

Curriculum
of
Diploma Programme
in
Fire Technology & Safety



State Board of Technical Education (SBTE)
Bihar

Semester – IV Teaching & Learning Scheme

Board of Study	Course Codes	CourseTitles	Teaching & Learning Scheme (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2448401	Design & Installation of Fire Detection and Fire Fighting Systems	3	-	4	2	9	6
	2448402	Fire Modeling and Risk Assessment	2	1	-	2	5	4
	2448403	Structural Fire Protection	3	-	4	2	9	6
	2448404	Fire Suppression, Control Equipment & Materials	2	1	-	2	5	4
	2418305	Python Programming (CE, CSE, AIML, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT)	3	-	4	2	9	6
	2448406	Safety in Construction and Mines	-	-	4	2	6	3
	2400111	Principals of Management (Non-exam course) (CE, AIML, AE, CHE, CSE, ME, ME (Auto), FTS, MIE)	1	-	-	-	1	1
Total			14	2	16	12	44	30

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

Semester - IV Assessment Scheme

Board of Study	Course Codes	Course Titles	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term work & Self-Learning Assessment (TWA)		Lab Assessment(LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
	2448401	Design & Installation of Fire Detection and Fire Fighting Systems	30	70	20	30	20	30	200
	2448402	Fire Modeling and Risk Assessment	30	70	20	30	-	-	150
	2448403	Structural Fire Protection	30	70	20	30	20	30	200
	2448404	Fire Suppression, Control Equipment & Materials	30	70	20	30	-	-	150
	2418305	Python Programming (CE, CSE, AIML, ME, ME (Auto), ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT)	30	70	20	30	20	30	200
	2448406	Safety in Construction and Mines	-	-	10	15	20	30	75
	2400111	Principals of Management (Non-exam course) (CE, AIML, AE, CHE, CSE, ME, ME (Auto), FTS, MIE)	25	-	-	-	-	-	25
		Total	175	350	110	165	80	120	1000

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

- A) **Course Code** : 2448401(T2448401/P2448401/S2448401)
- B) **Course Title** : Design & Installation of Fire Detection and Fire Fighting Systems
- C) **Pre- requisite Course(s)** :
- D) **Rationale** :

Fire controlling officers and professionals are generally responsible to design the proper firefighting system and mechanisms for a particular situation and needs of the building and occupancy. Proper design and installation of firefighting systems for different occupancy based on different fire protection systems such as water-based fire protection, foam based fire protection, gas based fire protection and dry chemical based fire protection system. The knowledge and skills about the design & installation of fire detection and firefighting system is very essential when a professional has to deal with the precautionary measures to be taken for the control of different and typical fire conditions. This course will help the diploma students to design and utilize different fire protection systems at different occupancies.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

After completion of the course, the students will be able to-

- CO-1** Install water-based hydrant system in different types of occupancies.
- CO-2** Design automatic sprinkler system for a given Occupancy.
- CO-3** Elaborate foam-based firefighting systems at different fire sites.
- CO-4** Demonstrate gas-based fire protection system.
- CO-5** Explain dry chemical and related fire protection system.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	3	2	2	-	2	-	3		
CO-2	3	-	-	2	2	2	3		
CO-3	3	-	2	-	2	-	3		
CO-4	3	2	-	2	2	2	3		
CO-5	3	-	2	-	2	-	3		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Fire Technology & Safety	2448401	Design & Installation of Fire Detection and Fire Fighting Systems	03	-	04	02	09	06

Legend:

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H) Assessment Scheme:

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			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Fire Technology & Safety	2448401	Design & Installation of Fire Detection and Fire Fighting Systems	30	70	20	30	20	30	200

Legend:

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I) **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), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units: T2448401**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Calculation of fire water demand.</p> <p><i>TSO 1b.</i> Explain water storage tank and related terminologies.</p> <p><i>TSO 1c.</i> Establish the Relationship between the air pressure and volume in tanks.</p> <p><i>TSO 1d.</i> Plan the installation of Hydrant System basic understanding and related terminologies.</p> <p><i>TSO 1e.</i> Calculate the pressure and discharge requirement.</p> <p><i>TSO 1f.</i> Design appropriate spacing between hydrant post.</p> <p><i>TSO 1g.</i> Use suitable Pipe material and size as per requirement</p>	<p>Unit-1.0 Water Based Fire Protection</p> <p>1.1 Fire water demand calculation, water storage tank capacity and related terminologies.</p> <p>1.2 Water storage tank equipment and accessories.</p> <p>1.3 Relationship of air pressure and volume in tanks.</p> <p>1.4 Hydrant System- Definition and basic components.</p> <p>1.5 Pressure and discharge requirement, spacing between hydrant post.</p> <p>1.6 Pipe material and size.</p>	CO1
<p><i>TSO 2a.</i> Develop Sprinkler System and its various layouts.</p> <p><i>TSO 2b.</i> Ensure proper placement of mains and branch lines.</p> <p><i>TSO 2c.</i> Design Sprinkler system spacing area permitted for protection.</p>	<p>Unit-2.0 Sprinkler System</p> <p>2.1 Sprinkler System layout- Sprinkler system zoning, tree system, looped system, gridded system.</p> <p>2.2 Placement of mains and branch lines.</p> <p>2.3 Sprinkler system spacing.</p> <p>2.4 Maximum area permitted for protection.</p> <p>2.5 Sprinkler system type- wet pipe system, dry pipe system, pre-action system and deluge system.</p>	CO2
<p><i>TSO 3a.</i> Explore different types Systems for fire protection.</p> <p><i>TSO 3b.</i> Use of foam water sprinkler for given condition</p> <p><i>TSO 3c.</i> Elaborate diked and non-diked area protection.</p> <p><i>TSO 3d.</i> Demonstrate Foam Fire Fighting at fixed sites.</p> <p><i>TSO 3e.</i> Give the description of Storage tank fire tactics.</p>	<p>Unit-3.0 Foam Based Fire Protection</p> <p>3.1 System types –Fixed, Semi fixed and mobile foam systems. related terminologies</p> <p>3.2 Fixed cone roof, external floating roof and internal floating roof protection with foam water sprinkler system.</p> <p>3.3 Diked and non-diked area protection.</p> <p>3.4 Foam Fire Fighting at fixed sites- Size of fire, type of fuel, depth of fuel.</p> <p>3.5 Storage tank fire tactics for cone roof, floating roof and horizontal tanks.</p>	CO3
<p><i>TSO 4a.</i> Explain Halogenated Agents and System of fire protection.</p> <p><i>TSO 4b.</i> Apply design consideration of Flooding</p>	<p>Unit-4.0 Gas Based Fire Protection</p> <p>4.1 Halogenated Agents and System.</p>	CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p>system.</p> <p><i>TSO 4c.</i> Design Carbon dioxide storage. Piping systems with accessories with proper safety consideration</p> <p><i>TSO 4d.</i> Ensure Quantity and venting requirements for different system for Gas base fire protection.</p>	<p>4.2 Flooding system, design consideration-NFPA-12A and NFPA-12B.</p> <p>4.3 Halon Replacement agents and systems, Extinguishing Mechanism.</p> <p>4.4 Carbon Dioxide Application System, Concentration for extinguishment, life safety consideration NFPA-12, components of carbon dioxide system.</p> <p>4.5 Carbon dioxide storage, piping system, valves and operating devices, discharge nozzles, system controls, control panels, alarms.</p> <p>4.6 Quantity and venting requirements for different system, use and limitation of systems.</p>	
<p><i>TSO 5a.</i> Design dry chemical-based fire protection system.</p> <p><i>TSO 5b.</i> Carryout proper Inspection, testing and maintenance as per standard procedures.</p> <p><i>TSO 5c.</i> Explore standard listed agents for metal fires.</p>	<p>Unit-5.0 Dry Chemical Based Fire Protection System</p> <p>5.1 System design NFPA-17, storage of chemical and expellant, system actuation and distribution system.</p> <p>5.2 Inspection, testing and maintenance procedures for chemical systems.</p> <p>5.3 Standard and listed agents for metal fires MET-L-X powder, Na-X powder, other combustible metal extinguishing agent.</p>	CO5

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2448401

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 1.1.</i> Develop drawings of suction and delivery arrangement of pumps.	1.	Development of suction and delivery arrangement of main, standby and jockey pump for a given sample of pump house.	CO1
<i>LSO 2.1.</i> Design layout of Sprinkler system.	2.	Installation of a sprinkler for a given sample of an occupancy	CO2
<i>LSO 3.1.</i> Use operation guidelines of hydrant system.	3.	Demonstration of hydrant system with its major components	CO1
<i>LSO 4.1.</i> Apply foam-based fire protection system.	4.	Preparation of a Plan of foam-based fire protection system.	CO3
<i>LSO 5.1.</i> Use of gas-based fire protection system.	5.	Preparation of drawing for a gas fire protection system given sample of an occupancy.	CO4
<i>LSO 6.1.</i> Use of dry chemical-based fire protection system.	6.	Development of a plan of dry chemical-based fire protection system with the major components in a given sample of the hazardous location.	CO5
<i>LSO 7.1.</i> Applications of water spray system for fire protection at LPG store.	7.	Design of water spray system in a given sample of LPG storage facility.	CO5
<i>LSO 8.1.</i> Demonstrate components of water mist/emulsify system.	8.	Demonstration various components of water mist/emulsify system for a given model.	CO2

L) **Suggested Term Work and Self Learning: S2448401** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. **Assignments:**

1. Prepare a Hydrant System and its various components for a high-rise building. CO-1
2. Development of water Sprinkler System and its various types for a typical occupancy area. CO-2
3. Calculate the requirement of fire protection of a LPG store of your city. CO-5

b. **Micro Projects:**

- Workout the fire protection plans and hydrant system requirements of the Govt building of your city
- Calculate the fire control requirement of a small industry close to your institute

c. **Other Activities:**

1. Self-learning topics:

- Foam based Fire Fighting: Issue and challenges.
- Gas fire protection systems in advanced countries.
- Fire auditing system of LPG storage facility.

