GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA (JHAJJAR)

An Autonomous Institute

'A' GRADE ACCREDITED BY NAAC

Scheme of Studies and Examinations

(Under NEP-2020)

B-SCHEME

Common for B.Tech (Fire Technology and Safety)
and
B.Tech (Fire Technology and Safety- Working Professionals)

Effective from

Academic Session 2026-27 (From 2nd Year onwards)

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

1. DEFINITION OF CREDIT

1	1 Lecture (L) per week	1 Credit
2	1 Tutorial (T) per week	1 Credit
3	1 Practical (P) per week	0.5 Credit
4	2 Practical (Lab) per week	1 Credit

2. RANGE OF CREDIT

A range of credits from 160 to 170 for a student to be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honours or additional Minor Engineering, if he/she completes an additional 18-20 credits. These could be acquired through MOOCs.

3. STRUCTURE OF UNDERGRADUATE ENGINEERING PROGRAM (B.TECH)

Sr. No.	Category	Breakup of Credits
1	Basic Science Courses	21
2	Engineering Science Courses	21
3	Professional Core Courses	72
4	Professional Elective Courses (Relevant to chosen specialization/branch)	15
5	Indian Knowledge System	-
6	Open Electives Courses	9
7	Humanities and Social Sciences including Management courses	12
8	Project work, seminar and internship in industry or appropriate work place/ academic and research institutions in India/abroad	17
9	Value Added Courses	03
10	Mandatory Non Credit Courses – Audit Course	(Non-Credit)
	Total Credits	**170***

**Minor variation is allowed as per need of the programme.*

4. COURSE CODE AND DEFINITIONS

Sr. No.	Category	Course Code
1	Basic Science Courses	BSC
2	Engineering Science Courses	ESC
3	Professional Core Courses	PCC
4	Professional Elective Courses (Relevant to chosen specialization/branch)	PEC
5	Indian Knowledge System	IKS
6	Multidisciplinary Open Electives Courses	OEC
7	Humanities and Social Sciences including Management courses	HSMC
8	Laboratory Courses	LC
9	Mandatory Non-Credit Courses (Audit Course)	MC
10	Project	PR
11	Internship/ Practical Training/ Seminar	INT

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

Scheme of Studies and Examinations

Common for B.Tech (Fire Technology and Safety) – 3rd Semester

and

B.Tech (Fire Technology and Safety- Working Professionals) – 3rd 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	Basic Science Courses	BSC –FT-201B	Engineering Mathematics-III	3	1	0	4	4	40	60		100	3
2	Professional Core Courses	PCC-FT-203B	Fire Engineering	3	0	0	3	3	30	45		75	3
3	Professional Core Courses	PCC-FT-205B	First Aid and Paramedics	3	0	0	3	3	30	45		75	3
4	Professional Core Courses	PCC-FT-207B	Principles of Safety Management	3	0	0	3	3	30	45		75	3
5	Professional Core Courses	PCC-FT-209B	Fire Appliances and Rescue Equipments	3	0	0	3	3	30	45		75	3
6	Engineering Science Courses	ESC-ME-211B	Heat, Mass Transfer and Thermodynamics	3	0	0	3	3	30	45		75	3
7	Professional Core Courses	LC-PCC-FT-213B	Fire Engineering Lab	0	0	2	2	1	10		15	25	3
8	Professional Core Courses	LC-PCC-FT-215B	First Aid and Paramedics Lab	0	0	2	2	1	10		15	25	3
9	Engineering Science Courses	LC-ESC-FT-217B	Heat, Mass Transfer and Thermodynamics Lab	0	0	2	2	1	10		15	25	3
10	Professional Core Courses	LC-PCC-FT-219B	Fire Ground Operations-III	0	0	2	2	1	10		15	25	3
11	Mandatory Courses	MC-201B	Environmental Science	2	0	0	2	0	20		30	50*	3
Total Credits								**23**				**575**	

Note:

I. MC-201B is a mandatory non–credit course in which students will be required to obtain passing marks in theory. The marks in this qualifying paper will not be included in determining the percentage of marks obtained for the award of degree. However, these marks will be shown in detailed marks certificate of student.

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

Scheme of Studies and Examinations

Common for B.Tech (Fire Technology and Safety) – 4th Semester

and

B.Tech (Fire Technology and Safety- Working Professionals) – 4th 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-202B	Structural Fire Engineering	3	0	0	3	3	30	45		75	3
2	Professional Core Courses	PCC-FT-204B	Fire Protection	3	0	0	3	3	30	45		75	3
3	Professional Core Courses	PCC-FT-206B	Fluid Mechanics and Fire Service Hydraulics	3	0	0	3	3	30	45		75	3
4	Professional Core Courses	PCC-FT-208B	Industrial Hygiene and Occupational Health	3	0	0	3	3	30	45		75	3
5	Professional Core Courses	PCC-FT-210B	Electric Fire Safety Practice and Standards	3	0	0	3	3	30	45		75	3
6	Professional Elective Courses	Refer Table-I	Professional Elective-I	3	0	0	3	3	30	45		75	3
7	Professional Core Courses	LC-PCC-FT-212B	Structural Fire Engineering Lab	0	0	2	2	1	10		15	25	3
8	Professional Core Courses	LC-PCC-FT-214B	Fire Protection Lab	0	0	2	2	1	10		15	25	3
9	Professional Core Courses	LC-PCC-FT-216B	Fire Service Hydraulics Lab	0	0	2	2	1	10		15	25	3
10	Professional Core Courses	LC-PCC-FT-218B	Industrial Hygiene and Occupational Health Lab	0	0	2	2	1	10		15	25	3
11	Professional Core Courses	LC-PCC-FT-220B	Fire Ground Operations-IV	0	0	2	2	1	10		15	25	3
Total Credits								**23**				**575**	

Notes:

I. At the end of 4th semester each student has to undergo Practical Training based on Fire and Safety/ Fire and Safety Equipments Installation, Care and Maintenance/Fire and Safety Audits/Any Certificate Course related to Fire and Safety (Min Contact Hours must be 30 Hrs) of 4/6 weeks in Fire Service Department/Industry/ Multi-Speciality Hospital/Professional Organization/ Research Laboratory/ Training Centre/ Educational Institute/other building Occupancy having Fire Fighting Installations etc. and submit typed report along with a certificate from the organization & its evaluation shall be carried out in the 5th Semester.

II. **For Working Professionals:** Submit a Training/Project report of their work in their respective company/Organization for the period of summer training/industrial training for evaluation. The evaluation shall be carried out in the 5th Semester.

III. Choose any one from Professional Elective-I

IV. Students can take Massive Open Online Courses (MOOCs) approved by the concerned Chairperson Board of Studies (BoS). The doubt classes will be conducted of 1 hour per week. The students may opt for examinations from the Institute or from the concerned portal.

Table 1 Professional Elective – I

Sr. No.	Code	Subject
1	PEC-FT-222B	Industrial Psychology
2	PEC-FT-224B	Chemical Process Safety
3	PEC-FT-226B	Environmental Engineering and Management
4	PEC-FT-228B	Special Fire Hazards
5	----------	Any one MOOCS/Swayam Course

Course code	**BSC-FT-201B**				
Category	Basics Science Courses				
Course title	**Engineering Mathematics-III**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	3	1	0	**4**	
Course Objectives	The objectives of this course are • To develop the understanding of students regarding partial differential equations, numerical methods, transform calculus, and statistical techniques used in Fire Engineering analysis. • To familiarize the students with analytical and computational methods for solving differential equations, interpolation problems, numerical integration, and optimization models. • To make the students learn Laplace transform techniques, hypothesis testing procedures, and linear programming methods for mathematical problem solving. • To make the students familiar with the application of mathematical tools and numerical techniques in Fire Engineering and scientific computations.				
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 partial differential equations, numerical methods, Laplace transforms, linear programming, and statistical testing techniques.	Level 1: Remember
CO2	Explain the methods of solving partial differential equations, interpolation problems, numerical integration techniques, Laplace transform problems, and hypothesis testing procedures.	Level 2: Understand
CO3	Solve engineering and scientific problems using partial differential equations, interpolation techniques, numerical integration methods, and numerical solution procedures.	Level 3: Apply
CO4	Apply Laplace transform methods, linear programming techniques, and statistical testing procedures for solving engineering optimization and data analysis problems.	Level 3: Apply

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

Partial Differential Equations: First order linear partial differential equations, First order non-linear partial differential equations, Charpit's method, Second order linear partial differential equations and their classifications, Method of separation of variables and its applications to wave equation, One dimensional heat equations and two dimensional heat flow (steady state solutions only)

Unit-II

Numerical Methods: Solution of polynomial and transcendental equations – Bisection method, Regula-Falsi method and Newton-Raphson method, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae, Numerical integration, Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

Unit-III

Transform Calculus: Laplace Transforms and its Applications, Laplace transforms of elementary functions, properties of Laplace transforms, existence conditions, transforms of derivatives, transforms of integrals, Multiplication by t^n, Division by t, Evaluation of integrals by Laplace transforms, Laplace transform of unit step function, unit impulse function and periodic function, inverse transforms, convolution theorem, application to linear differential equations.

Unit-IV

Linear Programming: Linear programming problems formulation, solving linear programming problems using (i) Graphical method (ii) Simplex method (iii) Dual simplex method.

Testing of Hypothesis: Testing of hypothesis, Tests of significance for large samples, Student's t-distribution (applications only), Chi-square test of goodness of fit.

Suggested Readings:

- Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publishing Company Limited
- Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers
- Numerical Methods by P. Kandasamy, K. Thilagavathy, K. Gunavathi, S. Chand and Company
- Introductory Methods of Numerical Analysis by S. S. Sastry, PHI Learning.
- A Textbook of Engineering Mathematics by N. P. Bali and Manish Goyal, Laxmi Publications.

