

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					
	PO1	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

Year	Sem	Course Name	PO					
			1	2	3	4	5	6
I	I	Probability and Statistical Methods	3	3	2	1	2	1
		Safety Management	3	3	3	2	3	3
		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
	II	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
		Industrial Safety ,Environment and Simulation Laboratory	3	2	3	2	2	2
		Fire Engineering Laboratory	3	3	2	2	2	2
II	III	Project Work - Phase I	3	3	3	2	3	2
		Inplant Training	3	3	3	2	3	2
	IV	Project Work - Phase II	3	3	3	2	3	2

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

S. No.	Category	Credits Per Semester				Total Credits	Percentage %
		I	II	III	IV		
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	-	-	-	-	-	-
Total		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)

PROFESSIONAL CORE (PC)

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

PROGRAMME ELECTIVE (PE)

SEMESTER I, PROGRAMME ELECTIVE I

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-req
1.	60 PIS E11	Industrial Health and Hygiene	PE	3	3	0	0	3	N
2.	60 PIS E12	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	T	P	C	Pre -
1.	60 PIS E21	Safety in Chemical Industries	PE	3	3	0	0	3	N
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	Maintainability 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	T	P	C	Pre -
1.	60 PIS E31	Safety and Risk Analytics	PE	3	3	0	0	3	N
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	T	P	C	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	T	P	C	Pre-requisite
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	Reliability Engineering	PE	3	3	0	0	3	Probability 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	T	P	C	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	L	T	P	C	Pre-Requisite
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

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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	T	P	C
		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
PRACTICALS								
7.	60PIS1P1	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

SEMESTER II

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
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
PRACTICALS								
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	T	P	C
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	T	P	C
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)

FIRST SEMESTER

S. No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
THEORY								
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 – I	2	40	60	100	45	100
6	60 PAC 001	English for Research Paper Writing	2	100	-	100	-	-
PRACTICAL								
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 will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follows 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 101	Probability and Statistical Methods	Category	L	T	P	Credit
		PC	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

Course Outcomes

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
CO5	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's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	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

K.S.Rangasamy College of Technology–Autonomous R2022								
60 PIS 101-Probability and Statistics								
M.E-Industrial Safety Engineering								
Semester	Hours/Week			Totalhrs	Credit	MaximumMarks		
	L	T	P		C	CA	ES	Total
I	3	2	0	60	4	40	60	100
Probability and Random Variable Probability – Random variables – Moments – Moment generating function — Two-dimensional Random Variables– Correlation and Regression.								[9]
Reliability and Distributions Concepts of Reliability-Failure rate-Hazard rate- Mean time between failures (MTBF)-Mean time to failure (MTTF)-Standard distributions-Binomial, Poisson, Normal, Exponential, Uniform and Geometric distributions– Moment generating function, Mean and Variance.								[9]
Testing of Hypothesis Test based on Normal, t-distribution, chi-square and F-distributions. Non-Parametric Methods: The sign test for paired data, Mann-Whitney U test, Kruskal-Wallis test (H-test), Sampling distribution of statistic.								[9]
Design of Experiments Analysis of variance-One-way classification – Completely randomized design – Two-way classification – Randomized block design – Latin square Design – 2 ² Factorial designs.								[9]
Timeseries Components of Time series – Method of Least squares – Moving averages method (3 years and 5 years) – Exponential trend – Parabolic trend – Seasonal variations: Method of simple averages – Ratio to trend method– Ratio to moving average method – Link relative method								[9]
Total Hours [45 +15(Tutorial)]=60								
TextBook(s):								
1.	P.N.Arora, S.Arora., “Statistics for Management”, S.Chand and Company Limited,5th edition,2009							
2	Anderson, O.D, “Time Series Analysis: Theory and Practice,” North – Holland, Amsterdam, 1982.							
Reference(s):								
1.	Johnson,R.A., Miller, I and Freund, J., “Miller and Freund’s Probability and Statistics for Engineers”, Pearson Education,Asia,8 th Edition,2015.							
2.	Trivedi K.S, “Probability and Statistics with Reliability, Queuing and Computer Science Applications”, John Wiley & Sons, New Delhi, 2008							
3.	Probability and Statistics –Dr.Somesh Kumar, NPTEL online video courses.							

Course Contents and Lecture Schedule

S.No	Topic	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

4.7	2 ² 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- kavithak@ksrct.ac.in

60 PIS 102	SAFETY MANAGEMENT	Category	L	T	P	Credit
		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 safety culture	Understand

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-Medium; 1-Low

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
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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60 PIS 102 – Safety Management

Semester	Hours/Week			Total hrs	Credit	MaximumMarks		
	L	T	P			C	CA	ES
I	3	2	0	60	4	40	60	100
<p>Concepts and Techniques Evolution of modern safety concept- Safety Management functions- Safety as an integral part of business- Safety Organization- Safety Committee-budgeting for safety-safety policy- Statutory Provisions for safety management. Incident Recall Technique (IRT)- Job Safety analysis(JSA)/Job Hazard Analysis (JHA), safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.</p>								[10]
<p>Safety Audit – Introduction Audit Standards ILO- OSH – 2001, IS 14489 1998 code of practice on Occupational Safety and health audit- Components of safety audit, types of audit, audit methodology, non conformity reporting (NCR) - Electrical Safety Audit - checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list.</p>								[08]
<p>Accident, Investigation & Reporting Root cause analysis-RCA process-tools-cause effect diagram-corrective and preventive action-(CAPA).Basic Principle of Accident & Prevention concept of an accident, reportable and non reportable accidents, Near Miss Reporting and Analysis, At- Risk Behaviour Analysis - reporting to statutory authorities – principles of accident prevention – accident investigation and reporting – Response to Accidents -4P’s Evidences- Accident analysis-based on causes & injury-Problem solving tools for accident analysis -records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – Accident causation theories-domino sequence – supervisory role – role of safety committee –cost of accident - Accident Case Studies.</p>								[10]
<p>Safety Performance Monitoring ANSI (Z16.1) Recommended practice for compiling and measuring work injury experience -Proactive & Reactive Performance Monitoring – permanent total disabilities, permanent partial disabilities, temporary total disabilities – IS 3786:1984 Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate,Total injury illness incidence rate ,lost workday cases incidence rate(LWDI),Number of lost workdays rate – problems.</p>								[08]
<p>Safety Education and Training Importance of training-identification of training needs-training methods such as hands on training and table top exercise – Programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication – role of government agencies and private consulting agencies in safety training DGFASLI, NSC, ASSE, HSE, OSHA, NEBOSH – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Ethical Responsibilities -Domestic Safety and Training. Behaviour Based Safety(BBS) and safety culture: Pinpointing of unsafe behaviour-Positive reinforcement- observation and feedback. Evolution of Safety culture, Transformation requirement from reactive to proactive culture – Ethical responsibility for safety professional.</p>								[09]
Total Hours [45 +15(Tutorial)]								60
Textbook(s):								
1.	Ray Asfahl C “Industrial Safety and Health Management” ,Pearson Prentice Hall, 2003.							
2.	John V Grimaldi and Rollin H Simonds, “Safety Management”, All India Travellers Book Seller, New Delhi, 5 th Edition, 2001.							
Reference(s):								
1.	Heinrich H W ,“Industrial Accident Prevention”, McGraw-Hill Company, New York, 1980.							

Passed in BoS Meeting held on 20/07/22

Approved in Academic Council Meeting held on 23/07/2022



BoS Chairman

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

Course Contents and Lecture Schedule

S.No	Topic	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

Course Designers

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

Passed in BoS Meeting held on 20/07/22
Approved in Academic Council Meeting held on 23/07/2022


BoS Chairman

60 PIS 103	Industrial Safety, Health and Environment(SHE) Acts	Category	L	T	P	Credit
		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.	Apply
CO2	Execute legal provisions of Environment act and allied rules.	Analyze
CO3	Devise and execute Offsite and Onsite emergency preparedness.	Evaluate
CO4	Practise legal provisions pertaining to transport and handling of hazardous materials, boilers, explosive, motor, mines electricity and other acts.	Apply
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

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
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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K.S.Rangasamy College of Technology–Autonomous R2022								
60 PIS 103 - Industrial Safety, Health and Environment(SHE) Acts								
Semester	Hours/Week			Total hrs	Credit	MaximumMarks		
	L	T	P			C	CA	ES
I	3	2	0	60	4	40	60	100
Factories Act – 1948 Constitutional Background, chapters-sections-schedules –powers of Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures- Tamilnadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948- Forms, Registers and notices – Tamilnadu Safety Officer Rules 2005 - with updated Amendments.								[11]
Environment Act (protection) 1986 with allied rules Constitutional Background, General powers of the central government, prevention, control and abatement of environmental pollution- Biomedical Waste Management Rules, 2016-The Noise Pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001 – E-waste regulations- Classification of industries, consent order from pollution control board. Air Act 1981 and Water Act 1974: powers and functions of Pollution control boards -Central and state boards for the prevention and control of air pollution– prevention and control of air pollution and water pollution–penalties and procedures.								[12]
Manufacture, Storage and Import of Hazardous Chemical Rules 1989 and Major Accident Hazard Control Rules and Amendment Definitions – duties of authorities – responsibilities of occupier – notification of major accidents – information to be furnished – preparation of offsite and onsite plans – list of hazardous and toxic chemicals – safety reports – safety data sheets, Major Accident Hazard Control Rules. Hazardous Wastes (management, handling and Transboundary Movement) Rules 2016.								[10]
Other Acts and Rules Indian Boiler Act 2007, Static and Mobile Pressure Vessel Rules (SMPV), Motor Vehicle Rules, Mines Act 1952, Workman Compensation Act, Rules – Electricity Act and rules 2003 – Petroleum Rules 2002, Gas cylinder rules 2010-Explosives Act and rules 2008-Pesticides Act, Dock workers (Safety Health and welfare) Act 1986 and regulations 1990, Introduction to Labour codes 2020 , Industrial Relations Code, Code on Social Security and Occupational Safety ,Health and Working Conditions Code -Disaster Management Act 2005.-Ammoniumnitrate rules.								[15]
International Acts and Standards International Labour Organisation (ILO) Conventions and Recommendations, OSHA Regulations – Health and Safety At Work Act (HASAWA 1974, UK) – Elements and benefits of OSHAS 18001 – ISO 14001 – ISO 45001- European Safety and Health Legislations, American Petroleum Institute (API) Standards, Oil Industry Safety Directorate (OISD) Standards, National Fire Protection Association (NFPA) Standards, Atomic Energy Regulatory Board (AERB), American National Standards Institute(ANSI).								[12]
Total Hours [45 +15(Tutorial)]								60
Textbook(s):								
1.	Srinivasan S,“The Factories Act 1948 with Tamil Nadu Factories Rules 1950” Madras Book Agency, Chennai, 28 th Edition, 2017.							
2.	The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.							
Reference(s):								
1.	The Indian boilers act 1923, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.							
2.	The Mines Act 1952, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.							
3.	Bakshi P M , “The Constitution of India” , Lexis Nexis, 17 th Edition ,2020							
4.	Srinivasan S , “The Tamil Nadu Safety Officers Rules 2005” Madras Book Agency, Chennai, 28 th Edition, 2017.							

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Course Contents and Lecture Schedule

S.No	Topic	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	2
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	1
4.8	Code on Social Security	2
4.9	Occupational Safety Health and Working Conditions Code	1
4.10	Disaster Management Act 2005.-Ammoniumnitraterules.	2
5	International Acts and Standards	12
5.1	International Labour Organisation (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,	2
5.5	Oil Industry Safety Directorate (OISD) Standards	1
5.6	National Fire Protection Association (NFPA) Standards	1
5.7	Atomic Energy Regulatory Board (AERB), American National Standards Institute(ANSI).	2
	Total	60

1. **Course Designers**

Dr.V.Sundararaju - sundararaju@ksrct.ac.in

60 PED 001\ 60 PDB E26	Research Methodology and IPR	Category	L	T	P	Credit
		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, Apply
CO2	To gain the knowledge about sources and collection of research data	Remember, Understand, Analyze
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	CO	PO						PSO		
		1	2	3	4	5	6	1	2	3
Research Methodology and IPR	CO1	3	3	2	2	2	2	3	1	3
	CO2	3	3	2	2	2	2	3	1	3
	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's Category	Continuous Assessment Tests (Marks)		Model Exam (Marks)	End Semester Examination (Marks)
	1	2		
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

K.S.Rangasamy College of Technology – Autonomous R2022								
60 PED 001 \ 60 PDB E26- Research Methodology and IPR								
Common to all Branches								
Semester	Hours/Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	0	0	30	3	40	60	100
Research Design Overview of research process and design- Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys, Selection of the Right Medium and Journal for publication, Translation of Research								[09]
Data Collection and Sources Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.								[09]
Data Analysis and Reporting Overview of Multivariate Analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation. Checks for Plagiarism, Falsification, Fabrication, and Misrepresentation								[09]
Intellectual Property Rights Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.								[09]
Patents Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.								[09]
Total Hours								45
Text Book(s):								
1.	David I. Bainbridge, "Intellectual Property", Longman, 9th Edition, 2012.							