M) **Suggested Course Evaluation Matrix:** The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
Assignments			Micro Projects	Other Activities*			
CO-1	25%	25%	35%	-	-	25%	25%
CO-2	25%	25%	35%	-	-	25%	25%
CO-3	20%	15%	-	-	35%	10%	10%
CO-4	15%	15%	-	-	65%	15%	15%
CO-5	15%	20%	30%	-	-	25%	25%
Total Marks	30	70	40	-	10	20	30
			50				

Legend:

*: Other Activities include self-learning, seminar, visits, surveys, product development, software development etc.

** : Mentioned under point- (N)

: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Water Based Fire Protection	9	CO1	18	5	6	7
Unit-2.0 Sprinkler System	10	CO2	18	5	7	6
Unit-3.0 Foam Based Fire Protection	10	CO3	10	3	3	4
Unit-4.0 Gas Based Fire Protection	10	CO4	10	3	3	4
Unit-5.0 Dry Chemical Based Fire Protection System	9	CO5	14	4	5	5
Total	48	-	70	20	24	26

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Development of suction and delivery arrangement of main, standby and jockey pump for a given sample of pump house.	CO1	45	35	20
2.	Installation of a sprinkler for a given sample of an occupancy	CO2	45	35	20
3.	Demonstration of hydrant system with its major components	CO1	45	35	20
4.	Preparation of a Plan of foam-based fire protection system.	CO3	40	40	20
5.	Preparation of drawing for a gas fire protection system given sample of an occupancy.	CO4	45	45	10
6.	Development of a plan of dry chemical-based fire protection system with the major components in a given sample of the hazardous location.	CO5	45	45	10
7.	Design of water spray system in a given sample of LPG storage facility.	CO5	45	40	15
8.	Demonstration various components of water mist/emulsify system for a given model.	CO2	45	40	15

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Main pump, standby pump and jockey pump	Main pump, standby pump and jockey pump Power 5 - 25 HP Max Flow Rate 180 LPM - 300 LPM Head 40 Mtr - 160 Mtr Automatic Grade Automatic Speed (Round Per Minute) 3000	1,2
2.	Sprinkler systems	Sprinkler system A sprinkler system consists of a water supply (or supplies) and one or more sprinkler installations~ each installation consists of a set of installation control valves and a pipe array fitted with sprinkler heads. The sprinkler heads are fitted at specified locations at the roof or ceiling, and where necessary between racks, below shelves, or below obstructions. The main elements of a typical installation as per drawing	2,4
3.	Hydrant system	Single Headed Hydrant Valve Material of Construction Gun Metal, Stainless Steel End Connections and Flange Sizes Flanged Ends / Screwed to BSPT OR NPT threaded. Flange Size As per IS - 6392 / 1538 ANSI / As per Clients Specification Rubber Washers -- IS 937 (Type A) Cast Iron wheel --- IS 210 Pressure performance Hydraulic Test of seat --- 14 kg/Cm2 Hydraulic Test of Body --- 21 kg/Cm2 Flow Test at 7kg / Cm2 --- 900 LPM BIS (Bureau of Indian Standards) IS 5290 Type A.	3,5

R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Principles of Foam Fire Fighting	Fred Stowell	International Fire Service Training Association
2.	Designer's Guide to Automatic Sprinkler Systems, NFPA-2005	Robert M Gagnon	NFPA
3.	Operation of Fire Protection System	-	NFPA Special Edition
4.	Fire Service Manual, Fire Service Technology Equipment and media Fire Fighting Foam Technical Volume-1	-	-
5.	Fire Protection Handbook, Section-10 and 11	Arthur E. Cote	National Fire Protection Association

(b) Online Educational Resources: -

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

(c) Others: -

- A) **Course Code** : 2448402(T2448402/S2448402)
 B) **Course Title** : Fire Modeling and Risk Assessment
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

High-rise buildings fires are far more harmful than ordinary fires. In this regard, fire risk assessment is an important way to control fire risk and reduce losses. Comprehensive fire modelling helps in dynamic risk assessment of high-rise buildings. This course will develop the skills about different combustion models with available advance field modeling in fire engineering. This course also covers the fire hazard and risk analysis process and associated simplified growth calculations.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

After completion of the course, the students will be able to-

- CO -1** Perform fire loss investigation with basic tools of analysis.
CO -2 Apply different fire models in given situation of fire scene.
CO -3 Analyze various combustion field models for Fire risk assessment.
CO -4 Describe advance techniques in field modeling applicable to fire scenarios.
CO -5 Carryout fire hazard and risk analysis with simplified calculations.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	2	2	-	-	-	-	2	3	-
CO-2	2	3	2	-	2	-	-	2	-
CO-3	3	3	3	2	2	-	-	2	-
CO-4	3	2	2	3	2	-	1	2	-
CO-5	3	3	2	-	2	-	-	3	-

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J) **Theory Session Outcomes (TSOs) and Units: T2448402**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Identify the organizations for fire investigation.</p> <p><i>TSO 1b.</i> Explain the mechanism of fire problem characterization using data.</p> <p><i>TSO 1c.</i> Describe the basic tools for analysis process.</p> <p><i>TSO 1d.</i> Analyze the different approaches to fire data analysis.</p> <p><i>TSO 1e.</i> Apply strategies in analysis of fire investigations using data in program.</p> <p><i>TSO 1f.</i> Explain fire loss analysis approaches after data analysis.</p>	<p>Unit-1.0 Fire Loss Investigation</p> <p>1.1 Organization for fire investigation.</p> <p>1.2 Applicable data to characterize the fire problem.</p> <p>1.3 Basic tools for analysis.</p> <p>1.4 Approaches to fire data analysis.</p> <p>1.5 Applicable data in program and strategies analysis.</p> <p>1.6 Fire loss estimation using different analytic approaches.</p>	CO1
<p><i>TSO 2a.</i> Explain physical fire models in fire modeling.</p> <p><i>TSO 2b.</i> Describe mathematical fire models.</p> <p><i>TSO 2c.</i> Explain determine fire models.</p> <p><i>TSO 2d.</i> Elaborates computation fire models.</p> <p><i>TSO 2e.</i> Explain flam spread rate over liquid surface.</p> <p><i>TSO 2f.</i> Discuss current trends in fire modeling.</p>	<p>Unit-2.0 Introduction to Fire Modeling.</p> <p>2.1 Physical fire models.</p> <p>2.2 Mathematical fire models.</p> <p>2.3 Deterministic fire models.</p> <p>2.4 Computational fluid dynamics (CFD) models.</p> <p>2.5 Current trends in fire modelling.</p>	CO2
<p><i>TSO 3a.</i> Explain turbulent combustion in fire.</p> <p><i>TSO 3b.</i> Compare detailed chemistry over simplified chemistry in combustion process.</p> <p><i>TSO 3c.</i> Describe finite rote formulation combustion models.</p> <p><i>TSO 3d.</i> Explain combustion models on conserved scalar.</p> <p><i>TSO 3e.</i> Enlist the guideline for selecting combustion models in field modeling.</p> <p><i>TSO 3f.</i> Apply combustion models in field modeling.</p>	<p>Unit-3.0 Combustion Field Modeling.</p> <p>3.1 Turbulent combustion in fire.</p> <p>3.2 Detailed chemistry verses simplified chemistry.</p> <p>3.3 Finite rate formulation combustion models.</p> <p>3.4 Combustion models based on conserved scalar.</p> <p>3.5 Guidelines for selecting combustion models in field modeling.</p> <p>3.6 Applications of combustion models in field modeling.</p>	CO3
<p><i>TSO 4a.</i> Explain advance development in field modeling.</p> <p><i>TSO 4b.</i> Describe direct numerical simulation (DNS).</p> <p><i>TSO 4c.</i> Describe large eddy simulation (LES).</p> <p><i>TSO 4d.</i> Analyze the mechanism for formulation of numerical algorithm.</p> <p><i>TSO 4e.</i> Determine the constraints using worked examples.</p>	<p>Unit-4.0 Advance Techniques in Field Modeling.</p> <p>4.1 Next stage development and application.</p> <p>4.2 Direct numerical simulation (DNS).</p> <p>4.3 Large Eddy simulation (LES)</p> <p>4.4 Formulation of numerical algorithm.</p> <p>4.5 Worked example on Laze eddy simulation.</p>	CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 5a.</i> Explain fire hazard analysis.</p> <p><i>TSO 5b.</i> Explain fire risk analysis.</p> <p><i>TSO 5c.</i> Calculate fire growth algorithm.</p> <p><i>TSO 5d.</i> Estimate fire risk calculation.</p>	<p>Unit-5.0 Fire Hazard and Risk Analysis.</p> <p>5.1 Fire hazard analysis.</p> <p>5.2 Fire risk analysis.</p> <p>5.3 Simplified fire growth calculation.</p> <p>5.4 Simple fire hazard calculations.</p> <p>5.5 Simplified fire risk calculation.</p>	CO5

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: (Not Applicable)

L) **Suggested Term Work and Self Learning: S2448402** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. **Assignments:** Some Questions/ Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. **Micro Projects:**

- Develop a fire risk assessment model for a small multistoried building of your city.

c. **Other Activities:**

- Visit a high rise building and study the modelling used for fire risk assessment

1. Seminar Topics:

- Fire loss investigation.
- Physical fire models.
- Computational fluid dynamics (CFD) models.
- Fire hazard and risk analysis.

