

# Chhattisgarh Sami Vivekanand Technical University, Bhilai

## Diploma in Industrial Safety & Fire Safety Engineering

Semester -IV

- A) Course Code : 2129471(020)  
 B) Course Title : Fire Safety Engineering-II  
 C) Pre- requisite Course Code and Title :  
 D) Rationale : Fire risks and hazards are most common in various aspects of constructions industry and in industry which also sometimes leads in an injury, property loss, fatal or sometimes in a disaster therefore Fire safety engineering plays most vital role to control over such disasters related to fire. At diploma level students are expected to study about the Fire Safety Engineering-I so as to develop a safety working place and Zero accidents for contractor, visitor, worker and management of any industry.

E) Course Outcomes:

CO-1: To learn about various parts of fire fighting vehicles and appliances.

CO-2: To understand the fire service equipment.

CO-3: To learn about various types of wire and lines.

CO-4: To understand the Breathing apparatus and associated equipment.

CO-5: To learn about Preplanning, action on arrival and control

F) Scheme of Studies:

Board of Study	Course Code	Course Titles	Scheme of Studies (Hours/Week)			Credits L+T+(P/2)
			L	P	T	
Civil Engineering	2129471 (020)	Fire Safety Engineering-II	2	-	1	3
Civil Engineering	2129461 (020)	Fire Safety Engineering-II (Lab)	-	2	-	1

L- Lecture,

T- Tutorial,

P- Practical,

Legend: Lecture (L) → CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture and others).

Practical (P) → LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies).

Tutorial (T) → SL: Self Learning.

G) Scheme of Assessment:

Board of Study	Course Code	Course Titles	Scheme of Examination					
			Theory			Practical		Total
			ESE	CT	TA	ESE	TA	Marks
Civil Engineering	2129471 (020)	Fire Safety Engineering-II	70	20	30	-	-	120
Civil Engineering	2129461 (020)	Fire Safety Engineering-II (Lab)	-	-	-	40	60	100

ESE: End Semester Exam,

CT: Class Test,

TA: Teachers Assessment

Legend- PRA: Process Assessment, PDA: Product Assessment

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### Note:

- TA in Theory includes Sessional work (SW) and attendance (ATT) with weightage of 70% and 30% of total respectively.
- TA in practical includes performance of PRA, PDA and Viva-Voce with weightage of 50%, 40% and 10% respectively.
- 85% attendance is essential in theory and practical classes to appear in Examination.

### H) Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

Convert unit of the given physical quantity from one unit system to other.

### CO-1: To understand the fire fighting vehicles appliances.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Define different types of pumps, primers.  SO1.2 Design the layout of fire fighting vehicles and appliances.  SO1.3 To Learn various types of ladders, hose and control vans.	LI1.1 To perform Firefighting with fire tender.  LI1.2 To study the different types of tenders.  LI1.3 To demonstrate the use and rescue from turntable safety ladder.  LI1.4 To demonstrate the use and rescue with fire resistance suit.	<b>UNIT-1.0 FIRE FIGHTING VEHICLES AND APPLIANCES</b>  1.1 Introduction to Fire Fighting vehicles and appliances, Pumps-types of pumps, primers and cooling system – uses, maintenance, installation, specification.  1.2 Layout of fire fighting vehicles and appliances- Rescue tenders, Crash tenders hose laying tenders other tender.  1.3 Turntable ladders, hose laying tenders, control vans, Rescue boats (SCUBA). 1.4 Fire resistance suit– types, use and rescue.	SL1.1 Learn about pumps, primers cooling system.  SL1.2 Learning about fire fighting vehicles and appliances.

### SW-1 Suggested Sessional Work (SW):

#### a. Assignments:

- Define pumps and write the different types of pumps and primers?
- Draw Layout of fire fighting Vehicles and appliances?
- Define (SCUBA) and their applications?
- Write short notes on Crash Tender, Rescue Tender.

#### b. Mini Project:

- Collect & Prepare the various Layout of Fire Fighting Vehicles and appliances.

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**CO-2: To understand the different types of fire and their protection.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Recognize Use and maintenance, hydrants and standpipes.	LI2.1 To perform Firefighting with fire hydrant system.	<b>UNIT-2.0 FIRE SERVICE EQUIPMENT</b> 2.1 Introduction to Fire services equipments, Use and maintenance, hydrants and standpipes.	SL2.1 Demonstrate the maintenance of, hydrants and standpipes.
SO2.2 Identify the hose reels hose fittings &coupling.	LI2.2 To perform hose drills – laying three hose, connection and disconnection couplings.	2.2 Hose reels, hose fittings -coupling- Male & Female coupling.	SL2.2 Learning about hose fittings - coupling.
SO2.3 To know the Branch holders, Radial branches, hose fittings.	LI2.3 To study different types of monitor, branch holder &coupling.	2.3 Branch holders, Radial branches, Monitors, Nozzles, Collecting heads.  2.4 Suction, hose fittings, adopters and ramps.	SL2.3 Learning about Radial branches, Monitors, Nozzles, Collecting heads.

**SW-2 Suggested Sessional Work (SW):**

**a. Assignments**

1. Explain maintenance of hydrants and standpipes.
2. Write down different type of fittings & coupling.
3. Explain in brief about adopters & Rams.

**b. Mini Project:**

1. Prepare the list and diagram of branch holders, radial branches, monitors, nozzles, collecting heads.
2. Perform the fire emergency escape drill for fire?

**CO-3: To learn about various types of wire and lines.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Explain different Types-wire and rope lines.	LI3.1 To Perform the rope knots, bend and hitches.	<b>UNIT-3.0 ROPES AND LINES</b> 3.1 Introduction to ropes and lines, different types of wire and rope lines used in fire service.	SL3.1 Selection, installation and maintenance of different types of ropes & lines.
SO3.2 Learning about testing of lines, knots, Bends.	LI3.2 To perform the use of extended fire escape ladders and rescue.	3.2 Use and testing of lines, knots, Bends and hitches, Rope work. Inspection and maintenance.	SL3.2 Learning about Extension ladders, wheels escape, hook ladder.
SO3.3 Define uses and maintenance Small gear.	LI3.3 To perform the inspection of Wheel fire escape ladder and hook ladder.	3.3 Ladders: features of Extension ladders, wheels escape, hook ladder.	SL3.3 Learning about Bends and

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Session Outcomes	Laboratory Instruction (LI)	Class room Instruction	Self Learning
	LI3.4 Demonstrate the use of fire lamps and lightning set.	<p>Inspection and maintenance.</p> <p>3.4 Uses and maintenance. Small gear and miscellaneous equipment's.</p> <p>3.5 General-purpose tools and equipment, Lamps and lighting sets.</p>	hitches, Rope work.

### SW-3 Suggested Sessional Work (SW):

#### a. Assignments:

1. Explain different types of wire & rope.
2. Explain different types of ladders.
3. Define lamps & lighting set.

#### b. Mini Project:

1. Perform different types of knots and bends used in fire service
2. Perform the Safety inspection of all wire and rope, Ladder and Maintenance work ?.

### CO-4: To understand the Breathing apparatus and associated equipment.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
<p>SO4.1 Define the modern Breathing apparatus and associated equipment.</p> <p>SO4.2 Identify types and operational use of modern oxygen breathing apparatus.</p>	<p>LI4.1 To demonstrate the use of modern breathing apparatus.</p> <p>LI4.2 To demonstrate the Fire Fighting from foam making mobile equipment.</p> <p>LI4.3 To study the different types of hydraulic rescue equipment.</p> <p>LI4.4 To perform safety inspection of modern breathing apparatus.</p> <p>LI4.5 To perform safety inspection of cylinder pressure gauge.</p>	<p><b>UNIT-4.0 BREATHING APPARATUS AND ASSOCIATED EQUIPMENT</b></p> <p>4.1 Introduction to Breathing apparatus used for Fire Fighting, breathing apparatus and associated equipment, resuscitation apparatus used for Firefighting.</p> <p>4.2 Foam making equipment, Firefighting from Foam making equipment, method of use and maintenance.</p> <p>4.3 Hydraulic rescue equipment and their use.</p> <p>4.4 Breathing apparatus types and operational use of modern oxygen breathing apparatus.</p> <p>4.4 Modern compressed air - breathing apparatus and their uses.</p> <p>4.5 Identification of cylinders used with breathing apparatus.</p>	<p>SL4.1 Types and operational use of modern oxygen breathing apparatus.</p> <p>SL4.2 Learning about modern oxygen breathing apparatus.</p> <p>SL4.2 Learning about Foam making equipment and hydraulic rescue equipment.</p>

### SW-4 Suggested Sessional Work (SW):

### a. Assignments:

1. Write the specification, use and maintenance of foam making equipment.
2. Explain various types and operation of modern breathing apparatus.
3. What is Modern compressed air -breathing apparatus and write down their uses.

### b. Mini Project:

1. Draw and Identification of cylinders used with breathing apparatus
2. Prepare an inspection checklist for your laboratory equipment.

### CO-5: To understand the Building Fire safety systems.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Design of fire ground operation Preplanning.	<b>Fire Ground operation-</b> LI5.1 To perform and practice different word of command used in appliance drill.	<b>UNIT-5.0 FIRE GROUND OPERATIONS</b> <b>5.1</b> Fire ground operation preplanning, action on arrival and control, methods of rescue, method of entry.	SL5.1 learn about Basics of Fire Investigations and their causes.
SO5.2 Define Fire ground Safety Procedures.	LI5.2 To perform and practice hose drills in a crew.	5.2 Personal safety while Firefighting.	SL5.2 Learning about Fire ground operation procedure.
SO5.3 Explain Basics of Fire Investigations.	LI5.3 To perform and practice three-men hydrant drill with hydrant post and hose pipe.  LI5.4 To perform and practice four men hydrant drill with hydrant post and hose  LI5.5 To perform and practice four men trailer pump drill with trailer pump suction pipe hose pipe and hose fitting.  LI5.6 To perform and practice ladder drill and its application.	5.3 Control procedure and use of other safety equipment.  5.4 Ventilation and salvage fire ground operations.  5.5 Fire ground Safety Procedures.  5.6 Basics of Fire Investigations of fire root causes.	SL5.3 Learning about Fire ground Safety Procedures.

