A) Course Code : 2129371(020)
B) Course Title : Fire Safety Engineering-I
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 understand the chemistry and physics of Fire.

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

CO-3: (a) To learn about various types of industrial Fire protection systems.

(b) To learn about the fire explosion and protection.

CO-4: To understand the Building Fire safety systems.

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	2129371(020)	Fire Safety Engineering-I	2	-	1	3
Civil Engineering	2129361(020)	Fire Safety Engineering-I (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	2129371 (020)	Fire Safety Engineering-I	70	20	30	-	-	120
Civil Engineering	2129361 (020)	Fire Safety Engineering-I (Lab)	-	-	-	40	60	100

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

Legend - PRA: Process Assessment, PDA: Product Assessment

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 understand the Chemistry and Physics of fire.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Define different types of fire in solid liquid and gases. SO1.2 Characterization different type of fire explosions. SO1.3 To Learn the hazards and root cause of the disaster through various case studies.	LI1.1 To Study the chemistry of fire and their types. LI1.2 SCBA (self contained breathing apparatus) drill. LI1.3 To study of different types of fire safety PPE'S.	**UNIT-1.0 Fire Chemistry** 1.1 Fire properties of solid, liquid and gases-fire spread-toxicity of products of combustion. 1.2 Theory of combustion and explosion – vapour clouds – flash fire – jet fires – pool fires – unconfined vapour cloud explosion, shock waves – auto-ignition – boiling liquid expanding vapour explosion. 1.3 Case studies – Flixborough, Mexico disaster, Piper Alpha, Bombay Victoria dock ship explosions, Bhopal gas tragedy.	SL1.1 Fire properties and fire hazards and root cause of the disaster through various case studies.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. What are fire hazards?
2. Write down the fire properties of solid, liquid and gases?
3. Write short notes on –
   - I. Flash Fire
   - II. Pull Fire
   - III. Jet fire
   - IV. VCE
   - V. BLEVE

b. Mini Project:

1. Prepare the fire risk assessment chart of your classroom.

c. Other Activities (Specify):

1. Perform the fire safety audit of your laboratory

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 various types of fire and their extinguishing methods. SO2.2 Identify the different type of fire in solid, liquid, gas, metal and electrical. SO2.3 To know the different fire hydrant system and demonstrate by the fire hydrant system.	LI2.1 To study about Fire protection - graphic symbols and safety signs. LI2.2 Hose drills – laying one hose, connection and disconnection couplings. LI2.3To Study about fire branches and nozzles	**Unit 2.0 Fire Prevention and Protection.** 2.1 Sources of ignition – fire triangle- fire tetrahedron – principles of fire extinguishing – active and passive fire protection systems. 2.2 Various classes of fires – A, B, C, D, E – types of fire extinguishers. 2.3 Principles of Fire extinguishing methods- Cooling, Starvation, Smothering (Blanketing), Retarding chain reaction. 2.4 Fire stoppers – hydrant pipes – hoses – monitors – fire watchers – layout of stand pipes. 2.5 Fire station-fire alarms and sirens – maintenance of fire trucks – foam generators – escape from fire rescue operations – fire drills – notice-first aid for burns.	SL2.1 Demonstrate fire rescue operation. SL2.2 Learning about first aid for burns. SL2.3 Learning to handle the fire emergency.

SW-2 Suggested Sessional Work (SW):

a. Assignments

1. Explain fire triangle with suitable diagram.
2. Explain fire tetrahedron in brief with neat and clean diagram.
3. Write down different types of fire and their extinguishing agents.
4. Explain the first aid procedure for Burns.

b. Mini Project:

1. Perform the fire mock drill for class A, B & C type of fire.

c. Other Activities (Specify):

1. Perform the mock drill for fire rescue operation.

CO-3: (a) To learn about various types of industrial Fire protection systems.
(b) To learn about the fire explosion and protection.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Explain different fire protection system. SO3.2 Learning of arising of fire alarming and siren system and escape from the fire. SO3.3 Define the different types of fire extinguishers and their use. SO3.4 Define the installation and maintenance of fire safety systems. SO3.5 Explain the various explosion protection system.	LI3.1 Study and use of different fire extinguishing Hand Appliances - water, foam, dry powder, ABC Powder, CO2-Firefighting exercise. LI3.2 To Study and demonstration of fire safety systems. LI3.3 Demonstrate the arising of fire alarming and siren system and escape from the fire.	**Unit-3.0 Industrial Fire Protection Systems.** 3.1 Sprinkler system, fire hydrants, stand pipe, deluge, drenchers, smoke detector, Fire detection and Alarm systems-their installation and maintenance compliances with standards. 3.2 Other suppression systems – CO2 system, foam system, dry chemical powder (DCP) system, halon system – need for halon replacement – smoke venting. **Unit-4.0 Explosion Protection Systems.** 4.1 Principles of explosion-detonation and blast waves-explosion parameters. 4.2 Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure. 4.3 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-hazards in LPG, ammonia (NH3), Sulphur dioxide (SO), chlorine (CL) etc.	SL3.1 Selection, installation and maintenance of fire protection system in accordance with standards.

SW-3 Suggested Sessional Work (SW):

a. Assignments:
1. Explain different type of fire suppression system.
2. Define the installation and maintenance of smoke detectors.
3. Write a note fire hydrant system.

b. Mini Project:
1. Perform the fire mock drill for class A, B, C type of fire.
2. Perform the safety inspection of all fire extinguishers.

b. Other Activities (Specify):
1. Prepare a inspection checklist for your laboratory equipment.

CO-4: 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 safe building accordance with the standards. SO5.2 Calculation of fire load in buildings. SO5.3 fire safety installation in high rise buildings.	LI5.1 To study of fire risk assessment in building. LI5.2 Demonstrate fire rescue operation in building.	**Unit-5.0 Building Fire Safety** 5.1 Objectives of fire safe building design, Fire load calculation, fire resistant material and fire testing. 5.2 Structural fire protection – structural integrity – concept of egress design – exists – width calculations - fire certificates – fire safety requirements for high rise buildings – snookers.	SL5.1 Fire safety of buildings according to standards.

SW-4 Suggested Sessional Work (SW) :

a. Assignments:

1. Write the requirements of fire safe building design.
2. Explain, how to calculate the fire loads in high rise buildings?

b. Mini Project:

1. Prepare the fire risk assessment of your college building.

C. Other Activities (Specify):

1. Perform fire safety audit of your college building and prepare the audit report.

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 chemistry	4	6	4	14
II	Fire prevention and protection	4	6	4	14
III	Industrial fire protection systems	4	6	4	14
IV	Explosion protection systems	4	6	4	14
V	Building fire safety	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 the chemistry of fire and their types.	20	15	5
LI1.2	SCBA (Self contained breathing apparatus) drill.			
LI1.3	To study of different types of fire safety PPE'S.			
LI2.1	To study about Fire protection - graphic symbols and safety signs.			
LI2.2	Hose drills – laying one hose, connection and disconnection couplings.			
LI2.3	Rescue drills – The fireman's lift, fireman's drag, and fireman's hand stretchers.			
LI 3.1	To Study and use of different fire extinguishing Hand Appliances - water, foam, dry powder, ABC Powder, CO2-Firefighting exercise.			
LI3.2	Demonstrate the arising of fire alarming and siren system and escape from the fire.			
LI4.1	To study of fire risk assessment in building.			
LI4.2	Demonstrate fire rescue operation in building.			

* 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	Fire Prevention Hand Book	Derek, James	Butterworths and Company, London	1986
2	Hand Book of Fire Technology	Gupta, R.S	Orient Longman, Bombay	1977
3	Firefighting Principles & Practices	William E. Clark,		1991.

