GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Fire Technology and Safety

Subject Code : DI01070011

Subject Name : Fundamental of Fire Safety

w. e. f. Academic Year:	2026-27
Semester:	1st
Category of the Course:	PCC

Prerequisite:	Students should have basic knowledge of: 1. General science principles 2. Basic chemistry and physics related to heat and combustion 3. Industrial and workplace safety practices 4. Common safety signs and symbols 5. Basic first aid and emergency awareness
Rationale:	Fire is one of the major hazards in industries, commercial buildings and residential areas. Knowledge of fire science, fire prevention, detection and firefighting techniques is essential for maintaining the safety of life, property and the environment. This subject provides a basic understanding of the causes of fire, classification of fires, fire behaviour, methods of fire prevention and operation of fire fighting equipment. The course also introduces students to the storage of hazardous goods, fixed fire fighting installations, rural and urban fire conditions, gas fires, forest fires and special fire situations. The course develops the ability to identify fire hazards, understand basic fire protection systems and respond effectively during emergencies. It also creates awareness regarding fire safety rules, industrial safety practices and applicable statutory requirements.

Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcome	RBT Level
1	Explain the basic principles of fire science, combustion, fire behavior, fire classification and fire extinguishing methods.	U
2	Identify hazardous materials and explain the principles of safe storage, segregation, handling and emergency response.	A
3	Explain the purpose, types and basic operation of fixed firefighting installations and fire protection systems.	R , N
4	Explain the causes, characteristics and basic firefighting approaches for rural fires, urban fires and fires involving flammable gases.	A
5	Explain the causes and basic prevention and control measures for forest fires and special fire situations, including hydrocarbon and marine/ocean fire scenarios.	E

*Revised Bloom's Taxonomy (RBT)

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA (M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage

1.	**Chemistry and Physics of Fire and Fire Extinguishment**
	
	1.1 Chemistry and Physics of Fire
	• Introduction to fire
	• Definition and concept of fire
	• Fire triangle
	• Fire tetrahedron
	• Chemical properties of fire
	• Physical properties of fire
	• Process of combustion
	• Stages of fire development
	• Heat transfer:
	  ○ Conduction
	  ○ Convection
	  ○ Radiation
	• Classification of fire
	• Sources and causes of fire
	• Flash point
	• Fire point
	• Ignition temperature
	• Explosion and types of explosion
	• Fire behaviour of:
	  ○ Solids
	  ○ Liquids
	  ○ Gases
	• Smoke and toxic gases
	• Principles of fire prevention and control
	• Extinguishing agents and their properties
	• Basics of fire dynamics
		6	20

	• Fire safety precautions and risk reduction **1.2 Fire Extinguishment** • Principles of fire extinguishment • Starvation • Cooling • Smothering • Inhibition of chemical chain reaction • Classification of fires • Spread of fire • Fire extinguishing media • Selection of suitable extinguishing media		

2.	**Storage and Handling of Hazardous Materials**
	2.1 Introduction to Hazardous Materials
	• Definition and classification of hazardous materials
	• Properties and characteristics of hazardous materials
	• Sources and types of hazards
	• Fire and explosion hazards associated with hazardous materials
	• Health and environmental hazards
	
	2.2 Hazard Identification and Risk Assessment
	• Identification of hazardous materials and associated hazards
	• Basic principles of hazard identification
	• Risk assessment and risk control
	• Safety Data Sheets (SDS)
	• Hazard communication and safety labelling
	
	2.3 Storage and Segregation of Hazardous Materials
	• General principles of safe storage
	• Compatibility and segregation of hazardous materials
	• Storage of:
	  ○ Flammable liquids
	  ○ Flammable gases
	  ○ Explosive materials
	  ○ Toxic and corrosive materials
	• Storage quantity and inventory control
	• Safe layout and design of hazardous material storage areas
	• Ventilation and temperature control
	• Fire protection and emergency access
		7	20

	2.4 Handling and Transportation • Safe handling of hazardous materials • Loading and unloading precautions • Internal transportation and movement of hazardous materials • Prevention of leakage, spillage and accidental release • Use of suitable containers and equipment • Personal Protective Equipment (PPE) **2.5 Emergency Response and Safety Management** • **Emergency response to leakage, spillage and fire** • Emergency evacuation procedures • Spill control and containment • First response and notification procedures • Waste disposal and environmental protection • Inspection, maintenance and safety audits • Accident prevention and case studies		
3.	**Fixed Firefighting Installations** **3.1 Introduction to Fixed Firefighting Systems** • Objectives and importance of fire protection installations • Types of fixed firefighting installations • Basic principles of fixed fire protection systems **3.2 Fire Detection and Alarm Systems** • Automatic fire detection systems • Fire detection sensors and devices • Fire alarm systems • Basic operation and applications **3.3 Water-Based Firefighting Systems** • Fire hydrant system • Wet riser system • Down-comer system • Automatic sprinkler system • Deluge system • Water spray system **3.4 Special Fire Suppression Systems** • Foam fire protection systems • Gaseous fire suppression systems	10	20