### SW-5 Suggested Sessional Work (SW):

#### a. Assignments:

1. Write the fire ground operation.
2. Explain, Fire ground safety procedures?
3. Explain basics of fire investigations and their causes?
4. Explain methods of rescue and their types?

#### b. Mini Project:

1. List out Fire ground operation safety procedures chart
2. Prepare the Fire Investigations report of your nearby fire accident.

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**Legend:** CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

**Note:** Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

### I) Suggested Specification Table (For ESE of Classroom Instruction CI+SW+SL):

Unit Number	Unit Title	Marks Distribution			Total Marks
		R	U	A	
I	FIRE FIGHTING VEHICLES AND APPLIANCES	4	6	4	14
II	FIRE SERVICE EQUIPMENT	4	6	4	14
III	ROPES AND LINES	4	6	4	14
IV	BREATHING APPARATUS AND ASSOCIATED EQUIPMENT	4	6	4	14
V	FIRE GROUND OPERATIONS	4	6	4	14
Total		20	30	20	70

**Legend:** R: Remember, U: Understand, A: Apply and above

### J) Suggested Specification Table (For ESE of Laboratory Instruction\*):

Laboratory Instruction Number	Short Laboratory Experiment Title	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LI1.1	To study about Fire fighting Vehicles and appliances.	20	15	5
LI1.2	To study the different types of hose, branches, coupling, nozzle.			
LI1.3	To study the Fire Insurance and Investigation			
LI2.1	Study the rope knots ,bend and hitches			
LI2.2	To prepare Fire Accident investigation Report			
LI2.3	To study the different fire escape ladders.			
LI 3.1	Planning of evacuation routes and exits in terms of fire engineering- Exercise.			
LI3.2	To study the modern self contained breathing apparatus equipments.			
LI4.1	To study the practical designing methods of evacuation passages and exists.			
LI4.2	To study the special fire protection features for modern buildings.			
LI4.3	To study the Fire Insurance and Investigation			
LI4.4	To study the Fire safety audits, Risk Assessment.			
LI5.1	Case study of fire safety and capital investment.			

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L15.2	To study the special fire protection features for modern buildings.			
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\* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals.

**Legend:** PRA: Process Assessment, PDA : Product Assessment

**Note :** Only one experiment has to performed at the end semester examination of 40 Marks as per assessment scheme.

### (K) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Industrial visits
4. Industrial Training
5. Demonstration
6. Others

### L) Suggested Learning Resources:

#### (a) Books :

S.No.	Title	Author	Publisher	Edition & Year
1.	Fundamentals of Firefighter skills	IAFC	J&B learning	2013
2.	Fire Service Pump Operation	IAFC	J&B learning	2013
3.	Fire Service Hydraulics & Pump Operation	Paul Spurgeon	Fire Engineering Series, Penwell Publications	-
4.	Fundamental of Firefighting skill	David Schottky	Jones and Bartlett	2014

#### (b) Open source software and website address:

1. <https://www.nist.gov/el/fire-research-division-73300/fire-modeling-programs>
2. <https://fire.nv.gov/uploadedfiles/firenv.gov/content/bureaus/FST/4-ifipp-PSsm.pdf>
3. <https://dgfscdhg.gov.in/national-building-code-india-fire-and-life-safety>
4. <https://www.osha.gov/personal-protective-equipment>
5. [https://dgt.gov.in/sites/default/files/Fire%20Tech%20\\_%20Ind.%20Safety%20Mgmt\\_CTS%202.0\\_NSQ\\_F-3.pdf](https://dgt.gov.in/sites/default/files/Fire%20Tech%20_%20Ind.%20Safety%20Mgmt_CTS%202.0_NSQ_F-3.pdf)
6. <https://mohua.gov.in/upload/uploadfiles/files/Chap-7.pdf>
7. <https://www.hse.gov.uk/toolbox/fire.htm>

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## M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications/description	Relevant Experiment Number
1	Fire safety PPE's(Personal Protective Equipment's)	Safety Helmet(Red) Safety Earmuff Safety Goggle Safety Gloves Safety Shoes, Safety boot Safety Radium Jacket	All experiments
2	Fire Tender	With all equipment	LI1.1
4	Fire Hose pipe	RRL (rain for rubber lining) type- A and RRL (rain for rubber lining)Type -B	LI2.2
5	Branch	Short branch Triple purpose nozzle Revolving nozzle Fire fog nozzle Landon hand control branch, foam making -10 X-5X branch Multipurpose nozzle	LI2.3
6	Fire Hydrant system with pump	Hose box, Hose reel, Pumps, Panel	LI2.1
7	Fire alarm/siren set	Control panel, manual call point, Response indicator Heat detector smoke detector	LI2.1
8	Fire Resistant suit	-	-
9	Fire Blanket	-	-
10	Fire Bucket with stand	-	-
	Mobile foam making equipment unit 100ltr	-	LI4.2
11	Tunable fire safety ladder	-	LI1.3
12	Fire safety Ropes	Marine rope and lines	LI3.1
13	Breathing apparatus set	Oxygen cylinder, face mask,	LI4.1
14	Fire resistance suit		



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## N) Mapping of POs & PSOs with COs:

Course Outcomes (COs) Titles	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	Basic knowledge PO-1	Discipline knowledge PO-2	Experiments & Practice PO-3	Engineering Tools PO-4	The Engineer & Society PO-5	Environment & Sustainability PO-6	Ethics PO-7	Individual & Team work PO-8	Communication PO-9	Life Long learning PO-10	PSO-1	PSO-2
CO-1: To learn about various parts of fire fighting vehicles and appliances.	2	3	2	2	2	0	0	2	0	1	2	1
CO-2: To understand the fire service equipment.	2	2	3	2	2	0	0	1	0	2	2	1
CO-3: To learn about various types of wire and lines.	2	2	3	2	2	0	0	1	0	2	2	1
CO-4: To understand the Breathing apparatus and associated equipment.	2	2	3	2	2	0	0	1	0	2	2	2
CO-5: To learn about Preplanning, action on arrival and control.	2	2	3	2	2	0	0	1	0	2	2	1

Legend: 1 – Low, 2 – Medium, 3 – High

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**O) Course Curriculum Map:**

POs & PSOs No.	COs No.& Title	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,8,10 PSO-1,2	CO-1: To learn about various parts of fire fighting vehicles and appliances.	SO1.1 SO1.2 SO1.3	LI1.1 LI1.2 LI1.3 LI1.4	1.1 1.2 1.3 1.4	SL1.1 SL1.2
PO-1,2,3,4,5,8,10 PSO-1,2	CO-2: To understand the fire service equipment.	SO2.1 SO2.2 SO2.3	LI2.1 LI2.2 LI2.3	2.1 2.2 2.3 2.4	SL2.1 SL2.2 SL2.3
PO-1,2,3,4,5,8,10 PSO-1,2	CO-3: To learn about various types of wire and lines.	SO3.1 SO3.2 SO3.3	LI3.1 LI3.2 LI3.3 LI3.4	3.1 3.2 3.3 3.4 3.5	SL3.1 SL3.2 SL3.3
PO-1,2,3,4,5,8,10 PSO-1,2	CO-4: To understand the Breathing apparatus and associated equipment.	SO4.1 SO4.2	LI4.1 LI4.2 LI4.3 LI4.4 LI4.5	4.1 4.2 4.3 4.4 4.5	SL4.1 SL4.2 SL4.3
PO-1,2,3,4,5,8,10 PSO-1,2	CO-5: To learn about Preplanning, action on arrival and control.	SO5.1 SO5.2 SO5.3	LI5.1 LI5.2 LI5.3 LI5.4 LI5.5 LI5.6	5.1 5.2 5.3 5.4 5.5 5.6	SL5.1 SL5.2 SL5.3

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- A) **Course Code** : 2129472(020)
- B) **Course Title** : Legal Provision on Safety, Health and Environment
- C) **Pre- requisite Course Code and Title** :
- D) **Rationale** : Legal provisions plays an important role in good health and safety of the worker and environmental management in any industry .The various Acts and laws is to establish adequate safety measures and to enhance the health and welfare of workers employed in a factory. The Act also protects workers from various industrial and occupational hazards. The conservations and protection of environment is controlled through several national and international laws. Such laws bring awareness among people. Need for such legislation arose because of the increasing exploitation of environment.

E) **Course Outcomes:**

**CO-1: To understand the health and welfare provisions given in factories act.**

**CO-2: To understand different provisions of Environmental pollution act.**

**CO-3: To understand out important legislations given in Hazardous chemical rules**

**CO-4: To understand important legislations related to health, Safety and Environment in other important acts.**

**CO-5: To understand some other acts & international acts.**

F) **Scheme of Studies:**

Board of Study	Course Code	Course Titles	Scheme of Studies (Hours/Week)			Credits L+T+(P/2)
			L	P	T	
Civil Engineering	2129472(020)	Legal Provision on Safety Health and Environment	3	-	1	4

L- Lecture,

T- Tutorial,

P- Practical,

Legend: Lecture (L) → CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture and others).

Practical (P) → LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies).

Tutorial (T) → SL: Self Learning.

G) **Scheme of Assessment:**

Board of Study	Course Code	Course Titles	Scheme of Examination					
			Theory			Practical		Total
			ESE	CT	TA	ESE	TA	Marks
Civil Engineering	2129472 (020)	Legal Provision on Safety Health and Environment	70	20	30	-	-	120

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Convert unit of the given physical quantity from one unit system to other.

### CO-1: To understand the health and welfare provisions given in Factories act.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 To understand provisions relating to Factory Act.  SO1.2 To know safety, health & welfare, working hours employment of young persons.  SO1.3 To learn special provisions relating to penalties and procedure of the act.	--	<b>UNIT-1.0 FACTORIES ACT – 1948</b> 1.1 Factory Act and Rules 1.2 Statutory authorities 1.3 Inspecting staff, health, safety, provisions relating to hazardous processes, Welfare, working hours, employment of young persons. 1.4 Special provisions. 1.5 Penalties and procedures. 1.6 Chhattisgarh Factories Rules.	SL1.1 To study about different provisions of Factories act 1948.

