

Nirma University
School of Engineering
Chemical Engineering Department

Course Policy

B.Tech. Semester - VII**Academic Year: 2021-22**

Course Code & Name	:	2CHOE26 Introduction to Fire and Safety Engineering
Credit Details	:	Lectures-3, Tutorial-0, Practicals-0 Credits-3
Course Co-ordinator	:	Dr. Ankur Dwivedi
Contact No. & Email	:	079-71652145, email: ankur_dwivedi@nirmauni.ac.in
Office	:	A 110
Visiting Hours	:	<u>Visiting Hours:</u> 1:30 to 2:00 p.m. (Tuesday, Wednesday) 10:00 to 12:00 p.m. (working Saturday)
Course Faculty	:	Dr. Nimis Shah
Contact No. & Email	:	079-71652132, email: nimish.shah@nirmauni.ac.in
Office	:	A 108
Visiting Hours	:	<u>Visiting Hours:</u> 1:30 to 2:00 p.m. (Thursday, Friday) 10:00 to 12:00 p.m. (working Saturday)

1. Introduction to the Course

1.1 Importance of the course

“Introduction to Fire and Safety Engineering” is mainly designed for the undergraduate students of all the engineering branches. This course provides an understanding of fire safety fundamentals, causes of fire, chemistry of fire, the fire and rescue services, fire safety alarms, detectors, fire extinguishers, fire protection systems, risk management and fire insurance etc. Also the study associated with different fire incidents will be very helpful to investigate the cases in real life in case of fire in any professional place or at home.

1.2 Objective of the course

To provide a fundamental knowledge of Fire and Safety; which is mandatory for an engineer for a better understanding of protection of life and property.

2. **Course Outcomes (CO)**

COs are clear statements of the expectations for student achievements in the course.

After successful completion of the course, student will be able to

1. explain the fire process and its chemistry
2. choose fire protection system and extinguisher
3. analyze fire accident
4. compare fire insurance and policies

3. **Syllabus**

Syllabus		Teaching Hours
Unit I	Introduction	03
	Fire in history, fire losses, fire causes, interested parties in fire safely, fire protection standards and practice, how much safety is enough?	
Unit II	The Fire Process	05
	Introduction, fire triangle, fire tetrahedron, fuels, smouldering, metal fires, combustion of dusts, ease of ignition, heat, ignition processes, thermal feedback, fire stages, structure of flames, flame height/length, fire plume, plume features, flame progression.	
Unit III	Chemistry of Fire	03
	Matter around us, Avogadro's hypothesis, work versus energy, energy in chemical reactions, oxidation and reduction, chemical chain reaction in fire, flame chemistry, reducing atmosphere, vapor pressure of liquids, flammability limits and flammable range, estimating lower flammability limit (LFL), flash point, fire point, ignition point, ignition energy, Different type of combustion processes (Rapid, Spontaneous, Explosive combustions).	
Unit IV	Heat Transfer in Fires	04
	Fundamentals of heat, heat transfer and heat flux, modes of heat transfer, temperatures versus heat in fire, severity and growth of fire, spontaneous heating and spontaneous combustion, heat release rate.	

Unit V	Fire Detectors and Alarms	04
	Introduction, basics of detectors and alarms, detector types based on effects, heat detectors, smoke detectors, optical flame detectors, gas-sensing detectors, application-specific detectors, selection of detectors, alarm systems, fire alarm systems and control panel, principle of operation, selecting detectors and alarm systems.	
Unit VI	Fire Extinguishers	06
	Firefighting fundamentals, first-aid firefighting extinguishers, common features of extinguishers, types of extinguishers, classification of fires (Class A, B, C, D, E and F) and suitability of extinguishers, rating of extinguishers, hazard categorization and placement of extinguishers.	
Unit VII	Fixed Fire Protection Systems	08
	Introduction, water-based fixed fire protection systems, automatic sprinklers, foam systems, water spray systems, water mist systems, carbon dioxide flooding systems, clean agents, draining out fire water.	
Unit VIII	Risk Management and Fire Insurance	05
	Origins of general insurance and emergence of risk management, hazard versus risk, hazard identification and analysis, risk assessment and control, principles of insurance, fire insurance policy, covers available, insurance value, reinsurance, emergency preparedness, features of emergency plans, line of action.	
Unit IX	Investigating Fire Incidents	07
	Background to fire investigation, practice of investigation, arson, who should investigate fires? when should an investigation begin? evidence, witnesses, burn patterns, sketches. Photographs and diagrams, material or sequence evidence, records or paper evidence, interpreting evidence and report writing, 'electrical' fires.	

3.1. Self-Study

The self-study components of the syllabus will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content. Students are expected to study these topics on their own. These topics will not be taught in the classroom. Students should refer the books available in the library for the same.