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2	Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education.
Reference(s):	
1.	Chawla H S., "Introduction to Intellectual Property Rights", CBS PUB & DIST PVT Limited, INDIA, 2019.
2.	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
4.	Arun K. Narasani, Kankanala K.C., Radhakrishnan V., "Indian Patent Law and Practice", Oxford University Press, 2010.
5.	Richard Stim, "Patent, Copyright & Trademark - An Intellectual Property Desk Reference", NOLO Publishers, 2020.
6.	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	No.of hours
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-filing, 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

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Passed in BoS Meeting held on 20/07/22

Approved in Academic Council Meeting held on 23/07/2022



BoS Chairman

60 PIS 1P1	Design and Fabrication of Safety Device	Category	L	T	P	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	To design and fabricate a working model of a safety device	Analyze
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	2	1	1	2	3	2
3- Strong;2-Medium;1-Some						

Passed in BoS Meeting held on 20/07/22
Approved in Academic Council Meeting held on 23/07/2022


BoS Chairman

K.S.Rangasamy College of Technology–Autonomous R2022**60 PIS 1P1 – Design and Fabrication of Safety Device**

Semester	Hours/Week			Total hrs	Credit	MaximumMarks			
	L	T	P		C	CA	ES	Total	
I	0	0	4	30	2	60	40	100	
<ul style="list-style-type: none">• The objective of this project is to provide opportunity for the students, to develop the skill of building a safety device and to control the hazard. The students have to take one small item for design and fabrication.• Every project work shall have a guide who is the member of the faculty of the institution and if possible with an industry guide also.• The item chosen may be a small safety device (Example– Machine guard, trip systems, an alarm signal and a control system etc.)• The students are required to design and fabricate the chosen item in the college and demonstrate its working apart from submitting the project report. The report should contain assembly drawing, parts drawings and process charts relating to fabrication.• The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.• This final report shall be typewritten form as specified in the guidelines. The continuous assessment shall be made as prescribed in the regulations.									30

Course Designers

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

60 PIS 1P2	Technical Seminar	Category	L	T	P	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
3- Strong;2-Medium;1-Some						

K.S.Rangasamy College of Technology–Autonomous R2022**60 PIS 1P2 – Technical Seminar**

Semester	Hours/Week			Total hrs	Credit	MaximumMarks		
	L	T	P		C	CA	ES	Total
I	0	0	4	45	1	100	0	100

- Every student should present a seminar in any topic relevant to the area of industrial safety engineering or societal issues pertaining to safety individually.
- Three reviews have to be conducted by the committee of minimum of three members one of which should be the technical Seminar Coordinator
- 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

Course Designers

1. Dr.V.Sundararaju - sundararaju@ksrct.ac.in
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 Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester	
				Continuous Assessment	End Semester	Max. Marks	End Semester Exam	Total
THEORY								
1	60 PIS 201	Fire Engineering and Explosion	2	40	60	100	45	100
2	60 PIS 202	Computer Aided Hazard	2	40	60	100	45	100
3	60 PIS 203	Environment Safety	2	40	60	100	45	100
4	60 PIS E2*	Professional Elective – II	2	40	60	100	45	100
5	60 PIS E3*	Professional Elective- III	2	40	60	100	45	100
6	60 PAC 002	Disaster Management	2	100	-	100	-	-
PRACTICAL								
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 will 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	T	P	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	Identify suitable fire protection system for industrial setup.	Remember, Understand, Analyze
CO4	Devise installation and maintenance fire safety systems as per statuses.	Remember, Understand, Analyze
CO5	Associate basic principles of fire and explosion protection systems	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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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

K.S.Rangasamy College of Technology–Autonomous R2022

60 PIS 201 Fire Engineering and Explosion

M.E-Industrial Safety Engineering

Semester	Hours/Week			Total hrs	Credit	MaximumMarks		
	L	T	P		C	CA	ES	Total
II	3	2	0	60	4	40	60	100

Physics and Chemistry of Fire
 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 – vapour clouds – flash fire – jet fires – pool fires – unconfined vapour cloud explosion, shock waves – auto ignition and spontaneous ignition – Boiling Liquid Expanding Vapour Explosion (BLEVE)– case studies – Flixborough, Mexico disaster, BP Texas, Piper Alpha, Peterborough & Bombay Victoria dock ship explosions - Buncefield fire – Jaipur oil fire 2009- Bombay high-vizag [10]

Fire Prevention and Protection
 Sources of ignition – fire triangle – fire tetrahedron - principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D – types of fire extinguishers – fire stoppers – hydrant pipes – hoses – monitors – designing of fire station– maintenance of fire trucks – foam generators – escape from fire rescue operations – fire drills – notice-first aid for burns [9]

Industrial Fire Protection Systems
 Sprinkler-hydrants-stand pipes – special fire suppression systems like deluge and emulsifier, selection criteria of the above installations, reliability, maintenance, evaluation and standards – alarm and detection systems. Other suppression systems – CO₂ system, foam system, dry chemical powder (DCP) system, halon system – need for halon replacement – smoke venting. Portable extinguishers – flammable liquids – server room and tank farms safety – indices of inflammability-firefighting systems – Relevant standards - Oil Industry Safety Directorate(OISD),American Petroleum Institute & other standards. [10]

National Building Code
 Introduction to National Building Codes (NBC)-Objectives of fire safe building design, fire load and calculation, fire resistant material and fire testing – fire water requirements-structural fire protection – structural integrity – concept of egress design – exits width calculations - fire certificates – fire safety requirements for high rise buildings – snookers- National Fire Protection Association (NFPA) Life Safety Code [8]

Explosion Protecting Systems
 Principles of explosion-Explosion Pentagon- detonation and blast waves-explosion parameters – Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure-explosion venting-inert gases, plant for generation of inert gas-rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO₂) and halons-.Explosion protection for flammable, toxic and compressed gases and liquid storages- Qualifying Standards and approving agencies. [8]

Total Hours [45 +15(Tutorial)]=60

TextBook(s):

1.	Jain V K, "Fire Safety in Buildings", New Age International (P) Limited Publishers,New Delhi, 2 nd Edition,2015.
2	Derek James, "Fire Prevention Hand Book", Butterworth-Heinemann,London,1986.

Reference(s):

1.	Gupta R S, "Hand Book of Fire Technology", Orient Longman, Bombay,2 nd Edition, 2010.
2.	DinkoTuhtar, "Fire and Explosion Protection" – A system approach, Ellis Horwood Ltd, 1999.

Course Contents and Lecture Schedule

S.No	Topic	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	2
1.2	– vapour clouds – flash fire – jet fires – pool fires – unconfined vapour cloud explosion, shock waves – auto ignition and spontaneous ignition –	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
2.6	Tutorial	3
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 ₂ 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 ₂) and halons-.Explosion protection for flammable, toxic and compressed gases and liquid storages- Qualifying Standards and approving agencies	2
5.5	Tutorial	3
	Total	60

CourseDesigners

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

60 PIS 202	Computer Aided Hazard Analysis	Category	L	T	P	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 issues.	Remember, Understand, Apply
CO2	Understand and apply hazard analysis techniques for scenario and non-scenario based.	Remember, Understand, Apply
CO3	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	Perform consequence analysis for hazardous chemicals.	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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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

K.S.Rangasamy College of Technology–Autonomous R2022

60 PIS 202- Computer Aided Hazard Analysis

M.E-Industrial Safety Engineering

Semester	Hours/Week			Total hrs	Credit	MaximumMarks		
	L	T	P			C	CA	ES
II	3	2	0	60	4	40	60	100

Introduction
Introduction, hazard, hazard monitoring, different stages of process life time – Hazard reduction approaches and inherent safety review Selection of hazard evaluation techniques - Factors influencing the selection of hazard evaluation techniques- decision making process- hazard review for management changes -combined hazard review- hazard evaluation - Risk issues. [9]

Hazard Evaluation Techniques
Non Scenario Based:- Checklist analysis, safety review, relative ranking, preliminary hazard analysis (PHA), fire explosion and toxicity index (FETI) Scenario Based:- Fault Tree Analysis & Event Tree Analysis, Logic symbols, methodology, minimal cut set ranking - various indices – what-if analysis/checklist analysis - hazard operability studies (HAZOP) -Hazard analysis (HAZAN) - Failure Mode and Effect Analysis (FMEA) . [9]

Risk-Based Determination of The Adequacy of Safeguard
Scenarios from scenario-based Hazard Evaluations- Severity of consequence- Frequency of Initiating Causes- Effectiveness of Safeguards- Risk Estimation using Risk Matrix or Direct Calculation, Layer of Protection Analysis (LOPA), Safety Integrity Level (SIL). Hazard evaluation software aids – Risk Phast V 6.6 (DNV), HazardReview LEADER, HAZOP manager, HAZOP+ (Reliability workbench), PHA manager, LOPA manager, PHAPro,FEME-Pro,ALPHA. [9]

Instrumentation
Applications of Advanced Equipments and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyzer (TGA), Accelerated Rate Calorimeter (ARC), Principles of operations, Controlling parameters, Applications, advantages. Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitiveness Test, Impact Sensitiveness Test(BAM) and Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test. [9]

Consequences Analysis
Logics of consequences analysis- Estimation- Hazard identification based on the properties of chemicals- Chemical inventory analysis- identification of hazardous processes- Estimation of source term, Gas or vapour release, liquid release, two phase release- Heat radiation effects, BLEVE, Pool fires and Jet fire- Gas/vapour dispersion- Explosion, UVCE and Flash fire, Explosion effects and confined explosion- Toxic effects- Plotting the damage distances on plot plant/layout [9]

Total Hours [45 +15(Tutorial)]=60

TextBook(s):

1. Sam Mannan., "Lees' Loss Prevention in Process Industries", Vol1,Vol2,Vol3,Butterworth-Heinemann,, London, 4th Edition 2012.
2. "Methodologies for Risk and Safety Assessment in Chemical Process Industries", Commonwealth Science Council, UK.2004.

Reference(s):

1. Course Material – "Intensive Training Programme on Consequence Analysis", Process Safety Centre, Indian Institute of Chemical Technology, Tarnaka & CLRI, Chennai.
2. "Guidelines for Hazard Evaluation Procedures", Centre for Chemical Process safety, AIChE 3rd Edition, 2008.
3. "Guidelines for Chemical Process Quantitative Risk Analysis", 2nd Edition, Centre for Chemical Process safety, AIChE, 2000

Course Contents and Lecture Schedule

S.No	Topic	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 the damage distances on plot plant/layout.	1
5.6	Tutorial	3
	Total	60

Course Designers

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

60 PIS 203	Environmental Safety	Category	L	T	P	Credit
		PC	3	2	0	4

Objective

- 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

CO1	Associate air pollutants, causes and effects and execute controls measures for air pollution at domestic and industrial level pertaining to air pollution statues	Remember, Understand, Apply
CO2	Associate water pollutants, causes and effects and execute controls measures for water pollution at domestic and industrial level pertaining to water pollution statues	Remember, Understand, Apply
CO3	Understand the characteristics of hazardous waste and execute controls measures for land pollution at domestic and industrial level pertaining to hazardous waste management statues.	Remember, Understand, Analyze
CO4	Experiment sampling techniques to measure the level of gaseous pollutants and particulate matters in industrial sector and environment.	Remember, Understand, Analyze
CO5	Investigate hazards and implement Pollution control measures at Major hazardous industries.	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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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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60 PIS 203- Environmental Safety

M.E-Industrial Safety Engineering

Semester	Hours/Week			Total hrs	Credit	MaximumMarks		
	L	T	P		C	CA	ES	Total
II	3	2	0	60	4	40	60	100
Air Pollution								
Classification and properties of air pollutants – Pollution sources – Effects of air pollutants on human beings, Animals, Plants and Materials - automobile pollution-hazards of air pollution-concept of clean coal combustion technology - ultra violet radiation, infrared radiation, radiation from sun-hazards due to depletion of ozone - deforestation-ozone holes-automobile exhausts- stack emissions - CFC- Statutory Provisions related to Air Pollution - Emission standards : Permissible Limits - National Ambient Air Quality Standards(NAAQS) - MNAS - EURO Norms - Legal Compliance to								[9]
Water Pollution								
Classification of water pollutants-health hazards-sampling and analysis of water-water treatment - different industrial effluents and their treatment and disposal -advanced wastewater treatment - effluent quality standards and laws-chemical industries, tannery, textile effluents-common treatment - Statutory Provisions related to Water Pollution- Effluent standards: Permissible Limits – Legal Compliance to statutory norms.								[9]
Hazardous Waste Management								
Hazardous waste management in India-waste identification, characterization and classification-technological options for collection, transport ,storage, treatment and disposal of hazardous waste- Disposal Facilities - Secured Landfills - selection charts for the treatment of different hazardous wastes-methods of collection and disposal of solid wastes-health hazards-toxic ,E-waste and radioactive wastes-incineration and vitrification - hazards due to bio-process-dilution-standards and restrictions – recycling and reuse- Statutory Provisions related to Hazardous waste management &								[9]
Environmental Measurement and Control								
Sampling and analysis – dust monitor – gas analyzer, particle size analyzer –pH meter – gas chromatograph – atomic absorption spectrometer- Inductive Coupled Spectrophotometer. 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 – National								[10]
Pollution Control in Major hazardous (MAH)Industries								
Environmental Impact Assessment (EIA) – Pollution control in process industries like cement, paper, petroleum-petroleum products-textile-tanneries-thermal power plants -dyeing and pigment industries - eco-friendly energy - National Environment Assessment and Monitoring Authority (NEAMA).								[8]
Total Hours [45 +15(Tutorial)]=60								
TextBook(s):								
1.	Sam Mannan., "Lees' Loss Prevention in Process Industries", Vol1,Vol2,Vol3,Butterworth-Heinemann,, London, 4 th Edition 2012.							
2	"Methodologies for Risk and Safety Assessment in Chemical Process Industries", Commonwealth Science Council, UK.2004.							
Reference(s):								
1.	Course Material – "Intensive Training Programme on Consequence Analysis", Process Safety Centre, Indian Institute of Chemical Technology, Tarnaka& CLRI, Chennai.							
2.	"Guidelines for Hazard Evaluation Procedures", Centre for Chemical Process safety, AIChE 3 rd Edition, 2008.							
3.	"Guidelines for Chemical Process Quantitative Risk Analysis", 2 nd Edition, Centre for Chemical Process safety, AIChE, 2000							

Course Contents and Lecture Schedule

S.No	Topic	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	automobile pollution-hazards of air pollution-concept of clean coal combustion technology - ultra violet radiation, infrared radiation, radiation from sun-hazards due to depletion of ozone -	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	– Legal Compliance to statutory norms	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

Passed in BoS Meeting held on 20/07/22

Approved in Academic Council Meeting held on 23/07/2022



BoS Chairman

	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

Course Designers

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60 PIS 2P1	Industrial Safety ,Environment and Simulation Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objective

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

CO1	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						

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS 2P1 - Industrial Safety ,Environment and Simulation Laboratory								
PIS: M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	0	0	4	60	2	60	40	100
<p>NOISE LEVEL MEASUREMENT AND ANALYSIS: Measurement of sound pressure level in dB for Impact, continuous and intermittent sources at various networks, peak and average values.</p> <p>BURST STRENGTH TEST of packaging materials like paper bags, corrugated cartoons, wood etc.</p> <p>EXHAUST GAS MEASUREMENT AND ANALYSIS OF WATER: Measurement of SO_x, NO_x, CO_x, hydrocarbons. Waste water analysis, Sampling and Analysis of water (pH, COD, DO, Sulphate and heavy metals).</p> <p>ENVIRONMENTAL PARAMETER MEASUREMENT: Dry Bulb Temperature, Wet Bulb Temperature, Determination of relative humidity, wind Flow, Particle size Measurement & Air sampling analysis.</p> <p>TRAINING IN USAGE AND SKILL DEVELOPMENT OF PERSONAL PROTECTIVE EQUIPMENT: Respiratory and nonrespiratory demonstration-self contained breathing apparatus. Safety helmet, belt, hand gloves, goggles, safety shoe, gum boots, ankle shoes, face shield, nose mask, ear plug, ear muff, antistatic and conducting plastics/rubber materials, apron and leg guard.</p> <p>STATIC CHARGE TESTING on plastic, rubber, ferrous and non-ferrous materials. Illumination testing - by lux meter.</p> <p>ELECTRICAL SAFETY - Insulation resistance for motors and cables, Estimation of earth resistance, Earth continuity test, Sensitivity test for ELCB. LOTO system</p> <p>MACHINE GUARDING AND INTERLOCKING SYSTEMS SOFTWARE USAGE – ALOHA, Accident Analysis ,Safety Audit Packages, Consequence Analysis (CISCON), Fire, Explosion and Toxicity Index (FETI), Reliability Analysis for Mechanical system and Electrical System, Failure Mode Analysis. STUDY OF FIRST-AID, Road safety signals and symbols.</p>								
Total Hours								60
Reference(s):								
1.	Industrial Safety Laboratory Manual.							