Useful Video Links:

Unit No.	Topic	Link	Source
Unit -I	One Dimensional Heat Equation	https://youtu.be/GmIcbqdvIgc?si=4XnsNAbmcXVgE5ur	**IIT Roorkee**
Unit-II	Solution by Separation of Variables	https://youtu.be/W3HXK1Xe4nc?si=aqwoXZcWjcdiWifm	**IIT Kharagpur**
	Bisection Method	https://youtu.be/3FhE9De2__o?si=LM8q56foPk4yBvDb	**IIT Madras**
	Newton-Raphson Method	https://www.youtube.com/watch?v=ZcbFQz_Kwog	**IIT Madras**
	Introduction to numerical differentiation interpolation formula	https://www.youtube.com/watch?v=bnUsBhPLekE	**IIT Roorkee**
	Divided Difference interpolation	https://www.youtube.com/watch?v=DnfC0IUmUe4	**IIT Roorkee**

Unit-III	Laplace Transform	https://www.youtube.com/watch?v=c9NibpoQjDk	**IIT Madras**
	Laplace Transform & its existence	https://www.youtube.com/watch?v=2LyY4t0Gfvs	**IIT Kharagpur**
	Properties of Laplace Transform-Part-1	https://www.youtube.com/watch?v=SN0dcSyoJIE	**IIT Madras**
	Properties of Laplace Transform-Part-2	https://www.youtube.com/watch?v=MV3a-sQqDRc	**IIT Madras**
	Convolution Theorem for Laplace Transfroms	https://www.youtube.com/watch?v=niOMKg9FMO8	**IIT Madras**
Unit-IV	Simplex Method	https://www.youtube.com/watch?v=RcPhmPhjMbc	**IIT Kharagpur**
	Testing of Hypothesis-Basic Concepts	https://www.youtube.com/watch?v=IEP3swFeauE	**IIT Kharagpur**
	Testing of Hypothesis-I	https://www.youtube.com/watch?v=14PQawp_rjk	**IIT Kharagpur**
	Chi-Square Distribution	https://www.youtube.com/watch?v=lQ1ec1nQvKM	**IIT Madras**

Course Code	**PCC-FT-203B**				
Category	Professional Core Courses				
Course Title	**Fire Engineering**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	3	0	0	**3**	
Course Objectives	The objectives of this course are • To make the students learn the fundamentals of fire science, combustion behaviour, fire development mechanisms, and the effects of heat and smoke during fire incidents. • To familiarize the students with fire prevention principles, building fire safety requirements, structural fire protection measures, and fire safety standards used in different occupancies. • To develop the understanding of students regarding fire protection systems, fire detection and alarm systems, extinguishing agents, and inspection and maintenance practices for fire safety equipment. • To acquaint the students with industrial fire hazards, explosion phenomena, emergency response procedures, firefighting strategies, rescue operations, and recent developments in fire engineering.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 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 key terminologies related to fire science, combustion, fire behaviour, fire prevention, fire protection systems, industrial fire hazards and emergency response practices.	Level 1: Remember
CO2	Explain the principles of combustion, fire development, smoke movement, building fire safety, fire protection systems and industrial firefighting practices.	Level 2: Understand
CO3	Apply fire prevention methods, fire safety standards, firefighting techniques, emergency response procedures and fire protection system practices for different fire scenarios.	Level 3: Apply
CO4	Analyze fire behaviour, industrial fire and explosion hazards, smoke movement, fire protection system performance and emergency management strategies for effective fire safety planning.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 1.5 marks each and remaining eight questions of 9 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 Science and Fire Behaviour: Introduction to fire engineering, Scope and importance of fire engineering, Introduction to NBC, NBCS, IS, NFPA and OISD fire safety standards, Fire, Fire triangle and fire tetrahedron, Classification of fires and combustible materials, Physical and chemical properties of fuels, Flash point, Fire point and Auto-ignition temperature, Fundamentals of combustion, Types of combustion, Ignition and ignition sources, Limits of flammability, Fire causation theories, Electrical fire hazards and electrical safety, Static electricity and lightning protection, Basic stoichiometry of combustion, Fire load and fire severity, Stages of fire development, Fire spread and fire behaviour, Smoke and products of combustion, Smoke production and movement, Smoke density and visibility, Toxicity of smoke and fire gases, Effects of heat and smoke on human body, Principles of fire extinguishment.

Unit–II

Fire Prevention and Building Fire Safety: Principles of fire prevention, Fire hazards and fire risk assessment, Fire safety practices and housekeeping, Electrical fire hazards and electrical safety, Static electricity and lightning protection, Storage and handling of flammable and combustible materials, Classification of buildings based on occupancy as per NBCS, Fire prevention in various occupancies, Fire resistant construction and structural fire protection, Compartmentation and fire barriers, Fire doors and dampers, Means of egress and evacuation requirements, Exit systems, Staircases and refuge areas, Smoke control and pressurization systems, Fire safety audit and inspection procedures.

Unit–III

Fire Protection Systems and Equipment: Active and passive fire protection systems, Water as extinguishing agent, Fire water supply systems, Fire hydrant systems, Hose reels and hose cabinets, Fire pumps, Portable fire extinguishers and extinguishing agents, Foam fire protection systems, Dry chemical powder systems, CO_2 and clean agent systems, Automatic sprinkler systems, Water spray and deluge systems, Fire detection and alarm systems, Smoke, Heat and Flame detectors, Conventional and addressable fire alarm systems, Public address and emergency communication systems, Selection, Installation, Inspection, testing and maintenance of fire protection systems.

Unit–IV

Industrial Fire Safety and Emergency Response: Industrial fire hazards and process fire safety, Fire and explosion hazards in industries, BLEVE, UVCE and dust explosions, Fire safety in oil and gas Industries, Chemical and petrochemical industries, Power plants and warehouses, Fire safety in storage tanks and pipelines, Grounding and bonding, Incident Command System (ICS), Firefighting organization and strategy, Breathing apparatus and personal protective equipment, Rescue and evacuation techniques,Ventilation, Salvage operation, Ropes, Lines, Ladders, Emergency response planning and disaster management, Post-Fire investigation and reporting, Case studies of major industrial fires and explosions, Recent developments in fire engineering and smart fire safety systems.

Suggested Readings:

- Manual of Firemanship by HMSO
- Fire Safety in Buildings by V K Jain, New Age publishers, New Delhi
- Principles of Fire Safety Engineering by A. K. Das, PHI Publishers.
- Fundamentals of Fire Safety in Building Design by Dr. Than Singh Sharma, Aayush Publications, New Delhi
- Handbook of Fire Technology by R.S.Gupta, Orient Longman Pvt. Ltd., Kolkata
- Manual of Fire Safety by N. Sesha Prakash, CBS Publishers & Distributors Pvt. Ltd.
- National Building Code (NBC) Part-4 Life and Safety (2016- Edition)- Bureau of Indian Standards
- National Building Construction Standards-2026, Part F, Bureau of Indian Standards

- Fire Protection and Prevention: The Essential Handbook by Barendra Mohan Sen, UBS Publishers and Distributors, New Delhi

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Basics of Fire-Part 1	https://youtu.be/eLeZ2zc2hgI?si=VeWVsuhIkwRf-XYd	NPTEL (IIT Madras)
	Basics of Fire-Part 2	https://youtu.be/NzIbiOAJONc?si=7H_mIiQm18vvULrd	NPTEL (IIT Madras)
	Combustion	https://youtu.be/n6HAyxdup_U?si=IMSS2Ye7w01SQQNz	NPTEL (IIT Delhi)
Unit-II	Emergency Scene Management (ESM)	https://youtu.be/uibCRbELVbA?si=z9JrmlCfMjKvDR4g	NPTEL (IIT Kanpur)
	Safety practices for Fire protection	https://youtu.be/-XRu7BSouvY?si=ogFdjHXtUbAbHWly	NPTEL (IIT Madras)
Unit-III	Fire safety: Internal planning, Detection and Suppression	https://youtu.be/e3Orj5XDj2M?si=YghWp5QRE9ECcIKA	NPTEL (IIT Delhi)
	Sprinklers I	https://youtu.be/ZKsqIPM810M?si=5uIMn1w6so-tb7oU	NPTEL (IIT Roorkee)
	Sprinklers II	https://youtu.be/Z82ypLX2gn8?si=bdPqswwPWQ-DB613	NPTEL (IIT Roorkee)
Unit-IV	Fire Safety: Escape and Refuge	https://youtu.be/O6CYQt9vi_Y?si=D-3_DCTnQ3fF6Bxm	NPTEL (IIT Delhi)
	Ventilation	https://youtu.be/K58rDFPGJO0?si=b4r8Lxa3UgPiMnNZ	NPTEL (IIT Delhi)

Course Code	**PCC-FT-205B**					
Category	Professional Core Courses					
Course Title	**First Aid and Paramedics**					
Scheme and Credits	L	T	P	**Credits**	**Semester-III**	
	3	0	0	**3**		
Course Objectives	The objectives of this course are ● To make the students familiar with the fundamentals of first aid, emergency care procedures, cardiopulmonary resuscitation, and basic life support techniques. ● To develop the understanding of students regarding the structure and functions of the human body, types of wounds and injuries, and appropriate first aid management methods. ● To familiarize the students with medical emergencies, environmental injuries, poisoning, bites, burns, and emergency response procedures for different casualty conditions. ● To make the students learn casualty handling methods, ambulance services, accident management procedures, rescue techniques, and disaster response practices.					
Assessment	30 Marks					
End Semester Examination	45 Marks					
Total	75 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 terms related to first aid, emergency care, human body systems, wounds, injuries, medical emergencies, casualty handling, accidents and disaster management.	Level 1: Remember
CO2	Explain the concepts of first aid and emergency, human body, injury and wound management, fracture care, medical conditions, causality handling and accidents management.	Level 2: Understand
CO3	Apply first aid and other techniques for managing injuries, wound and medical emergencies, causalities and accidents.	Level 3: Apply
CO4	Analyze emergency situations, injury conditions, accident scenarios, and medical cases to determine appropriate first aid measures, rescue procedures and emergency response actions.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 1.5 marks each and remaining eight questions of 9 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 First Aid and Emergency Care: Introduction to first aid, Principles of first aid, Role and responsibilities of first aider, General rules of first aid, Sequence of actions at emergency scene, First Aid kit and its contents, Vital signs- A, B, C (Airway, Breathing and Circulation) and patient assessment,

Cardiopulmonary Resuscitation (CPR), Artificial respiration, Recovery position, Emergency action procedures, Basic Life Support (BLS), Transportation of casualties, Training and ethics in first aid.

Unit-II

Human Body: Study of the human body and its various systems such as musculoskeletal system, Respiratory system, Circulatory system, Digestive system, Central nervous system etc.
Wounds: Wound, Types, Management, Bleeding and its types, Control of bleeding.
Injuries: Injuries, First Aid for various injuries, Soft tissue injuries, Head injuries, Chest injuries, Eye injuries and blindness, Burn and its types, Rule of Nine, Electrical injuries, Fractures and Dislocations, Sprains and Strains, Bandages and Slings, Immobilization techniques.

Unit-III

Medical Emergencies and Environmental Injuries: Heart attack and Angina, Stroke and Hypertension, Diabetes mellitus, Hyperglycemia and Hypoglycemia, Seizures and Epilepsy, Fever and Meningitis, Fainting and Shock, Allergy and Anaphylaxis, Headache and Migraine, Earache and Toothache, Abdominal pain, Vomiting and Diarrhea, Poisoning and Toxic Exposure, Snake bite, Dog bite and Insect bite, Drowning and Choking, Unconsciousness, Frostbite and Heat stroke, Childbirth emergencies, Protection of body from extreme weather conditions.

Unit-IV

Casualty Handling and Ambulance Services: Handling and transportation of casualties, Lifting techniques and rescue methods, Stretchers and their types, Ambulance services and patient transportation, Minor illness management**.**
Accident Management: Accidents and their types, Accident reporting and record keeping, Accident investigation procedures, Medical history assessment, Observation of signs and symptoms, Preparation of diagnosis reports, Duties and responsibilities of paramedics, Communication during emergencies, Disaster and mass casualty management, Safety precautions during rescue operations.

