



**GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA
(JHAJJAR)
An Autonomous Institute**

‘A’ GRADE ACCREDITED BY NAAC

**Evaluation Scheme & Syllabus For
3rd Year
Bachelor of Technology Fire Technology and Safety
(Effective from the Session: 2026-27)**



APPROVED BY AICTE, NEW DELHI AND AFFILIATED TO MDU, ROHTAK

**GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA,
JHAJJAR (HR.)**

**Scheme of Studies and Examinations
B.Tech (Fire Technology and Safety)– 5th Semester
w.e.f. 2026-27**

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Schedule (Marks)				Exam Duration in H
				L	T	P			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Professional Core Courses	PCC-FT-301A	Fire Safety Risk Assessment	3	0	0	3	3	40	60		100	3
2	Professional Core Courses	PCC-FT-303A	Fire Dynamics	3	0	0	3	3	40	60		100	3
3	Professional Core Courses	PCC-FT-305A	Fire Safety Codes and Standards	3	0	0	3	3	40	60		100	3
4	Engineering Science Courses	ESC-ME-307A	Strength of Materials	3	0	0	3	3	40	60		100	3
5	Professional Core Courses	PCC-FT-309A	Fire Protection	3	0	0	3	3	40	60		100	3
6	Professional Elective Courses	Refer Table 2	Professional Elective-II	3	0	0	3	3	40	60		100	3
7	Professional Core Courses	LC-FT-311A	Fire Dynamics Lab	0	0	2	2	1	25		25	50	3
8	Engineering Science Courses	LC-ME-313A	Strength of Materials Lab	0	0	2	2	1	25		25	50	3
9	Professional Core Courses	LC-FT-315A	Fire Ground Operations-V	0	0	2	2	1	25		25	50	3
10	Internship	INT-FT-317A	Internship Seminar-I	0	0	2	2	1	50		-	50	3
11	Mandatory Non Credit Courses – Audit Courses	MC-301A	Essence of Indian Traditional Knowledge	2	0	0	2	-	40	60	-	100	3
Total Credits								22				800	

Notes:

- I. MC-301A is a mandatory non –credit course in which the students will be required passing marks in theory. However these marks will not be added in the total marks.
- II. They may also opt for Massive Open Online Courses (MOOCs) offered through SWAYAM, SWAYAM Plus, or NPTEL platforms subject to approval by the concerned Chairperson, Board of Studies (BoS)/Head of the Department.

Table 2 Professional Elective – II

Sr. No.	Code	Subject
1	PEC-FT-319A	Special Fire Hazards
2	PEC-FT-321A	Offshore Structures under Special Environmental Loads including Fire Resistance
3	PEC-FT-323A	Fire Service Communication and Mobilizing
4	PEC-FT-325A	Fire and Life Safety Audit
5	-----	MOOCs offered through SWAYAM, SWAYAM Plus, or NPTEL platforms

**GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA,
JHAJJAR (HR.)**

Scheme of Studies and Examinations

B.Tech (Fire Technology and Safety) – 6th Semester

w.e.f. 2026-27

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Load Per Week	Credits	Examination Schedule (Marks)				Exam Duration in H
				L	T	P			Assessment	End Semester Examination		Total	
										Theory	Practical		
1	Professional Core Courses	PCC-FT-302A	Fire Testing	3	0	0	3	3	40	60		100	3
2	Professional Core Courses	PCC-FT-304A	Fire Appliances and Rescue Equipments	3	0	0	3	3	40	60		100	3
3	Professional Core Courses	PCC-FT-306A	Automobile Engineering Safety	2	0	0	2	2	40	60		100	3
4	Professional Elective Courses	Refer Table 3	Professional Elective-III	3	0	0	3	3	40	60		100	3
5	Open Elective Courses	Refer Table 4	Open Elective-I	3	0	0	3	3	40	60		100	3
6	Humanities and Social Sciences including Management courses	HSMC-FT-308A	Energy Environment Ethics and Society	3	0	0	3	3	40	60		100	3
7	Professional Core Courses	LC-FT-310A	Fire Testing Lab	0	0	2	2	1	25		25	50	3
8	Professional Core Courses	LC-FT-312A	Automobile Safety Lab	0	0	2	2	1	25		25	50	3
9	Professional Core Courses	LC-FT-314A	Basic Computer Skills and AutoCAD Lab	0	0	2	2	1	25		25	50	3
10	Professional Core Courses	LC-FT-316A	Fire Ground Operations-VI (Rescue Operations)	0	0	2	2	1	25		25	50	3
Total Credits								21				800	

Notes:

- I. At the end of the 6th Semester, each student shall undergo 4–6 weeks of Practical Training in any one of the following areas: Fire and Safety, Fire and Safety Equipment Installation, Care and Maintenance, Fire and Safety Audits, or any certificate course related to Fire and Safety (minimum contact hours: 30 hours). The training may be undertaken in a Fire Service Department, Industry, Multi-Speciality Hospital, Professional Organization, Research Laboratory, Training Centre, Educational Institute, or any other building occupancy having fire-fighting installations. The student shall submit a typed training report along with a certificate issued by the concerned organization. The evaluation of the training shall be carried out in the 7th Semester.

- II. **For Working Professionals:** Students shall submit a Training/Project Report based on their work in their respective company/organization for the period of the summer/industrial training. The evaluation shall be carried out in the 7th Semester.
- III. Students must choose one course from the Professional Elective–III category (Table 3) and one course from the Open Elective–I category (Table 4). They may also opt for Massive Open Online Courses (MOOCs) offered through the SWAYAM, SWAYAM Plus, or NPTEL platforms, subject to the approval of the concerned Chairperson, Board of Studies/Head of the Department.

Table 3 Professional Elective – III

Sr. No.	Code	Subject
1	PEC-FT-318A	Fire Modelling
2	PEC-FT-320A	Safety Practice in Chemical and Nuclear Industries
3	PEC-FT-322A	Building Design and Drawing
4	PEC-FT-324A	Industrial Hygiene and Occupational Health
5	PEC-FT-326A	Nuclear Reactors and Safety
6	PEC-FT-328A	Computational Fluid Dynamics
7	-----	MOOCs offered through SWAYAM, SWAYAM Plus, or NPTEL platforms

Table 4 Open Elective Courses – I

Sr. No.	Code	Subject	Offered by	Departments Eligible to Choose the Course
1	OEC-01A	Engineering Ethics	Department of Electronics and Communication Engineering	All Engineering Departments
2	OEC-02A	Waste Management	Department of Civil Engineering	All Engineering Departments except the Department of Civil Engineering
3	OEC-03A	Internet of Things and Edge Computing	Department of Computer Science and Engineering	All Engineering Departments
4	OEC-04A	Project Management	Department of Mechanical Engineering	All Engineering Departments
5	OEC-05A	Renewable Energy Resources	Department of Electrical Engineering	All Engineering Departments
6	OEC-06A	United Nation's Sustainable Development Goals	Department of Electronics and Communication Engineering	All Engineering Departments
7	OEC-07A	Computer Aided Risk Analytics	Department of Fire Technology and Safety	All Engineering Departments
8	OEC-08A	Health, Safety and Environment	Department of Fire Technology and Safety	All Engineering Departments except the Department of Fire Technology and Safety
9	OEC-09A	Fundamentals of Additive Manufacturing	Department of Mechanical Engineering	All Engineering Departments except the Department of Mechanical Engineering
10	-----	MOOCs offered through SWAYAM, SWAYAM Plus, or NPTEL platforms	Online Platforms	All Engineering Departments

Course Code	PCC-FT-301A					
Category	Professional Core Courses					
Course Title	Fire Safety Risk Assessment					
Scheme and Credits	L	T	P	Credits	Semester -V	
	3	0	0	3		
Course Objectives	The objectives of this course are • To introduce students to the concepts of hazards, risk assessment and fire safety evaluation in industrial and engineering systems. • To develop understanding of risk analysis methodologies, accident causation theories and safety performance measurement techniques. • To familiarize students with qualitative and quantitative risk assessment tools used for identification and evaluation of fire and industrial hazards. • To provide knowledge of human reliability analysis techniques and their role in accident prevention and safety management					
Assessment	40 Marks					
End Semester Examination	60 Marks					
Total	100 Marks					
Duration of Exam	03 Hours					

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe hazards, risk, accident causation, fire risk scenarios and safety performance parameters used in fire safety risk assessment and evaluation.	Level 1: Remember
CO2	Explain the principles of hazard identification, qualitative and quantitative risk assessment, accident analysis and human reliability evaluation techniques.	Level 2: Understand
CO3	Apply risk assessment methodologies and analytical tools for evaluation of fire, explosion and industrial safety hazards.	Level 3: Apply
CO4	Analyze fire safety risks, accident scenarios, human reliability factors and consequences associated with industrial processes and hazardous systems.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Risk and Hazards: Definition, Accepted and Imposed risk, Perception and Qualification of Risk, ALARP, Cost Benefit Analysis, Fire explosion and toxic gas release, General principles of Fire Risk Assessment, Risk indices, Acceptance Criteria for Risk, As Low As Reasonably Practicable (ALARP), Risk Contour, F-N Curve, Individual Risk and Societal Risk, Hazards, Types of Hazards, Structure of Hazard Identification and Risk Assessment (HIRA), Fire Risk Scenarios, Fire Protection Measures as Fire Barriers, Hazardous Area Classification Study, Vulnerability Analysis.

Unit-II

Safety Performance: Introduction to Indian standard IS-3786, Accident, Classification of industrial accidents and special cases according to IS-3786, Theories of Accident Prevention, Principles of accident causation, Incident, Dangerous occurrence, Disabling (Lost-Time), Injury, Non-disabling injury, Reportable lost-time injury, Non-reportable lost- Time injury, Days of disablement (Lost time), Frequency rate, Weighed Frequency rate, Severity rate, Incidence rate, Frequency-severity index, Safe-T-score, Fatal accidents frequency rate.

Unit-III

Risk Assessment: Introduction, Basic Quantitative Risk Assessment (QRA), Principles of QRA, Probability Theory, Set Theory and Boolean Algebra, Use of Boolean Algebra and Cut Sets, Combination of frequencies, Logic Tree Approach, Fault Tree Analysis (FTA), Event Tree Analysis (ETA), Qualitative risk assessment, Types of Consequences, Consequence Analysis Methodologies and Source Models, HAZOP, Conducting a HAZOP study, Computerized Reporting System, HAZOP of batch process, Extension of HAZOP, Application of HAZOP to human reliability, Failure Mode and Effects Analysis (FMEA), Methodology of FMEA, Critically Analysis, Corrective Action, Preventive Action and Follow up.

Unit-IV

Human Reliability Analysis (HRA): Factors Leading to Human Error, Characteristics of HRA Techniques, Techniques for Human Error Rate Prediction (THERP), Accident Sequence Evaluation Program (ASEP), Techniques using Expert Judgement, Operator Action Tree (OAT).

Suggested Readings:

- Fundamentals of Industrial Safety & Health- K.U.Mistry, SiddharthPrakashan.
- Industrial Safety Health and Environment management Systems by Jain and Rao, Khanna Publishers
- Safety Management- R.K. Mishra- AITBS Publishers.
- Safety Management in Industry by N.V. Krishnan, Jaico Publishing House, 1997
- Industrial Safety by Ronald P. Blake, Prentice Hall, New Delhi, 1973
- Occupational Safety and health by David L. Goetsch, Prentice Hall
- Modern Accident Investigation and Analysis by Ted S. Ferry, John Wiley & Sons
- Hazard Analysis Techniques for System by Clifton A. Erison, A John Wiley & Sons, Inc., Publication
- An Introduction to Reliability and Maintainability Engineering by Charles E. Ebeling, McGraw Hill.
- Probabilistic Risk Assessment and Management for Engineers and Scientists by Hiromitsu Kumamoto and E.J. Henley, IEEE Press.
- Quantitative Risk Assessment in Fire Safety by Ganapathy Ramachandran and David Charters, Spon Press

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Safety Engineering & Accident-Causing Mechanisms	https://youtu.be/91YpCY-1Fy0?si=9m7dc3xTVnvlrINi	NPTEL (IIT Kharagpur)
Unit-II	Safety Performance Indicators Part-I	https://youtu.be/Nl89F0ISMog?si=no1jVjb6NRo52Xbl	NPTEL (IIT Kharagpur)

	Safety and Accident Loss Statistics	https://youtu.be/dlhXg7KkD0M?si=sb4EekkmyQFYBDqA	NPTEL (IIT Roorkee)
Unit-III	Fault Tree Analysis (FTA)-Construction	https://youtu.be/ZEShNJX3kcg?si=v4BPg658xrIST1kZ	NPTEL (IIT Kharagpur)
	Event Tree Analysis (ETA)	https://youtu.be/ikbC5_6qTvs?si=UV_joy0Ou7HMGV9I	NPTEL (IIT Kharagpur)
	Hazard and operability study (HAZOP)	https://youtu.be/n1s1UB80JgA?si=5E90ZscSGd1Sj7QE	NPTEL (IIT Kharagpur)
	Failure Mode Effect Analysis (FMEA)	https://youtu.be/7bFjH_ZVARI?si=tg9BGYp1RTi9zwp	NPTEL (IIT Kharagpur)

Course Code	PCC-FT-303A				
Category	Professional Core Courses				
Course Title	Fire Dynamics				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are • To make students familiar with the fundamentals of fire science, combustion phenomena and heat transfer processes involved in fire dynamics. • To provide an understanding of flame behavior, flammability characteristics and combustion mechanisms of gases, liquids and solids. • To expose students to compartment fire development, flashover phenomena and fire growth behavior in enclosed spaces. • To develop knowledge of smoke movement, smoke control principles and computational approaches used in fire dynamics analysis.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the principles of combustion, heat transfer, ignition and fire behavior associated with fire dynamics.	Level 1: Remember
CO2	Explain the characteristics of flames, burning phenomena, compartment fire development and smoke movement processes under fire conditions.	Level 2: Understand
CO3	Apply fire dynamics concepts for interpretation of combustion behavior, heat release, fire growth and smoke control mechanisms.	Level 3: Apply
CO4	Analyze the influence of combustion, ventilation, compartment conditions and smoke movement on fire development and fire safety performance.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Fire Science and Combustion: Fire, Classification of Fire, Fire triangle, Fire tetrahedron, The Physical Chemistry of Combustion in Fire, Thermodynamics of Combustion – Stoichiometry, Thermo-chemistry, Chemical equilibrium, Thermal equilibrium, Summary of the heat transfer equations, Conduction, Convection and radiation, Pyrolysis, Ignition mechanisms.

Unit - II

Flames: Flammability, Limits of flammability, Analysis of the Structure of the reaction zone and flame temperature, Measurement and Interpretation of flammability diagram, The structure of a premixed flame, Heat losses from premixed flames, Measurement of burning velocities, Variation of burning velocity with experimental parameters, Introduction to diffusion flame, Structure of diffusion flame, Burning of condensed phases, Burning of droplet clouds, Diffusion flame height, Flame spread theory, Fire plume dynamics.

Unit-III

Burning of Liquids and Solids: Classification of liquids, Flash points and their relationship to flammability limits. The wick effect and its relevance to the ignition of high flashpoint liquid pools, Application of the flash point and fire point to the ignition of solids, Spread of flame in solid, Burning of liquids, Burning of solids, Simple thermal model for the steady burning of liquids and solids, Combustion efficiency, Ventilation-controlled fires, Heat release rate.