Course Designers

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

60 PIS 2P2	Fire Engineering Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objective

- 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.
-

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- Strong;2-Medium;1-Some						

K.S.Rangasamy College of Technology–Autonomous						R2022			
60 PIS 2P2 – Fire Engineering Laboratory									
PIS: M.E. Industrial Safety Engineering									
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks			
	L	T	P			C	CA	ES	Total
II	0	0	4	60	2	60	40	100	
Study of Fire Extinguishing - Water CO ₂ , Foam, Carbon dioxide (CO ₂), Dry chemical powder. Principles of Fire Extinguishing Cut section Model Fire Extinguishers and its operations for Water CO ₂ type Fire Extinguishers and its operations for CO ₂ type Fire Extinguishers and its operations for Foam type Fire Extinguishers and its operations for Dry Chemical Powder type Fire hose reel and fire hydrant systems Fire mock Drill Fire Tender Operation. (Fire Station and Airport Authority) Fire fighters Personal Protective Equipment									
								Total Hours	60
Reference(s):									
1.	Fire Engineering Laboratory Manual.								

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)
THIRD SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester 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
PRACTICAL								
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 will 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.**

K.S.Rangasamy College of Technology – Autonomous R2022

60 PIS 3P1 PROJECT WORK PHASE I

M.E. INDUSTRIAL SAFETY ENGINEERING

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	0	0	20	60	10	100	0	100
Objective(s)	<ul style="list-style-type: none"> • To impart the practical knowledge to the students pertaining to industrial safety. • To emphasize the current safety practices and risk assessment procedures adopted by industries. • To provide an exposure to the students to refer, read and review the research articles, journals and conference proceedings. • To relate the project work with the collected research article. • To enhance their problem solving and critical thinking skills. 							
Course Outcomes	<p>At the end of the course, the students will be able to</p> <ol style="list-style-type: none"> 1. Select problems prevailing in industries/ societal by EHS audit and confirm the title. 2. Understands the Literature review process and technical writing. 3. Explain and prepare a project report for the stated problem. 4. Present and justify the work done for the identified problem. 5. Write and publish a journal review paper. 							
<ul style="list-style-type: none"> • The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. • Three reviews have to be conducted by the committee of minimum of three members one of which should be the guide • Each review has to be evaluated for 100 marks. • The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student. • Attendance is compulsory for all reviews. If a student fails to attend review for some valid reason, one or two chance may be given. • Problem should be selected through EHS audit in the concerned industries. • Students have to collect journal papers related to their work minimum of 25 journals. • Report has to be prepared by the students as per the then format by the institution. Preliminary implementation can be done if possible. 								

K.S.Rangasamy College of Technology – Autonomous R2022

60 PIS 3P2 Industrial Safety Assessment – Internship

M.E. INDUSTRIAL SAFETY ENGINEERING

Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	0	0	4	4	2	100	0	100
Objective(s)	<ul style="list-style-type: none"> • Make exposure for the students to actual working environment and enhance their knowledge • Provide students the opportunity to test their interest in a particular career before permanent commitments are made • To develop skills in the application of theory to practical work situations • Enhance the ability to improve student's creativity skills and sharing ideas • To cultivate student's leadership ability and responsibility to perform or execute the given task 							
Course Outcomes	<p>At the end of the course, the students will be able to</p> <ol style="list-style-type: none"> 1. Understand the psychology of the workers, their habits, attitudes and approach to problems along with the practices followed either at factory or at site 2. Familiarized with various Design, Manufacturing, Analysis, Automation and their applications along with relevant aspects of industry management 3. Understand the scope, functions and job responsibilities in various departments of an organization 4. Interpreting the theoretical knowledge with real time site conditions while executing projects 5. Develop detailed report of the complete project during the training. 							
<ul style="list-style-type: none"> • Students undergo internship or industrial training during second semester summer vacation (Minimum of one Month) • Reports containing the observation of the students after the training with their personal comments/suggestion are to be prepared and submitted in the beginning of third semester • A technical presentation to be done by the students immediately after submission of the report at the beginning of third semester 								

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 Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
PRACTICAL								
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 will 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.

K.S.Rangasamy College of Technology – Autonomous						R 2022		
60 PIS 4P1 - Project Work Phase – II								
M.E. INDUSTRIAL SAFETY ENGINEERING								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
IV	0	0	32	60	16	60	40	100
Objective(s)	<ul style="list-style-type: none"> ● To offer a platform to the learner to check on the compliance pertaining to industrial safety. ● To implement their innovative ideas to forefront the risk issues. ● To retrieve the hazards by adopting suitable assessment methodologies. ● To relate problems in global context and suggest recommendations. ● To enhance their decision making and critical thinking ability. 							
Course Outcomes	<p>At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> 1. Select problems prevailing in industries or societal by EHS audit and confirm the title. 2. Understands the Literature review process and technical writing. 3. Able to explain and prepare a project report for the stated problem. 4. Able to present and justify the consolidated work done for the identified problem in the forum. 5. Acquire competence in suggesting methodology to minimize and eliminate the Problem or redesign workstation / equipment to overcome hazardous situations. 							
Methodology	<ul style="list-style-type: none"> ● Three reviews have to be conducted by the committee of minimum of three members one of which should be the guide ● Each review has to be evaluated for 100 marks. ● Attendance is compulsory for all reviews. If a student fails to attend review for some valid reason, one or two chance may be given. ● The project carried out must address industrial safety issues/societal issues which mainly pose threat to life, property and environment ● They should publish the paper preferably in the journals/conferences. ● Final review will be done by the committee that consists of minimum of three members one of which should be the guide (if possible include one external expert examiner). ● Report has to be prepared by the students as per the then format by the institution ● The report should be submitted by the students at the end of the fourth semester. 							

60 PIS E11	Industrial Health and Hygiene	Category	L	T	P	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	PO1	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- Strong;2-Medium;1-Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
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)			

K.S.Rangasamy College of Technology–Autonomous R2022

60 PIS E11- Industrial Health and Hygiene

Semester	Hours/Week			Total hrs	Credit	MaximumMarks		
	L	T	P			C	CA	ES
I	3	0	0	45	3	40	60	100

Anatomy,Physiology ,Hazard and Pathology

Definition- Anatomy and Physiology of human organs – The lungs, Skin, Ear , Eyes and skin – Functions of organs – Impairment of organs – Effects of various hazards on organs - Cardio pulmonary resuscitation - audiometric tests, eye tests, vital functional tests. Exposure routes of toxic materials and protective mechanisms, Recognition of health hazards, Methods for measuring and evaluating health hazards.

Physical Hazards

Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage- Noise Induced Hearing Loss (NIHL), risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, Noise and Vibration Mapping, noise control programmes, industrial audiometry, hearing conservation programmes- vibration - Standards, whole body vibration, Hand - Arm vibration types, effects, instruments, surveying procedure, permissible exposure limit.

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

[10]

Chemical Hazards

Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure Vs. dose - Indian standards (IS), TLV, IDLH, LD₅₀, LC₅₀, STEL, PEL, REL Methods of Evaluation, process or operation description, field survey, sampling methodology, Industrial hygiene calculations, Comparison with OSHAS Standard. Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures, Gas and Vapour monitors, dust sample collection devices, personal sampling. Methods of Control - Engineering Control, Design maintenance considerations, design specifications - General Control Methods - Industrial Hygiene Audit - training and education.

[09]

Biological and Ergonomical Hazards

Classification of Bio hazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases - Epidemic -Pandemic -Covid-19 and WHO guidelines for Covid-19-Biohazard control Programmes, employee health Programmes-laboratory safety programmes- animal care and handling-biological safety cabinets - building design. Work Related Musculoskeletal Disorders –carpal tunnel syndrome (CTS) - Repetitive Strain Injury (RSI) - Tendon pain-disorders of the neck-back injuries – Posture Assessment - Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA). Illumination and Ventilation –hazards – control and measurements.

[09]

Occupational Health, Physiology and Toxicology

Concept and spectrum of health - functional units and activities of occupational health services, pre-employment and Periodical medical examinations – occupational related diseases, levels of prevention of diseases, 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 – 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 - Fitness test .Industrial toxicology, local, systemic, acute and chronic effects, temporary and cumulative effects, carcinogens entry into human systems.

[10]

Man as a system component – allocation of functions – efficiency – occupational work capacity – aerobic and anaerobic work – evaluation of physiological requirements of jobs – parameters of measurements – categorization of job heaviness – work organization – stress – strain – fatigue – rest pauses – shift work – personal hygiene.

[07]

Total Hours **45**

Textbook(s):

1. Danuta Koradecka, "Hand book of Occupational Safety and Health", CRC Press, 2010.



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

Course Contents and Lecture Schedule

S.No	Topic	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 ₅₀ , LC ₅₀ , 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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BoS Chairman

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	– parameters of measurements – categorization of job heaviness – work organization – stress – strain – fatigue – rest pauses – shift work – personal hygiene	2
	Total	45

Course Designers

1. Dr.V.Sundararaju - sundararaju@ksrct.ac.in
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Passed in BoS Meeting held on 20/07/22
Approved in Academic Council Meeting held on 23/07/2022


BoS Chairman

60 PIS E12	Industrial Noise and Vibration control	Category	L	T	P	Credit
		ES	3	3	3	3

Objective

- 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 mapping.	Apply
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 remedial measures	Analyze

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- Strong;2-Medium;1-Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
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)			

K.S.Rangasamy College of Technology–Autonomous R2022

60 PIS E12 - Industrial Noise and Vibration control

Semester	Hours/Week			Total hrs	Credit	MaximumMarks		
	L	T	P			C	CA	ES
I	3	0	0	45	3	40	60	100
Noise Pollution Sound and its propagation - Noise – Industrial Noise – Workers exposure level – Noise Level measurement - Decibel – Sound level meter – Permissible exposure levels under the Factories Act 1948 and Tamil Nadu Factories Rules 1950 – Occupational Deafness as Notifiable Disease – Use of sound level meter and other means to determine noise exposure.								[09]
Noise mapping Identification of the existence of noise problems – Severity of noise problems and their impacts over health – Noise source diagnosis – summary of Diagnostic approaches – Noise Mapping- Case study of noise problem in Engineering Industry – Noise survey procedure.								[09]
Noise control Measures Techniques involving minimal noise modification – Techniques requiring equipment to be added to the existing machinery – Techniques requiring equipment redesign – Use of personal protective equipments – 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.								[12]
Vibration Vibration - Industrial Vibration - Whole body Vibration – Standards -Vibration isolating materials – Vibration monitoring.								[05]
Vibration Risks And Their Control Potential Hazards of Industrial Tools and operations that produce vibration – Daily Vibration Dose – measurement Technique – Hand – Arm Vibration (HAV) – Injuries from HAV – Back pain Risks from mobile machine operations – Ergonomics of Vibrating Tools – Right Tool for the Job in the right way (Ergonomics) – Tool design and maintenance – Keeping hands warm – Multiple shift breaks – Job rotation and maintenance.								[10]
Total Hours								45
Textbook(s):								
1.	Paul N Cheremisinoff, Peter P Cheremisinoff, Ernest E Allen, “ Industrial Noise Control Handbook”, Ann Arbor Science Publishers, 1977							
2.	Lasithan L G, “Mechanical Vibrations and Industrial Noise Control”, Prentice Hall India Learning Private Limited, 2015.							
Reference(s):								
1.	“Handbook of Industrial Noise Control” NASA, Washigton D.C.							
2.	Arnold P G Peterson, “Handbook of Noise Measurement”, 9 th Edition, 1980.							
3.	Cyril M Harris Allan G Piersol, “Harris’ Shock and Vibration Handbook”, McGraw Hill Publications, New York, 5 th Edition, 2002.							
4.	Munjai M L, “ Noise and Vibration Control”, World Scientifc, 2013.							

Passed in BoS Meeting held on 20/07/22

Approved in Academic Council Meeting held on 23/07/2022



BoS Chairman

Course Contents and Lecture Schedule

S.No	Topic	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	– Tool design and maintenance – Keeping hands warm	1
5.7	Multiple shift breaks – Job rotation and maintenance.	2
	Total	45

Course Designers

1. Dr.V.Sundararaju - sundararaju@ksrct.ac.in

Passed in BoS Meeting held on 20/07/22
Approved in Academic Council Meeting held on 23/07/2022


BoS Chairman

60 PIS E13	Plant Layout and Material Handling
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Category	L	T	P	Credit
ES	3	0	0	3

Objective

- 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 working conditions.	Understand
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-Medium;1-Some						

Assessment Pattern

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

K.S.Rangasamy College of Technology–Autonomous R2022								
60 PIS E13 – Plant Layout and Material Handling								
Semester	Hours/Week			Total hrs	Credit	MaximumMarks		
	L	T	P			C	CA	ES
I	3	0	0	45	3	40	60	100
Plant Location Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions Safe location of chemical storages in the form of bullets, spheres, cylinders for LPG, LNG, CNG, acetylene, ammonia, chlorine – explosives and propellants.								[9]
Plant Layout Safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, approach roads, plant railway lines, security towers. Safe layout for process industries, engineering industry, construction sites, pharmaceuticals, pesticides, fertilizers, refineries, food processing, nuclear power stations, thermal power stations, metal powders manufacturing, fireworks and match works.								[9]
Working Conditions Principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation, hood and duct design, air conditioning, ventilation standards, application. Purpose of lighting, types, advantages of good illumination, glare and its effect, lighting requirements for various work, standards- Housekeeping, principles of 5S and 7S.								[9]
Manual Material Handling and Lifting Tackles Preventing common injuries, lifting by hand, team lifting and carrying, handling specific shape machines and other heavy objects – accessories for manual handling, hand tools, jacks, hand trucks, dollies and wheel barrows – storage of specific materials - problems with hazardous materials, liquids, solids – storage and handling of cryogenic liquids - shipping and receiving, stock picking, dock boards, machine and tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car loading – personal protection – ergonomic considerations. Fiber rope, types, strength and working load inspection, rope in use, rope in storage - wire rope, construction, design factors, deterioration causes, sheaves and drums, lubrication, overloading, rope fitting, inspection and replacement – slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection.								[9]
Mechanical Material Handling Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, maintenance safety rules, inspection and inspection checklist – conveyors, precautions, types, applications. Powered industrial trucks, requirements, operating principles, operators selection and training and performance test, inspection and maintenance, electric trucks, gasoline operated trucks, LPG trucks – power elevators, types of drives, hoist way and machine room emergency procedure, requirements for the handicapped, types- Escalator, safety devices and brakes, moving walks – man lifts, construction, brakes, inspection.								[9]
Total Hours							45	
Textbook(s):								
1.	Encyclopaedia of Occupational Safety and Health”							
2.	“Accident Prevention Manual for Industrial Operations” N.S.C.							
Reference(s):								
1.	Alexandrov. M.P. “Material Handling Equipment” Mir Publishers							
2.	Apple M. James “Plant Layout and Material Handling”							
3.	Spivakosky , “Conveyors and Related Equipment”, Vol.I & II Peace Pub., Moscow, 1982.							