M) **Suggested Course Evaluation Matrix:** The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
Assignments			Micro Projects	Other Activities*			
CO-1	20%	20%	20%	-	20%	-	-
CO-2	20%	20%	20%	25%	20%	-	-
CO-3	25%	25%	20%	25%	20%	-	-
CO-4	20%	20%	20%	25%	20%	-	-
CO-5	15%	15%	20%	25%	20%	-	-
Total Marks	30	70	20	20	10	-	-
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

** : Mentioned under point- (N)

: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Fire Loss Investigation	8	CO1	10	3	3	4
Unit-2.0 Introduction to Fire Modeling.	8	CO2	10	3	2	5
Unit-3.0 Combustion Field Modeling.	10	CO3	12	5	2	3
Unit-4.0 Advance Techniques in Field Modeling.	12	CO4	12	5	6	9
Unit-5.0 Fire Hazard and Risk Analysis.	10	CO5	12	4	6	10
Total	48	-	70	20	19	31

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical): (Not Applicable)

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)

R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1	Quantitative Risk Assessment in Fire Safety	Ramachandran Ganapathy	Publisher: Taylor & Francis Ltd ISBN: 9780367576998, 9780367576998
2	Handbook on Fire & Life Safety in Buildings -	Barender Mohan Sen	Techno World; 2022nd edition (24 May 2022); Techno World 2022/edition B0B2PHFGM3
3	Principles of Fire Risk Assessment in Buildings	David Yung	John Wiley & Sons Inc
4	Fire Protection Handbook Volume-I Section-3	Arthur E.Cote	National Fire Protection Association Publisher, 19 th Edition ISBN- 0-87765-474-3
5	Computation fluid dynamics in fire engineering	Guan Heng Yeoh and Kwok Kit Yven	Elsevier Inc Publisher ISBN: 978-07506-8589-4

(b) Online Educational Resources:

- 1) <https://www.youtube.com/watch?v=CC3Q2vtkfxg>
- 2) <https://www.youtube.com/watch?v=XCAzoaNYBAs>
- 3) <https://www.youtube.com/watch?v=F8alrh4U0Io>
- 4) <https://humanfocus.co.uk/e-learning/fire-risk-assessment-training/>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

- A) **Course Code** : 2448403(T2448403/P2448403/S2448403)
 B) **Course Title** : Structural Fire Protection
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

The structural performance of steel, concrete or timber structures exposed to unwanted fires is important for fire engineers because burning building collapse due to failure of structures at elevated temperature during fire. In-depth understanding about engineering approach to fire protection, fire resistance construction as well as assessing the damages due to fire if any. is necessary from diploma pass outs of Fire technology and safety. This course will help to students to take up preventive precautions during handling of such scenario in the field. This course covers the fire effects on building, analysis of structural damage and post fire analysis.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

After completion of the course, the students will be able to-

- CO- 1** Identify the structural terms of building collapse due to causes of fire.
CO- 2 Describe effect of fire, smoke movement and smoke control pressurization system for a building.
CO- 3 Analyze structural damage for different load bearing and non-load bearing elements.
CO- 4 Distinguish between post fire analysis and planning/design for reduction of fire spread.
CO- 5 Explain types of building construction with their collapse hazard.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	2	-	3	2	3	2	1	-	-
CO-2	3	3	3	2	2	-	2	-	-
CO-3	2	2	-	-	-	2	1	-	-
CO-4	-	1	3	2	1	2	1	-	-
CO-5	3	-	-	3	3	3	3	-	-

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					Total Credits (C)
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	
			L	T				
Fire Technology & Safety Engineering	2448403	Structural Fire Protection	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/ implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits= (1xCIhours) + (0.5xLIhours) + (0.5xNotionalhours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Fire Technology & Safety Engineering	2448403	Structural Fire Protection	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) **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), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units: T2448403**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain construction terms of building design.</p> <p><i>TSO 1b.</i> Describe girder gusset plate, types of wall and braced frame construction.</p> <p><i>TSO 1c.</i> Explain the principles of structural fire protection</p> <p><i>TSO 1d.</i></p>	<p>Unit-1.0 Building Structural Terms</p> <p>1.1 Constructive terms of building - Arch, Beam and its types, Buttress, Deck, Façade and Fire cut beam. Building joints, staircases. ducts types of wall, Lintel joist, suspended ceiling and braced frame construction.</p> <p>1.2 Principles of structural fire protection,</p> <p>1.3 Fire resistance of building elements</p>	CO1
<p><i>TSO 2a.</i> Impact of fire on the behavior of concrete, steel, and wood at elevated temperatures;</p> <p><i>TSO 2b.</i> Discuss smoke movement in tall structure with stack, wind and opening influences.</p> <p><i>TSO 2c.</i> Explain smoke control at the design stage of building.</p> <p><i>TSO 2d.</i> Describe pressurization system with different types.</p> <p><i>TSO 2e.</i> Describe the smoke spread control during fire occurrences.</p>	<p>Unit-2.0 Fire and Smoke Effects on Building</p> <p>2.1 The effect of fire on the behavior of concrete, steel, and wood at elevated temperatures</p> <p>2.2 Smoke movement in buildings- Stack effect, Wind effects, Influence of openings</p> <p>2.3 Smoke control during building design- Smoke shaft and Mechanical ventilation.</p> <p>2.4 Pressurization system and their types</p> <p>2.5 Study of smoke control pressurization system for a building and Control of smoke spread.</p>	CO2
<p><i>TSO 3a.</i> Explain various fire causes of wall collapse.</p> <p><i>TSO 3b.</i> Define reasons of roof collapse for different types of construction.</p> <p><i>TSO 3c.</i> Distinguished between stairway and floor collapse.</p> <p><i>TSO 3d.</i> Explain precast concrete slab collapse.</p> <p><i>TSO 3e.</i> Describe the root causes of column collapse at high temperature.</p>	<p>Unit-3.0 Analysis of Structural Damage due to Fire</p> <p>3.1 Wall collapse- Masonry wall, Concrete wall and wood frame walls due to fire .</p> <p>3.2 Roof collapse- Sloping peak roof, Timber truss roof, Flat roof and steel roof, Column collapse due to fire .</p> <p>3.3 Stairway collapse, Floor Collapse-Terrazzo floor</p> <p>3.4 Collapse of wooden I beam, Precast concrete slabs.</p>	CO3
<p><i>TSO 4a.</i> Explain fire retardant compartmentation.</p> <p><i>TSO 4b.</i> Distinguish between fire diagram and photographic documentation.</p> <p><i>TSO 4c.</i> Describe the salient feature of fire site planning from firefighting point of view.</p> <p><i>TSO 4d.</i> Define concept of compartmentation and type of compartments.</p> <p><i>TSO 4e.</i> Explain principles and types of fire and roof venting.</p>	<p>Unit-4.0 Post Fire Analysis</p> <p>4.1 Fire Retarding compartmentation, fire fact sheet.</p> <p>4.2 Fire diagram and fire photographic documentation, Fire planning and design.</p> <p>4.3 Confinement of fire site planning access to firefighting appliances, Contribution of external walls and roof covering.</p>	CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	4.4 Concept of compartments and types, Construction of compartments, Space and circulation. 4.5 Principles and types of fire and roof venting, Effect of wind on roof vent.	
<p><i>TSO 5a.</i> Identify the fire collapse hazards and explain types of buildings and construction.</p> <p><i>TSO 5b.</i> Define fire severity with its influencing factors.</p> <p><i>TSO 5c.</i> Describe thermal properties of common combustibles.</p> <p><i>TSO 5d.</i> Determine the fire resistance time for different types of compartments.</p> <p><i>TSO 5e.</i> Explain explosion prevention tactics during enclosures fires.</p>	<p>Unit-5.0 Building Type, Construction and Hazards.</p> <p>5.1 Types of building and construction and their collapse hazards due to fire.</p> <p>5.2 Fire severity and factors controlling fire severity in buildings.</p> <p>5.3 Thermal properties of wall fixtures & geometrical properties of a room compartment.</p> <p>5.4 Calculation of fire resistance of a compartment.</p> <p>5.5 Heat balance for an enclosure during a fire Reduction of risk of fires explosions.</p>	CO5

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2448403

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO1.1 Familiarization with building structural layouts with fire protection systems at site	1	Develop 2d digital building models having only structural elements details and following fire protection system using any CAD software: <ul style="list-style-type: none"> Hydrant point Sprinkler head Long branch pipe 	CO1, CO2, CO3
LSO2.1 Demonstration of layouts of fire protection systems such as Sprinkler installation, fire extinguisher and safety sign boards.	2	Develop 3d models of following fire fighting system using any CAD software: <ul style="list-style-type: none"> Sprinkler installation Fire extinguisher Safety sign boards 	CO1, CO2, CO3
LSO3.1 Familiarization with layouts Static water tank and accessories, firefighting pumps arrangements and deluge valve.	3	Develop layout of following fire fighting system using any CAD software: <ul style="list-style-type: none"> Static water tank and accessories Fire fighting pumps arrangements Deluge valve 	CO1, CO2, CO3
LSO4.1 Compare the tensile strength of a building component at normal temperature versus elevated temperature.	4	Determine the tensile strength for a given sample of column having size 1800mmx1800mmx2500mm at elevated temperature of 300°C.	CO4, CO5
LSO5.1 Compare the tensile strength of a steel rod at normal temperature versus elevated temperature.	5	Determine the tensile strength for a given sample of steel rod having 12mm diameter with 3m length at elevated temperature of 300°C.	CO4, CO5
LSO6.1 Compare the fire resistance of a building component at normal temperature versus elevated temperature.	6	Calculate the fire resistance time for a given sample of building component and compare it with standard fire resistance time available in standards.	CO4, CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO7.1 Understand the smoke movement up to 3 meter in a given room from the available source of smoke.	7	Determine the response time of a smoke detector in a closed compartment through smoke generation apparatus at ground level.	CO4, CO5

