indurkhya N.								

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Course	Contents and Lecture Schedule
S.No	Торіс
1	Basics of safety and risk
1.1	Introduction to safety and risk management
1.2	Hazard triangle- safety ontology
1.3	qualitative Risk assessment
1.4	quantitative risk assessment
2	Safety data quality assessment and pre processing
2.1	Creation of safety database -Hazard and risk data
2.2	Incident Investigation data
2.3	Behavioural and organizational safety data
2.4	Data dimensions and information quality
2.5	missing data handling – data transformation – data reduction
3	Descriptive safety analytics
3.1	Probability distribution – sample and statistics
3.2	safety data visualization data tool – data exploration
3.3	Predictive safety analytics - Predictive risk analytics -
3.4	Prescriptive safety analytics
3.5	Behavioral safety analytics and injury epidemiology
4	Safety performance evaluation and monitoring
4.1	Leading and lagging indicators for measuring safety performance
4.2	control charts for safety performance
4.3	evaluation and monitoring
4.4	safety capability analysis

Analysis of Safety Reports and Narratives

Safety report and use of text analytics

document classification using KNN

preprocessing of text data

Topic modelling

Risk quantification

# Course Designers

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5.1

5.2

5.3

5.4

5.5

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Passed in BoS Meeting held on 18/05/23 Approved in Academic Council Meeting held on 03/06/2023

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**BoS Chairman** 

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2

2

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2 45

Total

	60 PIS E32 Bio Safety	Category	L	Т	Ρ	Credit
60 PIS E32		PC	3	0	0	3
Objectives						

Course provides the introductory framework to the practices and principles when working with . infectious biological agents. Focus is placed on an introduction to infectious agents, assessment of biological hazards and risks, overview of laboratory safety, risk mitigation personal protective equipment and biosafety cabinets, program management, and biosafetyguidelines and regulations

#### Prerequisite

#### Nil

#### **Course Outcomes**

#### On the successful completion of the course, students will be able to

CO1	Checklist of risk factors when working with biological agents.	Remember, Understand, Apply
CO2	Survey of appropriate personal protective equipment (PPE) based on different tasks, work areas, temperatures and organisms.	Remember, Understand, Apply
CO3	Do Safety consideration differences when working in a biological safety cabinet (BSC), a fume hood, and a laminar flow clean air center.	Remember, Understand, Apply
CO4	Corresponding risk groups with biosafety level of a biosafety lab	Remember, Understand, Apply
CO5	Knowledge of how various federal regulatory agencies regulate the practice of biosafety	Remember, Understand, Apply

#### **Mapping with Program Outcomes**

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	2	2
	3- St	rong;2-l	Vedium	;1-Som	e	

#### **Assessment Pattern**

Bloom's Category	Continuous Ass	End Sem Examination		
Bloom's Category	1	2	(Marks)	
Remember (Re)	10	10	20	
Understand (Un)	20	20	40	
Apply (Ap)	30	30	40	
Analyze (An)	0	0	0	
Evaluate (Ev)	0	0	0	
Create (Cr)	0	0	0	

refined **BoS Chairman** 

	K.S.Rangasamy College of Technology–Autonomous R2022									
				60 PIS I	E32–Bio Safety	/				
	M.E. Industrial Safety Engineering									
Seme	ester Hours/Week Total Hrs Credit Maximum Marks									
Ocific	3101	L	Т	Р	TotalTits	С	CA	ES	Tot	al
		3	0	0	45	3	40	60	100	)
		to Infectious A ia, fungi, and paras						used by	prions,	[09]
		ological Hazards of vented infection - m						agent –w	ays and	[09]
biologic	al ĥaz	Safety Overview: ards - difference b ps in the workplace	between e							[09]
Types c	of PPE	ation: Personal P - limitations of eac d chemicals used -	h PPEs, a	and selec	tion of PPE ba	sed on task	s, work a	irea, temp		[09]
		y Cabinets (BSC) -Bio								[09]
								Tota	l Hours	45
Text Bo	ook(s):									
1. B										
2. La										
Refere	nce(s)	:								
1. <u>B</u>	iosafet	y Trainings   CDC								

r formed Bos Chairman

Cours	e Contents and Lecture Schedule	
S.No	Торіс	No.of Hours
1	Introduction to Infectious Agents	9
1.1	overview of bio organisms	1
1.2	diseases caused by prions, viruses, bacteria	3
1.3	diseases caused by fungi, and parasites	3
1.4	different ways diseases transmission	2
2	Assessing Biological Hazards &Bio risks	9
2.1	risk factors involved working with biological agent	3
2.2	ways and means to prevented infection	2
2.3	modifying the agent	2
2.4	method of handling agent	2
3	Laboratory Safety Overview: Common Lab Hazards & Basic Safety	
3.1	Hierarchy of controls for biological hazards	3
3.2	difference between engineering controls and work practice controls	3
3.3	elimination replacing sharps in the workplace	3
4	Bio risk Mitigation: Personal Protective Equipment (PPE)	
4.1	need for personal protective equipment	1
4.2	Types of PPE - limitations of each PPEs	2
4.3	selection of PPE based on tasks, work area, temperature, organisms, and chemicals used	3
4.4	difference between masks and respirators and suitability	3
5	Biological Safety Cabinets (BSC)	9
5.1	Bio safety Program Management	3
5.2	Bio safety Regulations & Guidelines	6
	Tot	al 45

# **Course Designers**

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**BoS Chairman** 

			L	Т	Ρ	Credit	
60 PIS E33	Safety in Textile Industry	PC	3	0	0	3	
Objectives							

The syllabus deals with safe handling of materials involved in work atmosphere, exposure to noise ٠ levels and certain ergonomic considerations to be accomplished in textile industry

# Prerequisite

#### Nil

### **Course Outcomes**

#### On the successful completion of the course, students will be able to

CO1	Understand the process flow of textile manufacturing.	Remember, Understand, Apply
CO2	Choose adequate guarding of textile machineries.	Remember, Understand, Apply
CO3	Understand the health hazards in textile industry related to dust, fly and noise.	Remember, Understand, Analyze
CO4	Recognize suitable personal protective equipments used industries.	Remember, Understand, Analyze
CO5	Relate legal provisions pertaining to textile industry.	Remember, Understand, Apply

#### **Mapping with Program outcomes**

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	2	2
	3- St	rong;2-l	Medium	;1-Som	Э	

#### **Assessment Pattern**

Bloom's Category	Continuous Ass	End Sem Examination		
Bloom's Category	1 2		(Marks)	
Remember (Re)	10	10	20	
Understand (Un)	20	20	40	
Apply (Ap)	30	30	20	
Analyze (An)	0	0	20	
Evaluate (Ev)	0	0	0	
Create (Cr)	0	0	0	

ronned **BoS Chairman** 

	K.S.Rangasamy C	•					R2022		
				ety in Textile I					
		M.E.	Industria	I Safety Engir	neering				
Semest	Hours	/Week		Total Hrs	Credit	N	/laximum l	Marks	
Semesi	L	Т	Р	TOLATTIS	С	CA	ES	Tot	al
	3	0	0	45	3	40	60	10	0
and synth jute fabri carding,	tion on to process flow char netic fibre, manufacturer c manufacture-accident combing, drawing, flyer /spinning specific to jute	; iv) spun hazard, frames a	and filan guarding and ring	nent yarn to fa of machinery frames, doubl	bric manufa / and safet	acture, v) y precau	jute spinn tions in c	ing and pening,	[09]
hazards i	Hazards-I )sizing processes- cook oms and shuttless looms								[09]
	Hazards- II bleaching, dyeing, print	ing, mech	anical fini	ishing operatio	ns and efflu	ents in te	xtile proce	esses.	[09]
Health ha	<b>nd Welfare</b> azards in textile industr onal diseases, personal Special precautions for s	protective	e equipm	ent-health and	d welfare m				[09]
	t <b>atues</b> provision of factories a t and waste disposal in te			other statues a	applicable to	o textile i	ndustry –	effluent	[09]
							Tota	l Hours	45
Reference	ce(s) :								
1. "Sa	fety in Textile Industry",	Thane Be	lapur Ind	ustries Associa	ation, Mumb	ai.			
2. 100	) Textile Fires – analysis	, findings	and recor	mmendations L	PA.				
3. Gro	over and Henry DS, "Ha	and Book of	of Textile	Testing and Q	uality Contro	ol".newvo	ork.1960		
				<b>U</b> .	,	,	,		

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BoS Chairman

	e Contents and Lecture Schedule	
S.No	Торіс	No.of Hours
1	Introduction.	9
1.1	Introduction to process flow charts of i) short staple spinning, ii) long staple spinning, iii) viscose rayon and synthetic fibre, manufacturer	2
1.2	, iv) spun and filament yarn to fabric manufacture, v) jute spinning and jute fabric manufacture-accident hazard,	2
1.3	guarding of machinery and safety precautions in opening, carding, combing, drawing, flyer frames and ring frames	2
1.4	Safety precautions in doubles, rotor spinning, winding, warping, softening/spinning specific to jute	2
1.5	Automated machines	1
2	Process Hazards-I	9
2.1	hazards i)sizing processes- cooking vessels, transports of size, hazards due to steam	2
2.2	Hazards ii) Loom shed – shuttle looms and shuttless looms	2
2.3	Hazards iii) knitting machines	2
2.4	Hazards iv) non-wovens	2
2.5	fire prevention in textile industry	1
3	Process Hazards- II	9
3.1	Scouring, bleaching,	2
3.2	dyeing, printing,	2
3.3	mechanical finishing operations	3
3.4	Effluents in textile processes.	3
4	Health And Welfare	9
4.1	Health hazards in textile industry related to dust, fly and noise generated-	2
4.2	control measures-relevant occupational diseases	2
4.3	personal protective equipment-	2
4.4	health and welfare measures specific to textile industry,	2
4.5	Special precautions for specific hazardous work environments.	1
5	Safety Statues	9
5.1	Relevant provision of factories act and rules and other statues applicable to textile industry	5
5.2	effluent treatment and waste disposal in textile industry.	4
	Total	45

# **Course Designers**

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2. Mrs.S.Chandralekha

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		Category	L	T P Cre	Credit	
60 PIS E34	Environmental Impact Assessment	nt PC 3 0 0	3			
Objective						

#### Objective

- To provide the in depth knowledge on Environment and Its impact on the surroundings when a major ٠ project is being carried out in a location.
- To provide the basic knowledge on Environmental impact assessment (EIA) and its legal requirements.
- To understand about the various terms and terminologies relating to EIA.
- To know the implications of EIA in maintaining the global environmental management plan.

# Prerequisite

Nil

#### **Course Outcomes**

#### On the successful completion of the course, students will be able to

CO1	Know the basic things about Environmental Impact assessment	Remember, Understand,
001	and its relevance to the Legal and regulatory aspects.	Apply
CO2	Understand about the EIA and various assessment techniques and	Remember, Understand,
002	standard involved in decision making process.	Apply
002	Evolute the EIA evotors	Remember, Understand,
CO3	Evaluate the EIA system.	Apply
CO4	Apply and practice the EIA management system with the proper	Remember, Understand,
004	guideline and evaluation criteria.	Analyze
	Design the concept, implement the process and to excel	Remember, Understand,
CO5	Environmental Impact assessment procedure in carrying out the	Apply
	major project in their career from the case studies.	

#### **Mapping with Program Outcomes**

COs	PO1	PO2	PO3	PO4	PO5	PO6	
CO1	3	3	3	2	2	2	
CO2	3	3	3	2	2	2	
CO3	3	3	3	2	2	2	
CO4	3	3	2	2	2	2	
CO5	3	3	2	3	2	2	
3- Strong;2-Medium;1-Some							

#### **Assessment Pattern**

Bloom's Category	Continuous Ass	End Sem Examination	
Bloom's Category	1	2	(Marks)
Remember (Re)	10	10	10
Understand (Un)	20	20	30
Apply (Ap)	30	0	30
Analyze (An)	0	30	30
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

refined **BoS Chairman** 

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K.S.Rangasamy College of Technology–Autonomous R2022										
60 PIS E34 –Environmental Impact Assessment										
M.E. Industrial Safety Engineering										
Sei	mester	Hours	/Week		Total Hrs	Credit	Ν	/laximum N	larks	
	mester	L	Т	Р	TotalTits	С	CA	ES	Tot	al
II 3 0 0 45 3 40 60 100							)			
Envii Asse Refe	essment(E erence in E	I Impact Assessme RA) - Legal and F IA- Issues in EIA-	Regulatóry national –	aspects cross sec	in India – Typ ctoral - social a	pes and lim				[09]
Com Chec for F econ decis	ponents cklists.Imp Prediction omic env sion-maki		g - analys nt techniqu f impacts rdsand gu	is - pred ues - cos - air - w idelines f	iction of impac t benefit analys /ater - soil - r	sis - analysi noise - biol	s of alterr ogical - ɗ	natives - m cultural - s	ethods ocial -	[09]
Tren EIA -	ds in EIA - use ofre	al Impact Assessn practice and evalu gulations and AQM	ation critei		icity building fo	or quality as	surance.	Expert Sys	stem in	[09]
<b>Environmental Management Plan</b> Document planning - collection and organization of relevant information - use of visual display materials – teamwriting - reminder checklists. Environmental monitoring - guidelines - policies - planning of monitoring programmesEnvironmental Management Plan. Post project audit.						[09]				
	e Studies									[09]
Case studies of EIA of developmental projects.						45				
Total Hours							45			
Text book(s):										
<ol> <li>Canter. L.W., "Environmental Impact Assessment", McGraw Hill, New York, 1996.</li> <li>Petts, J., "Handbook of Environmental Impact Assessment", Vol. I and II, Blackwell Science, London, 1999</li> </ol>							٦,			
Refe	erence(s)	:								

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S.No	Торіс	No.of
0.110	l opio	Hours
1	Introduction	9
1.1	Environmental Impact Assessment (EIA) -	2
1.2	Environmental Impact Statement (EIS) -	2
1.3	Environmental Risk Assessment(ERA)	1
1.4	Legal and Regulatory aspects in India – Types and limitations of EIA - Terms of Reference in EIA	2
1.5	Issues in EIA- national – cross sectoral - social and cultural.	2
2	Environmental Analysis and Assessment Techniques	9
2.1	Components - screening - setting - analysis - prediction of impacts - mitigation.	2
2.2	Matrices - Networks – Checklists .Importance assessment techniques - cost benefit analysis	2
2.3	- analysis of alternatives - methods for Prediction and assessment of impacts - air - water - soil - noise - biological - cultural - social - economic environments.	2
2.4	Standards and guidelines for evaluation.	2
2.5	Public Participation in environmental decision-making	1
3	Environmental Impact Assessment Evaluation	9
3.1	Trends in EIA practice and evaluation criteria	2
3.2	capacity building for quality assurance.	2
3.3	Expert System in EIA	2
3.4	Use of regulations and AQM.	3
4	Environmental Management Plan	9
4.1	Document planning - collection and organization of relevant information	1
4.2	use of visual display materials – team writing - reminder checklists	2
4.3	Environmental monitoring - guidelines - policies - planning of monitoring programmes	2
4.4	Environmental Management Plan.	2
4.5	Post project audit.	2
5	Case Studies	9
5.1	Case studies of EIA of developmental projects.	9
	Total	45

# **Course Designers**

- 1. Dr.V.Sundararaju
- 2. Mrs.S.Chandralekha
- sundararaju@ksrct.ac.in chandralekha@ksrct.ac.in

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		Category	L	Т	Ρ	Credit
60 PIS E35	E35 Integrated Management Systems	PC	3	0	0	3
Ohiectives						

#### Jujectives

- To impart the significance of ISO certification. ٠
- To give insight to PDCA cycle. ٠
- To scrutinize the standards from the elementary view. •
- To give exposure of transition from OHSAS 18001 to ISO 45001. ٠
- To make the learner competent in areas pertaining to integrated management system both at national and • international level.