	• Fixed extinguishing systems **3.5 Supporting Components** • Fire pumps • Water supply arrangements • Control valves • Piping systems • Installation standards and codes • Inspection, testing and maintenance • Operation of firefighting installations • Safety precautions during installation and operation • Troubleshooting and system reliability • Case studies and practical applications		
4.	**Rural, Urban and Gas Fires** **4.1 Rural and Urban Fire** • Comparative study of rural fire and urban fire • Causes of rural fires • Characteristics of rural fire • Characteristics of urban fire • Fire extinguishing media used in rural and urban fires • Counter-fire method • Basic firefighting approach and safety precautions **4.2 Gas Fires** • Classification of gases • Properties and hazards of flammable gases • Firefighting procedures for gas fires • Gas leakage and emergency response • LPG fire • CNG fire • LNG fire • Safety precautions during gas fire incidents	10	20
5.	**Forest, Snow and Special Fire Situations** **5.1 Forest Fire** • Causes of forest fires • Classification of forest fires • Factors affecting forest fire spread • Prevention of forest fires • Fire detection and early warning	12	20

	• Counter-fire method • Basic forest firefighting approaches • Safety precautions during forest fire operations **5.2 Hydrocarbon and Special Fire Situations** • Classification and hazards of hydrocarbon gases • Hydrocarbon gases stored in cold/snow-covered regions • Basic fire and safety challenges in extreme environmental conditions • Special fire situations and emergency response **5.3 Ocean and Marine Fire** • Causes of marine and ocean fires • Fire hazards in ships and marine environments • Basic firefighting considerations • Emergency response and evacuation • Safety precautions during marine fire incidents		
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**20**	**30**	**20**	**10**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:
(a) Books:

1. D.R.Varma, Agni Suraksha.
2. K.K. Binsoi- Fire Science Equipement and Management Part- I&II.
3. Post H.S.C. Diploma inFire Service Engineering, NIFDEM-Nagpur.
4. Station Officer & Instructor Course- Home Dept. of India National fire Service College.
5. B.S.C Fire Gujarat University Ahmedabad.
6. Safe handling of Hazardous Materials – A.K. Rohatagi –Mumbai.
7. Fire Chief's Hand Book - James F. Casey, Newyork.
8. Fire Service Drill Book - by Home Office- Fire Dept. London.

(b) Open source software and website:

- National Fire Protection Association (NFPA) – Fire safety, fire prevention and fire protection resources.
- National Disaster Management Authority (NDMA), Government of India – Disaster management and emergency preparedness resources.
- Bureau of Indian Standards (BIS) – Standards and technical information related to fire and safety.
- National Building Code of India – Fire and Life Safety provisions.
- U.S. Fire Administration (USFA) – Fire prevention and fire safety education resources.
- International Labour Organization (ILO) – Occupational safety and health resources.
- Fire safety training videos and learning resources published by recognized government, fire service and safety organizations.

Suggested Course Practical List:

1. Identification of different classes of fire.
2. Demonstration of fire triangle and fire tetrahedron.
3. Identification of different types of fire extinguishing media.
4. Demonstration of operation of portable fire extinguishers.
5. Practical demonstration of the PASS technique.
6. Hose handling practice.
7. Identification and demonstration of branch pipes and nozzles.
8. Fire alarm testing and demonstration.
9. Identification of fire detection devices.
10. Demonstration of PPE usage.
11. Preparation of a fire hazard identification checklist.
12. Inspection of fire safety arrangements in a building.
13. Preparation of an emergency evacuation plan.
14. Mock fire drill.
15. Evacuation exercise.
16. Visit to a fire station and emergency response centre.
17. Demonstration of firefighting equipment and systems.
18. Inspection of fixed firefighting installations in a building.

List of Laboratory/Learning Resources Required:

1. Portable fire extinguishers:

    - Water
    - Foam
    - Dry Chemical Powder
    - Carbon Dioxide

2. Fire buckets
3. Fire blankets
4. Fire hoses
5. Branch pipes and nozzles
6. Fire hydrant system demonstration arrangement
7. Fire alarm system
8. Smoke and heat detectors
9. Fire safety signs and symbols
10. Personal Protective Equipment (PPE)
11. Fire safety inspection checklist
12. Fire safety charts and posters
13. Emergency communication equipment
14. Evacuation and mock-drill equipment
15. Audio-visual teaching aids
16. Basic fire fighting system models or demonstration units

Suggested Project List:

1. Fire Hazard Identification and Risk Assessment of a College Building
2. Preparation of a Fire Safety Plan for an Educational Institution
3. Study of Portable Fire Extinguishers Used in an Industrial Workplace
4. Inspection and Evaluation of Fixed Fire fighting Installations
5. Preparation of an Emergency Evacuation Plan
6. Study of Hazardous Goods Storage and Segregation Practices
7. Preparation of a Fire Safety Checklist for a Workshop
8. Study of Fire Safety Arrangements in a Commercial Building
9. Preparation of a Fire Safety Awareness Programme
10. Case Study of a Major Fire or Hazardous Material Incident

Suggested Activities for Students: If any

1. Visit to a Fire Station and Emergency Response Centre.
2. Demonstration of Fire fighting Equipment and Systems.
3. Practical training on the use of Fire Extinguishers.
4. Inspection of Fixed Fire fighting Installations in Buildings.
5. Fire safety awareness campaign.
6. Fire evacuation and mock drill.
7. Fire hazard identification survey.
8. Poster and safety slogan competition.
9. Industrial fire safety visit.
10. Group presentation on a fire incident case study.

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