Suggested Readings:

- Manual of first aid to the injured by St. John Ambulance Association.
- First aid text book by American National Red Cross
- Manual of First aid instruction by US Bureau of Mines
- Accident First Aid by V.V. Yudenich, Mir Publishers, Moscow

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Basic Life Support (BLS)- Part 1 by NPTEL	https://www.youtube.com/watch?v=LAJJDH5ol4M	NPTEL (IIT Madras)
	Basic Life Support (BLS) - Part 2 by NPTEL	https://www.youtube.com/watch?v=kYZvMk88zx4	NPTEL (IIT Madras)
	CPR	https://www.youtube.com/watch?app=desktop&v=BQNNOh8c8ks	St. John Ambulance
Unit-II	Circulatory System	https://www.youtube.com/watch?v=b0bOclBpyME	NPTEL (IIT Guwahati)
	Muscular System	https://www.youtube.com/watch?v=ijiEeazaotE	NPTEL (IIT Guwahati)
	Respiratory System	https://www.youtube.com/watch?v=974jAldy8JY&t=5s	SWAYAM (IIT Madras)

	Head Injury	https://www.youtube.com/watch?v=a4cIFZx1f2E	St. John Ambulance
Unit-III	Stroke- Signs & Symptoms	https://www.youtube.com/watch?v=PhH9a0kIwmk	St. John Ambulance
	Diabetic Emergency	https://www.youtube.com/watch?v=L06DNMRcy98&t=144s	St. John Ambulance
Unit-IV	How to Treat a Fracture & Fracture Types	https://www.youtube.com/watch?v=2v8vlXgGXwE	St. John Ambulance
	Accident Investigation, Reporting	https://www.youtube.com/watch?v=VhuZ6M7a8N8	NPTEL (IIT Kharagpur)

Course Code	**PCC-FT-207B**				
Category	Professional Core Courses				
Course Title	**Principles of Safety Management**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	3	0	0	**3**	
Course Objectives	The objectives of this course are • To introduce students to the fundamentals of safety management, accident prevention principles and industrial safety practices. • To develop understanding of hazard identification, risk assessment and hazard control techniques used in industries. • To familiarize students with safety training methods, accident investigation procedures and occupational safety management systems. • To provide knowledge of safety auditing, performance evaluation techniques and industrial safety compliance practices.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 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 safety management, hazards, risks, accidents, safety culture, training, PPEs, safety audits and industrial safety practices.	Level 1: Remember
CO2	Explain hazard identification methods, risk assessment techniques, safety training procedures, accident investigation methods and safety management systems used in industries.	Level 2: Understand
CO3	Apply hazard control measures, permit to work systems, safety training techniques, safety auditing procedures and performance evaluation techniques for industrial safety management.	Level 3: Apply
CO4	Analyze safety performance indicators, human factors, accident causes, audit findings and compliance practices for improvement of industrial safety management systems.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 1.5 marks each and remaining eight questions of 9 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 Safety Management: Introduction to safety and safety management, objectives and principles of safety management, integration of health, safety and environment, safety and productivity, general instructions for safety, concepts of hazard, risk, accident, incident and near miss, types of accident, accident causation theories, accident prevention principles, direct and indirect costs of accidents, safety culture and safety climate, human factors in safety management, roles and responsibilities of management, supervisors, workers and safety professionals in industrial safety management.

Unit-II

Hazard Identification, Risk Assessment and Control: Hazard identification and risk assessment (HIRA), Job Safety Analysis (JSA), qualitative and quantitative risk assessment techniques, hierarchy of hazard control measures, introduction to personal protective equipment (PPE), safety in design and engineered safety, permit-to-work systems, contractor safety management, safety in plant operation and maintenance, machine safety, electrical safety, lockout/tagout (LOTO), work-at-height safety, fire and explosion hazard identification.

Unit-III

Safety Training, Communication and Incident Management: Safety education and training, objectives and methods of safety training, elements of the safety training cycle, Behaviour-Based Safety (BBS), behaviour-oriented training techniques, safety communication and awareness, safety awareness programmes, causes of preventable injuries, accident and incident investigation procedures, root cause analysis, reporting and documentation systems, safety committees and their functions, emergency preparedness and response planning, elements of Safety Management Systems (SMS), overview of ISO 45001 Occupational Health and Safety Management Systems.

Unit-IV

Safety Auditing, Performance Evaluation and Compliance: Introduction to safety auditing and inspection systems, types and procedures of safety audits, responsibilities of the audit team, safety surveys and safety observation techniques, safety performance measurement and indicators, frequency rate, severity rate, incidence rate and Safe-T-Score, safety benchmarking, continuous improvement in safety management, overview of applicable safety legislation and statutory compliance, industrial safety compliance practices.

Suggested Readings

- Fundamentals of Industrial Safety & Health by K.U. Mistry, Siddharth Prakashan.
- Industrial Safety Health and Environment management Systems by Jain and Rao, Khanna Publishers
- Safety Management by 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

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Accident, Accident Investigation	https://youtu.be/VhuZ6M7a8N8?si=AJ0gXnTGKOd9KPFK	NPTEL (IIT Kharagpur)
	Safety Engineering & Accident causing mechanisms	https://youtu.be/91YpCY-1Fy0?si=4L5f1y_NiOLGSm-4	NPTEL (IIT Kharagpur)
Unit-II	Personal Protective Equipment	https://youtu.be/eLnv6Eb2Pq0?si=cbAkgLUqZ9QEJoWQ	NEPTEL (IIT Delhi)
Unit-III	Safety Education	https://youtu.be/v-eltsixu4I?si=2T9UetPJdllhk7YN	NPTEL (IIT Kharagpur)
	Safety Committee Meeting	https://youtu.be/N12BEnI1hCY?si=TdR-4HO58IZsM5mp	IIT Consultancy
Unit-IV	Safety Audit	https://youtu.be/HuYIDi0QQm8?si=y_vJEkJHAVaP81WS	NPTEL (IIT Kharagpur)
	Safety Performance Indicators	https://youtu.be/NI89F0ISMog?si=sxTayTaCNV23t7a1	NPTEL (IIT Kharagpur)

Course Code	**PCC-FT-209B**				
Category	Professional Core Courses				
Course Title	**Fire Appliances and Rescue Equipments**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	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	30 Marks				
End Semester Examination	45 Marks				
Total	75 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 6 parts of 1.5 marks each and remaining eight questions of 9 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
- NFPA Manual
- National Building Construction Standard by Bureau of Indian Standards, New Delhi
- Related IS Codes and Standards

Course Code	**ESC-ME-211B**				
Category	Engineering Science Courses				
Course Title	**Heat, Mass Transfer and Thermodynamics**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	3	0	0	**3**	
Course Objectives	The objectives of this course are ● To make the students familiar with the fundamental concepts of thermodynamics and their applications in fire and safety engineering. ● To develop the understanding of students regarding heat transfer mechanisms and their role in fire behavior, thermal insulation and industrial safety applications. ● To familiarize the students with mass transfer, combustion processes, flame characteristics and products of combustion relevant to fire dynamics. ● To make the students learn about explosion phenomena, industrial fire hazards, emergency planning and fire safety practices involving hazardous materials and explosives.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 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 technical terms of thermal engineering related to fire and safety engineering.	Level 1: Remember
CO2	Explain the fundamental concepts of thermodynamics, heat and mass transfer, and their influence on fire development, flame behavior, combustion, explosion and fire effluents in engineering systems.	Level 2: Understand
CO3	Apply the principles of thermodynamics, heat transfer, combustion, and explosion safety to solve problems in industrial fire safety.	Level 3: Apply
CO4	Analyze fire and explosion hazards, combustion characteristics, thermal behavior of materials, and industrial fire safety measures to evaluate risk control strategies.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 1.5 marks each and remaining eight questions of 9 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 Thermodynamics: Basic concepts of thermodynamics, System, Surrounding and boundaries, Types of thermodynamic systems, Thermodynamic properties, State and process, Cyclic process, Reversible and irreversible processes, Work and Heat, Ideal Gas Laws, Equation of state, Specific seat, Zeroth Law of thermodynamics, First Law of thermodynamics, Steady flow energy equation, Enthalpy, Applications of thermodynamics in fire and safety engineering.

Unit-II

Heat Transfer Fundamentals: Introduction to heat transfer, Modes of heat transfer, Thermal conductivity, Heat conduction through plane walls and cylinders, Composite walls, Convection heat transfer, Natural and Forced convection, Radiation heat transfer, Black body and Grey body radiation, Stefan–Boltzmann Law, Heat transfer in fire situations, Thermal insulation and Fire resistant materials, Heat transfer applications in industrial safety.

Unit–III

Mass Transfer and Combustion: Introduction to mass transfer, Diffusion and mass flux, Fick's Law of diffusion, Convective mass transfer, Heat and mass transfer analogy, Fundamentals of combustion, Types of combustion, Combustion of solid, liquid and gaseous fuels, Complete and Incomplete combustion, Stoichiometric combustion, Products of combustion, Smoke and fire effluents, Fire behavior and flame characteristics.

Unit-IV

Explosion and Industrial Fire Safety Applications: Explosion fundamentals, Types of explosions, Fire and explosion hazards in industries, Flammable liquid storage hazards, Major Accident Hazard (MAH) Control, On-Site and Off-Site emergency planning, Petroleum and Explosives Safety Organization (PESO), Fire and explosion prevention measures, Industrial fire safety applications.

Fires Involving Explosives: Introduction, Industrial processes and hazards of explosives, Explosives and fireworks manufacture and filling, Explosive storage, Explosive transport, Causes of fire and methods of protection, Fire extinguishing ball, Jet fire, Pool fire, Boilover, Fire fighting involving explosives in transit, Match manufacture and storage, Material used, Process, Causes of fire and protective measures, Fire fighting.

Suggested Readings:

- Heat and Mass Transfer -3rd edition by PK Nag 2007 Tata McGraw Hill
- Heat and Mass Transfer – revised edition by RK Rajput . S. Chand Publication.
- Heat & Mass transfer 4rd edition by 2014 Yunus A- Cengel Tata McGraw Hill
- Principles of heat transfer by Kreith Thomas Learning 2001
- Fundamental of Heat and Mass Transfer by M. Thirumaleshwar. Pearson.
- Fundamental of Heat and Mass Transfer- 4th edition by C.P.Kothandaraman

Useful Video Links:

Unit No.	Topic	Link	Source
Unit-II	Heat Transfer	https://youtu.be/6Zpf3YpkNCM?si=WhLLog7VWHqqB9q8	NPTEL (IIT Kharagpur)
	Conduction	https://youtu.be/hZBpV_QVJ3Y?si=gkdZn4iSXVXpIvyk	NPTEL (IIT Kharagpur)
	Convection	https://youtu.be/zw884u2pWw0?si=UXn4GVnim-mBMULQ	NPTEL (IIT Kharagpur)

	Radiation	https://youtu.be/TIFGm-QusM4?si=gxeW7TYVqtnnCbHt	NPTEL (IIT Kharagpur)
Unit-III	Combustion	https://youtu.be/Fyq4Q5yWDDU?si=UiglMcNy2y8j5Pvz	NPTEL (IIT Madras)
	Stoichiometric combustion	https://youtu.be/yh1h23fbWtw?si=vxkNdc1J-4UlK5Kt	NPTEL (IIT Madras)
Unit-IV	Explosion	https://youtu.be/19IGLmowQuw?si=EaRFaaiJAikgqlCN	NPTEL (IIT Kharagpur)
	Classification of explosion	https://youtu.be/uwr9a98YJ64?si=xD9qtgX97NJzDtZf	NPTEL (IIT Madras)
	Explosives	https://youtu.be/1_3OOsnjWjo?si=IOwl5pmE7brHZYdr	NPTEL (IIT Kharagpur)
	Nature and properties of explosives	https://youtu.be/i7nE6Pl5uWU?si=cTmdJs1p8Wfc0DvV	NPTEL (IIT Kharagpur)
	Cause of fire and methods of protection	https://youtu.be/PJhjs3gtfEU?si=uBlsCxFZY9eeAlqz	NPTEL (IIT Madras)
	Fire Protection	https://youtu.be/n6HAyxdup_U?si=oxC3ENbX0qMw-Cex https://youtu.be/krnmHKZ87Wg?si=TUKEin4bND_zczdl	NPTEL (IIT Delhi)