Course Contents and Lecture Schedule

S.No	Topic	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

Passed in BoS Meeting held on 20/07/22

Approved in Academic Council Meeting held on 23/07/2022



BoS Chairman

	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

Course Designers

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

60 PIS E14	Personal Protective Equipment	Category	L	T	P	Credit
		ES	3	0	0	3

Objective

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 respiratory protective equipment	Analyze
CO2	Acquires competence in selection and storage of PPE. Suggest measure on PPE matrix and work zone monitoring	Apply
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-Medium;1-Some						

Assessment Pattern

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

K.S.Rangasamy College of Technology–Autonomous R2022								
60 PIS E14 –Personal Protective Equipment								
Semester	Hours/Week			Total hrs	Credit	MaximumMarks		
	L	T	P			C	CA	ES
I	3	0	0	45	3	40	60	100
Introduction Concepts of personal protective equipment -Need for Personal Protective Equipments-general Principles- sources of help-requirements-procurement procedures - user involvement.								□
Non Respiratory Personal Protective Equipments Head protection-helmet, hoods, bump caps, soft caps, Hair net and caps-Eye and Face protection-spectacles, goggles ,types of goggles and face shields-Hearing Protection – ear muff, ear plugs and combination- Body Protection: coats, aprons, full suits, proximity suits, high visibility clothing, personal flotation devices, puncture resistant and cut resistant clothing- Fall Protection: safety belt, safety harness, lanyard, grabbing device, lifeline, fall arrestor, climbing safety system and safety net-emergency showers- eye wash fountains- eye and face wash fountain- Hand, finger and arm protection: gloves and its types, pads, finger guard, sleeves, creams and lotions-Foot and Leg protection: safety shoes- instep guard, steel insole, rubber boots, non sparking shoes, non conductive shoes and slip resistant shoes – maintenance procedures - limitations - relevant Indian standards - Personal Training.								□
Respiratory Personal Protective Equipments Respiratory Protection, selection of the respiratory protective equipment, quality of breathing air, respiratory fit testing, SCBA, Hose mask, Air-line respirator, air-supplied suits and hoods, air-purifying respirators, canister mask, filter respirator and others- maintenance procedures- limitations Pre Employment – Fitness test - health surveillance relevant Indian standards – Personal Training.								□
Procurement, Storage, Inspection, Quality Testing And Ergonomic Considerations Types – selection of PPE: selection, suitability, approved lables, usage, training, monitoring, retraining, instruction aids, safety reminders, specialized training- storage of PPE -Inspection: PPE Matrix- PPE Audit –Quality – work zone monitoring Psychology-human factors- ergonomic application -PPE design considerations.								□
IS Standards Safety Helmet IS 2925:1984; Eye Protectors – IS 5983:1980;Ear protectors – IS 9167:1979;Safety goggles- IS 7524 (Part I & II):1979 ,IS 5983:1980; Welding Helmets – IS 1179-1967; Safety Shoes – IS 5852-1996/IS 11226:1993 ;Gumboots-IS 12254:1993 /IS 13695:1993 Hand Protectors – IS 4770:1991; Safety clothing – IS 2573 – 1986; Canister type respirator – IS 8523:1977 Cartridge type respirator IS 8522:1977; Dust Respirator IS 9473:1980 and Introduction to EU Directive 89/686/EEC								□
Total Hours								45
Textbook(s):								
1.	"Industrial Safety "National Institute of Industrial Research, New delhi, 2003							
2.	John V. Grimaldi and Rollin H. Simonds, "Safety Management", All India Travelers Book seller, New Delhi, 2001.							
Reference(s):								
1.	"Industrial safety I & II ",National safety council, Mumbai							
2.	BIS Standards							

Course Contents and Lecture Schedule

S.No	Topic	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

Passed in BoS Meeting held on 20/07/22

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BoS Chairman

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

Course Designers

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

60 PIS E15	Explosion Technology and Safety
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Category	L	T	P	Credit
ES	3	0	0	3

Objective

- 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- Strong;2-Medium;1-Some						

Assessment Pattern

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

K.S.Rangasamy College of Technology–Autonomous R2022								
60 PIS E15 – Explosion Technology and Safety								
Semester	Hours/Week			Total hrs	Credit	MaximumMarks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	40	60	100
Introduction Loud Bang and Disruption- Blast Wave in an Explosion; Prediction from Dimensional Considerations- Typical Examples of Explosions and Classification -Theory of Blast Waves - Shock Hugoniot and Rayleigh Line -Properties behind Constant Velocity Shock - Blast waves; Concentration of Mass at Front, Snow Plow Approximation								[9]
Characteristics of Blast Waves Decay of a Blast Wave, Sach's Scaling - Overpressure and Impulse in the near and Far Field - Missiles, Fragments and Shrapnel, Craters - Interaction of Blast with Objects and Structures - Reflection and Transmission of Blast Waves, Impedance - Amplification of Reflected Blast waves, Spall, Damage to Organs, Mushroom Cloud - Damage from Blast waves, Iso-damage Curve								[9]
Energy Release in an Explosion Energy Release in a Chemical Reaction, Standard Heats of Formation - Stoichiometry, Equivalence Ratio and Heat Release in Fuel-rich and Oxidizer-rich Compounds - Energy release calculations, Higher and Lower Calorific Values, Internal Energy of Formation								[9]
Rate of Energy Release Concentration, Activation Energy, Energy Release Profile - Thermal Theory of Explosions - Application of Thermal Theory and Inferences Modeling of Rate of Energy Release- Role of Chain carriers in an explosion - Fire and Combustion -Combustion and Explosions - Case Histories of explosions involving Volatile Liquids								[9]
Detonations Introduction to Detonations- Structure of Detonation -Realizable States in a Detonation-One Dimensional Model of a Detonation-Case Histories of explosions Involving Detonation or Quasi-Detonation- Different Types of Explosions -Explosions in Confined and Unconfined Geometries - Dust Explosion - Physical Explosions-Rupture of Cryogenic Storage Vessels and Pressure Vessels - Condensed Phase Explosions - 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								[9]
Total Hours								45
Textbook(s):								
1.	Baker, W.E., Explosions in Air, University of Texas Press, Austin, 1973							
2.	Ramamurthi, K. Explosions and Explosion Safety, McGraw Hill, New Delhi, 2011							
Reference(s):								
1.	Crowl, D. A. and Louvar, J.F., Chemical Process safety, Prentice Hall, NJ, 2002							
2.	Stull, D.R., Fundamentals of Fire and Explosion, AIChE Monograph Series, Vol. 73, No. 10, 1977							
3.	Kinney G. F. and Graham K. J., Explosive Shocks in Air, Springer, Berlin, 1985							
4.	Cooper P. W. and Kurowski S.R., Introduction to the Technology of Explosives, Wiley-VCH, New York, 1966							

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	Introduction	
1.1	Loud Bang and Disruption	1
1.2	Typical Examples of Explosions and Classification	1
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	1
2.4	Missiles, Fragments and Shrapnel, Craters - Interaction of Blast with Objects and Structures	2
2.5	Reflection and Transmission of Blast Waves, Impedance	1
2.6	Amplification of Reflected Blast waves	1
2.7	Spall, Damage to Organs, Mushroom Cloud, Damage from Blast waves, Iso-damage Curve	1
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	1
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	2

Passed in BoS Meeting held on 18/05/23

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



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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	1
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

Course Designers

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60 PIS E16	Fire Risk Calculations	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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, Apply
CO2	• To apply concept of factor affecting fire damages	Remember, Understand, Apply
CO3	• To apply concept of Fire Protection Engineering	Remember, Understand, Analyze
CO4	• To apply concept of Fire Protection and Insurance	Remember, Understand, Analyze
CO5	• To apply concept of simulation software in calculations	Remember, Understand, 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- Strong;2-Medium;1-Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	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

Passed in BoS Meeting held on 18/05/23

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


BoS Chairman

K.S.Rangasamy College of Technology–Autonomous							R2022	
60 PIS E16 – Fire Risk Calculations								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
I	3	0	0	45	3	40	60	100
APPLICATION OF FIRE RISK ANALYSIS Basic field of application, Methods of application Probability Concept: Basic concept of Probability Theory, Independence and conditionality, Random Variables and Probability Distributions, Key parameters of probability Distributions, Commonly used Probability Distributions.								[09]
STATISTICS & EXTREME VALUE THEORY Introduction, Basic concept of statistical analysis, Key parameters of descriptive statistics, Correlation, Regression and Analysis of Variance, Hypothesis Testing in Classical Statistical Inference, Sampling Theory. Extreme Order Distribution, Behaviour of Large Losses Average Loss, Economic Value of Fire Protection Measures, Factor Affecting fire damages, Analysis of test results, Fire Severity and fire resistance.								[09]
RELIABILITY Component Life, Failure Rate, Estimating the parameters of a Distribution, System Reliability, Bayesian Methods. Probability Models in Fire Protection Engineering: Decision Trees, Fault Trees, Markov Chains, Queuing Models of Fire Company Availability, Stress-Strength model in Fire Safety, Engineering Economics.								[09]
UTILITY THEORY Utility, Utility Functions, Fire Protection and Insurance, Decision Analysis, Construction of Utility Function Value of Human Life: Methods of Valuing Human Life, Applications, Cost-Benefit Analysis, General Decisions								[09]
COMPUTER SIMULATION FOR FIRE PROTECTION Engineering Computer Simulation Methodology, Tools of Simulation, Variance Reduction Techniques, Statistical Termination Tests, Flexibility versus Computation, Simulation Languages.								[09]
Total Hours								45
Text book(s):								
1	Dougal Drysdale , “An introduction to fire dynamics” ,Willey Publications, Thrid Edition,2011							
2	Bjorn karlsson, Jammes G Quintiere, “Enclosure Fire Dynamics” CRC press, second edition,2022							
Reference(s):								
1	“Fundamentals of Firefighter skills”, IAFC, J&B learning, 2013							
2	“Fire Service Pump Operator” IAFC, J&B learning, 2013							
3	Paul Spurgeon, “Fire Service Hydraulics & Pump Operation”, Fire Engineering Series, Penwell Publications							

Course Contents and Lecture Schedule

S.No	Topic	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

1. Dr.V.Sundararaju - sundararaju@ksrct.ac.in

60 PIS E21	Safety in Chemical Industries	Category	L	T	P	Credit
		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 and inherent safe design	Remember, Understand, Apply
CO2	Conduct pre and post plant commissioning with HMIS labelling, and document inspection report.	Remember, Understand, Apply
CO3	Devise operating procedures and emergency procedures start up and shut down operation	Remember, Understand, Analyze
CO4	Approve Work permit for maintenance with recommended safety measures.	Remember, Understand, Analyze
CO5	Devise emergency preparedness and plan to mitigate emergency situations	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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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

K.S.Rangasamy College of Technology–Autonomous							R2022		
60 PIS E21 -Safety in Chemical Industries									
M.E. Industrial Safety Engineering									
Semester	Hours/Weeks			Total Hrs	Credit	Maximum Marks			
	L	T	P			C	CA	ES	Total
II	3	0	0	45	3	40	60	100	
Safety in Process Design and Pressure System Design Chemical Plant Location and Layout – Inter Distance between facilities - Design process, conceptual design and detail design, assessment, inherently safer design- chemical reactor, types, batch reactors, reaction hazard evaluation, assessment, reactor safety, operating conditions, unit operations and equipments, utilities. Pressure system, pressure vessel design, standards and codes, ASME section 8 division I, II, III- pipe works and valves- IS 2379:1990 Colour coding of pipelines- heat exchangers- process machinery- over pressure protection, pressure relief devices and design, fire relief, vacuum and thermal relief, special situations, disposal- flare and vent systems- failures in pressure system - Static Electricity, Earthing and bonding.									[10]
Plant Commissioning and Inspection Commissioning phases and organization, process safety information, P&I, preliminary hazard analysis-pre-commissioning documents, process commissioning, commissioning problems, post commissioning documentation. Plant inspection, pressure vessel, pressure piping system, non-destructive testing, pressure testing, leak testing and monitoring- plant monitoring, performance monitoring, condition, vibration, corrosion, acoustic emission-pipe line inspection - Hazardous Materials Identification Systems (HMIS) Labelling.									[09]
Plant Operations Operating discipline, operating procedure and inspection, format, emergency procedures- hand over and permit system- start up and shut down operation- Distributed Control Systems (DCS) and Programmable Logic control (PLC) Systems- refinery units- operation of fired heaters, driers, storage- operating activities and hazards- Safety Instrumented System (SIS) – Safety Critical Equipments, trip systems- Safety Integrity Level (SIL), SOP - exposure of personnel – Safety in batch processes – Reactive Hazards.									[09]
Plant Maintenance, Modification and Emergency Planning Management of maintenance, hazards- Corrosion Effects- preparation for maintenance, isolation, purging, cleaning, confined spaces, permit system- maintenance equipment- hot works- tank cleaning, repair and demolition- online repairs- maintenance of protective devices- modification of plant, problems- controls of modifications. Emergency preparedness, onsite emergency- offsite emergency, disaster planning -APELL									[08]
Storage of hazardous chemicals General consideration, petroleum product storages, storage tanks and vessel- storages layout- segregation, separating distance, secondary containment- venting and relief, excess flow valve, RoV valve, emergency shutdown valve, atmospheric vent, pressure, vacuum valves, flame arrestors, fire relief- fire prevention and protection- LPG storages, pressure storages - Mounded Bullet - layout, instrumentation, vapourizer, refrigerated storages- LNG storages, hydrogen storages, toxic storages, chlorine storages, ammonia storages, other chemical storages- underground storages- Plant and Cross Country Pipelines – Trucks - loading and unloading facilities- drum and cylinder storage- ware house, storage hazard assessment of LPG and LNG.									[09]
Total Hours								45	
Text Book(s):									
1.	Sam Mannan., "Lees 'Loss Prevention in Process Industries", Vol1, Vol2, Vol3, Butterworth-Heinemann., London, 4 th Edition, 2012.								
2.	Fulekar M H, "Industrial Hygiene and Chemical Safety", I.K. International Publishing House, 2016.								
Reference(s) :									
1.	"Quantitative Risk Assessment in Chemical Process Industries" American Institute of Chemical Industries, Centre for Chemical Process safety, 2 nd Edition, 1999.								
2.	Fawcett H H and Wood W S, "Safety and Accident prevention in Chemical Operations", 2nd Edition, John Wiley & Sons, New York, 1982.								
3.	Charles D Reese, "Occupational Health and Safety Management: A Practical Approach", CRC Press, 3 rd Edition, 2018.								