### SW-1 Suggested Sessional Work (SW):

#### a. Assignments:

- Define
- Hazardous process
  - Worker
  - Child
  - Adolescent
  - Manufacturing Process

- Define
- Competent Person
  - Day
  - week
  - calendar year
  - Occupier.

#### b. Mini Project:

List out the various penalties under Factory Act 1948.

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### c. Other Activities (Specify):

List the important duties of Inspectors under Factories Act 1948.

### CO-2: To understand different provisions of Environmental pollution act.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
<p>SO2.1 To know different powers of central government with regard to Environment protection act.</p> <p>SO2.2 To know different rules regarding Biomedical waste, Noise pollution.</p> <p>SO2.3 To understands about Air act 1981 and Water act 1974.</p>	--	<p><b>UNIT 2.0 ENVIRONMENT PROTECTION ACT</b></p> <p>2.1 Environmental protection act 1986.</p> <p>2.2 Biomedical waste (Management and Handling) Rules, 1989.</p> <p>2.3 The Noise Pollution (Regulation and Control) Rules, 2000.</p> <p>2.4 The Batteries (Management and Handling Rules) 2001.</p> <p>2.5 Air (Prevention and control) Act 1981.</p> <p>2.6 Water (Prevention and Control) Act 1974.</p>	<p>SL2.1 Learn provisions of Environmental pollution Act.</p> <p>SL2.2 Understanding structure of pollution control board.</p>

### SW-2 Suggested Sessional Work (SW):

#### a. Assignments:

- What are the objectives of Environment Protection act 1986?
- What are the objectives of water pollution act 1974?

#### b. Mini Project:

Measure noise level and environment pollution level of your college campus and conclude it.

#### c. Other Activities (Specify):

Write a short note on Employers Liability act.

### CO-3: To understand out important legislations related to health, Safety and Environment given in Hazardous chemical rules.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
<p>SO3.1 Explain duties of authorities and responsibilities of occupier.</p> <p>SO3.2 To understand about safety reports and safety data sheets.</p>	--	<p><b>UNIT-3.0 MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES, 1989</b></p> <p>3.1 Definitions, duties of authorities, responsibilities of occupier, notification of major accidents, information to be furnished.</p>	<p>SL3.1 To prepare onsite and offsite emergency plan.</p>

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Session Outcomes (SOs)	Laboratory Instruction	Class room Instruction (CI)	Self Learning
		3.2 Preparation of offsite and onsite plans – list of hazardous and toxic chemicals  3.3 Safety reports – Material safety data sheets (MSDS).	

### SW-3 Suggested Sessional Work (SW):

#### a. Assignments:

- What are hazardous chemical, and how they are defined by regulatory agencies?
- What are safety data sheets and what information they include to comply with hazardous chemical rules and regulations.

#### b. Mini Project:

Develop a program to educate employees about hazardous chemical safety and its compliance.

#### c. Other Activities (Specify):

List out the 5 different hazardous chemicals and write down their safety data sheet.

### CO-4: To understand out important legislations related to health, Safety and Environment in other important acts.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 To understand provisions in Indian Boiler Act.  SO4.2 To learn Workman compensation act and rules  SO4.3 To know building and other construction workers act.	--	<b>UNIT-4.0 SAFETY, HEALTH &amp; ENVIRONMENT RELATED IMPORTANT LEGISLATION.</b>  4.1 Indian Boiler Act, 1923 and Rules made there under.  4.2 Workman's Compensation Act and Rules.  4.3 Electricity Act and Rules.  4.4 Hazardous Wastes (Management and Handling) Rules, 1989, with amendments in 2000-Hazardous Materials Transportation protection Rules.  4.5 Building and other Construction Workers Act, 1996.	SL4.1 To learn about different important rules and legislations.

### SW-4 Suggested Sessional Work (SW):

#### a. Assignments:

What are the objectives of workmen's compensation act 1923

#### b. Mini Project:

Discuss about the registration of Establishments provisions of Building and other construction workers act 1996.

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### C. Other Activities (Specify):

List the general provisions of Indian Boiler's Act.

### C0-5 : To understand some other acts & international acts.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 To learn occupational safety and health act.  SO5.2 To understand Different aspects in OHSAS18001 and ISO 14001.  SO5.3 ILO conventions and recommendations.	--	<b>UNIT-5.0 OTHER ACT AND RULES</b>  5.1 The Dock Workers (Safety, Health& welfare) Act ,1996.  5.2 ISO 14001.  5.3 ILO Conventions and recommendations  5.4 Petroleum Rules, Gas Cylinder Rules.  5.5 Pesticides Act, Insecticide Act and Rules.  5.6 Calcium Carbide Rules.  5.7 Radiation Protection Rules.  5.8 Indian Explosives Act, 1983.	SL5.1 To learn about occupational safety and health act.

### SW-5 Suggested Sessional Work (SW) :

#### a. Assignments:

- What is the role of OSHA in enforcing workplace safety regulations?
- What is purpose of OSHA?
- Write short notes on ILO conventions in providing safety health and welfare or workers.
- Explain the history of ILO.

#### b. Mini Project:

Prepare a list for safety precaution of your home gas cylinder.

### C. Other Activities (Specify): NA

**Legend:** CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

**Note:** Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

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## I) Suggested Specification Table (For ESE of Classroom Instruction CI+SW+SL):

Unit Number	Unit Title	Marks Distribution			Total Marks
		R	U	A	
I	FACTORIES ACT – 1948	4	6	4	14
II	ENVIRONMENT PROTECTION ACT	4	6	4	14
III	MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES, 1989	4	6	4	14
IV	SAFETY, HEALTH & ENVIRONMENT RELATED IMPORTANT LEGISLATION	4	6	4	14
V	OTHER ACT AND RULES	4	6	4	14
Total		20	30	20	70

Legend: R: Remember, U: Understand, A: Apply and above

## J) Suggested Specification Table (For ESE of Laboratory Instruction\*): Nil

Laboratory Instruction Number	Short Laboratory Experiment Title	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
-	-	-	-	-

\* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals

Legend : PRA: Process Assessment, PDA : Product Assessment

## (K) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Industrial visits
4. Industrial Training
5. Demonstration
6. Others

## L) Suggested Learning Resources:

### (a) Books :

S.No.	Title	Author	Publisher	Edition & Year
1	The Environment Act (Protection) 1986 with allied rules"	V. Sudhish Pai	Commercial Law Publishers (India) Pvt. Ltd. New Delhi.	1986
2	Water (Prevention and control of pollution) act 1974	Lakshay Kumar	Commercial Law publishers (India) Pvt. Ltd., New Delhi.	1974
3	Air (Prevention and control	EBC	Commercial Law	1981



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	of pollution) act 1981		Publishers (India) Pvt. Ltd., New Delhi	
4	Explosive Act, 1884 and Explosive rules, 1883 (India), (2002)	Sonthal Parganas	Eastern Book company, Lucknow, 10 th Edition.	1984
5	The manufacture, storage and import of hazardous chemical rules 1989		Madras Book Agency, Chennai.	1989
6	ISO 9000 to OHSAS 18001	Dr. K.C. Arora, S.K. Kataria & amp; Sons	ISO 9000 to OHSAS 18001	
7	The Factory Act	Madras Book Agency	Madras Book Agency, Chennai	2000

**(b) Open source software and website address:**

1. <https://labour.gov.in/sites/default/files/Factories Act 1948.pdf>
2. <https://legislative.gov.in/actsofparliamentfromtheyear/environment-protection-act-1986>
3. [https://cpcb.nic.in/air-pollution/#:~:text=The%20Air%20\(Prevention%20and%20Control,of%20air%20pollution%20in%20India](https://cpcb.nic.in/air-pollution/#:~:text=The%20Air%20(Prevention%20and%20Control,of%20air%20pollution%20in%20India)
4. <https://legislative.gov.in/sites/default/files/A1981-14.pdf>
5. <https://legislative.gov.in/actsofparliamentfromtheyear/environment-protection-act-1986>
6. <https://cpcb.nic.in/upload/home/water-pollution/A1977-36.pdf>

**M) List of Major Laboratory Equipment and Tools: Nil**

S. No.	Name of Equipment	Broad Specifications/description	Relevant Experiment Number
-	-	-	-

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## N) Mapping of POs & PSOs with COs:

Course Outcomes (COs) Titles	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	Basic knowledge PO-1	Discipline knowledge PO-2	Experiments & Practice PO-3	Engineering Tools PO-4	The Engineer & Society PO-5	Environment & Sustainability PO-6	Ethics PO-7	Individual & Team work PO-8	Communication PO-9	Life Long learning PO-10	PSO-1	PSO-2
CO-1: To understand the health and welfare provisions given in factories act.	2	3	2	2	2	0	0	2	0	1	2	1
CO-2: To understand different provisions of Environmental pollution act.	2	2	3	2	2	0	0	1	0	2	2	1
CO-3: To understand out important legislations given in Hazardous chemical rules	2	2	3	2	2	0	0	1	0	2	2	1
CO-4: To understand important legislations related to health, Safety and Environment in other important acts.	2	2	3	2	2	0	0	1	0	2	2	2
CO-5: To understand some other acts & international acts.	2	2	3	2	2	0	0	1	0	2	2	1

Legend: 1 – Low, 2 – Medium, 3 – High

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## O) Course Curriculum Map:

POs & PSOs No.	COs No.& Title	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,8,10 PSO-1,2	CO-1: To understand the health and welfare provisions given in factories act.	SO1.1 SO1.2 SO1.3	-	1.1, 1.2 1.3, 1.4 1.5, 1.6	SL1.1
PO-1,2,3,4,5,8,10 PSO-1,2	CO-2: To understand different provisions of Environmental pollution act.	SO2.1 SO2.2 SO2.3	-	2.1, 2.2 2.3, 2.4 2.5, 2.6	SL2.1 SL2.2
PO-1,2,3,4,5,8,10 PSO-1,2	CO-3: To understand out important legislations given in Hazardous chemical rules	SO3.1 SO3.2	-	3.1 3.2 3.3	SL3.1
PO-1,2,3,4,5,8,10 PSO-1,2	CO-4: To understand important legislations related to health, Safety and Environment in other important acts.	SO4.1 SO4.2 SO4.3	-	4.1, 4.2 4.3, 4.4 4.5	SL4.1
PO-1,2,3,4,5,8,10 PSO-1,2	CO-5: To understand some other acts & international acts.	SO5.1 SO5.2 SO5.3	-	5.1, 5.2, 5.3, 5.4 5.5, 5.6, 5.7, 5.8	SL5.1

**Legend:** CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

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- A) Course Code : 2129473(020)  
 B) Course Title : Occupational Health and Hygiene  
 C) Pre- requisite Course Code and Title :  
 D) Rationale : The Occupational health and hygiene aims to promote and maintain the highest degree of physical, mental and social well-being of workers in all occupations to prevent departures from health caused by their working conditions; the protection of workers in their employment from risk resulting from factors adverse to health; the placing and maintenance of the workers in an occupational environment adapted to his physiological and psychological make-up.