Course Code	**LC-PCC-FT-213B**				
Category	Professional Core Courses				
Course Title	**Fire Engineering Lab**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	0	0	2	**1**	
Course Objectives	The objectives of this course are: • To bridge theory and practice by giving students hands-on experience with real-world firefighting equipment, systems, and safety procedures. • To develop practical skills in identifying fire types, selecting appropriate extinguishing agents, and operating fire detection and suppression systems. • To foster critical awareness of fire hazards, structural fire safety, and compliance with national (NBCS) and international (NFPA) fire safety standards. • To prepare students for emergency scenarios by providing training to respond effectively using appropriate firefighting tools and decision-making strategies.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 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 different types of fires, fire elements, extinguishing agents and their appropriate applications in real-life scenarios.	Level 2: Understand
CO2	Demonstrate the operation and usage of various fire detection, suppression, and firefighting systems including fire extinguishers, hose fittings, sprinkler systems and mobile equipments.	Level 3: Apply
CO3	Analyze the calorific values, flashpoint and fire point of the different fuels.	Level 4: Analyze
CO4	Evaluate structural integrity under fire conditions and interpreting building occupancies and combustion products as per national and international standards.	Level 5: Evaluate

List of Experiments

Sr. No.	Contents
1	To determine the flashpoint and fire point of different fuels using Pensky-Marten apparatus.
2	To study different types of fuels and their calorific values.
3	To study different types of fire and its elements.
4	To study different types of extinguishing media- water, foam, dry powder, ABC Powder, CO2, Halon.
5	To study of Modular Automatic Fire Extinguishers, Trolley Mounted fire extinguishers.
6	To study the different causes and phases of fire.
7	To study the fire detection systems.
8	To study the basic fire protection equipments.

9	To study the Mobile firefighting equipments
10	To study different types of sprinkler systems
11	To study the products of combustion.
12	To study different types of occupancies as per National Building Construction Standards (Latest Edition).
13	To study structural integrity under fire using standard methods of NFPA.
14	To study different types of hose fittings and their application.

At least 10 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-PCC-FT-215B**				
Category	Professional Core Course				
Course Title	**First Aid and Paramedics Lab**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	0	0	2	**1**	
Course Objectives	The objectives of this course are: • To familiarize students with first aid kits, emergency equipment and basic medical response procedures. • To develop understanding of major human body systems related to first aid and emergency care. • To train students in CPR, bandaging, slings and safe handling and transportation of victims. • To enable students to understand medical emergencies, accident investigation, reporting and record keeping procedures.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 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 use of first aid equipment, major human body systems, and basic emergency care procedures.	Level 2: Understand
CO2	Demonstrate cardiopulmonary resuscitation (CPR), bandaging, slings, and victim dressing techniques.	Level 3: Apply
CO3	Perform casualty handling, stretcher operations, and victim transportation techniques in emergency situations.	Level 3: Apply
CO4	Analyze medical conditions, accident investigations, reporting procedures, and record keeping for effective emergency response.	Level 4: Analyze

List of Experiments

Sr. No.	Contents
1	To study the first aid kit.
2	To study different human systems: Respiratory, Circulation, Nervous, Digestive and Excretory systems.
3	To study and perform different techniques of Respiration (CPR).
4	To study various types of Bandages and Slings.
5	To perform the victim's dressing using various types of bandages by first aid responder.
6	To study maintenance of various charts related to casualties.
7	To study of stretchers and its types.
8	To perform and practice the different methods of handling and transportation of victims.
9	To study different types of medical conditions.
10	To study accidents, investigations, reporting and record keeping.

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-ESC-FT-217B**				
Category	Engineering Science Courses				
Course Title	**Heat, Mass Transfer and Thermodynamics Lab**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	0	0	2	**1**	
Course Objectives	The objectives of this course are • To develop understanding of thermodynamic principles, heat transfer mechanisms, and mass transfer phenomena relevant to industrial and fire safety engineering. • To provide practical knowledge of internal combustion engines, boilers, refrigeration systems, cooling towers, and thermal engineering equipment. • To analyze conduction, convection, radiation, combustion, and diffusion processes through experimental investigations. • To develop the ability to evaluate thermal system performance, energy balance, and industrial fire and explosion hazards using engineering principles and safety practices.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 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 operating principles of thermodynamic systems, internal combustion engines, boilers, and industrial thermal systems.	Level 2: Understand
CO2	Determine the thermodynamic, heat transfer, and mass transfer characteristics of engineering systems through laboratory experiments.	Level 3: Apply
CO3	Investigate the combustion characteristics and energy performance of thermal systems through experimental studies.	Level 3: Apply
CO4	Analyze industrial fire and explosion hazards to recommend appropriate fire prevention and safety measures.	Level 4: Analyze

List of Experiments

Sr. No.	**Contents**
1	To study the basic thermodynamic properties and verify the ideal gas laws.
2	To determine the specific heat capacity of a given substance.
3	To verify the First Law of Thermodynamics using a steady flow process apparatus.
4	To study the working of 2-stroke petrol and diesel engine.
5	To study the working of 4-stroke petrol and diesel engine.
6	To study low and high pressure boilers and their accessories and mountings.
7	To prepare the heat balance sheet for an internal combustion engine.
8	To determine thermal conductivity of insulating and fire resistant materials.

9	To study heat conduction through composite walls and cylinders.
10	To analyze natural and forced convection heat transfer characteristics.
11	To study radiation heat transfer and verify Stefan–Boltzmann law.
12	To determine diffusion coefficient using Fick's law of diffusion experiment.
13	To study combustion characteristics of solid, liquid, and gaseous fuels under complete and incomplete combustion conditions.
14	To study different types of cooling towers and their industrial safety applications.
15	To study industrial fire and explosion hazards including pool fire, jet fire, boilover, and fire prevention measures.

At least 10 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-PCC-FT-219B**				
Category	Professional Core Courses				
Course Title	**Fire Ground Operations -III**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	0	0	2	1	
Course Objectives	The objective of this course are ● To provide foundational knowledge of various fire-fighting tools and equipment including hoses, extinguishers, ropes, and ladders. ● To train students in standard operational techniques such as hose drills, rope handling, extinguisher usage, and ladder operations under simulated conditions. ● To develop students' ability to inspect, test, and maintain the performance and safety of fire-fighting equipment as per standard protocols. ● To instill discipline, coordination, and response skills essential for effective participation in real-life fire emergency operations.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 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 procedures for hose rolling techniques, rope types, and ladder configurations along with their operational relevance in fire safety.	Level 2: Understand
CO2	Work as an individual and in a group with the capacity to be a leader as well as an effective team member.	Level 3: Apply
CO3	Perform standard hose and extinguisher drills, ladder and rope tests, and demonstrate practical handling and maintenance of fire service equipment.	Level 3: Apply
CO4	Analyze the condition and performance of fire-fighting tools and equipment through standard testing methods and drills to ensure operational readiness.	Level 4: Analyze

List of Experiments

1	To study and perform extinguisher drills.
2	To study fire hose (Deliveryhose, Suction hose), Hose binding, Washing, Storage.
3	To study and perform rolling of hoses (Coil roll, Figure of 8 roll, Flaking roll, Dutch roll).
4	To perform different hose tests (Suction hose test, Delivery hose test, Hose reel hose test)
5	To perform the hose drill (Lifting, Lowering, Carrying, Laying, Connect, Disconnect, Remove the kink, Under running)
6	To study the rope construction and types of ropes (Natural rope (a. Italian hemp, b. Manila, c. Sisal, d. Coir, e. Cotton, f. Jute), Manmade rope (a. Synthetic, b. Nylon, c. Steel, d. Cara mandala))

7	To study and perform rolling of ropes.
8	To study and perform testing of ropes.

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

Course code	**MC-201B**				
Category	Mandatory Courses				
Course title	**Environmental Science**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III/IV**
	2	0	0	-	
Course Objectives	The objectives of this course are • To create awareness of the multidisciplinary nature and importance of environmental studies, including the sustainable management and conservation of natural resources. • To develop an understanding of ecosystem dynamics, biodiversity, pollution types, and their impacts on environmental and human health. • To foster critical thinking on social, ethical, and legislative aspects of environmental protection, emphasizing the role of individuals and society. • To engage students in practical learning through field work and case studies to apply environmental concepts for sustainable development and responsible citizenship.				
Assessment	20 Marks				
End Semester Examination	30 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	Describe key terminologies of environmental studies, natural resources, ecosystems, pollution, environmental laws and human-environment interactions.	Level 1: Remember
CO2	Explain the relationships among ecosystems, biodiversity, pollution, social issues, environmental ethics and related legislation for sustainable development.	Level 2: Understand
CO3	Apply principles of environmental management, pollution control, disaster management and sustainable practices in real world environmental contexts.	Level 3: Apply
CO4	Analyze environmental issues, population growth impacts, climate change, welfare programs and the role of information technology in promoting public health and environmental sustainability.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 4 parts (Covering all units) of 1.5 marks each and remaining eight questions of 6 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

The Multidisciplinary Nature of Environmental Studies: Definition, Scope and Importance.

Natural Resources: Renewable and Non-Renewable Resources; Natural Resources and Associated Problems.

(a) Forest Resources: Use and Over-Exploitation, Deforestation, Case Studies, Timber Extraction, Mining, Dams and their effects on Forests and Tribal People.

(b) Water Resources: Use and Over-Utilization of Surface and Groundwater, Floods, Drought, Conflicts Over Water, Dams—Benefits and Problems.

(c) Mineral Resources: Use and Exploitation, Environmental Effects of Extracting and Using Mineral Resources, Case Studies.

(d) Food Resources: World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer and Pesticide Problems, Waterlogging, Salinity, Case Studies.

(e) Energy Resources: Growing Energy Needs, Renewable and Non-Renewable Energy Sources, Use of Alternate Energy Sources, Case Studies.

(f) Land Resources: Land as a resource, Land Degradation, Man-Induced Landslides, Soil Erosion and Desertification.

Role of an Individual in Conservation of Natural Resources, Equitable Use of Resources for Sustainable Lifestyles.

Unit-II

Ecosystems: Producers, Consumers and Decomposers, Energy Flow in the Ecosystem, Ecological Succession, Food Chains, Food Webs and Ecological Pyramids—Introduction, Types, Characteristic Features, Structure and Function of Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem and Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans and Estuaries).

Biodiversity and Its Conservation: Introduction, Definition, Genetic Diversity, Species Diversity and Ecosystem Diversity. Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation, Hotspots of Biodiversity.

Values of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values.

Threats to Biodiversity: Habitat Loss, Poaching of Wildlife and Man–Wildlife Conflicts, Endangered and Endemic Species of India.

Conservation of Biodiversity: In-situ and Ex-situ Conservation.

Unit-III

Environmental Pollution: Definition, Causes, Effects and Control Measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution and Nuclear Hazards.

Solid Waste Management: Causes, Effects and Control Measures of Urban and Industrial Wastes, Role of an Individual in Prevention of Pollution, Pollution Case Studies.