Unit-IV

The Pre –Flashover Compartment Fire: The growth period and the definition of flashover, Growth to flashover.

The Post- Flashover Compartment Fire: Regimes of burning, Fully-developed fire behavior, Temperatures achieved in full – developed fire, Fire resistance and fire severity, Methods of calculating fire resistance, Projection of flames from burning compartments, Spread of fire from a compartment.

Smoke Movement and Smoke Control: Smoke production, Average plume temperature, Volumetric plume flow, Hazard of smoke, Principal of smoke movement, Flow through openings, Stack effect, Influence of floor and partition, Wind effect, Smoke management, Computational tool for design.

Suggested Readings:

- Fundamental of Fire Safety in Building Design by Dr. Than Singh Sharma, Aayush Publications, 2014
- NBCS-2026 (National Building Construct Code 2026)
- Fire Dynamics by Gregory Gorbett, James Pharr, Shijin Kozhurnal, 3rd Edition, 2026
- Fire Dynamics (Fire Prevention & Protection System) by Mr. MahendraPartap Singh, 2025
- Large Outdoor Fire Dynamics by Keisuke Himoto, CRC Press, 2022
- Manual of Fire Safety by N Sesha Prakash, CBS Publishers & Distributors Pvt. Ltd.
- Fire Dynamics by V.K. Jain, New Age International Publishers, 2020

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Fuel and the Combustion Process	https://youtu.be/s57q7CiWrT8?si=kHUVFUW9FmsuhU6Y	NPTEL (IIT Kanpur)
	Thermodynamics of Combustion	https://youtu.be/R80x6F1kp7g?si=a4BaBwXCEt48Q0Dg	NPTEL (IIT Kanpur)
Unit-II	Limit of Flammability	https://youtu.be/Oc02IDGAVJ0?si=W5srtC60NVCKLS1Q	NPTEL (IIT Kanpur)
Unit-III	Steady Burning of Liquid and Solid Fuels	https://youtu.be/wJUJ-wsJUWE?si=9hwrKDBRcoFpCIYG	NPTEL (IIT Kanpur)
	Ignition of Liquids and Solids	http://elearn.psgcas.ac.in/nptel/courses/video/103107156/lec22.pdf	NPTEL (IIT Roorkee)

Unit-IV	The Pre- Flashover Compartment Fire	http://elearn.psgcas.ac.in/nptel/courses/video/105102176/105102176.html	NPTEL (IIT Delhi)
	The Post-Flashover Compartment Fire	http://elearn.psgcas.ac.in/nptel/courses/video/105102176/lec6.pdf	NPTEL (IIT Delhi)
	Description of Smoke	https://www.nptelprep.in/courses/105107213/materials	NPTEL (IIT Roorkee)
	Smoke Management	https://youtu.be/JV1yoFaB-0o?si=QEkKNUMvZYyYdrpm	NPTEL (IIT Delhi)

Course Code	PCC-FT-305A				
Category	Professional Core Courses				
Course Title	Fire Safety Codes and Standards				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce students to national and international fire safety codes, standards and regulations used in fire protection engineering practice. • To develop understanding of standards related to fire detection, alarm systems and fixed fire protection systems for buildings and industrial occupancies. • To familiarize students with standards and specifications associated with fire extinguishers, firefighting equipment, hose systems and fire service appliances. • To provide knowledge of standards related to firefighter personal protective equipment, rescue equipment and operational safety requirements in fire service practice.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the terminology, codes, standards, and specifications related to fire safety engineering.	Level 1: Remember
CO2	Explain the requirements and provisions of fire safety codes and standards for fire protection systems, firefighting equipment, and personal protective equipment.	Level 2: Understand
CO3	Apply fire safety codes and standards for the selection, inspection, testing, and maintenance of fire protection and firefighting systems.	Level 3: Apply
CO4	Analyze the suitability and implementation of fire safety standards, firefighting equipment and protective systems in engineering and fire service applications.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit – I

Fire Safety Codes and Fire Detection Standards: Introduction to fire safety codes and standards, Role and significance of BIS, ISO and NFPA standards in fire safety engineering, Terminology and glossary associated with fire safety, National Building Code provisions related to fire and life safety, Fire safety signs and graphical symbols used in fire protection plans, Standards related to fire brigade control rooms and drill towers, Fire safety

requirements and Fire No Objection Certificate provisions for buildings and industrial occupancies, Standards and specifications related to fire detection and alarm systems, Heat, Smoke, Flame and gas detectors, VESDA systems, Notification appliances, Interconnections and integration of fire alarm systems, Standards related to sprinkler systems and fixed fire protection systems, Interpretation and application of fire safety standards in engineering practice.

Relevant Standards: IS 8757, IS 957, IS 5888, IS 12349, IS 12407, IS 15394, IS 18006, IS 2189, IS/ISO 7240 Series, IS 15908, IS 9972, IS 15105, IS 16088, IS 16534 and relevant NFPA Standards.

Unit – II

Standards for Fire Extinguishers and Extinguishing Media: Classification and specification of portable and fixed fire extinguishers, Standards related to extinguishing agents including water, Foam, Dry chemical powder and carbon dioxide, Installation, Inspection, Testing and maintenance requirements of extinguishers, Performance and safety requirements of extinguishers and extinguishing media, Operational requirements and marking systems for extinguishers and extinguishing agents, Interpretation and application of standards related to fire extinguishers and extinguishing systems in fire safety engineering practice.

Relevant Standards: IS 2190, IS 4152, IS 4308, IS 4862 Part 1, IS 4947, IS 4989, IS 11108, IS 11833, IS 12835 Part 1, IS 14951, IS 15220, IS 15221, IS 15222, IS 15493, IS 15496, IS 15497, IS 15501, IS 15505, IS 15506, IS 15517, IS 15519, IS 15525, IS 15528, IS 15683, IS 15835, IS 16018, IS 19452 and relevant NFPA Standards.

Unit – III

Standards for Fire Hose Systems, Pumps and Fire Service Appliances: Standards and specifications related to fire hoses, Hose fittings, Couplings, Branches, Nozzles and delivery equipment, Performance requirements of fire hose systems and accessories, Inspection, Testing and maintenance requirements of hose systems and fittings, Classification, Specification and operational requirements of fire pumps, Fire tenders and fire service appliances, Pump performance standards, Testing and operational standards for firefighting vehicles and fire service equipment, Interpretation and application of standards related to firefighting equipment and fire service operations.

Relevant Standards: IS 636, IS 884, IS 2930, IS 3844, IS 8423, IS 14851, IS 14933, IS 15051, IS 901–909, IS 937, IS 952, IS 2871, IS 3582, IS 4643, IS 5131, IS 5612 Part 1 & 2, IS 5714, IS 8090, IS 8442, IS 9668, IS 11101, IS 942, IS 943, IS 944, IS 947, IS 948, IS 950, IS 951, IS 955, IS 5896 Part 1, IS 6067, IS 6070, IS 10460, IS 10993, IS 12469, IS 12717, IS 15301 and relevant NFPA Standards.

Unit – IV

Standards for Personal Protective Equipment and Rescue Equipment: Standards related to firefighter personal protective equipment, Protective clothing, Helmets, Gloves, Boots and respiratory protection equipment, Standards related to self-contained breathing apparatus and firefighter safety equipment, Specification and performance requirements of firefighter protective systems, Standards related to rescue equipment, Ropes, Ladders and small firefighting gear, Inspection, Testing and maintenance requirements of rescue and firefighting equipment, Interpretation and application of PPE and rescue equipment standards in fire service practice.

Relevant Standards: IS 2745, IS 4355, IS 9995, IS 15381, IS 16874, IS 16890, IS 18582 Part 6, IS 18589 Part 3, 4 & 6, IS 18804, IS 19198, IS 926, IS 927, IS 928, IS 8096, IS 12796, IS 12859, IS 12861, IS 12862, IS 939, IS 4571, IS 5896 Part 3, NFPA 1983 and NFPA 1932.

Suggested Readings:

- Relevant Indian Standards (IS codes)
- Relevant NFPA standards

Course Code	ESC-ME-307A				
Category	Engineering Science Courses				
Course Title	Strength of Materials				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce students to the concepts of force systems, equilibrium conditions and analysis of engineering structures. • To develop understanding of stresses, strains and mechanical behavior of materials under different loading conditions. • To familiarize students with the principles of truss analysis, moment of inertia, shear force and bending moment in structural members. • To provide knowledge of bending stresses, beam deflection and pressure vessel behavior along with associated safety considerations.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the fundamental concepts of force systems, equilibrium, stresses, strains and structural behavior of engineering materials and members.	Level 1: Remember
CO2	Explain the concepts of force, behavior of trusses, beams and pressure vessels under different loading and support conditions.	Level 2: Understand
CO3	Apply the laws, principles of force, stress analysis, moment of inertia, shear force, bending moment, beam bending and deflection for solving engineering problems.	Level 3: Apply
CO4	Analyze the force system, structural response, bending behavior and safety aspects of beams, trusses and pressure vessels subjected to different loading conditions.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Force and its effects: Units and measurement of force, Characteristics of force vector representation, Bow's notation, Types of forces, action and reaction, tension & thrust.

Force Systems: Coplanar and space force systems, Coplanar, concurrent and non -concurrent forces, Free body diagrams, Resultant and components of forces, concept of equilibrium, parallelogram law of forces,

Equilibrium of two forces, super-position and transmissibility of forces, Newton's third law, triangle law of forces, parallelogram law, Lami's theorem.

Unit-II

Simple Stresses & Strains: Introduction, types of stresses and strains, Poisson's ratio, stresses and strain in simple and compound bars under axial loading, stress strain diagrams, Hooks law, elastic constants & their relationships, temperature stress & strain in simple & compound bars under axial loading, Numericals.

Trusses and Frames: Truss, classification of truss, assumptions in truss analysis, perfect truss, analysis of perfect plane truss using method of joints and method of sections, Numericals.

Unit-III

Moment of Inertia: Area moment of inertia, mass moment of inertia, parallel axis and perpendicular axis theorems, radius of gyration, polar moment of inertia, product of inertia, problem based on composite figures and solid objects, centroid and center of gravity, Numericals.

Shear Force & Bending Moments: Definitions, SF & BM diagrams for cantilevers, simply supported beams with or without over-hang and calculation of maximum BM & SF and the point of contra-flexure under (i) concentrated loads, (ii) uniformly distributed loads over whole span or a part of it, (iii) combination of concentrated loads and uniformly distributed loads, (iv) uniformly varying loads and (v) application of moments, Numericals.

Unit-IV

Bending Stresses in Beams: Theory of bending, Flexural formula, Moment of resistance and section modulus, Bending of symmetrical sections.

Deflection of beams: Slope and deflection concept, Differential equation of elastic curve, slope and deflection in different type of beams.

Pressure Vessels: Introduction, Classification of pressure vessels, materials used, Stresses in pressure vessels, Hazards associated with pressure vessels, Safety devices, Inspection and testing, Fire protection systems for pressure vessels.

Suggested Readings:

- Strength of Materials by Sadhu Singh, Dhanpat Rai Publishing Company, New Delhi
- Strength of Materials by G. H. Ryder, Macmillan, India
- Mechanics of Materials by R. C. Hibbeler, Cengage Learning India Pvt. Ltd., New Delhi
- Strength of Materials by R.K. Rajput, S. Chand Publication, New Delhi
- Engineering Mechanics by Irving H. Shames, PHI Publication, New Jersey
- Engineering Mechanics by Dr. D. S. Kumar, Kataria & Sons, New Delhi
- Strength of Materials by S. Ramamrutham, Dhanpat Rai Publishing Company, New Delhi

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Introduction to Forces	https://www.youtube.com/watch?v=YXuGB2Fd4Eg	NPTEL(IIT Madras)
	Force System-I	https://nptel.ac.in/courses/112106286	NPTEL(IIT Madras)
	Force System-II	https://nptel.ac.in/courses/112106286?utm	NPTEL(IIT Madras)
	Equilibrium of rigid bodies	https://www.youtube.com/watch?v=g2VwjkrAuM&list=PLq7jO-L_k0yUk2tfPwhea9asGRBXcUEpL&index=11	NPTEL(IIT Kanpur)
Unit-II	Basic Introduction of Stresses	https://nptel.ac.in/courses/112106319	NPTEL(IIT Madras)
	Analysis of Strain	https://www.youtube.com/watch?v=iJTHPgYAqvQ&list=PL27C4A6AEA552F9E6&index=7	NPTEL(IIT Kharagpur)
	Truss	https://nptel.ac.in/courses/122104015	NPTEL(IIT Kanpur)
	Truss – Method of Joints	https://www.youtube.com/watch?v=GKLEysulS08&list=PLLy_2iUCG87AgdE8-bSTgt-Id4lhZwf7p&index=17	NPTEL(IIT Roorkee)
	Truss – Method of Sections	https://www.youtube.com/watch?v=NIBjOIwfKhE&list=PLLy_2iUCG87AgdE8-bSTgt-Id4lhZwf7p&index=18	NPTEL(IIT Roorkee)
Unit-III	Friction	https://nptel.ac.in/courses/112107539	NPTEL(IIT Roorkee)
	Moment of Inertia	https://nptel.ac.in/courses/112107539	NPTEL(IIT Roorkee)
	Moments and Product of Inertia	https://www.youtube.com/watch?v=ZwuWzE1qAi4	NPTEL(IIT Delhi)
	Shear Force and Bending Moment	https://nptel.ac.in/courses/112107146	NPTEL(IIT Roorkee)
Unit-IV	Bending Stress in Beams	https://nptel.ac.in/courses/105105108	NPTEL(IIT Kharagpur)
	Deflection of Beams	https://nptel.ac.in/courses/105105108	NPTEL(IIT Kharagpur)
	Column Buckling Theory	https://www.youtube.com/watch?v=q6WPVDgiWjQ	NPTEL(IIT Guwahati)
	Pressure Vessels	https://www.youtube.com/watch?v=aI-oyoaiCpU	NPTEL(IIT Madras)

Course Code	PCC-FT-309A				
Category	Professional Core Courses				
Course Title	Fire Protection				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are • To provide knowledge of the principles, components and operation of fire detection, alarm and notification systems used in fire protection engineering. • To develop understanding of water-based, water spray, water mist and foam fire suppression systems and their applications in different occupancies and hazards. • To familiarize students with gaseous, chemical and industrial fire protection systems, explosion protection methods and associated safety considerations. • To enable students to learn inspection, testing, maintenance and design considerations of various fire protection systems in accordance with standard engineering practices and codes.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the principles, components, and terminology of fire detection, alarm, and fire protection systems used in fire and safety engineering.	Level 1: Remember
CO2	Explain the working principles, design concepts, and applications of fire detection, water-based, foam, gaseous, and chemical fire protection systems.	Level 2: Understand
CO3	Apply the principles of fire detection and fire protection systems to select appropriate fire safety measures for buildings and industrial occupancies.	Level 3: Apply
CO4	Analyze the performance of fire protection systems and industrial fire and explosion hazards to recommend suitable fire protection strategies.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit – I

Fire Detection and Alarm Systems: Active and passive fire protection systems, components of fire detection and alarm systems, heat, smoke, flame and gas detectors, VESDA systems, notification appliances, detector selection and spacing concepts, false alarm management, interconnections and integration, gas and vapor

detection systems, electrochemical sensors, inspection, testing and maintenance of fire detection and alarm systems.

