GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Minor/Hons. Program
Level: UG
Branch: Minor/Hons. Industrial Process Safety
Subject Code: BE040AA011
Subject Name: Fundamental of Fire Engineering

w. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	Core Courses

Prerequisite:	A good understanding regarding basics of physics & chemistry
Rationale:	The main objective of this subject is to study the fundamentals of fire, its occurrence firefighting system, its installation. It also provides platform to analyze the conditions for fire occurrence and reparability studies.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Describe Fundamental Principles of Fire Engineering	29%
CO-2	Explain Fire Prevention and Protection Systems	29%
CO-3	Apply methods to evaluate fire resistance and assess the reparability of fire-damaged structural components for effective reinstatement of buildings	24%
CO-4	Describe Fire Risk Management and Safety Practices	18%

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA (I)	PBL (I)	ESE (V)	
45	0	30	45	120	04	70	0	0	30	50	150

**** Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.***

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, PA = Progressive Assessment, ESE = End-Semester Examination

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Content:

Sr. No.	Content	Total Hrs
1	Introduction: History of fire service, Basic physics, Units, Guidelines for writing the units, Force, resultant force, Laws of force, Laws of motion, Mass and weight, work, power, energy, Law of conservation of energy, Mechanics – rest and motion, Acceleration, Acceleration due to gravity, Newton laws of motion, Machines and engines, Efficiency, Friction.	5
2	Basic Chemistry and physics of fire, Atomic structure, Elements, compounds, Pure substance and mixture, Physical and chemical changes, Condition for the changes, Energy changes, Effects of heat on matter, Combustion, Temperature, Specific heat capacity, Catalyst, Chemical reaction, Exothermic reaction and endothermic reaction, Transmission of heat, Flash and fire point, Ignition temperature, Flammables and combustible chemicals, Spontaneous combustion, Triangle of combustion, Tetrahedron fire, Spread of fire.	8
3	Classification of fire, General Causes of fire, Detection of fire, extinguishing methods, first aid firefighting equipment's, Fire bucket, Fire beater, hose real hose, Portable extinguisher, depends on weight, depends on operating method, depends on content, Depends on position of nozzle, Construction, Operation, Maintenance, Refilling, Importance of passive fire protection system for occupants life safety and buffer time to emergency responders.	7
4	Fixed firefighting installations using water, Hydrant or fire water system, Classification of hydrant system, Sprinkling system, Major foam pourer system, Steam drenching system, Emulsification, Special fires and firefighting, Air craft fire, Ships fire	6
5	Approximate method for calculating the fire resistance of structures. Fire resistance limits of structures, coefficient of fire resistance, fire duration.	4
6	Reparability of fire damaged structures: Assessment of fire severity - assessment of damage concrete, steel, masonry, timber - feasibility of repair -Repair techniques: Columns, beams, floors, etc. - a case study on building reinstatement.	7
7	Fire risk assessment structure and layout, Means of escape principles: Basic requirements and what to look for, Fire signage: National requirements, Fire Alarms & fire detection: Basic components, and testing, Emergency lighting: When it is required, Basic components, and testing, Alternatives to emergency lighting	8
	TOTAL	**45**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**25**	**10**	**20**	**-**	**-**

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. T. Z Harmathy - Fire Safety Science and engineering
2. Jain V K – Fire Safety in Building Dr. Thank Singh Sharma- Fundamental of fire safety in building.
3. BIS, "IS 2189:2008 –Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System – Code of practice" Bureau of Indian Standards, New Delhi, 2008.
4. BIS, NBC Part IV – Fire and Life Safety", Bureau of Indian Standards, New Delhi, 2016.

List of Practicals/Tutorials:

1. Demonstration of different types of fire extinguisher
2. Demonstration of different types of fire hydrant systems
3. Numerical based on calculation of fire resistance limits of structures
4. Numerical based on fire duration
5. Demonstration of fire alarm system and fire detection
6. Determination of flash and fire point by Pensky – Martin Apparatus
7. Determination of flash and fire point by Able's apparatus
8. Demonstration of first aid fire equipment
9. Determination of pH and conductivity of fire water
10. Demonstration of fireproofing materials and testing fire retardancy (ASTM E84 concept).
11. Evacuation drill simulation and calculation of escape time for given occupancy.
12. Fire load calculation and assessment of a compartment
13. Study of Personal Protective Experiments
14. Determination of rate of burning of different combustible materials

List of Open Source Software/learning website:

Reference to NIST, NFPA and NPTEL can be made for a better understanding regarding fire studies, Codes for fire protection and application of active and passive fire suppression system.

List of suggested activities for Problem Based Learning:

Sr. No.	Description	No. of Hours	Total Hrs.
1	Technical Video based learning related to the subject	Duration of video: 5h Report preparation: 5h	**10**
2	Assignment writing Numerical based assignment is preferable.	5 assignments of 4h each.	**20**
3	Videos on Industrial safety/Disaster Management aspects based on subject	Duration of video: 5h Report preparation: 5h	**10**
4	Poster/chart PowerPoint preparation on technical topics	Duration:6 h	**6**
5	Self-learning on-line course	Minimum duration of the course should be 10h.	**10**
6	Discussion on research paper based on relevant subject	5 research paper: 20h	**20**
7	Group Discussion on emerging/trending technical topics based on subject	Duration: 1 h each	**1**
8	Annotated Video Explanation of Concept / Problem	10h (Preparation * Recording + Submission)	**10**
9	Online Technical Quizzes/Simulations	Multiple quizzes summing up to 10h	**10**
		Max. Hours to be allotted	**45**

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