### E) Course Outcomes:

CO-1: Student will be able to learn about the occupational physical hazards and safety.

CO-2: Student will know the chemical hazard & biological hazard and its safety.

CO-3: Student will understand the occupational health toxicology.

CO-4: Student will know the occupational mental ill health and safety.

CO-5: Student will understand the welfare and First Aid.

### F) Scheme of Studies:

Board of Study	Course Code	Course Titles	Scheme of Studies (Hours/Week)			Credits L+T+(P/2)
			L	P	T	
Civil Engineering	2129473(020)	Occupational Health and Hygiene	2	-	1	3
Civil Engineering	2129462(020)	Occupational Health and Hygiene (Lab)	-	2	-	1

L- Lecture,

T- Tutorial,

P- Practical,

Legend: Lecture (L) → CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture and others).

Practical (P) → LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies).

Tutorial (T) → SL: Self Learning.

### G) Scheme of Assessment:

Board of Study	Course Code	Course Titles	Scheme of Examination					
			Theory			Practical		Total
			ESE	CT	TA	ESE	TA	Marks
Civil Engineering	2129473 (020)	Occupational Health and Hygiene	70	20	30	-	-	120
Civil Engineering	2129462 (020)	Occupational Health and Hygiene (Lab)	-	-	-	40	60	100

ESE: End Semester Exam,

CT: Class Test,

TA: Teachers Assessment

Legend- PRA: Process Assessment, PDA: Product Assessment

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### Note:

- TA in Theory includes Sessional work (SW) and attendance (ATT) with weightage of 70% and 30% of total respectively.
- TA in practical includes performance of PRA, PDA and Viva-Voce with weightage of 50%, 40% and 10% respectively.
- 85% attendance is essential in theory and practical classes to appear in Examination.

### H) Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

Convert unit of the given physical quantity from one unit system to other.

### CO-1: Student will be able to learn about the occupational physical hazards and safety.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Define the noise pollution and TLV of noise.  SO1.2 Explain the vibration hazards and safety.  SO1.3 Learn about the radiation hazard and safety.  SO1.4 Learn about Illumination types and glare effect.	LI1.1 Demonstrate the Noise Level Measurement (a) Measurement of Sound pressure level in dBA and db linear. (b) Frequency analysis of noise.  LI1.2 To study of vibration and its adverse effect on health.  LI1.3 To study the ionization and non-ionization radiation and its effect.  LI1.4 Demonstrate the Measurement of Illumination.  LI1.5 Determination of relative humidity and effective corrective temperature.	<b>UNIT-1.0 OCCUPATIONAL PHYSICAL HAZARD</b>  1.1 Noise- adverse effect of noise, noise exposure regulation, properties of sound, sound measuring instruments, industrial audiometry, Permissible threshold exposure limits - short term and long term effects of exposures – Preventive and control measures.  1.2 Vibration- types, adverse effects, instruments, surveying procedure, permissible exposure limit. Cold and heat stress.  1.3 Radiation- Ionizing radiation- types, effects, monitoring instruments, control programs, non-ionizing radiations- types, effects, monitoring instruments, control programs,  1.4 Illumination- types, standards, glare effect.	SL1.1 Learning about the permissible level of Noise exposure for different work area.  SL1.2 Knowing about the permissible level of Vibration and radiation exposure.

### SW-1 Suggested Sessional Work (SW):

#### a. Assignments:

1. Define vibration and Illumination in detail?
2. Write down about ionizing and non-ionizing radiations and their prevention.
3. What is noise? Write down about Noise Induced Hearing Loss (NIHL).

**b. Mini Project:**

1. Prepare the chart for minimum and maximums exposure limit for noise, vibration, radiation and illumination.

**CO-2: Student will know the chemical hazard & biological hazard and its safety.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
<p>SO2.1 To understand recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases.</p> <p>SO2.2 To learn TLV - Methods of Evaluation, process or operation description.</p> <p>SO2.3 To know chemical hazards and biological hazard's methods of Control - Engineering Control, training and education, P.P.E selection and use.</p>	<p>LI2.1 To study the Selection and use of occupational personal protective equipment.</p> <p>LI2.2 Discuss or demonstrate emergency eye irritation and use of eye wash fountain.</p>	<p><b>UNIT-2.0 CHEMICAL BIOLOGICAL HAZARD A SAFETY</b></p> <p>2.1 Chemical Hazard- Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases,</p> <p>2.2 Types, concentration, Route of entry to human system, TLV - Methods of Evaluation, process or operation description.</p> <p>2.3 Methods of Control - Engineering Control, training and education, P.P.E selection and use.</p> <p>2.4 Biological Hazard- Classification of Bio-hazardous agents –bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases.</p> <p>2.5 Bio-hazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets - building design.</p>	<p>SL2.1 Learning about the chemical hazards and its safety.</p> <p>SL2.2 Learning about different occupations chemical hazards.</p> <p>SL2.3 Know the biological hazard's and their methods of control.</p>

**SW-2 Suggested Sessional Work (SW):**

**a. Assignments**

1. Explain in brief, what is chemical hazards and its safety?
2. Explain different biological hazards and its safety procedure.
3. Define Bio-hazardous agents and bacterial agents in detail.

**b. Mini Project**

1. Prepare list of bio-hazardous agents in detail and its safety procedure.

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CO-3: Student will understand the occupational health toxicology.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Define Pre-employment and post-employment medical examinations.	LI3.1 Ear Testing on audiometer & demonstration of various models of audiometer	<b>UNIT-3.0 OCCUPATIONAL HEALTH AND TOXICOLOGY</b> 3.1 Concept and spectrum of health - functional units and activities of occupational health services. 3.2 Pre-employment and post-employment medical examinations. 3.3 Occupational related diseases, levels of prevention of diseases, notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax 3.4 Lead-nickel, chromium and manganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc) their effects and prevention. 3.5 Audiometric tests, eye tests, vital function tests. 3.6 Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems. 3.7 Work related musculoskeletal disorders-Carpal Tunnel Syndrome (CTS)- Tendon pain disorders of the neck- back injuries.	SL3.1 Student will learn the industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects.  SL3.2 Student will know pre-employment and post-employment medical examinations
SO3.2 Explain Occupational related diseases, levels of prevention of diseases.	LI3.2 Explanation of various notifiable occupational diseases with photographic models.		

**SW-3 Suggested Sessional Work (SW):**

**a. Assignments:**

1. Explain causes of work related mental ill health?
2. Define the changes in the nature of work and developing work skills?
3. Explain, what is gas poisoning (such as CO, ammonia, coal and dust etc.) their effects and prevention?

**b. Mini Project:**

1. Audiometric tests, eye tests, vital function tests.
2. Perform the safety inspection of your laboratory equipment.

**c. Other Activities (Specify):**

1. Prepare inspection checklist for your laboratory equipment.

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**CO-4: Student will know the occupational mental ill health and safety.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
<p>SO4.1 Evaluate the physiological requirements of jobs, parameters of measurements &amp; categorization of job heaviness.</p> <p>SO4.2 Define the inter-personal relationship, balancing act (home: work) effects, distress mechanism.</p> <p>SO4.3 Explain the balancing act (home: work) effects, distress mechanism.</p>	<p>LI4.1 To perform Physical Fitness Test (PFI Test).</p> <p>LI4.2 Explanation on the charts of industrial noise, notifiable diseases, physical health hazards, chemical health hazards, industrial dermatosis, prevention and control</p>	<p><b>UNIT-4.0 OCCUPATIONAL PHYSIOLOGY &amp; ERGONOMICS</b></p> <p>4.1 Introduction to Ergonomics-Man-man factor, Man -machine factor, Man- environment factor, allocation of functions – efficiency – occupational work capacity.</p> <p>4.2 Aerobic and anaerobic work – evaluation of physiological requirements of jobs – parameters of measurements – categorization of job heaviness.</p> <p>4.3 Work organization – stress – strain – fatigue – rest pauses – shift work – personal hygiene.</p> <p>4.4 Occupational stress-Organisational set-up, work environment, work culture, age-mix of working group, inter-personal relationship, balancing act (home: work) effects, distress mechanism.</p>	<p>SL4.1 Student will learn the balancing act (home: work) effects, distress mechanism.</p>

### SW-4 Suggested Sessional Work (SW):

#### a. Assignments:

1. What do you mean by occupational stress?
2. Explain various ergonomics factor?
3. Write short notes on Work organization stress, strain & fatigue.