Unit – II

Water-Based Fire Protection Systems: Extinguishing mechanism and limitations of water, automatic sprinkler systems, principles and types of sprinkler systems, sprinkler heads and classification, k-factor, deluge systems, water supply requirements as per NBC, fire pumps and pump house arrangements, terrace tanks and terrace pumps, overview of fire pump sizing concepts, Standpipe and hose systems, wet risers, internal and external hydrants, zoning in standpipe systems, hose reels, inspection, testing and maintenance of water-based fire protection systems.

Unit – III

Water Spray, Water Mist and Foam Systems: Water spray systems, components and applications, ultra-high-speed water spray systems, methods of extinguishment, response time and design considerations, water mist systems, methods of generating water mist, mist classification, spray characteristics, applications and limitations, Firefighting foams, types and properties of foam concentrates, extinguishing mechanism and limitations of foam, expansion ratio, low, medium and high expansion foam systems, foam generating equipment, foam protection systems for storage tanks and industrial hazards, foam application concepts.

Unit – IV

Gaseous, Chemical and Industrial Fire Protection Systems: Carbon dioxide fire suppression systems, extinguishing mechanism and limitations of CO₂, total flooding and local application systems, components and safety precautions, Clean agent fire suppression systems, inert gas and synthetic agents, extinguishing mechanisms, design concentration concepts, pressure relief vents, applications and limitations, Dry chemical powder, aerosol and wet chemical extinguishing systems, extinguishing mechanisms, applications and maintenance, overview of agent quantity calculations, Industrial fire and explosion hazards, Explosion prevention and protection systems, deflagration venting and explosion suppression systems, fire protection considerations in industrial occupancies.

Suggested Readings:

- Industrial Safety, Health & Environment Management System by R.K. Jain & Sunil S. Rao, Khanna Publishers.
- Fire Safety in Buildings by V.K. Jain, New Age International Publishers.
- Fire Protection and Prevention: The Essential Handbook Volume 1 & 2 by B.M. Sen, UBS Publishers.
- Principles of Fire Safety Engineering: Understanding Fire and Fire Protection by Akhil Kumar Das, PHI Learning Private Limited (Prentice Hall India).
- Industrial Safety and Health Management by C. Ray Asfahl and David W. Rieske, Pearson India
- Relevant IS Standards.
- SFPE Handbook of Fire Protection Engineering by Morgan J. Hurley, Society of Fire Protection Engineers (SFPE) / Springer.
- Relevant NFPA Standards.

Course Code	LC-FT-311A				
Category	Professional Core Courses				
Course Title	Fire Dynamics Lab				
Scheme and Credits	L	T	P	Credits	Semester-V
	0	0	2	1	
Course Objectives	The objectives of this course are • To provide practical exposure to the ignition, combustion and burning characteristics of gaseous, liquid and solid fuels. • To develop experimental understanding of flame behavior, flame spread and fire growth phenomena under different fire conditions. • To familiarize students with measurement techniques for burning rate, heat release rate, smoke production and toxic gas emissions in fire experiments. • To enable students to study the influence of ventilation and compartment conditions on smoke movement and compartment fire dynamics.				
Assessment	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Explain the ignition characteristics, and flame behavior of combustible solids, liquid fuels and gas-air mixtures through laboratory experiments.	Level 2: Understand
CO2	Apply experimental methods to determine flash point, fire point, flame spread, flame height, burning rate and mass loss characteristics of combustible materials during combustion.	Level 3: Apply
CO3	Apply fire testing techniques to measure heat release rate, smoke production and toxic gas emissions of combustible materials.	Level 3: Apply
CO4	Analyze the effect of compartment conditions and ventilation on smoke movement, smoke stratification and compartment fire growth behavior.	Level 4: Analyze

List of Experiments

Sr. No.	Contents
1	To determine the flash point and fire point of liquid fuels using Pensky-Martens Closed Cup and Cleveland Open Cup apparatus.
2	To study the ignition behavior of combustible solids under radiant heat exposure.
3	To study the ignition behavior of liquid fuels under radiant heat exposure.
4	To determine the burning velocity of gas-air mixtures using cone angle method.
5	To study the characteristics of premixed and diffusion flames.

6	To determine the flame spread rate over solid combustible surfaces.
7	To determine the flame height and burning rate of liquid pool fires.
8	To determine the burning rate and mass loss rate of solid fuels during combustion.
9	To measure the heat release rate of combustible materials using cone calorimeter.
10	To measure smoke production and toxic gas emissions during combustion.
11	To study smoke layer formation and smoke stratification in compartment fires.
12	To study the effect of ventilation on compartment fire growth and smoke movement.

Note: At least 8 experiments are to be performed by the students. Faculty members can add 2-3 extra experiment if they feel useful to add.

Course Code	LC-ME-313A				
Category	Engineering Science Courses				
Course Title	Strength of Materials Lab				
Scheme and Credits	L	T	P	Credits	Semester-V
	0	0	2	1	
Course Objectives	The objectives of this course are • To familiarize the students with the operation and applications of material testing machines and equipment used in strength of materials laboratory experiments. • To develop the understanding of students regarding the mechanical behavior and strength characteristics of engineering materials under different loading conditions. • To enable the students to perform experimental determination of shear force, bending moment, hardness, impact strength, mechanical advantage, and efficiency of engineering systems. • To make the students learn the analysis and evaluation of experimental results related to material properties and structural behavior.				
Assessment	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Apply the principles of shear force and bending moment for drawing shear force and bending moment diagrams of simply supported beams under different loading conditions.	Level 3: Apply
CO2	Apply standard testing procedures for conducting tensile, compression, bending, and shear tests on engineering materials using the Universal Testing Machine (UTM).	Level 3: Apply
CO3	Analyze the mechanical behavior and strength characteristics of engineering materials under tensile, compressive, bending, shear, and impact loading conditions using experimental observations and test data.	Level 4: Analyze
CO4	Analyze the hardness characteristics and surface resistance of engineering materials using Brinell, Rockwell, and Vickers hardness testing methods.	Level 4: Analyze
CO5	Evaluate the mechanical advantage, efficiency, and performance characteristics of winch crabs and screw jacks through experimental testing and calculations.	Level 5: Evaluate

List of Experiments

Sr. No.	Contents
1	To draw shear force and bending moment diagrams for simply supported beams subjected to point loads and distributed loads.
2	To study the Universal Testing Machine (UTM) and perform tensile tests on engineering materials.

3	To perform compression and bending tests using the Universal Testing Machine (UTM).
4	To perform shear tests on engineering materials using the Universal Testing Machine (UTM).
5	To study the impact testing machine and perform Izod and Charpy impact tests.
6	To study the Brinell hardness testing machine and perform the Brinell hardness test.
7	To study the Rockwell hardness testing machine and perform the Rockwell hardness test.
8	To study the Vickers hardness testing machine and perform the Vickers hardness test.
9	To determine the mechanical advantage and efficiency of single purchase and double purchase winch crabs.
10	To determine the mechanical advantage and efficiency of simple and compound screw jacks.

Note: At least 8 experiments are to be performed by the students. Faculty members can add 2-3 extra experiment if they feel useful to add.

Course Code	LC-FT-315A				
Category	Professional Core Courses				
Course Title	Fire Ground Operations-V				
Scheme and Credits	L	T	P	Credits	Semester-V
	0	0	2	1	
Course Objectives	The objectives of this course are • To develop the understanding of students regarding ropes, ladders, hoses, pumps, water relay systems, and water tenders used in firefighting operations. • To familiarize the students with testing procedures, operational methods, and maintenance practices of firefighting equipment and accessories. • To make the students learn firefighting drills, foam generation techniques, pumping operations, and salvage procedures used during fire emergencies. • To develop the practical skills of students in handling firefighting equipment, conducting operational tests, and performing coordinated firefighting and rescue drills.				
Assessment	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Explain the construction, types, operational features, testing methods, and applications of ropes, ladders, hoses, pumps, water relay systems, and water tenders used in firefighting operations.	Level 2: Understand
CO2	Perform rolling, testing, operational handling, and maintenance procedures of ropes, ladders, hoses, pumps, and firefighting equipment during practical firefighting exercises.	Level 3: Apply
CO3	Demonstrate foam drills, extinguisher drills, pumping drills, water relay operations, and salvage procedures using firefighting appliances and foam-making equipment.	Level 3: Apply
CO4	Analyze the operational performance, testing results, and functional suitability of firefighting equipment, pumping systems, and relay operations under different firefighting conditions.	Level 4: Analyze

List of Experiments

Sr. No.	Contents
1	To study and perform rolling of Ropes.
2	To study and perform testing of Ropes.
3	To study different types of Ladders and their parts.
4	To study and perform rolling of Hoses.
5	To perform different ladder test

	(a) Round test (b) String test (c) Extension line test
6	To perform Hose tests (a) Suction hose test (b) Delivery hose test (c) Hose reel hose test
7	To study and perform extinguisher drill.
8	To study and perform the drill using Foam making equipment: (a) FB-2 with (Knap Sack Tank) (b) FB-5X (c) FB- 10X (d) FB-20 (e) FM Generator (f) Inline inductor (g) Foam Monitor
9	To perform foam drill with foam test.
10	To perform four men pump drill with pump test.
11	To perform six men pump drill with pump test.
12	To perform close water pumping drill.
13	To perform open water pumping drill.
14	Salvage: (a) Types of Salvage sheet (b) Salvage before fire (c) Salvage during fire (d) Salvage after fire
15	Pump: (a) Bucket pump (b) Portable pump (c) Trailer pump
16	Test: (a) Pump output test (b) Vacuum test (c) Suction test
17	Water Relay: (a) Types of water relay (b) Close relay (c) Open relay (d) Uses of Portable dam
18	Types of Water tender: (a) Type A (b) Type B (c) Type X

Other drills and tests can be performed as decided by department (time to time) depending upon the scope of course.

Course code	INT-FT-317A				
Category	Seminar/Internship				
Course Title	Industrial Seminar -I				
Scheme and Credits	L	T	P	Credits	Semester-V
	0	0	2	1	
Course Objectives	The objectives of this course are • To make the students familiar with industrial practices, fire safety systems, emergency response procedures, and safety management activities followed in industries, fire academies, and related organizations. • To develop the understanding of students regarding practical applications of fire protection engineering, industrial safety practices, firefighting operations, and hazard control measures in real working environments. • To familiarize the students with professional work culture, technical documentation, safety regulations, reporting procedures, and operational responsibilities in industries and fire service organizations. • To make the students learn practical problem-solving approaches, communication skills, technical report writing, seminar presentation, and professional ethics through industrial training exposure.				
Assessment	50 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Assessment of Industrial Seminar–I shall be based on the case study, seminar presentation, viva-voce, training report, and certificate of practical training undergone by the student at the end of the IV Semester from an Industry/Institute/Professional Organization/Research Laboratory/Training Centre/Software Organization, with the prior approval of the Director of the Institute/Head of the Department.

Course Outcomes: After successful completion of this course, the students will be able to

CO	Skill Demonstrated	Level
CO1	Describe the organizational structure, fire safety systems, industrial operations, emergency response procedures, and safety practices followed in industries and fire service organizations.	Level 1: Remember
CO2	Explain the working principles, operational procedures, safety regulations, and fire protection practices observed during industrial training.	Level 2: Understand
CO3	Apply fire safety practices, operational procedures, safety rules, and technical knowledge for performing assigned activities during industrial training.	Level 3: Apply
CO4	Analyze industrial operations, fire hazards, emergency response systems, and safety management practices based on observations and training experience.	Level 4: Analyze
CO5	Evaluate the effectiveness of fire protection measures, industrial safety practices, emergency preparedness systems, and operational procedures followed in the organization.	Level 5: Evaluate
CO6	Prepare and present a comprehensive industrial training report and seminar based on practical learning, observations, technical findings, and professional experience gained during training.	Level 6: Create

Course Code	MC-301A				
Category	Mandatory Non Credit Courses – Audit Courses				
Course Title	Essence of Indian Traditional Knowledge				
Scheme and Credits	L	T	P	Credits	Semester -V
	2	0	0	-	
Course Objectives	The objectives of this course are • To make the students familiar with the fundamentals, structure, and components of the Indian Knowledge System including Vedas, Upavedas, Vedangas and Upangas. • To develop the understanding of students regarding the relationship between modern science and the Indian Knowledge System. • To familiarize the students with the principles of yoga, holistic healthcare, and their significance in physical and mental well-being. • To make the students learn the practical relevance and applications of the Indian Knowledge System through case studies and interdisciplinary approaches.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the concepts related to the Indian Knowledge System, Vedas, Upavedas, Vedangas, Upangas, yoga and holistic healthcare.	Level 1: Remember
CO2	Explain the structure, principles, and interdisciplinary relevance of the Indian Knowledge System in relation to modern science and healthcare practices.	Level 2: Understand
CO3	Apply the concepts of yoga, holistic healthcare, and Indian Knowledge traditions for promoting well-being and understanding their practical significance in contemporary society.	Level 3: Apply
CO4	Analyze the contributions and applications of the Indian Knowledge System in science, healthcare, education, and societal development through case studies and interdisciplinary perspectives.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Contents

- Basic Structure of Indian Knowledge System: Ashtadasha Vidya (Eighteen Branches of Knowledge in the Indian Knowledge System), Veda, Upaveda (Ayurveda, Dhanurveda, Gandharvaveda, Sthapatyaveda etc.), Vedanga (Shiksha, Kalpa, Nirukta, Vyakarana, Jyotisha, Chhanda), Upanga (Dharmashastra, Mimansa, Purana, Tarkashastra).
- Modern Science and Indian Knowledge System.
- Yoga and Holistic Healthcare.
- Case Studies.

Suggested Readings:

- Cultural Heritage of India – Course Materials by V. Sivaramakrishnan, Bharatiya Vidya Bhavan, Mumbai
- Modern Physics and Vedant by Swami Jitatmanand, Bharatiya VidyaBhavan
- Holistic Science and Vedant by Swami Jitatmanand, Bharatiya VidyaBhavan
- Tarkasangraha of Annam Bhatta by V. N. Jha (English Translation), International Chinmaya Foundation, Velianad, Ernakulam
- Yoga Sutra of Patanjali by Ramakrishna Mission, Kolkata
- Yoga-Darshanam with Vyasa Bhashya by G. N. Jha (English Translation), Edited by R. N. Jha, Vidyanidhi Prakashan, Delhi
- Science of Consciousness, Psychotherapy and Yoga Practices by R. N. Jha, VidyanidhiPrakashan, Delhi
- Shodashang Hridayam by P. B. Sharma (English Translation)

Course Code	PEC-FT-319A				
Category	Professional Electives Courses				
Course Title	Special Fire Hazards				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are • To provide knowledge of fire hazards, emergency response procedures and preventive measures associated with transportation and railway systems. • To develop understanding of marine, port and aviation fire safety systems, rescue operations and firefighting strategies. • To familiarize students with fire and explosion hazards in industrial occupancies, high-rise buildings and specialized hazardous environments. • To acquaint students with fire safety management, evacuation strategies, firefighting challenges and safety measures related to complex infrastructures and nuclear facilities.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the fire hazards, safety features, emergency response procedures and preventive measures associated with transportation, marine, aviation, industrial and building fire safety systems.	Level 1: Remember
CO2	Explain the fire protection systems, firefighting operations, evacuation procedures and safety management practices used in different hazardous occupancies and infrastructures.	Level 2: Understand
CO3	Apply fire safety principles and emergency response concepts for management of fire and explosion hazards in transportation, industrial, marine, aviation and high-rise building environments.	Level 3: Apply
CO4	Analyze fire risk scenarios, operational challenges and mitigation strategies associated with complex fire emergencies and hazardous installations.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Transportation Safety: Fundamentals of transportation fire safety, Passenger and commercial vehicle fires, Hazardous material transportation, MSDS, HAZCHEM code, Placards and TREM cards, LNG/LPG transportation hazards, Electric vehicle and lithium-ion battery fire hazards, Emergency response procedures, Preventive measures and case studies.