#### Prerequisite

#### Nil

#### **Course Outcomes**

#### On the successful completion of the course, students will be able to

CO1	Understand the structure and features of OHSAS 18001.	Remember, Understand, Apply
CO2	Understand the significance of ISO 45001 OSHMS.	Remember, Understand, Apply
CO3	Implement ISO 45001 as per legal requirements.	Remember, Understand, Analyze
CO4	Understand the significance of ISO 14001 Environment Management System	Remember, Understand, Analyze
CO5	Understand the significance of ISO 9001 Quality Management System.	Remember, Understand, Apply

# Mapping with program outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	3
CO2	3	2	3	2	3	3
CO3	2	2	3	2	2	3
CO4	3	2	2	2	2	3
CO5	3	2	2	3	2	3
3- Strong;2-Medium;1-Some						

### **Assessment Pattern**

Bloom's Category	Continuous Ass	End Sem Examination	
Bloom's Category	1	2	(Marks)
Remember (Re)	20	20	20
Understand (Un)	20	20	40
Apply (Ap)	30	20	30
Analyze (An)	0	10	10
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

ronned **BoS Chairman** 

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	K.S.Rangasamy C						R2022		
				ated Manageme					
M.E. Industrial Safety Engineering									
Semester	Hours	/Week		Total Hrs	Credit		/laximum l		
	L	Т	Р	Total Hrs	С	CA	ES	Tot	
	3	0	0	45	3	40	60	100	0
FOHSR -Planı procedure – C 18001- corres 9001:1994 – G	dardIntroduction – De ning – Guidelines, m DH & S management spondence between ( suidelines (18002:2000)	ethodology system ele OHSAS 18 )) for impler	steps de ement, spe 001, ISO2 nenting Ol	veloping action ecification and s 2000, ISO1800 HSAS 18001.	plan-OHSA scope- Bene 1, ISO 1500	P -OH&S fits of cert 01, ISO 14	policy- cei tification of 1001:1996	rtification OHSAS and ISO	[09
of ISO 45001- OHSAS 18001	0 45001- need for ISO developing OH&S P and ISO 45001Gap A	Policy –guid Analysis -m	lelines- Be igration fro	enefits -Certific om OHSAS 1800	ation Proced	lure-corres			[08
Guidelines for Organisational identification-a requirements - – Documental measurement,	blementation and Oper structure and Res roles and workers p ssessment of OH&S Planning actions – OH tion. Operational Plan analysis and performa	ponsibilities participatior risks and I&S objectiv nning and ance evalua	s, Clauses – Plann other ris ves and th control – ition – OHS	s 4 – 10 – 0 ing –actions to sks to an OHS eir planning –co Emergency P SMS audit –Con	address ris MS- Deter mpetence an Preparedness tinual improv	k and op mination d awarene and res ement – B	portunities of legal ar ess-Commi ponse –Mo eyond ISO	-hazard nd other unication onitoring, 45001.	[10
environmental documentation SO 14000 to t	S, ISO 14001, specifica aspects and managen for a ISO 14000 base he Management. Audi mparative study betwee	nent progra ed EMS, ste ting ISO140	mmes, cla ps in ISO )00-Gener	uses 4.1 to 4.5. 14001.Implemer al principles of E	Documentati ntation plan, f Environmenta	on require Registratio Il Audit, Au	ments, 3 le n, Importan	vels of ice of	[09
ISO 9001Intro management- explanation an – Control of no	duction to ISO 900 Steps for implementing d Audit concepts – Me onconforming product ed – Audit of quality ma	1- Scope, g ISO 9001 easurement – Analysis o	Applicatio :2008: Cho , analysis of data – I	on – Range of eck list – Proces and improvemer mprovement – 0	f ISO stand s approach - nt: General – Certification c	ards – P - Documer Monitorino of quality m	ntation- Cla g and meas nanagemen	use-wise surement	[0
							Tota	l Hours	4
Text book(s):									
-	C Dr, "ISO 9000 to O		-		-				
2. ISO 450	01:2018 – Occupation	nal Health a	nd Safety	Management Sy	vstem.				
Deference/e	):								
Reference(s				ont System" Bo	rnan Press 2	nd Edition	2010		
	Pardy, Terri Andrews,"	' Integrated	Managem	eni oystem, be	////u/////////////////////////////////		2019.		
1 Wayne I	Pardy, Terri Andrews," C Grover, Sachin Gro		-					Press,	
2 Ramesh		over, " Provi	iding Safe	& Health workpl	ace with ISO	45001:20		Press,	

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# **Course Contetns and Lecture Schedule**

S.No	Торіс	No.of Hours
1	OHSAS Standard	9
1.1	Introduction – Development of OHSAS standard – Structure and features of OSHAS 18001	2
1.2	FOHSR -Planning – Guidelines, methodology steps developing action plan-OHSAP	2
1.3	OH&S policy- certification procedure – OH & S management system element, specification and scope- Benefits of certification of OHSAS 18001-	3
1.4	correspondence between OHSAS 18001, ISO22000, ISO18001, ISO 15001, ISO 14001:1996 and ISO 9001:1994 Guidelines (18002:2000) for implementing OHSAS 18001	2
2	ISO 45001	8
2.1	ISO 45001- need for ISO 45001 – Terms and definitions	1
2.2	structure and features of ISO 45001- contents of ISO 45001- developing OH&S Policy – guidelines	2
2.3	-Benefits -Certification Procedure-	2
2.4	correspondence between OHSAS 18001 and ISO 45001Gap Analysis -	2
2.5	migration from OHSAS 18001 to ISO 45001.	1
3	ISO 45001 Implementation and Operation, Checking and Review	10
3.1	Guidelines for structure and Responsibilities	1
3.2	Clauses 4 – 10 – Context of the Organisation-Leadership- Organisational roles and workers participation – Planning –actions to address risk and opportunities –hazard identification-assessment of OH&S risks and other risks to an OHSMS	3
3.3	Determination of legal and other requirements -Planning actions – OH&S objectives and their planning –competence and awareness-	2
3.4	Communication – Documentation. Operational Planning and control.	2
3.5	Emergency Preparedness and response –Monitoring, measurement, analysis and performance evaluation – OHSMS audit –Continual improvement – Beyond ISO 45001	2
4	ISO 14001	9
4.1	EMS, ISO 14001, specifications, objectives, Environmental Policy, Guidelines & Principles (ISO 14004), environmental aspects and management programmes,	2
4.2	clauses 4.1 to 4.5. Documentation requirements, 3 levels of documentation for a ISO 14000 based EMS, steps in ISO 14001.Implementation plan, Registration, Importance of ISO 14000 to the Management.	3
4.3	Auditing ISO14000-General principles of Environmental Audit,	1
4.4	Auditor, steps in audit, Audit plan – comparative study between OHSAS 18001 and ISO 14001 - Case studies.	3
5	ISO 9001	9
5.1	Introduction to ISO 9001- Scope, Application – Range of ISO standards – Principles of quality management	1
5.2	Steps for implementing ISO 9001:2008: Check list – Process approach – Documentation- Clause-wise explanation and Audit concepts	2
5.3	Measurement, analysis and improvement: General – Monitoring and measurement – Control of nonconforming product – Analysis of data – Improvement	2
5.4	Certification of quality management system – Steps involved	2
5.5	Audit of quality management system: Purpose – Types of quality audits – Case studies.	2
	Total	45

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1. Dr.V.Sundar	srct.ac.in					
		Category	L	Т	Ρ	Credit
60 PIS E36	Fundamental of Sustainable Development	PC	3	0	0	3
Obiectives		•				

- To gain knowledge on sustainable engineering, materials and design principles for sustainability. •
- To appreciate the importance of Life cycle thinking and life cycle cost analysis.
- To gain knowledge on the basics of life cycle assessment and guidelines from ISO standards for ٠ conducting life cycle Assessment.
- To impart the knowledge and skill to conduct Life cycle impact assessment for sustainable • development.

# Prerequisite

#### Nil

# **Course Outcomes**

# On the successful completion of the course, students will be able to

CO1	Explain life cycle thinking and Carryout life cycle cost analysis for products.	Remember, Understand, Apply
CO2	Carryout Life cycle inventory analysis for products.	Remember, Understand, Apply
CO3	Allocate flows for processes with multiple products and functions	Remember, Understand, Analyze
CO4	Carryout sensitivity analysis and to identify suitable methods to address uncertainty.	Remember, Understand, Analyze
CO5	Carryout life cycle impact assessment using inventory data.	Remember, Understand, Apply

# **Mapping with Program Outcomes**

COs	PO1	PO2	PO3	PO4	PO5	PO6		
CO1	3	3	2	2	2	3		
CO2	3	2	3	2	3	2		
CO3	3	2	3	3	3	2		
CO4	3	2	2	2	2	2		
CO5	3	2	2	3	2	3		
	3- Strong;2-Medium;1-Some							

#### **Assessment Pattern**

Bloom's Category	Continuous Ass	End Sem Examination	
Bioonin's Category	1	2	(Marks)
Remember (Re)	10	10	10
Understand (Un)	20	20	40
Apply (Ap)	30	30	30
Analyze (An)	0	0	20
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

n formed **BoS Chairman** 

r formed Bos Chairman

	K.S.Rangasamy C						R2022		
	60 F			al of Sustainab		nent			
	1		Industria	I Safety Engir	neering	1			
Semester Hours/Week Total Hrs Credit Maximum Marks									
Semes	L T P C CA ES		Tot	al					
	3	0	0	45	3	40	60	100	0
Introduct Sustaina engineer populatio	able Engineering tion to sustainability –Do bleEngineering-Material ring design-wateruse an on trend-environmental s of green engineering on	consum d demand riskasse	otion and d –water essment-0	d environmen scarcity – wa Green materi	tal impact- ter use for als-design	-sustainal energy for sus	pility metro production stainability	rics for -Global -Design	[09
Sustaina Sustaina Complex Internatio Boundar Process	ability Assessment Too bility Assessment tools - Life Cycles- Quantitat onal standards on LCA y- Unit Processes- Data and functional unit- Data LCA Databases	- Water fo ive and \- Goal a ı Collection	Qualitativ ind Scop n- DataVa	ve Methods S e- Functional alidation- Data	Supporting Unit- Proc Allocation-	Life Cy duct Syst Relating	cle Asse tem and Data to t	ssment- System the Unit	[08
Multifund allocation allocated in US LC	on Of Flows For Multip ction Processes and S n methodmass-basis o d flows for truck transpor CI Database- Avoiding A ative Analysis of Allocatio	ystems- A r an ener ting vege Illocation-	Allocation gy-basis tables an disaggree	for allocation d fruits - An E gation- system	<ul> <li>economic xample of A</li> </ul>	c basis- Allocation	allocation of Proces	factor- s Flows	[10
Uncerta Sources Uncertai Uncertai Assumpt EIO-LCA	inty Analysis of Uncertainty and Varia ntyand Variability- Qualit nty andVariability- Sensi tions- LCA Screening via Example: Automobile M	bility Rele ative and tivity Analy Economic lanufactur	vant to L0 Semi-Qua /sis- Case cInput-Ou ing	CA- Uncertaint antitative Metho Study of Effe tput Models- E	ods- Quanti cts of Shipp ilO-LCA Inp	tative Me bing Dista	thods to A nce	ddress	[09
Overview life cycl Characte	te Impact Assessment v of Impacts and Impact eimpact assessment (I erization –OptionalEleme -various LCA methods –	t Assessm LCIA),- M ents of L0	ent- impa andatory CIA- Norr	act categories Elements of malization - G	-Impact Ase LCIA- Se rouping - \	election - Neighting	Classific -advance -EDIP-Re	ation - ed LCA cipe	[09
							Tota	I Hours	45
Text boo				11 84 11	<u></u>				
2 Life	Scott Matthews, Chris T. He Cycle Assessment : Princi tection agency ,2006.				-				
Referen									
	hael Z.Hauschild , Rosenb		K., Olsen	, Stig (Eds.) "Life	e Cycle Asse	ssment -TI	neory and F	Practice"	
1 Mic Spr	inger International Publishi	ng , 2015							
1 Mic Spr	vid T. Allen, David R. Shoni	ng , 2015 nard, "Susta	ainable En	gineering: Conco	epts, Design	and Case	Studies", P		all,

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# **Course Contents and Lecture Schedule**

S.No	Торіс	No.ofHours
1	Sustainable Engineering	9
1.1	Introduction to sustainability –Definition-pillars of sustainability-magnitude of sustainability challenge	2
1.2	Sustainable Engineering-Material consumption and environmental impact-sustainability metrics for engineering design	1
1.3	water use and demand –water scarcity – water use for energy production	3
1.4	Global population trend-environmental risk assessment-Green materials	1
1.5	design for sustainability-Design principles of green engineering - Concepts on Green building- Carbon credit - Renewable power generation	2
2	Sustainability Assessment Tools	8
2.1	Sustainability Assessment tools – Water foot print- Ecological Footprint -	1
2.2	Life Cycle Thinking- Simple and Complex Life Cycles- Quantitative and Qualitative Methods Supporting Life Cycle Assessment	1
2.3	International standards on LCA- Goal and Scope- Functional Unit- Product System and System Boundary- Unit Processes	1
2.4	Data Collection- Data Validation- Data Allocation- Relating Data to the Unit Process and functional unit-	2
2.5	Data Aggregation- Identifying and Using Life Cycle Data Sources	1
2.6	Free and Licensed LCA Databases	2
3	Allocation Of Flows For Multiple Products	10
3.1	Multifunction Processes and Systems- Allocation of Flows for Processes with Multiple Products	2
3.2	allocation method mass-basis or an energy-basis for allocation- economic basis- allocation factor	2
3.3	allocated flows for truck transporting vegetables and fruits - An Example of Allocation of Process Flows in US LCI Database	2
3.4	Avoiding Allocation- disaggregation- system expansion	2
3.5	Displacement approach - Comparative Analysis of Allocation and System Expansion	2
4	Uncertainty Analysis	9
4.1	Sources of Uncertainty and Variability Relevant to LCA- Uncertainties in Results-	2
4.2	Methods to Address Uncertainty and Variability- Qualitative and Semi-Quantitative Methods-	2
4.3	Quantitative Methods to Address Uncertainty and Variability- Sensitivity Analysis-	2
4.4	Case Study of Effects of Shipping Distance Assumptions-	1
4.5	LCA Screening via Economic Input-Output Models- EIO-LCA Input-Output LCA Model- EIO-LCA Example: Automobile Manufacturing	2
5	Life Cycle Impact Assessment Methods, Soft Wares and Databases	9
5.1	Overview of Impacts and Impact Assessment- impact categories	1
5.2	Impact Assessment Models for LCA- life cycle impact assessment (LCIA)	2
5.3	Mandatory Elements of LCIA- Selection - Classification - Characterization –Optional Elements of LCIA	2
5.4	Normalization - Grouping - Weighting -advanced LCA method	2
5.5	Various LCA methods –Eco invent database-GABI - OPENLCA-IMPACT 2002 –EDIP- Recipe	2
	Total	45

# **Course Designers**

r formed Bos Chairman

# 1. Dr.V.Sundararaju

# sundararaju@ksrct.ac.in

		Category	L	Т	Ρ	Credit
60 PIS E41	Human Factors Engineering	PE	3	0	0	3

# Objective

- To give an overview on ergonomic and anatomy. •
- To impart facts about human behaviour. •
- To understand the influence of ergo design in accident prevention. ٠
- To know about work related musculoskeletal disorders. •
- To make the learner to be ergo- aware at all places. •

# Prerequisite

Nil

# **Course Outcomes**

## On the successful completion of the course, students will be able to

CO1	Explain human anatomy, anatomy of spine and pelvis, posture and	Remember, Understand,
001	biomechanics.	Apply
CO2	Identify human behaviour using BBS and motivate through	Remember, Understand,
002	management theories.	Apply
CO3	Design work station for static and dynamic worker considering	Remember, Understand,
003	anthropometric factors and work station parameters.	Analyze
CO4	Assess ergonomic risk factors of workers using posture evaluation	Remember, Understand,
004	tool.	Analyze
CO5	Employ Principles for design of visual and auditory displays in real	Remember, Understand,
005	time situation	Apply

# Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6		
CO1	3	3	3	2	2	2		
CO2	3	3	3	2	2	2		
CO3	3	3	3	2	2	2		
CO4	3	3	2	2	2	2		
CO5	3	3	2	3	2	2		
	3- Strong;2-Medium;1-Some							

#### **Assessment Pattern**

Bloom's Category	Continuous Ass	End Sem Examination		
Bioonin's Category	1	2	(Marks)	
Remember (Re)	10	10	10	
Understand (Un)	20	20	30	
Apply (Ap)	30	0	30	
Analyze (An)	0	30	30	
Evaluate (Ev)	0	0	0	
Create (Cr)	0	0	0	

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				an Factors En					
			Industria	I Safety Engin		1			
Semester	Hours	/Week		Total Hrs	Credit	Ν	Maximum	Marks	
Gemester	L	Т	Р		С	CA	ES	Tota	al
	3	0	0	45	3	40	60	100	)
	and Anatomy								
system, a br directions for anatomy of th bad posture, disorders in th directions.	o ergonomics: The ief history of ergon rergonomics. Ana le spine and pelvis, Posture stability a ne workplace, beha	nomics, at tomy, Pos Bio Mech nd posture	ttempts to sture and anical as a adaptat	o humanize w Bio Mechani pect of body m ion, low back	vork, moder cs: Some ovement .P pain, risk f	n ergono basic bio osture: ( actors fo	omics, and o mechan Good post r musculo	d future ics and ture and oskeletal	[09]
difference on of Motivation, and Conflicts Changing att Based Safety	ferences, Factors safety, Method of Job satisfaction. N Reaction to frus itudes Learning, P (BBS) – ABC theor	measuring Manageme tration, Er rinciples c -y – Impler	g characte ent theorie motion ar of Learnir	eristics, Accide es of motivatio nd Frustration. ng, Forgetting,	ent Pronene on, Job enri Attitudes-[	ss. Motiv chment tl Determina	ation, Con heory. Fru ation of a	mplexity ustration ttitudes,	[09]
Designing for in ergonomics design for eve Fundamental standing work	try for Work Desig a population of us s, principals of appl eryone, anthropome aspects of standing kers, design for se ic work, effectivene	ers, perce ied anthro etry and pe g and sittin ated work	pometry i ersonal sp ng, an erg ers, work	n ergonomics, bace, effectiven jonomics appro s surface desig	application less and co bach to worl gn, visual d	of anthro st effectiv k station o isplay un	pometry i veness. design, de	n design, esign for	[09]
Man - Machin Applications of controller – M design ,meas controlling, tra Anatomy and place, design <b>Evaluation T</b> The Strain Inc perceived exe	ne System and Re of human factors e Man vs Machine. E sures for preventin aining biomechanics of m of manual handling ools: Rapid Upper dex, NIOSH Lifting e ertion scale, Muscle	petitive W engineering irgonomics g in work anual hand tasks, lifti Limb Asse equation, N Fatigue A	forks and g, man a s interven c related dling, pre ing, pushi essment ( Measuren sssessme	I Manual Hand is a sensor, m itions in Repet musculoskelet vention of man ng, pulling, car (RULA), Rapid nent of work eff	Iling Task nan as info titive works al disorder nual handling rying and p Entire Body fort and fatig	rmation p , handle s (WMSI g injuries ostural st / Assessr gue: Borg	design, k Ds), reduc in the wor ability. <b>Po</b> nent (REE g rating of	ey board ction and <sup>c</sup> k <b>stural</b>	
A general info	trols and Virtual E prmation-processing the design of vis	g model of ual andau	the users					ness	
	al (synthetic) enviro	onments, re		ssues on huma			nce.	ays and	[09]
controls- virtu		onments, re					nce.		[09] 45
controls- virtu Text book(s)	:		esearch is	ssues on huma	an skill and	performar	nce. Tota	ays and	
controls- virtuText book(s)1.McCorm	: nick Ernest J, "Hum	an Factors	esearch is s In Engin	eering and Des	an skill and   sign", Mcgra	performar	nce. Tota	ays and	
controls- virtu       Text book(s)       1.     McCorm	:	an Factors	esearch is s In Engin	eering and Des	an skill and   sign", Mcgra	performar	nce. Tota	ays and	
controls- virtu         Text book(s)         1.       McCorm         2.       Bridger         Reference(s)	: nick Ernest J, "Hum R S, "Introduction to	an Factors o Ergonom	esearch is In Engin nics",CRC	eering and Des Press,3 <sup>rd</sup> Edi	sign", Mcgration, 2015.	performar aw-Hill Bc	nce. Tota	ays and	

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2.	Khan M I, "Industrial Ergonomics", Prentice Hall of India, 2018.
3.	Wickens C D, Hee J, Liu Y, "Introduction to Human Factors Engineering", Prentice Hall of India, 2 <sup>nd</sup> Edition, 2013.

# **Course Contents and Lecture Schedule**

S.No	Торіс	No.of Hours
1	Ergonomics and Anatomy	9
1.1	Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics,	2
1.2	attempts to humanize work, modern ergonomics, and future directions for ergonomics.	2
1.3	Anatomy, Posture and Bio Mechanics: Some basic bio mechanics and anatomy of the spine and pelvis,	1
1.4	Bio Mechanical aspect of body movement .Posture: Good posture and bad posture, Posture stability and posture adaptation, low back pain,	2
1.5	risk factors for musculoskeletal disorders in the workplace, behavioral aspects of posture, effectiveness and cost effectiveness, research directions.	2
2	Human Behavior	9
2.1	Individual differences, Factors contributing to personality, Fitting the man to the job, Influence of difference on safety,	1
2.2	Method of measuring characteristics, Accident Proneness. Motivation, Complexity of Motivation, Job satisfaction. Management theories of motivation, Job enrichment theory	2
2.3	Frustration and Conflicts, Reaction to frustration, Emotion and Frustration.	2
2.4	Attitudes-Determination of attitudes, Changing attitudes Learning, Principles of Learning, Forgetting,	2
2.5	Motivational requirements- Behavior Based Safety (BBS) – ABC theory – Implementation.	2
3	Anthropometry for Work Design	9
3.1	Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics,	1
3.2	principles of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness.	
3.3	Fundamental aspects of standing and sitting, an ergonomics approach to work station design.	2
3.4	design for standing workers, design for seated workers, work surface design,	2
3.5	visual display units, guidelines for design of static work, effectiveness and cost effectiveness, research directions	2
4	Man - Machine System and Repetitive Works and Manual Handling Task	9
4.1	Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Man vs Machine.	
4.2	Ergonomics interventions in Repetitive works, handle design, key board design measures for preventing in work related musculoskeletal disorders (WMSDs), reduction and controlling, training	
4.3	Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the work place, design of manual handling tasks, lifting, pushing,	2

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	pulling, carrying and postural stability.	
4.4	<b>Postural Evaluation Tools: Rapid</b> Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA), The Strain Index, NIOSH Lifting equation,	2
4.5	Measurement of work effort and fatigue: Borg rating of perceived exertion scale, Muscle Fatigue Assessment method, Hand Activity Level (HAL).	2
5	Display, Controls and Virtual Environments	9
5.1	A general information-processing model of the users, cognitive system, problem solving, effectiveness.	2
5.2	Principles for the design of visual and auditory displays- Design of controls- combining displays and controls-	4
5.4	Virtual (synthetic) environments, research issues on human skill and performance.	3
	Total	45

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# **Course Designers**

- Dr.V.Sundararaju
   Mrs.S.Chandralekha
- sundararaju@ksrct.ac.in chandralekha@ksrct.ac.in

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			L	Т	Ρ	Credit
60 PIS E42	Cognitive Ergonomics	PE	3	0	0	3
<b>•••</b>						

Objective

- To impart the basics of anthropometry. •
- To understand the human performance pertaining to job •
- To know the facts about cognitive ergonomics. •
- To address concepts pertaining to cognitive abilities, human machine interaction, human perception • and decision making.
- To outline the significance of safety climate •

#### Prerequisite

Nil

## **Course Outcomes**

# On the successful completion of the course, students will be able to

CO1	Design an ergo work station using ergonomics tools.	Remember, Understand, Apply
CO2	Pinpoint the components of cognitive ergonomics.	Remember, Understand, Apply
CO3	Guide on decision making pertaining to ergonomics.	Remember, Understand, Analyze
CO4	Assess mental workload and give suggestions	Remember, Understand, Analyze
CO5	Create a safety climate in the workplace.	Remember, Understand, Apply

# Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	2	2
	3- St	rong;2-l	Vedium	;1-Som	e	

## Assessment Pattern

Bloom's Category	Continuous Ass	End Sem Examination					
BIOONIS Category	1	2	(Marks)				
Remember (Re)	10	10	10				
Understand (Un)	20	20	30				
Apply (Ap)	30	0	30				
Analyze (An)	0	30	30				
Evaluate (Ev)	0	0	0				
Create (Cr)	0	0	0				

Passed in BoS Meeting held on 18/05/23 Approved in Academic Council Meeting held on 03/06/2023

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	<u> </u>		M.E.	Industria	l Safety Engir	neering				
Sa	mester	Hours	s/Week		Total Hrs	Credit	N	laximum I	Marks	
Sei	liestei	L	Т	Р	C CA ES		Tot	al		
		3	0	0	45	3	40	60	10	0
Anth	ropometry									
		opulation of us								
		principals of a								[10
		r everyone, ant							less.	
		ects of standing			nomics appro	ach to work	station de	esign		
		formation proc			<i>.</i>					
		component – a								500
		ork – evaluatior								[09
	sonal hygier	job heaviness -	– work org	anization -	– stress – stra	iin – laugue	– rest pa	uses – sr	IIIT WOLK	
		cognitive ergo	nomice							
			ncerned	with n	nental proc	esses -	percep	ntion of	decision	
		reasoning and i								[08
		operator workle			- Onalienges i	in anocation	or attorn			
		d assessment								
-		nce, attention, d	istraction.	human err	or. work stres	s. risk perce	ption, and	Kansei		
		ese may relate								[10
		nierarchical tasł					doad, hun	nan error		-
ident	ification/acci	dant investigati	on, and sit	uation awa	areness asses	sment.				
		dent investigati								
Safe		Pinpointing of	Unsafe b							
<b>Safe</b> Evolu		Pinpointing of ety culture, Tra	Unsafe k ansformati							[08
<b>Safe</b> Evolu		Pinpointing of	Unsafe k ansformati					culture –	Ethical	-
Safe Evolu respo	onsibility for	Pinpointing of ety culture, Tra	Unsafe k ansformati					culture –		[08 45
Safe Evolu respo Text	book(s):	Pinpointing of ety culture, Tra safety professio	Unsafe k ansformational.	on require	ement from re	eactive to p	oroactive	culture –	Ethical	-
Safe Evolu respo	onsibility for book(s): David B Ka	Pinpointing of ety culture, Tra safety profession ber, Guy Boy ,"	Unsafe k ansformational. Advances	on require	ement from re	eactive to p	ss,2010	culture – Tota	Ethical I Hours	-
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Safe Evolu respo Text 1. 2.	onsibility for book(s): David B Ka	Pinpointing of ety culture, Tra safety profession ber, Guy Boy ,"	Unsafe k ansformational. Advances	on require	ement from re	eactive to p	ss,2010	culture – Tota	Ethical I Hours	-
Safe Evolu respo Text 1. 2. Refe	book(s): book(s): David B Ka Peter A Ha prence(s): Proceeding	Pinpointing of ety culture, Tra safety profession ber, Guy Boy ," ncock, " Humar	Unsafe k ansformational. Advances	on require	ement from re ve Ergonomics rgonomics", A	eactive to p	ss,2010	culture – <b>Tota</b> lition,1999	Ethical I Hours	- 45
Safe Evolu respo Text 1. 2. Refe 1.	book(s): book(s): David B Ka Peter A Ha prence(s) : Proceeding conference	Pinpointing of ety culture, Tra safety profession ber, Guy Boy ," ncock, " Humar gs of Engi	Unsafe b ansformational. Advances Performa	on require in Cognitiv nce and E Psycholo	ve Ergonomics rgonomics", A gy and (	s", CRC Pre cademic Pro	ss,2010 ess,2 <sup>nd</sup> Ec	dition,1999	Ethical I Hours 9 interna	- 4
Safe Evolu respo Text 1. 2.	book(s): David B Ka Peter A Ha rence(s) : Proceeding conference McCormick	Pinpointing of ety culture, Tra safety profession ber, Guy Boy ," ncock, " Humar gs of Engi c,Canada,2016	Unsafe b ansformational. Advances Performa neering	in Cognitiv nce and E Psycholo s In Engin	ement from re ve Ergonomics rgonomics", A gy and ( eering and De	eactive to p s", CRC Pre cademic Pro Cognitive sign", Mcgra	ss,2010 ess,2 <sup>nd</sup> Ecgonom aw-Hill Bo	dition,1999	Ethical I Hours 9 interna	4

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	Contents and Lecture Schedule	
S.No	Торіс	No.of Hours
4		
1	Anthropometry	10
1.1	Designing for a population of users, percentile, sources of human variability,	2
1.2	anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics,	2
1.3	Application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness.	2
1.4	Fundamental aspects of standing and sitting	2
1.5	, an ergonomics approach to work station design	2
2	Human as an information processing system	9
2.1	Man as a system component – allocation of functions – efficiency	1
2.2	occupational work capacity – aerobic and anaerobic work	1
2.3	evaluation of physiological requirements of jobs –	1
2.4	parameters of measurements – categorization of job heaviness	1
2.5	work organization – stress – strain – fatigue – rest pauses – shift work – personal hygiene.	2
3	Components of cognitive ergonomics	8
3.1	Cognitive ergonomics concerned with mental processes -	2
3.2	perception, decision making,memory,reasoning and response execution -	2
3.3	Challenges in allocation of attention, multiple task performance	2
3.4	operator workload measurement.	2
4	Human Error and assessment	10
4.1	Skilled performance, attention, distraction, human error, work stress, risk perception, and	2
4.2	Kansei engineering as these may relate to human- system design, safety and productivity.	2
4.3	Assessment methodologies - hierarchical task analysis, cognitive task analysis, mental workload	2
4.4	human error identification/accident investigation,	2
4.5	Situation awareness assessment.	2
5	Safety culture	8
5.1	Pinpointing of Unsafe behavior-Positive reinforcement	2
5.2	observation and feedback.	1
5.3	Evolution of Safety culture,	1
5.4	Transformation requirement from reactive to proactive culture	2
5.5	Ethical responsibility for safety professional.	2
	Total	45

# **Course Designers**

- 1. Dr.V.Sundararaju
- 2. Mrs.S.Chandralekha

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	Behaviour Based Safety and Safety	Category	L	Т	Ρ	Credit
60 PIS E43	Culture	PE	3	0	0	3

#### Objective

- To impart facts about human behaviour and attitude. ٠
- To provide insight into human error and how it can be reduced. •
- To understand the significance the communication process. •
- To explain the concept behind behaviour modification. •
- To guide the learner to create a safety culture at workplace •

# Prerequisite

Nil

# **Course Outcomes**

## On the successful completion of the course, students will be able to

CO1	Describe the fundamentals of Behavioural safety.	Remember, Understand, Apply
CO2	Monitor the performance of the worker.	Remember, Understand, Apply
CO3	Assess the communication process at worker's level.	Remember, Understand, Analyze
CO4	Determine behaviour Modification among workers.	Remember, Understand, Analyze
CO5	Identifies need based training with real life examples	Remember, Understand, Apply,Analyze

## Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	
CO1	3	2	3	2	2	2	
CO2	3	3	2	2	3	3	
CO3	2	3	3	2	2	3	
CO4	2	3	2	2	2	3	
CO5	3	2	2	3	2	2	
3- Strong;2-Medium;1-Some							