L) **Suggested Term Work and Self Learning: S2448403** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

1. Identify a design fire and having an expressed relationship between heat flux or fire temperature as a function of time
2. Determine of the temperature mainly in the structural members, system, and components by a heat transfer analysis.
3. Calculate of the structural system's response while considering the elevated temperature effect on stiffness and strength.

b. Micro Projects:

- Visit a building damaged due to fire and prepare a report on structural failure with photographs and site details.
- Collect reports from the Local fire brigade office of fire damaged building and critically study the structural damages reported in the report.

c. Other Activities:

1. Seminar Topics:

- Case study on Burning Buildings.
- Comparative study with and without smoke control installation based on past incidents.
- Fire Resistance properties of building materials.
- Fire audit /survey reports preparation.

M) **Suggested Course Evaluation Matrix:** The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	20%	20%	20%	-	20%	20%	20%
CO-2	20%	20%	20%	25%	20%	10%	20%
CO-3	25%	25%	20%	25%	20%	15%	20%
CO-4	20%	20%	20%	25%	20%	15%	20%
CO-5	15%	15%	20%	25%	20%	40%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Building Structural Terms	8	CO1	10	3	3	4
Unit-2.0 Fire and Smoke Effects on Building	8	CO2	10	3	2	5
Unit-3.0 Analysis of Structural Damage	10	CO3	12	5	2	3
Unit-4.0 Post Fire Analysis	12	CO4	12	5	6	9
Unit-5.0 Building Type, Construction and Hazards.	10	CO5	12	4	6	10
Total	48	-	70	20	19	31

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Develop 2d digital building models having only structural elements details and following fire protection system using any CAD software: <ul style="list-style-type: none"> • Hydrant point • Sprinkler head • Long branch pipe 	CO1, CO2, CO3	40	40	20
2.	Develop 3d models of following fire fighting system using any CAD software: <ul style="list-style-type: none"> • Sprinkler installation • Fire extinguisher • Safety sign boards 	CO1, CO2, CO3	40	40	20
3.	Develop layout of following fire fighting system using any CAD software: <ul style="list-style-type: none"> • Static water tank and accessories • Fire fighting pumps arrangements • Deluge valve 	CO1, CO2, CO3	50	30	20
4.	Determine the tensile strength for a given sample of column having size 1800mmx1800mmx2500mm at elevated temperature of 300°C.	CO4, CO5	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
5.	Determine the tensile strength for a given sample of steel rod having 12mm diameter with 3m length at elevated temperature of 300°C.	CO4, CO5	40	40	20
6.	Calculate the fire resistance time for a given sample of building component and compare it with standard fire resistance time available in standards.	CO4, CO5	40	40	20
7.	Determine the response time of a smoke detector in a closed compartment through smoke generation apparatus at ground level.	CO4, CO5	40	40	20

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/ practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	AutoCAD Software	2023 Version	1,2,3
2.	Sprinkler Heads	Pendant type Red quartzible bulb type sprinkler	4
3.	Tensile Strength measurement Apparatus	0-500 KN.	5,6
4.	Laboratory furnace	0-500°C	6,7
5.	Smoke detector	Ionization Type	8
6.	Smoke Generator	Portable Type	8

R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Failure point- How to determine burning building stability	Howard J. Hill,	PennWell Corporation Publisher, ISBN: 978-1-59370-283-0
2.	Structural fire fighting	Bernard J.(Ben) Klaene and Russell E. Sanders.	National Fire Protection Association Publisher ISBN: 0-87765-444-1
3.	Collapse of burning building – A guide to fire ground safety	Vincent Dunn	PennWell Corporation Publisher, ISBN: 0-87814-902-3
4.	Structural Design for Fire Safety	Buchanan Andrew H.	John Wiley & Sons Inc ISBN: 9780470972892, 9780470972892
5.	Structural Fire Engineering, 1st Edition	Venkatesh Kumar R. Kodur, .M. Z. Naser,	McGraw Hill ISBN: 9781260128581

(b) Online Educational Resources:

- 1) <https://www.bia.gov/as-ia/ofpsm/dfmc/sfpp>
- 2) https://onlinecourses.nptel.ac.in/noc20_ce09/preview
- 3) <https://greenwgroup.co.in/training-courses/cfps-exam-prep/>
- 4) <https://dife.in/>
- 5) https://www.youtube.com/watch?v=RMDDOI5c_fE
- 6) <https://www.youtube.com/watch?v=hsJEqMUDFac>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

- A) **Course Code** : 2448404(T2448404/S2448404)
- B) **Course Title** : Fire Suppression, Control Equipment and Material
- C) **Pre- requisite Course(s)** :
- D) **Rationale** :

Fire is a devastating element that can destroy a business, especially when it is out of control. From damage to a physical site, employees and visitors can come into harm, as well as stock and equipment be damaged. Fire spreads fast and therefore it is important that key systems are put in place to minimalism the potential impact of fire. Fire suppression systems are systems installed within a building or site that acts to stop fire from spreading within the site or even extinguish it entirely. There are various suppression systems types available and each will use a different method of fire suppression. This course covers the fire suppression mechanisms against fire.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

After completion of the course, the students will be able to-

- CO- 1** Use Fire extinguish agents for suppressing the fire in the typical residential and commercial buildings
- CO- 2** Install water-based suppression system as per requirement with proper pipe sizing
- CO- 3** Explain Carbon Dioxide Suppression Systems with specification and safety attributes
- CO- 4** Apply Dry and Wet Chemical Suppression Systems for fire suppression as per specific needs and circumstances
- CO- 5** Demonstrate Manual Fire Suppression Systems.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	3	3	3	2	3	2	1	-	-
CO-2	3	3	3	2	2	-	2	-	-
CO-3	2	2	-	-	3	3	1	-	-
CO-4	-	1	3	2	1	2	1	-	-
CO-5	3	-	-	3	2	3	3	-	-

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Fire Technology & Safety Engineering	2448404	Fire suppression, control equipment and material	02	01	-	02	05	04

Legend:

CI: Classroom Instruction (Includes different instructional/ implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits= (1xCIhours) + (0.5xLIhours) + (0.5xNotionalhours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Fire Technology & Safety Engineering	2448404	Fire suppression, control equipment and material	70	30	20	30	-	-	150

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) **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), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units: T2448404**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain the theory of fire suppression</p> <p><i>TSO 1b.</i> Ensure appropriate suppression agents as per attributes</p> <p><i>TSO 1c.</i> Elaborate the Fire extinguish agents and their applications</p>	<p>Unit-1.0 Fire Suppression Agents and Mechanisms</p> <p>1.1 Theory of suppression</p> <p>1.2 Suppression agents and attribute</p> <p>1.3 Life cycle of fire/fire triangle and tetrahedron</p> <p>1.4 Fire extinguish agents and their applications</p>	CO1
<p><i>TSO 2a.</i> Enlist the components of water-based suppression systems.</p> <p><i>TSO 2b.</i> Explain the attributes of fire suppression system</p> <p><i>TSO 2c.</i> Calculate the water requirement</p>	<p>Unit-2.0 Water Based Suppression System</p> <p>2.1 Basic components of water-based suppression systems.</p> <p>2.2 Types of systems / components / applications. Attributes of system components.</p> <p>2.3 Spacing / location / placement of discharge devices. Methods for sizing piping / piping configurations. water requirement</p>	CO2
<p><i>TSO 3a.</i> Explain the components of carbon dioxide suppression systems</p> <p><i>TSO 3b.</i> Ensure type of system necessary to suppress the fire.</p> <p><i>TSO 3c.</i> Calculate design criteria placement of discharge devices.</p> <p><i>TSO 3a.</i> Ensure proper piping configuration for safety requirement against fire</p>	<p>Unit-3.0 Carbon Dioxide Suppression Systems</p> <p>3.1 Basic components of carbon dioxide suppression systems. Types of systems / components / applications.</p> <p>3.2 Attributes of system components. System design criteria. Spacing / location / placement of discharge devices.</p> <p>3.3 Methods for sizing piping / piping configurations. supply requirements. Safety considerations.</p>	CO3
<p><i>TSO 4a.</i> Explain the conditions and situation of using Dry and Wet Chemical Suppression Systems</p> <p><i>TSO 4b.</i> Demonstrate the use of Portable Fire Extinguishers</p> <p><i>TSO 4c.</i> Perform the testing of Portable Fire Extinguishers</p>	<p>Unit-4.0 Dry and Wet Chemical Suppression Systems</p> <p>4.1 Basic components of dry and wet chemical suppression systems. Types of systems / components /</p> <p>4.2 Portable Fire Extinguishers - Classifications of portable fire extinguishers.</p> <p>4.3 Testing of portable fire extinguishers. Spacing / location / placement of discharge devices.</p>	CO4
<p><i>TSO 5a.</i> Describe Manually Operated Fire Suppression System.</p> <p><i>TSO 5b.</i> Install fire Detection and Suppression System</p>	<p>Unit-5.0 Manual Fire Suppression Systems</p> <p>5.1 Manually Operated Fire Suppression System.</p> <p>5.2 Fire Detection and Suppression System. As per AIS 135.</p>	CO5