3.2. **References**

1. Das, Akhilkumar, Principles of Fire safety Engineering, PHI publication
2. Handbook of Fire and Explosion Protection Engineering Principles, William Andrew an imprint of Elsevier
3. Fire Hazards in Industry, Norman Thomson, Butterworth-Heinemann is an imprint of Elsevier.
4. Robert Burke, Fire Protection Systems and Response, CRC Press
5. John A. Purkiss, Fire Safety Engineering Design of Structures. Butterworth-Heinemann is an imprint of Elsevier
6. R. Craig Schroll, Industrial Fire Protection Handbook, CRC Press

L= Lecture, T=Tutorial, P= Practical, C=Credit

4. **Laboratory details**

NA

5. **Term assignment**

Term Assignment at the end of the course will be in the form of either video presentation, power point presentation, quiz, poster making, model making etc. Students will be assigned topics in either individual or in groups, in order to present the work in the form of above mentioned method. Plagiarized content in the submission will not be accepted. Details will be covered in the first lecture by the concerned faculty. Submission and Assessment duration: 08/11/2021-13/11/2021.

6. **Assessment Policy**

6.1 Component wise Continuous Evaluation (CE) & Semester End Examination (SEE) weightage

Assessment scheme	CE			SEE
Component weightage	0.6			0.4
	Class Test 35% (35 marks)	Sessional Exam 35% (35 marks)	Term Assignment 30% (30 marks)	100 marks

6.2 Assessment Policy for Continuous Evaluation (CE)

Assessment of Continuous Evaluation comprises of three components.

1. Class Test will be conducted as per academic calendar. It will be conducted online/ offline for the duration of 1 hour 15 minutes and will be of 35 marks.
2. Sessional Exam will be conducted as per academic calendar. It will be conducted offline for the duration of 1 hour 15 minutes and will be of 35 marks.

3. There will be Term Assignment of 30 marks at the end of the course in terms of either video presentation, power point presentation, quiz, poster making, model making etc. Details as given in Section 5 above.

6.3 Assessment Policy for Semester End Examination (SEE)

A written examination of 3 hrs duration will be conducted for the course as per academic calendar. It will carry 100 marks and marks obtained out of 100 will be converted as per weightage assigned.

7. Lesson Plan

Session No.	Topic	Mapped CO
	Introduction	
1	Overview of the course, Discussion on Course Policy, Course on LMS, Importance of the course, Evaluation, Linkages of the course with other course/'s and Professional relevance	-
2	Fire in history, fire losses and fire causes.	1
3	Interested parties in fire safety, fire protection standards and practice. How much safety is enough?	
	The Fire Process	
4	Introduction, fire triangle, fire tetrahedron	1
5	fuels, smouldering, metal fires, combustion of dusts, ease of ignition, heat.	
6	Ignition processes, thermal feedback, fire stages,	
7	Structure of flames, flame height/length.	
8	Fire plume, plume features, flame progression.	
	Chemistry of Fire	
9	Matter around us, Avogadro's hypothesis, work versus energy, energy in chemical reactions, oxidation and reduction, chemical chain reaction in fire.	1
10	flame chemistry, reducing atmosphere, vapor pressure of liquids, flammability limits and flammable range, estimating lower flammability limit (LFL).	
11	Flash point, fire point, ignition point, ignition energy, Different type of combustion processes (Rapid, Spontaneous, Explosive combustions).	
	Heat Transfer in Fires	
12	Fundamentals of heat, heat transfer and heat flux.	1
13	Modes of heat transfer, temperatures versus heat in fire.	
14	Severity and growth of fire.	
15	Spontaneous heating and spontaneous combustion, heat release rate.	
	Fire Detectors and Alarms	
16	Introduction, basics of detectors and alarms.	2

17	Detector types based on effects, heat detectors, smoke detectors, optical flame detectors, gas-sensing detectors, Application-specific detectors.	
18	Selection of detectors, alarm systems, fire alarm systems and control panel.	
19	Principle of operation, selecting detectors and alarm systems.	
	Fire Extinguishers	
20	Firefighting fundamentals.	2
21	First-aid firefighting extinguishers, common features of extinguishers.	
22	Types of extinguishers, classification of fires (Class A, B, C, D, E and F) and suitability of extinguishers.	
23	Rating of extinguishers.	
24	hazard categorization and placement of extinguishers.	
25	Practical demonstration.	
	Fixed Fire Protection Systems	
26	Introduction of the systems.	2
27	water-based fixed fire protection systems.	
28	Automatic sprinklers.	
29	Foam systems, water spray systems.	
30	Water mist systems.	
31	Carbon dioxide flooding systems,	
32	Clean agents.	
33	Draining out fire water.	
	Risk Management and Fire Insurance	
34	Origins of general insurance and emergence of risk management.	4
35	Hazard versus risk, hazard identification and analysis.	
36	Risk assessment and control.	
37	Principles of insurance, fire insurance policy, covers available, insurance value, reinsurance.	
38	Emergency preparedness, features of emergency plans, line of action.	
	Investigating Fire Incidents	
39	Background to fire investigation, practice of investigation,	3
40	Arson act, who should investigate fires?	
41	when should an investigation begin? evidence, witnesses, bum patterns, sketches.	
42	when should an investigation begin? evidence, witnesses, bum patterns, sketches.	
43	Photographs and diagrams, material or sequence evidence, records or paper evidence.	
44	interpreting evidence and report writing, 'electrical' fires	
45	Practical demonstration of fire extinguishers and Revision.	