#### Assessment Pattern

Continuous Ass	End Sem Examination						
1 2		(Marks)					
10	10	10					
20	20	30					
30	0	30					
0	30	30					
0	0	0					
0	0	0					
	<b>1</b> 10 20	20 20 30 0					

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				ased Safety a		Culture			
				rial Safety Eng					
Hours/Week – Credit Maximum Marks									
Semester L T P Total Hrs C CA ES Total							al		
	3	0	0	45	3	40	60	100	
Fundamental	s of Behavioral Sa	fetv	-						
Historical bac Unsafe acts, p and conseque process-Near Feedback to v	kground-H.W-Heinr personal factors and nces-components o Miss Management vorkers-Improvemer	ich Theor d proximat of behavio t Program nt, Review	te factors or of Safe ome-Sugg and effe	-ABC Analysis ty Programme gestion schem	s for a beha e – Critical l les for the	vior of A behaviors	ctivator. B and obse	ehavior ervation	[09]
Goals and ob Training and o and pocket g process-Demo Immediate/Fu Respiratory Ha		ring activa such as c and Rewa ative perf ncertain (f	ators-polic hecklists ards for ormance C/V)-posi	and flow-char positive perfo -Consequence	ts-pre-job s rmance-Re classificati	afety Inst inforceme on-positiv	ructions-m ent of mo /e/Negativ	nanuals nitoring e(P/N)-	[10]
Observation p critical Behavi of safety critic	and Communicatic rocedure-Observati ors-Observation Re al activities such as oyees, workers und	on checkli sult charts startup/S	st-comm s, graphs hutdown	and displays- orientation pro	Tool Box Ta ogramme-w	alks-Frequ atch over	uent obser new emp	vations loyees,	[08]
responsibilities rules-safe ope and work cloth written warnin	ificationSafety first s-worker responsibil rating procedures ( ing-compliance mo g and removal from information-training	ities-New, SOP)-work nitoring-Ha the site-sa	young, a kplace Ha arassing l afety sign	nd contract wo azardous mate behaviors-Disc age-safety me	orkers respo rial informat ciplinary acti etings – Dig	onsibilities ion syste ons-verb jital displa	s-project sa m (WHMIS al warning ay of	S)-PPE	[08]
precautionary information-training needs, and need based training with real life examples. <b>Safety Culture</b> Safety culture- Commitment –policy-management-individual- safety culture framework- assumptions-espoused values – artefacts -Attitude towards safety-Traditional safety Vs behavioral safety-Acts of indifference-Acts of improper attitude-Acts due to lack of knowledge-At-Risk Behavior model-intentional, unintentional and Habitual At-Risk Behaviors-Four stages of Being-Rushing, Frustration, fatigue and complacency-four critical errors-eyes not on the task, mind not on the task, Being in or moving into the "Line of Fire" and loosing the balance, traction or group-critical Error reduction techniques(CERT)-Advanced safety skills and awareness training-case study on the knowledge of hazards and relevant procedures.						[10]			
							Tota	l Hours	45
Text book(s)									
1. Kaila H	L, "Industrial Safety	and Huma	an Behav	iour", AITBS P	ublishers,20	013.			
2. Roughto	on J E, J JMercurio	" Develop	oing An E	ffective Safety	Culture", B	utterworth	n Heinema	nn, 2012	2.
Reference(s)	:								
	lmans,"Human Beh	aviour in H	lazardou	s Situations". E	Butterworth	Heinema	nn ,2012.		
	R Krause, "The Be								
	D Reese, "Occupat							RC Pres	s, 3 <sup>ro</sup>
	Hancock, " Human	Performar	ice and F	raonomics" A	cademic Pr	ess 2 <sup>nd</sup> Fr	dition 1990	2	
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S.No	Торіс	No.of Hours
1	Fundamentals of Behavioral Safety	9
1.1	Historical background-H.W-Heinrich Theory and pyramid	2
1.2	Accident causal Analysis-Unsafe conditions, Unsafe acts, personal factors and proximate	1
1.3	factors- ABC Analysis for a behavior of Activator. Behavior and consequences-components of	3
1.4	behavior of Safety Programme –           Critical behaviors and observation process-Near Miss Management Programme-           Suggestion	1
1.5	Schemes for the effective implementation-Feedback to workers-Improvement, Review and effectiveness of feedback.	2
2	Performance Monitoring and Consequences	10
2.1	Goals and objectives for monitoring activators-policies and procedures-priorities and accountabilities-Training and education-	2
2.2	Job Aids such as checklists and flow-charts-pre-job safety Instructions-manuals and pocket guides-Recognition and Rewards for positive performance-	2
2.3	Reinforcement of monitoring process-Demerit factors for Negative performance-	2
2.4	Consequence classification-positive/Negative(P/N)-Immediate/Future (I/F)- certain/Uncertain (C/V)-positive, Immediate and certain (PIC)-	2
2.5	case study on Respiratory Hazards.	2
3	Observation and Communication Process	8
3.1	Observation procedure-Observation checklist-communication of Near Miss Behaviors, Injury causes and critical Behaviors	2
3.2	-Observation Result charts, graphs and displays-Tool Box Talks-Frequent observations of safety critical activities such as startup/Shutdown-	2
3.3	orientation programme-watch over new employees, younger employees, workers under pressure/stress	2
3.4	workers running/rushing, and new contractions/sub-contractors	2
4	Behavior Modification	8
4.1	Safety first approach to all Work-management responsibilities-supervisor responsibilities- worker responsibilities-New, young, and contract workers responsibilities	2
4.2	project safety rules-safe operating procedures (SOP)-workplace Hazardous material information system (WHMIS)-PPE and work clothing-	2
4.3	compliance monitoring-Harassing behaviors-Disciplinary actions-verbal warning, written warning and removal from the site-safety signage-	2
4.4	safety meetings – Digital display of precautionary information-training needs, and need based training with real life examples.	2
5	Safety Culture	10
5.1	Safety culture- Commitment –policy-management-individual- safety culture framework- assumptions-espoused values – artefacts -Attitude towards safety-	2
5.2	Traditional safety Vs behavioral safety-Acts of indifference-Acts of improper attitude-Acts due to lack of knowledge-At-Risk Behavior model-intentional, unintentional and Habitual At-Risk Behaviors-	2
5.3	Four stages of Being-Rushing, Frustration, fatigue and complacency-four critical errors- eyes not on the task, mind not on the task,	2
5.4	Being in or moving into the "Line of Fire" and loosing the balance, traction or group-critical Error reduction techniques(CERT)-	2
5.5	Advanced safety skills and awareness training-case study on the knowledge of hazards and relevant procedures.	2
	Total	60

# **Course Designers**

1. Dr.V.Sundararaju

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		Category	L	Т	Р	Credit
60 PIS E44	Ergonomic Tools and Techniques	PE	3	0	0	3

# Objective

- To impart the basics of ergonomics
- To understand the human performance pertaining to job
- To know the facts about ergonomic tools.
- To address work related musculoskeletal disorder by ergonomic intervention
- To outline the significance of ergonomic tools

#### Prequisite

Nil

# Course Outcomes

## On the successful completion of the course, students will be able to

CO1	Understand the basics of ergonomics study	Remember, Understand, Apply
CO2	Perform subjective assessment in ergonomic study	Remember, Understand, Apply
CO3	Analyze physical and psychological discomfort	Remember, Understand, Analyze
CO4	Apply postural evaluation tools	Remember, Understand, Analyze
CO5	Propose ergonomic projects	Remember, Understand, Apply

## Mapping with Programme Outccomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	2	2
3- Strong;2-Medium;1-Some						

# Assessment Pattern

Bloom's Category	Continuous Ass	Continuous Assessment Tests (Marks)			
Bloom's Category	1	1 2			
Remember (Re)	10	10	10		
Understand (Un)	20	20	30		
Apply (Ap)	30	0	30		
Analyze (An)	0	30	30		
Evaluate (Ev)	0	0	0		
Create (Cr)	0	0	0		

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	K.S.Rangasamy College of Technology–Autonomous R2022							2		
	60 PIS E44 Ergonomic Tools and Techniques									
			M.E.	Industria	al Safety Engi	neering				
Sor	nester	Hours	Week		Total Hrs	Credit	Ν	/laximum l	Marks	
Sei	liestei	L	Т	Р	TOLATTIS	С	CA	ES	Tot	al
		3	0	0	45	3	40	60	10	5
	duction									
		mechanics and ar						-working	posture	[09]
		ols- fundamentals	of RULA, F	REBA,NIC	OSH lifting equa	ation, OCRA	۹.			
-		sessment Tools							<i>.</i> .	
		nethods for assess				disorder ris	sk factors	-qualities	of good	[09]
		- advantage and di								
		of physiological a				Dutch Mus		4-1 <b>O</b>		
		ssess levels of m								[09]
		Musculoskeletal qu -NIOSH generic jol				evers of me	ntal disco	mon – jo	D Sliess	
		uation Tools	J Sliess y	lestionna						
		imb Assessment (F		nid Entire	- Rody Assess	ment (REB		- Lifting e	nuation	[09]
		s on exercises.			buy Assess		, <b>N</b> IOOI		quation,	[00]
		s – project planni	na							
		roject management		actors to	ols for proiect r	nanagemen	t-case stu	udies .		[09]
	Total Hours						45			
Text book(s):										
1. Denninis A. Attwood et al,"Ergonomic Solutions for Process industries" Gulf Professional Publishing,200						2004				
2.										
3.										

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S.No	Course Contents and Lecture Schedule S.No Topic						
3.100	Горіс	No.of Hours					
1	Introduction	9					
1.1	Basics of biomechanics and anthropometry of human body –	1					
1.2	work station design-working posture Assessment tools-	3					
1.3	fundamentals of RULA,REBA	2					
1.4	fundamentals of NIOSH lifting equation	2					
1.5	fundamentals of OCRA.	1					
2	Subjective Assessment Tools	9					
2.1	Introduction- methods for assessing work related Musculoskeletal disorder risk factors-	4					
2.2	qualities of good questionnaires	3					
2.3	- advantage and disadvantages of questionnaire.	2					
3	Assessment of physiological and psychological discomfort	9					
3.1	Methods to assess levels of musculoskeletal discomfort -	1					
3.2	The Dutch Musculoskeletal Questionnaire (DMQ)-	2					
3.3	Nordic Musculoskeletal questionnaire,	2					
3.4	Methods to assess levels of mental discomfort – job stress questionnaire	2					
3.5	–NIOSH generic job stress questionnaire.	2					
4	Postural Evaluation Tools	9					
4.1	Rapid Upper Limb Assessment (RULA)	3					
4.2	Rapid Entire Body Assessment (REBA)	3					
4.3	NIOSH Lifting equation	2					
4.4	OCRA – hands on exercises	1					
5	Human factors – project planning	9					
5.1	Introduction- project management	3					
5.2	human factors tools for project management	3					
5.3	case studies .	3					
	Total	45					

# **Course Designers**

- 1. Dr.V.Sundararaju
- 2. Mrs.S.Chandralekha

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**BoS Chairman** 

		Category	L	Т	Ρ	Credit
60 PIS E45	Ergonomics in Automotive Design	PE	3	0	0	3

## Objective

- To impart the basics of ergonomics ٠
- To understand the automotive ergonomics •
- To know the facts about controls and displays
- To address work study with ergonomic intervention ٠
- To outline the significance of virtual ergonomic tools •

## Prequisite

# Nil

## **Course Outcomes**

## On the successful completion of the course, students will be able to

CO1	Understand the basics of ergonomics study	Remember, Understand, Apply
CO2	Understand the need for automotive ergonomics	Remember, Understand, Apply
CO3	Understand the significance of controls and displays in automotives	Remember, Understand, Analyze
CO4	Apply work study and perform ergonomic intervention study	Remember, Understand, Analyze
CO5	Apply virtual ergonomic techniques in automotive design.	Remember, Understand, Apply

# Mapping with Programme Outccomes

COs	P01	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4 3 3 2 2 2 2						
CO5	3	3	2	3	2	2
	3- St	rong;2-l	Vedium	;1-Som	e	

#### Assessment Pattern

Bloom's Category	Continuous As	End Sem Examination	
Bioonin's Category	1	2	(Marks)
Remember (Re)	10	10	10
Understand (Un)	20	20	30
Apply (Ap)	30	0	30
Analyze (An)	0	30	30
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

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r formed Bos Chairman

					of Technology				R202	2
		6			nics in Autom		gn			
			M.E.	Industria	al Safety Engi	neering				
Som	nester	Hours	/Week		Total Hrs	Credit	Ν	Aaximum	Marks	
Gen	IESIEI	L	Т	Р	Totarris	С	CA	ES	Tot	al
		3	0	0	45	3	40	60	10	0
Definit	ion ,dom	ergonomics ains and applicatio anatomy of the sp					lechanics	: Some ba	asic bio	[09]
		o Automotive Erg notive ergonomics		metric an	d biomechanic	al data in a	utomotive	e design		[09]
		<b>Displays</b> kaging, Automobile	control a	nd display	/s, In vehicle a	nd external	visibility c	of the drive	er	[09]
Entry	and exi	nd method study by drivers and p d Measurement	bassenger	s, Driver	distraction an	d driving p	erforman	ce meası	irement,	[09]
Assessment methods and applications Virtual Ergonomics evaluation technique and its application in automotive design, Automotive craftsmanship						[09]				
								Tota	l Hours	45
Text	book(s):									
1.	Bhise, V	.D., 2016. Ergonor	nics in the	automoti	ve design proc	ess. CRC P	ress			
2.	Harvey,	C. and Stanton, N.	A., 2016. I	Jsability e	evaluation for in	n-vehicle sy	stems. Cl	RC Press.		

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S.No	Торіс	No.of
		Hours
1	Introduction to ergonomics	9
1.1	Definition ,domains and application of ergonomics	2
1.2	Anatomy, Posture and Bio Mechanics:	2
1.3	Some basic bio mechanics and anatomy of the spine and pelvis	3
1.4	application of biomechanics	2
2	Introduction to Automotive Ergonomics	9
2.1	Need for Automotive ergonomics,	4
2.2	Anthropometric data in automotive design	3
2.3	biomechanical data in automotive design	2
3	Controls and Displays	9
3.1	Occupant Packaging	1
3.2	Automobile control and displays	2
3.3	In vehicle visibility of the driver	2
3.4	external visibility of the driver	2
4	Work study and method study	9
4.1	Entry and exit by drivers and passengers,	2
4.2	Driver distraction	3
4.3	driving performance measurement	2
4.4	Driver Workload Measurement	2
5	Assessment methods and applications	9
5.1	Virtual Ergonomics evaluation technique	3
5.2	Application of virtual ergonomics in automotive design	3
5.3	Automotive craftsmanship	3
	Total	45

# **Course Designers**

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		Category	L	Т	Ρ	Credit
60 PIS E46	Applied Ergonomics	PE	3	0	0	3

Objective

- To impart the basics of anthropometry. •
- To understand the human performance pertaining to job •
- To know the facts about cognitive ergonomics. •
- To address concepts pertaining to cognitive abilities, human machine interaction, human perception • and decision making.
- ٠ To outline the significance of safety climate

#### Prerequisite

Nil

#### Course Outcomes

## On the successful completion of the course, students will be able to

CO1	Design an ergo work station using ergonomics tools.	Remember, Understand, Apply
CO2	Pinpoint the components of applied ergonomics.	Remember, Understand, Apply
CO3	Guide on decision making pertaining to ergonomics.	Remember, Understand, Analyze
CO4	Assess mental workload and give suggestions	Remember, Understand, Analyze
CO5	Create a safety climate in the workplace.	Remember, Understand, Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	2	2
	3- St	rong;2-l	Vedium	;1-Som	е	