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5c. Operate fire alarm system TSO 5d. Explain Manual actuation mechanism of fire suppression	5.3 Fire detectors Fire alarm & visual indicator 5.4 Fire indicator & control panel Fire extinguishing agent container 5.5 Manual actuation mechanism	

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: (Not Applicable)

L) Suggested Term Work and Self Learning: S2448404 Some sample suggested assignments, micro project and other q activities are mentioned here for reference.

a. Assignments:

1. Collect National & international standards used for fire suppression systems, and material used

2. Micro Projects:

- Visit a smart city construction site and prepare a report on fire suppression systems USED
- Collect case study of rescue operations of fire suppression systems

b. Other Activities:

1. Seminar Topics:

- Modern fire suppression systems
- Highrise fire suppression systems
- Safety in fire suppression systems

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	20%	20%	20%	-	20%	-	-
CO-2	20%	15%	20%	25%	20%	-	-
CO-3	15%	15%	20%	25%	20%	-	-
CO-4	25%	25%	20%	25%	20%	-	-
CO-5	20%	25%	20%	25%	20%	-	-
Total Marks	30	70	20	20	10	-	-
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

** : Mentioned under point- (N)

: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course for progressive assessment

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Fire suppression agents and Mechanisms	10	CO1	10	3	3	4
Unit-2.0 Water based suppression system	10	CO2	15	5	4	6
Unit-3.0 Carbon Dioxide Suppression Systems	10	CO3	10	4	2	3
Unit-4.0 Dry and Wet Chemical Suppression Systems	10	CO4	20	4	7	9
Unit-5.0 Manual Fire Suppression Systems	8	CO5	15	4	6	5
Total	48	-	70	20	22	28

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical): (Not Applicable)

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)

R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Fire Detection & Suppression Systems	IFSTA	FPP/IFSTA; 4th edition ISBN-10 : 0132786052 ISBN-13 : 978-0132786058
3.	Design and Fabrication of an Automatic Sprinkler Fire Fighting System	Abdalsalam Ahmed, Abdulsalam Mansor & Abdulgani Albagul	Conference paper
4.	Fire Detection and Suppression Systems by	Lynne Murnane, Ted Boothroyd (Author)	Intl Fire Service Training Assn; ISBN-10 : 0879392673
5	Fire Protection Equipment and Systems	Ronald Spadafora	Pearson; ISBN-10 : 0135028280 ISBN-13 : 978-0135028285
6	Fire Suppression Practices and Procedures	Eugene E Mahoney	Editorial : Pearson; ISBN-10 : 0131517732 ISBN-13 : 978-0131517738

(b) Online Educational Resources:

- 1) https://safeprofir.com/fire_detection_and_suppression_system.php
- 2) <https://www.vighnaharta.in/fire-detection/user-manual/fss042d-um-mak-1-3.pdf>
- 3) <https://www.firetrace.com/fire-suppression-systems>
- 4) <https://www.youtube.com/watch?v=k9tY3FDQ06Q>
- 5) <https://www.youtube.com/watch?v=Qt3GF1O3ZSc>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

- A) **Course Code** : 2448406(P2448406/S2448406)
 B) **Course Title** : Safety in Construction and Mines
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

The construction and mining agencies pay top priorities to the health and well-being of their workers against any kind of hazardous including fire while they are on the construction and mining sites. It is also a legal requirement. Safety at Construction and mining is essential to the project's sustainability, as it reduces the environmental impact and provides a healthy and safe living environment for the project's residents.

This course covers the safety aspects on building construction including fire and safety against fire in mining.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

After completion of the course, the students will be able to-

- CO- 1 Demonstrate safety in construction and mining specifically under fire breakout.
 CO- 2 Explain safety in construction & demolition operations involved with construction industry.
 CO- 3 Follow the standards practices of demolition of fire damaged building structure
 CO- 4 Explain the safety aspect of fire in coal mines.
 CO- 5 Carryout safe rescue and recovery from accidents in construction and mines.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	2	-	3	2	3	2	1	-	-
CO-2	3	3	3	2	2	-	2	-	-
CO-3	2	2	-	-	-	2	1	-	-
CO-4	-	1	3	2	1	2	1	-	-
CO-5	3	-	-	3	3	3	3	-	-

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Fire Technology & Safety Engineering	2448406	Safety in construction and Mines	-	-	04	02	06	03

Legend:

CI: Classroom Instruction (Includes different instructional/ implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits= (1xCIhours) + (0.5xLIhours) + (0.5xNotionalhours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Fire Technology & Safety Engineering	2448406	Safety in construction and Mines	-	-	10	15	20	30	75

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) **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), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units: UNDERPINNING THEORY ONLY**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain the necessity of safety at construction site</p> <p><i>TSO 1b.</i> Ensure safe access to materials and machines at construction</p> <p><i>TSO 1c.</i> Demonstrate the possible events of accident at construction</p>	<p>Unit-1.0 Basic Construction Safety Aspects</p> <p>1.1 Construction safety-good house keeping , site planning and layout,</p> <p>1.2 Safe access of materials and machines at site</p> <p>1.3 Accident causes and its effects at construction site</p>	CO1
<p><i>TSO 2a.</i> Ensure proper safety during excavation drilling & blasting, trenching, strutting, piling</p> <p><i>TSO 2b.</i> Carryout safe operations of construction during Caissons, under water concreting, Cofferdams</p> <p><i>TSO 2c.</i> Demonstrate the safe practices of construction of Highrise buildings and bridges</p>	<p>Unit-2.0 Safety in Construction Operation</p> <p>2.1 Underground works Excavation, drilling & blasting, trenching, strutting, piling & safety in using and operation machinery and equipment relating to above components.</p> <p>2.2 Under water operations, River draining, well sinking, Caissons, under water concreting, Cofferdams & special operation connected with irrigation works, Use of related machinery and equipment, Movement of Materials & personnel</p> <p>2.3 High rise building, bridges, roads, railways, construction operations</p>	CO2
<p><i>TSO 3a.</i> Observe proper precautions while carrying out demolition of old /damaged structures.</p> <p><i>TSO 3b.</i> Ensure the life of public while demolition is taking place</p> <p><i>TSO 3c.</i> Demonstrate safety measures as per standards during handling building materials</p> <p><i>TSO 3d.</i> Explain special safety aspects while handling glass, paints, varnishes, and petroleum products</p>	<p>Unit-3.0 Safety in Demolition Operation</p> <p>3.1 Planning Precautions prior to demolition,</p> <p>3.2 Protection of public, Precautions during demolition. Sequence of demolition operations from safety point of view</p> <p>3.3 Safety measures with respect to building materials including cement, lime, timber,</p> <p>3.4 steel, glass, paints, varnishes, and petroleum products Roof collapse- Sloping peak roof, Timber truss roof, Flat roof and steel roof, Column collapse due to fire.</p>	CO3
<p><i>TSO 4a.</i> Explain fire causes in the coal mines.</p> <p><i>TSO 4b.</i> Elaborate the fire detection in mines</p> <p><i>TSO 4c.</i> Take all possible measure to prevent the fire in the coal mines</p>	<p>Unit-4.0 Safety in Coal Mines</p> <p>4.1 Coal Mine fire - Classification of mine fire, the genesis of mine fire,</p> <p>4.2 Spontaneous heating of coal, incubation period, detection of fire,</p> <p>4.3 prevention, and control of mine fire in underground coal mines</p>	CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 5a.</i> Describe rescue operations carried out in mining</p> <p><i>TSO 5b.</i> Demonstrate rescue equipment used in fire in mining</p> <p><i>TSO 5c.</i> Carryout the recovery operations after mining fire</p> <p><i>TSO 5d.</i> Explain the rescue and recovery mechanism of construction accident</p>	<p>Unit-5.0 Rescue and Recovery in Construction and Mining Operations</p> <p>5.1 Rescue and Recovery operations in mines,</p> <p>5.2 Rescue station, Rescue equipment, classification,</p> <p>5.3 recovery operations after mine fire, explosion, and inundation</p> <p>5.4 Rescue and recovery from construction accidents</p>	CO5

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2448406

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO1.1 Familiarize with building structural layouts with fire protection systems at site	1	Maintaining good housekeeping, site planning and layout at Construction site.	CO1, CO2, CO3
LSO2.1 Observe safety rules while working in construction industry	2	Demonstration of the working at construction operation with applicable safety rules	CO1, CO2, CO3
LSO3.1 Use safety gadgets during construction activities	3	Demonstration of safety gadgets and SOPs of construction activities	CO1, CO2, CO3
LSO4.1 Develop awareness about safety while working on underground excavation	4	Construction operation especially underground work excavation	CO4, CO5
LSO5.1 Follow safety norms and practices working on construction in underwater situation	5	Construction operation especially underwater situations	CO4, CO5
LSO6.1 Take utmost precautions while conduct of demolition operation during construction	6	Demolition operations of building	CO4, CO5
LSO7.1 Take utmost precautions while conduct of demolition operation of fire damaged building	7	Demolition operations of fire damaged buildings	CO4, CO5
LSO8.1 Develop insight about safety to observe while working in mines	8	Demonstration of fire safety aspects in coal minis	CO4, CO5
LSO9.1 Ensure the preventive measures of fire breakouts in mines	9	Prevention of fire under coal mines	CO4, CO5
LSO10.1 Carryout required the rescue and recovery during fire at construction sites and mines.	10	Demonstrate the rescue and recovery procedures at fire hazards at construction sites and mines	CO4, CO5