#### b. Mini Project:

1. Draw the different ergonomic posture of your back.

#### b. Other Activities (Specify):

1. Prepare a list that may cause to increase the occupational stress.



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**CO-5: Student will understand the welfare and First Aid.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Understand the design of Safe working environment. SO5.2 Define the SO5.3 Explain the lifesaving actions care of unconscious victim, C.P.R., control of blood loss.	LI5.1 To perform and demonstrate the CPR.  LI5.2 First Aid practice for different injuries.  LI5.3 Demonstrate treatment for shock victim.  LI5.4 Demonstrate the ABC techniques to support airway, breathing and circulation.	<b>UNIT-5.0 LIFE SAVING ACTIONS AND FIRST AID</b> 5.1 First Aid, First Aid Rules, Method to give effective First aid as per injury or illness.  5.2 Lifesaving actions: care of unconscious victim ABC, DRSABC, CPR(Cardio pulmonary resuscitation), AED and function of human body, control of blood loss, shock management, injuries, wounds and bleeding, bone & joint injuries, burn & scald& stings, poisoning.  5.3 Medical emergencies: heart attack, stroke, epilepsy, diabetic coma, allergy, dressing & bandages, first aid in mines & quarries.  5.4 First aid Equipments; Stretcher, Ambulance.	SL5.1 To understand design of Safe working environment.  SL5.2 To learn lifesaving procedures CPR, First-aid, ABC and DRSABC methods.

### SW-4 Suggested Sessional Work (SW):

#### a. Assignments:

1. Write short notes on 1) ABC, 2) DRSABC, 3) CPR, 4) AED
2. Explain safe working environment and eating facilities?
3. Define, what is burn Injury and its First Aid procedure?
4. What is CPR? Explain, how will you handle the Unconscious person?

#### b. Mini Project:

1. Perform safety inspection of your First Aid Box.

**Legend:** CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

**Note:** Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

### I) Suggested Specification Table (For ESE of Classroom Instruction CI+SW+SL):

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Unit Number	Unit Title	Marks Distribution			Total Marks
		R	U	A	
I	OCCUPATIONAL PHYSICAL HAZARD	4	6	4	14
II	CHEMICAL & BIOLOGICAL HAZARD AND SAFETY	4	6	4	14
III	OCCUPATIONAL HEALTH AND TOXICOLOGY	4	6	4	14
IV	OCCUPATIONAL PHYSIOLOGY ERGONOMICS	4	6	4	14
V	LIFE SAVING ACTIONS AND FIRST AID	4	6	4	14
Total		20	30	20	70

Legend: R: Remember, U: Understand, A: Apply and above

## J) Suggested Specification Table (For ESE of Laboratory Instruction\*):

Laboratory Instruction Number	Short Laboratory Experiment Title	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LI1.1	Demonstrate the Noise Level Measurement (a) Measurement of Sound pressure level in dBA and dB linear. (b) Frequency analysis of noise.	20	15	5
LI1.2	To study of vibration and its adverse effect on health.			
LI1.3	To study the ionization and non-ionization radiation and its effect.			
LI1.4	Demonstrate the Measurement of Illumination.			
LI1.5	Determination of relative humidity and effective corrective temperature.			
LI2.1	To study the Selection and use of occupational personal protective equipment.			
LI2.2	Discuss or demonstrate emergency eye irritation and use of eye wash fountain			
LI 3.1	Ear Testing on audiometer & demonstration of various models of audiometer			
LI 3.2	Explanation of various notifiable occupational diseases with photographic models.			
LI4.1	To perform Physical Fitness Test (PFI Test).			
LI4.2	Explanation on the charts of industrial noise, notifiable diseases, physical health hazards, chemical health hazards, industrial dermatosis, prevention and control			
LI5.1	To perform and demonstrate the CPR.			

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LI5.2	First Aid practice for different injuries.			
LI5.3	Demonstrate treatment for shock victim.			
LI5.4	Demonstrate the ABC techniques to support airway, breathing and circulation.			

\* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals.

**Legend :** PRA: Process Assessment, PDA : Product Assessment

**Note:** Only one experiment has to performed at the end semester examination of 40 Marks as per assessment scheme.

### (K) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Industrial visits
4. Industrial Training
5. Demonstration
6. Others

### L) Suggested Learning Resources:

#### (a) Books:

S.No.	Title	Author	Publisher	Edition & Year
1	Handbook of Occupational Health and Safety	NSC Chicago	NSC Chicago	1982
2	Hand Book on First Aid	Multi Disciplinary Centre on Safety, Health & Environment	Multi Disciplinary Centre on Safety, Health & Environment, Bhubaneswar, Odisha	2012
3	Occupational Health and Hygiene in Industries	Raja Sekhar Mamillapalli, Visweswara Rao	PharmaMed Press / BSP Books; 1st edition (1 January 2021)	2021

#### (b) Open source software and website address:

1. <https://ncert.nic.in/textbook/pdf/ievs105.pdf>
2. <https://www.ioha.net/about/occupational-hygiene/>
3. <https://www.ise.org.in/>
4. <https://aiihph.gov.in/departments-of-occupational-health/>

### M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications/description	Relevant Experiment Number
1	Fire safety PPE's(Personal Protective Equipments)	Safety Helmet(Red, Blue, White, Yellow) Safety Earmuff Safety Goggle Safety Gloves Safety Shoes, Safety boot Safety Radium Jacket	LI2.1
2	Sound Level Meter, Octave filter set	For Noise measurement	LI1.1
3	Eye wash fountain with shower	For Chemical hazard safety	LI2.2
4	Step Test Stool (HT 46 CM) and stopwatch	Perform Physical Fitness Test	LI4.1
7	Ambo bag	For CPR	
8	Advanced CPR Training dummy with monitor & printer	Monitor, printer, dummy, Brand -mediPrakt	LI5.1
9	First aid kit (complete set)	<ul style="list-style-type: none"><li>• plasters in a variety of different sizes and shapes</li><li>• small, medium and large sterile gauze dressings</li></ul>	LI5.2

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		<ul style="list-style-type: none"><li>• at least 2 sterile eye dressings</li><li>• triangular bandages</li><li>• crepe rolled bandages</li><li>• safety pins</li><li>• disposable sterile gloves</li><li>• tweezers</li><li>• scissors</li><li>• alcohol-free cleansing wipes</li><li>• sticky tape</li><li>• thermometer (preferably digital)</li><li>• skin rash cream, such as hydrocortisone or calendula</li><li>• cream or spray to relieve insect bites and stings</li><li>• antiseptic cream</li><li>• painkillers such as paracetamol</li><li>• antihistamine cream or tablets</li><li>• distilled water for cleaning wounds</li></ul>	
10	Audiometer	For ear testing	LI3.1
11	Photographic models of occupational diseases with	For graphic model stud	LI3.2

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## N) Mapping of POs & PSOs with COs:

Course Outcomes (COs) Titles	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	Basic knowledge PO-1	Discipline knowledge PO-2	Experiments & Practice PO-3	Engineering Tools PO-4	The Engineer & Society PO-5	Environment & Sustainability PO-6	Ethics PO-7	Individual & Team work PO-8	Communication PO-9	Life Long learning PO-10	PSO-1	PSO-2
CO-1 Student will be able to learn about the occupational physical hazards and safety.	2	3	2	2	2	0	0	2	0	1	2	1
CO-2 Student will know the chemical hazard & biological hazard and its safety.	2	2	3	2	2	0	0	1	0	2	2	1
CO-3 Student will understand the occupational health toxicology.	2	2	3	2	2	0	0	1	0	2	2	1
CO-4 Student will know the occupational mental ill health and safety.	2	2	3	2	2	0	0	1	0	2	2	2
CO-5 Student will understand the welfare and First Aid.	2	2	3	2	2	0	0	1	0	2	2	1

Legend: 1 – Low, 2 – Medium, 3 – High

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## O) Course Curriculum Map:

POs & PSOs No.	COs No.& Title	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,8,10 PSO-1,2	CO-1 Student will be able to learn about the occupational physical hazards and safety.	SO1.1 SO1.2 SO1.3 SO1.4	LI1.1 LI1.2 LI1.3 LI1.4 LI1.5	1.1 1.2 1.3 1.4	SL1.1 SL1.2
PO-1,2,3,4,5,8,10 PSO-1,2	CO-2 Student will know the chemical hazard & biological hazard and its safety.	SO2.1 SO2.2 SO2.3	LI2.1 LI2.2	2.1 2.2 2.3 2.4 2.5	SL2.1 SL2.2 SL2.3
PO-1,2,3,4,5,8,10 PSO-1,2	CO-3 Student will understand the occupational health toxicology.	SO3.1 SO3.2	LI3.1 LI3.2	3.1, 3.2 3.3, 3.4 3.5, 3.6 3.7	SL3.1 SL3.2
PO-1,2,3,4,5,8,10 PSO-1,2	CO-4 Student will know the occupational mental ill health and safety.	SO4.1 SO4.2 SO4.3	LI4.1 LI4.2	4.1 4.2 4.3 4.4	SL4.1
PO-1,2,3,4,5,8,10 PSO-1,2	CO-5 Student will understand the welfare and First Aid.	SO5.1 SO5.2 SO5.3	LI5.1 LI5.2 LI5.3 LI5.4	5.1 5.2 5.3 5.4	SL5.1 SL5.2

**Legend:** CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

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- A) Course Code : 2129474(020)  
 B) Course Title : Safety in Engineering Industry  
 C) Pre- requisite Course Code and Title :  
 D) Rationale : Safety engineering concepts provide the structure for both safety and industrial design engineers to develop intrinsically safe equipment, systems, processes and facilities. It becomes imperative on the part of engineers and managers to adopt methods and use devices that will reduce the risks to the physical body and health of the workers. The personal protection takes paramount importance both in engineering practices and managerial functions. Ideally, early on safety design will ensure not only safe design for people, but also, a safe operational concept to handle industrial and non-industrial incidents and minimize the cause-effect.

E) Course Outcomes:

CO-1: To learn about safety in machinery work area.

CO-2: To understand the principle of machine guarding.

CO-3: To understand the safety in welding and gas cutting.

CO-4: To understand the safety in cold and hot working of metals.

CO-5: To understand the safety in finishing, inspection and testing.