# Assessment Pattern

Bloom's Category	Continuous Ass	sessment Tests (Marks)	End Sem Examination				
BIOOTII'S Category	1	2	(Marks)				
Remember (Re)	10	10	10				
Understand (Un)	20	20	30				
Apply (Ap)	30	0	30				
Analyze (An)	0	30	30				
Evaluate (Ev)	0	0	0				
Create (Cr)	0	0	0				

ronned **BoS Chairman** 

	K.S.Rangasamy (	College of	Technol	ogy-Autonom	nous		R2022		
	<b>U</b>			Applied Ergon					
M.E. Industrial Safety Engineering									
Semester Hours/Week Total Hrs Credit Maximum Marks									
	L	Т	Р	Totarris	С	CA	ES	Tot	
III	3	0	0	45	3	40	60	100	)
anatomy a system-me health.	on to Ergonomics D and Biomechanics – a etabolism-cardiovascula	pplication ar system	of biome -respirato	echanics-overv ory system -	iew of hum structure	an body- and func	- Musculo tion-postu	skeletal ire and	[08]
Human er Organisati functions evaluation specializat	ion-job enlargement –J	of taxono ponsibility otivation o rgonomics lob enrichr	omy of h and auth f work-M –job sa nent work	human error, j hority-types of laslow gratifica atisfaction-sign < organization.	ob factors, decision-li ation theory s of job s	environr ne organ - workers atisfaction	nental co lisation al s motivatio n-job rota	nditions nd staff on -Job ition-job	[10]
design pro essentials –machine problems		c data – r ng tools – nents-mac	neasuren software hine com	nents- how to tools- designin ponents-enviro	use anthro g for static a onmental co	pometric and dyna mponent	data – st mic work- s Tools.	atistical Human -	[10]
design pro essentials	<b>cs for design</b> Human ocess – anthropometric - Ergo tools – measuri system- human compo	c data – r ng tools –	neasuren software	nents- how to to tools- designin	use anthro g for static	pometric and dyna	data – st mic work-	atistical	[08]
Cognitive human vis importance solving. Ge	ergonomics Workpla ionhearing sense in cognitive ergonom uidelines for cognitive v flight-visibility-lighting	ace ergono and impo nics - Com work senso	omics - rtance of nmon cog ory recept	Human senso auditory perfo gnitive tasks – ion and percep	ry system-h ormance. –L decision m otion – Visua	ong term ong term naking –p al environ	ognitive sy n memory planning- p	and its problem	[09]
			-				Tota	I Hours	45
Text bool	k(s):								
2 Mar	Bridger,"Introduction to k S Sanders,Ernest J I ate Limited,7 <sup>th</sup> edition,2	Mccormick				& Design"	, Mcgraw	-Hill educ	cation
Referenc	· · · · ·								
	Khan,"Industrial Ergono	omics", PH	Learnin	g Private Limite	ed,New Dell	hi,2013.			
2. Chri Eng	stoper D Wickens, Sal ineering", Pearson-Pre	llie E.Gord ntie Hall, 2	on-Becke	er, Yili Liu ,Joh ,2004	n D.Lee "A	n introdu			
Prer	ell P Groover, " Work s ntice Hall,New Delhi,2 <sup>nd</sup>	d edition,20	06			-			
	z,StephanA,Johnson,S on, 2007	teven,Holo	ombHath	naway,Scottsda	ale, "Work E	Design: In	dustrial E	rgonomic	cs",7 <sup>th</sup>

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S.No	Торіс	No.of Hours
1	Introduction to Ergonomics	8
1.1	Definition, domains and Applications of Ergonomics- Basics of Human anatomy and Biomechanics –	2
1.2	application of biomechanics-overview of human body	1
1.3	- Musculoskeletal system-metabolism-cardiovascular system-respiratory system - structure and function- posture and health.	4
2	Organization Ergonomics	10
2.1	Job Factors - fitting person to job and fitting a job to a person(FPJ & FJP) -Human errors-brief descriptions of taxonomy of human error, job factors, environmental conditions	2
2.2	Organisation ergonomics – responsibility and authority-types of decision-line organisation and staff functions matrix	2
2.3	organisation motivation of work-Maslow gratification theory- workers motivation -	2
2.4	Job evaluation in organisational ergonomics –job satisfaction-signs of job satisfaction- job rotation-	2
2.5	job specialization-job enlargement –Job enrichment work organization.	2
3	Ergonomics for design	10
3.1	Human oriented design –anthropometry –anthropometry data – anthropometric design process –	2
3.2	anthropometric data – measurements- how to use anthropometric data – statistical essentials - Ergo tools – measuring tools – software tools-	4
3.3	designing for static and dynamic work- Human –machine system- human components-machine components-	2
3.4	environmental components Tools problems	2
4	Ergonomics for design	8
4.1	Human oriented design –anthropometry –anthropometry data – anthropometric design process –	2
4.2	anthropometric data – measurements- how to use anthropometric data – statistical essentials	2
4.3	Ergo tools – measuring tools – software tools-	2
4.4	designing for static and dynamic work- Human –machine system- human components-machine components- environmental components Tools problems	2
5	Cognitive ergonomics	9
5.1	Workplace ergonomics - Human sensory system-human cognitive system - human vision	1
5.2	hearing sense and importance of auditory performance. –Long term memory and its importance in cognitive ergonomics -	2
5.3	Common cognitive tasks – decision making –planning- problem solving.	2
5.4	Guidelines for cognitive work sensory reception and perception – Visual environment and lighting –	2
5.5	physics of light-visibility-lighting system-auditory environment – effect of noise	2
	Total	45

# **Course Designers**

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60 PIS E51     Safety in Construction       PE     3     0     0     3			Category	L	Т	Ρ	Credit
	60 PIS E51	Safety in Construction	PE	3	0	0	3

Objective

- To give insights on construction industry and the work nature. •
- To understand the construction accidents and contributing causes. •
- To know the Indian and international regulations pertaining to construction work. •
- To impart knowledge on construction machineries. •
- To describe means and ways for safe demolition activity.

Prerequisite

Nil

Course Outcomes

# On the successful completion of the course, students will be able to

CO1	Understand construction industry, hazards, causes, activities and relate with BOCW act.	Remember, Understand, Apply
CO2	Identify types of excavation, scaffold hazards and suggest adequate control measures.	Remember, Understand, Apply
CO3	Relate OSHA standards for fall protection and fall prevention in construction practice.	Remember, Understand, Analyze
CO4	Understand Operation and maintenance of Earth moving machinery and investigate accidents.	Remember, Understand, Analyze
CO5	Formulate Demolition, types and safe demolition activity in industrial and domestic site	Remember, Understand, Apply

Mapping with program outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6			
CO1	3	3	3	2	2	2			
CO2	3	3	3	2	2	2			
CO3	3	3	3	2	2	2			
CO4	3	3	2	2	2	2			
CO5	3	3	2	3	2	2			
	3- Strong;2-Medium;1-Some								

## Assessment Pattern

Bloom's Category	Continuous Ass	End Sem Examination				
Bloom's Category	1	2	(Marks)			
Remember (Re)	10	10	10			
Understand (Un)	20	20	30			
Apply (Ap)	30	0	30			
Analyze (An)	0	30	30			
Evaluate (Ev)	0	0	0			
Create (Cr)	0	0	0			

rowned **BoS Chairman** 

	K.S.Rangasa	my Colleg	ge of Teo	hnology-Auto	onomous		R2	022	
				afety in Const					
		M.E.	Industria	al Safety Engi	neering	•			
Semester	Hours	s/Week		Total Hrs	Credit		laximum	Marks	
	L	Т	Р		С	CA	ES	Tot	
	3	0	0	45	3	40	60	100	)
causes of fa factors asso other constr aids for sat	Causes and Manag atal accidents, types a pociated with these acc function workers act a fe construction – per fon – Recording of acc	nd causes cident – co nd rules 1 mits to w	s of accid onstructio 996- Pre ork – too	lents related to n regulations, contract activition of box meeting	various con contractual ities, precor g- quality a	nstruction clauses - nstruction ssurance	activities - the build meeting	, human ling and - design	[09]
Hazards O shafts – sca structural fra spaces – w construction	f Construction and affolding , types, caus ame work, dismantling orking on contaminate of high rise buildings	Preventions bes of accing – tunnel ed sites –	on: Exca dents, sc ing – bla work ov	avations, baser caffold inspection sting, pre blas er water - roac	ment and v on checklist t and post d works – p	wide exca t – false v blast insp oower plar	work – ere pection – o nt constru	ection of confined ctions –	[09]
heights, Saf stairways, g protection, s – working c	Heights: Fall protect e access and egress angways and ramps, safety harness, safety on fragile roofs, work ent case studies.	– safe use Mobile el nets, fall	e of ladde levated V arrestors	rs- Scaffolding Vorking Platfor , controlled acc	s, requirem ms(MEWPs cess zones,	ent for sa s) – fall p safety m	fe work pl revention onitoring	atforms, and fall systems	[09]
tower crane conveyors loaders, du	on Machinery: Select es, crane inspection - concrete mixers, cor mpers, motor grader, ng tools, scaffolding	checklist ncrete vibr , concrete	- build ators – s pumps,	er's hoist, wir afety in earth n welding mach	nches, chai noving equi nines, use c	n pulley pment, ex of portabl	blocks – cavators, e electric	use of dozers, al tools,	[09]
Safety in D safe demoli hazards fro	emolition Work: Sat tion, pre survey inspe m demolition - Indian nethods –Case studie	ection, me standard	thod state	ement, site su	pervision, s	afe cleara	ance zone	, health	[09]
							Tota	l Hours	45
Text book(									
	s V J and Tomasin K						· · · · · ·		
	na S C and Vinee ruction", Khanna Publ				ealth and	Environn	nental Ma	anageme	nt in
Reference									
1. Charle press	es D Reese and Jar 2006	mes V Ed	lison, "Ha	andbook of O	SHA Const	ruction S	afety and	l Health"	,CRC
-	R W andHudson R, "C							mann, 19	85
	acharajee S K, "Safety								05.
3. Bhatta	acharajee S K, Salety	/ Manager	nent in C	onstruction", K	hanna Publ	ishers,20	13.		00.

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## Course Contents and Lecture Schedule

S.No	Торіс	No.of Hours
1	Accidents Causes and Management Systems	9
1.1	Problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities,	2
1.2	human factors associated with these accident – construction regulations, contractual clauses – the building and other construction workers act and rules 1996-	3
1.3	Pre contract activities, preconstruction meeting - design aids for safe construction – permits to work	2
1.4	tool box meeting- quality assurance in construction - compensation – Recording of accidents and safety measures – Education and training.	2
2	Hazards Of Construction and Prevention	9
2.1	Excavations, basement and wide excavation, trenches, shafts –.	1
2.2	scaffolding , types, causes of accidents, scaffold inspection checklist – false work – erection of structural frame work,	2
2.3	dismantling – tunneling – blasting, pre blast and post blast inspection –	2
2.4	confined spaces – working on contaminated sites – work over water -	2
2.5	road works – power plant constructions – construction of high rise buildings	2
3	Working at Heights	9
3.1	Fall protection in construction OSHA 3146 – OSHA requirement for working at heights, Safe access and egress – safe use of ladders	1
3.2	<ul> <li>Scaffoldings, requirement for safe work platforms, stairways, gangways and ramps, Mobile elevated Working Platforms(MEWPs) –</li> </ul>	2
3.3	fall prevention and fall protection, safety harness, safety nets, fall arrestors, controlled access zones, safety monitoring systems –	2
3.4	working on fragile roofs, work permit systems, Safety pass – Alternative equipments for scaffolding work -	2
3.5	accident case studies.	2
4	Construction Machinery	9
4.1	Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist -	1
4.2	builder's hoist, winches, chain pulley blocks – use of conveyors - concrete mixers, concrete vibrators –	2
4.3	safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps, welding machines,	2
4.4	use of portable electrical tools, drills, grinding tools, scaffolding, hoisting cranes –	2
4.5	use of conveyors and mobile cranes – manual handling.	2
5	Safety in Demolition Work	9
5.1	Safety in demolition work, manual, mechanical, using explosive	1
5.2	- keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone,	2
5.3	health hazards from demolition - Indian standard	2
5.4	- trusses, girders and beams – first aid – fire hazards and preventing methods –	2
5.5	Case studies.	2
	Total	45

# **Course Designers**

1. Dr.V.Sundararaju Passed in BoS Meeting held on 18/05/23 Approved in Academic Council Meeting held on 03/06/2023 sundararaju@ksrct.ac.in

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		Category	L	Т	Ρ	Credit
60 PIS E52	Dock Safety	PE	3	0	0	3

Objective

- To understand the nature of work and process involved in Docks. •
- To know the types of docks and its safe handling. •
- To familiarize on the regulations pertaining to safety and welfare of dock workers. •
- To carryout testing and examination of lifting equipments and tackles. •
- To explain the significance of emergency action plans. •

## Prerequisite

Nil

# **Course Outcomes**

## On the successful completion of the course, students will be able to

CO1	Understand the statues pertaining to dock safety.	Remember, Understand, Apply
CO2	Identify cargo, types of cargo ships and formulate procedures to maintain safety on ships	Remember, Understand, Apply
CO3	Examine and test the lifting appliances.	Remember, Understand, Analyze
CO4	Understand testing, examination and inspection of containers.	Remember, Understand, Analyze
CO5	Draft and enact emergency action plans	Remember, Understand, Apply

Mapping with program outcomes

COs	P01	PO2	PO3	PO4	PO5	PO6			
CO1	3	3	3	2	2	2			
CO2	3	3	3	2	2	2			
CO3	3	3	3	2	2	2			
CO4	3	3	2	2	2	2			
CO5	3	3	2	3	2	2			
	3- Strong;2-Medium;1-Some								

#### Assessment pattern

Bloom's Category	Continuous As	End Sem Examination			
Bioonin's Category	1	2	(Marks)		
Remember (Re)	10	10	10		
Understand (Un)	20	20	30		
Apply (Ap)	30	0	30		
Analyze (An)	0	30	30		
Evaluate (Ev)	0	0	0		
Create (Cr)	0	0	0		

ronned **BoS Chairman** 

	K.S.Rangasamy						R2022		
				52 - Dock Safe					
			Industria	al Safety Engi	neering	1			
Semester	Hours	Week		Total Hrs Credit		ſ	Maximum	Marks	
Cernester	L	Т	Р	rotarrio	С	CA	ES	Tot	
III	3	0	0	45	3	40	60	10	0
	fety Legislation H								
under, other s manufacture, (protection) ac Responsibility of port authori and loose gea	workers (safety, he statues like markin storage and impor it, 1989 – few case of different agenci ties – dock labour h ar etc. – employers ersons and dock	ng of hear t of hazar s laws to in es for safe poard – ow s of dock	vy packag dous che nterpret th ety, health vner of sh workers I	ges act 1951 micals. Rules ne terms used i n and welfare in ip master, age ike stevedores	and the ru 1989 frame in the dock nvolved in c nt of ship – s – clearing	iles frame ed under safety sta dock work owner of and forv	ed there of the enviro atues. ( –respons ( lifting app warding aq	under - onment sibilities oliances gents –	[11
<b>Working On</b> natch beams and its safety accesses – sa nold of the sh nternal comb management	nd Advisory Comm <b>Board the Ship</b> - hatch covers incl features – safety afety in storage etc ip and on decks – ustible engines like - Storage – types,	Types of c luding its r in chippin c. – illumin - safety pr e fort-lift tr hazardous	argo ship marking, I ng and pa nation of o recautions rucks-pay s cargo.	s – working or Mechanical ope ainting operation decks and in h s needed – sa loaders etc. N	n board shi erated hatc ons on boa iolds – haz fety in use Working wit	ps – Safe h covers rd ships ards in w of transp h electric	of differer – safe me vorking ins port equip city and el	nt types eans of side the oment - lectrical	[03
nethods of rig ranstainer, to portainers – tr natural fiber ro	ances Different typ gging of derricks, s op lift trucks and anstainers – toplift opes – wire rope ch	afety in th other cor trucks – c ains, differ	ne use of ntainers - derricks in rent types	container hand - testing and different riggi of slings and l	dling/lifting examination ng etc- use oose gears	appliance on of lifti and care	es like por ng applia e of synthe	tainers, nces – etic and	[08
use-safety in i conveyors an inspection of c of containers board the ship	uipment The diffe he use of selfloadi d cranes. Safe us containers – carriag for safe operation. and ashore – loa pecific chemical fro	ng contair se of spec ge of dang Handling ding and u	ner vehicle cial lift tru gerous go of differer unloading	es, container s licks inside col ods in containe nt types of carg of cargo ident	ide lifter, fo ntainers – ers and ma go – stackir ification of	rk lift truc Testing, intenance ng and ur berths/wa	ck, dock ra examination and certion stacking for the stacking for the stac	ailways, on and ification both on transfer	[09
Emergency A and explosion concerning sp Dock workers	ction Plan and Do s - collapse of liftin illage of dangerous (SHW) rules and ading, handling of	g applianc s goods et d  regulatio	ces and bi c., - Prepa ons 1990	uildings, sheds aration of on-s -related to lift	etc., - gas ite emerger ing appliar	leakages ncy plan a nces, Co	s and prec and safety ntainer ha	autions report. andling,	[08
							Tota	l Hours	45
Text book(s)									
,	and Health in Dock	-		Ū.		-			
	ck Workers Act 194	48 with rul	es 1962",	Universal Lav	v Publishing	g, New De	elhi,2016.		
Reference(s)									
1. Velitchk	ovitchJ,"Guide to S	afety and	Health in	Dock Work", I	LO,1976.				
2. Taylor D	A, "Introduction to	Marine E	ngineerin	g", Butterworth	-Heineman	n, 2 <sup>nd</sup> Edi	tion 1996.		
3. Srinivas	an R, "Harbour, Do	ck and Tu	innel Engi	neering". CPH	Pvt Limited	1,28 <sup>th</sup> Edit	tion,2016		
	S R, "Course in		-	-					