Disaster Management: Floods, Earthquakes, Cyclones and Landslides.

Social Issues and the Environment: From Unsustainable to Sustainable Development, Urban Problems Related to Energy, Water Conservation, Rainwater Harvesting, Watershed Management, Resettlement and Rehabilitation of People, Problems and Concerns, Case Studies.

Environmental Ethics: Issues and Possible Solutions, Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies, Wasteland Reclamation, Consumerism and Waste Products.

Environmental Legislation: Environment Protection Act, Air Prevention and Control of Pollution Act, Water Prevention and Control of Pollution Act, Wildlife Protection Act, Forest Conservation Act, Issues Involved in Enforcement of Environmental Legislation, Public Awareness.

Unit-IV

Human Population and the Environment: Population Growth, Variation among Nations, Population Explosion, Family Welfare Programme, Environment and Human Health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human Health, Case Studies.

Field Work *(Equivalent to 10 Lecture Hours)*

- Visit to a Local Area to Document Environmental Assets—River, Forest, Grassland, Hill or Mountain.
- Visit to a Local Polluted Site—Urban, Rural, Industrial or Agricultural.
- Study of Common Plants, Insects and Birds.
- Study of Simple Ecosystems—Pond, River, Hills, Slopes, etc.

Suggested Readings:

- Environmental Biology by K.C. Agarwal, Nidi Pub. Ltd., Bikaner
- The Biodiversity of India by Bharucha, MAP in Publishing Pvt.Ltd., Ahmedabad.
- Hazardous Waste Incineration by R.C. Brunner, McGraw Hill Inc.,1989
- Environmental Chemistry by A.K. De, Wiley Eastern Ltd.
- Global Biodiversity Assessment by V.H. Heywood & R.T.Watson, Cambridge University Press, 1995, 1140p.
- Environmental Protection and Laws by H. Jadhav & V.M. Bhosale, Himalaya Pub. House, Delhi, 1995, 284p.
- Matter Hazardous by A.K. Mhaskar, Techno-Science Publications.
- Waste Water Treatment by M.N. Rao & A.K. Datta, Oxford & IBH Publ. Co. Pvt. Ltd., 1987, 345p.
- Environmental Chemistry by B.K. Sharma, Goel Publ. House, Meerut, 2001.
- Survey of the Environment, The Hindu.
- Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II by R.K. Trivedi, Enviro Media.
- Introduction to Air Pollution by R.K. Trivedi & P.K. Goel, Techno-Science Publications.
- Environmental Management by K.D. Wagner, W.B. Saunders Co., Philadelphia, USA, 1998, 499p.
- A Textbook of Environmental Education by Dr. J.P. Yadav, G.V.S. Publishers.

Useful Video Links:

Unit No.	Topics	Links
Unit-I	Environment Science: Introduction	https://www.youtube.com/watch?v=5QxxaVfgQ3k
	Natural Resources	https://www.youtube.com/watch?v=CXCT2R1K6Ts
	Ecosystem	https://www.youtube.com/watch?v=1dBU6HB8G6s
Unit-II	Biodiversity and its conservation	https://archive.nptel.ac.in/courses/102/104/102104068/
Unit-III	Sustainable Water Management In Urban Areas	http://digimat.in/nptel/courses/video/127106004/L29.ht
	Environmental Pollution	https://archive.nptel.ac.in/courses/123/105/123105001/
Unit-IV	Population and population growth	https://archive.nptel.ac.in/courses/102/104/102104068/
	National Family Welfare Programme	https://www.youtube.com/watch?v=X5F99L8ZEtc

Course Code	**PCC-FT-202B**				
Category	Professional Core Courses				
Course Title	**Structural Fire Engineering**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	3	0	0	**3**	
Course Objectives	The objective of this course are • To provide knowledge of building construction, fire safety requirements, and structural fire protection principles. • To develop understanding of fire-resistant construction, means of escape, fire detection systems, and passive fire protection measures in buildings. • To familiarize students with fire behaviour, fire load assessment, compartmentation, and fire safety design of building structures. • To create awareness about national and international standards related to fire safety in buildings and structural fire protection.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 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 buildings, construction, structural components, and fire safety terminology as per NBCS and IS standards.	Level 1: Remember
CO2	Explain the principles of fire development, building fire behavior, human response, fire detection systems, and compartmentation strategies in fire-safe design.	Level 2: Understand
CO3	Apply national codes and structural safety principles to assess exit planning, stair design, fire-resistant construction techniques, and fire safety systems for safe building designs.	Level 3 : Apply
CO4	Analyze building fire safety, fire severity and structural performance under fire conditions using fire resistance tests, design equations, and material behavior in elevated temperatures.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 1.5 marks each and remaining eight questions of 9 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

Building Fire Safety: Classification of building based on occupancy as per National Building Construction Standards (NBCS), Classification of types of construction according to fire resistance as per NBCS,General fire safety requirements applicable to all individual occupancies,fire zones as per NBCS, General exit requirements as per NBCS, Means of escape, Internal staircases, Horizontal exits, Fire tower, Ramps, Fire lifts, External fire escape ladders, Planning of location and calculation of capacity, Number and width of exit

as per NBCS for different types of occupancy, Sizes layout and various kinds of stairs in different kind of building, Egress and containment. Fire hazards in stilt parking, Basement parking and podium parking.

Unit-II

Building Materials: Introduction to the elements of structure, Study of different kinds of components of super-structures, Various common types of buildings with reference to relevant I.S. specifications, Different types of walls, Roofs and floors and their construction methods. Behaviour of elements of structure in a fire, Causes of wall collapse, Criteria for assessing the fire properties of building materials and elements of structure, Standards and guides for passive fire protection.

Unit-III

Fire Protection in Buildings: Fire safety in buildings, Process of fire development, Fire behaviour, Human behaviour, Fire detection and control system, Fire resistance, Fire design time, Fire load, and grading of occupancies by Fire load, Controlling fire spread, Compartmentation, Defend in place theory, Fire severity, Equivalent fire severity, Fire resistance test, Fire resistance of assemblies – Walls, Floors, Beams, Columns, Penetrations, joints, Fire doors, Ducts and glasses, Testing and inspection of fire doors, Firestop system, Material and fire dampers, Building construction for fire safety. Fire safety design of façade, Building integrated and building attached photovoltaic system.

Unit-IV

Structural Design: Design of structures exposed to fire - Structural design at normal temperatures, Loads, Structural design in fire conditions, Design equation, Loads for fire design, Structural analysis for fire design, Material properties in fire, Design of individual members exposed to fire, Design of structural assemblies exposed to fire, Structural Steel Fire Protection.

Concrete Structures: Behaviour of concrete structures in fire, Concrete materials in fire, Spalling of cover concrete, Concrete and steel reinforcing temperatures, Mechanical properties of concrete at elevated temperatures, Design of concrete members exposed to fire - Continuous slabs and beams, Axial restraint. International standards for structural fire protection.

Suggested Readings

- Fire Safety in Buildings by V K Jain, New Age publishers, New Delhi.
- National Building Construction Standards (NBCS)- Part-F (Latest Edition) Bureau Of Indian Standards
- Fundamentals of Fire Safety in Building Design by Dr. Than Singh Sharma, Aayush Publications, New Delhi
- Principles of Fire Safety Standards for Building Construction by M. Ya. Roytman, Amerind Publishing Co. Pvt. Ltd., New Delhi
- Structural Design For Fire Safety by Andrew H. Buchanan & Anthony K. Abu, John Wiley and Sons Ltd., New York, U.S.A.
- Relevant IS & NFPA codes
- Building materials and construction by B. C. Punmia, Laxmi Publications.

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	General Exit Requirements as per NBC	https://www.youtube.com/watch?v=O6CYQt9vi_Y	NPTEL (IIT Delhi)
	Stairs, Sizes layout	https://www.youtube.com/watch?v=hxakW1miEcM	NPTEL (IIT Kharagpur)
Unit-II	Roofs and floors construction methods	https://www.youtube.com/watch?v=ptsDs8bcxTI	NPTEL (IIT Delhi)
	Building Construction, Components of Super Structure	https://www.youtube.com/watch?v=X9tNq4kRm9s	Unacademy
Unit-III	Fire detection and control system	https://www.youtube.com/watch?v=vNKXzw6GCHw	NPTEL (Madras)
	Building construction for fire safety	https://www.youtube.com/watch?v=Z15UfahUsG0&t=251s	NPTEL (IIT Delhi)
Unit-IV	Fire resistance	https://www.youtube.com/watch?v=SuepcXmNREU	NPTEL (IIT Delhi)
	Structural Steel Fire Protection	https://www.youtube.com/watch?v=uOegFI_jNEc&t=775s	NPTEL (IIT Delhi)

Course Code	**PCC-FT-204B**				
Category	Professional Core Courses				
Course Title	**Fire Protection**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	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	30 Marks				
End Semester Examination	45 Marks				
Total	75 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 6 parts of 1.5 marks each and remaining eight questions of 9 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 CO_2, 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 byAkhil 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	**PCC-FT-206B**				
Category	Professional Core Courses				
Course Title	**Fluid Mechanics and Fire Service Hydraulics**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	3	0	0	3	
Course Objectives	The objectives of this course are • To introduce students to the fundamentals of fluid mechanics and hydrostatics relevant to fire protection engineering applications. • To develop understanding of fluid flow principles, fire hydraulics and flow measurement techniques used in firefighting systems. • To familiarize students with the operation, performance and maintenance of fire pumps, priming systems and hydrant systems. • To provide knowledge of sprinkler hydraulics, fire water distribution systems and hydraulic design considerations in fire protection engineering.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 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 fluid mechanics, fire hydraulics, fire pumps, hydrant systems, and sprinkler hydraulics used in fire protection engineering.	Level 1: Remember
CO2	Explain the behaviour of fluids, flow characteristics, hydraulic principles, pump operations and water distribution systems used in firefighting applications.	Level 2: Understand
CO3	Apply the principles of fluid mechanics and fire hydraulics to analyze fire water supply, pumping, hydrant, and sprinkler systems for fire protection.	Level 3: Apply
CO4	Analyze the hydraulic performance of fire water supply, pumping, hydrant, and sprinkler systems to ensure efficient and reliable fire protection.	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 Fluid Mechanics: Units and systems of measurements, Fluid properties: Density, Specific gravity, Viscosity, Surface tension and capillarity, Newtonian and non-Newtonian fluids, Concept of fluid and flow, Ideal and real fluids, Use of water in fire protection services.

Hydrostatics: Pressure, Pressure head, Pascal's law, Hydrostatic pressure distribution, Pressure variation in compressible and incompressible fluids, Effect of external force on pressure in vessels, Fluid pressure measurement using manometers and Bourdon pressure gauges.

Fire water storage concepts, Estimation of capacity of fire water tanks and reservoirs, Time of filling and emptying tanks, Applications of fluid mechanics in fire protection engineering.

Unit – II

Fluid Flow and Fire Hydraulics: Types of fluid flow, Flow rate and continuity equation, Concept of system and control volume, One-dimensional flow analysis, Euler's equation of motion, Bernoulli's equation and its engineering applications, Measurement of fluid flow using venturimeter, Orifice meter and pitot tube, Flow through pipes, Pressure loss in pipes and hoses, Friction loss calculations, Flow through pipes in series and parallel, Impulse-momentum principle and its applications in fire hydraulics, Design and operation of nozzles, Flow through nozzles, Discharge coefficient, Power transmitted through nozzles, Condition for maximum power transmission, Relation between nozzle and hose diameter, Fire stream characteristics and nozzle reaction.