4	Fire and explosion protection – A System Approach,	DinkoTuhtar,	Ellis Horwood Ltd	1989
5	Fire fighters hazardous materials reference book	Nostrand Rein Hold, Newyork	-	1991
6	Accident Prevention manual for industrial operations,	-	N.S.C., Chicago	1982
7	Handbook of Fire & Explosion Protection Engineering Principles for Oil, Gas, Chemical, & Related Facilities	Dennis P. Nolan,	William Andrew Publishers	1997

(b) Open source software and website address:

1. **https://www.bis.gov.in/**
2. **https://hsseworld.com/**
3. **https://dgfscdhg.gov.in/national-building-code-india-fire-and-life-safety**
4. https://www.osha.gov/personal-protective-equipment
5. **https://ohsonline.com/Articles/2007/12/Fire-Detection-and-Alarm-Systems-A-Brief-Guide.aspx**
6. **https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=10**
7. **https://www.nfpa.org/News-and-Research/Publications-and-media/Blogs-Landing-Page/NFPA-Today/Blog-Posts/2021/07/16/Fire-Extinguisher-Types**

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)	SCBA (Self-contained breathing Apparatus) Safety Helmet(Red, Blue, White, Yellow) Safety Earmuff Safety Goggle Safety Gloves Safety Shoes, Safety boot Safety Radium Jacket	LI1.2 & LI 1.3
2	Fire Hose pipe	Canvas Hose Pipe, PVC hose pipe	LI2.2
3	Couplings	Threaded type , interlocking type (Instantaneous type) , sure lock, Delivery hose coupling, suction hose coupling	LI2.2
4	Branch	Short branch/standard branch ,Nozzles Revolving branch,, Fog branch, triple , Landon hand control branch, foam making -10 X-5X branch	LI2.3
5	Fire Extinguisher	Water Type Foam Type Dry Chemical Powder (ABC) CO_2 Type	LI3.1
6	Fire alarm/siren set	-	LE3.2
7	Manual call point	-	LE3.2

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 chemistry and physics of Fire.	2	3	2	2	2	0	0	2	0	1	2	1
CO-2 To understand and the different types of Fire and their protection.	2	2	3	2	2	0	0	1	0	2	2	1
CO-3 To learn about various types of industrial Fire protection systems.	2	2	3	2	2	0	0	1	0	2	2	1
CO-4 To understand the basic fundamentals of Fire Propagation.	2	2	3	2	2	0	0	1	0	2	2	2
CO-5 To learn about the fire explosion and protection.	2	2	3	2	2	0	0	1	0	2	2	1

Legend: 1 – Low, 2 – Medium, 3 – High

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 chemistry and physics of Fire.	SO1.1 SO1.2 SO1.3	LI1.1 LI1.2 LI1.3	1.1 1.2 1.3	SL1.1
PO-1,2,3,4,5,8,10 PSO-1,2	CO-2 To understand and the different types of Fire and their protection.	SO2.1 SO2.2 SO2.3	LI2.1 LI2.2 LI2.3	2.1 2.4 2.2 2.5 2.3	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 industrial Fire protection systems.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	LI3.1 LI3.2 LI3.3	3.1 4.1 3.2 4.2 4.3	SL3.1
PO-1,2,3,4,5,8,10 PSO-1,2	CO-4 To understand the basic fundamentals of Fire Propagation.	SO5.1 SO5.2 SO5.3	LI5.1 LI5.2	5.1 5.2	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.

A) Course Code : 2129372(020)

B) Course Title : Fire Codes and Standard

C) Pre- requisite Course Code and Title :

D) Rationale : Fire code and standard is a subject which fulfills all statutory requirements for the firefighting appliances as well as fire fighters personal. Students will be able to control and minimize the fire related hazards and risk associated with industry and to develop safe working environment by compliances with the fire code and standard specifications. Students will also belearn and demonstrate the industrial, municipal and state life safety and fire protection measures in accordance with Bureau of Indian Standards (BIS) and National Building code (NBC).

E) Course Outcomes:

CO-1: To learn about the specification of firefighting equipment and fire fighting Personal Protective Equipment.

CO-2: To understand the various fire safety codes and standards for designing the building and temporary structure.

CO-3: Student will know the various fire safety codes and standards for Rescue &firefighting equipmentmen's, Hydraulic platforms, Industrial, Municipal and State life safety & fire protection measures.

F) 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	L 2129372 (020)	Fire Codes and Standard	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.

G) 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	2129372 (020)	Fire Codes and Standard	70	20	30	-	-	120

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

Legend – PRA: Process Assessment, PDA: Product Assessment

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 the specification of firefighting equipment and fire fighting Personal Protective Equipment.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Define specification of fire-fighting equipment. SO1.2 Identify technical parameter/ specification specific reference to appliances. SO1.3 To know code, standard and specification concerning to safety of fire-fighting personnel protective equipment, safety gears and other devices.	--	**UNIT-1.0 Specification of fire-fighting equipment** 1.1 Specification of fire-fighting equipment. 1.2 Technical parameter/ specification specific reference to appliances. 1.3 Code, Standard and specification concerning to safety of fire-fighting P.P.E. i.e., Breathing Apparatus, Safety gears and other devices.	SL1.1 Students will be able to use fire fighting equipments and PPE in accordance with Indian standards.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. What is PPE? Write different types of fire fighting equipments and their Indian standards.
2. Write full form of SCBA. Which Indian standard is used for SCBA?
3. What is scope of work for sprinkler system? Which Indian Standard is used in fire sprinkler system installation?
4. Write specification of Fire hydrant system. Which Indian standard is used for fire hydrant system installation?
5. How will you perform the testing of fire sprinkler system?

b. Mini Project:

1. Prepare a chart of different type of modern fire fighting equipments and their material used in it
2. Prepare a chart of PPEused in fire rescue operation with suitable diagram.

CO-2: To understand the various fire safety codes and standards for designing the building and temporary structure.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Identify Code & Standards concerning construction & Design of building Code and Practice for construction of temporary structures. SO2.2 Learn about Code & Standards for Pandal/ Samiyana and scaffolding.	--	**Unit 2.0 Building design and temporary structure** 2.1 Code & Standards concerning construction & Design of building 2.2 Code and Practice for construction of temporary structures.	SL2.1 Student will be able to minimize fire related accidents in buildings and pandals etc.

Session Outcomes (SOs)	Laboratory	Class room Instruction (CI)	Self Learning (SL)
		2.3 Code & Standards for Pandal/ Samiyana and scaffolding.	

SW-2 Suggested Sessional Work (SW) :

a. Assignments

1. Explain fire safety code and standard for temporary structure.
2. Write the correct procedure to erect scaffolding for high rise buildings by compliance with the standards

b. Mini Project:

1. Inspect your college building's structure design to comply with the standards.

c. Other Activities (Specify):

1. Prepare Safety audit report for college building and nearest under construction building for compliance with standard

CO-3: Student will know the various fire safety codes and standards for Rescue &firefighting equipmentmen's, Hydraulic platforms, Industrial, Municipal and State life safety & fire protection measures.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 DefineInternational code & standard for Hydraulic platform when erected. SO3.2 To implementInternational code & standard for Turntable ladder when using. SO3.3 Rescue and fire-fighting must be in accordance to the International and national code & standard. SO3.4 Comply the Code and standard for passive fire protection system and materials. SO3.5 Municipal and state life safety and fire protection in accordance with standards.	--	**Unit-3.0 Firefighting devices and rescue operation** 3.1 International and National code & standard for Hydraulic platform. 3.2 International and National code & standard for Turntable ladder. 3.3 International and National code & standard forother Rescue and fire-fighting devices and components. **Unit-4.0 Passive fire protection** 4.1 Code and standard for passive fire protection system and materials **Unit-5.0 Municipal and state life safety and fire protection** 5.1 Code, Standard and byelaws concerning Industrial, Municipal and State life safety & fire protection measures.	SL1.1 Learn the fire rescue operation& life safety measures

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. Define International code & standard for Hydraulic platform when erected.
2. What is the procedure for safe erection of turntable ladder and rescue with Turntable ladder according to standards.
3. How will you perform Rescue and fire-fighting in accordance with International and national code & standard?
4. Explain the Code and standard for passive fire protection system and materials.
5. Write short note on Municipal and state life safety and fire protection in accordance with standards

c. Other Activities (Specify):

1. Demonstrate the fire rescue operation.
2. Write the PPE list for fire rescue 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	Specification of fire-fighting equipment	3	7	10	20
II	Building design and temporary structure	2	3	5	10
III	Firefighting devices and rescue operation	3	7	10	20
IV	Passive fire protection	2	3	5	10
V	Municipal and state life safety and fire protection	2	3	5	10
Total		12	23	35	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	
-	-	-	-	-

(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	National building Code of India	Bureau of Indian Standard (BIS), Gov. of India	-	-
2	Indian Standard	Bureau of Indian Standard (BIS), Gov. of India	-	-
3	National Fire Code of Sprinklers NFPA	National Fire protection association(NFPA)	-	-
4	Code of practice for fire safety of buildings (general): Details of construction (IS 1642)	Bureau of Indian Standard (BIS), Gov. of India	-	-
5	The Chhattisgarh Fire and Emergency Service Act, 201 8	Chhattisgarh Act	-	-
6	Fire Precautionary Measures in Construction of Temporary Structures and Pandals-Code of Practice	Bureau of Indian Standard (BIS), Gov. of India	-	-

(b) Open source software and website address:

1. https://www.bis.gov.in/standards/technical-department/national-building-code/?lang=de
2. https://cpwd.gov.in/Publication/Booklet-Guide-for-Using-NBC-2016.pdf
3. https://law.resource.org/pub/in/bis/S03/is.1641.1988.html
4. http://mptownplan.nic.in/act%20&%20Rules/NationalBuilding%20Code%20Part-IV%20(Fire%20Safety).pdf
5. https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=290
6. https://law.resource.org/pub/in/bis/S03/is.1641.1988.html
7. https://www.indianemployees.com/acts-rules/details/chhattisgarh-fire-and-emergency-service-act-2018#:~:text=THE%20CHHATTISGARH%20FIRE%20AND%20EMERGENCY,connected%20therewith%20and%20incidental%20thereto.
8. https://law.resource.org/pub/in/bis/S03/is.8758.1993.pdf

M) List of Major Laboratory Equipment and Tools: Nil

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

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 the specification of firefighting equipment and fire fighting Personal Protective Equipment.	2	3	2	2	2	0	0	2	0	1	2	1
CO-2: To understand the various fire safety codes and standards for designing the building and temporary structure.	2	2	3	2	2	0	0	1	0	2	2	1
CO-3: Student will know the various fire safety codes and standards for Rescue & firefighting equipmentmen's, Hydraulic platforms, Industrial, Municipal and State life safety & fire protection measures.	2	2	3	2	2	0	0	1	0	2	2	1

Legend: 1 – Low, 2 – Medium, 3 – High

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 the specification of firefighting equipment and fire fighting Personal Protective Equipment.	SO1.1 SO1.2 SO1.3	--	1.1 1.2 1.3	SL1.1
PO-1,2,3,4,5,8,10 PSO-1,2	CO-2: To understand the various fire safety codes and standards for designing the building and temporary structure.	SO 2.1 SO 2.2	--	2.1 2.2 2.3	SL2.1
PO-1,2,3,4,5,8,10 PSO-1,2	CO-3: Student will know the various fire safety codes and standards for Rescue & firefighting equipmentmen's, Hydraulic platforms, Industrial, Municipal and State life safety & fire protection measures.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	--	3.1 3.2 3.3 4.1 5.1	SL3.1

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.

A) Course Code : 2129373(020)

B) Course Title : Industrial Safety Management

C) Pre- requisite Course Code and Title :

D) Rationale : Safety is very important aspect for any industry as azero accident workplace environment boosts the morale of the team members working in any hazardous, risky and dangerous situations. Recognizing these facts industries prepare their own safety policy, safety manual and have a separate department/section for safety so as to create proper awareness and provide the know-how-about the safety. Adherence to the useful information, rules, and mandatory requirements governing the safety and guidelines will help prevent occupational injuries and accidents. Industrial safety refers to the management of all operations and events within an industry in order to protect its employees and assets by minimizing hazards, risks, accidents, and near misses.

E) Course Outcomes:

CO-1: To learn about the modern safety concept, safety policy of organization to their employees and contractor.

CO-2 To understand the basic technique of safety survey, safety audit, safety inspection and JSA.

CO-3 To understand the industrial accident investigation, and reporting.

CO-4 To understand the industrial Safety Performance Monitoring.

CO-5 To learn about importance of safety education and training.

F) 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	2129373 (020)	Industrial Safety Management	2	-	1	3
2.	Civil Engineering	2129363 (020)	Industrial Safety Management (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:

S. No	Board of Study	Course Code	Course Titles	Scheme of Examinations					
				Theory			Practical		Total Marks
				ESE	CT	TA	ESE	TA	
1.	Civil Engineering	2129373 (020)	Industrial Safety Management	70	20	30	-	-	120
2.	Civil Engineering	2129363 (020)	Industrial Safety Management (Lab)	-	-	-	40	60	100

ESE: End Semester Exam, CT: Class Test, TA: Teachers Assessment
Legend – PRA : Process Assessment, PDA : Product Assessment

Note:

i) TA in Theory includes Sessional work (SW) and attendance (ATT) with weightage of 70% and 30% of total respectively.

ii) 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 the modern safety concept, safety policy of organization to their employees and contractor.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Evolute the modern safety concept. SO1.2 Explain importance of safety policy to any organization. SO1.3 Define the role of safety committee to create safe working environment to their employees. SO1.4 Define the essentials for budgeting for safety.	LI1.1 To study the safety policy of any organization.	**UNIT-1.0 Concepts** 1.1 Evolution of modern safety concept. 1.2 Safety policy. 1.3 Safety Organization. 1.4 Line and staff functions for safety. 1.5 Safety Committee. 1.6 Budgeting for safety.	SL1.1 Student will learn the importance of safety. SL1.2 Importance of safety policy and budgeting of safety in any organization.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Define modern safety concept.
2. Explain importance of safety policy to any organization.
3. Define the role of safety committee to create safe working environment to their employees.
4. Define the essentials for budgeting for safety.

b. Micro Project:

1. Prepare a safety policy for your university's students and employees.

c. Other Activities (Specify):

1. Prepare a chart that what essentials should be there in Budgeting for safety.

CO-2: To understand the basic technique of safety survey, safety audit, safety inspection and JSA.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Define the Incident Recall Technique (IRT). SO2.2 To understand the Disaster control, Job Safety Analysis (JSA). SO2.3 To know the Safety survey, Safety inspection, Safety sampling and Safety Audit.	LI2.1 To perform safety audit of your laboratory. LI2.2 To perform safety inspection of your laboratory. LI2.3 To perform a Job safety Analysis (JSA) of your laboratory equipment.	**Unit 2.0 Techniques** 2.1 Incident Recall Technique (IRT). 2.2 Disaster control. 2.3 Job Safety Analysis (JSA). 2.4 Safety survey. 2.5 Safety inspection. 2.6 Safety sampling. 2.7 Safety Audit.	SL1.1 Student will learn how to perform safety audit and inspection in any industry.