Trains Safety: Structural features of trains, Railway stations, Tunnels and metro rail systems, Railway fire hazards, passenger evacuation, Tunnel fire safety, Rescue operations, Emergency response strategies and case studies.

Unit-II

Marine and Port Fire Safety: The maritime environment, Types of vessels, Constructional features of passenger and cargo ships, Fire detection and suppression systems in ships, Cargo hazards and safety measures, Marine firefighting and rescue operations, Emergency planning, Preventive measures and strategic management, Fire protection facilities for ports handling hydrocarbons as per OISD-STD-156, Ships and marine technology fire extinguishing systems for protection of galley cooking equipment as per IS 17564, Ships and Marine technology windows and side scuttles for fire-resistant constructions as per IS 18280, Shipbuilding testing, Installation and maintenance of marine portable fire appliances- Code of practice as per IS 3947, Loading and unloading hazards, Firefighting systems in ports and terminals, Emergency response systems, Preventive measures and case studies.

Unit-III

Aviation Fire Safety: Constructional features of aircraft, Aircraft fire hazards, Air crashes and emergency landings, Rescue operations in aircraft fires, Airport fire hazards, Hangar protection systems, Crash fire tenders and rapid intervention vehicles, Airport categorization and firefighting appliances as per international standards and case studies.

Industrial and High-Rise Fire Safety: Fire safety in iron and steel industries, Petroleum refineries, Fertilizer plants, Pharmaceutical industries, Coal-based industries and thermal power plants, Hydrogen hazards, BLEVE, Vapor cloud explosions, Rocket propellants, Industrial emergency response procedures, Preventive measures and case studies.

Unit-IV

Building Fire Safety: Fundamentals of fire-safe building design, Life safety systems for high-rise buildings, Structural fire protection, Alarm and signaling systems, Smoke movement and smoke control systems, Refuge areas, Fire lifts, Façade fire hazards, Evacuation strategies, Firefighting challenges in high-rise buildings and case studies.

Nuclear Safety: Radiation and its types, Nuclear reactors, Radiation emergencies, Firefighting and rescue operations in radiation hazard areas, Radiation safety measures, Radioactive waste management, Nuclear accidents, Mitigation measures and strategic management.

Suggested Readings:

- Radioactive Materials by B.M. Rao, Himalaya Publishing House.
- Fire Safety in Buildings by V K Jain, New Age Publishers, New Delhi.
- Indian Buildings Congress Manual of Fire Safety in Buildings by Indian Building Congress, Nabhi Publication
- Industrial Safety, Health and Environment Management Systems by R. K. Jain and Sunil S. Rao, Khanna Publishers

- Handbook on Fire and Life Safety in Buildings by Barendra Mohan Sen, Techno World
- Airport, Aircraft and Aviation Fire Safety by P. K. Sarkar, S. K. Kataria and Sons
- Marine Fire Prevention, Firefighting and Fire Safety by D. K. Gupta, CBS Publishers and Distributors
- OISD-STD-156

Course Code	PEC-FT-321A				
Category	Professional Elective Courses				
Course Title	Offshore Structures under Special Environmental Loads including Fire Resistance				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce students to offshore structures, environmental loading conditions and hydrodynamic effects associated with offshore engineering systems. • To develop understanding of structural behavior, stress analysis and dynamic response of offshore structural members and riser systems. • To familiarize students with offshore fire hazards, fire development behavior and fire protection systems used in offshore installations. • To provide knowledge of structural design methodologies and material behavior of steel, concrete and composite members under fire conditions.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the terminology related to offshore structures, environmental loading, structural behavior, and fire safety engineering.	Level 1: Remember
CO2	Explain the principles of offshore structural systems, environmental loading, structural response, fire safety, and structural behavior under fire.	Level 2: Understand
CO3	Apply the principles of offshore structural analysis, fire safety, and structural fire design to offshore engineering applications.	Level 3: Apply
CO4	Analyze the structural performance and fire safety of offshore structures under environmental and fire loading conditions.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Offshore Structures and Environmental Loading: Introduction to offshore structures, Classification and novelty of offshore platforms, Fixed platforms, Compliant platforms, Guyed towers, Articulated towers, Tension leg platforms (TLP), SPAR platforms, Semisubmersibles, Floating production storage and offloading systems (FPSO), Jack-up rigs, Drill ships, Buoyant leg structures (BLS), Triceratops and regasification platforms. Environmental loading on offshore structures, Wave loads, Airy wave theory, Wheeler's and Chakrabarti's modifications, Random waves and wave spectra, Pierson-Moskowitz spectrum, ISSC spectrum, JONSWAP spectrum, Wind loads and wind spectra, Current loads, Ice loads, Seismic loads, Springing and ringing effects, Blast loads and fire loads.

Unit-II

Structural Behavior and Dynamic Response of Offshore Structures: Unsymmetrical bending, Shear center, Curved beams with small and large initial curvature, Stress analysis in curved beams, Circular, Rectangular, Triangular, Trapezoidal, T and I sections, Simplified stress estimation methods, Marine risers and offshore structural components, Low-pressure risers, High-pressure drilling risers, Flexible risers, Top tensioned risers (TTR), Vortex-induced vibration (VIV), Dynamic response of offshore structural members, Hydrodynamic effects on offshore structures, Fatigue behavior of offshore components, VIV suppression systems and research case studies.

Unit-III

Fire Safety in Offshore Structures: Introduction to offshore fire safety, Fire and explosion characteristics in offshore platforms, Classification of fire, Pool fire, Jet fire, Flash fire and fireball, Minimum ignition energy, Fire risk assessment, Fire scenarios in offshore installations, Causes of offshore fire accidents and lessons learned, Fire development and behavior, Combustion characteristics of materials, Ignition and spread of fire, Open fires, Compartment fires, T-squared fire model, Pre-flashover, Flashover and post-flashover behavior, Fire protection systems in offshore structures, Active and passive fire protection systems, Fire detection and alarm systems, Firefighting equipment, Compartmentation, Fire-resistant construction, Egress and human behavior during emergencies, Offshore evacuation systems, Fire resistance and equivalent fire severity, Fire resistance testing methods and fire-resistance ratings.

Unit-IV

Structural Design under Fire: Material behavior at elevated temperatures, Thermal properties of steel and concrete, Specific heat, density, Thermal conductivity and thermal diffusivity, Mechanical properties and constitutive models of steel and concrete under fire conditions, Temperature assessment methods for structural members, Eurocode approach, Fire rating methods, Bare and protected steel sections, Strength assessment of steel members under fire, Design of concrete members under fire, Temperature analysis methods, Wickstrom's method, Hertz's method, 500°C isotherm method and zone method, Composite structures under fire, Composite beams and columns, Critical temperature approach, Moment capacity approach, Numerical examples on steel, Concrete and composite structural members exposed to fire.

Suggested Readings:

- Design Aids of Offshore Structures Under Special Environmental Loads Including Fire Resistance by Srinivasan Chandrasekaran and Gaurav Srivastava.
- Dynamics of Offshore Structures by James F. Wilson.
- Offshore Structures: Design, Construction and Maintenance by Mohammad H. El-Reedy.
- Design of Offshore Concrete Structures by M. S. Troitsky.
- Structural Fire Engineering by VenkateshKodur.
- Fire Safety Engineering Design of Structures by John A. Purkiss.
- Offshore Engineering: An Introduction by Srinivasan Chandrasekaran.
- Handbook of Offshore Engineering by SubrataChakrabarti.
- Environmental Engineering and Management by Suresh K. Dhameja, S.K. Kataria& Sons.
- Environmental Impact Assessment: Methodologies by Y. Anjaneyulu and ValliManickam, B.S. Publications.
- Industrial Safety and Environment by Amit Gupta, University Science Press.
- Industrial Safety and Environment by A. Prashar, P.Bansal, Kataria Press.
- Process Safety Management and Risk Hazard Analysis by Srinivasan Chandrasekaran, CRC Press.
- Fire and Explosion Protection Engineering Principles by Dennis P. Nolan, CRC Press.

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Introduction of offshore structures	https://youtu.be/pyvR3uN1nRQ	NPTEL (IIT Madras)
	Fixed offshore platform	https://youtu.be/Q4ptPBcKtiM	NPTEL (IIT Madras)
	Wave load on off shore structure	https://youtu.be/r7XVuxkTi80	NPTEL (IIT Madras)
Unit-II	Dynamics of offshore structures	https://nptel.ac.in/courses/114106038?utm	NPTEL (IIT Madras)
	Shear center	https://youtu.be/UexSV-vDS98	NPTEL (IIT Madras)
Unit-III	Offshore fire safety	https://youtu.be/n6HAyxdup_U	NPTEL (IIT Delhi)
Unit-IV	Fire resistance steel	https://youtu.be/uOegFI_jNEc	NPTEL (IIT Delhi)

Course Code	PEC-FT-323A				
Category	Professional Elective Courses				
Course Title	Fire Service Communication and Mobilizing				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce students to the organization, layout and operational requirements of fire service control rooms, watch rooms and fire stations. • To develop understanding of the roles, responsibilities and communication procedures associated with fire service personnel and emergency response systems. • To familiarize students with equipment, signaling systems and call handling arrangements used in fire control and mobilization systems. • To provide knowledge of testing procedures, standby arrangements and radio communication systems used in fire service operations.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the terminology related to fire service organization, communication systems, emergency call handling, and wireless communication.	Level 1: Remember
CO2	Explain the principles of fire service control rooms, communication systems, call handling procedures, and wireless communication.	Level 2: Understand
CO3	Apply fire service communication, mobilization, and emergency response procedures for effective fire service operations.	Level 3: Apply
CO4	Analyze fire service communication systems and operational procedures to improve emergency response efficiency.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Fire Service Control Room and Watch Room: Introduction, Control rooms, General requirements and considerations-. General requirements, Centralization problems, Administrative system implications, Safeguard against breakdown, Watch rooms, The station ground, The turn out area, The telephone call area.

Roles and Responsibilities of Fire Personnel: Introduction to the fire department, Roles and responsibilities of fire personnel.

Unit-II

Equipment In Control Room, Watch Room, and Fire Stations: Automatic fire alarm system terminations, Fire telephone, Running call facilities, Enquiry bell, Station bells, Firemen's call bell systems, Public address system, Tele printer, Turn out lighting, Alternative lighting, Control of traffic light, Automatic appliance starter, Appliance room door control, Exchange telephone lines and switchboards, Key and lamp units, Private telephone circuit, Priority signaling facilities, Appliance turn out indicator lights, Radio apparatus, Clock and calendar, Tape recorder, Control room consoles, Maps and diagrams, Availability and fire situation displays, Records – log book, occurrence book, First attendance and other mobilizing data, Route and special risk cards, General information, Microfilm systems.

Unit-III

Fire Call Handling Procedures: General principles calls by exchange telephone, Running calls, Fire telephones and other private circuits, Automatic fire detection system, Calls received from various radio systems, Part time station arrangements, Salutations.

Call-Out Systems: Firemen's call bell system, Fire sirens – siren installations, Maintenance and testing, War emergency use, Radio pocket alerting system – General description, The transmitter, The pocket alerter, The home battery charger, Alerter transmitter battery chargers, Public address call out systems, Methods of controlling call out systems – Local control, Remote control.

Unit-IV

Testing, Fault Reporting and Alternative Arrangements: Testing arrangements, Fault reporting and alternative arrangements, Fusing and identification of electrical circuits, Standby power arrangements.

Radios And Wireless Communication: Frequency spectrum, Characteristics, Selection, and Allocation, Types of radio scheme, Mobile radio equipment, Transportable and personal sets, Personal paging system, “figaro” low frequency communication systems, Hazards attending the use of radio equipment in flammable atmosphere or in the vicinity of explosives.

Suggested Readings:

- Manual of Firemanship.
- HMSO Fire Service Manual Fire Service Communication and Mobilizing (Volume 1).
- Relevant NFPA Manual and IS code

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Introduction Fire Service Control Room	https://youtu.be/8QIny3MFXzI?si=D83353CbM6-IVS_g	NPTEL (IIT Delhi)
Unit-II	Records in Fire Stations	https://youtu.be/mKecK1byRk8?si=iMHbRqtRg3KuRNgf	NPTEL (IIT Delhi)
Unit-III	Fire call Handling Procedures	https://youtu.be/9_LvrgKEncM?si=1QuHdL23oFJY93ht	NPTEL (IIT Delhi)
Unit-IV	Testing, Fault Reporting	https://youtu.be/TNCyIw9JC6k?si=G4zml-7wtVBZS4CT	NPTEL (IIT Hy.)
	Radios and Wireless Communication	https://youtu.be/F3slBe2r8vA?si=1Oo7YJ4Fww4I6h0K	NPTEL (IIT Kanpur)

Course Code	PEC-FT-325A				
Category	Professional Elective Courses				
Course Title	Fire and Life Safety Audit				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce students to the principles, procedures and statutory requirements associated with fire and life safety audits. • To develop understanding of audit standards, quality assurance systems and documentation practices used in fire safety management. • To familiarize students with fire safety planning, organizational responsibilities and emergency management practices in industrial and commercial occupancies. • To provide knowledge of evaluation, monitoring and continual improvement techniques for effective fire safety performance management.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the terminology, standards, procedures, and documentation related to fire and life safety audits.	Level 1: Remember
CO2	Explain the principles of fire and life safety auditing, fire safety management, and performance evaluation.	Level 2: Understand
CO3	Apply fire and life safety audit procedures, standards, and management practices to evaluate fire safety compliance.	Level 3: Apply
CO4	Analyze fire safety performance, audit findings, and corrective actions to improve fire and life safety management.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Fire & Life Safety Audit Fundamentals: Introduction, objectives and need of fire and life safety audit, types of audits and inspections, legal and statutory requirements for fire safety audit, audit planning and methodology, pre-audit preparation, collection and verification of information, site inspection and cross verification, identification of non-compliance, audit documentation, preparation and submission of audit report, recommendations and corrective actions, advantages and limitations of fire and life safety audit, opening and closing meetings.