Unit – III

Fire Pumps and Priming Systems: Classification and operation of fire pumps, Centrifugal pumps, Reciprocating pumps, Multistage pumps, Portable and vehicle-mounted fire pumps, Jockey pumps, Pump characteristics and performance curves, Cavitation and priming principles,Net positive suction head (NPSH), Priming devices and systems, Maintenance and testing of fire pumps, Operational safety and troubleshooting of pump systems.

Unit – IV

Hydrant Systems: Hydrant systems and hydrant accessories, Inspection, testing and maintenance of hydrants, Sources of water supply, Fire water distribution systems, Storage tanks, fire flow requirements, Determination of fire flow with reference to fire load and relevant standards, Principles and operational considerations of water relay systems.

Sprinkler System Hydraulics: Fundamentals of sprinkler hydraulics, Hydraulic analysis of sprinkler systems, Flow and pressure relationships in sprinkler systems, Sprinkler discharge characteristics, Pressure balancing in sprinkler systems, Role of pressure reducing valves, Water supply requirements for automatic sprinkler systems, Safety margins and redundancy in sprinkler system design.

Suggested Readings:

- Hydraulics and Fluid Mechanics by P.N. Modi, Dr. S.M. Seth, Rajsons Publications
- Hydraulic Mechanics and Hydraulics Machines by Dr. J. Lal, Metropolitan Book Pvt. Ltd.
- Manual of Firemanship
- Fire Service Hydraulics by Dr. G.C. Mishra, Masood Books
- Fluid Mechanics and Hydraulic Machines by Dr. R. K. Bansal, Laxmi Publications
- Fire Service Hydraulics and Pump Operations by Paul Spurgeon
- Sprinkler Hydraulics by Wass Jr.
- Fire Pumps and Hydraulics by I.E. Ditts and T.M. Harris.
- Fire-Fighting Hydraulics byPurington

Course Code	**PCC-FT-208B**				
Category	Professional Core Courses				
Course Title	**Industrial Hygiene and Occupational Health**				
Scheme and Credits	L	T	P	**Credits**	**Semester -IV**
	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	30 Marks				
End Semester Examination	45 Marks				
Total	75 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 industrial hygiene, hazards, occupational health and personal protective equipment used in occupational safety engineering.	Level 1: Remember
CO2	Explain the principles of exposure assessment, toxicology of industrial chemicals, ventilation systems, hazards, occupational diseases and PPE systems in industrial environments.	Level 2: Understand
CO3	Apply industrial hygiene principles, exposure control methods, ventilation techniques, ergonomic practices, and PPE selection procedures for managing workplace hazards and occupational risks.	Level 3: Apply
CO4	Analyze different hazards along with occupational health risks, exposure patterns, and control measures for improving workplace safety and health conditions.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 1.5 marks each and remaining eight questions of 9 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, Shyamaraj 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 Managementby NaseerElahi, Kalpaz Publications.
- Safety Management System and Documentation Training Programme Handbook (Pb 2019) by SV Paul, CBS Publication.
- Safety, Occupational Health and Environmental Management in Constructionby S.C.Sharma, Vinit Kumar, Khanna Publishers.
- Industrial Safety and Maintenance Managementby M.P. Poonia, S.C. Sharma, P. Sojan Lal, Khanna Publishing House, New Delhi

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Introduction of Industrial Hygiene	https://youtu.be/lJnLdUFx2gc	NPTEL (IIT Roorkee)
	Toxicological properties and routes of exposure	https://youtu.be/jZvgAUYtS_Y	NPTEL (IIT Roorkee)
	Dose response relationship	https://youtu.be/IxRvsiZkZQ0	NPTEL (IIT Roorkee))
Unit-II	Noise vibration and radiation	https://youtu.be/IxRvsiZkZQ0	NPTEL (IIT Roorkee)
	Heat and stress	https://youtu.be/eIBHwaoG7rM	NPTEL (IIT Guwhati)
Unit-III	Radiation Effects	https://youtu.be/ttfmgTweI-4	NPTEL (IIT Madras)
Unit-IV	Safety Law	https://youtu.be/jFDWlKayrTc?list=PLbRMhDVUMngdXebaRB59KdKwstzuAovua	NPTEL (IIT Kharagpur)

Course Code	**PCC-FT-210B**				
Category	Professional Core Courses				
Course Title	**Electrical Fire Safety Practice and Standards**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	3	0	0	**3**	
Course Objectives	The objectives of this course are • To introduce students to electrical materials, wiring systems, protection devices and electrical safety practices used in industrial and fire safety applications. • To develop understanding of electrical fire hazards, insulation failures, electrical shock phenomena and fire investigation procedures. • To familiarize students with hazardous area classification, explosion proof equipment and statutory safety requirements related to electrical systems. • To provide knowledge of electrical fire prevention, safety management practices and investigation techniques for electrical failures and fires.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 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 electrical systems, protection devices, electrical fires, hazardous zones and fire safety.	Level 1: Remember
CO2	Explain the principles of electrical systems, protection devices, electrical fire mechanisms, shock phenomena, hazardous area classification, and statutory requirements.	Level 2: Understand
CO3	Apply electrical safety principles, protection systems, firefighting procedures, and statutory guidelines to minimize electrical fire and shock hazards.	Level 3: Apply
CO4	Analyze electrical failures, fire incidents, hazardous installations, and management practices to recommend appropriate preventive and control measures.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 1.5 marks each and remaining eight questions of 09 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: Conductor, Classification and property of conductors, Semiconductors, Cables, Wires, Wire splicing and termination, Joints, General electrical accessories and insulating materials.

Terminology: Electrical fire, Failure, Defect, Seed defect, Modes and mechanism of failure, Failure rate, Metal fatigue, Elasticity of metals, Creep, Stress, Strain, Elastic and endurance limit.
Wiring System: System of supply, Selection of wiring, Rules and system of wiring, Separation of power and lighting circuit, Necessity of earthing, System of earthing, Rules of earthingand Methods of improving the earth resistance.

Unit-II

Protection Devices: Introduction, Features of good protective device, Relays, Fuses, Circuit breaker, General specification of MCB's, Trip mechanism, ELCB, RCCB.

Electrical Fire: Introduction, Causes of electrical fires, Failure of insulation, Types and causes, Transformer failure, Failure modes, Investigation overheating/ burning of crimped sockets, Failure of plug and socket connectors.

Unit-III

Electrical Shock Phenomenon: Shocks from AC and DC system, Medical analysis of electrical shock, Prevention of shocks, Safety precaution in electrical plant, Safety precaution against contacts shock, Flash shocks and burns.

Electricity and the Fire Service: Introduction, Electrical hazards and safeguards, Firefighting procedure, Fires in generating stations, Fires in transformers, Fires in substations, Fires in cable boxes, Fires in industrial premises, Fires in private dwellings, Fires involving storage batteries, Fires involving electric railways, Fires in motor cars, relevant standards.

Unit-IV

Hazardous Zones: Classification of hazardous zones, intrinsically safe and explosion proof electrical apparatus, Selection of equipment in hazardous area Electrical Fires, Hazards of static electricity, Safety procedures in electrical maintenance, statutory requirements from electrical inspectorate, Introduction to Indian Electricity Act and Rules.

Investigation of failures and fires: Process of investigation, failure investigation: step by step approach, investigation of electrical fire, action plan.

Role of the Management: Materials and Training, preparation of specification, selection of supplier, inspection of material, training of staff, tools and instruments.

Suggested Readings:

- Electrical Wiring Estimating and Costing by S.L. Uppal, Khanna Publishers.
- Electrical Fires and Failures by A.A. Hattangadi, TMH Publishers.
- Electricity Fire Risk by G.S. Hoges.
- NFPA Manual.
- J.P. Handbook.
- Electrical Safety, Fire Safety and Safety Management by S. Rao, Khanna Publishers, Delhi
- Electrical Safety Handbook by John Cadick, TMH publishers, 6th Edition
- Basic Electrical Engineering by C.L.Wadhwa, New Age Publishers

Course Code	**LC-PCC-FT-212B**				
Category	Professional Core Courses				
Course Title	**Structural Fire Engineering Lab**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	0	0	2	**1**	
Course Objectives	The objectives of this course are • To provide hands-on practical knowledge of the mechanical and structural properties of construction materials such as steel, concrete, timber and burnt clay bricks under normal and fire-exposed conditions. • To build competency in analyzing material behavior under loading, bending, and elevated temperature conditions for safe structural design and fire safety applications. • To familiarize students with destructive and non-destructive testing techniques for evaluating the performance, durability and integrity of structural materials. • To enhance understanding of fire resistance and fire performance testing of structural components, fire doors and fire stop materials in accordance with relevant national and international standards.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 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 properties of steel, concrete, timber, and burnt clay bricks using standard laboratory tests.	Level 2: Understand
CO2	Demonstrate testing procedures for tensile strength, compressive strength, strain, moisture content, water absorption, and Young's Modulus.	Level 3: Apply
CO3	Analyze the behavior of structural materials using destructive and non-destructive testing methods.	Level 4: Analyze
CO4	Evaluate the fire resistance and fire performance of structural components and firestop systems as per relevant standards.	Level 5: Evaluate

List of Experiments

Sr. No.	Contents
1	To determine the tensile strength of steel at ambient temperature.
2	To measure the strain in steel using strain gauge.
3	To determine the compressive strength of concrete at ambient temperature.

4	To determine the compressive strength of concrete by Non-Destructive Testing.
5	To determine the moisture content of timber using oven drying methods.
6	To study the fire resistance testing of structural components including fire doors, beams, columns, slabs, and facade systems according to relevant standards.
7	To determine the Young's Modulus of a bar material under non-uniform bending by measuring its deflection.
8	To evaluate the fire performance of firestop and sealing materials according to relevant standards.
9	To determine the water absorption of burnt clay brick.
10	To determine the compressive strength of burnt clay brick.

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-PCC-FT-214B**				
Category	Professional Core Courses				
Course Title	**Fire Protection Lab**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	0	0	2	**1**	
Course Objectives	The objectives of this course are • To provide practical knowledge of fire detection, alarm and fire protection systems used in fire safety engineering. • To develop understanding of the operation, inspection, testing and maintenance procedures of fire protection systems and equipment. • To familiarize students with extinguishing agents, foam systems and firefighting equipment used in fire suppression applications. • To provide hands-on exposure to testing procedures, operational demonstrations and maintenance practices as per relevant fire safety standards and codes.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 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 about the components, operation, applications and limitations of fire detection, alarm and fire protection systems used in firefighting.	Level 2: Understand
CO2	Perform operational testing, inspection and maintenance procedures for fire protection systems and portable fire extinguishers as per relevant standards.	Level 3: Apply
CO3	Determine the physical properties, expansion ratio and drainage characteristics of firefighting foam concentrates and foam systems.	Level 4: Analyze
CO4	Assess the performance, applications and maintenance requirements of firefighting agents, foam systems and fire protection equipment.	Level 5: Evaluate

List of Experiments:

Sr. No.	**Contents**
1	To study the components, principle of operation, testing and maintenance of Fire Detection and Alarm Systems.
2	To study the layout, components and basic requirements of Fire Pump House as per relevant standards.
3	To study the components, principle of operation, inspection, testing and maintenance of Fire Hydrant Systems.
4	To study the components, principle of operation and applications of Automatic Sprinkler Systems.
5	To perform operational testing and discharge demonstration of portable fire extinguishers including water, foam and dry chemical powder type extinguishers as per relevant IS standards.
6	To study Passive Fire Protection Systems including fire doors, fire stopping systems and

	compartmentation.
7	To study the extinguishing mechanism, applications and limitations of water as a firefighting agent.
8	To study the extinguishing mechanism, applications and limitations of Dry Chemical Powder extinguishing agents.
9	To determine the physical properties of foam concentrates used for mechanical foam firefighting systems as per relevant IS standards.
10	To determine the expansion ratio and drainage characteristics of mechanical firefighting foam.
11	To study the operation and applications of foam generating equipment and foam protection systems.
12	To conduct inspection, testing and maintenance procedures for fire protection systems as per relevant codes and standards.