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S.No	Торіс	No.of Hours			
1	History of Safety Legislation	11			
1.1	1.1 History of dock safety statues in India-background of present dock safety statues- dock workers (safety, health and welfare) act 1986 and the rules and regulations framed there under, other statues like marking of heavy packages act 1951 and the rules framed there under				
1.2	manufacture, storage and import of hazardous chemicals. Rules 1989 framed under the environment (protection) act, 1989 – few cases laws to interpret the terms used in the dock safety statues.	2			
1.3	Responsibility of different agencies for safety, health and welfare involved in dock work –responsibilities of port authorities – dock labour board –	2			
1.4	owner of ship master, agent of ship – owner of lifting appliances and loose gear etc. – employers of dock workers like stevedores – clearing and forwarding agents – competent persons and dock worker.	2			
1.5	Forums for promoting safety and health in ports – Safe Committees and Advisory Committees. Their functions, training of dock workers.	2			
2	Working On Board the Ship	9			
2.1	Types of cargo ships – working on board ships – Safety in handling of hatch beams – hatch covers including its marking,	1			
2.2	Mechanical operated hatch covers of different types and its safety features – safety in chipping and painting operations on board ships –	2			
2.3	safe means of accesses – safety in storage etc. – illumination of decks and in holds – hazards in working inside the hold of the ship and on decks – safety precautions needed –	2			
2.4	safety in use of transport equipment - internal combustible engines like fort-lift trucks-pay loaders etc.	2			
2.5	Working with electricity and electrical management – Storage – types, hazardous cargo.	2			
3	Lifting Appliances.	8			
3.1	Different types of lifting appliances – construction, maintenance and use, various methods of rigging of derricks,	1			
3.2	safety in the use of container handling/lifting appliances like portainers, transtainer, top lift trucks and other containers –	2			
3.3	testing and examination of lifting appliances – portainers – transtainers –	2			
3.4	toplift trucks – derricks in different rigging etc- use and care of synthetic and natural fiber ropes –	2			
3.5	wire rope chains, different types of slings and loose gears	1			
4	Transport Equipment	9			
4.1	The different types of equipment for transporting containers and safety in their use-safety in the use of selfloading container vehicles, container side lifter, fork lift truck, dock railways, conveyors and cranes	2			
4.2	. Safe use of special lift trucks inside containers – Testing, examination and inspection of containers – carriage of dangerous goods in containers and maintenance and certification of containers for safe operation.	2			
4.3	Handling of different types of cargo – stacking and unstacking both on board the	2			

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	ship and ashore –	
4.4	loading and unloading of cargo identification of berths/walking for transfer operation of specific chemical from ship to shore and vice versa –	2
4.5	restriction of loading and unloading operations.	1
5	Emergency Action Plan and Dock Workers (SHW) Regulations 1990.	8
5.1	Emergency action Plans for fire and explosions - collapse of lifting appliances and buildings, sheds etc., - gas leakages and precautions concerning spillage of dangerous goods etc.,	3
5.2	- Preparation of on-site emergency plan and safety report. Dock workers (SHW) rules and regulations 1990-related to lifting appliances	2
5.3	, Container handling, loading & unloading, handling of hatch coverings and beams, Cargo handling, conveyors, dock railways, forklift	3
	Total	45

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## **Course Designers**

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**BoS Chairman** 

60 PIS E53     Electrical Safety       PE     3     0     0     3			Category	L	Т	Р	Credit
	60 PIS E53	Electrical Safety	PE	3	0	0	3

Objective

- To explain the facts of electrical installation and maintenance activities. •
- To identify the hazards and faulty electrical appliances. •
- To understand the classes of insulation and PPE. •
- To explain the safer means of accessing electrical appliances. •
- To know the statutory requirements concerned with electrical safety. •

### Prerequisite

Nil

#### **Course Outcomes**

_	On the successful completion of the course, students will be able to								
	Indicate Statues, standards pertaining to electrical safety and first aid	Remember, Understand,							
	measures.	Apply							
<u> </u>	Diagnose Classes of insulation and hazardous conditions.	Remember, Understand,							
CO2		Apply							
<u> </u>	Inspect FRLS insulation, grounding, circuit breaker and PPE.	Remember, Understand,							
CO3		Analyze							
CO4	Plan and schedule lock out tag out and work permit.	Remember, Understand,							
C04		Analyze							
CO5	Setup Safe and explosion proof electrical apparatus.	Remember, Understand,							
		Apply							

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	
CO1	3	3	3	2	2	2	
CO2	3	3	3	2	2	2	
CO3	3	3	3	2	2	2	
CO4	3	3	2	2	2	2	
CO5	3	3	2	3	2	2	
3- Strong;2-Medium;1-Some							

#### Assessment Pattern

Bloom's Category	Continuous Ass	End Sem Examination	
Bibbill's Category	1	2	(Marks)
Remember (Re)	10	10	10
Understand (Un)	20	20	30
Apply (Ap)	30	0	30
Analyze (An)	0	30	30
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

ronned **BoS Chairman** 

60 PIS E53 – Electrical Safety           PIS: M.E. Industrial Safety Engineering           Semester         Hours/Week         Total Hrs         Credit         Maximum Marks           III         3         0         0         45         3         40         60         100           Concepts and Statutory Requirements         Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act 2003 and rules-statutory requirements from electrical inspectorate-international and Indian standards on electrical safety – first adi-cardio pulmonary resuscitation(CPR) - case studies.         Electrical Hazards           Primary and secondary hazards-shocks, burns, scalds, falls- burns classification, burn chart-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy-current surges-over current and short circuic current-heeling effects, electricity -definition, sources, hazardous contions, control-electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electricits setty code ANS. Lightning, hazards, lightning arrestor, installation – earthing, specification, search patholic settical engineering - voltage - safe limits of amperage – voltage - safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection-aeut fault protection-RLS insulation-insulation and continuity test-system grounding-equipment grounding-rubber mats and relevant fault protection -RLS insulation-musulation and continuity test-system grounding-equi			K.S.Ran	gasamy C	ollege of	Technology-	Autonomo	us		R2022		
Semester         Hours/Week         Total Hrs         Credit         Maximum Marks           III         3         0         0         45         3         40         60         100           Concepts and Statutory Requirements         Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act 2003 and rules-statutory (requirements from electrical inspectorate-international and Indian standards on electrical safety – first aid-cardio pulmonary resuscitation(CPR) - case studies.         Electrical Hazards           Primary and secondary hazards-shocks, burns, scalds, falls- burns classification, burn chart-human safety in the use of electricityEnergy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy-current surges-over current and short circuit current-heating effects of [rece-coron aeffect-static electricity -definition, sources, hazardous conditons, control-electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance         Protection Systems           Protection Systems         Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection-earth fault protecton FIRLS         If           Soluction, insulation and continuity test-system grounding-equipment grounding-rubber mats hand relevant standards-Earth Leakage Circuit Breaker (ELCB)- Residual Cu				60	PIS E53	<ul> <li>Electrical Sa</li> </ul>	afety					
Semester         L         T         P         Iotal Hrs         C         CA         ES         Total           III         3         0         0         45         3         40         60         100           Concepts and Statutory Requirements         Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical guipment-Indian electricity act 2003 and rules-statutory (I)         [0]           Introduction – electrical assection (CPR) case studies.         [Electrical Hazards         [1]         [2]         [1]         [2]         [2]         [2]         [2]         [2]         [2]         [2]         [2]         [2]         [2]         [2]         [2]         [2]         [2]         [2]         [2]         [2]         [3]         [4]				PIS: M.E	E. Indust	rial Safety Eng	gineering					
L         I         P         C         C         LS         Lotal           III         3         0         0         45         3         40         60         100           Concepts and Statutory Requirements         Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act 2003 and rules-statutory (0           requirements from electrical inspectorate-international and Indian standards on electrical safety – first aid-cardio pullmonary resuscitation(CPR)- case studies.         Electrical Hazards           Primary and secondary hazards-shocks, burns, scalds, falls- burns classification, burn chart-human safety in the use of electricity.Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy-current surges-over current and short circuit current-heating effects of current-electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI. Lightning hazards, lightning arrestor, installation – earthing, specifications, control-electrical safety code ANSI. Lightning hazards, lightning arrestor, installation – earth and relevant the maintenance entropy to the maters and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection-earth fault protection-IRLS insulation-induced-ground fault circuit interrupter-use of low voltage-electrical gurds-Personal protective equipment – safety in handing hand held electrical appliances tools and medical equip	Sor	nector	Hours	s/Week		Total Hrs	Credit	N	Maximum	Marks		
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S.No	Торіс	No.of Hours
1	Concepts and Statutory Requirements	9
1.1	Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference	2
1.2	Working principles of electrical equipment-Indian electricity act 2003 and rules-statutory requirements from electrical inspectorate	2
1.3	international and Indian standards on electrical safety	2
1.4	first aid-cardio pulmonary resuscitation(CPR)- case studies.	3
2	Electrical Hazards	10
2.1	Primary and secondary hazards-shocks, burns, scalds, falls- burns classification, burn chart-human safety in the use of electricity.Energy leakage-	2
2.2	clearances and insulation-classes of insulation-voltage classifications-excess energy- current surges-over current and short circuit current-	2
2.3	heating effects of current-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control-electrical causes of fire and explosion-	2
2.4	ionization, spark and arc-ignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor,	2
2.5	installation – earthing, specifications, earth resistance, earth pit maintenance	2
3	Protection Systems	10
3.1	Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage.	2
3.2	<ul> <li>voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection-earth fault protection.</li> </ul>	2
3.3	FRLS insulation-insulation and continuity test-system grounding-equipment grounding- rubber mats and relevant standards-Earth Leakage Circuit Breaker (ELCB)- Residual Current Circuit Breaker(RCCB)cable wires-	2
3.4	maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards- Personal protective equipment –	2
3.5	safety in handling hand held electrical appliances tools and medical equipments	2
4	Selection, Installation, Operation and Maintenance	9
4.1	Role of environment in selection-safety aspects in application - protection and interlock-	2
4.2	self diagnostic features and fail safe concepts-lock out and tag out (LOTO)-work permit system-	3
4.3	contact prevention techniques-Human protection – rubber mat-	2
4.4	discharge rod and earthing devices- cabling and cable joints-preventive maintenance	2
5	Hazardous Zones	7
5.1	Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-	2
5.2	increase safe equipment-their selection for different zones-	2
5.3	temperature classification-grouping of gases-	2
5.4	use of barriers and isolators-equipment certifying agencies	1
	Total	45

## **Course Designers**

1. Dr.V.Sundararaju

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2. Mrs.S.Chandralekha

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	Reliability Engineering	Category	L	Т	Ρ	Credit
60 PIS E55		PE	3	0	0	3

Objective

- To learn the concept of reliability.
- To describe the reliability prediction models.
- To enhance knowledge on hazard plotting and risk assessment.
- To ascertain functionality of safety barriers system ensuring safety for the human beings.
- To study the probability of failure on demand in regard with factory setting.

#### Prerequisite

Nil

#### Course Outcomes

#### On the successful completion of the course, students will be able to

CO1	Understand the significance of reliability metrics.	Remember, Understand,
001		Apply
CO2	Calculate failure data analysis using exponential, normal, gamma	Remember, Understand,
002	and Weibull distribution and draw hazard plotting	Apply
CO3	Solve problems and work on m/n configuration systems, series	Remember, Understand,
003	parallel systems.	Analyze
CO4	Understand the concepts of reliability testing and reliability	Remember, Understand,
CO4	allocation.	Analyze
CO5	Conduct risk assessment to identify the industrial problem and	Remember, Understand,
CO5	provide suitable solution.	Apply

#### Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	
CO1	3	3	3	2	2	2	
CO2	3	3	3	2	2	2	
CO3	3	3	3	2	2	2	
CO4	3	3	2	2	2	2	
CO5	3	3	2	3	2	2	
3- Strong;2-Medium;1-Some							

#### Assessment Pattern

Plaam'a Catagony	Continuous Ass	End Sem Examination	
Bloom's Category	1	2	(Marks)
Remember (Re)	10	10	10
Understand (Un)	20	20	30
Apply (Ap)	30	0	30
Analyze (An)	0	30	30
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

ronned **BoS Chairman** 

	K.S.Rangasamy College of Technology–Autonomous R20							022		
	60 PIS E55 – Reliability Engineering									
	M.E. Industrial Safety Engineering									
Sa	emester Hours/Week Total Hrs Credit Maximum Marks						Marks			
00	mester	L	Т	Р		С	CA	ES	Tot	
	III 3 0 0 45 3 40 60 100									)
Relia prior effec	i and a p tiveness.	tion – failure rate – oosteriori concept								[09]
Time techi	niques – ł	distributions – Exp lazard plotting.	oonential, ı	normal, G	Samma, Weibu	ll, ranking o	of data – p	probability	plotting	[09]
Serie Baye	es and pa	ediction Models rallel systems – R m – cut and tie set							ation of	[09]
Relia	ability test	<b>nagement</b> ing – Reliability gr ility allocation – Re			Non-parametri	c methods	– Reliabi	lity and li	fe cycle	[09]
Defir		nent measurement of assessment.	risk – risk	analysis	s techniques –	risk reduc	tion reso	urces – ir	ndustrial	[09]
								Tota	I Hours	45
Text	t book(s):									
1	Srinath	_ S, "Reliability Eng	gineering",	Affiliated	East-West Pre	ess Pvt. Ltd,	New Del	hi, 4 <sup>th</sup> Edi	tion 2006	
2	Charles 2009.	E Ebeling, "An Intro	oduction to	o Reliabili	ty and Maintair	nability Engi	ineering",	Tata Mcg	ıraw Hill,	
Refe	erence(s)									
1	Mohamr	ned Modarres et al	, "Reliabilit	ty and Ris	sk analysis", Cl	RC Press, 2	edition	, 2009.		
2		/ N A, "Reliability E								
	<ul> <li>Bhaskar S, Narayanamoorthy S, "Statistical Quality Control and Reliability Engineering", Anuradh agencies Publishers,2002.</li> </ul>									
3			July S, C	Slalistical	Quality Cont	toi and Re	eliability i	ngineerir	ng", Anur	adha