Unit-II

Audit Standards and Quality Assurance: Types of audits, components of fire and life safety audit, audit model and audit process, audit checklist and documentation, non-conformity reporting (NCR), fire load calculation and occupancy classification, reports from government agencies, consultants and experts, analysis of fire and property damage records, implementation of audit recommendations and corrective actions, organizational responsibilities for fire safety, audit report and action planning, standardization and quality assurance, overview of NBCS 2026 fire and life safety provisions, IS 14489:2018, ISO 9001, ISO 14001, ISO 45001, OISD standards, TAC guidelines, checklist for fire safety audit and inspection.

Unit-III

Fire Safety Management and Planning: Fire safety policy, scope and objectives of fire safety management, fire prevention strategies, organizational structure, roles and responsibilities, stakeholder consultation and participation, legal and regulatory compliance, provision of resources and support, leadership and commitment, management of change, fire safety training and competency requirements, emergency response planning, evacuation procedures, assembly points, mock drills, permit-to-work systems, emergency incident planning and post-incident management.

Unit-IV

Evaluation, Monitoring and Review: Workplace fire safety inspection, evaluation of compliance with fire safety legislation and standards, fire incident and near miss reporting and investigation, fire loss and damage analysis, performance monitoring indicators, internal fire safety audits, corrective and preventive actions, continual improvement techniques, management review, documentation and record keeping, review of fire safety performance and audit effectiveness.

Suggested Readings:

- Fundamentals of fire safety in building design by Dr. Than Singh Sharma, Aayush Publications.
- Essentials of Building Life and Fire Safety by Virendra Kumar Paul, COPAL Publishing Group.
- Fire Safety in Buildings by V. K. Jain, New Age International Publishers.
- National Building Construction Standards, 2026 by BIS New Delhi, India
- Occupational Health and Safety management by Chales D. Reese, Taylor & Francis Group.
- A Hand Book of Fire Technology by R.S. Gupta, Universities Press (India) Pvt. Ltd.
- Manual of Fire Safety by N. Sesha Prakash, CBS Publishers.

Course Code	PCC-FT-302A				
Category	Professional Core Courses				
Course Title	Fire Testing				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce students to the objectives, standards, instrumentation and reporting procedures associated with fire testing practices. • To impart knowledge of the fire performance, combustion behavior and testing characteristics of different engineering materials. • To develop understanding of fire resistance evaluation methods for structural elements and passive fire protection systems. • To acquaint students with performance testing, inspection and quality assurance practices related to fire detection and fire suppression systems.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the principles, standards, terminology and testing methods associated with fire testing and evaluation procedures.	Level 1: Remember
CO2	Explain the fire behavior, combustion characteristics and performance evaluation of materials, structural elements and fire protection systems under fire conditions.	Level 2: Understand
CO3	Apply fire testing concepts and standard procedures for interpretation, inspection and performance assessment of fire protection materials and systems.	Level 3: Apply
CO4	Analyze fire test results, fire resistance performance and reliability of materials, structural assemblies and fire protection systems for safety evaluation.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Fundamentals of Fire Testing and Fire Test Standards: Objectives and significance of fire testing, Classification of fire tests, Reaction-to-fire and fire resistance tests, Standard fire exposure curves, Overview of BIS, ASTM, ISO, NFPA and UL fire testing standards, Laboratory instrumentation and measurement techniques, Sample preparation methods, Calibration procedures, Repeatability and reproducibility in fire testing, Fire test reporting and interpretation.

Unit–II

Fire Testing of Materials: Combustibility and non-combustibility tests, Flammability tests, Flame spread tests, limiting oxygen index test, Smoke density measurement, Toxic gas emission analysis, Heat release rate measurement using cone calorimeter, Fire testing of wood, Plastics, Rubber, Textiles, Cables and composite materials, Evaluation of thermal degradation and combustion characteristics of materials.

Unit–III

Structural Fire Resistance Testing: Fire resistance and fire endurance concepts, Furnace testing methods, Fire resistance rating, Testing of steel, Reinforced concrete and timber structural elements, Testing of fire doors, Fire walls and fire partitions, Temperature-time curves for structural fire testing, Passive fire protection systems and their evaluation, Interpretation of structural fire test results.

Unit–IV

Fire Testing of Detection and Suppression Systems: Performance testing of smoke, Heat and flame detectors, Testing and evaluation of fire alarm systems, Sprinkler discharge and performance testing, Testing of portable fire extinguishers, Foam quality and foam system performance tests, Fire testing of electrical cables and insulation systems, Quality assurance in fire testing laboratories, Inspection, Testing and maintenance practices for fire protection systems.

Suggested Readings:

- Fire Safety in Buildings by V.K. Jain, New Age International Publishers
- Fire Safety in Building by Dr. Than Singh Sharma
- Manual of Fire Safety by N Sesha Prakash, CBS Publishers and Distributors
- Fire Protection and Prevention: The Essential Handbook Volume 1 & 2 by B.M. Sen, UBS Publishers
- National Building Construction Standard 2026 by Bureau of Indian Standards (BIS)
- An Introduction to Fire Dynamics by Dougal Drysdale, Wiley
- Fire Protection Handbook by Arthur E. Cote, National Fire Protection Association (NFPA)
- SFPE Handbook of Fire Protection Engineering by Morgan J. Hurley, Springer
- ASTM Standards on Fire Testing of Materials and Structures by ASTM International
- NFPA Codes and Standards by National Fire Protection Association (NFPA)
- Enclosure Fire Dynamics by Björn Karlsson and James G. Quintiere, CRC Press
- Fire from First Principles: A Design Guide to Fire Safety Engineering by Paul Stollard and John Abrahams, Routledge

Course Code	PCC-FT-304A				
Category	Professional Core Courses				
Course Title	Fire Appliances and Rescue Equipments				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Objectives	The objectives of this course are • To make the students familiar with different types of fire appliances, firefighting vehicles, fire pumps and associated operational systems used in fire services. • To develop the understanding of students regarding firefighting equipment, rescue tools, ladders, ropes and operational safety procedures used during emergency response. • To familiarize the students with rescue operations, casualty handling methods, incident command systems and personal protective equipment used in fire and rescue services. • To make the students learn about specialized rescue systems, modern firefighting technologies and advanced emergency response equipment used in contemporary fire services.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the terminology related to fire appliances, rescue equipment, personal protective equipment and modern firefighting technologies.	Level 1: Remember
CO2	Explain the principles, functions, and operational features of fire appliances, rescue equipment, personal protective equipment and modern firefighting technologies.	Level 2: Understand
CO3	Apply fire appliances, rescue equipment, personal protective equipment and rescue techniques in emergency response operations.	Level 3: Apply
CO4	Analyze the suitability and performance of fire appliances, rescue systems and modern firefighting technologies for different emergency scenarios.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Fire Appliances and Firefighting Vehicles: Introduction to Fire Appliances, Classification of Fire Appliances, Functional Requirements of Fire Appliances, Fire Tender Chassis and Vehicle Design, Water

Tender, Foam Tender, Multipurpose Tender, Crash Fire Tender, Rescue Tender, Hose Laying Tender and Control Van, Fire Pumps and Priming Systems, Midship and PTO Pump Configurations, Hose Reels and Hose Management Systems, Water and Foam Monitors, Vehicle Stability and Load Distribution, Technical Specifications of Fire Appliances, Preventive Maintenance and Inspection Procedures.

Unit-II

Firefighting Equipment and Rescue Tools: Portable Fire Extinguishers and their Applications, Hydraulic Rescue Equipment, Hydraulic Cutters, Spreaders, Rams and Combi Tools, Pneumatic Rescue Equipment, Air Lifting Bags and Jacks, Electric Power Tools, Electric Cutters, Electric Saws and Chain Saws, Portable Lighting Systems and Power Sources, Ladders and Ladder Appliances, Extension Ladders, Hook Ladders, Turntable Ladders and Snorkels, Ropes and Lines Used in Fire Services, Knots, Hitches and Their Applications, Testing and Safety Procedures of Rescue Equipment.

Unit-III

Rescue Operations: Principles of Rescue Operations, Search and Rescue Techniques, Rescue Planning and Operational Safety, Casualty Handling Methods, One Rescuer and Two Rescuer Techniques, Multi Rescuer Techniques, Stretchers and Casualty Transportation Methods, Rescue from Fire Incidents and High-Rise Buildings, Rescue During Earthquakes, Floods and Other Disasters, Incident Command System (ICS) in Rescue Operations,

Personal Protective Equipments: Personal Protective Equipment (PPE), Safety Belts and Harnesses, Breathing Apparatus and Associated Equipment, Oxygen Breathing Apparatus, Compressed Air Breathing Apparatus, BA Control Systems and Cylinder Management, Gas Masks and Respirators, Airline and Filter Type Respirators.

Unit-IV

Specialized Rescue Systems and Modern Firefighting Technologies: SCUBA and Water Rescue Equipment, HAZMAT Rescue Equipment, Emergency Rescue Tender (ERT), HAZMAT Van and Decontamination Systems, Robotics in Firefighting and Rescue Operations, Drones in Fire and Rescue Services, Thermal Imaging Systems, Ultra High Pressure Systems (UHPS), Compressed Air Foam Systems (CAFS), Communication and Monitoring Systems in Emergency Response, Smart Fire Appliances and Sensor Networks, Artificial Intelligence in Fire and Rescue Operations, Recent Developments in Firefighting and Rescue Technologies.

Suggested Readings:

- Fire Safety in Buildings by V.K. Jain, New Age International Publishers
- Safety Management by R.K. Mishra, AITBS Publishers
- Manual of Fire Safety by N Sesha Prakash, CBS Publishers and Distributors
- Fire Protection and Prevention: The Essential Handbook Volume 1 & 2 by B.M. Sen, UBS Publishers
- National Building Construction Standard by Bureau of Indian Standards, New Delhi
- Related IS Codes, Standards and NFPA Manual

Course Code	PCC-FT-306A				
Category	Professional Core Courses				
Course Title	Automobile Engineering Safety				
Scheme and Credits	L	T	P	Credits	Semester-VI
	2	0	0	2	
Course Objectives	The objectives of this course are • To introduce students to the construction, classification and working principles of automobile engines and associated fuel systems. • To develop understanding of transmission, braking, suspension, steering and electrical systems used in automobiles. • To familiarize students with lubrication, cooling, pollution control techniques and modern developments in electric and hybrid vehicles. • To provide knowledge of fire fighting vehicles, automobile safety devices and relevant rules, regulations and standards related to automotive systems.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the terminology related to automobile systems, fire service vehicles, hybrid vehicles, and safety regulations.	Level 1: Remember
CO2	Explain the principles of automobile systems, transmission, steering, suspension, electrical systems, fire service vehicles, and safety standards.	Level 2: Understand
CO3	Apply the principles of automobile systems and safety regulations in the operation and maintenance of fire service vehicles.	Level 3: Apply
CO4	Analyze the performance of automobile systems and fire service vehicles to enhance operational safety and efficiency.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Introduction: Automobiles, Types of automobiles, Various systems in automobiles, Engine classification, Construction, Details of engine components, Combustion in S.I. engines, Combustion in C.I. engines, Study of fuel system components, Function of carburetors, Construction details, Diesel fuel feed systems, Carburetion and mass distribution of mixture, Supercharging, Fuel injection and injection sections.

Unit II

Transmission System: Components of transmission system, PTO.

Clutch: Types, Construction, Operation and fault finding of clutches.

Gear Box: Types of gear box, Functions of gear box, Operation and maintenance of gear box.

Differential: Necessity, Construction of differential systems, Axles, Types and application.

Brakes: Types, Construction and operation of hydraulic, Pneumatic brake systems, Maintenance of brakes, Wheels and tyres.

Unit-III

Suspension: Necessity, Types, Construction and operation, Shock absorber, Coil springs, Independent suspension.

Steering System: Constructional details, Types of steering gear box, Steering geometry, Caster, Camber, King pin inclination, Effect of steering geometry on directional stability, Power steering.

Electrical System: Ignition systems, Magnet ignition, Battery ignition, Electronic ignition, Merits and demerits, Working, Self-starter, Dynamo voltage regulator, Battery construction, Operation and maintenance, Pollution, Air pollution, Euro norms, Pollution control techniques.

Lubricating System: Types, Components, Lubricating oil, Cooling system.

Unit-IV

Introduction to Electric and Hybrid Vehicles: Invention of hybrid automobile, Key features of hybrid automobile, Early hybrid vehicles, Woods gas-electric car, Hybrid automobiles.

Fire Fighting Vehicles

Fire Bikes: Construction & operation of fire bikes.

Tenders: Construction & operation of fire tenders and trucks.

Fire Boats: Construction & operation of fire boats & other water borne applications.

Rules and Regulations: CMV rules regarding safety devices for drivers, Passengers, Rules & regulations of RTO, Laboratory testing of vehicles, Road testing of vehicles, Automobile safety devices.

I.S. Codes: 15682, 15702, 15715, 15718, 15721, 15811, 15355, 19026, 19032.

Suggested Readings:

- Automobile Engineering Vol.I & II, Kirpal Singh, Standard Publishers.
- Automobile Engineering Vol.I, II & III, P.S. Gill, Kataria and Sons.
- Automobile Engineering, R. K. Rajput, Laxmi Publications.
- Automobile Engineering, R. B. Gupta, Satya Prakashan New Delhi.
- Automobile Engineering, Ramakrishna, PHI Learning Pvt. Ltd.
- Automobile Engineering, K. K. Jain, R. B. Asthana, Tata Mc Graw Hill.
- Automobile Mechanics, Crause, W. H., Tata McGraw Hill.
- Automotive Mechanics, Joseph Heitner, East West Press.
- Course in Automobile Engineering, Sharma R. P, Dhanpat Rai and Sons
- Automotive Engines, Srinivasan S., Tata McGraw Hill.
- Motor Vehicle Technology, J.A. Dolan, Heinemann Educational Books.

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Introduction to Automobile	https://youtu.be/H_RgFXjg-5s?si=yvCwREZctTNUVkoQ	NPTEL (IIT Madras)
	Vehicle Dimensions Engines	https://youtu.be/2b0YaDrdO1I?si=PQAU2EXqdeUcYEz4	NPTEL (IIT Madras)
Unit-II	Power Transmission System	https://youtu.be/0UhDnbsTuU8?si=vHC7cz_5xI80-qoA	NPTEL (IIT Madras)
	Wheels and Tyres	https://youtu.be/fVmBXtSKDw8?si=rtLK8GmGBTLxolhT	NPTEL (IIT Madras)
	Brakes	https://youtu.be/k3SeZgZWlqM?si=K-JySea_7QiE8gdB	NPTEL (IIT Madras)
Unit-III	Lubricating System	https://youtu.be/AGm2QSxYsVA?si=S7NWKIahRjB54CX7	NPTEL (IIT Guwahati)
	Steering Systems	https://youtu.be/HQr343nWLul?si=I-CK4i-YXvjSJIO6	NPTEL (IIT Madras)
Unit-IV	Introduction to Electric and Hybrid Vehicles	https://youtu.be/_xM7X8k9g0s?si=nw2zatZCDZT5ULw9	NPTEL (IIT Kanpur)

Course Code	HSMC-FT-308A				
Category	Humanities and Social Sciences including Management courses				
Course Title	Energy Environment Ethics and Society				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Objectives	The objectives of this course are • To make the students familiar with conventional and renewable energy resources, global energy scenarios, environmental challenges, and sustainable energy solutions. • To develop the understanding of students regarding the interaction between society, environment, population growth, technology, and environmental management practices. • To familiarize the students with ecosystem structure, biodiversity, environmental sustainability concepts, lifecycle assessment, environmental ethics, and international environmental standards. • To make the students learn ethical principles, professional ethics, moral values, organizational culture, and codes of ethics relevant to engineering and professional practices.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the terminology related to energy, environment, ecosystems, sustainability, and professional ethics.	Level 1: Remember
CO2	Explain the principles of energy resources, environmental systems, sustainable development, and ethical practices.	Level 2: Understand
CO3	Apply sustainability principles, environmental assessment methods, and ethical practices to engineering problems.	Level 3: Apply
CO4	Analyze the interrelationship between energy, environment, sustainability, and professional ethics in engineering applications.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Energy Linkage with Development: World energy scenario, Fossil fuel resource- estimates and duration, India's energy scenario, Finite/ depleting energy resources, Coal, Oil, Gas, Nuclear fission, Promises and present status of nuclear fusion energy, Renewable energy, Solar, Hydro, Wind, Biomass, Ocean, Tidal, Wave and geothermal, Synergy between energy and environment, Global environment issues, Greenhouse gas emission, Global warming, Green energy solutions.