F) Scheme of Studies:

Board of Study	Course Code	Course Titles	Scheme of Studies (Hours/Week)			Credits L+T+(P/2)
			L	P	T	
Civil Engineering	2129474 (020)	Safety in Engineering Industry	2	-	1	3
Civil Engineering	2129463 (020)	Safety in Engineering Industry (Lab)	-	2	-	1

L- Lecture,

T- Tutorial,

P- Practical,

Legend: Lecture (L) → CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture and others).

Practical (P) → LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies).

Tutorial (T) → SL: Self Learning.

G) Scheme of Assessment:

Board of Study	Course Code	Course Titles	Scheme of Examination					
			Theory			Practical		Total
			ESE	CT	TA	ESE	TA	Marks
Civil Engineering	2129474 (020)	Safety in Engineering Industry	70	20	30	-	-	120
Civil Engineering	2129463 (020)	Safety in Engineering Industry (Lab)	-	-	-	40	60	100

ESE: End Semester Exam,

CT: Class Test,

TA: Teachers Assessment

Legend- PRA: Process Assessment, PDA: Product Assessment



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### Note:

- i) TA in Theory includes Sessional work (SW) and attendance (ATT) with weightage of 70% and 30% of total respectively.
- ii) TA in practical includes performance of PRA, PDA and Viva-Voce with weightage of 50%,40% and 10% respectively.
- iii) 85% attendance is essential in theory and practical classes to appear in Examination.

### H) Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course. Convert unit of the given physical quantity from one unit system to other.

### CO-1: To learn about safety in machinery work area.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Define different types of safety rules in metal working machinery.	LI1.1 To study safety in wood turning machine operation.	<b>UNIT-1.0 SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES</b> 1.1 General safety rules, principles, maintenance, inspections of turning machines, boring machines, milling machine, planning machine and grinding machines. 1.2 Safety principles maintenance, types of hazards in wood working machinery. 1.3 Safety Principles, Maintenance, Types of hazards in metal working. 1.4 Electrical guards, work area, material handling, inspection. 1.5 safety Codes and standard for saws.	SL1.1 To learn general safety rules and principle of inspection.
SO1.2 To define safety principles in metal and wood working.	LI1.2 To study safety in drilling machine.		SL1.2 To learn material handling inspection.
SO1.3 To learn the hazards in machinery work area.	LI1.3 To study safety on Boring machine operation.		SL1.3 To learn types of hazards in metal and wood working.
	LI1.4 To perform safety inspection of metal working machinery.		
	LI1.5 To perform safety inspection of wood working machines.		

### SW-1 Suggested Sessional Work (SW):

#### a. Assignments:

1. What is machine guarding? Write different types of machine guarding.
2. Write down different types of machines in metal working?
3. Write short notes on –
  - I. Turning
  - II. Boring
  - III. Wood turning
  - IV. Hazards in wood working

**b. Mini Project:**

1. Prepare the machine safety assessment chart of your Institute's workshop.

**c. Other Activities (Specify):**

1. Perform the Machine safety audit of your laboratory.

**CO-2: To understand the principle of machine guarding.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 To understand the principle of guarding in machine work area.  SO2.2 To identify the different type of guarding in machine work area.	LI2.1 To Study about the machine guarding.  LI2.2 To Study about safe working principle of lathe operation.  LI2.3 To Study safety in molding operation.	<b>UNIT-2.0 PRINCIPLES OF MACHINE GUARDING</b>  2.1 Guarding during maintenance, Definition, Policy for ZMS (Zero Mechanical State)– guarding of hazards - point of operation protective devices.  2.2 Machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard.  2.3 Positional control guard, fixed guard fencing-guard construction- guard opening.  2.4 Benefits of good guarding systems.	SL2.1 To learn Guarding in wood working.  SL2.2 Learning about protective device.  SL2.3 To learn machine guarding system.  SL2.4 To learn Benefits of good Guarding system.

**SW-2 Suggested Sessional Work (SW):**

**a. Assignments**

1. Guarding in carpentry shop.
2. Explain protective guarding.
3. Explain benefits of good guarding systems ?
4. Write down types of machine guarding system ?

**b. Mini Project:**

1. Prepare the list of guarding equipment in your Institute.

**c. Other Activities (Specify):**

1. Visit a machine work area in your locality.

**CO-3: To understand the safety in welding and gas cutting.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Explain different welding processes.  SO3.2 Learning of hazards in welding.  SO3.3 Selection of	LI3.1 To Study safety in power saw cutting operation.  LI3.2 To Study arc welding operation and its safety.  LI3.3 To Study gas welding operation and its safety.	<b>UNIT-3.0SAFETY IN WELDING AND GAS CUTTING</b>  3.1 Gas welding and oxygen cutting, resistances welding, arc welding and cutting.  3.2 Common hazards,	SL3.1 To learn Selection, installation and maintenance of gas welding and arc welding protection system in

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Session Outcomes	Laboratory Instruction	Class room Instruction	Self Learning
associated equipment and instruments.	LI3.4 To study about safety in brazing, soldering and metalizing.  LI3.5 To study safety in storage and handling of gas cylinders.  LI3.6 To perform safety inspection of gas cylinder of your laboratory.	personal protective equipment, training, safety precautions in brazing, soldering and metalizing.  3.3 Selection, care and maintenance of the associated equipment and instruments.  3.4 Safety in generation, distribution and handling of industrial gases-colour coding.  3.5 Flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.	accordance with standards.  SL3.2 To learn types of welding operation and associated equipment.  SL3.2 To learn Brazing, soldering and metalizing Process.

### SW-3 Suggested Sessional Work (SW):

#### a. Assignments:

1. Explain Gas welding and oxygen cutting operation and its safety.
2. Explain difference between brazing, soldering and metalizing.
3. Write down the metals suitable for brazing and soldering.

#### b. Mini Project:

1. Prepare the safety checklist for inspection of your welding machine and cylinders.
2. Prepare the steps required for safety in welding site.

#### c. Other Activities (Specify):

1. Prepare an inspection checklist for welding site.

### CO-4: To understand the safety in cold and hot working of metals.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Explain safety in different cold working processes.  SO4.2 Learning of safety and guarding in hot working processes.  SO4.3 Selection of associated protective equipment and instruments.	LI4.1 To Study hazard and safety in cold forming.  LI4.2 To Study safety in hot working of metals.  LI4.3 To study hazard and safety in hand or foot-operated presses.	<b>UNIT-4.0 SAFETY IN COLD FORMING AND HOT WORKING OF METALS</b>  4.1 Safety in Cold working, power presses, point of operation safe guarding, auxiliary mechanisms.  4.2 Hand or foot-operated presses, power press set up and die removal, inspection and maintenance metal	SL4.1 To learn Hot Working and cold forming operation.  SL 4.2 To learn inspection and maintenance metal sheers – press brakes.  SL 4.3 To learn safety in gas

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		sheers-press brakes.  4.3 Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills safety.  4.4 Safety in gas furnace operation, work environment, material handling in foundries.	furnace operation.
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### SW-4 Suggested Sessional Work (SW):

#### a. Assignments:

1. Explain difference in hot and cold working.
2. Explain power press operation.
3. Write a note safety in forging operation.

#### b. Mini Project:

1. Prepare the safety protocol for hot working processes.
2. Perform the safety operation in hot forging area.

#### c. Other Activities (Specify):

1. Prepare an inspection checklist for laboratory equipment.

### CO-5: To understand the safety in finishing, inspection and testing.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Understanding of various heat treatment operations.  SO5.2 Learning of Boiler mountings and accessories.  SO5.3 Learning of safety in pressure vessels.	LI5.1 To Study safety in finishing. LI5.2 To Study safety in inspection and testing.  LI5.3 To Study safety in air leakage testing operation.	<b>UNIT-5.0 SAFETY IN FINISHING, INSPECTION AND TESTING</b>  5.1 Heat treatment operations, electro plating, paint shops, sand and shot blasting safety in inspection and testing.  5.2 Hydro testing, valves, boiler drums and headers.  5.3 Pressure vessels, air leak test, steam testing, personal monitoring devices	SL5.1 To learn Radiation hazards, and administrative controls  SL5.2 To learn Heat treatment operations  SL5.3 To learn Safety of boilers (both fire tube and water tube).

### SW-5 Suggested Sessional Work (SW):

#### a. Assignments:

1. Write the need for heat treatment?
2. Explain Safety in power plant operation?
3. Explain hydro testing, valves, boiler drums and headers.

#### b. Mini Project:

1. Prepare list of safety equipment needed in boiler operation.

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### C. Other Activities (Specify):

1. Prepare the safety protocol in boiler operation.

**Legend:** CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

**Note:** Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

### I) Suggested Specification Table (For ESE of Classroom Instruction CI+SW+SL):

Unit Number	Unit Title	Marks Distribution			Total Marks
		R	U	A	
I	SAFETY IN METAL WORKING MACHINERY AND OD WOOD WORKING MACHINES	4	6	4	14
II	PRINCIPLES OF MACHINE GUARDING	4	6	4	14
III	SAFETY IN WELDING AND GAS CUTTING	4	6	4	14
IV	SAFETY IN COLD FORMING AND HOT FORMING OF METALS	4	6	4	14
V	SAFETY IN FINISHING, INSPECTION AND TESTING	4	6	4	14
Total		20	30	20	70

**Legend:** R: Remember, U: Understand, A: Apply and above

### J) Suggested Specification Table (For ESE of Laboratory Instruction\*):

Laboratory Instruction Number	Short Laboratory Experiment Title	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LI1.1	To Study Wood turning lathe machine operation	20	15	5
LI1.2	To Study Safety in drilling machine			
LI1.3	To Study Boring machine operation			
LI1.4	To Study material Handling inspection			
LI2.1	To Study machine guarding operation			
LI2.2	To Study the working principle of lathe operation			
LI2.3	To Study molding operation			
LI3.1	To Study power saw cutting operation			
LI3.2	To Study arc welding operation			
LI3.3	To Study welding safety equipment			
LI3.4	To Study types of welding process			
LI3.5	To Study Gas welding process			
LI4.1	To Study Shearing operation			

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LI4.2	To Study sheet metal operation			
LI4.3	To Study work holding devices			
LI5.1	To Study measuring devices Operation			
LI5.2	To Study Precision measuring devices			
LI5.3	To Study air leakage testing operation			

\* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals

**Legend :** PRA: Process Assessment, PDA : Product Assessment

**Note :** Only one experiment has to performed at the end semester examination of 40 Marks as per assessment scheme.

### (K) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Industrial visits
4. Industrial Training
5. Demonstration
6. Others

### L) Suggested Learning Resources:

#### (a) Books :

S.No.	Title	Author	Publisher	Edition & Year
1	Accident Prevention Manual.	National Safety Council, Chicago, USA	National Safety Council, Chicago, USA	1982
2	Occupational Safety Manual, BHEL, Trichy		BHEL	1977
3	Safety Management	John V. Grimaldi and Rollin H. Simonds	All India Travelers Book seller, New Delhi.	1989
4	Safety in Industry	N.V. Krishnan	Jaico Publishery House	1996
5	Indian Boiler acts and Regulations	Government of India	Government of India	
6	Safety in the use of wood working machines	HMSO, UK	HMSO, UK	1992
7	Health and Safety in welding and Allied processes	Welding Institute, UK,	High Tech. Publishing Ltd., London	1989

**(b) Open source software and website address:**

1. [https://www.dir.ca.gov/dosh/cal\\_vpp/best\\_practices\\_symposiums/machine-guarding.barry-blodgett.pdf](https://www.dir.ca.gov/dosh/cal_vpp/best_practices_symposiums/machine-guarding.barry-blodgett.pdf)
2. <https://rlsdhamal.com/principles-of-machine-guarding/>
3. <https://www.baylor.edu/ehs/doc.php/380460.pdf>
4. <http://dSPACE.cusat.ac.in/jspui/bitstream/123456789/5181/1/Principles%20of%20machine%20guarding.pdf>
5. <https://dish.tn.gov.in/assets/pdf/Safety%20in%20Welding%20&%20Gas%20Cutting%20Operations.pdf>
6. <https://dish.tn.gov.in/assets/pdf/Safety%20in%20Welding%20&%20Gas%20Cutting%20Operations.pdf>

**M) List of Major Laboratory Equipment and Tools:**

S. No.	Name of Equipment	Broad Specifications/description	Relevant Experiment Number
1	Wood turning lathe machine	Centre Height, 6.5 inch ; Length Of Bed, 4,5,6 & 8 Feet ; Model No, IWTL/4 ; Face Plate Diameter, 7 inch ; Body Material, Iron	LI1.1
2	Drilling machine	Portable Universal Radial Drilling Machine is required to drill, core drill, ream, counter bore and tap holes of different sizes upto dia	LI1.2
3	Boring machine	boring spindle diameter of 100 mm, maximum torque on the spindle of 1100 Nm	LI1.3
4	Power saw cutting	Power Consumption, 1050w ; Cutting Blade Size, 110MM	LI3.1
5	Arc welding machine	Welding Current Range : 150 to 1200 Amps. b) Duty Cycle : Continuous, even for 1200 Amps. c) Open Circuit Voltage : 72 Volts (DC)	LI3.2 & LI3.4
6	Gas welding machine	Automatic Grade, Automatic ; Frequency (Hz), 50 htz ; Weight (kg), 10 Kg ; Current, 200-500 amp ; Portable, Yes	LI3.3
7	Air leakage testing Machine	Resolution & Accuracy Test pressure - 50 bar. (Differential type) ; or 0.1 to 1.0 cc/m. Accuracy 0.075%	LI 5.2 & LI5.3
8	Gas cylinders for welding	-	LI3.2, LI3.3

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## N) Mapping of POs & PSOs with COs:

Course Outcomes (COs) Titles	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	Basic knowledge PO-1	Discipline knowledge PO-2	Experiments & Practice PO-3	Engineering Tools PO-4	The Engineer & Society PO-5	Environment & Sustainability PO-6	Ethics PO-7	Individual & Team work PO-8	Communication PO-9	Life Long learning PO-10	PSO-1	PSO-2
CO-1 To learn about safety in machinery work area.	2	3	2	2	2	0	0	2	0	1	2	1
CO-2 To understand the principle of machine guarding.	2	2	3	2	2	0	0	1	0	2	2	1
CO-3 To understand the safety in welding and gas cutting.	2	2	3	2	2	0	0	1	0	2	2	1
CO-4 To understand the safety in cold and hot working of metals.	2	2	3	2	2	0	0	1	0	2	2	2
CO-5 To understand the safety in finishing, inspection and testing.	2	2	3	2	2	0	0	1	0	2	2	1

Legend: 1 – Low, 2 – Medium, 3 – High



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## O) Course Curriculum Map:

POs & PSOs No.	COs No.& Title	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,8,10 PSO-1,2	CO-1: To learn about safety in machinery work area.	SO1.1 SO1.2 SO1.3	LI1.1 LI1.2 LI1.3 LI1.4 LI1.5	1.1 1.2 1.3 1.4 1.5	SL1.1 SL1.2 SL1.3
PO-1,2,3,4,5,8,10 PSO-1,2	CO-2: To understand the principle of machine guarding.	SO2.1 SO2.2	LI2.1 LI2.2 LI2.3	2.1 2.2 2.3 2.4	SL2.1 SL2.2 SL2.3 SL2.4
PO-1,2,3,4,5,8,10 PSO-1,2	CO-3: To understand the safety in welding and gas cutting.	SO3.1 SO3.2 SO3.3	LI3.1 LI3.2 LI3.3 LI3.4 LI3.5 LI3.6	3.1 3.2 3.3 3.4 3.5	SL3.1 SL3.2 SL3.3
PO-1,2,3,4,5,8,10 PSO-1,2	CO-4: To understand the safety in cold and hot working of metals.	SO4.1 SO4.2 SO4.3	LI4.1 LI4.2 LI4.3	4.1 4.2 4.3 4.4	SL4.1 SL4.2 SL4.3
PO-1,2,3,4,5,8,10 PSO-1,2	CO-5: To understand the safety in finishing, inspection and testing.	SO5.1 SO5.2 SO5.3	LI5.1 LI5.2 LI5.3	5.1 5.2 5.3	SL5.1 SL5.2 SL5.3

**Legend:** CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

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- A) **Course Code** : 2129475(020)
- B) **Course Title** : Safety in Chemical Industry
- C) **Pre- requisite Course Code and Title** :
- D) **Rationale** : Chemicals as elements, compounds, mixtures, solutions and emulsions are very widely used and transported in the modern industrial society. Of necessity, they are also used in schools, universities and other training facilities to educate pupils in their safe use and handling and also are commonly used in domestic situations for cleaning, gardening and DIY. However, there are chemicals that should not mix or get in contact with others, as they can produce byproducts that may be toxic, carcinogenic, explosive etc, or can be dangerous themselves. To avoid disasters and mishaps, maintaining safety is considered paramount, especially by chemists. Chemical safety includes all those policies, procedures and practices designed to minimize the risk of exposure to potentially hazardous chemicals. This includes the risks of exposure to persons handling the chemicals, to the surrounding environment, and to the communities and ecosystems within that environment.

**CO-1: Student will be able find out the general safety precaution in chemical industry.**

**CO-2: Student will learn the basic concept of hazard in Chemical operation and their prevention.**

**CO-3: Student will know the Chemical Process safety.**

**CO-4: Student will be able to apply the Safety measures in transportation of chemical.**

**CO-5: Student will learn safety in maintenance, testing and inspection operation.**

### E) Scheme of Studies:

S. No.	Board of Study	Course Code	Course Titles	Scheme of Studies (Hours/Week)			
				L	P	T	Credits L+T+(P/2)
1.	Civil Engineering	2129475 (020)	Safety in Chemical Industry	2	-	1	3

L- Lecture,

T- Tutorial,

P- Practical,

Legend: Lecture (L) → CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture and others).

Practical (P) → LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies).

Tutorial (T) → SL: Self Learning.

### F) Scheme of Assessment:

S. No	Board of Study	Course Code	Course Titles	Scheme of Examinations					
				Theory			Practical		Total Marks
				ESE	CT	TA	ESE	TA	
1.	Civil Engineering	2129475 (020)	Safety in Chemical Industry	70	20	30	-	-	120

ESE: End Semester Exam, CT: Class Test, TA: Teachers Assessment

Legend – PRA: Process Assessment, PDA: Product Assessment

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### Note:

- TA in Theory includes Sessional work (SW) and attendance (ATT) with weightage of 70% and 30% of total respectively.
- TA in practical includes performance of PRA,PDA and Viva-Voce with weightage of 50%, 40% and 10% respectively.
- 85% attendance is essential in theory and practical classes to appear in Examination.

### G) Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

Convert unit of the given physical quantity from one unit system to other.

### CO-1: Student will be able find out the general safety precaution in chemical industry.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Identify the safety aspects of Chemical Industry.  SO1.2 To understand the safety precautions in chemical industry?  SO1.3 Control Measures To Minimize The Risk of Chemical Hazards.	--	<b>UNIT-1.0 GENERAL</b>  1.1 Types of Chemical Hazards.  1.2 Hazards due to material (property), Loading Unloading and Transportation.  1.3 Hazards associated with pollution, fire, explosion, toxic release.  1.4 Control measures of chemical hazards.  1.5 Control measures for fire, explosive, reactive, toxic and radioactive.  1.6 Pipe line transfer and corrosive Hazards.	SL1.1 To identify safety aspects and safety management of Chemical industry.  SL1.2 To identify the Chemical Hazards.  SL1.3 To Identify the Control measures toxic and radioactive.

### SW-1 Suggested Sessional Work (SW):

#### a. Assignments:

- Explain the Types of Chemical Hazards.
- What are the 7 safety measures for controlling hazardous chemicals?
- List the examples for flammable and explosive chemical.

#### b. Mini Project:

- Prepare the colour codes for safety in chemical Industries.