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4.	Vyas M N, "Safety and Hazards Management in Chemical Industries", Atlantic Publishers and Distributors Pvt Ltd, 1 st edition,2017.
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Course Contents and Lecture Schedule

S.No	Topic	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 operations and equipments, utilities.	1
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

Course Designers

1. Dr.V.Sundararaju - sundararaju@ksrct.ac.in

60 PIS E22	Safety in Engineering Industries	Category	L	T	P	Credit
		PC	3	0	0	3

Objective

- To impart knowledge on industrial machineries, its operation and guarding system.
- 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 Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	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

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E22 - Safety in Engineering Industries								
M.E. Industrial Safety Engineering								
Semester	Hours/Weeks			Total Hrs	Credit C	Maximum Marks		
	L	T	P			CA	ES	Total
II	3	0	0	45	3	40	60	100
Safety in Metal Working Machinery and Wood Working Machines General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines. Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards								[08]
Machine Guarding and ZMS. Basic Principle of Machine guarding- Machinery Hazards- protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, - fixed guard fencing- guard construction- guard opening.Design of machine guarding –IS standards – Special machines. Selection and suitability: lathe-drilling-boring-milling-grinding-shaping-sawing-shearing-presses-forge hammer-flywheels-shafts-couplings-gears-sprockets wheels and chains-pulleys and belts- authorized entry to hazardous installations-benefits of good guarding systems. Maintenance-Types- Zero Mechanical State (ZMS), Definition, Policy for ZMS.								[10]
Safety in Welding and Gas Cutting Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – Non Return Valve (NRV) - flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.								[09]
Safety in Cold Forming and Hot Working of Metals Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes , hazards and control measures. Safety in gas furnace operation, Ferrous and Non Ferrous Furnace, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.								[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.								[09]
Total Hours								45
Text Book(s):								
1.	Philip Hagan, "Accident Prevention Manual for Business and Industry", N.S.C.Chicago, 13 th Edition, 2009							
2.	"Occupational Safety Manual" BHEL, Trichy, 1988.							
Reference(s) :								
1.	"Accident Prevention Manual",National Safety Council, Chicago, 1982.							
2.	Krishnan N V, "Safety in Industry", Jaico Publishing House, 1996.							
3.	Safety in the use of wood working machines, HSE, UK 2005.							
4.	"Health and Safety in Welding and Allied Processes", welding Institute, UK, High Tech. Publishing Ltd., London, 1989.							

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Course Contents and Lecture Schedule

S.No	Topic	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

Course Designers

1. Dr.V.Sundararaju

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60 PIS E23	Mechanical Integrity Assessment	Category	L	T	P	Credit
		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	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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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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60 PIS E23- Mechanical Integrity Assessment								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	0	0	45	3	40	60	100
Concepts and Practices of Mechanical Integrity 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.								[09]
Inspection, Testing, Examination and Assessment Form Competency required for inspection-knowledge of inspection techniques-deterioration mechanisms, process & operations, design & Technology, Metallurgy and maintenance-periodical testing-legal requirements-relevant provisions of the factories Act 1948, Boilers Act 2007, the Electricity Act 2003, 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-visual examination-external examination and internal examination-non-invasive techniques such as non-destructive examination-destructive testing such as pneumatic test and hydraulic test-written scheme of examination-examination report and conclusions-integrity assessment-condition monitoring-temperature, noise, vibration, deteriorationmechanism-thermographyapplication-qualityassurance								[09]
Maintenance and Repair of Equipments 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 specifying inspection technique and frequency-safe system of work-safety integrity level-safety instrumented system-standard/safe operating procedures(SOP)-Lockout/Tagout system(LOTO)-safe isolation procedures-blinding and blanking-double block and bleed valve(DBB)-work permit system-hot work, confined space work, excavation work, working at heights-chimney cleaning work-silo cleaning work.								[09]
Corrosion Prevention and Control 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-Electrochemical potential for different metals and noble metals-potential corrosion damages-materials of construction-metal alloying for corrosion prevention-inspection programme for each piece of equipment-special equipment or “bad actors” requiring individualized attention-inspection strategy and interval-corrosion control-organic coatings, Electrochemical methods-Anodic protection and cathodic protection-corrosion inhibitors-corrosion monitoring-vetrasonic thickness measurement-Radiography testing-pipeline inspection-Assessment of corrosion under insulation-corrosion rate estimation-Remaining Assessment.								[08]
On-Going Fitness for Service of Buildings, Machines and Electrical Systems Stability of structural and civil system-foundations-anchor bolts-supports-pipe hangers, pipe bridges-assessment-repair work-key utility service systems-electric power, electronic gadgets, electrical junctions, joints cable tray, electrical distribution system and connections-thermography examination-electrical/electronic equipments, requiring the hazardous Area classification-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]
Total Hours								45
Text Book(s):								
1.	“Guidelines for Mechanical Integrity Systems”, Centre for Chemical Process Safety, AIChE: Wiley, 2006.							
2.	American Petroleum institute: Recommended practice for fitness-for-service: API RP 579, Washington-D.C., 2000.							
Reference(s) :								
1.	Roy E Sanders, “ Chemical Process Safety”, Elsevier, 3 rd Edition, 2006							
2.	Wlater L Frank, David K Whittle, “ Revalidating Process Hazard Analyses”, Wiley-AIChE, 2001.							
3.	“Dangerous Substances and Explosive Atmosphere Regulations-2009 (DSEAR) ACOP”, HSE, UK., 2 nd Edition, 2015.							
4.	“Pressure Safety System Regulation- 2000 (PSSR) ACOP”, HSE, UK, 2 nd Edition, 2014.							

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Course Contents and Lecture Schedule

S.No	Topic	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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4.3	inspection programme for each piece of equipment-special equipment or “bad actors” requiring individualized attention-inspection strategy and interval	2
4.4	corrosion control-organic coatings, Electrochemical methods-Anodic protection and cathodic protection-	2
4.5	corrosion inhibitors-corrosion monitoring-ultrasonic thickness measurement-Radiography testing-pipeline inspection-Assessment of corrosion under insulation-corrosion rate estimation-Remaining Assessment	2
5	On-Going Fitness for Service of Buildings, Machines and Electrical Systems	
5.1	Stability of structural and civil system-foundations-anchor bolts-supports-pipe hangers, pipe bridges-assessment-repair work-	2
5.2	Key utility service systems-electric power, electronic gadgets, electrical junctions, joints cable tray, electrical distribution system and connections	2
5.3	Thermography examination-electrical/electronic equipments, requiring the hazardous Area classification-	1
5.4	Critical utility systems such as fire water, cooling water, absorption tank, exploding suppression, quenching-	1
5.5	Failure analysis of alarms, sensors and interlocks-voltage drop calculation-	1
5.6	Integrity of fire fighting equipments-their maintenance and up keeping-	1
5.7	Mechanical integrity audits-documentation	1
	Total	45

Course Designers

1. Dr.V.Sundararaju - sundararaju@ksrct.ac.in

60 PIS E24	Maintainability Engineering	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

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

Mapping with Programme Outcome

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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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
60 PIS E24- Maintainability Engineering								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	0	0	45	3	40	60	100
Maintenance Concept Need for maintenance – Maintenance definition – Maintenance objectives – Challenges of Maintenance management – Tero technology – Scope of maintenance department – Maintenance costs.								[06]
Maintenance Models Proactive/Reactive maintenance – Imperfect maintenance – Maintenance policies – PM versus break down maintenance – Optimal PM schedule and product characteristics – Optimal Inspection frequency: Maximizing profit – Minimizing downtime – Replacement models								[12]
Maintenance Logistics Human factors – Crew size decisions: Learning curves – Simulation – Maintenance resource requirements: Optimal size of service facility – Optimal repair effort – Maintenance planning – Maintenance scheduling – Spare parts control – Capital spare.								[11]
Maintenance Quality Maintenance excellence –Five Zero concept –FMECA –Root cause analysis – System effectiveness – Design for maintainability – Maintainability allocation – CMMS – Reliability Centred Maintenance.								[08]
Total Productive Maintenance TPM features – Chronic and sporadic losses – Equipment defects – Six major losses – Overall Equipment Effectiveness – TPM pillars –TPM implementation – Autonomous maintenance								[08]
Total Hours								45
Text Book(s):								
1.	Andrew K.S.Jardine& Albert H.C.Tsang, "Maintenance, Replacement and Reliability", Taylor and Francis, 2 nd edition, 2013.							
Reference(s) :								
1.	BikasBadhury&S.K.Basu, "Tero Technology: Reliability Engineering and Maintenance Management", AsianBooks, 2003.							
2.	3eichi Nakajima, "Total Productive Maintenance", Productivity Press, 1993							

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Course Contents and Lecture Schedule

S.No	Topic	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 - sundararaju@ksrct.ac.in

60 PIS E25	Design and Analysis of Experiments	Category	L	T	P	Credit
		PC	3	0	0	3

Objective

- Describe how to design experiments, carry them out and analyse the yield data.
- 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

CO1	Students are able to design number of experiment that is needed to achieve required level of confidence.	Remember, Understand, 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	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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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

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


BoS Chairman

Create (Cr)	0	0	0
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K.S.Rangasamy College of Technology–Autonomous							R2022	
60 PIS E25 –Design and Analysis of Experiments								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	0	0	45	3	40	60	100
Experimental Design Fundamentals Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, and linear regression model.								[06]
Single Factor Experiments Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests.								[09]
Multifactor Experiments Definition and principles - Complexity and Design - Numbering System for Factorial Designs - Two and three factorfull factorial experiments, Model for two factors - 2K factorial Experiments, Confounding and blocking designs.								[10]
Special Experimental Designs Fractional factorial design, nested designs, Split plot design, Introduction to Response Surface Methodology, Experiments with random factors, rules for expected mean squares, approximate F- tests.								[10]
Taguchi Methods Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, case studies.								[10]
Total Hours								45
Text Book(s):								
1.	Montgomery, D.C., "Design and Analysis of experiments", John Wiley and Sons, 8th edition, 2012.							
2.	Krishnaiah K, Shanabudeen P, "Applied design of experiments and Taguchi methods", PHI, 2012.							
Reference(s) :								
1.	NicoloBelavendram, "Quality by Design; Taguchi techniques for industrial Experimentation", Prentice Hall, 1995.							
2.	Phillip J.Rose, "Taguchi techniques for quality engineering", McGraw Hill, 1996.							

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


BoS Chairman

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

1. Dr.V.Sundararaju - sundararaju@ksrct.ac.in

60 PIS E26	Safety In Food Package and Preservation	Category	L	T	P	Credit
		PC	3	0	0	3

Objective

- The course will make the candidates understand the format of food safety legislation as it relates to the 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	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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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

K.S.Rangasamy College of Technology–Autonomous							R2022	
60 PIS E26 Safety In Food Package and Preservation								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	0	0	45	3	40	60	100
Introduction Organization and management; quality, quality assurance, quality control, total quality management; good manufacturing practices, safety, hazards, risk								[09]
HACCP Principles of HACCP, overview of biological, chemical and physical hazard in foods, designing safety into food and processes; FSSAI-grades and standard of identity, Codex Alimentarius,								[09]
Other standards ISO:9000 series and ISO:14000 series, national laws and regulations: PFA, FPO, BIS and Agmark and international laws and regulations, Food Safety Act;								[09]
Testing Quality testing – objective analysis, sensory assessment, rapid microbiological techniques; acceptance sampling; operational characteristics, risks, attributes sampling plan, variables sampling plan, administration of acceptance sampling; adulteration of food; identification of adulterants both qualitative and quantitative; additives in foods; types, names, uses, maximum permissible limits;								[09]
Safety Procedures Sanitation in food processing facilities; definition, important and application; laws and regulation governing sanitation; establishment of SOPs; personal hygiene and hygienic food handlings, employee health, cleaning compounds; choosing of cleaning compounds, handling and storing of cleaning compounds, sanitization methods; waste disposal; solid and liquid; waste control; quality control aspect of processing plant for milk, meat, fish, poultry, foods, vegetables and cereals; customers service; complaint handling, product recall.								[09]
Total Hours								45
Reference(s) :								
1.	Ali, Food Quality Assurance: Principles and Practices, CRC Press, 2003							
2.	M. Pearson and T.R. Dutson, Kluwer HACCP in Meat, Poultry and Fish Processing, Academic Publishers, 1995							
3.	J. P. F. D'Mello, Food Safety Contaminants and Toxins, Oxford University Press, 2003							

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


BoS Chairman

Course Contents and Lecture Schedule

S.No	Topic	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	HACCP	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 - sundararaju@ksrct.ac.in
2. Mrs.S.Chandralekha - chandralekha@ksrct.ac.in

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


BoS Chairman

60 PIS E31	Safety and Risk Analytics	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- 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	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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E31–Safety and Risk Analytics								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
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]
Safety data quality assessment and preprocessing Creation of safety database -Hazard and risk data- Incident Investigation data – Behavioural and organizational safety data- Data dimensions and information quality – missing data handling – data transformation – data reduction								[09]
Descriptive safety analytics Probability distribution – sample and statistics – safety data visualization data tool – data exploration- Predictive safety analytics - Predictive risk analytics -Prescriptive safety analytics-Behavioral safety analytics and injury epidemiology								[09]
Safety performance evaluation and monitoring Leading and lagging indicators for measuring safety performance – control charts for safety performance and evaluation and monitoring – safety capability analysis								[09]
Analysis of Safety Reports and Narratives Safety report and use of text analytics –preprocessing of text data – document classification using KNN- Topic modelling -Risk quantification.								[09]
Total Hours								45
Text Book(s):								
1.	Probabilistic Risk Assessment and Management for Engineers and Scientists, by H Kumamoto and E J Henley, IEEE Press.							
2.	An Introduction to Statistical Learning by James, G., Witten, D., Hastie, T., and Tibshirani, R., Springer.							
Reference(s) :								
1.	Pattern Recognition and Machine Learning by Christopher M Bishop, Springer.							
2.	Introduction to data mining by Tan, P. N., Steinbach, M., & Kumar, V. (2016). Pearson Education India.							
3.	Text mining: predictive methods for analysing unstructured information, by Weiss S M, Indurkhya N, Zhang T and Damerau F J, Springer.							