Unit-II

Society and environment: Exponential growth in population, Environment and optimum sustainable population, Free access resources and the tragedy of commons, Environment problems and impact of P.A.T (Population, Affluence and Technology), Environmentally beneficial and harmful technologies, Environment impact assessment policies and auditing, Interaction between environment, Life support systems and socio-culture system.

Unit-III

Ecosystem: Definition, Concepts, Structure, Realm of ecology, Lithosphere, Hydrosphere, Biosphere, Atmosphere, Energy balance to earth, Matter and nutrient recycling in ecosystems, Nitrogen, Oxygen, Carbon and water cycles, Food producers, Consumers and decomposers, Food chains, Biodiversity, Threat and conservation of biodiversity, Environmentally sustainable economic growth, Introduction to design for environment (DFE), Product lifecycle assessment for environment and ISO 14000, Triple bottom-line of economic, Environment and social performance, Environmental ethics, Its world impact and challenges.

Unit-IV

Ethics and Moral Values: Ethical situations, Objectives of ethics and its study, Role morality and conflicts, Values, Policies and organization Culture, Non-professional, Quasi- and hard professionals, Preventive, Personal, Common and professional ethics, Different ethical value criteria like utilitarian, Virtue, Right and duty ethics with discussion on the case of priority for improvement of urban (high traffic) or rural (low traffic) intersections causing equal number of fatalities, Codes of ethics and their limitations, Institute of engineers code for corporate member, IEEE and ACM professional-code.

Suggested Readings:

- A Textbook of Energy, Environment, Ethics and Society by H. K. Gupta and K. Gupta, Laxmi Publications Private Limited.
- Principles of Energy, Environment, Ethics and Society by R. Sivakumar and Vijay Nicole Pvt. Ltd.
- Energy, Environment Ecology & Society by D. K. Gupta and D. Gupta, Dhanpat Rai & Co. (P) Ltd
- Energy and Environment Management by R. Jain and A. Gupta, CBS Publishers.
- Energy and Environment in India: A Study of Energy Management by K.C. Gupta, Gyan Publishing House.
- Professional ethics in engineering by V Jayakumar, Lakshmi Publications
- Professional ethics - for engineers by D. G. Harkut and G.R. Bamnote, Notion press books.
- Environmental Engineering by M. P. Poonia, S.C. Sharma and S. Kumar, Khanna Book Publishing
- Environmental Issues in India by Ragarajan, Pearson India Publisher.
- Textbook of Environmental Engineering by P.V. Rao, PHI Learning Pvt Ltd

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Environment and development	https://youtu.be/moZIHBSp5fM?list=PLwdnzlV3og_oXmzczhk-7vTPBxBMhz56Hx	NPTEL (IIT Guwahati)
	Solar energy utilization methods	https://youtu.be/UHOZeiKgGAK	NPTEL (IIT Guwahati)
	Climate change and green house	https://youtu.be/iJDpJ3ODvVw	NPTEL (IIT Kanpur)
Unit-II	Ecology and environment	https://youtu.be/47Wtk0sGOng?list=PLyqSpQzTE6M_vO7rLpxKZWqai4uJP2bDa	NPTEL (IIT Madras)

	Environment Impact assessment	https://youtu.be/9-MEVIXr3Ko?list=PLLy_2iUCG87CkrNdXME16BCptwGx1fl67	NPTEL (IIT Roorkee)
Unit-III	Ecology and environment	https://youtu.be/ib97cb6rNBg	NPTEL (IIT Madras)
	Biodiversity	https://youtu.be/SHxAOoxhKTA	NPTEL (IIT Kanpur)
	EIA and life cycle assessment	https://youtu.be/sOdmK34gn3c	NPTEL (IIT Madras)
Unit-IV	Engineering ethics	https://youtu.be/EVWcuFXeSgk?list=PLbRMhDVUMngdL7ofhT7uH9_XBk4-2qsIL	NPTEL (IIT Kharagpur)
	Ethical Theories	https://youtu.be/HtOlPvsu7CE	NPTEL (IIT Kharagpur)

Course Code	LC-FT-310A				
Category	Professional Core Courses				
Course Title	Fire Testing Lab				
Scheme and Credits	L	T	P	Credits	Semester-VI
	0	0	2	1	
Course Objectives	The objectives of this course are • To impart practical knowledge of fire testing procedures and standard methods used for evaluation of combustible and structural materials. • To develop experimental understanding of flammability, flame spread, smoke generation and heat release behavior of materials under fire conditions. • To acquaint students with fire resistance assessment techniques for structural components, fire doors and electrical insulation systems. • To provide hands-on exposure to testing, calibration and performance evaluation of fire detection and firefighting equipment.				
Assessment	25 Marks				
End Semester Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Conduct flammability, limiting oxygen index, flame spread and smoke density tests on combustible and building materials using standard fire testing procedures.	Level 3: Apply
CO2	Determine the heat release characteristics and fire resistance performance of structural, insulation and electrical materials through laboratory fire testing methods.	Level 3: Apply
CO3	Test and calibrate fire detection and firefighting equipment for evaluation of operational and discharge performance characteristics.	Level 3: Apply
CO4	Evaluate the fire performance and resistance characteristics of materials, structural elements and fire protection equipment based on experimental observations and test results.	Level 4: Analyze

List of Experiments:

Sr. No.	Contents
1	To conduct horizontal and vertical flammability tests on combustible materials.
2	To determine the limiting oxygen index (LOI) of solid combustible materials.
3	To conduct flame spread test on building materials.
4	To measure smoke density generated from combustible materials.

5	To determine the heat release rate of materials using cone calorimeter.
6	To conduct fire resistance test on steel structural specimens.
7	To conduct fire resistance test on RCC structural elements.
8	To evaluate the fire integrity and insulation performance of fire doors.
9	To conduct fire resistance test on electrical cables and insulation materials.
10	To test and calibrate smoke detectors.
11	To determine the foam expansion ratio and drainage time of firefighting foam.
12	To evaluate the performance and discharge characteristics of portable fire extinguishers.

At least 8 experiments to be studied/performed from the above list and other experiments can be studied/performed depending upon the scope of course as decided by the department.

Course Code	LC-FT-312A				
Category	Professional Core Courses				
Course Title	Automobile Safety Lab				
Scheme and Credits	L	T	P	Credits	Semester-VI
	0	0	2	1	
Course Objectives	The objectives of this course are • To provide practical knowledge of automobile engine systems, fuel systems and vehicle subsystems with emphasis on operational safety and hazard prevention. • To develop understanding of transmission, steering, suspension and braking systems used for vehicle stability and safe operation. • To familiarize students with automotive safety devices, intelligent vehicle safety technologies and accident prevention systems. • To provide hands-on exposure to emission control technologies, vehicle safety inspection procedures and safety systems in electric and hybrid vehicles.				
Assessment	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Explain the construction, working and safety aspects of automobile engines, ignition systems and fuel systems.	Level 2: Understand
CO2	Discuss the operation and safety features of transmission, suspension and steering systems used in automobiles.	Level 2: Understand
CO3	Apply automotive safety principles for understanding braking systems, stability systems and passenger protection systems.	Level 3: Apply
CO4	Analyze the performance and safety aspects of emission control systems and electric and hybrid vehicle safety systems.	Level 4: Analyze

List of Experiments

Sr. No.	Contents
1	To study the constructional details, working principles, operational safety, and hazard prevention methods in multi-cylinder petrol and diesel engines.
2	To study the role of cooling and lubrication systems in preventing overheating, frictional wear, fire hazards, and engine failure.
3	To study the safe operation and functioning of engine starting systems, contact point ignition systems, and electronic ignition systems.
4	To study the construction, working principles, and safety aspects of carburetors, diesel fuel injection systems, and gasoline fuel injection systems.
5	To study the constructional details, working principles, and safe operation of coil spring clutch, diaphragm spring clutch, and double disc clutch systems.
6	To study the operation and safety features of synchromesh gearbox, transaxle with dual-speed range, four-wheel drive systems, and transfer cases.

7	To study rear-wheel drive, front-wheel drive, differentials, drive axles, and four-wheel drive systems with emphasis on stability and safe torque transmission.
8	To study front and rear suspension systems and their role in ride comfort, vehicle stability, vibration reduction, and accident prevention.
9	To study manual steering, rack and pinion steering, power steering systems, tilt and telescopic steering wheels, and collapsible steering columns.
10	To study various types of bias-ply tyres, radial tyres, wheel constructions, wheel balancing, and tyre safety parameters.
11	To study the construction, operation, and safety aspects of hydraulic and pneumatic braking systems.
12	To study the working principles, efficiency, and operational safety of drum brake and disc brake systems.
13	To study the operation and safety features of ABS, parking brake systems, and auxiliary braking systems.
14	To study seat belts, airbags, headrests, crumple zones, side-impact protection systems, and child safety features.
15	To study traction control systems (TCS), electronic stability control (ESC), lane departure warning systems, adaptive cruise control, and collision avoidance systems.
16	To study emission control technologies such as catalytic converters, exhaust gas recirculation (EGR), evaporative emission control systems, and vehicular pollution standards.
17	To study vehicle safety inspection procedures, lighting systems, warning devices, mirrors, and accident prevention measures.
18	To study battery safety, electrical isolation systems, thermal runaway prevention, charging safety, and emergency shutdown systems in electric and hybrid vehicles.

Note:At least 10 experiments to be performed from the above list and other experiment can be performed depending upon the scope of course as decided by the department.

Course Code	LC-FT-314A				
Category	Professional Core Courses				
Course Title	Basic Computer Skills and AutoCAD Lab				
Scheme and Credits	L	T	P	Credits	Semester-VI
	0	0	2	1	
Course Objectives	The objectives of this course are • To develop the understanding of students regarding the use of Microsoft Office tools for document preparation, spreadsheet management, data analysis, and technical presentations. • To familiarize the students with formatting, editing, graphical representation, and file management techniques using MS Word, MS Excel, and MS PowerPoint. • To make the students learn the fundamentals of AutoCAD software, drawing environment setup, and preparation of engineering drawings using standard drafting practices. • To develop the practical skills of students in creating, editing, analyzing, and presenting technical and engineering drawings using computer-based applications and drafting tools.				
Assessment	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Explain the functions and applications of Microsoft Word, Excel and PowerPoint tools used for document processing, data handling and presentation preparation.	Level 2: Understand
CO2	Apply formatting, calculation, chart creation and presentation techniques using Microsoft Office applications.	Level 3: Apply
CO3	Apply AutoCAD commands and drawing tools for creation of engineering drawings and drafting layouts.	Level 3: Apply
CO4	Analyze and prepare engineering component drawings and sectional views using AutoCAD software.	Level 4: Analyze

List of Experiments

1. To study the basics of Microsoft Word.

a) File Management:

- Opening, creating and saving a document, locating files, copying contents in some different file(s)

b) Editing a document:

- Entering text, cut, copy, paste using toolbars,
- Use of spell check
- PDF file and its conversion in different file formats (MS Word/Excel etc.)
- Scanning, editing and printing of a document

c) Formatting a document:

- Using different fonts, changing font size and colour, changing the appearance through bold/ italic/ underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods
- Aligning of text in a document, justification of document, Inserting bullets and numbering Formatting paragraph,

- Inserting page breaks and column breaks, line spacing
- Use of headers, footers, inserting footnote, end note,
- use of comments, Inserting date, time, special symbols, importing graphic images, drawing tools

d) Tables and Borders:

- Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table
- How to change docx file to doc file
- Print preview, zoom, page setup, printing options
- Using Find, Replace options

2. To study the basics of Microsoft Excel.

- Starting Excel open worksheet:** enter, edit data, formulae to calculate values, format data, create chart, printing chart, save worksheet, switching between different spreadsheets.
- Menu commands:** Create, format charts, organize, manage data, solving problem by analyzing data, creating graphs
- Work books:** Managing workbooks (create, open, close, save, rename), working in work books Editing a worksheet: copying, moving cells, pasting, inserting, deleting cells, rows, columns, find and replace text, numbers of cells, formatting worksheet
- Creating a chart:** Working with chart types, changing data in chart, formatting a chart, use chart to analyze data using a list to organize data, sorting and filtering data in list
- Formulas:** Addition, subtraction, division, multiplication, percentage and auto sum

3. To study the Microsoft Power point Presentation.

- Introduction to PowerPoint** How to start PowerPoint Working environment: concept of toolbars, slide layout, templates etc. Opening a new/existing presentation Different views for viewing slides in a presentation: normal, slide sorter etc.
- Addition, deletion and saving of slides
- Insertion of multimedia elements:** Adding text boxes, importing pictures, tables and charts etc.
- Formatting slides, Text formatting, changing slide layout, changing slide colour scheme Changing background, Applying design template
- Slide Show:** Viewing the presentation using slide navigator, Slide transition Animation effects etc.

4. To study various commands used in Auto- CAD software.

5. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing, naming layers, setting line types for different layers using various type of lines in engineering drawing, saving the file with .dwg extension.

6. Layout drawing of a building using different layer and line colors indicating all Building details.

7. To make a drawing of line, arc, circle, ellipse, triangle etc.

8. To make a drawing of a flange.

9. To make a drawing of a bushing assembly.

10. To make an isometric dimensioned drawing of a connecting rod using isometric grid and snap.

11. To make different types of bolts and nuts with internal and external threading in ACME and square threading standards.

12. To make a quarter sectional isometric view of a cotter joint.

At least 8 experiments to be performed from the above list and other experiment can be performed depending upon the scope of course as decided by department.