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.

Text Books/ Reference Books:

- Industrial Fire Protection Engineering by Robert G. Zalosh.
- NFPA Fire Protection Handbook - National Fire Protection Association.
- SFPE Handbook of Fire Protection Engineering - Society of Fire Protection Engineers.
- Fire Protection Systems by A. Maurice Jones Jr.
- Principles of Fire Protection by Arthur E. Cote and Percy Bugbee.
- National Building Construction Standard Part-F: Fire and Life Safety.
- Relevant Indian Standards related to Fire Detection and Alarm Systems, Hydrant Systems, Sprinkler Systems, Fire Pumps, Fire Extinguishers and Foam Systems.
- Relevant NFPA Standards including NFPA 10, NFPA 11, NFPA 13, NFPA 14, NFPA 20, NFPA 24, NFPA 72 and NFPA 101.
- UL Standards related to Fire Protection Systems and Equipment.
- Manufacturer manuals and technical data sheets related to Fire Detection Systems, Sprinkler Systems, Fire Pumps, Hydrant Systems and Foam Systems.

Course Code	**LC-PCC-FT-216B**				
Category	Professional Core Courses				
Course Title	**Fire Service Hydraulics Lab**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	0	0	2	**1**	
Course Objectives	The objectives of this course are • To introduce students to fundamental principles and tools used in hydraulic and fire safety systems. • To develop students ability to conduct experiments and analyze hydraulic performance in fire protection applications. • To familiarize students with essential fire protection components such as hydrants, pumps, and sprinkler systems. • To instill practical skills for evaluating and maintaining fluid dynamics equipment used in fire engineering.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 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 of water supply systems, hydrant types, and the physical properties of water used in fire protection.	Level 2: Understand
CO2	Apply the continuity equation and flow measurement techniques to measure discharge through pipes, nozzles, and firefighting hoses.	Level 3: Apply
CO3	Analyze the impact of free water jets on different surfaces and evaluate flow characteristics through different firefighting equipment.	Level 4: Analyze
CO4	Evaluate the performance, efficiency, and operational reliability of pumps and automatic sprinkler systems used in fire suppression.	Level 5: Evaluate

List of Experiments

Sr. No.	**Contents**
1	To study pressure measurement devices.
2	To study and identify different types of fire hydrants and their components.
3	To measure force exerted by jet on stationary and moving plates (Impact of jet apparatus).
4	To determine discharge through rectangular and trapezoidal notches.
5	To verify Bernoulli's theorem for flow through pipes.
6	To determine pressure loss in pipes due to friction (Darcy-Weisbach Equation)
7	To determine coefficient of discharge for venturimeter.
8	To determine efficiency of centrifugal pump and plot operational characteristics curve.
9	To determine efficiency of reciprocating pump.
10	To test the activation and spray pattern of a sprinkler head.

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-PCC-FT-218B**				
Category	Professional Core Courses				
Course Title	**Industrial Hygiene and Occupational Health Lab**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	0	0	2	**1**	
Course Objectives	The objectives of this course are • To provide practical exposure to measurement and monitoring techniques used for assessment of occupational health hazards in workplaces. • To develop understanding of industrial hygiene instruments and methods used for evaluation of physical, chemical and ergonomic hazards. • To familiarize students with occupational health assessment procedures, air monitoring techniques and workplace safety evaluation practices. • To provide hands-on knowledge of personal protective equipment evaluation, workplace ventilation assessment and industrial exposure monitoring techniques.				
Assessment	10 Marks				
End Semester Examination	15 Marks				
Total	25 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 air sampling, dust monitoring, gas detection and ergonomic assessment for identification of occupational health hazards in industries.	Level 3: Apply
CO2	Assess personal protective equipment practices, workplace exposure conditions and control measures for improvement of occupational health and safety.	Level 4: Analyze
CO3	Evaluate noise exposure, lung function, hearing capability, occupational fitness and workplace ventilation conditions using standard assessment techniques.	Level 5: Evaluate
CO4	Measure workplace noise, illumination, heat stress, airborne contaminants and gas concentrations using industrial hygiene instruments and monitoring devices.	Level 5: Evaluate

List of Experiments:

S.No.	**Contents**
1	To measure workplace noise levels using an Integrated Sound Level Meter.
2	To evaluate noise exposure dose using a personal noise dosimeter.
3	To measure illumination levels at workplace using a Lux Meter.
4	To assess thermal comfort and heat stress using WBGT apparatus.

5	To perform lung function testing using a Spirometer.
6	To evaluate hearing capability and hearing loss using a Pure Tone Audiometer.
7	To conduct vision testing for occupational fitness assessment.
8	To conduct air sampling and dust monitoring using a personal air sampling pump.
9	To determine airborne dust concentration using a High Volume Air Sampler.
10	To monitor the presence of toxic gases using portable gas detection instruments.
11	To detect the presence of flammable gases using a combustible gas indicator.
12	To assess ergonomic risk factors associated with body posture and manual material handling activities.
13	To select, use and maintain Personal Protective Equipment used in industries.
14	To assess workplace ventilation effectiveness using airflow measurement devices.
15	To monitor ammonia concentration and evaluate control measures in industrial environments.

Note: At least 10 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-PCC-FT-220B**				
Category	Professional Core Courses				
Course Title	**Fire Ground Operations -IV**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	0	0	2	**1**	
Course Objectives	The objectives of this course are • To familiarize students with essential fire-fighting equipment including hoses, extinguishers, ropes, and ladders used in field operations. • To train students in correct handling techniques and drills for fire hoses, extinguishers, and ladders following safety protocols. • To develop practical competence in inspecting, testing, and maintaining the functional readiness of fire-fighting equipment. • To promote teamwork, coordination, and responsiveness essential for real-time fire emergency handling through structured drills and exercises.				
Assessment	10 Marks				
End Semester Practical Examination	15 Marks				
Total	25 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 operational principles, testing standards, and storage techniques for fire-fighting hoses, hydrant, extinguishers, ladders and ropes.	Level 2: Understand
CO2	Perform hydrant drills, hydrant testing, and fire extinguisher operations for emergency response.	Level 3: Apply
CO3	Demonstrate pump drills and ladder testing procedures using standard firefighting practices.	Level 3: Apply
CO4	Analyze the readiness, safety, and effectiveness of fire-fighting equipment through inspection and standard testing methods.	Level 4: Analyze

List of Experiments

Sr. No.	Contents
1	To study different types of hydrants: Ball type, Sluice valve, Screw down, Pillar and post types of valves.
2	To study different types of hydrant fittings, Types of hydrant gear, Hydrant testing equipment.
3	To perform three men hydrant drill (Add, Remove and replace of hose, Dividing breeching, Collecting breeching.
4	To perform four men hydrant drill (Add, Remove and replace of hose, Dividing breeching, Collecting breeching).
5	To perform hydrant test.
6	To study different types of fire extinguishers, Rating of portable extinguishes for class A, B and C fires. Limitations of portable extinguishers, Operation, Refilling, Testing and maintenance of fire

	extinguishers, Inspection requirement of portable extinguishers.
7	To perform a foam drill.
8	To perform four men pump drill.
9	To perform a six men pump drill.
10	To study different types of ladders and their parts.
11	To perform different ladder tests (Round test, String test, Extension line test).

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

Course Code	**PEC-FT-222B**				
Category	Professional Elective Courses				
Course Title	**Industrial Psychology**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	3	0	0	**3**	
Course Objectives	The objectives of this course are • To introduce students to the fundamentals, development and applications of industrial psychology in workplace environments. • To develop understanding of individual behaviour, motivation, job satisfaction and psychological factors influencing work performance. • To familiarize students with employee selection methods, job analysis techniques and fair employment practices used in organizations. • To provide knowledge of performance appraisal, organizational training and career development practices in industrial management.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 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, theories, psychological factors and workplace practices associated with industrial psychology and employee behaviour.	Level 1: Remember
CO2	Explain the principles of motivation, job satisfaction, employee selection, job analysis, performance appraisal and organizational training used in workplaces.	Level 2: Understand
CO3	Apply psychological principles and assessment techniques for employee management, performance evaluation and workplace development.	Level 3: Apply
CO4	Analyze individual behaviour, motivational factors, appraisal systems and training practices for improving organizational effectiveness and employee performance.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 1.5 marks each and remaining eight questions of 9 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 to Industrial Psychology: Nature and Development of Industrial/Work Psychology - Historical background, Scientific Management, Time and Motion Study, Hawthorne Studies, World War I & II, Scope &Challenges, Current status.

Unit-II

People at Work: Individual Differences, Personality, Intelligence, Emotional Intelligence, Creativity & Innovation, Perception & Attitudes. Motivation, Expectancy, Equity & Goal Setting Theories,

ModernApproach to Motivation: Employee Predisposition, Expectations, Goals, & Incentives Job Satisfaction- Job Characteristic Theory (Diagnostic Model), Measuring Job Satisfaction Psychometric Testing at Work- Cognitive Abilities.

Unit-III

Managing People at Work-I: Employee Selection- Techniques, Fair Employment Practices, Recruitment, Biographical Information, Interviews, References& Letters of Recommendation. Job Analysis, Types, Newer Developments.

Unit-IV

Managing People at Work-II Performance Assessment: Evaluation & Appraisal- Objective & Subjective Techniques, Bias in Appraisals, Development Plans, Organizational Training,Types of Training, Psychological Issues, Career Development & Planning.

Suggested Readings:

- Introduction to Industrial and Organizational Psychology by Duane P. Schultz & Sydney, Ellen Schultz Pearson Education, New Delhi.
- Industrial Psychology by Michael G. Aamodt, Cengage Learning, Delhi.
- Work Psychology by L. Matthewman, Anabel Rose & Amanda Hetherington, Oxford University Press, New Delhi.
- Work in the 21st Century: An Introduction to Industrial and Organizational Psychology by Frank J. Landy& Jeffrey M. Conte, Wiley India, New Delhi.
- Industrial Psychologyby Ashish Pandey & Atul Kumar Sharma, Global Academic Publishers, New Delhi.