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**CO-2: Student will learn the basic concept of hazard in Chemical operation and their prevention.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
<p>SO2.1 To know the Handling of Chemicals.</p> <p>SO2.2 Identify hazardous materials- Safety measures for storage.</p> <p>SO2.3 To understand the Safety aspects associated with the storing.</p>	--	<p><b>UNIT-2.0 STORAGE SPECIFIC HAZARDS AND CONTROLS</b></p> <p>2.1 Receiving, Storing and Handling of Chemicals.</p> <p>2.2 Safe receipt, unloading procedure to Bulk tanks.</p> <p>2.3 Stacking along Drum storage sheds or warehouses.</p> <p>2.4 Hazardous materials- Safety measures for storage of other items such as Petroleum Products.</p> <p>2.5 Safety aspects associated with the storing and usage of gas cylinders, color coding.</p>	<p>SL2.1 To understand various handling operations in Chemicals Industry.</p> <p>SL2.2 To understand the hazardous materials.</p> <p>SL2.3 To understand the Safety aspects associated with the storing and usage of gas cylinders.</p> <p>SL2.4 To understand the Safe receipt, unloading procedure to Bulk tanks.</p>

**SW-2 Suggested Sessional Work (SW) :**

**a. Assignments**

1. What is the importance of chemical handling safety?.
2. Explain Safety measures for storage of other items such as Petroleum Products ?
3. Explain the safety aspects associated with the storing and usage of gas cylinders ?

**b. Mini Project:**

1. Make a project on different types of hazardous materials.

**CO-3: Student will know the Chemical Process safety.**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
<p>SO3.1 To understand the Distributed Control System.</p> <p>SO3.2 To understand the Use of appropriate gauges, valves, trips, alarms, interlocks, auto controls.</p> <p>SO3.3 To understand the importance Monitoring and control of hazardous exposures.</p>	--	<p><b>UNIT-3.0 PROCESS HAZARDS AND CONTROLS</b></p> <p>3.1 Use of appropriate gauges, valves, trips, alarms, interlocks, auto controls</p> <p>3.2 Safety features associated with Distributed Control System (DCS).</p> <p>3.3 Safety aspects of Analytical (Chemical) Laboratories.</p> <p>3.4 Sampling (including handling aspects of glass wares, gas bombs</p>	<p>SL3.1 To know the Process Hazard Analysis (PHA)?</p> <p>SL3.2 To Understand Monitoring and control of hazardous exposures</p> <p>SL3.3 To know the Distributed Control System (DCS).</p>

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Session Outcomes	Laboratory	Class room Instruction (CI)	Self Learning (SL)
		etc.  3.5 Monitoring and control of hazardous exposures.	

### SW-3 Suggested Sessional Work (SW):

#### a. Assignments:

1. What Is Process Hazard Analysis (PHA) ?.
2. Explain safety features associated with Distributed Control System (DCS).
3. Explain Monitoring and control of hazardous exposures.

#### b. Other Activities (Specify):

1. Prepare a power point presentation showing use of appropriate gauges, valves, trips, alarms, interlocks, auto control.

### CO-4: Student will be able to apply the Safety measures in transportation of chemical.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 To Identify the Safety measures for controlling hazardous chemicals.  SO4.2 To prepare the list of Hazardous substances by all modes of transportation.  SO4.3 To understand the Guidelines For Transporting chemicals and hazardous materials.	--	<b>UNIT-4.0 TRANSPORTATION OF CHEMICALS</b> 4.1 Safety measures for controlling hazardous chemicals  4.2 Safety precautions for flammable/explosive/radioactive/other hazardous.  4.3 Hazardous substances by all modes of transportation  4.4 Guidelines for Transporting chemicals and hazardous materials  4.5 Transportation of chemicals symbols and Uses  4.6 Materials Safety Data Sheet	SL4.1 To understand the importance of Safety precautions for flammable and Explosive material  SL4.2 To understand hazardous substances by all modes of transportation

### SW-4 Suggested Sessional Work (SW) :

#### a. Assignments:

1. What type of label is used for transportation of chemicals?.
2. What precautions are required for transportation of hazardous chemicals?.
3. Explain Guidelines For Transporting chemicals and hazardous materials ?.
4. What is a materials safety data sheet?

#### b. Other Activities (Specify):

1. Prepare a PPT and showing different Transportation of chemicals symbols and their Uses.

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CO-5: Student will learn safety in maintenance, testing and inspection operation.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
<p>SO5.1 To Guide through model checklist along with class room exercise on permit preparatory work.</p> <p>SO5.2 To Identify the importance of Detailed coverage on Permit- To- Work System (PTWS).</p> <p>SO5.3 To understand the Types of testing methods.</p>	--	<p><b>UNIT-5.0 INSPECTION, TESTING &amp; MAINTENANCE</b></p> <p>5.1 Inspection techniques for plants, storage and reaction vessels.</p> <p>5.2 Checklists for routine inspection, preventive and break down maintenance.-Testing.</p> <p>5.3 Types of testing methods including different NDT &amp; other methods like Liquid (Dye) Penetration.</p> <p>5.4 Detailed coverage on Permit-To- Work System (PTWS).</p> <p>5.5 Guide through model checklist along with class room exercise on permit to work.</p>	<p>SL5.1 To understand the Types of testing methods.</p> <p>SL5.2 To understand Inspection techniques for plants, storage and reaction vessels.</p> <p>SL5.3 To understand the importance Permit-To- Work System (PTWS).</p>

**Legend:** CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

## SW-5 Suggested Sessional Work (SW):

### a. Assignments:

1. Explain Checklists for routine inspection, preventive and break down maintenance.-Testing
2. Explain detailed coverage on Permit- To- Work System (PTWS).
3. What are the Types of testing methods?

## H) Suggested Specification Table (For ESE of Classroom Instruction CI+SW+SL):

Unit Number	Unit Title	Marks Distribution			Total Marks
		R	U	A	
I	GENERAL	4	6	4	14
II	STORAGE SPECIFIC HAZARDS AND CONTROLS	4	6	4	14
III	PROCESS HAZARDS AND CONTROLS	4	6	4	14
IV	TRANSPORTATION OF CHEMICALS	4	6	4	14
V	INSPECTION, TESTING & MAINTENANCE	4	6	4	14
Total		20	30	20	70

**Legend:** R: Remember, U: Understand, A: Apply and above

### (K) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Industrial visits
4. Industrial Training
5. Demonstration
6. Others

### I) Suggested Learning Resources:

#### (a) Books :Essential Reading:

S.No.	Title	Author	Publisher
1	Accident Prevention Manual for Industrial Operations	Michigan Ave	National Safety Council,425
2	Encyclopedia of Occupational Health and Safety	V.J. Davies & K. Tomasin	Thomas Telford Publishing, London
3	Safety and Health for Engineers	Roger L Brauer,	Van Nostrain Reinhold
4	Modern Methods of Material Handling	Linger L	Linger L
5	Loss Prevention in the Process Industries	Butterworth Heinemann.	Mc Graw-Hill
6	Chemical Process Safety Fundamentals with Applications	Crowl	Pearson Education India
7	Safety at Work	John Ridley.	Charles D. Reese and James Edison

#### (b) Open source software and website address:

1. <https://www.hse.gov.uk/chemicals/index.htm>
2. <https://iosh.com/health-and-safety-professionals/improve-your-knowledge/occupational-health-toolkit/chemical-hazards/>
3. <https://www.hse.gov.uk/chemical-classification/index.htm>
4. <https://www.cdc.gov/niosh/npg/default.html/>
5. <https://www.meity.gov.in/content/chemical-handling-disposal>

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## J) Mapping of POs & PSOs with COs:

Course Outcomes (COs) Titles	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	Basic knowledge PO-1	Discipline knowledge PO-2	Experiments & Practice PO-3	Engineering Tools PO-4	The Engineer & Society PO-5	Environment & Sustainability PO-6	Ethics PO-7	Individual & Team work PO-8	Communication PO-9	Life Long learning PO-10	PSO-1	PSO-2
CO-1: Student will be able find out the general safety precaution in chemical industry.	2	3	2	2	2	0	0	2	0	1	2	1
CO-2: Student will learn the basic concept of hazard in Chemical operation and their prevention.	2	2	3	2	2	0	0	1	0	2	2	1
CO-3: Student will know the Chemical Process safety.	2	2	3	2	2	0	0	1	0	2	2	1
CO-4: Student will be able to apply the Safety measures in transportation of chemical.	2	2	3	2	2	0	0	1	0	2	2	2
CO-5: Student will learn safety in maintenance, testing and inspection operation.	2	2	3	2	2	0	0	1	0	2	2	2

Legend: 1 – Low, 2 – Medium, 3 – High



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**K) Course Curriculum Map:**

POs & PSOs No.	COs No.& Title	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,8,10 PSO-1,2	CO-1: Student will be able find out the general safety precaution in chemical industry.	SO1.1 SO1.2 SO1.3	--	1.1 1.4 1.2 1.5 1.3 1.6	SL1.1 SL1.2 SL1.3
PO-1,2,3,4,5,8,10 PSO-1,2	CO-2: Student will learn the basic concept of hazard in Chemical operation and their prevention.	SO2.1 SO2.2 SO2.3	--	2.1 2.2 2.3 2.4 2.5	SL2.1 SL2.2 SL2.3 SL2.4
PO-1,2,3,4,5,8,10 PSO-1,2	CO-3: Student will know the Chemical Process safety.	SO3.1 SO3.2 SO3.3	--	3.1 3.4 3.2 3.5 3.3	SL3.1 SL3.2 SL3.3
PO-1,2,3,4,5,8,10 PSO-1,2	CO-4: Student will be able to apply the Safety measures in transportation of chemical.	SO4.1 SO4.2 SO4.3	--	4.1 4.4 4.2 4.5 4.3 4.6	SL4.1 SL4.2
PO-1,2,3,4,5,8,10 PSO-1,2	CO-5: Student will learn safety in maintenance, testing and inspection operation.	SO5.1 SO5.2 SO5.3	--	5.1 5.4 5.2 5.5 5.3	SL5.1 SL5.2 SL5.3

**Legend:** CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.