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	Basics of safety and risk	9
1.1	Introduction to safety and risk management	2
1.2	Hazard triangle- safety ontology	1
1.3	qualitative Risk assessment	3
1.4	quantitative risk assessment	3
2	Safety data quality assessment and pre processing	9
2.1	Creation of safety database -Hazard and risk data	1
2.2	Incident Investigation data	2
2.3	Behavioural and organizational safety data	2
2.4	Data dimensions and information quality	2
2.5	missing data handling – data transformation – data reduction	2
3	Descriptive safety analytics	9
3.1	Probability distribution – sample and statistics	2
3.2	safety data visualization data tool – data exploration	2
3.3	Predictive safety analytics - Predictive risk analytics -	2
3.4	Prescriptive safety analytics	2
3.5	Behavioral safety analytics and injury epidemiology	1
4	Safety performance evaluation and monitoring	9
4.1	Leading and lagging indicators for measuring safety performance	2
4.2	control charts for safety performance	3
4.3	evaluation and monitoring	2
4.4	safety capability analysis	2
5	Analysis of Safety Reports and Narratives	9
5.1	Safety report and use of text analytics	1
5.2	preprocessing of text data	2
5.3	document classification using KNN	2
5.4	Topic modelling	2
5.5	Risk quantification	2
	Total	45

Course Designers

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

60 PIS E32	Bio Safety	Category	L	T	P	Credit
		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 biosafety guidelines 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- Strong;2-Medium;1-Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
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

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E32–Bio Safety								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100
Introduction to Infectious Agents overview of bio organisms -diseases caused by prions, viruses,bacteria, fungi, and parasites and different ways diseases transmission.								[09]
Assessing Biological Hazards &Bio risks risk factors involved working with biological agent –ways and means to prevented infection - modifying the agent- method of handling agent								[09]
Laboratory Safety Overview: Common Lab Hazards & Basic Safety hierarchy of controls for biological hazards - difference between engineering controls and work practice controls,- elimination replacing sharps in the workplace.								[09]
Biorisk Mitigation: Personal Protective Equipment (PPE) need for personal protective equipment-Types of PPE - limitations of each PPEs, and selection of PPE based on tasks, work area, temperature, organisms, and chemicals used - difference between masks and respirators and suitability								[09]
Biological Safety Cabinets (BSC) -Biosafety Program Management-Biosafety Regulations & Guidelines								[09]
Total Hours								45
Text Book(s):								
1.	Biological safety principles and practices, “ Diane O Fleming, Debra L. Hunt ,3 rd edition							
2.	Laboratory Biosafety Manual, World Health Organization							
Reference(s) :								
1.	Biosafety Trainings CDC							

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


BoS Chairman

Course Contents and Lecture Schedule

S.No	Topic	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
	Total	45

Course Designers

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

60 PIS E33	Safety in Textile Industry	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- The syllabus deals with safe handling of materials involved in work atmosphere, exposure to noise 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- Strong;2-Medium;1-Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
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

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E33 Safety in Textile Industry								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100
Introduction Introduction to process flow charts of i) short staple spinning, ii) long staple spinning, iii) viscose rayon and synthetic fibre, manufacturer, iv) spun and filament yarn to fabric manufacture, v) jute spinning and jute fabric manufacture-accident hazard, guarding of machinery and safety precautions in opening, carding, combing, drawing, flyer frames and ring frames, doubles, rotor spinning, winding, warping, softening/spinning specific to jute – Automated machines.								[09]
Process Hazards-I hazards i) sizing processes- cooking vessels, transports of size, hazards due to steam ii) Loom shed – shuttle looms and shuttless looms iii) knitting machines iv) non-wovens – fire prevention in textile industry								[09]
Process Hazards- II Scouring, bleaching, dyeing, printing, mechanical finishing operations and effluents in textile processes.								[09]
Health And Welfare Health hazards in textile industry related to dust, fly and noise generated-control measures-relevant occupational diseases, personal protective equipment-health and welfare measures specific to textile industry, Special precautions for specific hazardous work environments.								[09]
Safety Statues Relevant provision of factories act and rules and other statues applicable to textile industry – effluent treatment and waste disposal in textile industry.								[09]
Total Hours								45
Reference(s) :								
1.	"Safety in Textile Industry", Thane Belapur Industries Association, Mumbai.							
2.	100 Textile Fires – analysis, findings and recommendations LPA.							
3.	Groover and Henry DS, "Hand Book of Textile Testing and Quality Control".newyork,1960							
4.	Shenai V.A., "A technology of textile processing", Vol.I, Evak Publicationa,1990.							

Course Contents and Lecture Schedule

S.No	Topic	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

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

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

Objective

- To provide the in depth knowledge on Environment and Its impact on the surroundings when a major 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 and its relevance to the Legal and regulatory aspects.	Remember, Understand, Apply
CO2	Understand about the EIA and various assessment techniques and standard involved in decision making process.	Remember, Understand, Apply
CO3	Evaluate the EIA system.	Remember, Understand, Apply
CO4	Apply and practice the EIA management system with the proper guideline and evaluation criteria.	Remember, Understand, Analyze
CO5	Design the concept, implement the process and to excel Environmental Impact assessment procedure in carrying out the major project in their career from the case studies.	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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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

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



BoS Chairman

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E34 –Environmental Impact Assessment								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	0	0	45	3	40	60	100
Introduction Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) -Environmental Risk Assessment(ERA) - Legal and Regulatory aspects in India – Types and limitations of EIA - Terms of Reference in EIA- Issues in EIA- national – cross sectoral - social and cultural.								[09]
Environmental Analysis and Assessment Techniques Components - screening - setting - analysis - prediction of impacts - mitigation. Matrices - Networks - Checklists.Importance assessment techniques - cost benefit analysis - analysis of alternatives - methods for Prediction andassessment of impacts - air - water - soil - noise - biological - cultural - social - economic environments. Standardsand guidelines for evaluation. Public Participation in environmental decision-making								[09]
Environmental Impact Assessment Evaluation Trends in EIA practice and evaluation criteria - capacity building for quality assurance. Expert System in EIA - use ofregulations and AQM.								[09]
Environmental Management Plan 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]
Case Studies Case studies of EIA of developmental projects.								[09]
Total Hours								45
Text book(s):								
1	Canter. L.W., “Environmental Impact Assessment”, McGraw Hill, New York, 1996.							
2.	. Petts, J., “Handbook of Environmental Impact Assessment”, Vol. I and II, Blackwell Science, London, 1999							
Reference(s) :								
1	The World Bank Group, “Environmental Assessment Sourcebook”, Vol. I, II & III, the World Bank, 1998							

Course Contents and Lecture Schedule

S.No	Topic	No.of 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 - sundararaju@ksrct.ac.in
2. Mrs.S.Chandralekha - chandralekha@ksrct.ac.in

60 PIS E35	Integrated Management Systems	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To impart the significance of ISO certification.
- To give insight to PDCA cycle.
- To scrutinize the standards from the elementary view.
- To give exposure of transition from OHSAS 18001 to ISO 45001.
- 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 Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
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

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


BoS Chairman

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BoS Chairman

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E35 - Integrated Management Systems								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	0	0	45	3	40	60	100
OHSAS Standard Introduction – Development of OHSAS standard – Structure and features of OSHAS 18001 – FOHSR -Planning – Guidelines, methodology steps developing action plan-OHSAP -OH&S policy- certification procedure – OH & S management system element, specification and scope- Benefits of certification of OHSAS 18001- correspondence between OHSAS 18001, ISO22000, ISO18001, ISO 15001, ISO 14001:1996 and ISO 9001:1994 – Guidelines (18002:2000) for implementing OHSAS 18001.								[09]
ISO 45001 ISO 45001- need for ISO 45001 – Terms and definitions -structure and features of ISO 45001- contents of ISO 45001- developing OH&S Policy –guidelines- Benefits -Certification Procedure-correspondence between OHSAS 18001 and ISO 45001Gap Analysis -migration from OHSAS 18001 to ISO 45001.								[08]
ISO 45001 Implementation and Operation, Checking and Review Guidelines for structure and Responsibilities, 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- Determination of legal and other requirements -Planning actions – OH&S objectives and their planning –competence and awareness- Communication – Documentation. Operational Planning and control – Emergency Preparedness and response –Monitoring, measurement, analysis and performance evaluation – OHSMS audit –Continual improvement – Beyond ISO 45001.								[10]
ISO 14001 EMS, ISO 14001, specifications, objectives, Environmental Policy, Guidelines & Principles (ISO 14004), environmental aspects and management programmes, 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. Auditing ISO14000-General principles of Environmental Audit, Auditor, steps in audit, Audit plan – comparative study between OHSAS 18001 and ISO 14001 – Case studies.								[09]
ISO 9001 Introduction to ISO 9001- Scope, Application – Range of ISO standards – Principles of quality management- Steps for implementing ISO 9001:2008: Check list – Process approach – Documentation- Clause-wise explanation and Audit concepts – Measurement, analysis and improvement: General – Monitoring and measurement – Control of nonconforming product – Analysis of data – Improvement – Certification of quality management system – Steps involved – Audit of quality management system: Purpose – Types of quality audits – Case studies.								[09]
Total Hours								45
Text book(s):								
1	Arora K C Dr, "ISO 9000 to OHSAS 18001", S.K. Kataria& Sons, Delhi,2010.							
2.	ISO 45001:2018 – Occupational Health and Safety Management System.							
Reference(s) :								
1	Wayne Pardy, Terri Andrews, " Integrated Management System", Bernan Press,2 nd Edition,2019.							
2	Ramesh C Grover, Sachin Grover, " Providing Safe & Health workplace with ISO 45001:2018", Notion Press,							
3	Garry Cornell, " The ISO 14001: 2015 Companion", Advisera Expert Solutions Ltd, 2017.							
4	Milton P Dentch, "The ISO 45001:2018 Implementation Hand book", ASQ Quality Press,2018.							

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BoS Chairman

Course Contents and Lecture Schedule

S.No	Topic	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

Course Designers

Passed in BoS Meeting held on 18/05/23
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BoS Chairman

1. Dr.V.Sundararaju - sundararaju@ksrct.ac.in

60 PIS E36	Fundamental of Sustainable Development	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- 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 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 Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
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

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BoS Chairman

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BoS Chairman

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E36 –Fundamental of Sustainable Development								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	3	0	0	45	3	40	60	100
Sustainable Engineering Introduction to sustainability –Definition-pillars of sustainability-magnitude of sustainability challenge – SustainableEngineering-Material consumption and environmental impact-sustainability metrics for engineering design-wateruse and demand –water scarcity – water use for energy production-Global population trend-environmental riskassessment-Green materials-design for sustainability-Design principles of green engineering - Concepts on Greenbuilding- Carbon credit - Renewable power generation								[09]
Sustainability Assessment Tools Sustainability Assessment tools – Water foot print- Ecological Footprint -Life Cycle Thinking- Simple and ComplexLife Cycles- Quantitative and Qualitative Methods Supporting Life Cycle Assessment-International standards on LCA- Goal and Scope- Functional Unit- Product System and System Boundary- Unit Processes- Data Collection- DataValidation- Data Allocation- Relating Data to the Unit Process and functional unit- Data Aggregation- Identifying andUsing Life Cycle Data Sources- Free and Licensed LCA Databases								[08]
Allocation Of Flows For Multiple Products Multifunction Processes and Systems- Allocation of Flows for Processes with Multiple Products- allocation methodmass-basis or an energy-basis for allocation- economic basis- allocation factor- allocated flows for truck transporting vegetables and fruits - An Example of Allocation of Process Flows in US LCI Database- Avoiding Allocation- disaggregation- system expansion- Displacement approach - Comparative Analysis of Allocation and System Expansion								[10]
Uncertainty Analysis Sources of Uncertainty and Variability Relevant to LCA- Uncertainties in Results- Methods to Address Uncertaintyand Variability- Qualitative and Semi-Quantitative Methods- Quantitative Methods to Address Uncertainty andVariability- Sensitivity Analysis- Case Study of Effects of Shipping Distance Assumptions- LCA Screening via EconomicInput-Output Models- EIO-LCA Input-Output LCA Model- EIO-LCA Example: Automobile Manufacturing								[09]
Life Cycle Impact Assessment Methods, Soft Wares and Databases Overview of Impacts and Impact Assessment- impact categories -Impact Assessment Models for LCA- life cycleimpact assessment (LCIA),- Mandatory Elements of LCIA- Selection - Classification - Characterization –OptionalElements of LCIA- Normalization - Grouping - Weighting -advanced LCA methods-various LCA methods –Eco inventdatabase-GABI - OPENLCA-IMPACT 2002 –EDIP-Recipe								[09]
Total Hours								45
Text book(s):								
1	H. Scott Matthews, Chris T. Hendrickson and Deanna H. Matthews, “Life Cycle Impact Assessment”2015.							
2.	Life Cycle Assessment : Principles and Practice ,Scientific application international corporation , Environmental Protection agency ,2006.							
Reference(s) :								
1	Michael Z.Hauschild , Rosenbaum, Ralph K., Olsen, Stig (Eds.) “Life Cycle Assessment -Theory and Practice” Springer International Publishing , 2015							
2	David T. Allen, David R. Shonnard, “Sustainable Engineering: Concepts, Design and Case Studies”, Prentice Hall, 2011.							
3	Vezzoli, Carlo Design for Environmental Sustainability Life Cycle Design of Products, Springer-VerlagLondon,2011							

Course Contents and Lecture Schedule

S.No	Topic	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

Passed in BoS Meeting held on 18/05/23

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BoS Chairman

1. Dr.V.Sundararaju

- sundararaju@ksrct.ac.in

60 PIS E41	Human Factors Engineering	Category	L	T	P	Credit
		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.
- 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 biomechanics.	Remember, Understand, Apply
CO2	Identify human behaviour using BBS and motivate through management theories.	Remember, Understand, Apply
CO3	Design work station for static and dynamic worker considering anthropometric factors and work station parameters.	Remember, Understand, Analyze
CO4	Assess ergonomic risk factors of workers using posture evaluation tool.	Remember, Understand, Analyze
CO5	Employ Principles for design of visual and auditory displays in real time situation	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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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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BoS Chairman

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E41- Human Factors Engineering								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	0	0	45	3	40	60	100
Ergonomics and Anatomy Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, and future directions for ergonomics. Anatomy, Posture and Bio Mechanics: Some basic bio mechanics and anatomy of the spine and pelvis, Bio Mechanical aspect of body movement .Posture: Good posture and bad posture, Posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioral aspects of posture, effectiveness and cost effectiveness, research directions.								[09]
Human Behavior Individual differences, Factors contributing to personality, Fitting the man to the job, Influence of difference on safety, Method of measuring characteristics, Accident Proneness. Motivation, Complexity of Motivation, Job satisfaction. Management theories of motivation, Job enrichment theory. Frustration and Conflicts, Reaction to frustration, Emotion and Frustration. Attitudes-Determination of attitudes, Changing attitudes Learning, Principles of Learning, Forgetting, Motivational requirements- Behavior Based Safety (BBS) – ABC theory – Implementation.								[09]
Anthropometry for Work Design Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness. Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design for standing workers, design for seated workers, work surface design, visual display units, guidelines for design of static work, effectiveness and cost effectiveness, research directions.								[09]
Man - Machine System and Repetitive Works and Manual Handling Task Applications of human factors engineering, man as a sensor, man as information processor, man as controller – Man vs Machine. Ergonomics interventions in Repetitive works, handle design, key board design ,measures for preventing in work related musculoskeletal disorders (WMSDs), reduction and controlling, training Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the work place, design of manual handling tasks, lifting, pushing, pulling, carrying and postural stability. Postural Evaluation Tools: Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA), The Strain Index, NIOSH Lifting equation, Measurement of work effort and fatigue: Borg rating of perceived exertion scale, Muscle Fatigue Assessment method, Hand Activity Level (HAL).								[09]
Display, Controls and Virtual Environments A general information-processing model of the users, cognitive system, problem solving, effectiveness. Principles for the design of visual and auditory displays- design of controls- combining displays and controls- virtual (synthetic) environments, research issues on human skill and performance.								[09]
Total Hours								45
Text book(s):								
1.	McCormick Ernest J, "Human Factors In Engineering and Design", Mcgraw-Hill Book,2016.							
2.	Bridger R S, "Introduction to Ergonomics",CRC Press,3 rd Edition, 2015.							
Reference(s) :								
1.	Dan Mc Leod, "The Ergonomics Manual", Philip Jacobs & Nancy Larson, 2000.							