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	History and Genesis of Psychology	https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_hs14	NPTEL(IIT Kharagpur)
	Scientific management and time motion study	https://onlinecourses-archive.nptel.ac.in/noc18_me68/preview?utm_source	NPTEL(IIT Roorkee)
Unit-II	Organizational Behaviour (Personality, Attitude and Perception)	https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_mg73	NPTEL(IIT Hyderabad)
Unit-III	Recruitment and Selection	https://www.digimat.in/nptel/courses/video/122105020/122105020.html?utm_source	NPTEL IIT(Kharagpr)
Unit-IV	Performance Evaluation and Career development and Planning	https://www.classcentral.com/course/youtube-core-human-resource-management-i-47643?utm_source	NPTEL(IIT kharagpur)

Course Code	**PEC-FT-224B**				
Category	Professional Elective Courses				
Course Title	**Chemical Process Safety**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	3	0	0	**3**	
Course Objectives	The objectives of this course are • To develop the understanding of students regarding foundational understanding of process safety culture, risk perception, and regulatory frameworks in industrial operations. • To make the students familiar with knowledge of toxicology, industrial hygiene, and hazard identification related to chemical exposure. • To train students in preventive strategies for fire, explosion, and chemical reactivity hazards in process industries. • To introduce safety design strategies, relief systems, and real-world case-based learning for effective hazard mitigation.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 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 terms related to process safety, toxicology, industrial hygiene, fire and explosion, reliefs, safety strategies and hazard mitigation frameworks.	Level 1: Remember
CO2	Explain the fundamentals of risk analysis, fire/explosion prevention, toxicant exposure control, chemical reactivity and process safety strategies.	Level 2: Understand
CO3	Apply process safety principles, industrial hygiene practices, fire and explosion prevention methods, and relief system concepts to industrial processes.	Level 3: Apply
CO4	Analyze process hazards, toxic exposures, fire and explosion risks and safety strategies to recommend appropriate risk control measures.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 1.5 marks each and remaining eight questions of 9 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: Definition, myths about process safety, Safety culture, Essential features of safety culture, Individual risk, Societal risk and risk populations, Voluntary and involuntary risk, Safety metrics, Safety and accident loss statistics, Risk perception, Risk tolerance/acceptance and risk matrix, Risk management and hazardous substance rules, The CCPS 20 elements of risk-based process safety, Inherently safer design, strategies.

Unit-II

Toxicology: Introduction, Routes & exposure, Entry routes for toxicants and methods for control, Elimination of toxicants from the body, Effects of toxicants on the body, Dose response relationship, Dose response and threshold dose: predictive models and extrapolation, Relative toxicity.

Industrial Hygiene: Regulations and identification, Anticipating and identifying hazardous workplace exposures, Globally harmonized system for safety data sheets, Globally harmonized system for labeling, evaluate the magnitude of exposures and responses, noise, Vibration and radiation, develop and evaluate control techniques to prevent exposures, National Fire Protection Association Diamond.

Unit-III

Concepts to Prevent Fires and Explosions: Inerting and purging, Static electricity, General design methods to prevent fire, Explosion-proof equipment and instruments, Ventilation, Fire extinguishers, Sprinkler systems, Industry's fire and explosion protection strategy.

Chemical Reactivity: Key steps in reactivity hazard evaluation, Commitment, Awareness and identification of reactive chemical hazards, controlling reactive hazards.

Unit-IV

Introduction to Reliefs: Relief concepts, Definitions, Type of reliefs and characteristics, Code requirements, Relief system design, Relief installation practices, Relief effluent handling.

Safety Strategies, Procedures and Designs: Process safety strategies, Safe operating procedures, Safe work practices, Designs for process safety, Designs for runaway reactions, Designs and practices for the safe handling of dusts, Case histories and lessons learned.

Suggested Readings:

- Chemical Process Safety: Fundamentals with applications by Crowl and Louvar (2002), New Jersey: Prentice Hall.
- Evaluating Process Safety in the Chemical Industry by Arendt and Lorenzo (2000), New York: CCPS.
- Lees Handbook of Loss Prevention in Chemical Process Industries: hazard identification, assessment and control by Lees F. P. (2005), Butterworths.
- King's safety in the process industries by King et al. (1998), London: Wuerz Publishing Ltd.

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Safety and Accident Loss Statistics	https://www.youtube.com/watch?v=dlhXg7KkD0M	NPTEL (IIT Roorkee)
	Risk Management and Hazardous Substance Rules	https://www.youtube.com/watch?v=QYBA9FNoNDw	
Unit-II	Introduction, Routes & Exposure	https://www.youtube.com/watch?v=jZvgAUYtS_Y	
	Dose Response Relationship	https://www.youtube.com/watch?v=jZvgAUYtS_Y	
	Dose Response and Threshold Dose: Predictive models and Extrapolation	https://www.youtube.com/watch?v=_Ut_1L2JlQA	
Unit-III	Designs to prevent Fire and Explosion: Inerting and Purging	https://www.youtube.com/watch?v=PaBDQ-lOGRM	
	Sprinkler Systems	https://www.youtube.com/watch?v=ZKsqIPM810M	
Unit-IV	Introduction to Reliefs	https://www.youtube.com/watch?v=Cs8DQ_9f5qM	
	Type of Reliefs	https://www.youtube.com/watch?v=Q-4601m2zag	

Course Code	**PEC-FT-226B**				
Category	Professional Elective Courses				
Course Title	**Environmental Engineering and Management**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	3	0	0	**3**	
Course Objectives	The objective of this course are • To develop understanding of air, water, solid, and hazardous waste pollution and control methods. • To familiarize students with environmental monitoring, treatment techniques, and waste management practices. • To develop awareness about environmental management systems, cleaner technologies, and sustainable industrial practices. • To enable students to understand environmental legislation, ISO 14001 EMS, and pollution prevention strategies.				
Assessment	30 Marks				
End Semester Examination	45 Marks				
Total	75 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 pollution control, waste management, and environmental management.	Level 1: Remember
CO2	Explain the principles of pollution control, waste treatment, and environmental management systems.	Level 2: Understand
CO3	Apply pollution control and waste management techniques for environmental protection.	Level 3 : Apply
CO4	Analyze environmental pollution and management practices to recommend sustainable solutions.	Level 4: Analyze

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 partsof 1.5 marks each and remaining eight questions of 9 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

Air Pollution: Sources of air pollution, Effects of air pollution, Classification of pollutants, Atmospheric transport of pollutants-Wind profiles, Atmosphere stability, Inversion, Turbulence, Dispersion and diffusion of air pollutants, Gaussian plume dispersion model, Principles and techniques of ambient air and stack emission monitoring, Particulate matter control equipments, Working principles of gravity settlers , cyclones, wet scrubbers, fabric filters and electrostatic precipitators, Gaseous control methods- an overview of absorption, Adsorption and combustion methods; Biological methods for VOC and odor control.

Unit-II

Waste Water: Physical, chemical and biological characteristic of waste water, Effects of pollutants on water quality and aquatic life, Physical unit operations in waste water treatment-Flow equalization, Sedimentation and flotation, Chemical unit processes in waste water treatment-Coagulation and flocculation, Chemical precipitation and adsorption, Biological unit processes: kinetics of microbial growth.
Aerobic Treatment Systems: Working principle and design parameters of trickling filter, Activated sludge process and rotating biological contactor.
Anaerobic Treatment Systems: Mechanism of anaerobic process, Low rate and high rate digesters, Working principle and applications of anaerobic filters and UASB, Biological nitrification: Denitrification, Characteristics and treatment methods forthe waste water from fertilizer plants, petroleum refineries, Pulp and paper mills and distilleries.

Unit-III

Solid Wastes: Environmental, Aesthetic and health risk, Sources, Quantities and composition of solid wastes, Storage, collection and transportation of urban solid waste, Disposal options- Sanitary landfills, Composting and its variations, Anaerobic digestion, Incineration and pyrolysis, Vermicomposting, Recovery alternative, Monitoring of solid wastes.

Hazardous Wastes: Definition and classification, Health and environmental effects, Treatment, Disposal and management of hazardous wastes, Legal frame work for hazardous waste management in India.

Unit-IV

Environmental Management in Industries: Principles and requirements of ISO 14001 EMS, Environmental auditing and auditing for waste minimization, Environmental impact assessment, Prediction and assessment of impacts, Methods of impact analysis, Indian scenario, Public participation in environmental decision making, Strategies for pollution prevention- Recycle and reuse, Cleaner technologies.

Life cycle Assessment: Principle and methodology, Industrial ecology, Clean development mechanism (CDM), Carbon trading.

Suggested Readings

- Environmental Pollution Control Engineering by C.S. Rao, New Age International (P) Ltd.
- Wastewater Treatment by M.N. Rao and A.K. Dutta, Oxford & IBH, Publishing Co. Pvt. Ltd, New Delhi.
- Handbook of solid waste Disposal and Management by Pavani, J. L, New Age International (P) Ltd.
- Waste Water Engineering: Treatment, Disposal, Reuse by Metcalf and Eddy Inc, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- Environmental Impact Assessment by Canter. L.W, Irwin / McGraw – Hill,NewYork.
- Environmental Engineers Handbook by David, H.F. Liu, Lewis Publishers, New York.
- Industrial Safety, Health and Environment Management System by R.K. Jain and S.S. Rao, Khanna Publishers.
- Safety in Chemical Plants/ Industry & its Management by B. K. B.Rao, R .K. Jain, V. Kumar, Khanna Publishers.
- Environmental Health and safety: Principles and Practices by S. Alauddin, C. Bhattacharya, S. Rawat, A. K. Saran, RK Publication.

Useful Video Links

Unit No.	Topic	Link	Source
Unit-I	Introduction of air pollution	https://youtu.be/u142u-wJFwI?list=PLLy_2iUCG87BwOQUbS7WSdMVWHDXByk-w	NPTE (IIT Roorkee)
	Impact of air pollution	https://youtu.be/z4YFkK3Wtsg?list=PLLy_2iUCG87BwOQUbS7WSdMVWHDXByk-w	NPTE (IIT Roorkee)
	Atmospheric stability and lapse rate	https://youtu.be/rQjTM7AVK2k?list=PLLy_2iUCG87BwOQUbS7WSdMVWHDXByk-w	NPTE (IIT Roorkee)
Unit-II	Water and waste water characteristics	https://youtu.be/wI7uvQThX8A	NPTEL (IIT Madras)
	Coagulation and flocculation	https://youtu.be/p2ZtijyhLQE?list=PLLy_2iUCG87A3YUD6wAYrgnhCsYhk72Tw	NPTE (IIT Roorkee)
	USAB Reactor	https://youtu.be/tNq7lZLqCiU	NPTE (IIT Kharagpur)
Unit-III	MSW management	https://youtu.be/cjIacnNRLHE?list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv	NPTE (IIT Guwahati)
	Landfilling	https://youtu.be/19JtBKeENAQ	NPTE (IIT Guwahati)
Unit-IV	EMS	https://youtu.be/BYqLRGawoH0	NPTE (IIT Guwahati)
	EIA	https://youtu.be/_iLdyhgFv1U?list=PLA44FuTLCwbfl50Onai5LZRDw9mAIlzfS	NPTE (IIT Guwahati)

Course Code	**PEC-FT-228B**				
Category	Professional Elective Courses				
Course Title	**Special Fire Hazards**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	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	30 Marks				
End Semester Examination	45 Marks				
Total	75 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 and standards related to transportation, industrial, building, and nuclear fire safety.	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 6 parts of 1.5 marks each and remaining eight questions of 9 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 IS3947, 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
- Relevant OISD Standard