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S.No	Торіс	No.of Hours
1	Reliability Concept	9
1.1	Reliability function – failure rate	2
1.2	mean time between failures (MTBF) – mean time to failure (MTTF) –	2
1.3	A priori and a posteriori concept - mortality curve	2
1.4	useful life – availability – maintainability	2
1.5	system effectiveness.	1
2	Failure Data Analysis	9
2.1	Time to failure distributions	2
2.2	Exponential, normal, Gamma, Weibull distributions	3
2.3	ranking of data –.	2
2.4	probability plotting techniques – Hazard plotting	2
3	Reliability Prediction Models	9
3.1	Series and parallel systems – RBD approach	2
3.2	Standby systems – m/n configuration	2
3.3	Application of Bayes' theorem – cut and tie set method	2
3.4	Markov analysis	1
3.5	Fault Tree Analysis – limitations.	2
4	Reliability Management	9
4.1	Reliability testing – Reliability growth monitoring	2
4.2	Non-parametric methods	2
4.3	Reliability and life cycle costs	2
4.4	Reliability allocation	2
4.5	Replacement model.	1
5	Risk Assessment	9
5.1	Definition and measurement of risk	1
5.2	Risk analysis techniques	3
5.3	Risk reduction resources	3
5.4	industrial safety and risk assessment.	2
	Total	45

## **Course Designers**

- 2. Dr.V.Sundararaju
- 3. Mrs.S.Chandralekha

- sundararaju@ksrct.ac.in chandralekha@ksrct.ac.in
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		Category	L	Т	Ρ	Credit
60 PIS E56	Safety in Energy Sector	PE	3	0	0	3

Objective

- To learn the concept of energy •
- To describe the fundamental of energy utility. •
- To enhance knowledge on energy storage. •
- To ascertain functionality of safety barriers system ensuring energy control measures. •
- To train in situation handling. •

### Prerequisite

Nil

#### Course Outcomes

#### On the successful completion of the course, students will be able to

CO1	Understand the fundamental concepts of energy	Remember, Understand,
001		Apply
CO2	Discuss the health and safety management system in energy	Remember, Understand,
002	sector	Apply
CO3	Draft emergency control measures for energy storage and handling	Remember, Understand,
003		Analyze
CO4	Evaluate the risk issues in energy storage	Remember, Understand,
004		Analyze
CO5	Mitigate high risk situation at energy sector	Remember, Understand,
005		Apply,Analyze

#### Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	2	2
	3- St	rong;2-l	Vedium	;1-Som	e	

### **Assessment Pattern**

Plaam'a Catagony	Continuous Ass	End Sem Examination	
Bloom's Category	1	2	(Marks)
Remember (Re)	10	10	10
Understand (Un)	20	20	30
Apply (Ap)	30	0	30
Analyze (An)	0	30	30
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

ronned **BoS Chairman** 

io PIS ESG – Safety In Energy Sector           M.E. Industrial Safety Engineering           Semester         Hours/Week         Total Hrs         Credit         Maximum Marks           111         3         0         0         45         3         40         60         100           Energy Industry Safety Fundamentals :Energy Sector-Definition and categories-Renewable and Non-Renewable Energy Industries-Hazards in Generating Station, Transmission System and Distribution System-Physiological aspects of electric shock-Effects on human-Precatutionary Measures-Cardio-pulmonary Resuscitation (CPR))-Diagnosis of Faults-Insulation Faults- Arcing Faults-Arc Flash and Arc Blast-Fires and Explosions-Indian Electricity Art 2003 and Indian Electricity Rules 1965-Implementing Electrical Safet Work Programme (NFPA 70E)-Case Studies         [09]           Requirements for Accident Reporting and Investigation-Safety Committee Meeting-Flash Hazard Analysis-Induction and Orientation Training-Emergency Preparedness         [09]           Energy Control Programme. Wechanical Energy Control-Machine-guarding Principles-Trip Guards-Control-Safe Distance Criteria-Insulation-Switchboards and Control Rooms-Ingress Protection as per IEC 60529-Physical Risk Control-Personal Protective Equipment (PE)-Arc Rating OFPE in cal/cm2-Safety for Safety Control Programme-General and Specific Energy Control         [09]           Safety For Safety Control Programme-General and Specific Energy Control Machine-guarding Principles-Trip Guards-Emergency Stop-Fixed Guards-Adjustable Guard-Acid Batteries-Li+Jon Batteries-Hydrogen Energy Storage-Safety for Safety Grage-Safety In Electrochamical Ener		K.S.F	Rangasam	ny Colleg	e of Technolo	gy-Autono	omous		R2	022
Semester         Hours/Week         Total Hrs         Credit         Maximum Marks           III         3         0         0         45         3         40         60         100           Energy Industry Safety Fundamentals : Energy Sector-Definition and categories-Renewable and Non- Renewable Energy Industries-Hazards in Generating Station, Transmission System and Distribution System-Physiological aspects of electric shock-Effects on human-Precautionary Measures-Cardio- pulmonary Resuscitation (CPR)/Diagnosis of Faults-Insulation Faults- Arcing Faults-Arc Flash and Arc Biast-Fires and Explosions-Indian Electricity Act 2003 and Indian Electricity Rules 1956-Implementing Electrical Safe Work Programme (NFPA 70E)-Case Studies         (09]           Health and Safety Management System: Roadmap for creating Health and Safety Management System- Safety Policy and Safety Organisation-Hazard Identification and Risk Assessment (HIRA)-Legal Requirements for Accident Reporting and Investigation-Safety Commitee Meeting-Flash Hazard Analysis- Finergy Control Programme/Mechanical Energy Control-Machine-guarding Principles-Trip Guards- Emergency Stop-Fixed Guards-Adjustable Guard-Interlock Giard-Sensor Devices-Electrical Energy Control-Safe Distance Criteria-Insulation-Switchboards and Control Rooms-Ingress Protection as per IEC 00529-Physical Risk Control-Personal Protective Equipment (PEP)-Arc Rated FR Shits and FR Pants or FR Coverali-Different Claregories of Arc Flash Suits-Required Arc Rating of PPE in cal/cm2-Selection and Maintenance of PPE-Residual Current Devices (RCD)-Circuit Protection Devices-Electrical Power System Earthing-Energy Control Programme-Kenergy Storage Downes-Battery Management System-Safety considerations in various categories of energy storage-forsai Fuel-Hydrogen Fuel-Coal- Farthi	60 PIS E56 – Safety in Energy Sector									
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Health and Safety Management System: Roadmap for creating Health and Safety Management System-         Safety Policy and Safety Organisation-Hazard Identification and Risk Assessment (HIRA)-Legal         Requirements for Accident Reporting and Investigation-Safety Committee Meeting-Flash Hazard Analysis:         NFPA 70E Tables-Grounding and GFCI-Contractor Safety Management-Management of Change-Safety         Induction and Orientation Training-Emergency Preparedness         Emergency Stop-Fixed Guards-Adjustable Guard-Interlock Giard-Sensor Devices-Electrical Energy         Control-Safe Distance Criteria-Insulation-Switchboards and Control Rooms-Ingress Protection as per IEC         60529-Physical Risk Control-Personal Protective Equipment (PPE)-Arc Rated FR Shirts and FR Pants or         FR Coveral-Different Categories of Arc Flash Suits-Required Arc Rating of PPE in cal/cm2-Selection and         Maintenance of PPE-Residual Current Devices (RCD)-Circuit Protection Devices-Electrical Power System         Safety in Energy Storage Systems Lead-Acid Batteries-Li-lon Batteries-Hydrogen Energy Storage-         System-Safety considerations in various categories of energy storage rooms-Battery Management         System-Sofety considerations and Management Hazardous Chemical Storage-Fossil Fuel-Hydrogen Fuel-Coal-         Full Risk Situations and Management Hazardous Chemical Storage-Fossil Fuel-Hydrogen Fuel-Coal-         Full Risk Situations and Management Hazardous Chemical Storage-Fossil Fuel-Hydrogen Fuel-Coal-         Full Protection-Hierarchy of Controls-Fall Protection Programme-Excavation work-Ea							Tules 1	300-imple	menung	
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Requirements for Accident Reporting and Investigation-Safety Committee Meeting-Flash Hazard Analysis-       [09]         NFPA 70E Tables-Grounding and GFCI-Contractor Safety Management-Management of Change-Safety       Induction and Orientation Training-Emergency Preparedness         Energy Control Programme:Mechanical Energy Control-Machine-guarding Principles-Trip Guards- Emergy Control-Safe Distance Criteria-Insulation-Switchboards and Control Rooms-Ingress Protection as per IEC 60529-Physical Risk Control-Personal Protective Equipment (PPE)-Arc Rated FR Shirts and FR Pants or FR Coverall-Different Categories of Arc Flash Suits-Required Arc Rating of PPE in cal/cm2-Selection and Maintenance of PPE-Residual Current Devices (RCD)-Circuit Protection Devices-Electrical Power System Earthing-Energy Control       [09]         Safety in Energy Storage Systems Lead-Acid Batteries-Li-Ion Batteries-Hydrogen Energy Storage- Super Capacitors-Safety in Electrochemical Energy Management System-Power Conversion System-State-of- Charge (SOC)-State-of-Health (SOH-Guidance for avoidance of Electrostatic Hazards-Some specific requirements for Fuel Storage Yards-Hazardous Area Classification (HAC)-Flameproof and Explosion- proof Equipment-Intrinsically Safe concept and practice.       [09]         High Risk Situations and Management Hazardous Chemical Storage-Fossil Fuel-Hydrogen Fuel-Coal- Fall Protection-Hierarchy of Controls-Fall Protection Programme-Excavation work-Earth Moving Equipment and Work involving high vehicles and long equipment safety-Working on or near the overhead Inees-Tree trimming work-Line Clearance-Earthing of overhead line-Protection against lightening-Confined Space Work-Hot Work-Lockout/Tagout (LOTO) System-Tool Box Talks-Case Studies-Near Miss Studies.       [09]         1       Niresh Behar										
NFPA 70E Tables-Grounding and GFCI-Contractor Safety Management-Management of Change-Safety       Induction and Orientation Training-Emergency Preparedness         Emergy Control Programme:Mechanical Energy Control-Machine-guarding Principles-Trip Guards-Emergency Stop-Fixed Guards-Adjustable Guard-Interlock Giard-Sensor Devices-Electrical Energy Control-Safe Distance Criteria-Insulation-Switchboards and Control Rooms-Ingress Protection as per IEC 60529-Physical Risk Control-Personal Protective Equipment (PPE)-Arc Rated FR Shirts and FR Pants or FR Coverall-Different Categories of Arc Flash Suits-Required Arc Rating of PPE in cal/cm2-Selection and Maintenance of PPE-Residual Current Devices (RCD)-Circuit Protection Devices-Electrical Power System Earthing-Energy Control Programme-General and Specific Energy Control       [09]         Safety in Energy Storage Systems Lead-Acid Batteries-Li-Ion Batteries-Hydrogen Energy Storage-Safety in Electrochemical Energy Storage Tower Conversion System-State-of-Charge (SOC)-State-of-Health (SOH-Guidance for avoidance of Electrostatic Hazards-Some specific requirements for Fuel Storage Yards-Hazardous Chemical Storage-Fossil Fuel-Hydrogen Fuel-Coal-Fall Protection-Hierarchy of Controls-Fall Protection Programme-Excavation work-Earth Moving Equipment and Work involving high vehicles and long equipment safety-Working on or near the overhead lines-Tree trimming work-Line Clearance-Earthing of overhead line-Protection against lightening-Confined Space Work-Hot Work-Lockout/Tagout (LOTO) System-Tool Box Talks-Case Studies-Near Miss Studies.       [09]         Text book(s):       1       Niresh Behari, "Enhancing Safety culture in the energy sector: A complete Guide,worldwide publishing group,2020       8       Sudhakara reddy, "Energy security and development –The global context and indian perspectives, Springe										
Energy Control Programme:Mechanical Energy Control-Machine-guarding Principles-Trip Guards-Emergency Stop-Fixed Guards-Adjustable Guard-Interlock Giard-Sensor Devices-Electrical Energy Control-Safe Distance Criteria-Insulation-Switchboards and Control Rooms-Ingress Protection as per IEC 0529-Physical Risk Control-Personal Protective Equipment (PPE)-Arc Rated FR Shirts and FR Pants or FR Coverall-Different Categories of Arc Flash Suits-Required Arc Rating of PPE in cal/cm2-Selection and Maintenance of PPE-Residual Current Devices (RCD)-Circuit Protection Devices-Electrical Power System Earthing-Energy Control Programme-General and Specific Energy Control       [09]         Safety in Energy Storage Systems Lead-Acid Batteries-Li-Ion Batteries-Hydrogen Energy Storage-Super Capacitors-Safety in Electrochemical Energy Storage Devices-Energy Storage Safety Management System-Device Management System-Serie voidance of Electrostatic Hazards-Some specific requirements for Fuel Storage Yards-Hazardous Area Classification (HAC)-Flameproof and Explosion-proof Equipment-Intrinsically Safe concept and practice.       [09]         High Risk Situations and Management Hazardous Chemical Storage-Fossil Fuel-Hydrogen Fuel-Coal-Faelt Noving High vehicles and long equipment safety-Working on or near the overhead lines-Tree trimming work-Line Clearance-Earthing of overhead line-Protection against lightening-Confined Space Work-Hot Work-Lockout/Tagout (LOTO) System-Tool Box Talks-Case Studies-Near Miss Studies.       [09]         1       Niresh Behari," Enhancing Safety culture in the energy sector: A complete Guide, worldwide publishing propectives, Springer, 2015       45         Reference(s):       1       Muhammad Asif, "Handbook of energy and environmental security", Academic press, 2022       1       45 <td></td>										
Emergency Stop-Fixed Guards-Adjustable Guard-Interlock Giard-Sensor Devices-Electrical Energy       [09]         Control-Safe Distance Criteria-Insulation-Switchboards and Control Rooms-Ingress Protection as per IEC       [09]         60529-Physical Risk Control-Personal Protective Equipment (PPE)-Arc Rated FR Shirts and FR Pants or       [09]         FR Coverall-Different Categories of Arc Flash Suits-Required Arc Rating of PPE in cal/cm2-Selection and       [09]         Safety in Energy Storage Systems Lead-Acid Batteries-Li-lon Batteries-Hydrogen Energy Storage-       [09]         Super Capacitors-Safety in Electrochemical Energy Storage to considerations in various categories of energy storage rooms-Battery Management       [09]         System-Safety considerations in various categories of energy storage rooms-Battery Management       [09]         System-Safety considerations in various categories of energy storage rooms-Battery Management       [09]         System-Safety considerations in various categories of energy storage-Fossil Fuel-Hydrogen Fuel-Coal-       [09]         Charge (SOC)-State-of-Health (SOH-Guidance for avoidance of Electrostatic Hazards-Some specific       [09]         Frequirements for Fuel Storage Yards-Hazardous Chemical Storage-Fossil Fuel-Hydrogen Fuel-Coal-       [09]         Fall Protection-Hierarchy of Controls-Fall Protection Programme-Excavation work-Earth Moving       [09]         Guipment-Intrinsically Safety culture in the energy sector: A complete Guide, worldwide publishing group,2020       [09]										
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2 Michael land," security management for occupational safety CRC press, 1st edition 2013	1 Muham	mad Asif,"Handbool	of energy	y and env	vironmental sec	curity",Acad	emic pres	s,2022		
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S.No	Торіс	No.of Hours
1	Energy Industry Safety Fundamentals	9
1.1	:Energy Sector-Definition and categories-Renewable and Non-Renewable Energy Industries-	2
1.2	Hazards in Generating Station, Transmission System and Distribution System- Physiological aspects of electric shock-	2
1.3	Effects on human-Precautionary Measures-Cardio-pulmonary Resuscitation (CPR)	2
1.4	Diagnosis of Faults-Insulation Faults- Arcing Faults-Arc Flash and Arc Blast	2
1.5	Fires and Explosions-Indian Electricity Act 2003 and Indian Electricity Rules 1956- Implementing Electrical Safe Work Programme (NFPA 70E)-Case Studies	1
2	Health and Safety Management System	9
2.1	Roadmap for creating Health and Safety Management System-Safety Policy and Safety Organisation	2
2.2	Hazard Identification and Risk Assessment (HIRA)-Legal Requirements for Accident Reporting and Investigation-Safety Committee Meeting-	3
2.3	Flash Hazard Analysis-NFPA 70E Tables-Grounding and GFCI-Contractor Safety Management-Management of Change	2
2.4	Safety Induction and Orientation Training-Emergency Preparedness	2
3	Energy Control Programme	9
3.1	Mechanical Energy Control-Machine-guarding Principles-Trip Guards-Emergency Stop- Fixed Guards-Adjustable Guard-Interlock Guard	2
3.2	Sensor Devices-Electrical Energy Control-Safe Distance Criteria-Insulation-Switchboards and Control Rooms-Ingress Protection as per IEC 60529-Physical Risk Control-Personal Protective Equipment (PPE)	2
3.3	Arc Rated FR Shirts and FR Pants or FR Coverall-Different Categories of Arc Flash Suits- Required Arc Rating of PPE in cal/cm2-	2
3.4	Selection and Maintenance of PPE-Residual Current Devices (RCD)-Circuit Protection Devices- Electrical Power System Earthing-Energy Control Programme-General and Specific Energy Control	3
4	Safety in Energy Storage Systems	9
4.1	Lead-Acid Batteries-Li-Ion Batteries-Hydrogen Energy Storage-Super Capacitors-Safety in Electrochemical Energy Storage Devices	2
4.2	Energy Storage Safety Management System-Safety considerations in various categories of energy storage rooms	2
4.3	Battery Management System-Device Management System-Energy Management System- Power Conversion System	2
4.4	State-of-Charge (SOC)-State-of-Health (SOH-Guidance for avoidance of Electrostatic Hazards-Some specific requirements for Fuel Storage Yards Hazardous Area Classification (HAC)-Flameproof and Explosion-proof Equipment-Intrinsically Safe concept and practice.	3
5	High Risk Situations and Management	9
5.1	Hazardous Chemical Storage-Fossil Fuel-Hydrogen Fuel-Coal-Fall Protection-Hierarchy of Controls-Fall Protection Programme-	1
5.2	Excavation work-Earth Moving Equipment and Work involving high vehicles and long equipment safety-Working on or near the overhead lines- Studies-Near Miss Studies	3
5.3	Tree trimming work-Line Clearance-Earthing of overhead line	3
5.4	Protection against lightening-Confined Space Work-Hot Work-Lockout/Tagout (LOTO) System-Tool Box Talks-Case	2
	Total	45