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 BoS Chairman

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 nd Edition,2013.

Course Contents and Lecture Schedule

S.No	Topic	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.	2
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.	1
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	2
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	Postural Evaluation Tools: Rapid 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

Course Designers

1. Dr.V.Sundararaju - sundararaju@ksrct.ac.in
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60 PIS E42	Cognitive Ergonomics	Category	L	T	P	Credit
		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.
- 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- Strong;2-Medium;1-Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	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

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


BoS Chairman

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BoS Chairman

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E42 - Cognitive Ergonomics								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	0	0	45	3	40	60	100
Anthropometry Designing for a population of users, percentile, sources of human variability, anthropometry and its uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry in design, design for everyone, anthropometry and personal space, effectiveness and cost effectiveness. Fundamental aspects of standing and sitting, an ergonomics approach to work station design								[10]
Human as an information processing system Man as a system component – allocation of functions – efficiency – occupational work capacity – aerobic and anaerobic work – evaluation of physiological requirements of jobs – parameters of measurements – categorization of job heaviness – work organization – stress – strain – fatigue – rest pauses – shift work – personal hygiene.								[09]
Components of cognitive ergonomics Cognitive ergonomics concerned with mental processes - perception, decision making, memory, reasoning and response execution - Challenges in allocation of attention, multiple task performance and operator workload measurement.								[08]
Human Error and assessment Skilled performance, attention, distraction, human error, work stress, risk perception, and Kansei engineering as these may relate to human- system design, safety and productivity. Assessment methodologies - hierarchical task analysis, cognitive task analysis, mental workload, human error identification/accident investigation, and situation awareness assessment.								[10]
Safety culture Pinpointing of Unsafe behavior-Positive reinforcement- observation and feedback. Evolution of Safety culture, Transformation requirement from reactive to proactive culture – Ethical responsibility for safety professional.								[08]
Total Hours								45
Text book(s):								
1.	David B Kaber, Guy Boy ,”Advances in Cognitive Ergonomics”, CRC Press,2010							
2.	Peter A Hancock, “ Human Performance and Ergonomics”, Academic Press,2 nd Edition,1999							
Reference(s) :								
1.	Proceedings of Engineering Psychology and Cognitive Ergonomics,13 th international conference,Canada,2016							
2.	McCormick Ernest J, “Human Factors In Engineering and Design”, Mcgraw-Hill Book, 2016.							
3.	Bridger R S , “Introduction to Ergonomics”, CRC Press,3 rd Edition, 2015.							
4.	Theresa Stack, Lee T Ostrom, Cheryl A Wilhelmsen, “ Occupational Ergonomics: A Practical Approach”, Wiley,2016							

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
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

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**BoS Chairman**

60 PIS E43	Behaviour Based Safety and Safety Culture	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- To impart facts about human behaviour and attitude.
- 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

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	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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BoS Chairman

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E43 - Behaviour Based Safety and Safety Culture								
PIS: M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	0	0	45	3	40	60	100
Fundamentals of Behavioral Safety Historical background-H.W-Heinrich Theory and pyramid-Accident causal Analysis-Unsafe conditions, Unsafe acts, personal factors and proximate factors-ABC Analysis for a behavior of Activator. Behavior and consequences-components of behavior of Safety Programme – Critical behaviors and observation process-Near Miss Management Programme-Suggestion schemes for the effective implementation-Feedback to workers-Improvement, Review and effectiveness of feedback.								[09]
Performance Monitoring and Consequences Goals and objectives for monitoring activators-policies and procedures-priorities and accountabilities-Training and education-Job Aids such as checklists and flow-charts-pre-job safety Instructions-manuals and pocket guides-Recognition and Rewards for positive performance-Reinforcement of monitoring process-Demerit factors for Negative performance-Consequence classification-positive/Negative(P/N)-Immediate/Future (I/F)-certain/Uncertain (C/U)-positive, Immediate and certain (PIC)-case study on Respiratory Hazards.								[10]
Observation and Communication Process Observation procedure-Observation checklist-communication of Near Miss Behaviors, Injury causes and critical Behaviors-Observation Result charts, graphs and displays-Tool Box Talks-Frequent observations of safety critical activities such as startup/Shutdown-orientation programme-watch over new employees, younger employees, workers under pressure/stress, workers running/rushing, and new contractors/sub-contractors								[08]
Behavior Modification Safety first approach to all Work-management responsibilities-supervisor responsibilities-worker responsibilities-New, young, and contract workers responsibilities-project safety rules-safe operating procedures (SOP)-workplace Hazardous material information system (WHMIS)-PPE and work clothing-compliance monitoring-Harassing behaviors-Disciplinary actions-verbal warning, written warning and removal from the site-safety signage-safety meetings – Digital display of precautionary information-training needs, and need based training with real life examples.								[08]
Safety Culture 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]
Total Hours								45
Text book(s):								
1.	Kaila H L, “Industrial Safety and Human Behaviour”, AITBS Publishers,2013.							
2.	Roughton J E, J JMercurio, “ Developing An Effective Safety Culture”, Butterworth Heinemann, 2012.							
Reference(s) :								
1.	JuniDaalmans,“Human Behaviour in Hazardous Situations”, Butterworth Heinemann ,2012.							
2.	Thomas R Krause, “The Behaviour –Based Safety Process”, Wiley, 2 nd Edition,1996.							
3.	Charles D Reese, “Occupational Health and Safety Management: A Practical Approach”, CRC Press, 3 rd Edition,2018.							
4.	Peter A Hancock, “ Human Performance and Ergonomics”, Academic Press,2 nd Edition,1999							

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 BoS Chairman

Passed in BoS Meeting held on 18/05/23
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BoS Chairman

Course Contents and Lecture Schedule

S.No	Topic	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 factors-	1
1.3	ABC Analysis for a behavior of Activator. Behavior and consequences-components of behavior of Safety Programme –	3
1.4	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

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BoS Chairman

60 PIS E44	Ergonomic Tools and Techniques	Category	L	T	P	Credit
		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

Prerequisite

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 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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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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BoS Chairman

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E44 Ergonomic Tools and Techniques								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	0	0	45	3	40	60	100
Introduction Basics of biomechanics and anthropometry of human body – work station design-working posture Assessment tools- fundamentals of RULA,REBA,NIOSH lifting equation, OCRA.								[09]
Subjective Assessment Tools Introduction- methods for assessing work related Musculoskeletal disorder risk factors-qualities of good questionnaires- advantage and disadvantages of questionnaire.								[09]
Assessment of physiological and psychological discomfort Methods to assess levels of musculoskeletal discomfort -The Dutch Musculoskeletal Questionnaire (DMQ)-Nordic Musculoskeletal questionnaire, Methods to assess levels of mental discomfort – job stress questionnaire –NIOSH generic job stress questionnaire.								[09]
Postural Evaluation Tools Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA), NIOSH Lifting equation, OCRA – hands on exercises.								[09]
Human factors – project planning Introduction- project management- human factors tools for project management-case studies .								[09]
Total Hours								45
Text book(s):								
1.	Dennis A. Attwood et al, "Ergonomic Solutions for Process industries" Gulf Professional Publishing, 2004							
2.	R.S. Bridger, "Introduction to Ergonomics", Taylor & Francis, 2 nd Edition, 2007.							
3.	Amit Bhattacharya et al, " Occupational Ergonomics theory and applications" MerceDekkerInc,							

Course Contents and Lecture Schedule

S.No	Topic	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

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

60 PIS E45	Ergonomics in Automotive Design	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

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

Prerequisite

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 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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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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BoS Chairman

K.S.Rangasamy College of Technology–Autonomous							R2022	
60 PIS E45 Ergonomics in Automotive Design								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	0	0	45	3	40	60	100
Introduction to ergonomics Definition ,domains and application of ergonomics Anatomy, Posture and Bio Mechanics: Some basic bio mechanics and anatomy of the spine and pelvis,– application of biomechanics								[09]
Introduction to Automotive Ergonomics Need for Automotive ergonomics, Anthropometric and biomechanical data in automotive design								[09]
Controls and Displays Occupant Packaging, Automobile control and displays, In vehicle and external visibility of the driver								[09]
Work study and method study Entry and exit by drivers and passengers, Driver distraction and driving performance measurement, Driver Workload Measurement								[09]
Assessment methods and applications Virtual Ergonomics evaluation technique and its application in automotive design, Automotive craftsmanship								[09]
Total Hours								45
Text book(s):								
1.	Bhise, V.D., 2016. Ergonomics in the automotive design process. CRC Press							
2.	Harvey, C. and Stanton, N.A., 2016. Usability evaluation for in-vehicle systems. CRC Press.							
3.	Gkikas, N., 2016. Automotive Ergonomics: Driver-Vehicle Interaction. CRC Press							

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BoS Chairman

Course Contents and Lecture Schedule

S.No	Topic	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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60 PIS E46	Applied Ergonomics	Category	L	T	P	Credit
		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.
- 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- Strong;2-Medium;1-Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	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

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E46 Applied Ergonomics								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	0	0	45	3	40	60	100
Introduction to Ergonomics Definition, domains and Applications of Ergonomics- Basics of Human anatomy and Biomechanics – application of biomechanics-overview of human body- Musculoskeletal system-metabolism-cardiovascular system-respiratory system - structure and function-posture and health.								[08]
Organization Ergonomics 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 Organisation ergonomics – responsibility and authority-types of decision-line organisation and staff functions matrix organisation motivation of work-Maslow gratification theory- workers motivation -Job evaluation in organisational ergonomics –job satisfaction-signs of job satisfaction-job rotation-job specialization-job enlargement –Job enrichment work organization.								[10]
Ergonomics for design Human oriented design –anthropometry –anthropometry data – anthropometric design process – anthropometric data – measurements- how to use anthropometric data – statistical essentials - Ergo tools – measuring tools – software tools- designing for static and dynamic work- Human –machine system- human components-machine components-environmental components Tools. - problems..								[10]
Ergonomics for design Human oriented design –anthropometry –anthropometry data – anthropometric design process – anthropometric data – measurements- how to use anthropometric data – statistical essentials - Ergo tools – measuring tools – software tools- designing for static and dynamic work- Human –machine system- human components-machine components-environmental components Tools.								[08]
Cognitive ergonomics Workplace ergonomics - Human sensory system-human cognitive system - human vision –hearing sense and importance of auditory performance. –Long term memory and its importance in cognitive ergonomics - Common cognitive tasks – decision making –planning- problem solving. Guidelines for cognitive work sensory reception and perception – Visual environment and lighting –physics of light-visibility-lighting system-auditory environment – effect of noise								[09]
Total Hours								45
Text book(s):								
1.	R.S.Bridger,"Introduction to Ergonomics",CRC Press,3 rd edition,2008.							
2	Mark S Sanders,Ernest J McCormick," Human Factors in Engineering & Design", Mcgraw-Hill education Private Limited,7 th edition,2016.							
Reference(s):								
1.	M.I.Khan,"Industrial Ergonomics", PHI Learning Private Limited,New Delhi,2013.							
2.	Christoper D Wickens, Sallie E.Gordon-Becker, Yili Liu ,John D.Lee "An introduction to Human Factors Engineering", Pearson-Prentie Hall, 2 nd edition,2004							
3.	Mikell P Groover, " Work systems and the Methods,Measurement and Management of Work",Pearson-Prentice Hall,New Delhi,2 nd edition,2006							
4.	Knoz,StephanA,Johnson,Steven,HolcombHathaway,Scottsdale, "Work Design: Industrial Ergonomics",7 th edition, 2007							

Course Contents and Lecture Schedule

S.No	Topic	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

1. Dr.V.Sundararaju - sundararaju@ksrct.ac.in

Passed in BoS Meeting held on 18/05/23
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BoS Chairman

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



BoS Chairman

60 PIS E51	Safety in Construction	Category	L	T	P	Credit
		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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E51 - Safety in Construction								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	0	0	45	3	40	60	100
Accidents Causes and Management Systems: Problems impeding safety in construction industry-causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accident – construction regulations, contractual clauses – the building and other construction workers act and rules 1996- Pre contract activities, preconstruction meeting - design aids for safe construction – permits to work – tool box meeting- quality assurance in construction - compensation – Recording of accidents and safety measures – Education and training.								[09]
Hazards Of Construction and Prevention: Excavations, basement and wide excavation, trenches, shafts – scaffolding , types, causes of accidents, scaffold inspection checklist – false work – erection of structural frame work, dismantling – tunneling – blasting, pre blast and post blast inspection – confined spaces – working on contaminated sites – work over water - road works – power plant constructions – construction of high rise buildings.								[09]
Working at Heights: Fall protection in construction OSHA 3146 – OSHA requirement for working at heights, Safe access and egress – safe use of ladders- Scaffoldings, requirement for safe work platforms, stairways, gangways and ramps, Mobile elevated Working Platforms(MEWPs) – fall prevention and fall protection, safety harness, safety nets, fall arrestors, controlled access zones, safety monitoring systems – working on fragile roofs, work permit systems, Safety pass – Alternative equipments for scaffolding work - accident case studies.								[09]
Construction Machinery: Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist - builder's hoist, winches, chain pulley blocks – use of conveyors - concrete mixers, concrete vibrators – safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps, welding machines, use of portable electrical tools, drills, grinding tools, scaffolding, hoisting cranes – use of conveyors and mobile cranes – manual handling.								[09]
Safety in Demolition Work: Safety in demolition work, manual, mechanical, using explosive - keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition - Indian standard - trusses, girders and beams – first aid – fire hazards and preventing methods –Case studies.								[09]
Total Hours								45
Text book(s):								
1.	Davies V J and Tomasin K “Construction Safety Hand Book”, Thomas Telford Ltd., London, 1990.							
2.	Sharma S C and Vineetkumar,“ Safety,Occupational Health and Environmental Management in Construction”, Khanna Publishers, 1 st Edition,2013.							
Reference(s):								
1.	Charles D Reese and James V Edison, “Handbook of OSHA Construction Safety and Health”,CRC press,2006							
2.	King R W andHudson R, “Construction hazard and Safety Hand book”, Butter Worth- Heinemann, 1985.							
3.	Bhattacharajee S K, “Safety Management in Construction”, Khanna Publishers,2013.							
4.	“Health and Safety in Construction” ,HSE publications,3 rd Edition,2006							

Course Contents and Lecture Schedule

S.No	Topic	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	- Scaffoldings, requirement for safe work platforms, stairways, gangways and ramps, Mobile elevated Working Platforms(MEWPs) –	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

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Passed in BoS Meeting held on 18/05/23

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BoS Chairman

60 PIS E52	Dock Safety	Category	L	T	P	Credit
		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	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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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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BoS Chairman

K.S.Rangasamy College of Technology–Autonomous						R2022		
60 PIS E52 - Dock Safety								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	0	0	45	3	40	60	100
<p>History of Safety Legislation History of dock safety statues in India-background of present dock safety statues- dock workers (safety, health and welfare) act 1986 and the rules and regulations framed there under, other statues like marking of heavy packages act 1951 and the rules framed there under - manufacture, storage and import of hazardous chemicals. Rules 1989 framed under the environment (protection) act, 1989 – few cases laws to interpret the terms used in the dock safety statues. Responsibility of different agencies for safety, health and welfare involved in dock work –responsibilities of port authorities – dock labour board – owner of ship master, agent of ship – owner of lifting appliances and loose gear etc. – employers of dock workers like stevedores – clearing and forwarding agents – competent persons and dock worker. Forums for promoting safety and health in ports – Safe Committees and Advisory Committees. Their functions, training of dock workers.</p>								[11]
<p>Working On Board the Ship Types of cargo ships – working on board ships – Safety in handling of hatch beams – hatch covers including its marking, Mechanical operated hatch covers of different types and its safety features – safety in chipping and painting operations on board ships – safe means of accesses – safety in storage etc. – illumination of decks and in holds – hazards in working inside the hold of the ship and on decks – safety precautions needed – safety in use of transport equipment - internal combustible engines like forklift trucks-pay loaders etc. Working with electricity and electrical management – Storage – types, hazardous cargo.</p>								[09]
<p>Lifting Appliances Different types of lifting appliances – construction, maintenance and use, various methods of rigging of derricks, safety in the use of container handling/lifting appliances like portainers, transtainer, top lift trucks and other containers – testing and examination of lifting appliances – portainers – transtainers – toplift trucks – derricks in different rigging etc- use and care of synthetic and natural fiber ropes – wire rope chains, different types of slings and loose gears.</p>								[08]
<p>Transport Equipment 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. Safe use of special lift trucks inside containers – Testing, examination and inspection of containers – carriage of dangerous goods in containers and maintenance and certification of containers for safe operation. Handling of different types of cargo – stacking and unstacking both on board the ship and ashore – loading and unloading of cargo identification of berths/walking for transfer operation of specific chemical from ship to shore and vice versa – restriction of loading and unloading operations.</p>								[09]
<p>Emergency Action Plan and Dock Workers (SHW) Regulations 1990 Emergency action Plans for fire and explosions - collapse of lifting appliances and buildings, sheds etc., - gas leakages and precautions concerning spillage of dangerous goods etc., - Preparation of on-site emergency plan and safety report. Dock workers (SHW) rules and regulations 1990-related to lifting appliances, Container handling, loading & unloading, handling of hatch coverings and beams, Cargo handling, conveyors, dock railways, forklift.</p>								[08]
Total Hours								45
Text book(s):								
1.	"Safety and Health in Dock work", International Labour Organization, 2 nd Edition, 1997.							
2.	"The Dock Workers Act 1948 with rules 1962", Universal Law Publishing, New Delhi, 2016.							
Reference(s):								
1.	Velitchkovitch J, "Guide to Safety and Health in Dock Work", ILO, 1976.							
2.	Taylor D A, "Introduction to Marine Engineering", Butterworth-Heinemann, 2 nd Edition 1996.							
3.	Srinivasan R, "Harbour, Dock and Tunnel Engineering". CPH Pvt Limited, 28 th Edition, 2016							
4.	Bindra S R, "Course in Dock & Harbour Engineering". Dhanpat Rai Publications (P) Limited, New Delhi, 2013							

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BoS Chairman

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BoS Chairman

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	History of Safety Legislation	11
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	3
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 combustibile 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

Course Designers

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60 PIS E53	Electrical Safety	Category	L	T	P	Credit
		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

CO1	Indicate Statues, standards pertaining to electrical safety and first aid measures.	Remember, Understand, Apply
CO2	Diagnose Classes of insulation and hazardous conditions.	Remember, Understand, Apply
CO3	Inspect FRLS insulation, grounding, circuit breaker and PPE.	Remember, Understand, Analyze
CO4	Plan and schedule lock out tag out and work permit.	Remember, Understand, 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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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

K.S.Rangasamy College of Technology–Autonomous							R2022	
60 PIS E53 – Electrical Safety								
PIS: M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
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.								[09]
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-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control-electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance								[10]
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 of conductor-joints-and connections, overload and short circuit protection-no load protection-earth fault protection.FRLS insulation-insulation and continuity test-system grounding-equipment grounding-rubber mats and relevant standards-Earth Leakage Circuit Breaker (ELCB)- Residual Current Circuit Breaker(RCCB)cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments.								[10]
Selection, Installation, Operation and Maintenance Role of environment in selection-safety aspects in application - protection and interlock-self diagnostic features and fail safe concepts-lock out and tag out (LOTO)-work permit system- contact prevention techniques-Human protection – rubber mat- discharge rod and earthing devices- cabling and cable joints-preventive maintenance								[09]
Hazardous Zones Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies								[07]
Total Hours								45
Text book(s):								
1.	Fordham Cooper W, “Electrical Safety Engineering”, Butterworth and Company, London, 3 rd Edition, 2002.							
2.	Rao S, Saluja H L, “ Electrical Safety, Fire Safety Engineering and Safety Management”, Khanna Publishers, New Delhi, 2009.							
Reference(s):								
1.	John Cadick Mary Capelli-Schellofeffer, Dennis K Neitzel and Al Winfield, “Electrical Safety Handbook”, Mc Graw Hill Education, 4 th Edition, 2012.							
2.	“Accident Prevention Manual for Industrial operations”, N.S.C., Chicago, 1982.							
3.	Massim A G ,Mitolo, “Electrical Safety of Low Voltage Systems”, Mc Graw Hill, 2009							
4.	Indian Electricity Act and Rules, Government of India, 2003.							

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BoS Chairman

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BoS Chairman

Course Contents and Lecture Schedule

S.No	Topic	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	– voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection-earth fault protection.	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

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BoS Chairman

60 PIS E55	Reliability Engineering	Category	L	T	P	Credit
		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, Apply
CO2	Calculate failure data analysis using exponential, normal, gamma and Weibull distribution and draw hazard plotting	Remember, Understand, Apply
CO3	Solve problems and work on m/n configuration systems, series parallel systems.	Remember, Understand, Analyze
CO4	Understand the concepts of reliability testing and reliability allocation.	Remember, Understand, Analyze
CO5	Conduct risk assessment to identify the industrial problem and provide suitable solution.	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 Assessment Tests (Marks)		End Sem Examination (Marks)
	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

K.S.Rangasamy College of Technology–Autonomous							R2022	
60 PIS E55 – Reliability Engineering								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
III	3	0	0	45	3	40	60	100
Reliability Concept Reliability function – failure rate – mean time between failures (MTBF) – mean time to failure (MTTF) – A priori and a posteriori concept - mortality curve – useful life – availability – maintainability – system effectiveness.								[09]
Failure Data Analysis Time to failure distributions – Exponential, normal, Gamma, Weibull, ranking of data – probability plotting techniques – Hazard plotting.								[09]
Reliability Prediction Models Series and parallel systems – RBD approach – Standby systems – m/n configuration – Application of Bayes' theorem – cut and tie set method – Markov analysis – Fault Tree Analysis – limitations.								[09]
Reliability Management Reliability testing – Reliability growth monitoring – Non-parametric methods – Reliability and life cycle costs – Reliability allocation – Replacement model.								[09]
Risk Assessment Definition and measurement of risk – risk analysis techniques – risk reduction resources – industrial safety and risk assessment.								[09]
Total Hours								45
Text book(s):								
1	Srinath L S, "Reliability Engineering", Affiliated East-West Press Pvt. Ltd, New Delhi, 4 th Edition 2006.							
2	Charles E Ebeling, "An Introduction to Reliability and Maintainability Engineering", Tata Mcgraw Hill, 2009.							
Reference(s):								
1	Mohammed Modarres et al, "Reliability and Risk analysis", CRC Press, 2 nd edition, 2009.							
2	Naikan V N A, "Reliability Engineering and Life Testing", PHI, 2013.							
3	Bhaskar S, Narayanamoorthy S, "Statistical Quality Control and Reliability Engineering", Anuradha agencies Publishers,2002.							
4	Smith C O, "Introduction to Reliability in Design", McGraw Hill, London, 1976.							

Course Contents and Lecture Schedule

S.No	Topic	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 - sundararaju@ksrct.ac.in
3. Mrs.S.Chandralekha - chandralekha@ksrct.ac.in

60 PIS E56	Safety in Energy Sector	Category	L	T	P	Credit
		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, Apply
CO2	Discuss the health and safety management system in energy sector	Remember, Understand, Apply
CO3	Draft emergency control measures for energy storage and handling	Remember, Understand, Analyze
CO4	Evaluate the risk issues in energy storage	Remember, Understand, Analyze
CO5	Mitigate high risk situation at energy sector	Remember, Understand, 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- Strong;2-Medium;1-Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	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

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


BoS Chairman

K.S.Rangasamy College of Technology–Autonomous							R2022	
60 PIS E56 – Safety in Energy Sector								
M.E. Industrial Safety Engineering								
Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
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 Blast-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 Committee Meeting-Flash Hazard Analysis-NFPA 70E Tables-Grounding and GFCI-Contractor Safety Management-Management of Change-Safety Induction and Orientation Training-Emergency Preparedness								[09]
Energy Control Programme: Mechanical Energy Control-Machine-guarding Principles-Trip Guards-Emergency Stop-Fixed Guards-Adjustable Guard-Interlock Guard-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-Super Capacitors-Safety in Electrochemical Energy Storage Devices-Energy Storage Safety Management System-Safety considerations in various categories of energy storage rooms-Battery Management System-Device Management System-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 lines-Tree trimming work-Line Clearance-Earthing of overhead line-Protection against lightning-Confined Space Work-Hot Work-Lockout/Tagout (LOTO) System-Tool Box Talks-Case Studies-Near Miss Studies.								[09]
Total Hours								45
Text book(s):								
1	Niresh Behari," Enhancing Safety culture in the energy sector: A complete Guide,worldwide publishing group,2020							
2	B Sudhakara reddy, "Energy security and development –The global context and indian perspectives, Springer,2015							
Reference(s):								
1	Muhammad Asif,"Handbook of energy and environmental security",Academic press,2022							
2	Michael land," security management for occupational safety,CRC press,1 st edition,2013							

Course Contents and Lecture Schedule

S.No	Topic	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/cm ² -	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

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sundararaju@ksrct.ac.in

Passed in BoS Meeting held on 18/05/23

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



BoS Chairman

60 PAC 001	ENGLISH FOR RESEARCH PAPER WRITING	Category	L	T	P	Credit
		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

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


BoS Chairman

AssessmentPattern

Bloom's Category	Continuous Assessment Tests (Marks)		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. Rangasamy College of Technology – Autonomous R 2022								
60 PAC 001 - ENGLISH FOR RESEARCH PAPER WRITING								
M.E. INDUSTRIAL SAFETY ENGINEERING								
Semester	Hours/Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	2	0	0	30	0	40	60	100
Introduction to Research Paper Writing								
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness							[6]	
Presentation Skills								
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction							[6]	
Title Writing Skills								
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check							[6]	
Result Writing Skills								
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions							[6]	
Verification Skills								
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first time submission							[6]	
Total Hours:							30	
TextBook(s):								
1.	Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011							
2.	Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006							
Reference(s):								
1.	Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006							
2.	Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.							
3.	Phill Williams, Advanced Writing skills for students of English, Rumian Publishers, 2018							
4.	Sudhir S. Pandhye, English Grammar and Writing Skills, Notion Press, 2017.							

Passed in BoS Meeting held on 18/05/23

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



BoS Chairman

Course Contents and Lecture Schedule

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

1. Dr.V.Sundararaju - sundararaju@ksrct.ac.in

60 PAC 002	DISASTER MANAGEMENT	Category	L	T	P	Credit
		PC	2	0	0	0

Objectives

- Summarize basics of disaster
- 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

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

Mapping with Programme Outcomes

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						

Assessment Pattern

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


BoS Chairman

Bloom's Category	Continuous Assessment Tests (Marks)		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. Rangasamy College of Technology – Autonomous R 2022								
60 PAC 002 – DISASTER MANAGEMENT								
M.E INDUSTRIAL SAFETY ENGINEERING								
Semester	Hours/Week			Total hrs	Credit	Maximum Marks		
	L	T	P			C	CA	ES
II	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 of Disasters and Hazards Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.								[6]
Disaster Prone Areas In India 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]
Disaster Preparedness and Management 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.								[6]
Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.								[6]
Total Hours:								30
TextBook(s):								

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


BoS Chairman

1.	Goel S. L., Disaster Administration and Management Text And Case Studies”, Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2.	NishithaRai, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “New Royal book Company,2007.
Reference(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.

Course Contents and Lecture Schedule

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

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


BoS Chairman

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

Course Designers

1. Dr.V.Sundararaju - sundararaju@ksrct.ac.in

60 PAC 003	CONSTITUTION OF INDIA	Category	L	T	P	Credit
		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 Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Pre-requisite

-NIL-

Course Outcomes

On the successful 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, Understand & 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

Mapping with Programme Outcomes

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

Passed in BoS Meeting held on 18/05/23

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



BoS Chairman

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		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. Rangasamy College of Technology – Autonomous R 2022								
60 PAC 003 – CONSTITUTION OF INDIA								
M.E INDUSTRIAL SAFETY ENGINEERING								
Semester	Hours/Week			Total hrs	Credit C	Maximum Marks		
	L	T	P			CA	ES	Total
II	2	0	0	30	0	40	60	100
History of Making of The Indian Constitution History, Drafting Committee, (Composition & Working)								[3]
Philosophy of The Indian Constitution Preamble, Salient Features								[3]
Contours of Constitutional Rights and Duties Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.								[6]
Organs of Governance Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.								[6]
Local Administration District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayat raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.								[6]

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


BoS Chairman

Election Commission		[6]
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.		
Total Hours:		30
TextBook(s):		
1.	The Constitution of India, 1950 (Bare Act), Government Publication.	
2.	Busi S N, Ambedkar B R, "Framing of Indian Constitution", 1st Edition, 2015.	
Reference(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	

Course Contents and Lecture Schedule

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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BoS Chairman

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