Course Code	LC-FT-316A				
Category	Professional Core Courses				
Course Title	Fire Ground Operations–VI (Rescue Operations)				
Scheme and Credits	L	T	P	Credits	Semester-VI
	0	0	2	1	
Course Objectives	The objectives of this course are • To develop the understanding of students regarding rescue techniques, lifting and carrying methods, knots, and emergency response procedures used in firefighting and rescue operations. • To familiarize the students with firefighting tenders, rescue tools, power tools, firefighting equipment, and personal protective equipment used during rescue and emergency operations. • To make the students learn the construction, operation, technical specifications, and practical applications of breathing apparatus sets and rescue equipment used in hazardous environments. • To develop the practical skills of students in performing rescue drills, confined space rescue, well rescue, building rescue, and emergency response operations under different accident scenarios.				
Assessment	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Explain the principles, applications, and operational procedures of rescue techniques, rescue tools, firefighting equipment, personal protective equipment, and breathing apparatus sets.	Level 2: Understand
CO2	Demonstrate lifting and carrying methods, knot practices, breathing apparatus drills, pump drills, and rescue procedures using appropriate rescue and firefighting equipment.	Level 3: Apply
CO3	Perform rescue operations in confined spaces, wells, buildings, and accident scenarios using suitable rescue tools, harness systems, and emergency response techniques.	Level 3: Apply
CO4	Analyze the operational requirements, equipment selection, and safety considerations involved in firefighting and rescue operations under different emergency conditions.	Level 4: Analyze

List of Experiments

Sr. No.	Contents
1	To practice different lift and carries.
2	To practice different types of knots using ropes.
3	To study different types of tenders (through industrial visits).
4	To study different types of Rescue tools and their applications.
5	To study different types of Power tools and their applications.
6	To study different types of Fire Fighting tools and their applications.
7	To study personal protecting equipments and their uses.
8	To study B.A. Set, its technical specifications and to perform drill using B.A. Set.
9	To study the types of B.A. Set: a) Open circuit b) Closed circuit
10	To perform rescue drill using full body harness.
11	To perform six men pump drill with pump test.
12	To perform drills on rescue from well.
13	To perform drill on rescue from confined space like tunnels.
14	To perform drills on Rescue from building.
15	To perform drills on rescue from accidents/incident.

Other drills and tests can be performed as decided by department (time to time) depending upon the scope of course.

Course Code	PEC-FT-318A				
Category	Professional Elective Courses				
Course Title	Fire Modelling				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce students to the fundamentals of fire modelling, simulation techniques and computational approaches used in fire safety engineering. • To develop understanding of numerical methods, thermodynamic principles and simulation analysis tools used in fire simulations. • To familiarize students with turbulence modelling, combustion phenomena and advanced fire dynamics simulations. • To provide knowledge of fire suppression modelling, model validation techniques and applications of fire simulations in engineering systems.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the terminology related to fire modelling, numerical methods, fire dynamics, combustion, and fire suppression.	Level 1: Remember
CO2	Explain the principles of fire simulation, numerical modelling, turbulence, combustion, and model validation.	Level 2: Understand
CO3	Apply fire modelling and numerical simulation techniques to predict fire behavior and suppression performance.	Level 3: Apply
CO4	Analyze fire simulation results and model performance to assess fire safety in engineering applications.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question no. one will have 6 parts of 2 marks each from all units and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Fundamentals of Fire Simulation and Modelling: Introduction to fire modelling and simulation, Basic model forms, Deterministic and probabilistic models, Basic simulation approaches, Handling stepped and event-based time in simulations, Discrete and continuous modelling, Numerical techniques in simulations, Sources and propagation of errors, Dynamical system simulations, Finite state simulations, Complex model simulations, Graph and network-based simulations, Actor-based simulations, Mesh-based simulations, Hybrid simulations, Introduction to parallel and distributed simulations, Data partitioning, Algorithm partitioning, Handling inter-partition dependencies, Introduction to probability and statistics for simulations, Queuing systems, Random noise, Random variate generation, Sensitivity analysis.

Unit-II

Numerical Methods and Simulation Analysis: Simulation result analysis and visualization tools, Display forms, Tables, Graphs, Multidimensional visualization techniques, User interfaces and web-based visualization tools, Validation and verification of model results, Index notation and matrix operations, Fundamentals of thermodynamics, Equation of state, Chemical and phase equilibrium, Droplet mass, Momentum and energy transfer, Taylor series expansion, Order of accuracy, Numerical time integration methods, Explicit and implicit numerical schemes, Finite difference methods, Stability restrictions, Lax equivalence theorem, Derivation of mass, Momentum and energy conservation equations, Pressure Poisson equation, Projection methods, Scalar transport schemes, Godunov's theorem.

Unit-III

Advanced Fire Dynamics and Turbulence Modelling: Time-splitting methods for source terms, Non-dimensional governing equations, Compressible and low-Mach number flow formulations, Velocity divergence constraints for low-Mach number flows, Thermal radiation modelling, Discrete ordinates method, Beer's law, Fundamentals of turbulence theory, Vortex dynamics, Kolmogorov and Batchelor theories, Energy and power spectra, Direct Numerical Simulation (DNS), Length scale requirements, Parallel computing in fire simulations, Estimation of computational cost, Reynolds Averaged Navier-Stokes (RANS) models, Turbulence modelling approaches, Statistical correlations, Large Eddy Simulation (LES), Sub-grid scale closures, Filtering techniques, Energy spectrum analysis, Nyquist limit and aliasing effects.

Unit-IV

Combustion, Fire Suppression and Model Validation: Turbulent boundary layers, Grid generation and mesh design, Mesh quality metrics, Models for mean chemical source terms, Turbulent combustion modelling, Extinction and ignition phenomena, Under-ventilated combustion, Formation of toxic products including carbon monoxide and soot, Pyrolysis, Flame spread mechanisms, Fire suppression modelling techniques, Water mist and suppression systems, Smoke movement and control, Model validation techniques, Verification procedures, Uncertainty quantification in fire modelling, Analysis of model input and output uncertainties, Applications of fire modelling in buildings, industrial facilities, and transportation systems.

Suggested Readings

- Introduction to Mathematical Fire Modeling, Second Edition By Marc L.Janssens.
- Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's
- Surface Fire Spread Model by Joe H. Scott, Robert E. Burgan.

Course Code	PEC-FT-320A					
Category	Professional Elective Courses					
Course Title	Safety Practice in Chemical and Nuclear Industries					
Scheme and Credits	L	T	P	Credits	Semester-VI	
	3	0	0	3		
Course Objectives	The objectives of this course are • To introduce students to the fundamentals of chemical process safety, industrial toxicology and occupational safety practices in chemical industries. • To develop understanding of fire, explosion and electrical hazards associated with chemical process industries and their preventive measures. • To familiarize students with process safety engineering, hazard evaluation techniques and risk assessment methodologies used in chemical plants. • To provide knowledge of nuclear safety engineering, radiation hazards and emergency preparedness measures in nuclear installations.					
Assessment	40 Marks					
End Semester Examination	60 Marks					
Total	100 Marks					
Duration of Exam	03 Hours					

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the terminology related to chemical process safety, fire and explosion hazards, risk assessment and nuclear safety.	Level 1: Remember
CO2	Explain the principles of chemical process safety, fire and explosion prevention, process risk assessment and nuclear safety systems.	Level 2: Understand
CO3	Apply process safety, fire protection, risk assessment and nuclear safety principles to industrial applications.	Level 3: Apply
CO4	Analyze chemical process hazards, fire and explosion risks and nuclear safety systems to recommend appropriate control measures.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Fundamentals of Chemical Process Safety: Introduction to chemical process industries, Major chemical and oil industry disasters: Flixborough disaster, Seveso disaster, Mexico LPG disaster, Bhopal disaster, Phillips disaster, Chemical hazards and hazard symbols, Incompatible chemicals, Fire classification, occupational safety and health regulations, The Factories Act, personal protective equipment (PPE), Toxic substances and industrial toxicology, Classes of toxicity, Routes of exposure, Effects of toxic substances, Dose-response relationship, Threshold limit values (TLV), Exposure standards, Airborne contaminants, confined space hazards, Respiratory protection, Prevention and control measures.

Unit-II

Fire, Explosion and Electrical Hazards in Chemical Industries: Workplace hazards, Dangerous substances, Fire triangle and fire tetrahedron, Ignition sources, Static electricity, Flammable and combustible liquids, Flash point, Flammability limits, Limiting oxygen concentration (LOC), Flammability diagrams, Explosion phenomena: BLEVE, Vapor cloud explosion (VCE), Detonation and deflagration, Electrical hazards, Causes and effects of electric shock, Path of electric current, Sources of electrostatic discharge, Grounding and bonding, Control of static electricity, Electrical hazard reduction techniques.

Unit-III

Process Safety Engineering and Risk Assessment: Decomposition and runaway reactions, Initiating factors, reactive chemical hazards, Thermal explosion hazards, Process hazard evaluation techniques, Process flow diagrams (PFD), Piping and instrumentation diagrams (P&ID), Process control systems, Alarms and interlocks, Chemical plant layout, Passive and active fire protection systems, Emergency shutdown systems, Safety integrity level (SIL), Inherent safety techniques, Hazard identification and risk assessment, HAZOP, Dow Fire and Explosion Index, Reliability concepts, Fault tree analysis (FTA), Event tree analysis (ETA), case studies: T2 Laboratories, Florida Synthon, North Carolina incident, Phenol-formaldehyde reaction.

Unit-IV

Nuclear Safety Engineering: Comparison of coal and nuclear power plants, Indian nuclear power scenario, three-stage nuclear power program, Nuclear fuels and fuel cycle, Types of nuclear reactors, Environmental aspects of nuclear power, Radiation and radiation hazards, Radiation protection principles, Defense in depth, multiple barrier concept, Reactor shutdown systems, Emergency core cooling systems, Passive safety systems, Sodium leak and fire protection, Design basis and beyond design basis accidents, Nuclear power plant licensing, PHWR, CANDU and FBR safety features, International Nuclear and Radiological Event Scale (INES).

Major Nuclear Accidents: Chernobyl and Fukushima, Risk management and emergency preparedness in nuclear installations.

Suggested Readings:

- Chemical Process Safety: Fundamentals with Applications by Daniel A. Crowl and Joseph F. Louvar, Prentice Hall, Sterling book House
- Industrial Safety and Health Management by R.K. Jain, Sunil S. Rao, Khanna Publications.
- Safety Management, 1st Edition by R.K. Mishra, AITBS Publisher India.
- Fundamental of industrial safety and health by KU Mistry, Shyamraj Global Commerce.
- Industrial Safety Management by Pravin M. Pathak, Jayant P. Khairnar, Notion Press.
- Principles of Industrial Safety Management: Understanding the Ws of Safety at Work by Akhil Kumar Das, PHI Learning
- Industrial Safety Management by Naseer Elahi, Kalpaz Publications.
- Safety Management System and Documentation Training Programme Handbook (Pb 2019) by SV Paul, CBS Publication.
- Safety, Occupational Health and Environmental Management in Construction by S.C.Sharma, Vinit Kumar, Khanna Publishers.
- Industrial Safety and Maintenance Management by M.P. Poonia, S.C. Sharma, P. Sojan Lal, Khanna Publishing House, New Delhi
- A Handbook On Industrial Safety and Fire Management by Ravi Kant Pandey, ChetanPrakashan

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Chemical industry accident	https://youtu.be/VhuZ6M7a8N8	NPTEL (IIT Kharagpur)
	Chemical hazard	https://youtu.be/n1s1UB80JgA	NPTEL (IIT Kharagpur)
	PPE confined space safety	https://youtu.be/WxyfKNQkj8g?list=PLp6ek2hDcoNCd093zjHjuo4Lu_pIr3rFr	NPTEL (IIT Delhi)
Unit-II	Fire triangles	https://youtu.be/eLeZ2zc2hgI	NPTEL (IIT Madras)
	Flammability and flash point	https://youtu.be/6btv5t8DXYU	NPTEL (IIT Roorkee)
Unit-III	Thermal explosion	https://youtu.be/O_FWY7vIAzs	NPTEL (IIT Madras)
	Runway: explosion at T2 laboratory	https://youtu.be/C561PCq5E1g	NPTEL (IIT Madras)
	Industrial safety integrity	https://youtu.be/jFDWIKayrTc	NPTEL (IIT Kharagpur)
Unit-IV	Nuclear reactor and safety	https://youtu.be/vQ5HrubRYVo?list=PLbMVogVj5nJR6nZje9ewAeZ7lvnoVV1X3	NPTEL (IIT Madras)
	Event tree analysis	https://youtu.be/ikbC5_6qTvs	NPTEL (IIT Kharagpur)

Course Code	PEC-FT-322A				
Category	Professional Elective Courses				
Course Title	Building Design and Drawing				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Objectives	The objectives of this course are • To develop the understanding of students regarding building drawing, building elements, foundations, doors, windows, staircases, roofs, trusses, and other structural components used in building construction. • To make the students familiar with NBCS–2026 provisions, building bye-laws, FAR, setbacks, architectural composition, planning principles, and building orientation. • To make the students learn building services such as water supply, drainage, electrification, ventilation, lighting, and fire safety services along with fire service layouts and arrangements. • To familiarize the students with the design and preparation of residential, commercial, and institutional building drawings including elevations, sections, ventilation, smoke ventilation, and energy efficient building concepts.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Define the terminology related to building planning, building elements, services, and fire safety drawings.	Level 1: Remember
CO2	Explain the principles of building planning, building services, fire protection systems, and building design.	Level 2: Understand
CO3	Prepare building and fire service drawings in accordance with applicable standards and functional requirements.	Level 3: Apply
CO4	Analyze building layouts and fire protection provisions to ensure safe and efficient building design.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Drawing of Building Elements: Drawing of various elements of buildings like footing, open foundation, raft, grillage, pile and well foundation, Drawing of frames of doors, windows, various types of door, window and ventilator, lintels and arches, stairs and staircases, trusses, flooring and roofs.

Unit-II

Building Planning: Provisions of National Building Construction Standards- 2026, Building bye-laws, open areas, setbacks, FAR terminology, Principles of architectural composition (i.e. unity, contrast etc.), Principles of architectural planning and orientation.

Unit-III

Building Services: Water supply, Drainage, Electrification, Ventilation, Lighting and Fire safety services.

Building Fire Services: Layout of water tank compartment, Pump house layout, Main fire pump, Stand by pump and Jockey pump arrangement, Drawings of hydrant post, Hose box, Hose reel, Dry riser, Wet riser and Down comer.

Unit-IV

Design and Drawing of Building: Design and preparation of detailed drawings of various types of building like residential, Commercial and Institutional buildings with elevation and sectional details, Functional requirements of buildings, Ventilation, Smoke ventilation and Energy efficient buildings, Introduction to perspective drawing.