## **Course Designers**

1. Dr.V.Sundararaju

sundararaju@ksrct.ac.in

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C0 DAC 004		Category	L	т	Р	Credit
60 PAC 001	ENGLISH FOR RESEARCH PAPER WRITING	PC	2	0	0	0

### Objectives

- Teach how to improve writing skills and level of readability •
- Tell about what to write in each section
- Summarize the skills needed when writing a Title •
- Infer the skills needed when writing the Conclusion •
- Ensure the quality of paper at very first-time submission •

### Pre-requisite

-NIL-

#### **Course Outcomes**

On the successful completion of the course, students will be able to

CO1	Understand that how to improve your writing skills and level of readability	Remember, Understand & Apply
CO2	Learn about what to write in each section	Remember, Understand &Apply
CO3	Understand the skills needed when writing a Title	Remember, Understand &Apply
CO4	Understand the skills needed when writing the Conclusion	Remember, Understand & Apply
CO5	Ensure the good quality of paper at very first-time submission	Remember, Understand &Apply

#### MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6		
CO1	3	3	2	2	3	1		
CO2	3	3	2	2	3	1		
CO3	3	3	2	2	3	1		
CO4	3	3	2	3	2	1		
CO5	3	3	2	3	2	1		
3- Strong;2-Medium;1-Some								

ronned **BoS Chairman** 

## AssessmentPattern

Bloom'sCategory	ContinuousAs (Ma	Model Exam (Marks)	
	1	2	
Remember (R)	10	10	20
Understand (U)	20	20	30
Apply (Ap)	30	30	50
Analyze (An)	0	0	0
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0
Total	60	60	100
Syllabus			

					of Technolog			2			
		60 F			FOR RESEAI						
			Hours/Wee		Total hrs	Credit		Maximum Mar	ks		
Semes	ster	L	T	P	rotarmo	C	CA	ES	Total		
	1	2	0	0	30	0	40	60	100		
Planning	g and Pre	paration,		r, Breakin	g up long ser lancy, Avoiding				[6]		
Clarifyir		id What,	Highlighting aper, Abstra		dings, Hedgin uction	g and Criti	cizing, Parap	hrasing and	[6]		
Key skil are nee	eded wher	ded when writing a		ion, skills	tills are neede needed when Final Check				[6]		
Skills ar		when writ			needed when en writing the (			are needed	[6]		
Useful p	ation Skills ohrases, cl omission	-	lagiarism, h	ow to ensi	ure paper is as	good as it	could possibl	y be the first	[6]		
								Total Hours:	30		
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2.	London,		te and Publi	sh a Scien	tific Paper, Ca	mbridge I In	iversity Pres	2006			
Referer	,				инс гарсі, Са	monuge On	iversity Fiest	2000			
1.		R Writing	for Science	e. Yale Uni	versity Press (	available or	n Google Boo	ks) 2006			
2.			•		, ,		0	/			
	•			2		ighman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.					
3.		iams. Adv	anced Writi	na skills fo	r students of E	nalish. Rum	hian Publishe	rs. 2018			

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S.No.	Topics	No.of hours
1.0	Introduction to Research Paper Writing	
1.1	Planning and Preparation, Word Order	2
1.2	Breaking up long sentences, Structuring Paragraphs and Sentences	1
1.3	Being Concise and Removing Redundancy	2
1.4	Avoiding Ambiguity and Vagueness	1
2.0	Presentation Skills	
2.1	Clarifying Who Did What, Highlighting Your Findings	2
2.2	Hedging and Criticizing	2
2.3	Paraphrasing and Plagiarism, Sections of a Paper	1
2.4	Abstracts, Introduction	1
3.0	Title Writing Skills	
3.1	Key skills are needed when writing a Title	1
3.2	Key skills are needed when writing an Abstract, key skills are needed when writing an Introduction	2
3.3	Skills needed when writing a Review of the Literature	2
3.4	Methods, results, discussion, conclusions, the final check	1
4.0	Result Writing Skills	
4.1	Skills are needed when writing the Methods	2
4.2	Skills needed when writing the Results	1
4.3	Skills are needed when writing the Discussion	1
4.4	Skills are needed when writing the Conclusions	2
5.0	Verification Skills	
5.1	Useful phrases	2
5.2	Checking Plagiarism	2
5.3	How to ensure paper is as good as it could possibly be the first time submission	2
	Course Designers	

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**BoS Chairman** 

60 PAC 002		Category	L	т	Р	Credit
00 FAC 002	DISASTER MANAGEMENT	РС	2	0	0	0

#### Objectives

- Summarize basics of disaster ٠
- Explain a critical understanding of key concepts in disaster risk reduction and • humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from • multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches Teach how • to improve writing skills and level of readability

#### Pre-requisite

-NIL-

#### **Course Outcomes**

#### Onthesuccessful completion of the course, students will beable to

CO1	Ability to summarize basics of disaster	Remember, Understand & Apply
CO2	Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.	Remember, Understand &Apply
CO3	Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.	Remember, Understand & Apply
CO4	Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.	Remember, Understand &Apply
CO5	Ability to develop the strengths and weaknesses of disaster management approaches	Remember, Understand & Apply

#### **MappingwithProgrammeOutcomes**

Cos	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
	/ledium;1-Some		2	5		1 -

#### AssessmentPattern

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Bloom'sCategory	ContinuousAss (Mar	Model Exam (Marks)	
	1	2	
Remember (R)	10	10	20
Understand (U)	20	20	30
Apply (Ap)	30	30	50
Analyze (An)	0	0	0
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0
Total	60	60	100

## Syllabus

	1.3			e of Technol			022	
				- DISASTER				
M.E INDUSTRIAL SAFETY ENGINEERING           Hours/Week         Total hrs         Credit         Maximum Ma							ke	
Semester	L	T	P			CA	Total	
11	2	0	0	30	0	40	60	100
Introduction Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.							[6]	
Repercussions Economic Dan Disasters: Eart Landslides And Oil Slicks And S	nage, Loss hquakes, ` Avalanche	s of Hum Volcanism s, Man-ma	an and A s, Cyclone ide disaste	es, Tsunamis r: Nuclear Rea	, Floods, Dr actor Meltdov	oughts And n, Industria	d Famines,	[6]
<b>Disaster Prone Areas In India</b> Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics					[6]			
<b>Disaster Preparedness and Management</b> Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.						,	JSI-DISASIEI	[0]
Preparedness: Application of F	Monitoring Remote Se	of Pheno nsing, Dat	mena Trig a from Me	• •		rd; Evaluat	on of Risk:	[6]
Preparedness: Application of F	Monitoring Remote Se and Commu ent Concept ar Techniques	of Pheno nsing, Dat unity Prepa nd Elemer s of Risk	mena Trig a from Me aredness. hts, Disaste Assessmei	er Risk Reduct	nd other Age ction, Global Operation in	rd; Evaluat encies, Mec and Natior Risk Asse	on of Risk: lia Reports: nal Disaster	

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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.
Refere	nce(s):
1.	Sahni, Pardeepet.al.," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, 2001.
2.	Subramanian R,"Disaster Management", Vikas publishing Housing Pvt. Ltd., 2018.
3.	Chu-huaKuei, Christian N Madu, Handbook of Disaster Management Risk Reduction & Management: Climate change and Natural Disaster, world scientific, 2017.
4.	JankiAndharia, Disaster studies: Exploring Intersectional ties in Disaster Discourse, Springer, 2020.

S.No.	Topics	No.of hours
1.0	Introduction	·
1.1	Disaster: Definition, Factors and Significance	2
1.2	Difference between Hazard and Disaster	2
1.3	Natural and Manmade Disasters	2
1.4	Difference, Nature	2
1.5	Types and Magnitude	1
2.0	Repercussions of Disasters and Hazards	
2.1	Economic Damage, Loss of Human and Animal Life	2
2.2	Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones	2
2.3	Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches	2
2.4	Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents	1
2.5	Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts	2
3.0	Disaster Prone Areas In India	
3.1	Study of Seismic Zones	1
3.2	Areas Prone to Floods and Droughts	2
3.3	Landslides and Avalanches	2

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3.4	Areas Prone to Cyclonic and Coastal Hazards with Special Reference To Tsunami	2
3.5	Post-Disaster Diseases and Epidemics	2
4.0	Disaster Preparedness and Management	
4.1	Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard	2
4.2	Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches	2
4.3	Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches	2
4.4	Application of Remote Sensing, Data from Meteorological and other Agencies	2
4.5	Media Reports: Governmental and Community Preparedness	1
5.0	Risk Assessment	
5.1	Disaster Risk: Concept and Elements	2
5.2	Disaster Risk Reduction, Global and National Disaster Risk Situation	2
5.3	Techniques of Risk Assessment	2
5.4	Global Co-Operation in Risk Assessment and Warning	2
5.5	People's Participation in Risk Assessment. Strategies for Survival	1

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## **Course Designers**

1. Dr.V.Sundararaju

sundararaju@ksrct.ac.in

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60 PAC 003		Category	L	т	Ρ	Credit
60 FAC 003	CONSTITUTION OF INDIA	AC	2	0	0	0

#### Objectives

- Understand the premises informing the twin themes of liberty and freedom from a civil rights • perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional. Role . and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917 and its impact on the initial drafting of the Indian Constitution.

#### **Pre-requisite**

-NIL-

#### **Course Outcomes**

### Onthesuccessful completion of the course, students will be able to

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.	Remember, Understand &Apply
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India	Remember, Understand &Apply
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.	Remember,Understan d &Apply
CO4	Discuss the passage of the Hindu Code Bill of 1956.	Remember, Understand & Apply
CO5	Discuss the role and functioning of election commission of India.	Remember, Understand & Apply

#### MappingwithProgrammeOutcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1

3- Strong;2-Medium;1-Some

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### AssessmentPattern

Bloom'sCategory	ContinuousAss (Ma	Model Exam (Marks)	
	1	2	
Remember (R)	10	10	20
Understand (U)	20	20	30
Apply (Ap)	30	30	50
Analyze (An)	0	0	0
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0
Total	60	60	100

# Syllabus

	K.S.			of Technolog			2		
				<u>– CONSTITU</u>					
	1			IAL SAFETY E		-			
<b>o</b> 1		Hours/Wee		Total hrs	Credit	-	Maximum Mark		
Semester	L	Т	Р		С	CA	ES	Total	
	2	0	0	30	0	40	60	100	
History of Makin	g of The In	idian Cons	titution					[3]	
History, Drafting (	Committee,	(Compositi	on & Work	ing)					
Philosophy of Th	ne Indian C	Constitutio	n					[3]	
Preamble, Salient Features									
Contours of Con	stitutional	Rights an	d Duties						
Fundamental Rig		•		eedom, Right ;	against Explo	pitation, Right	t to Freedom	[6]	
of Religion, Cultu								[0]	
State Policy, Fund			ignio, rugn						
Organs of Gover								[6]	
Parliament, Com		Jualification	is and Di	squalifications	Powers an	nd Functions	Executive	[0]	
President, Gove	•			•					
Qualifications, Po					omment an		or Judges,		
Local Administra									
District's Adminis						•			
Elected Represer		•		•	•		-	[6]	
Elected officials a	and their r	oles, CEO	ZilaPanch	ayat: Position	and role. Bl	lock level: O	rganizational		
Hierarchy (Differe	ent departm	ents), Villa	ge level: R	ole of Elected	and Appointe	ed officials, Ir	mportance of		
grass root democ	racy.								

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Election	n Commission Commission: Role and Functioning. Chief Election Commissioner and Election	[6]
Commis	ssioners - Institute and Bodies for the welfare of SC/ST/OBC and women.	
TextBoo	Total Hours:	30
1.	The Constitution of India,1950 (Bare Act),Government Publication.	
2.	Busi S N, Ambedkar B R, "Framing of Indian Constitution",1st Edition, 2015.	
Referer	nce(s):	
1.	Jain, M P, "Indian Constitution Law", 7th Edition, Lexis Nexis,2014	
2.	Basu, D D, "Introduction to the Constitution of India", Lexis Nexis, 2015.	
3.	Bhansali S R., "Textbook on The Constitution of India", Universal Publishers, 2015	
4.	Jain, M P., "Outlines of Indian Legal and Constitutional History", Lexis Nexis, 2014	

S.No.	Topics	No.of hours
1.0	History of Making of The Indian Constitution	
1.1	History	1
1.2	Drafting Committee, (Composition & Working)	2
2.0	Philosophy of The Indian Constitution	
2.1	Preamble, Salient Features	3
3.0	Contours of Constitutional Rights and Duties	
3.1	Fundamental Rights, Right to Equality, Right to Freedom	1
3.2	Right against Exploitation, Right to Freedom of Religion	1
3.3	Cultural and Educational Rights	1
3.4	Right to Constitutional Remedies	1
3.5	Directive Principles of State Policy, Fundamental Duties	2
4.0	Organs of Governance	
4.1	Parliament, Composition, Qualifications and Disqualifications	2
4.2	Powers and Functions, Executive	1
4.3	President, Governor, Council of Ministers	1
4.4	Judiciary, Appointment and Transfer of Judges	1
4.5	Qualifications, Powers and Functions	1
5.0	Local Administration	
5.1	District's Administration head: Role and Importance Municipalities	1
5.2	Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation	1
5.3	Panchayat raj: Introduction, PRI: ZilaPanchayat. Elected officials and their roles	1
5.4	CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments)	1
5.5	Village level: Role of Elected and Appointed officials, Importance of grass root democracy	2

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## **Course Designers**

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