L) **Suggested Term Work and Self Learning: S2448406** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

1. Collect international standards used for safety at construction sites

b. Micro Projects:

- Visit a smart city construction site and prepare a report on Safety measure observed at the construction site
- Collect case study of rescue operations of fire in mining

c. Other Activities:

1. Seminar Topics:

- Modern safety parameters at construction site.
- Highrise construction and safety parameters
- Safety in mining
- Historical fire accident in mines in India

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	-	-	20%	-	20%	20%	20%
CO-2	-	-	20%	25%	20%	10%	20%
CO-3	-	-	20%	25%	20%	15%	20%
CO-4	-	--	20%	25%	20%	15%	20%
CO-5	-	--	20%	25%	20%	40%	20%
Total Marks			20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

** : Mentioned under point- (N)

: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: (Not Applicable)

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Maintaining good housekeeping, site planning and layout at Construction site.	CO1	40	40	20
2.	Demonstration of the working at construction operation with applicable safety rules	CO1, CO2	40	40	20
3.	Demonstration of safety gadgets and SOPs of construction activities	CO2, CO3	50	30	20
4.	Construction operation especially underground work excavation	CO2, CO3	40	50	10
5.	Construction operation especially underwater situations	CO2, CO3	40	40	20
6.	Demolition operations of building	CO3	40	40	20
7.	Demolition operations of fire damaged buildings	CO3	40	40	20
8.	Demonstration of fire safety aspects in coal minis	CO4	40	50	10
9.	Prevention of fire under coal mines	CO4	40	50	10
10.	Demonstrate the rescue and recovery procedures at construction sites	CO5	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Protective Gloves	Leather, Canvas or Metal Mesh Gloves Chemical and liquid resistant gloves	1 to 5
2.	Foot Protection	Safety-toed shoes performance standards in ANSI Z41-1999 or provide equivalent protection. Shoes with slip-resistant soles	1 to 5
3.	Protective Glass	Face Shields UV protection, must comply with BSI standard Welding Shields FOR infrared or intense radiant light;	1 to 5
4.	Respiratory protection	3M Half Facepiece Reusable Respirator 6200 & Organic Vapor Acid Gas Cartridge 6003, Comfortable, Reusable & Breathable Design, Filtration, Air Compatible, Protect with Airborne	1 to 5

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
5.	Fall Protection	Anchorage Connectors for Personal Safety Complete roofer's fall protection system Reusable and extremely durable roof anchor	1 to 5
6.	Protective clothes	Coveralls for Personal Safety	1-10
7.	Construction Helmet	Hard Hat w/ Ratchet Suspension Personalized Safety Helmets	1-10
8.	Safety Harness	INDUSTRIAL SAFETY BELTS AND HARNESES - SPECIFICATION AS PER IS 3521- 1999	1-10
9.	Safety Netting	Protection against Debris falling	1-10
10.	Fire Extinguisher	Capacity: 4 Kg. Extinguishing Medium: Dry Powder IS 14609. Operating Temperature: -20 DegreeC to +55 DegreeC.	1-10
11.	Safety Cone	Safety cone Height 750 mm Chain Length 4 m Shape Cone Chain: S Type chain material Plastic	1-10
12.	Fire Protection	Smoke Alarms. Sprinklers.	1-10

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Occupational health and Safety in Construction Project Management	Lingard, H. & Rowlinson, S	Spon Press.
2.	Mine Disasters and Mine Rescue	M A Ramlu,	Universities Press (India), private Limited , 2nd edition
3.	Mine Rescue work, Oliver and Boyd	R. McADAM and D. davidson,	Edinburgh: Tweeddale Court, London
4.	Construction Safety	Hinze, J.W. (1997)	Prentice Hall
5.	Construction Safety Planning,	Mac Collum, D.V.	John Wiley & Sons

(b) Online Educational Resources:

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

(c) Others:

- A) **Course Code** : 2418305(T2418305, P2418305,S2418305)
- B) **Course Title** : Python Programming
(CE, CSE, AIML, ME, ME (Auto), ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT, RE)
- C) **Pre- requisite Course(s)** :
- D) **Rationale** :

Python programming has emerged as a popular programming language across wide range of application segments from Scientific to Machine Learning to mobile app development, and so on. Python is a high-level general-purpose programming language.

Because code is automatically compiled to byte code and executed, Python is suitable as a scripting language, Web application implementation language, etc.

In Python there are multiple levels of organizational structure: functions, classes, modules, and packages. These assist in organizing code. An excellent and large example is the Python standard library.

The Object-oriented Python provides a consistent way to use objects: in Python it is easy to implement new object types (called classes in object-oriented programming).

This introductory course to learn basic Python programming features which can be used as building blocks to develop different kind of applications using Python 3.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- CO-1** Use various data types and operators in formation of expressions.
- CO-2** Write and execute programs using control statements.
- CO-3** Perform relevant operations on Sequence data types
- CO-4** Create functions in modules
- CO-5** Use numpy in writing python programs
- CO-6** Handle data files and exceptions.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	1	-	1	-	-	-	-		
CO-2	1	2	2	1	-	1	-		
CO-3	1	2	2	1	-	1	-		
CO-4	1	2	2	1	-	1	2		
CO-5	1	2	2	1	-	1	-		
CO-6	1	2	2	1	-	1	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2418305	Python programming	03	-	04	02	09	06

Note: Prefix will be added to Course Code if applicable (T for theory Paper, P for Practical Paper and S for Term work)

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
	2418305	Python programming	30	70	20	30	20	30	200

Note: Prefix will be added to Course Code if applicable (T for theory Paper, P for Practical Paper and S for Term work)

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) **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), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units: T2418305**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Differentiate between Procedure Oriented P and Object Oriented Programming approach with example.</p> <p><i>TSO 1b.</i> Use the concept of Lvalue and Rvalue</p> <p><i>TSO 1c.</i> Write python program using various data types and operators</p>	<p>Unit 1: Fundamentals of Python Programming Syntax</p> <p>1.1 Introduction to Python Character Set, Python Tokens, Variables, Lvalue and Rvalue Concepts, and the Use of Comments.</p> <p>1.2 Overview of Data Types:</p> <ul style="list-style-type: none"> • Number Types: Integer, Floating Point, Complex • Boolean Type • Sequence Types: String, List, Tuple • None Type • Mapping Type: Dictionary • Distinction between Mutable and Immutable Data Types <p>1.3 Understanding Operators:</p> <ul style="list-style-type: none"> • Arithmetic Operators • Relational Operators • Logical Operators • Assignment Operator • Augmented Assignment Operators • Expressions and Statements • Type Conversion and Input/Output Mechanisms • Precedence of Operators • Expression Evaluation 	CO-1
<p><i>TSO 2a.</i> Write Python program using decision making statements</p> <p><i>TSO 2b.</i> Write Python program using loop structure to solve iterative problems</p>	<p>Unit-2.0 Conditional and Iterative statements</p> <p>2.1 Conditional statements:</p> <ul style="list-style-type: none"> • simple if statement • if- else statemen • if-elif-else statement <p>2.2 Iterative statements:</p> <ul style="list-style-type: none"> • while loop • for loop • range function • break and continue statements • nested loops 	CO-2

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 3a.</i> Perform various operations on string using string operators and methods</p> <p><i>TSO 3b.</i> Perform various operations on List using list operators and methods</p> <p><i>TSO 3c.</i> Perform various operations on tuples using tuples operators and methods</p> <p><i>TSO 3d.</i> Perform various operations on set using set methods</p> <p><i>TSO 3e.</i> Perform various operations on dictionary using dictionary methods</p>	<p>Unit-3.0 String, List, Tuples, set and Dictionary</p> <p>3.1 String:</p> <ul style="list-style-type: none"> • Indexing • string operations (concatenation, repetition, membership & slicing) • traversing a string using loops • built-in functions. <p>3.2 Lists:</p> <ul style="list-style-type: none"> • Introduction • Indexing in list • list operations: concatenation, repetition, membership & slicing, traversing a list, built- in list functions, linear search on list of numbers and counting the frequency of elements in a list <p>3.3 Tuples: Creating, initializing, accessing elements, tuple assignment, performing operations on tuples, tuple methods and built-in functions, nested tuples</p> <p>3.4 Set: Creating set, traversing, adding, removing data in set, performing set operations like join, Union intersection, difference</p> <p>3.5 Dictionary: accessing items in a dictionary using keys, mutability of dictionary: adding a new item, modifying an existing item, built-in dictionary functions.</p>	<p>CO-3</p>
<p><i>TSO 4a.</i> Create and use user defined functions to implement modular programming approach</p> <p><i>TSO 4b.</i> Differentiate variable scope with example.</p> <p><i>TSO 4c.</i> Import and use Python modules, libraries</p>	<p>Unit-4.0 Python Functions, Modules and packages</p> <p>4.1 Functions: types of function (built- in functions, functions defined in module, user defined functions), creating user defined function, arguments and parameters, default parameters, positional parameters, Lambda functions, returning value, scope of a variable: global scope, local scope</p> <p>4.2 Modules and Packages: Importing module using 'import' Regular Expressions, Exception Handling, PyPI Python Package Index, Pip Python package manager, Importing Libraries and Functions</p>	<p>CO-4</p>
<p><i>TSO 5a.</i> Write simple Python programs using numpy</p> <p><i>TSO 5b.</i> Use Numpy array in python program</p> <p><i>TSO 5c.</i> Use Numpy to solve linear algebra problem.</p>	<p>Unit-5.0 Numpy</p> <p>5.1 Introduction to NumPy</p> <p>5.2 Installation of NumPy</p> <p>5.3 NumPy Arrays:</p> <ul style="list-style-type: none"> • Understanding the NumPy array 	<p>CO-5</p>