8. Mapping of Session Learning Outcomes (SLO) with Course Learning Outcomes (CO)

Session No.	Session Learning Outcomes: After successful completion of the session, student will be able to	Mapped CO
	Introduction	
1	understand the importance, scope and policy of the course.	-
2	Fire in history, fire losses and fire causes.	1
3	Interested parties in fire safety, fire protection standards and practice. How much safety is enough?	1
	The Fire Process	
4	Introduction, fire triangle, fire tetrahedron	1
5	fuels, smouldering, metal fires, combustion of dusts, ease of ignition, heat.	1
6	Ignition processes, thermal feedback, fire stages,	1
7	Structure of flames, flame height/length.	1
8	Fire plume, plume features, flame progression.	1
	Chemistry of Fire	
9	Matter around us, Avogadro's hypothesis, work versus energy, energy in chemical reactions, oxidation and reduction, chemical chain reaction in fire.	1
10	flame chemistry, reducing atmosphere, vapor pressure of liquids, flammability limits and flammable range, estimating lower flammability limit (LFL).	1
11	Flash point, fire point, ignition point, ignition energy, Different type of combustion processes (Rapid, Spontaneous, Explosive combustions).	1
	Heat Transfer in Fires	
12	Fundamentals of heat, heat transfer and heat flux.	1
13	Modes of heat transfer, temperatures versus heat in fire.	1
14	Severity and growth of fire.	1
15	Spontaneous heating and spontaneous combustion, heat release rate.	1
	Fire Detectors and Alarms	
16	Introduction, basics of detectors and alarms.	2
17	Detector types based on effects, heat detectors, smoke detectors, optical flame detectors, gas-sensing detectors, Application-specific detectors.	2
18	Selection of detectors, alarm systems, fire alarm systems and control panel.	2
19	Principle of operation, selecting detectors and alarm systems.	2
	Fire Extinguishers	
20	Firefighting fundamentals.	
21	First-aid firefighting extinguishers, common features of extinguishers.	2
22	Types of extinguishers, classification of fires (Class A, B, C, D, E and F) and suitability of extinguishers.	2
23	Rating of extinguishers.	2

24	hazard categorization and placement of extinguishers.	2
25	Practical demonstration.	2
	Fixed Fire Protection Systems	
26	Introduction of the systems.	2
27	water-based fixed fire protection systems.	2
28	Automatic sprinklers.	2
29	Foam systems, water spray systems.	2
30	Water mist systems.	2
31	Carbon dioxide flooding systems,	2
32	Clean agents.	2
33	Draining out fire water.	2
	Risk Management and Fire Insurance	
34	Origins of general insurance and emergence of risk management.	4
35	Hazard versus risk, hazard identification and analysis.	4
36	Risk assessment and control.	4
37	Principles of insurance, fire insurance policy, covers available, insurance value, reinsurance.	4
38	Emergency preparedness, features of emergency plans, line of action.	4
	Investigating Fire Incidents	
39	Background to fire investigation, practice of investigation,	3
40	Arson act, who should investigate fires?	3
41	when should an investigation begin? evidence, witnesses, burn patterns, sketches.	3
42	when should an investigation begin? evidence, witnesses, burn patterns, sketches.	3
43	Photographs and diagrams, material or sequence evidence, records or paper evidence.	3
44	interpreting evidence and report writing, 'electrical' fires	3
45	Practical demonstration of fire extinguishers and Revision.	2

9. Teaching-learning methodology

1. Lectures: Mostly chalk and black board will be used to conduct the course. However, where required, Power Point Presentations (PPTs), Video lectures, Simulations/Animations, Recap lecture, Punctuated lecture, Problem based teaching (Discuss an example, Solve a problem), Open discussion, Polling, Surprise questionnaire, Whips- go around groups/taking rounds etc. will be used to enhance the teaching-learning process.

10. Active learning techniques

Active learning is a method of learning in which students are actively or experientially involved in the learning process. Following active learning techniques will be adopted for the course.

- Concept Map- Students will be given a word in chapter Fire Extinguishers, Fire Protection Systems etc. where they have to draw a mind map, using the concepts that come to their mind while thinking about the given topic.
- One Sentence Summary- Students have to summarize the entire session of Fire and Safety Engineering in one sentence.

11. Course Material

Following course material is uploaded on the course blog:

- Course Policy
- Lecture Notes
- Books / Reference Books / NPTEL video lectures
- Assignments
- Question bank
- Advanced topics

12. Course Outcome Attainment

Following means will be used to assess attainment of course outcomes.

- Use of formal evaluation components of continuous evaluation, semester end examination
- Informal feedback during course conduction

13. Academic Integrity Statement

Students are expected to carry out assigned work under Continuous Evaluation (CE) component independently. Copying in any form is not acceptable and will invite strict disciplinary action. Evaluation of corresponding component will be affected proportionately in such cases. Turnitin software will be used to check plagiarism wherever applicable. Academic integrity is expected from students in all components of course assessment.