SW-2 Suggested Sessional Work (SW) :

a. Assignments

1. What is safety inspection? Preparea safety checklist of your laboratory inspection.
2. How will you perform internal safetyaudit?
3. What is Job Safety Analysis? Write short note on Job Safety Analysis (JSA).
4. Distinguish between Safety audit and safety inspection.

b. Other Activities (Specify):

1. Prepare a safety checklist for inspection of your college laboratory equipments.
2. Perform safety audit of your laboratory and college buildings.

CO-3: To understand the industrial accident investigation and reporting.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Define concept of an accident that whether reportable and non-reportable accidents, SO3.2 Define unsafe act and condition. SO3.2 To learn about Principles of accident prevention, Supervisory role- Role of safety committee - Accident causation models - Cost of accident. SO3.3 Identify Overall accident investigation process.	LI3.1 To study the accident investigation and reporting.	**Unit-3.0 Accident Investigation and Reporting.** 3.1 Concept of an accident, reportable and non-reportable accidents, unsafe act and condition. 3.2 Henrich domino theory and sequence of accident. 3.3 Bird's triangle of accident. 3.4 Principles of accident prevention, Supervisory role- Role of safety committee - Accident causation models - Cost of accident. 3.5 Overall accident investigation process.	SL3.1 Define the procedure of accident investigation.

Session Outcomes (SOs)	Laboratory	Class room Instruction	Self Learning
		3.6 Records of accidents, accident reports Class exercise with case study.	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. Define unsafe act and unsafe condition.
2. Write down the accident investigation procedures.
3. What are the causes of accident? write down its preventive measures.
4. Define about Bhopal gas leak that what conditions leads to an accident/Tragedy. What lesson you learned from this tragedy.
5. Write definition on-
   - I. Safety
   - II. Hazard
   - III. Risk
   - IV. Accident
   - V. Near miss

b. Other Activities (Specify):

1. Prepare a chart for reportable and non-reportable accidents happens nearby you.
2. Prepare a chart of Near miss happened with you

CO-4: To understand the industrial safety performance monitoring.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Identify the Permanent total disabilities, permanent partial disabilities, temporary total disabilities. SO4.2 To understand the calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accide rate.	LI4.1 To study of safety performance monitoring.	**Unit-4.0 Safety Performance Monitoring.** 4.1 Fatal, non-fatal, disabling injury, temporary and permanent disablement, partial and total disablement, near miss accident, lost time accident. 4.2 Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate.	SL4.1 Define the type of accident.

SW-4 Suggested Sessional Work (SW) :

a. Assignments:

1. Define Accident frequency rate.
2. Write the different type of accident.
3. What is partial disabilities? Define the total disability.
4. What is lost time injury?

b. Other Activities (Specify):

1. Prepare a chart for Accident investigation checklist.
2. Prepare a chart of Near miss happened with you

CO-5: To learn about importance of safety education and training.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Identify the importance of training- SO5.2 Identification of need of training. SO5.2 To understand the training methods by programs, seminars, conferences, competitions. SO5.3 Define the role of government agencies and private consulting agencies in safety training.	LI5.1 To study the safety education and training. LI5.2 To study of personal protective equipment or PPE's. LI5.3 To study the case study of various accidents. LI5.4 To study of behaviors-based safety. LI5.5 To study about housekeeping in construction site.	**Unit-5.0 Safety Education and Training.** 5.1 Importance of training-identification of training needs. 5.2 Training methods – programmed , seminars, conferences, competitions 5.3 Method of promoting safe practice -motivation - communication. 5.4 Role of government agencies and private consulting agencies in safety training. 5.5 Creating safety awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign. 5.6 Domestic Safety and Training.	SL5.1 To learn safety education and safety training.

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. Define the Importance of training? What is need of training before performing any task?
2. What are the different types of Training methods? Explain in brief.
3. What is the Role of government agencies in safety training?
4. How will you Create safety awareness in any organization?
5. Define domestic Safety and Training.
6. What do you understand by safety campaign.

b. Mini Project:

1. Perform a safety slogan competition between students.
2. Prepare Safety awareness posters and display it in your college.
3. Prepare a power point presentation to per safety training

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

1. Prepare a chart for safety training tool box talk.

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	Concepts	2	3	5	10
II	Techniques	2	3	5	10
III	Accident Investigation and Reporting	3	7	10	20
IV	Safety Performance Monitoring	2	3	5	10
V	Safety Education and Training	3	7	10	20
Total		12	23	35	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 the safety policy of any organization.	20	15	5
LI2.1	To perform safety audit of your laboratory.			
LI2.2	To perform safety inspection of your laboratory.			
LI2.3	To perform a Job Safety Analysis (JSA) of your laboratory equipment.			
LI3.1	To study the accident investigation and reporting.			
LI4.1	To study of safety performance monitoring.			
LI5.1	To study the safety education and training.			
LI5.2	To Study of personal protective equipment or PPE's.			
LI5.3	LI5.3 To study the case study of various accidents.			
LI5.4	To study of behaviors-based safety.			
LI5.5	To study about housekeeping in construction site.			

* 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	Industrial safety management	L.M. Deshmukh	McGraw-Hill Company	2017
2	Industrial Safety, Health and Environment Management Systems	R. K. Jain , Sunil S. Rao	Khanna Publisher	2000
3	Accident Prevention Manual for Industrial Operations	National safety council	N.S.C.Chicago	1982
4	Industrial Accident Prevention	Heinrich H.W.	McGraw-Hill Company, New York	1980
5	Safety Management in Industry	Krishnan N.V.	Jaico Publishing House, Bombay	1997
6	Safety at Work	John Ridley	Butterworth & Co., London	1983
7	Industrial Safety	Blake R.B.	Prentice Hall, Inc., New Jersey	1973
8	Industrial Health and Safety Management	A.M. Sarma	Himalaya Publishing House	2010

(b) Open source software and website address:

1. https://www.osha.gov/safety-management.pdf
2. https://www.bis.gov.in/
3. https://hsseworld.com/
4. https://dgfscdhg.gov.in/national-building-code-india-fire-and-life-safety
5. https://www.osha.gov/personal-protective-equipment
6. https://ohsonline.com/Articles/2007/12/Fire-Detection-and-Alarm-Systems-A-Brief-Guide.aspx
7. https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=10
8. https://www.nfpa.org/News-and-Research/Publications-and-media/Blogs-Landing-Page/NFPA-Today/Blog-Posts/2021/07/16/Fire-Extinguisher-Types

M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	**Industrial safety PPE's(Personal Protective Equipments)**	SCBA (Self-contained breathing Apparatus) Safety Helmet(Red, Blue, White, Yellow, Green, Orange) Safety Earmuff Safety Goggle Safety Gloves Safety Shoes, Safety boot Safety Radium Jacket Safety Harness/Fall arrester	LI5.2

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 the modern safety concept, safety policy of organization to their employees and contractor	2	3	2	2	2	0	0	2	0	1	2	1
CO-2: To understand the basic technique of safety survey, safety audit, safety inspection and JSA.	2	2	3	2	2	0	0	1	0	2	2	1
CO-3: To understand the industrial accident investigation, and reporting	2	2	3	2	2	0	0	1	0	2	2	1
CO-4: To understand the industrial Safety Performance Monitoring.	2	2	3	2	2	0	0	1	0	2	2	2
CO-5: To learn about importance of safety education and training.	2	2	3	2	2	0	0	1	0	2	2	2

Legend: 1 – Low, 2 – Medium, 3 – High

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 the modern safety concept, safety policy of organization to their employees and contractor	SO1.1 SO1.2 SO1.3 SO1.4	LI1.1	1.1 1.4 1.2 1.5 1.3 1.6	SL1.1
PO-1,2,3,4,5,8,10 PSO-1,2	CO-2: To understand the basic technique of safety survey, safety audit, safety inspection and JSA.	SO2.1 SO2.2 SO2.3	LI2.1 LI2.2 LI2.3	2.1 2.4 2.2 2.5 2.3 2.6 2.4 2.7	SL2.1
PO-1,2,3,4,5,8,10 PSO-1,2	CO-3: To understand the industrial accident investigation, and reporting	SO3.1 SO3.2 SO3.3 SO3.4	LI3.1	3.1 3.4 3.2 3.5 3.3 3.5	SL3.1
PO-1,2,3,4,5,8,10 PSO-1,2	CO-4: To understand the industrial Safety Performance Monitoring.	SO4.1 SO4.2	LI4.1	4.1 4.2	SL4.1
PO-1,2,3,4,5,8,10 PSO-1,2	CO-5: To learn about importance of safety education and training.	SO5.1 SO5.2 SO5.3	LI5.1 LI5.5 LI5.2 LI5.3 LI5.4	5.1 5.5 5.2 5.3 5.4	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.

A) Course Code : 2129374(020)

B) Course Title : Safety in Construction

C) Pre- requisite Course Code and Title :

D) Rationale : Construction Industry causing construction hazards, injury, property loss and chances of severe accidents or sometimes life loss. Workers and the general public's safety are just as vital as the quality of the work. Every day, construction workers are at danger of injury. Therefore, safety in construction subjects helps to students to prepare, implement, and maintain safe working conditions to keep people safe from accidents, injuries, and illnesses. They achieve this by compliances with the safety laws and statutory requirements, and also job safety analysis tools, conducting workplace inspections, providing training on safe work processes, equipment, and technology, addressing unsafe workplace behaviors, and conducting audits to assess the effectiveness of policies and procedures, etc.

CO-1: The find out the basic causes of Accident and their control System.

CO-2: The basic concept of hazard in construction operation and their prevention.

CO-3: To perform the working at heights safety with relevant codes and standards of practice.

CO-4: The basic concept of Safety in construction of machinery and their suitability for the operation.

CO-5: The basic concept of safety in demolition operation.

F) 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	2129374 (020)	Safety in Construction	2	-	1	3
2.	Civil Engineering	2129362 (020)	Safety in Construction (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:

S. No	Board of Study	Course Code	Course Titles	Scheme of Examinations					
				Theory			Practical		Total Marks
				ESE	CT	TA	ESE	TA	
1.	Civil Engineering	2129374 (020)	Safety in Construction	70	20	30	-	-	120
2.	Civil Engineering	2129362 (020)	Safety in Construction (Lab)	-	-	-	40	60	100

ESE: End Semester Exam, CT: Class Test, TA: Teachers Assessment
Legend – PRA: Process Assessment, PDA: Product Assessment

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: The find out the basic causes of Accident and their control System.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Identify the safety aspects of construction planning. SO1.2 To understand the human factors in construction safety management. SO1.3 Identify the roles of various groups in ensuring safety in construction industry.	LI1.1 Study of construction planning and safety. LI1.2 Perform the Safety audit of construction site. LI1.3 Study of excavation safety.	**UNIT-1.0 ACCIDENTS CAUSES AND MANAGEMENT SYSTEMS** 1.1 Problems impeding safety in construction industry 1.2 Causes of fatal accidents, types and causes of accidents related to various construction activities 1.3 Human factors associated with this accident. 1.4 Construction regulations, contractual clauses – Pre contract activities, preconstruction meeting 1.5 Design aids for safe construction – permits to work – quality assurance in construction 1.6 Compensation Recording of accide and safety measures. 1.7 Education and training	SL1.1 To identify safety aspects and safety management of construction industry. SL1.1.2 To identify the cause of accidents. SL1.3 To identify the human factors associated with these accident

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Explain the Problems impeding safety in construction industry.
2. Explain how to classify the accidents in the industry.
3. Explain role of safety officers in construction industry to ensure safety as per standard norms.

b. Mini Project:

1. Prepare a safe working model of construction industry.

CO-2: The basic concept of hazard in construction operation and their prevention.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 To know the excavation- under-water works- under-pinning & shoring. SO2.2 Identify Tunneling- Blasting-Demolition- Pneumatic caissons. SO2.3 To understand the confined spaces – working on contaminated sites.	LI2.1 Study of Scaffolding safety and its inspection. LI2.2 Study of demolition safety.	**Unit-2.0 HAZARDSOF CONSTRUCTION AND PREVENTION** 2.1 Excavations, basement and wide excavation. 2.2 Trenches, shafts – scaffolding 2.3 Types, causes of accidents. 2.4 Scaffold inspection checklist – false work. 2.5 Erection of structural frame work, dismantling – tunneling – blasting, pre blast and post blast inspection. 2.6 Confined spaces – working on contaminated sites. 2.7 Work over water - road works 2.8 Power plant constructions 2.9 Constructions of high buildings.	SL2.1 To understand various unit operations of any construction in industry. SL2.2 To understand the importance of scaffold, trench. SL2.3 To understand the cause of accident SL2.4 To understand the transportation of explosive with safety measures.

SW-2 Suggested Sessional Work (SW) :

a. Assignments

1. To explain excavation under water with proper safety.
2. Explain importance of ladders and Scaffolds in construction safety.
3. To differentiate between temporary construction and permanent construction.

b. Mini Project:

1. Make a project on construction safety as per Indian standards with using conventional sign.
2. Prepare different national building code provision of construction safety.

CO-3: To perform the working at heights safety with relevant codes and standards of practice.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 To understand the safe working at height zone to prevent accident. SO3.2 To understand the importance of ladders-Scaffoldings, requirement for safe work platforms, stairways, gangways and ramps. SO3.3 To understand the importance of wearing of	LI3.1 To study the Safety in welding. LI3.2 To study the importance of fall arrestor and safety net. LI3.3 Study of Material handling equipment safety-crane, lift, hoist etc. LI3.4 Ladder safety-3 point contact of ladder- Exercise	**Unit-3.0WORKING HEIGHTS** 3.1 Fall protection in construction OSHA 3146 – OSHA requirement for working at heights. 3.2 Safe access and egress – safe use of ladders-Scaffoldings, requirement for safe work platforms, stairways, gangways and ramps.	SL3.1 To know the use of fall arrester while working on height. SL3.2 To prepare the safety checklist of ladder and scaffoldings. SL3.3 To know

Session Outcomes (SOs)	Laboratory Instruction	Class room Instruction (CI)	Self Learning
proper PPE kit.	LI3.5 To study the importance of safety Belt. LI3.6 To study the work permit system in construction.	3.3 fall prevention and fall protection, safety belts, safety nets, fall arrestors, controlled access zones. 3.4 safety monitoring systems – working on fragile roofs, work permit systems, height pass. 3.5 construction accident case studies.	the lesson learned from construction accident case studies.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. Explain types of construction materials are used.
2. Explain types of machinery and equipment used in construction safety.
3. Differentiate between hydraulic and pneumatic tool used in construction safety engineering.

b. Other Activities (Specify):

1. Prepare a power point presentation showing safety procedure in working with crane, wire rope, pulley, Temporary power supply, Mixers and Conveyors of construction safety.

CO-4: The basic concept of Safety in construction of machinery and their suitability for the operation.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 To Identify the safety in construction machinery. SO4.2 To prepare the safety checklist for various construction machinery. SO4.3 To understand the importance of safety devices in the machinery.	LI4.1 To prepare the inspection checklist of various construction machinery. LI4.2 To learn the confined space safety in construction. LI4.3 To study the preparation of safety checklist.	**Unit-4.0CONSTRUCTION MACHINERY** 4.1 Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist. 4.2 Safety in builder's hoist, winches, chain pulley blocks, Safe Load calculation. 4.3 Safe use of conveyors - concrete mixers, concrete vibrators 4.4 Safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps. 4.5 Safety in welding machines, use of portable electrical tools, drills, grinding tools. 4.6 Safety in manual handling in construction.	SL4.1 To understand the importance of different checklist regarding selection, inspection and operation. SL4.2 To understand Application of portable and transportable instruments.

SW-4 Suggested Sessional Work (SW) :

a. Assignments:

1. Explain different types of machinery used in industry.
2. Explain selection of machinery for different purpose.
3. Explain how to get better working environment for workers in any industry.
4. Explain the hazard sand safety in manual handling in in construction.
5. What precautionary measures should be adopted in welding of construction.

b. Other Activities (Specify):

1. Prepare a PPT and showing different working conditions of machinery used in industry.
2. Prepare the safety checklist of construction machinery.

CO-5: The basic concept of safety in demolition operation.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 To identify the types of explosive used to demolish any construction. SO5.2 To Identify the importance of first aid, extinguisher, PPE kit, truss, girder and beam. SO5.3 To understand the importance of any case study regarding demolition work of any construction.	LI5.1 Determine the construction hazard and prepare the risk assessment. LI5.2 Work at height safety in construction. LI5.3 To prepare pre survey safety inspection in demolition. LI5.4 To study about the safety signs in demolition.	**Unit-5.0SAFETY IN DEMOLITION WORK** 5.1Safety in demolition work, manual, mechanical, using explosive. 5.2 keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition. 5.3 Indian standard for demolition - trusses, girders and beams. 5.4 First aid in construction 5.5 Fire hazards and preventing methods.	SL5.1 To understand the Safety in demolition work of any construction. SL5.2 To understand importance of pre inspection, safe clearance zone, site supervision. SL5.3 To understand the importance of Indian standards to prevent accidents.

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 about safe working condition for labour and safe zone to prevent accident to demolished any building.
2. Explain prevention from any fire hazards while using explosives in demolition.
3. What are Do's and Don'ts of demolition work?

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	Accidents causes and management systems	4	6	4	14
II	Hazards of construction and prevention	4	6	4	14
III	Working at height	4	6	4	14
IV	Construction machinery	4	6	4	14
V	Safety in demolition work	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	Study of construction planning and safety.	20	15	5
LI1.2	Perform the Safety audit of construction site.			
LI1.3	Study of excavation safety.			
LI2.1	Study of Scaffolding safety and its inspection.			
LI2.2	Study of demolition safety.			
LI3.1	To study the Safety in welding.			
LI3.2	To study the importance of fall arrestor and safety net.			
LI3.3	Study of Material handling equipment safety-crane, lift, hoist etc.			
LI3.4	Ladder safety-3 point contact of ladder- Exercise			
LI3.5	To study the importance of safety Belt.			
LI3.6	To study the work permit system in construction.			
LI4.1	To prepare the inspection checklist of various construction machinery.			
LI4.2	To learn the confined space safety in construction.			
LI4.3	To study the preparation of safety checklist.			
LI5.1	Determine the construction hazard and prepare the risk assessment.			
LI5.2	Work at height safety in construction.			
LI5.3	To prepare pre survey safety inspection in demolition.			
LI5.4	To study about the safety signs in demolition.			

* 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 : ***Essential Reading:***

S.No.	Title	Author	Publisher	Edition & Year
1	Construction Safety Management	K.N. Vaid (Ed.)	National Institute of Construction Management and Research, Bombay	
2	Construction Safety Handbook	V.J. Davies & K. Tomasin	Thomas Telford Publishing, London	1990
3	Construction Safety, Security & Loss Prevention	James B. Fullman	John Wiley & Sons	1979
4	Modern Methods of Material Handling	Linger L		
5	Handbook of Temporary Structures in Construction	R.T. Ratay	Mc Graw-Hill	
6	Accident Prevention Manual for Industrial Operations	NSC, Chicago	NSC, Chicago	1982
7	Handbook of OSHA Construction safety and health	Charles D. Reese and James V. Edison	Charles D. Reese and James Edison	

(b) Open source software and website address:

1. https://app.croneri.co.uk/topics/accidents-causes-and-prevention/indepth
2. https://oshwiki.eu/wiki/Construction_safety_risks_and_prevention
3. https://www.hse.gov.uk/toolbox/height.htm
4. http://safariequipments.co.in/construction-machinery-equipments/
5. https://www.ask-ehs.com/blog/safety-in-demolition-works/

M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment/Experiment	Broad Specifications	Relevant Experiment Number
1	Smart Class Room or Industrial Visit	Other type of experiments are study based that's why it can be resolved or describe in the class by showing animation videos and real working videos in the smart board OR by site, industry visit real problems can be seen.	LI1.1, LI1.2, LI1.3, LI2.1, LI2.2, LI3.1, LI3.3,LI3.6, LI4.1, LI4.3, LI5.1,LI5.3, LI5.4
2	Aluminium folding ladder 10 feet	Aluminium folding ladder: It is made by aluminium folding type, easy to carry one place to another place without any difficulties. 10 feet ladder generally used in domestic purpose and easy to climb. It may be best practical equipment for students.	LI3.4
3	Face masks, helmet, gumboot, reflector jacket, goggles, dust masks, respirators, ear muff, ear plug, safety gloves , dust collectors	confined space safety in construction: generally for working in the confined space the safety equipment should be used as Face masks, helmet, gumboot, reflector jacket, goggles, dust masks, respirators, hearing protection, proper gloves for specific tasks, ventilation devices for airflow, and dust collectors	LI4.2, LI2.1
4	Personal Fall Arrest System (PFAS)	Safety equipment used to work at height	LI3.2, LI5.2
5	Ropes	Each types-used in construction site for different works like loading and shifting.	LI5.2
6	Work at height Structure (Field set-up)	Material -Iron, Height -20 ft approx	LI5.2
7	Confined space Structure (Field set-up)	below the earth -10-15ft setup, material-Iron	LI4.2
8	Work at height Structure for high rise building (Field set-up)	Material- iron, 15-20 ft approx	LI5.2
9	Suspended Scaffold with ladder (Field set-up)	Material-Iron field setup with ladder and all equipment	LI2.1
10	Safety net	ISI Test certified Rope as per IS 5175	LI3.2
11	Safety belt	ISI test certified as per IS 3521	LI3.5

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: The basic concept of safety in Accident causes and Management System.	2	3	2	2	2	0	0	2	0	1	2	1
CO-2: The basic concept of Safety in construction operation.	2	2	3	2	2	0	0	1	0	2	2	1
CO-3: To perform the safe working at heights with relevant codes and standards of practice.	2	2	3	2	2	0	0	1	0	2	2	1
CO-4: The basic concept of Safety in construction of machinery and their suitability for the operation.	2	2	3	2	2	0	0	1	0	2	2	2
CO-5: The basic concept of safety in demolition operation	2	2	3	2	2	0	0	1	0	2	2	2

Legend: 1 – Low, 2 – Medium, 3 – High

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: The basic concept of safety in Accident causes and Management System.	SO1.1 SO1.2 SO1.3	LI1.1 LI1.2 LI1.3	1.1 1.5 1.2 1.6 1.3 1.7 1.4	SL1.1 SL1.2 SL1.3
PO-1,2,3,4,5,8,10 PSO-1,2	CO-2: The basic concept of Safety in construction operation.	SO2.1 SO2.2 SO2.3	LI2.1 LI2.2	2.1 2.6 2.2 2.7 2.3 2.8 2.4 2.9 2.5	SL2.1 SL2.2 SL2.3 SL2.4
PO-1,2,3,4,5,8,10 PSO-1,2	CO-3: To perform the safe working at heights with relevant codes and standards of practice.	SO3.1 SO3.2 SO3.3	LI3.1 LI3.5 LI3.2 LI3.6 LI3.3 LI3.4	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: The basic concept of Safety in construction of machinery and their suitability for the operation.	SO4.1 SO4.2 SO4.3	LI4.1 LI4.2 LI4.3	4.1 4.5 4.2 4.6 4.3 4.4	SL4.1 SL4.2
PO-1,2,3,4,5,8,10 PSO-1,2	CO-5: The basic concept of safety in demolition operation	SO5.1 SO5.2 SO5.3	LI5.1 LI5.5 LI5.2 LI5.3 LI5.4	5.1 5.2 4.3	SL4.1

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.

A) Course Code : 2129375(020)

B) Course Title : Mines Hazard and Safety

C) Pre- requisite Course Code and Title :

D) Rationale : Mining industry is one of the industries causing environmental pollution and chances of severe accidents. Certain bindings are imposed through regulations on mining industry for safe workings and to control hazards associated with mines. Diploma student are required to be more acquainted with the major problems associated for mine work in connection with comfortable working conditions and various sources of problem creating agents. This course is designed to fulfill the required level knowledge of mine hazards for safe mining.

E) Course Outcomes :

CO-1 To understand the various mines hazard and their safety in Open case mines.

CO-2 To understand the various mines hazard and their safety in Underground mines.

CO-3 To understand the various mines hazard and their safety in tunneling.

CO-4 To learn the various risk in Mines, and to do the risk assessment.

CO-5 To understand accident analysis and disaster management

F) Scheme of Studies:

Board of Study	Course Code	Course	Scheme of Studies (Hours/Week)			Credits L+T+(P/2)
			L	P	T	
Mining Engineering	2129375 (020)	Mines Hazard and Safety	3	-	1	4
Mining Engineering	2129364 (020)	Mines Hazard and Safety (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	Scheme of Examination					
			Theory			Practical		Total
			ESE	CT	TA	ESE	TA	Marks
Mining Engineering	2129375 (020)	Mines Hazard and Safety	70	20	30	-	-	120
Mining Engineering	2129364 (020)	Mines Hazard and Safety (Lab)				40	60	100

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

Legend - PRA: Process Assessment, PDA : Product Assessment

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 understand the various mines hazard and their safety in Open case mines.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 To understand the safe working condition of heavy machinery and earth moving equipments in opencast mine. SO1.2 To understand how to prevent different types of fire in mines. SO1.3 To understand how to deal with explosive, safe transportation.	LI1.1 Study of working of soda acid fire extinguishers. LI1.2 Study of working of foam extinguishers. LI1.3 Study of erection of Double brick fire stopping.	**UNIT-1.0 Open Cast Mines** 1.1 Causes and prevention of accident - Heavy machinery and earth moving equipments, belt and bucket conveyors, drilling, hand tools-pneumatic systems, pumping, water, dust, electrical systems, and fire prevention. 1.2 Garage safety – accident reporting system. 1.3 Working condition. 1.4 Safe transportation. 1.5 Handling of explosives.	SL1.1 To identify various causes and prevention of accidents from heavy machinery and earth moving equipments in opencast mine.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Write different types of machinery and equipments used in opencast mines.
2. Write Causes and prevention of accidents from HEMM.
3. How to write accident report.
4. Define in own word safe working condition and safe transportation in opencast mines.
5. Explain how to deal with explosive in opencast mines.

b. Mini Project:

1. Prepare an opencast mines working model.

c. Other Activities (Specify):

1. Prepare a safe working guidelines for the industries in own words.

CO-2 To understand the various mines hazard and their safety in Underground mines.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 To Recognize various types of fire and their preventive measures in underground mine. SO2.2 To understand different types of accidents and explosions are occurred in underground mine. SO2.3 To understand safe working conditions in winding and transportation system in underground mine.	LI2.1 Study of erection of sand bag fire stopping. LI2.2 Study of erection of Polish /German type stone dust barriers. LI2.3 Study of various types of water dam constructed in U/G mines. LI2.4 Study of principle and working of self contained breathing apparatus Dragger 174-A. LI2.5 Study of principle and working of Aero lox Liquid oxygen apparatus. LI2.6 Study of principle and working of self rescuers.	**Unit 2.0 Underground Mines.** 2.1 Fall of roof and sides-effect of gases-fire and explosions. 2.2 Water flooding, inundation -warning sensors gas detectors. 2.3 Occupational hazards-working conditions. 2.4 Winding and transportation.	SL2.1 To Compare different types of accidents in underground mines like firedamp hazards, inundation, occupational dieses.

SW-2 Suggested Sessional Work (SW) :

a. Assignments

1. Explain reason of roof fall and side fall in underground mines.
2. Explain about inundation and occupational disease.
3. Explain safe working conditions for winding and transportation in underground mines

b. Mini Project:

1. Prepare a model of winding for underground mines.

c. Other Activities (Specify):

1. Write different types of Occupational disease their reason and remedial action.

CO- 3 To understand the various mines hazard and their safety in tunneling.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 To explain different types of hazards occurred in mining like inundation, ground collapse, collapse of tunnel face. SO3.2 To understand different types of gases emitted from mines like methane, hydrogen, hydrogen sulfide, CO, CO2, SOx, NOx etc. and dusts are coal dust, stone dust, metal dust etc. SO3.3 To understand the importance of PPE.	LI3.1 Measure dust concentration in given air sample.	**Unit-3.0 Tunneling** 3.1 Hazards from: ground collapse, inundation and collapse of tunnel face, falls from platforms and danger from falling bodies. 3.2 Atmospheric pollution (gases and dusts) – trapping – transport-noise-electrical hazards. 3.3 Noise and vibration from: pneumatic tools and other machines. 3.4 Ventilation and lighting. 3.5 Personal protective equipment.	SL3.1To explain atmospheric pollution (gas and dust) in tunneling.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. Explain about hazards in mines like inundation, ground collapse, and tunnel face collapse.
2. Explain different types of gas monitoring and dust monitoring instruments used in mines.
3. Write different sources of noise from underground mines.
4. Explain standard of ventilation and standard of lighting in mines as per given act.
5. Write about different types of PPE kit used in industries.

b. Other Activities (Specify):

1. Prepare a model of tunnel/adit to show working face, support, machineries, lighting etc.

CO- 4 To learn the various risk in Mines, and to do the risk assessment.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 To understand the various Elements of risk assessment. SO4.2 To explain different methods from risk assess like statistical method, fault tree analysis, fuzzy model etc. SO4.3 To understand various risks in mining like roof fall, side fall, pillar brust, air blast etc.	LI4.1 Prepare a plan for firefighting organization.	**Unit-4.0 Risk Assessment** 4.1 Basic concepts of risk-reliability and hazard potential. 4.2 Elements of risk assessment. 4.3 Statistical methods. 4.4 Control charts-appraisal of advanced techniques. 4.5 Fault tree analysis failure mode. 4.6 Effect analysis – quantitative structure. 4.7 Activity relationship analysis fuzzy model for risk assessment.	SL4.1 To find the various risk in mines and to do the risk assessment. Sl4.2 To implement the control measures of various mines risk.

SW-4 Suggested Sessional Work (SW) :

a. Assignments:

1. Define basic principal of risk assessment.
2. How to assess risk by different elements of risk assessment.
3. How to risk assessment by Statistical methods.
4. Explain Fault tree analysis failure mode.

b. Other Activities (Specify):

1. Write a case study about risk assessment of any industry.

CO- 5 To understand accident analysis and disaster management.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 To understand types of accidents and how to report that accidents. SO5.2 To understand importance of safety audit. SO5.3 To understand cost of accident in mining. SO5.4 To understand importance of mines act and mine rules.	---	**Unit-5 Accident Analysis and Management.** 5.1 Accidents classification and analysis-fatal, serious, minor and reportable accidents. 5.2 Safety audits-recent development of safety engineering approaches for mines. 5.3 Frequency rates-accident occurrence-investigation-measures for improving safety in mines. 5.4 Cost of accident. 5.5 Disaster management and emergency preparedness.	SL5.1 To classify different types of accident in mines. SL5.2 To implement the control measures of fire and hazards with compliances according to mines act and rules.

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 about classification of accidents with their causes and preventive measures.
2. How to write an accident report of any industries.
3. Write importance of safety audit of a industries.
4. Write in own word how to improve safety in mines.
5. Explain cost of accident of any mines or person.
6. Explain about disaster management and emergency preparedness.

b. Mini Project:

(a) write a case study of safety audit of any industry.

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	Open Cast Mines	4	6	4	14
II	Underground Mines	4	6	4	14
III	Tunneling	4	6	4	14
IV	Risk Assessment	4	6	4	14
V	Accident Analysis And Management	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	Study of working of soda acid fire extinguishers.	20	15	5
LI1.2	Study of working of foam extinguishers.			
LI1.3	Study of erection of Double brick fire stopping.			
LI2.1	Study of erection of sand bag fire stopping.			
LI2.2	Study of erection of Polish /German type stone dust barriers.			
LI2.3	Study of various types of water dam constructed in U/G mines.			
LI2.4	Study of principle and working of self contained breathing apparatus Dragger 174-A.			
LI2.5	Study of principle and working of Aero lox Liquid oxygen apparatus.			
LI2.6	Study of principle and working of self rescuers.			
LI3.1	Measure dust concentration in given air sample.			
LI4.1	Prepare a plan for firefighting organization.			

* 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	Safety in Mines	Kejiriwal, B.K.	Gyan Prakashan, Dhanbad	2001
2	DGMS Circulars-Ministry of Labour	DGMS	Lovely Prakashan-DHANBAD	2002

(b) Open source software and website address :

1. https://www.resources.qld.gov.au/__data/assets/pdf_file/0017/240353/qld-guidance-note-10.pdf
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2395565/
3. https://www.osha.gov/personal-protective-equipment
4. https://cloudogre.com/risk-assessment/
5. http://environmentclearance.nic.in/writereaddata/online/RiskAssessment/03112021oxlgoeu3xu266902137HIRASISCO.pdf

M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Self Contained Breathing apparatus	SCBA with oxygen distributer and pressure gauge, rubber febric breathing bag, alloy steel oxygen cylinder with capacity of 2 ltr. At charging pressure of 200 bar. Alkiali regenerating cartrage/ soda lime cartrage or similar specification.	LE1.1 to LE 1.4
2	Self Rescuer	Rescue apparatus fitted with nose clip, retaining cord, expiratory valve, mouthpiece, heat exchanger, chin rest and filter canister with catalyst. It should be placed in a container having a quick release lock. It must be able to use for at least one hour after its seal is broken or similar specification.	LE1.5
3	Soda-acid extinguisher	A 9 litre soda-acid, It has a 1.63 mm thick steel shell approximately 180 mm dia. and 530 mm high. The shell ends are dished and welded or riveted to the wrapper plate. The shell must be capable of withstanding pressures of up to 14 bar in the event of a blockage occurring in the discharge nozzle.	LE2.1
4	Foam extinguishers	Mechanical Foam [N2 Stored Pressure] KANEX 9 Ltrs. • Stored Pressure Type Controllable discharge mechanism applicable on Class A & B Fire Rating 2A & 21 B as per IS 15683 ISI Mark. Specifications: Brand Description 9 Liter Mechanical Foam Fire Extinguisher CAPACITY 9ltr TYPE Fire Extinguisher Discharge Time (Sec.) 40-50 Jet Length (Meters) 6-8 Test Pressure Kg/cm² 35 Warranty 12 months Warranty	LE3.1, LE4.2

5	Aero lox liquid oxygen apparatus	• Odourless and colourless • Blue in liquid form • Boiling point -183°C • Reacts chemically with many substances • Vigorously supports combustion • Materials not normally considered flammable can be ignited in an oxygen rich atmosphere. • Oxygen 99.5% • Moisture <2vpm	LE4.1
6	Gravimetric dust sampler	• extractive measurement in wet and sticky exhaust gases • optical scattered light measurement • measuring gas is sampled by a temperature regulated probe • measuring range: dust (in operation) 0...7.5 mg/m³ (max. 250 mg/m³)	LE5.1

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 various mines hazard and their safety in Open case mines.	2	3	2	2	2	2	0	2	1	1	2	1
CO-2 To understand the various mines hazard and their safety in Underground mines.	2	2	3	2	2	2	0	1	1	2	2	1
CO-3 To understand the various mines hazard and their safety in tunneling.	2	2	3	2	2	2	0	1	1	2	2	1
CO-4 To Learn the various risk in Mines, and to do the risk assessment.	2	2	3	2	2	2	0	1	1	2	2	2
CO-5 To understand accident analysis and disaster management.	2	2	3	2	2	2	0	1	1	2	2	1

Legend: 1 – Low, 2 – Medium, 3 – High

O) Course Curriculum Map:

POs & PSOs No.	COs No. & Title	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,5,6,8,9,10 PSO-1,2	CO-1 To understand the various mines hazard and their safety in Open case mines.	SO 1.1 SO 1.2 SO 1.3	LE 1.1 LE 1.2 LE 1.3	1.1 1.4 1.2 1.5 1.3	SL1.1
PO-1,2,3,4,5,6,8,9,10 PSO-1,2	CO-2 To understand the various mines hazard and their safety in Underground mines.	SO 2.1 SO 2.2 SO 2.3	LE2.1, LE2.5 LE2.2, LE2.6 LE2.3, LE2.4	2.1 2.2 2.3 2.4	SL2.1
PO-1,2,3,4,5,6,8,9,10 PSO-1,2	CO-3 To understand the various mines hazard and their safety in tunneling.	SO 3.1 SO 3.2 SO 3.3	LE3.1	3.1 3.2 3.3 3.4 3.5	SL3.1
PO-1,2,3,4,5,6,8,9,10 PSO-1,2	CO-4 To Learn the various risk in Mines, and to do the risk assessment.	SO 4.1 SO 4.2 SO 4.3	LE4.1	4.1, 4.2 4.3, 4.4 4.5 4.6 4.7	SL4.1 SL4.2
PO-1,2,3,4,5,6,8,9,10 PSO-1,2	CO-5 To understand accident analysis and disaster management.	SO 5.1 SO 5.2 SO 5.3 SO 5.4	--	5.1 5.2 5.3 5.4 5.5	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.