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	<ul style="list-style-type: none"> • The fundamental data structure in NumPy. • Creation of arrays using different methods: np.array(), np.zeros(), np.ones(), etc. • Exploring array attributes like shape, size, and dimensions. <p>5.4 Array Indexing and Slicing:</p> <ul style="list-style-type: none"> • Accessing elements and subarrays in NumPy arrays using indexing and slicing. • Demonstration of the difference between one-dimensional and multi-dimensional array indexing. <p>5.5 Array Operations:</p> <ul style="list-style-type: none"> • Performing element-wise operations on NumPy arrays. • Exploring universal functions (ufuncs) for mathematical operations. <p>5.6 Linear Algebra with NumPy:</p> <ul style="list-style-type: none"> • Introduction to linear algebra operations using NumPy. • Matrix multiplication, determinant, inverse, and solving linear equations. <p>5.7 File input and output with Numpy</p> <p>5.8 Broadcasting in Numpy</p>	
<p><i>TSO 6a.</i> Explain different types of Exceptions in python</p> <p><i>TSO 6b.</i> Write Python programs for exception handling in Python</p> <p><i>TSO 6c.</i> Differentiate different modes of file opening.</p> <p><i>TSO 6d.</i> Perform read, Write, Append operations in files</p>	<p>Unit 6: Exception and File Handling in Python</p> <p>6.1 Exception Handling: syntax errors, exceptions, need of exception handling, user-defined exceptions, raising exceptions, handling exceptions, catching exceptions, Try - except - else clause, Try - finally clause, recovering and continuing with finally, built-in exception classes.</p> <p>6.2 File Handling: text file and binary file, file types, open and close files, reading and writing text files, reading and writing binary files, file access modes</p>	<p>CO-6</p>

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2418305

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 1.1.</i> Write, execute and debug simple Python program using Integrated Development and Learning Environment (IDLE)</p> <p><i>LSO 1.2.</i> Write and execute simple 'C' program using variables, arithmetic expressions.</p>	1.	<p>a) Download and Install IDLE.</p> <p>Write and execute Python program to-</p> <p>b) Calculate the Area of a Triangle where its three sides a, b, c are given. $s=(a+b+c)/2$, Area=square root of $s(s-a)(s-b)(s-c)$ (write program without using function)</p> <p>c) Swap Two Variables</p> <p>d) Solve quadratic equation for real numbers.</p>	CO-1
<p><i>LSO 2.1.</i> Write and execute python programs using conditional statements.</p> <p><i>LSO 2.2.</i> Write and execute python programs using various types of Loop statements</p>	2.	<p>Write and execute Python program to-</p> <p>a) Check if a Number is Positive, Negative or zero.</p> <p>b) Check whether the given year is a Leap Year.</p> <p>c) Print all Prime Numbers in an Interval.</p> <p>d) Display the multiplication Table based on the given input.</p> <p>e) Print the Fibonacci sequence.</p> <p>f) Find the Factorial of a Number.</p>	CO-2
<p><i>LSO 3.1.</i> Write and execute Python program to perform various operations on string using string operators and methods</p>	3.	<p>Write and execute Python program to-</p> <p>a) Check whether the string is Palindrome</p> <p>b) Reverse words in a given String in Python</p> <p>c) identify in a strings the name, position and counting of vowels.</p> <p>d) Count the Number of matching characters in a pair of string (set)</p> <p>e) Python program for removing i-th character from a string</p>	CO-2, CO-3
<p><i>LSO 4.1.</i> Write and execute Python program to perform various operations on List using List operators and methods</p>	4.	<p>Write and execute Python program to-</p> <p>a) find largest number in a given list without using max().</p> <p>b) find the common numbers from two lists.</p> <p>c) create a list of even numbers and another list of odd numbers from a given list.</p> <p>d) To find number of occurrences of given number without using built-in methods.</p>	CO-2, CO-3
<p><i>LSO 5.1.</i> Write and execute Python program to perform various operations on Tuple using Tuple operators and methods.</p>	5.	<p>Write and execute Python program to-</p> <p>a) find the index of an item of a tuple.</p> <p>b) find the length of a tuple.</p> <p>c) to reverse a tuple.</p> <p>d) Write a Python program to sort a list of tuple by its float element. Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')] Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]</p>	CO-2, CO-3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 6.1.</i> Write and execute Python program to perform various operations on sets using set methods.	6.	Write and execute Python program to- a) create an intersection of sets. b) create a union of sets. c) create set difference. d) check if two given sets have no elements in common.	CO-2, CO-3
<i>LSO 7.1.</i> Write and execute Python program to perform various operations on Dictionary using Dictionary methods	7.	Write and execute Python program to- a) Write a Python script to concatenate two dictionaries to create a new one b) Write a Python script to merge two Python dictionaries. c) Write a Python program to combine two dictionary adding values for common keys. d1 = {'a': 100, 'b': 200, 'c':300} d2 = {'a': 300, 'b': 200, 'd':400} Sample output: d({'a': 400, 'b': 400, 'd': 400, 'c': 300})	CO-2, CO-3
<i>LSO 8.1.</i> Write and execute Python program to create user defined functions and call them.	8.	Write and execute Python program to- a) Write a Python function for reversing a string and call it. b) Write a Python function for calculating compound interest and call it. c) Write a Python function for calculating the factorial of a number and call it to calculate $n!/((n-r)!)!$ where symbol "!" stands for factorial.	CO-2, CO-4
<i>LSO 9.1.</i> Write and execute Python program to define a numpy array. <i>LSO 9.2.</i> Develop and execute Python program Using various types of Numpy operation.	9.	a) Write a python program to create a Numpy array filled with all zeros b) Write a python program to check whether a Numpy array contains a specified row c) Write a python program to Remove rows in Numpy array that contains non-numeric values d) Write a python program to Find the number of occurrences of a sequence in a NumPy array e) Write a python program to Find the most frequent value in a NumPy array f) Write a python program to Combine a one and a two-dimensional NumPy Array g) Write a python program to Flatten a Matrix in Python using NumPy h) Write a python program to Interchange two axes of an array	CO-2, CO-5
<i>LSO 10.1.</i> Develop and execute Python program to handle various type of exceptions. <i>LSO 10.2.</i> Develop and execute Python program to perform file operations.	10.	a) Using exception handling feature such as try...except, try finally- write minimum three programs to handle following types of exceptions. i. Type Error ii. Name Error	CO-6, CO-1, CO-2,

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
		iii. Index Error iv. Key Error v. Value Error vi. IO Error vii. Zero Division Error b) Write Python program to demonstrate file operations.	

Note: in addition to above listed practical, students are suggested to practice all the examples covered by the teacher during theory sessions.

L) Suggested Term Work and Self Learning: S2418305 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. **Assignments:** Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Create a shop billing system
2. Create income tax calculation system.
3. Develop number guessing game (random integer will be selected by the system and the user has to guess that integer in the minimum number of guesses. Maximum 5 guess allowed.)
4. Assign numbers to alphabet a-z as (1-26). User will input a word. System will convert it to a number by adding all the individual alphabets of that word.
5. Design a basic calculator program that performs arithmetic operations like addition, subtraction, multiplication, and division based on user input.
6. Any other micro-projects suggested by subject faculty on similar lines.

(Students may use file and sequence data types to develop above listed applications)

c. Other Activities:

1. Seminar Topics:
 - Tkinter widgets in python
 - Python date/time module and its applications
 - wxPython and its applications

- M) Suggested Course Evaluation Matrix:** The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	10%	10%	15%	16%	16%	10%	16%
CO-2	15%	15%	15%	16%	16%	15%	16%
CO-3	25%	25%	20%	18%	18%	25%	18%
CO-4	15%	15%	15%	16%	16%	15%	16%
CO-5	25%	25%	25%	18%	18%	25%	18%
CO-6	10%	10%	10%	16%	16%	10%	16%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

** : Mentioned under point- (N)

: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

- N) Suggested Specification Table for End Semester Theory Assessment:** Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Basics of Python Programming syntax	4	CO-1	7	3	2	2
Unit-2.0 Conditional and Iterative statements	6	CO-2	10	3	3	4
Unit-3.0 3.0 String, List, Tuples, set and Dictionary	12	CO-3	18	5	3	10
Unit-4.0 Python Functions, Modules and packages	7	CO-4	10	3	3	4
Unit-5.0 Numpy	12	CO-5	18	4	5	9
Unit-6.0 Exception and File Handling in Python	7	CO-6	7	2	2	3
Total	48	-	70	20	18	32