Suggested Readings:

- Building Design and Drawing by Vs Limaye and Ad Pawar, Nirali Prakashan
- Building Drawing: with an integrated approach to built environment by M.G. Shah, C.M. Kale and S.Y. Patki, McGraw-Hill
- Building Services Handbook by Fred Hall & Roger Greeno, Routledge
- Building Construction by B.C. Punmia, Er. Ashok Kumar Jain & Dr. Arun Kumar Jain, Laxmi
- Fire Safety in Buildings by V.K. Jain, New Age International Private Limited

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Design of footing	https://youtu.be/8ATp13mOhvg?si=lCdLVnSfxItfd6W7	NPTEL (IIT Kharagpur)
	Design of Staircases	https://youtu.be/hxakW1miEcM?si=JnL-clKJ1CF77ggY	NPTEL (IIT Kharagpur)
Unit-II	Introduction to Planning and Scheduling	https://youtu.be/Nto1VbJSQWs?si=mggmAURIE0BN-CoP	NPTEL (IIT Kanpur)
	National Building Code 2016 Part I	https://youtu.be/Dpy40oDxtfw?si=2QRKk3TJkech6Rq5	NPTEL (IIT Madras)
	National Building Code 2016 Part II	https://youtu.be/rVasz5j-2L8?si=T-zA_1DHTT1lv6ia	NPTEL (IIT Madras)
Unit-III	Design of Water Supply System	https://youtu.be/JIKkql7yqW4?si=Wj7a_oUKZH_9NZnV	NPTEL (IIT Delhi)
	Electrification	https://youtu.be/EC72aSUGqTM?si=IpSaLI91nUn95gLB	NPTEL (IIT Delhi)
	Fire Safety: Urban Planning	https://youtu.be/eAKTwc3_ixE?si=8czptB1wtBCA0yBs	NPTEL (IIT Delhi)
Unit-IV	Perspective Drawing	https://youtu.be/xclQSPs2SQw?si=VvcDZBu8dvUtwwie	NPTEL (IIT Madras)

Course Code	PEC-FT-324A				
Category	Professional Elective Courses				
Course Title	Industrial Hygiene and Occupational Health				
Scheme and Credits	L	T	P	Credits	Semester -VI
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce students to chemical, physical and occupational hazards associated with industrial work environments. • To develop understanding of industrial ventilation, exposure assessment and occupational hygiene practices for hazard control. • To familiarize students with occupational diseases, medical surveillance systems and workplace health protection measures. • To provide knowledge of personal protective equipment, respiratory protection systems and regulatory requirements for occupational safety management.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the terminology related to industrial hygiene, occupational health, workplace hazards and personal protective equipment.	Level 1: Remember
CO2	Explain the principles of industrial hygiene, occupational health, hazard control, ergonomics and personal protective equipment.	Level 2: Understand
CO3	Apply industrial hygiene practices, hazard control measures, occupational health procedures and personal protective equipment for workplace safety.	Level 3: Apply
CO4	Analyze workplace hazards, occupational health risks and personal protective equipment requirements to recommend appropriate control measures.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Chemical Hazards: Introduction to industrial hygiene, Types of chemical hazards in industry: Dust, Gases, Fumes, Mists, Vapours and smoke. Toxicological properties of chemicals and routes of exposure, Exposure assessment and air sampling techniques, Personal and area monitoring, Threshold limit values (TLV), Permissible exposure limits (PEL) and occupational exposure standards, Effects of key industrial chemicals such as chlorine, Ammonia, and other toxic gases. Storage, Handling and transportation of hazardous chemicals, Chemical safety in process industries.

Industrial Ventilation: Principles of natural and mechanical ventilation, General and local exhaust ventilation systems, Design considerations and control of airborne contaminants.

Unit-II

Physical Hazards: Illumination and lighting standards, Thermal radiation, Ultraviolet and ionizing/non-ionizing radiation, Preventive and control measures.

Noise: Measurement techniques, Noise surveys, Noise dose, Hearing loss mechanisms and noise control methods.

Vibration: Types, Effects on human body, Hand-arm and whole-body vibration, Isolation techniques.

Thermal Stress: Heat balance, Heat stress indices, Heat disorders, Prevention and control measures.

Work physiology: Classification of workload, Human energy expenditure, Work capacity, Job–man alignment, Fatigue and recovery.

Ergonomics: Principles, Human-machine interaction, Posture analysis and methods of reducing musculoskeletal and postural strain in industry.

Unit-III

Occupational Health and Diseases: Concept of occupational health and industrial medical services, Occupational diseases- Silicosis, Asbestosis, Pneumoconiosis, Lead, Nickel, Chromium, Manganese toxicity and their effects, Occupational cancer, Occupational dermatitis and other work-related diseases: Causes, Exposure pathways and prevention strategies, Medical surveillance of workers, Occupational health centre, Health records and reporting systems, Prevention and control of occupational diseases, Occupational hygiene practices and health risk reduction strategies, Occupational disease compensation systems and legal provisions, Fundamentals of first aid and emergency medical response in industries.

Unit-IV

Non Respiratory Personal Protective Equipments: Head protection, Hearing protection, Face and eye protection, Feet protection, Body protection, Selection, Use, Inspection, Care and maintenance of personal protective equipment.

Respiratory Personal Protective Equipments: Classification of respiratory hazards, Types of respirators and breathing apparatus, Selection criteria, Usage procedures and training requirements, Selection of respirators, Care & maintenance of breathing apparatus.

Workplace safety laws and regulatory requirements related to PPE usage, Industrial safety management practices for PPE compliance and occupational risk reduction.

Suggested Readings

- Industrial Safety and Health Management by R.K. Jain, Sunil S. Rao, Khanna Publications.
- Safety Management, 1st Edition by R.K. Mishra, AITBS Publisher India.
- Fundamental of industrial safety and health by KU Mistry, Shyamraj Global Commerce.
- Industrial Safety Management by Pravin M. Pathak, Jayant P. Khairnar, Notion Press.
- Principles of Industrial Safety Management: Understanding the Ws of Safety at Work by Akhil Kumar Das, PHI Learning
- Industrial Safety Management by Naseer Elahi, Kalpaz Publications.
- Safety Management System And Documentation Training Programme Handbook (Pb 2019) by SV Paul, CBS Publication.
- Safety, Occupational Health and Environmental Management in Construction by S.C. Sharma, Vinit Kumar, Khanna Publishers.
- Industrial Safety and Maintenance Management by M.P. Poonia, S.C. Sharma, P. Sojan Lal, Khanna Publishing House, New Delhi

Course Code	PEC-FT-326A				
Category	Professional Elective Courses				
Course Title	Nuclear Reactors and Safety				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce students to nuclear reactor fundamentals, radiation principles and nuclear power generation systems. • To develop understanding of nuclear reactor safety principles, event analysis and emergency response strategies in nuclear facilities. • To familiarize students with quality assurance practices, environmental safety considerations and site evaluation criteria for nuclear installations. • To provide knowledge of nuclear safety regulations, licensing procedures and safety review practices followed in nuclear industries.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the principles of nuclear reactors, radiation behaviour, reactor components, quality, environmental safety and nuclear fuel cycle processes.	Level 1: Remember
CO2	Explain nuclear reactor safety principles, radiation protection measures, event analysis methods, emergency response procedures, nuclear safety regulation used in nuclear facilities.	Level 2: Understand
CO3	Apply quality assurance, environmental safety and regulatory concepts for evaluation of nuclear safety practices and reactor operations.	Level 3: Apply
CO4	Analyze nuclear reactor incidents, safety systems and regulatory measures for improving nuclear safety and risk management.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Nuclear Reactor Fundamentals and Radiation: Energy sources, Nuclear Power, Production, Medical and societal applications of radiation, Nuclear fuel cycle, Basic Physics of Nuclear Reactors: Atomic Structure, Isotopes, Radioactivity, Half-life, Basics of fission reaction, Moderation, Criticality, Decay heat, Reactivity and Feedback, Breeding, Nuclear Reactor Types, Components of Nuclear Reactor, Present Reactor Types, Generation IV Concepts, Radiation sources and Protection, Radiation and its units, Natural, background and man-made Radiation, Biological Effects, Exposure limits and protection, Sources of radiation, shielding.

Unit-II

Nuclear Reactor Safety and Event Analysis: Safety Principles, Safety objectives, Defence in depth philosophy, Multiple barriers, Radwaste management, Levels of defence, Redundancy, Diversity Principles, Event analysis, core inventory, Emergency response, Safety Approach, Deterministic approach – Design Basis, Events and Beyond Design Basis Events, Acceptance Criteria, Probabilistic approach – Fault tree, Event tree, Failure rates. History of Events in Nuclear reactors and facilities, INES Scale, TMI, Chernobyl, Fukushima, Windscale, Thorp Reprocessing, Kyshtym, Vandellós, Tokaimura, NRX, David Besse, Enrico Fermi, Narora Fire, Monju and FBTR Sodium Leak, Radiation over exposures in Industry and Medical applications. Analysis of Some Events in NPP, Heat transfer and Fluid flow prediction, validation, Safety set points, Safety actions for events, Spurious opening of Pressurizer valve in a PWR, LOCA analysis Indian, PHWR, Station Blackout without Reactor Trip, FBTR.

Unit-III

Quality and Environmental Safety: Quality Assurance, Quality Assurance Plan, materials, Design, Fabrication, Maintenance, Surveillance, In Service Inspection, Training & Qualification, Quality Audit. Siting of Nuclear plants, Site evaluation Stages, Site Rejection Criteria, Earthquake, Geological criteria, Meteorological considerations, Flooding, Tsunami, Shoreline erosion, chemical explosion, Radiological impact study, Radioactivity path ways to humans, environmental Impact study.

Unit-IV

Nuclear Safety Regulation: Safety Regulation in India, Atomic Energy Regulatory Board, functions, safety Documents, Safety Review of site, design, regulatory inspections, safety review for PFBR, Koodankulam, Regulatory review of operating plants, Licensing stages, licensing of operating personnel, Training simulator, safety up-gradation, Review after TMI Chernobyl, Review after Fukushima, safety review for decommissioning, Safety Review of Radiation Facilities, medical X-ray units, Gamma irradiators, Safety Practices in India.

Suggested Readings:

- Nuclear Reactor Engineering (Principles and Concepts) by G. Vaidyanathan, S. Chand & Company, New Delhi
- Elements of Nuclear Safety by Jacques Libmann, Les Editions de Physique
- Nuclear Power Reactor Safety by E. E. Lewis, John Wiley and Sons, New York
- Nuclear Safety by Gianni Petrangeli, Butterworth-Heinemann
- NPTEL Web Course on Nuclear Reactor Technology by K. S. Rajan
- Radioactive Materials by B. M. Rao, Himalaya Publishing House

Useful Video Links:

Unit No.	Topic	Link	Source
Unit-I	Nuclear power generation	https://youtu.be/oPZrUW9GQRg?si=EK1gh_uKq7FaWxIb	NPTEL (IIT Guwahti)
	Nuclear reactions	https://youtu.be/vQ5HrubRYVo	NPTEL (IIT Madras)
Unit-II	Nuclear reactor and safety	https://youtu.be/vQ5HrubRYVo?si=7x8McU_4HuL7jwjp	NPTEL (IIT Madras)
	Radioactive waste	https://youtu.be/qYDjjJxc4h4	e-pathshala
Unit-III	Nuclear power production cycle	https://youtu.be/jAmrYtcknMc	NPTEL (IIT Madras)
	Nuclear reactor and safety	https://youtu.be/vQ5HrubRYVo?si=0b1pkcjiUcDMjfa	NPTEL (IIT Madras)
Unit-IV	Radiological protection	https://youtu.be/EzxZCgcLtkq	NPTEL (IIT Madras)
	Safety practices in NPP	https://youtu.be/k2NOPsYw6i0	NPTEL (IIT Madras)

Course Code	PEC-FT-328A				
Category	Professional Elective Courses				
Course Title	Computational Fluid Dynamics				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Objectives	The objectives of this course are • To familiarize students with numerical methods and discretization techniques used for solving fluid flow and fire dynamics problems. • To develop understanding of governing equations used in computational fluid dynamics such as continuity, momentum, and energy equations. • To enable students to analyze smoke propagation, heat transfer, ventilation, and fire behavior in buildings using CFD tools. • To develop the ability to interpret CFD simulation results for improving fire safety design and risk assessment in industrial and building environments.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Outcomes: After successful completion of this course, the students will be able to

COs	Skills Demonstrated	RBT Level
CO1	Describe the concepts related to fluid mechanics and heat transfer used in computational fluid dynamics (CFD).	Level 1: Remember
CO2	Understand the principles of numerical methods, turbulence models and CFD applications in fire and smoke movement analysis.	Level 2: Understand
CO3	Apply CFD software and simulation techniques to model fire scenarios, smoke propagation, and heat transfer problems in fire safety engineering.	Level 3: Apply
CO4	Analyze CFD simulation results to evaluate fire behavior, smoke control performance in buildings and industrial facilities.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 8 parts (preferably 2 from each unit/section) of 1.5 marks each and remaining eight questions of 12 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Introduction: Impact and application of CFD in diverse fields, Governing equation of fluid dynamics, Continuity, Momentum and energy, Generic integral form for governing equations, Initial and boundary conditions, Governing equation for boundary layers, Classification of partial differential equations, Hyperbolic, Parabolic, Elliptic and mixed types, Applications and relevance.

Unit-II

Basic Aspects of Discretization: Discretization techniques, Finite difference, Finite volume and finite element method, Comparison of discretization by the three methods, Introduction to finite differences, Transient one-dimensional and two-dimensional conduction, Explicit, Implicit, Crank-nicolson, ADI scheme, Stability criterion.

Difference Equations: Numerical errors, Grid independence test, Optimum step size.

Unit-III

Grid Generation: General transformation of the equation, Form of the governing equations suitable for CFD, Boundary fitted co-ordinate systems, Elliptic grid generation, Adaptive grid, Modern developments in grid generation.

Unit-IV

Steady One-Dimensional Convection and Diffusion: Central difference, Upwind, Quick, Exponential, False diffusion, Hybrid and power law schemes, Transient one dimensional heat conduction equation.

Representation of the Pressure Gradient Term and Continuity Equation: Staggered grid, Momentum equation, Pressure and velocity correction, Pressure correction equation, Numerical procedure for SIMPLE algorithm, Boundary condition for the pressure correction method, Stream function, Vorticity method, Discussion of case studies.

Suggested Readings:

- An Introduction to Computational Fluid Dynamics by H. Versteeg, W. Malalasekera, The Finite Volume Method (2nd Edition), Prentice Hall. (2007)
- Computational Fluid Dynamics by Sreenivas Jayanti, Springer (2016)
- Introduction to Computational Fluid Dynamics by Pardip Niyogi, S.K. Chakrabarty, M. K. Laha, Person India (2005)
- Computational Fluid Dynamics and Heat Transfer by S.Thanigaarasu, Techsar Pvt. Ltd. (2020)
- Computational Fluid Dynamics by Young-II Lim, MDPI (2021)

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Governing equation of Fluid Dynamics	https://youtu.be/AZknqweSR9w?si=U5atrcPzCqxjTUtC	NPTEL (IIT Madras)
	Partial Differential Equation	https://youtu.be/W2DvB1R6uJc?si=LCEN4sCr4NHDupdE	NPTEL (IIT Madras)
Unit-II	Finite Differences	https://youtu.be/j-Hpi1zd2fk?si=gxbUs2qurVY4Kso7	NPTEL (IIT Madras)
	Numerical Errors	https://youtu.be/UFg_yhh5nRU?si=wJpzAsoa9y4pzuTo	NPTEL (IIT Madras)
Unit-III	Introduction to Grid Generation	https://youtu.be/LY215hdSFd4?si=flqpzYPQWiBKfSIS	NPTEL (IIT Kharapur)
	Boundary Fitted Co-ordinate System	https://youtu.be/mHD3pFoUXD0?si=EYJntXxNg2plniHy	NPTEL (IIT Kharapur)
Unit-IV	Steady One Dimensional Convention, upwind	https://youtu.be/UFg_yhh5nRU?si=wJpzAsoa9y4pzuTo	NPTEL (IIT Madras)
	Numerical Procedure for SIMPLE Algorithm	https://youtu.be/S28FrU_xZ24?si=USOrI3XsQ9Pn0mMB	NPTEL (IIT Madras)