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Write and execute Python program to- a) Calculate the Area of a Triangle where its three sides a,b,c are given. $s=(a+b+c)/2$, Area=square root of $s(s-a)(s-b)(s-c)$ (write program without using function) b) Swap Two Variables c) Solve quadratic equation for real numbers.	CO-1	40	50	10
2.	Write and execute Python program to- a) Check if a Number is Positive, Negative or zero. b) Check whether the given year is a Leap Year. c) Print all Prime Numbers in an Interval. d) Display the multiplication Table based on the given input. e) Print the Fibonacci sequence. f) Find the Factorial of a Number.	CO-2	40	50	10
3.	Write and execute Python program to- a) Check whether the string is Palindrome b) Reverse words in a given String in Python c) identify in a strings the name, position and counting of vowels. d) Count the Number of matching characters in a pair of string (set) e) Python program for removing i-th character from a string	CO-2, CO3	40	50	10
4.	Write and execute Python program to- a) find largest number in a given list without using max(). b) find the common numbers from two lists. c) create a list of even numbers and another list of odd numbers from a given list. d) To find number of occurrences of given number without using built-in methods.	CO-2, CO-3	40	50	10
5.	Write and execute Python program to- a) find the index of an item of a tuple. b) find the length of a tuple. c) to reverse a tuple. d) Write a Python program to sort a list of tuple by its float element. Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')] Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]	CO-2, CO-3	40	50	10
6.	Write and execute Python program to- a) create an intersection of sets. b) create a union of sets. c) create set difference. d) check if two given sets have no elements in common.	CO-2, CO-3	40	50	10
7.	Write and execute Python program to- a) Write a Python script to concatenate two dictionaries to create a new one	CO-2, CO-3	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
	b) Write a Python script to merge two Python dictionaries. c) Write a Python program to combine two dictionary adding values for common keys. $d1 = \{ 'a': 100, 'b': 200, 'c': 300 \}$ $d2 = \{ 'a': 300, 'b': 200, 'd': 400 \}$ Sample output: $d(\{ 'a': 400, 'b': 400, 'd': 400, 'c': 300 \})$				
8.	Write and execute Python program to- a) Write a Python function for reversing a string and call it. b) Write a Python function for calculating compound interest and call it. c) Write a Python function for calculating the factorial of a number and call it to calculate $n/(!r)*!(n-r)$ where symbol "!" stands for factorial.	CO-2, CO-4	40	50	10
9.	a) Write a python program to create a Numpy array filled with all zeros b) Write a python program to check whether a Numpy array contains a specified row c) Write a python program to Remove rows in Numpy array that contains non-numeric values d) Write a python program to Find the number of occurrences of a sequence in a NumPy array e) Write a python program to Find the most frequent value in a NumPy array f) Write a python program to Combine a one and a two-dimensional NumPy Array g) Write a python program to Flatten a Matrix in Python using NumPy Write a python program to Interchange two axes of an array	CO-2, CO-5	40	50	10
h)	Using exception handling feature such as try...except, try finally-write minimum three programs to handle following types of exceptions. viii. TypeError ix. NameError x. IndexError xi. KeyError xii. ValueError xiii. IOError xiv. ZeroDivisionError	CO-2, CO-6	40	50	10
i)	Write and execute Python program to- a) Calculate the Area of a Triangle where its three sides a,b,c are given. $s=(a+b+c)/2$, Area=square root of $s(s-a)(s-b)(s-c)$ (write program without using function) b) Swap Two Variables c) Solve quadratic equation for real numbers.	CO-1	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Computer system	Processor Intel Core i5, 4 GB RAM, 15 GB free disk space	All
2.	Integrated Development and Learning Environment (IDLE)	S/w to be downloaded for python 3.11.3 or higher	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Introduction to Computing and Problem-Solving using Python	E. Balagurusamy	McGraw Hill Education (India) Pvt. Ltd. 1 st Edition /2016
2.	Learning Python Programming	Jeffrey Elkner, Allan B. Downey, Chris Meyers	Samurai Media Limited. 2016
3.	Python Programming	Ashok Namdev Kamthane and Amit Ashok Kamthane	McGraw Hill Education (India) Pvt. Ltd. 2020, 2 nd Edition
4.	Programming in Python	Dr. Pooja Sharma	BPB Publications 2017

(b) Online Educational Resources:

1. <https://docs.python.org/3/tutorial/>
2. <https://www.w3schools.com/python/>
3. <https://www.tutorialspoint.com/python/index.htm>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

- A) **Course Code** : 2400111(T2400111)
- B) **Course Title** : Principles of Management (Non-Exam Course)
(CE, AIML, AE, CHE, CSE, ME, ME (Auto), FTS, MIE)
- C) **Pre- requisite Course(s)** :
- D) **Rationale** :

The course is designed to provide students with an overview of the management functions and its role in organizations and society. The course aims to provide students with the basic managerial knowledge necessary for engineering students in the world of work. The course focuses on providing students with analytical, developmental, managerial, and technical skills that relate to managerial positions in organizations. This course is an introduction to the critical management skills involved in planning, organizing, controlling, leading and decision making in an organization. It provides a framework for understanding issues involved in both managing and being managed, and it will help you to be a more effective contributor to organizations that you join.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course out comes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

After completion of the course, the students will be able to-

- CO-1** Design strategic plan for various types of organizations.
- CO-2** Take decisions to handle world of work situations.
- CO-3** Formulate organizational hierarchy for different situations.
- CO-4** Identify various leadership styles.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	1	-	-	-	-	3	1		
CO-2	1	2	2	-	-	3	1		
CO-3	1	-	3	-	-	3	1		
CO-4	1	2	-	-	1	3	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Course Title	Scheme of Study (Hours/Week)				
	Classroom Instruction (CI)		Notional Hours (TW/ Activities+ SL)	Total Hours (CI+TW/ Activities)	Total Credits (C)
	L	T			
Principles of Management	01	-	-	01	01

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture(L), Tutorial(T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits= (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

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), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

I) Theory Session Outcomes (TSOs) and Units: T2400111

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain the nature of management</p> <p><i>TSO 1b.</i> List the steps of evolution of management.</p> <p><i>TSO 1c.</i> Differentiate between different plans.</p> <p><i>TSO 1d.</i> Design Strategic plan for the given world of work situation.</p> <p><i>TSO 1e.</i> Take decisions in the given situation with justification.</p>	<p>Unit-1.0 Introduction to Management and Planning</p> <p>1.1 Nature and Purpose.</p> <p>1.2 Evolution of Management Thoughts.</p> <p>1.3 System approach to Management Process.</p> <p>1.4 Types of Plans: Missions or Purpose, Objective or Goals, Strategies, Policies, Procedures.</p> <p>1.5 Decision Making.</p>	CO1, CO2
<p><i>TSO 2a.</i> Differentiate formal and informal organizations.</p> <p><i>TSO 2b.</i> Identify the levels of hierarchy in the given organization.</p> <p><i>TSO 2c.</i> List the staffing principles.</p>	<p>Unit-2.0 Organizing and Staffing</p> <p>2.1 Nature of Organizing</p> <p>2.2 Formal and Informal Organization</p> <p>2.3 Principles of Organizing, Organizational Hierarchy, Authority, and Power.</p> <p>2.4 Staffing, Recruitment, Selection, Performance Appraisal.</p>	CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 3a.</i> Explain the theories of motivation</p> <p><i>TSO 3b.</i> Differentiate between leadership styles</p>	<p>Unit-3.0 Motivation and Leadership</p> <p>3.1 Motivation</p> <p>3.2 McGregor Theory of X and Y</p> <p>3.3 Maslow Hierarchy of Needs Theory</p> <p>3.4 Herzberg's Motivation- Hygiene Theory</p> <p>3.5 Leadership: Definition, Ingredients, Styles, theories</p>	CO4

Note: One major TSO may require more than one Theory session/Period.

J) Suggested Term Work and Self Learning: Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

- Describe about adopting the systems approach in any organization.
- Write in brief about grapevine communication.
- Compare the traits Theory of X and Y as proposed by McGregor

b. Micro Projects:

- Apply Maslow's need hierarchy theory in workplace.

c. Other Activities:

1. Seminar Topics:

- Importance of management theories in the corporates.
- The hierarchy levels create smoothness in functioning of any organization.
- Leadership practices that are popular in current scenario.

2. Visits:

- Visit nearby corporate setup and report
- Interview leaders in the organization and identify leadership style'

3. Self-learning topics:

- Herzberg's Motivation- Hygiene Theory
- Leadership theories
- Motivation for efficient productivity

K) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

L) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)**M) Suggested Learning Resources:****(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Fundamentals of Management: Essential Concepts and Applications	Robbins S.P. and DeCenzo David A	Pearson Education
2.	Koontz Essentials of Management	Koontz	Tata McGraw Hill Latest Edition
4.	Principles and Practices of Management	Shejwalkar and Ghanekar	Tata McGraw Hill Latest Edition
5.	Fundamentals of Management	Robbins and Dinzo	2002, Pearson India.
6.	Organization Theory, Structure, Design and Application	Stephen P. Robbins	PHI, New Delhi, 2005

(b) Online Educational Resources:

1. <https://www.coursera.org/learn/principles-of-management>
2. <https://alison.com/course/an-introduction-to-the-principles-of-management>
3. <https://www.udemy.com/course/principles-of-management-j/>
4. <https://lumenlearning.com/courses/principles-of-management/>
5. <https://www.mygreatlearning.com/academy/learn-for-free/courses/principles-of-management>
6. <https://onlineprogrammes.insead.edu/leadership-programme-for-senior-executives>
7. implilearn.com/general-management-certification-training-course?utm_source=google&utm_medium=cpc&utm_term
8. <https://discovery.ucl.ac.uk/id/eprint/10115948/1/Educational-Resource-Management.pdf>
9. <https://libraries.etsu.edu/research/guides/management/oer>
10. <https://www.cmu.edu/teaching/designteach/syllabus/checklist/learningresources.html>

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(c) Others:
