GANGA INSTITUTE OF TECHNOLOGY AND MANAGEMENT, KABLANA (JHAJJAR)

An Autonomous Institute

'A' GRADE ACCREDITED BY NAAC

Evaluation Scheme & Syllabus For

Bachelor of Technology Fire Technology and Safety

(Effective from the Session: 2025-26)

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	22
3	Professional Core Courses	71
4	Professional Elective Courses (Relevant to chosen specialization/branch)	18
5	Indian Knowledge System	
6	Multidisciplinary Open Electives Courses	9
7	Humanities and Social Sciences including Management courses	15
8	Project work, seminar and internship in industry or appropriate work place/ academic and research institutions in India/abroad	14
9	Mandatory Non Credit Courses – Audit Course	(Non-Credit)
	Total Credits	**170**

**Minor variation is allowed as per need of the respective disciplines.*

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	MOEC
7	Humanities and Social Sciences including Management courses	HSMC
8	Laboratory Courses	LC
9	Mandatory Non-Credit Courses – Audit Course	MAU
10	Project	PR
11	Internship	INT

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

Scheme of Studies and Examinations

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

w.e.f. 2025-26

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-MFT-201A	Engineering Mathematics-III	3	1	0	4	4	40	60		100	3
2	Professional Core Course	PCC-FT-203A	Fundamentals of Fire Engineering	3	0	0	3	3	40	60		100	3
3	Professional Core Course	PCC-FT-205A	First Aid and Paramedics	3	0	0	3	3	40	60		100	3
4	Professional Core Course	PCC-FT-207A	Fluid Mechanics	3	0	0	3	3	40	60		100	3
5	Engineering Science Courses	ESC-ME-209A	Thermal Engineering	3	0	0	3	3	40	60		100	3
6	Humanities and Social Science including Management Courses	HSMC-01A	Fundamentals of Management and Organizational Behaviour	3	0	0	3	3	40	60		100	3
7	Professional Core Course	LC-FT-211A	Fire Engineering Lab	0	0	2	2	1	25		25	50	3
8	Professional Core Course	LC-FT-213A	First Aid and Paramedics Lab	0	0	2	2	1	25		25	50	3
9	Engineering Science Course	LC-FT-215A	Thermal Engineering Lab	0	0	2	2	1	25		25	50	3
10	Professional Core Course	LC-FT-217A	Fire Ground Operation-III	0	0	2	2	1	25		25	50	3
Total Credits								**23**				**800**	

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

Scheme of Studies and Examinations

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

w.e.f. 2025-26

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 Course	PCC-FT-202A	Structural Fire Engineering	3	0	0	3	3	40	60		100	3
2	Professional Core Course	PCC-FT-204A	Heat Transfer, Combustion and Explosives	3	0	0	3	3	40	60		100	3
3	Professional Core Course	PCC-FT-206A	Fire Service Hydraulics	3	1	0	4	4	40	60		100	3
4	Professional Core Course	PCC-FT-208A	Fundamentals of Safety Engineering	3	0	0	3	3	40	60		100	3
5	Professional Core Course	PCC-FT-210A	Safety in Construction	3	0	0	3	3	40	60		100	3
6	Professional Elective Courses	Refer Table-1	Professional Elective-I	3	0	0	3	3	40	60		100	3
7	Professional Core Course	LC-FT-212A	Structural Fire Engineering Lab	0	0	2	2	1	25		25	50	3
8	Professional Core Course	LC-FT-214A	Fire Service Hydraulics Lab	0	0	2	2	1	25		25	50	3
9	Professional Core Course	LC-FT-216A	Heat Transfer, Combustion and Explosives Lab	0	0	2	2	1	25		25	50	3
10	Professional Core Course	LC-FT-218A	Fire Ground Operation-IV	0	0	2	2	1	25		25	50	3
11	Mandatory Non Credit Courses – Audit Course	MC-201A	Environmental Science	2	0	1	3	-	40	60		-	3
Total Credits								**23**				**800**	

Notes:

I. MC-201A is a mandatory non –credit course in which the students will be required passing marks in theory.

II. 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.

III. Choose any one from Professional Elective-I

Table 1 Professional Elective – I

Sr. No.	Code	Subject
1	PEC-FT-220A	Electric Fire Safety Practice and Standards
2	PEC-FT-222A	Industrial Psychology
3	PEC-FT-224A	Chemical Process Safety

Course code	**BSC-MFT-201A**				
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 introduce the solution methodologies for second order partial differential equations with applications in engineering. ● To provide an overview of Numerical methods, Laplace transform and Linear programming to Fire engineers.				
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	Recall the basic concepts of engineering mathematics.	Level 1: Remember
CO2	Understand various methods of partial differential equations, numerical methods, Laplace transforms and Linear programming problems.	Level 2: Understand
CO3	Apply methods and techniques to solve engineering problems.	Level 3: Apply
CO4	Analyze different engineering problems and select the suitable methods to solve these problems.	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

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 a 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-203A**				
Category	Professional Core Courses				
Course Title	**Fundamentals of Fire Engineering**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	3	0	0	**3**	
Course Objectives	The objectives of this course are • To provide foundational knowledge of fire science, combustion, and physical principles critical to understanding fire behavior. • To develop understanding of emergency preparedness, fire prevention measures, and building codes related to fire safety. • To familiarize learners with various fire protection systems and technologies essential for minimizing fire-related risks. • To train students in the application of firefighting techniques and command systems across various industries and environments.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

COs	Skills Demonstrated	RBT Level
CO1	Recall key terminology, classifications, processes, systems, and equipment related to fire science, fire prevention, fire protection, and firefighting across various applications.	Level 1: Remember
CO2	Explain the fundamental concepts and applications of Fire Engineering.	Level 2: Understand
CO3	Apply fire engineering knowledge and safety procedures to select and use appropriate firefighting and protection systems in different industrial and built environments.	Level 3: Apply
CO4	Analyze the effectiveness of fire safety strategies, emergency response plans, and firefighting operations in diverse scenarios and industries.	Level 4: Analyse

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

Unit-I

Fire Engineering Science: Fire, Elements of fire, Classification of fire, Flash point, Fire point, Causes of fire, Phases of fire, Physical properties of matter, Temperature, Heat, Heat transmission, Thermal expansion, Hydraulics, Specific heat, Latent heat, Combustion, Types of combustion, Smoke, Electricity.

Buildings: Classification of buildings based on occupancy (as per latest National Building Code of India).

Unit-II

Emergency- Introduction, Emergency Evacuation, Process of Emergency Evacuation, Evacuation Plan, Means of Escape.

Fire Prevention: Elements of Construction, Elements of Structure, Fixed Installations–Fire doors, Smoke Ceiling, Compartmentation, Pressurization, Fire Safety Practice, Fire Safety Management.

Unit-III

Fire Protection: Fire Alarm and Detection Systems, Fire Extinguishers, Fire Hose Reels, Fire Hose Cabinets, Fire Hydrants, Fire Pumps, etc., Fire Sprinkler Systems, Fire Suppression Systems, Kitchen Fire Safety, General Requirements and Guidelines for the Installation of Fire Detection and Alarm System in the Buildings.

Unit-IV

Fire Fighting: Incident Command, Use of Compressed Air Breathing Apparatus at Incidents, Rescue, Fire-Fighting, Ventilation, Salvage Operation, Application and Equipment, Rope and Lines, Ladders.

Applications of Fire Engineering: Oil and Gas Industries, Pharmaceuticals Industries, Buildings, Fertilizer Industries, Steel Industries, Coal Industries, Airports, etc.

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 (Latest Edition)- Bureau of Indian Standards

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-205 A**				
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 understand the basics of the first Aid. ● To study the human body and its various systems like respiratory, circulatory, digestive, central nervous and musculoskeletal systems. ● To familiarize with different medical conditions. ● To understand different types of casualties handling and lifting techniques.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

COs	Skills Demonstrated	RBT Level
CO1	Define the different technical terms associated with first aid.	Level 1: Remember
CO2	Describe the fundamental concepts of the human systems, different medical conditions, accident and first aid.	Level 2: Understand
CO3	Demonstrate different medical conditions, injuries and process of accident investigation and providing the first aid.	Level 3: Apply
CO4	Select the suitable technique for handling casualty and investigate the accidents.	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

First Aid: Introduction, principles of first aid, first aid and resuscitation, training in first aid, general rules of first aid, role of first aider, sequence of action on arrival at scene, first aid kit, vital signs- A, B, C (Airway, Breathing, Circulation), action in emergency, CPR, artificial respiration.

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: Wounds and cases of wounds, bleeding and its types, control of bleeding.
Injuries: Injuries, first aid for various injuries, head injuries, chest injuries, eye injuries and blindness.

Unit-III

Medical Conditions: Angina, heart attack, stroke, diabetes mellitus, hyperglycemia, hypoglycemia, seizures in adults and children, fever meningitis, fainting, allergy, headache, migraine, sore throat, earache and toothache, abdominal pain, vomiting and diarrhea, childbirth, electric shock, burn and its types, rule of nine, poisoning and its types, bites frostbite, snake bite, dog bite, insect bite, drowning and choking, unconsciousness, protection of body from winter dryness.

Unit-IV

Fractures: First aid for fractures or broken bones, joints and its types, bandages and slings, handling of casualties, lifting technique and equipment, stretcher and its types, ambulance, installation and use in casualties transportation, dealing with minor illness.
Accidents: Accidents and its types, accident reporting, investigation and record keeping, study of human casualty including medical history checking, making of diagnosis report based on symptoms as narrated by the casualties and signs as observed by the paramedic, checking.

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 (BSL)- 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-207A**				
Category	Professional Core Course				
Course Title	**Fluid Mechanics**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	3	0	0	**3**	
Course Objectives	The objectives of this course are ● To be familiar with different types of tanks and to measure the capacity of tanks. ● To know about fluid pressure and its effects. ● To understand the Kinematics and Dynamics of fluids.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

COs	Skills Demonstrated	RBT Level
CO1	Define fundamental concepts of Fluid Mechanics.	Level 1: Remember
CO2	Explain the fluids, flow and fluid properties.	Level 2: Understand
CO3	Apply the principles and theorems related to fluid mechanics to solve the complex engineering problems.	Level 3: Apply
CO4	Analyze the different fluid properties, losses, discharge etc.	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

Measurements: Units of measurements, System of measurements, Capacity of tanks, Rectangular tank and Square tank with flat base and sloping base, Circular, Spherical tank, Elliptical tank, Time of filling and emptying a tank.

Basics of Hydraulics: Concept of fluid and flow, Properties of fluids, Newton's Law of viscosity, Types of fluids, Ideal and Real fluids, Surface tension and Capillarity, Newtonian and Non-Newtonian fluids, Use of water in fire service.

Unit-II

Hydrostatics: Concept of pressure, Pressure head, Pascal's law, Effect of shape and size of container on pressure, Effect of specific weight on pressure, Effect of external force on pressure in a vessel, Direction of pressure in a vessel, **Fluid statics:** Pressure variation in compressible and incompressible fluids, Forces on submerged plane surfaces and curved surfaces, Fluid pressure and its measurement (Manometer and Bourdon pressure gauge) , kinetic and Momentum correction factors,

Buoyancy: Stability of floating and submerged bodies, Oscillation of floating bodies.

Unit-III

Kinematics of fluid flow: Types of flow, Steady and Unsteady, Uniform and Non-uniform, Laminar and Turbulent, Eulerian and Lagrangian description of fluid flow, Streamline, Path line, Streak line, Flow rate and Continuity equation, One and Two dimensional flow, Velocity and Acceleration at a point, Differential equation of continuity in cylindrical and polar coordinates, Rotation, Vorticity and Circulation, Stream and Potential functions, Flow net, Problems.

Unit-IV

Dynamics of fluid flow: Concept of system and control volume, One dimensional method for flow analysis, Euler's equation of motion, Derivation of Bernoulli's equation for incompressible flow and its application (Venturimeter, Orifice meter, Pitot tube), Measurement of Fluid Flow through pipes, Impulse momentum relationship and its applications, Problems.

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

Useful Video Links:

Unit No.	Topic	Link	Source
Unit-I	Basics of Measurements	www.youtube.com/watch?v=z5KyhyWr6ps	IIT Guwahati
	Basic concepts & Types of Fluids	www.youtube.com/watch?v=F_7OhKUYV5c	IIT Bombay
Unit-II	Hydrostatic concepts, Buoyancy, Stability	www.youtube.com/watch?v=VTO5n4_PWMw&t=1s	SWAYAM
Unit-III	Fluid kinematics -I	www.youtube.com/watch?v=whCu4Xl3m98&list=PLbMVogVj5nJQEgL1sHuY24d6omOqXInnt&index=11	IIT Kharagpur
	Fluid kinematics – II	www.youtube.com/watch?v=6q_JPg0ST4s&list=PLbMVogVj5nJQEgL1sHuY24d6omOqXInnt&index=12	IIT Kharagpur
	Fluid kinematics – III	www.youtube.com/watch?v=tLqo55ILM3o&list=PLbMVogVj5nJQEgL1sHuY24d6omOqXInnt&index=14	IIT Kharagpur
Unit-IV	Bernoulli's Equation	www.youtube.com/watch?v=NcD9JNPMfUs	IIT Madras
	Flow obstruction devices like Venturimeter & Orificemeter	www.youtube.com/watch?v=bsR3o-cFyMU	IIT Guwahati

Course Code	**ESC-ME-209A**				
Category	Engineering Science Courses				
Course Title	**Thermal Engineering**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	3	0	0	**3**	
Course Objectives	The objectives of this course are ● To familiarize with the basic concepts of thermal engineering. ● To study the basic concepts of steam power generation, IC engines and calculation of different powers. ● To learn about the Refrigeration and air conditioning and associated problems.				
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	Recall fundamental concepts, laws, and definitions of thermodynamics, boilers, IC engines, and fuels involved in energy systems and thermal processes.	Level 1: Remember
CO2	Explain the principles of thermodynamic cycles, refrigeration, steam generation, and combustion processes, and interpret related system operations.	Level 2: Understand
CO3	Apply the knowledge of thermal engineering to deal with the engineering problems under various conditions.	Level 3: Apply
CO4	Analyze performance parameters, efficiency, and losses in boilers and IC engines, fuel characteristics and combustion processes for optimized energy use.	Level 4: Analyze

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

Unit-I

Introduction: Introduction, System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Thermodynamic Equilibrium, State, Property, Process, Cycle, Reversibility, Quasi – Static Process, Irreversible Process, Causes of Irreversibility, Energy in State and in Transition, Work and Heat, Point and Path Function, Entropy.

Unit-II

Ideal Gas laws - Boyle's Law, Charle's Law, Avagadro's Law, Equation of State, Specific Heat, Universal Gas Constant.

Laws of Thermodynamics: Zeroth Law of Thermodynamics, First law of Thermodynamics, Steady Flow Energy Equation, Second Law of Thermodynamics, Clausius Statement, Kelvin Plank's Statement, Perpetual Motion Machine, Third Law of Thermodynamics. Air Standard Cycles: Otto, Diesel, Carnot cycle, and Heat engine,

Unit-III

Air Conditioning: Introduction, Types of air conditioning systems, Hazards and structural precautions, special problems associated with each system, HVAC calculations.

Refrigeration: Introduction, definition & unit and principle of refrigeration, single stage vapour compression refrigeration cycle. COP of refrigeration, Common refrigerants and their properties, basic precautions, Hazards and method of control in Refrigerating and air conditioning plant.

Steam Generation and Powers: Introduction, Classification of Boilers, Selection of a Boiler, Essentials of a Good Boiler, Boiler Mountings and Accessories, Boiler Efficiency, Heat Losses in a Boiler Plant.

Unit-IV

IC Engines: Introduction, Classification of IC engine, Principles of Internal combustion engine, Basic terminology, Indicator Diagram, Ignition System, Brake Power, Horse Power, Indicated Power, Brake Mean Effective Pressure, Engine Efficiency, Testing of IC Engines, Heat Balance Sheet.

Fuels and Combustion: Introduction, Classification of Fuels- Solid, Liquid, Gas, Basic Chemistry, Air-Fuel Ratio, Volumetric and Weight Analysis, Calorific Values.

Suggested Readings:

- Thermodynamics: An Engineering Approach by Y. A.Cengel and M. A. Boles, McGraw Hill Education
- Engineering Thermodynamics by Dr. P.K.Nag, TMH Publication
- Engineering Thermodynamics by Dr. C.P.Arora, TMH Publication
- Internal Combustion Engines by V. Ganesan, TMH Publication
- Heat Transfer by J.P. Holman, John Wiley & Sons, New York publications
- Refrigeration and Air Conditioning by P. L. Ballaney, Khanna Publishers
- Refrigeration and Air Conditioning by Dr. C. P. Arora, TMH Publication
- Manual of Firemanship: Part -6C

Useful Video Links:

Unit No.	Topic	Link	Source
Unit-I	Systems and control volume	https://youtu.be/sGL6nMBNlcA?si=ahjNA1VGJU3ugFe9	NPTEL (IIT Gandhinagar)
	Reversible and Irreversible Processes	https://youtu.be/oOtu9dVVamU?si=qwAZAMVjkqZlRewD	NPTEL (IIT Khargpur)
	Basic Thermodynamics: Gibbs free energy	https://youtu.be/VVyNKTDfNjo?si=qOq1kAiCgzNTdrIy	NPTEL (IIT Kanpur)
	First law for closed systems	https://youtu.be/6fap22clD14?si=UvaUijHffZFeaKWQ	NPTEL (IIT Guwahti)
Unit-II	The Ideal GAS	https://youtu.be/1yymkQQOPAo?si=KCUruAzo7f_YqIn1	NPTEL (IIT Madras)
	Temperature and Zeroth Law of Thermodynamics	https://youtu.be/0murstvco0I?si=ES-Pisx188XwKQ_v	NPTEL (IIT Guwahti)
	Laws of thermodynamics	https://youtu.be/pXfuKdTtEWE?si=Q33b0OAviolAxF7j	NPTEL (IIT Guwahti)
Unit-III	Steam Generation and Powers	https://youtu.be/ZwT_KR2hKGY?si=onHGbiTheY0UMCQv	NPTEL (IIT Guwahti)
	Boiler Draught	https://youtu.be/-cr5vfV4YAI?si=JYxZzgfEzdQ_1blf	NPTEL (IIT Guwahti)
Unit-IV	Classification of Internal Combustion Engines	https://youtu.be/H_RgFXjg-5s?si=gQzZoJE_WVzA_qFl https://youtu.be/SU5VTGR2giY?si=gAaXSO5TnKXfuCTO	NPTEL (IIT Madras)
	Four-stroke and Two-stroke engines	https://youtu.be/q-CfzNh99sQ?si=Mq6x_sWWNR1rGqcI	NPTEL (IIT Guwahti)
	Fuels &Combustion, part A	https://youtu.be/LR7npspe-RI?si=mB7-kETuv2Nbq93Z	NPTEL (IIT Guwahti)
	Fuels &Combustion, Part B	https://youtu.be/7vqDaAtTw8M?si=vCB3JDwFkfYRJfPR	NPTEL (IIT Guwahti)

Course Code	**HSMC-01A**				
Category	Humanities and Social Science including Management Courses				
Course Title	**Fundamentals of Management and Organizational Behaviour**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III/IV**
	3	0	0	3	
Course Objectives	The objectives of this course are • Introduce students to foundational management theories, functions, and organizational concepts to build a strong conceptual framework. • Develop understanding of individual and group behavior, motivation, communication, and leadership in organizational settings. • Equip students with practical skills to manage interpersonal processes, conflicts, and team dynamics effectively. • Foster critical analysis of organizational structures, cultures, and change mechanisms to enhance adaptability and effectiveness in organizations.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

COs	**Skills Demonstrated**	**RBT Level**
CO1	Define fundamental management concepts, functions, organizational processes, and organizational behavior elements.	Level 1: Remember
CO2	Explain the roles, skills, and interrelationships in management, individual behaviors, group dynamics, and communication processes within organizations.	Level 2: Understand
CO3	Apply principles of management, motivation techniques, leadership styles, and conflict management strategies to solve organizational behavior challenges.	Level 3: Apply
CO4	Analyze organizational structure, culture, change processes, and behavioral dynamics to support effective decision-making and organizational development.	Level 4: Analyse

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

Unit-I

Introduction of Management: Meaning, Definitions, Nature of Management; Managerial Levels, Skills and Roles in an Organization.
Functions of Management: Planning, Organizing, Staffing, Directing & Controlling, Interrelationship of Managerial Functions, Scope of Management, Importance of Management, Difference between Management and Administration.

Unit-II

Introduction of Organization: Meaning and Process of Organization, Management v/s Organization.
Fundamentals of Organizational Behavior: Concepts, Evolution, Importance and Relationship with other Fields, Contemporary Challenges and Opportunities of OB**.**
Individual Processes and Behavior: Personality, Concept, Determinants and Applications.
Perception: Concept, Process and Applications

Learning: Brief Introduction
Motivation: Concept, Techniques and Importance

Unit-III

Interpersonal Processes: Teams and Groups, Definition of Group, Stages of Group Development, Types of Groups, Meaning of Team, Merits and Demerits of Team, Difference between Team and Group, Conflict- Concept, Sources, Types, Management of Conflict.

Leadership: Concept, Function, Styles, Qualities of Leadership.

Communication: Meaning, Process, Channels of Communication, Importance and Barriers of Communication.

Unit-IV

Organizational Processes: Organizational Structure, Meaning and Types of Organizational Structure and their effect on Human Behavior.
Organizational Culture: Elements, Types and Factors affecting Organizational Culture.
Organizational Change: Concept, Types and Factors affecting Organizational Change, Resistance to Change.

Suggested Readings:

- Fundamentals of Management by Robbins, S.P. and Decenzo, Pearson Education, New Delhi.
- Organizational Behaviour by Robbins, S.P. & Judge, T.A., Prentice Hall of India, New Delhi.
- Management concept practice and cases by Ghuman Karminder, Aswathappa K., Tata McGraw Hill, New Delhi
- Fundamental of Management by Chhabra T. N., Sun India Publications, New Delhi.
- Organizational Behaviour by Stephen P Robin, Pearson Education.
- Organizational Behaviour by McShane, Steven L, Tata McGraw Hill, New Delhi.
- Organizational Behaviour by FC Sharma, Shree Mahavir Publications.

Useful Video Links:

Unit No.	Topics	Links
Unit-I	Nature and Scope of Management	https://nptel.ac.in/courses/110105146
Unit-II	Perception and Personality	https://nptel.ac.in/courses/110103433
Unit-III	Group Dynamics	https://archive.nptel.ac.in/courses/110/106/110106145/
Unit-IV	Organizational Change, Resistance to Change.	https://nptel.ac.in/courses/110105146

Course Code	**LC-FT-211A**				
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 (NBC) and international (NFPA) fire safety standards. • To prepare students for emergency scenarios by training them to respond effectively using appropriate firefighting tools and decision-making strategies.				
Assessment	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

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

COs	Skills Demonstrated	RBT Level
CO1	Explain the 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 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 fire and its elements.
3	To study different types of extinguishing media- water, foam, dry powder, ABC Powder, CO2, Halon.
4	To study of Modular Automatic Fire Extinguishers, Trolley Mounted fire extinguishers.
5	To study the different causes and phases of fire.
6	To study the fire detection systems.
7	To study the basic fire protection equipments.
8	To study the Mobile firefighting equipments
9	To study different types of sprinkler systems

10	To study the products of combustion.
11	To study different types of occupancies as per National Building Code of India (Latest Edition).
12	To study structural integrity under fire using standard methods of NFPA.
13	To study different types of hose fittings and their application.

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

Course Code	**LC-FT-213A**				
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 study various human systems and different medical conditions. ● To understand the different casualties and casualties handling techniques.				
Assessment	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

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

COs	Skills Demonstrated	RBT Level
CO1	Describe the different items in the First Aid box and and elements of human systems.	Level 2: Understand
CO2	Apply the knowledge to provide the first aid to the casualty.	Level 3: Apply
CO3	Classify bandages, slings, stretchers and other medical conditions.	Level 4: Analyze
CO4	Measure the bleeding time, dressing time, blood pressure, scale of burn etc.	Level 5: Evaluate

List of Experiments

Sr. No.	Contents
1	To study the first aid kit.
2	To study different human systems Respiratory, Circulation and 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 measure the victim's dressing time 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 and 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-FT-215A**				
Category	Professional Core Courses				
Course Title	**Thermal Engineering Lab**				
Scheme and Credits	L	T	P	**Credits**	**Semester-III**
	0	0	2	**1**	
Course Objectives	The objectives of this course are • To provide students with practical exposure to the working principles of internal combustion engines, heat transfer mechanisms, and boiler systems • To understand real-world thermal engineering applications and evaluate performance characteristics of fuels, engines, and cooling systems.				
Assessment	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

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

COs	**Skills Demonstrated**	**RBT Level**
CO1	Describe the basic concepts of thermal engineering.	Level 2: Understand
CO2	Understand the working of different equipments used in the thermal plants.	Level 2: Understand
CO3	Apply the knowledge of thermal engineering to deal with the engineering problems.	Level 3: Apply
CO4	Determine the values of different parameters applicable in thermal engineering.	Level 4: Analyze

List of Experiments

Sr. No.	**Contents**
1	To study the working of 2 stroke Petrol engine.
2	To study the working of 2 stroke Diesel engine.
3	To study the working of 4 stroke Petrol engine.
4	To study the working of 4 stroke Diesel engine.
5	To study different types of fuels along with their flash point, fire point and calorific values.
6	To study low pressure boilers and their accessories and mountings.
7	To study high pressure boilers and their accessories and mountings.
8	To find the indicated horse power (IHP) on multi-cylinder petrol engine/diesel engine by Morse Test.
9	To prepare the heat balance sheet.
10	To study different types of cooling towers.
11	To find out the COP of Refrigerator

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

Course Code	**LC-FT-217A**				
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	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

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

COs	**Skills Demonstrated**	**RBT Level**
CO1	Explain the 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 (Delivery Hose, 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.
9	To study different types of Ladders and their parts.
10	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	**PCC-FT-202A**				
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 equip students with essential knowledge of building classifications, fire-resistant construction types, and exit planning requirements based on national codes and standards such as NBC and ISI. • To develop a thorough understanding of fire behavior, human response in fire emergencies, and the function of fire detection, control, and compartmentation systems in building design. • To enable students to apply structural fire safety principles for evaluating and designing buildings and components exposed to fire, using fire resistance testing, material behavior, and structural analysis under fire conditions.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

COs	Skills Demonstrated	RBT Level
CO1	Describe the classifications of buildings, types of construction, exit requirements, structural components, and fire safety terminology as per NBC and ISI 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 in buildings	Level 3 : Apply
CO4	Analyze fire severity and evaluate 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 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

Classification of building based on occupancy as per National Building Code of India (NBC), Classification of types of construction according to fire resistance as per NBC, General fire safety requirements applicable to all individual occupancies, fire zones as per NBC, general exit requirements as per NBC, 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 NBC 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

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 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

Fire design time, 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 Code (NBC)- Part-IV (Latest Edition)
- 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-204A**				
Category	Professional Core Courses				
Course Title	**Heat Transfer, Combustion and Explosives**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	3	0	0	**3**	
Course Objectives	The objectives of this course are ● To learn about the heat and modes of heat transfer. ● To make the students familiar with the combustion, products of combustion and their effects. ● To understand the different explosives and rules.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

COs	**Skills Demonstrated**	**RBT Level**
CO1	Define the different terms related to heat transfer, combustion and explosives.	Level 1: Remember
CO2	Describe the fundamentals concepts of heat transfer, combustion and explosives rules and acts.	Level 2: Understand
CO3	Apply the knowledge of heat transfer, combustion, explosive rules and acts to deal with the real life problems.	Level 3: Apply
CO4	Analyze the problems due to fire, combustion and explosives	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

Heat Transfer: Heat Transfer, Modes of Heat Transfer.
Conduction: Introduction, 1-D heat conduction through a plane wall, long hollow cylinder, Conduction equation in Cartesian, polar and spherical co-ordinate systems.
Convection: Forced Convection-Thermal and hydro-dynamic boundary layers, Equation of continuity, Momentum and energy equations.
Radiation: Terms used in radiation heat transfer, Stefan Boltzman Law, Kirchoff's law, Planck's law and Wein's displacement law, black body radiation, Heat exchange between non-black bodies, heat exchange between two parallel infinite black surfaces, grey bodies, effect of radiation shield.

Unit-II

Combustion: Combustion, types of combustion, complete and incomplete, smoldering, rapid, spontaneous, micro-combustion, chemical equations, stoichiometric combustion of a hydrocarbon in oxygen, stoichiometric combustion of a hydrocarbon in air, incomplete combustion of a hydrocarbon in oxygen, liquid fuels, gaseous fuels, solid fuels, combustion management

Product of Combustion- Products of combustion, fire effluents, assessment of fire effluents.

Unit-III

Explosion: Introduction, list of Explosives, types of chemical exlosives, causes of Explosion, Vapour Cloud Explosions (VCE), Unconfined Vapour Cloud Explosion (UVCE), confined explosions, dust collector, silos, Physical explosions, BLEVE, Major Accident Hazard (MAH) control, On-site and Off-site emergency plan.
Petroleum & Explosives Safety Organization (PESO): Objectives, roles and responsibilities, guidelines for safe inspection of explosives magazines/vans.

Unit-IV

Fires Involving Explosives: Introduction, Nature and properties of explosives, 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, boil over, Fire Fighting procedure, Fire Fighting classification, Fighting fires in above ground sites, Fighting fires in underground sites, 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-I	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-II	Combustion	https://youtu.be/Fyq4Q5yWDDU?si=UiglMcNy2y8j5Pvz	NPTEL (IIT Madras)
	Stoichiometric combustion	https://youtu.be/yh1h23fbWtw?si=vxkNdc1J-4UlK5Kt	NPTEL (IIT Madras)
Unit-III	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)
Unit-IV	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	**PCC-FT-206A**				
Category	Professional Core Courses				
Course Title	**Fire Service Hydraulics**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	3	1	0	4	
Course Objectives	The objectives of this course are • To familiarize with water supply and hydrant system. • To determine the impact of jet on different types of vanes. • To determine the discharge through pipes and different Fire Fighting Hoses. • To understand the construction and working of different types of Pumps. • To know about sprinkler and its applications				
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 key concepts and terminologies related to water properties, hydrant systems, pump types, nozzle design, and sprinkler components used in fire protection.	Level 1: Remember
CO2	Explain the principles of fluid dynamics, pump operations, sprinkler hydraulics, and jet impacts relevant to firefighting and fire suppression systems.	Level 2: Understand
CO3	Apply fluid mechanics equations and nozzle design principles to calculate discharge, pressure loss, power transmission, and sprinkler system demand in practical scenarios.	Level 3: Apply
CO4	Analyze the efficiency of fire suppression systems by examining pipe flows, pump performances, primer mechanisms, and pressure balance in sprinkler operations.	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

Water Supply : Properties of water, Density, Specific volume, Specific gravity, Latent heat of vaporization, Viscosity, kinematics viscosity, Water sources, Treatment process, Principles and Practical consideration of various methods of Water Relay and operational hints, water requirements with reference to ISI, Water distribution system, Storage tanks, Use of water in fire protection service, Distribution of water supply, Determination of fire flow in accordance with fire load,.

Hydrants: Types of hydrants, hydrant gear and characteristics, code of practice in respect of requirements and standardization of Hydrants, Hydrant Gears, Use of flow meter, Inspection and Testing of hydrants, care and maintenance, Fire hydrant system.

Impact of Free Jets: Impulse-momentum principle, Jet impingement on a stationary flat plate, inclined plate and a hinged plate, at the center of a stationary vane, on a moving flat plate, inclined plate, a moving vane and a series of vanes, Jet striking tangentially at the tip of a stationary vane and moving vanes.

Unit - II

Flow through Pipes and Fire Fighting Hoses: Basic introduction Continuity Equation, Pressure loss in pipes and governing equation, Flow measurement through pipes (series and parallel), Discharge through notches (rectangular and trapezoidal notch), Power transmission through pipeline.

Nozzle: Definition, Design of nozzle, Flow through nozzles, Power transmitted through nozzle, Condition for maximum transmission, Relation between nozzle and pipe diameter, Hoses of different diameters, Discharge coefficient, Hagen Poiseuille formula.

Unit - III

Pumps and Primers: Introduction, Types of pumps, Ejector pumps, Vehicle mounted fire pumps, Portable pump, Jockey pump- construction and its working.

Reciprocating pump- Introduction, Main parts of a reciprocating pump, Working, Slip of reciprocating pump.

Centrifugal pump- Introduction, Main parts of a centrifugal pump, Working, Minimum speed for starting a centrifugal pump, Multistage Centrifugal pump, Maintenance and servicing of pumps.

Primers: Definition and purpose of primers, Classification of primers, Role of primers in fire suppression systems, Chemical safety of primers in fire equipment.

Unit - IV

Sprinkler System Demand: Fundamentals of Sprinkler system hydraulics, Hydraulic analysis of side-fed tree sprinkler systems, Impact of flow and pressure in operating sprinkler systems, Pressure balancing in sprinkler head performance.

Automatic Sprinkler System: Water supply requirements for Automatic sprinkler system, Basic knowledge tools for hydraulic calculation, Role of pressure reducing valves, 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 by Purington

Course Code	**PCC-FT-208A**				
Category	Professional Core Courses				
Course Title	**Fundamentals of Safety Engineering**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	3	0	0	**3**	
Course Objectives	The objectives of this course are • To familiarize the students with safety, safety management and safety performance. • To understand accidents and the need for safety. • To evaluate the safety performance and cost of accidents. • To identify the roles and responsibilities of all the stakeholders towards safety.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

COs	Skills Demonstrated	RBT Level
CO1	Define key concepts related to accidents, safety measures, safety roles, and performance metrics used in industrial and organizational safety management.	Level 1: Remember
CO2	Explain the fundamental concepts, principles of accident prevention, responsibilities in safety management, and the importance of integrating safety, health, and environmental concerns.	Level 2: Understand
CO3	Apply structured safety training methods, emergency planning, job safety analysis, and communication strategies to promote workplace safety.	Level 3: Apply
CO4	Analyze the cost of accidents, safety management performance, the effectiveness of safety systems and engineered safety designs.	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

Accident: Introduction, types of accidents, causes of accidents, principle of accident prevention, accident investigation, and process of investigation, onsite and offsite emergency response plan, and cost of accident.

Safety: Introduction to safety, need for integration of health and environment safety, safety and productivity, points for consideration of safety, general instructions for safety, personal safety, personal protective equipment.

Unit-II

Safety Management: Objectives of safety management, principles of safety management, responsibilities of management, plant manager, engineers, individuals, line supervisors, safety managers, workers and trade unions in the field of safety, contractor, government, social organization, safety committee, role of safety committee, advantages.

Unit-III

Safety Education and Training: Elements of training cycle, objectives of training, training methods, types of training, behaviour oriented training, communication, purpose, barrier to communication, causes of preventable injuries, death off the job.

Unit-IV

Safety Audit: Safety audits, types of audit, audit goals, responsibilities of audit team, audit procedure, safety in design, engineered safety.

Safety Performance: Frequency rate, severity rate, incidence rate, activity rate, safe "T" score, safety surveys, Job Safety Analysis (JSA).

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)
	Personal Protective Equipment	https://youtu.be/eLnv6Eb2Pq0?si=cbAkgLUqZ9QEJoWQ	NEPTEL (IIT Delhi)
Unit-II	Safety Committee Meeting	https://youtu.be/N12BEnI1hCY?si=TdR-4HO58IZsM5mp	NPTEL- IITC
Unit-III	Safety Education	https://youtu.be/v-eltsixu4I?si=2T9UetPJdllhk7YN	NPTEL (IIT Kharagpur)
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-210 A**				
Category	Professional Core Courses				
Course Title	**Safety in Construction**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	3	0	0	**3**	
Course Objectives	The objective of this course are • To develop an understanding of safety challenges, responsibilities, and ergonomics in the construction industry. • To familiarize students with safety practices during various construction operations in compliance with national codes and standards. • To equip students with knowledge related to safe use of construction machinery, tools, and temporary utilities. • To create awareness of legal frameworks governing construction labor, health, welfare, and statutory safety obligations.				
Assessment	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

COs	Skills Demonstrated	RBT Level
CO1	Define key safety concepts, ergonomic considerations, construction hazards, and relevant terminologies, codes, and legal provisions related to construction safety.	Level 1: Remember
CO2	Explain the causes of accidents, safety measures in construction activities, material handling, and legal roles of stakeholders in promoting safe construction practices.	Level 2: Understand
CO3	Demonstrate the application of construction safety procedures, including equipment handling, site layout, evacuation plans, and compliance with safety codes and labor laws.	Level 3: Apply
CO4	Analyze construction project scenarios to identify safety gaps, assess risk levels, and recommend improvements aligned with legal standards and operational safety practices.	Level 4: Analyse

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

Unit-I

Introduction to Construction Industry: Safety issues in construction, Human factors in construction safety management, Roles of various groups in ensuring safety in construction industry, Framing, contract conditions on safety, related matters, Relevance of ergonomics in construction safety.

Unit-II

Safety in Various Construction Operations: Excavation, under water works, underpinning & shoring Ladders and Scaffolds, Tunneling, Blasting, Demolition, Pneumatic caissons, confined Space Temporary Structures, Indian Standards on construction safety, National Building Code Provisions on construction safety.

Unit-III

Safety in Material Handling and Equipments: Safety in storage & stacking of construction materials, Safety in the use of construction equipments, Vehicles, Cranes, Tower Cranes, Lifting gears, Hoists & Lifts, Wire Ropes, Pulley blocks, Mixers, Conveyors, Pneumatic and hydraulic tools in construction, Temporary power supply.

Unit-IV

Contract Labour (R&A) Act and Central Rules: Definitions, Registration of Establishments, Licensing of Contractors, Welfare and Health provisions in the Act and the Rules, Penalties, Rules regarding wages. Building & Other Construction Workers (RE & CS) Act, 1996 and Central Rules, 1998: Applicability, Administration, Registration, Welfare Board & Welfare Fund, Training of Building workers, General Safety, Health & Welfare provisions, Penalties.

Suggested Readings:

- Construction Safety Management by K.N. Vaid.
- Construction Safety Handbook by V.J. Davies and K. Tomasin.
- Construction Safety, Security & Loss Prevention, James B. Fullman.
- Modern Methods of Material Handling by L Linger.
- Handbook of Temporary Structures in Construction by R.T. Ratay.
- National Building Code of India, 2016 by BIS.
- Relevant Indian Standards published by BIS.
- Contract Labour Act and Central Rules.
- Building and Other Construction Workers (RE & CS) Act, 1996 and Central Rules.

Course Code	**LC-FT-212A**				
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 give students hands-on experience in testing the physical and mechanical properties of materials like timber, bricks, steel, and concrete. ● To gain practical experience in evaluating the fire-related and structural performance of building materials. ● To build practical skills in using non-destructive testing methods and measuring strain.				
Assessment	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

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

COs	Skills Demonstrated	RBT Level
CO1	Understand the principles and procedures of non-destructive testing methods used to assess the strength of concrete.	Level 2: Understand
CO2	Apply standard testing procedures to determine the physical and mechanical properties of materials such as steel and concrete.	Level 3: Apply
CO3	Analyze strain measurements in materials to determine mechanical properties such as Young's Modulus.	Level 4: Analyze
CO4	Evaluate experimental results to assess properties such as moisture content, compressive strength, workability and fire resistance of building materials.	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-FT-214A**				
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	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

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

COs	**Skills Demonstrated**	**RBT Level**
CO1	Explain the principles 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 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.
11	To visit the pump room of any occupancy and prepare a report on pump room.

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

Course Code	**LC-FT-216A**				
Category	Professional Core Courses				
Course Title	**Heat Transfer, Combustion and Explosives 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 fundamental heat transfer modes: conduction, convection, and radiation. • To equip students with skills to experimentally determine thermal properties and heat transfer coefficients. • To develop analytical understanding of heat exchanger performance and efficiency of extended surfaces (fins). • To introduce students to the basic concepts of combustion and the safe handling of explosives.				
Assessment	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

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

COs	Skills Demonstrated	RBT Level
CO1	Explain various heat transfer modes, thermal devices, and combustion materials used in experiments.	Level 2: Understand
CO2	Perform experiments to determine thermal conductivity, heat transfer coefficients, heat exchanger effectiveness, and emissivity.	Level 3: Apply
CO3	Analyze and interpret experimental data to assess heat transfer performance and combustion behavior under varying conditions.	Level 4: Analyze
CO4	Estimate the size and type of heat exchanger.	Level 5: Evaluate

List of Experiments

Sr. No.	Contents
1	To determine the thermal conductivity of metal rod.
2	To determine the thermal conductivity of composite wall.
3	To determine the surface heat transfer coefficient for a heated vertical tube under natural convection.
4	To determine average heat transfer coefficient of an externally heated horizontal pipe under forced convection.
5	To determine efficiency and effectiveness of Metallic Fin.
6	To verify the Stefan-Boltzmann constant for thermal radiation.
7	To measure the emissivity of the gray body (plate) at different temperature.
8	To find overall heat transfer coefficient and effectiveness of a heat exchanger under parallel and counter flow conditions.
9	Study of boiling (Critical Heat Flux apparatus) and Condensation of Heat Transfer.
10	To determine the heat transfer in lagged pipe apparatus.
11	To study the process of combustion and different stages of combustion.
12.	To study different types of explosives, care and handling of explosives.

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

Course Code	**LC-FT-218A**				
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	25 Marks				
End Semester Practical Examination	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

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

COs	**Skills Demonstrated**	**RBT Level**
CO1	Explain the operational principles, testing standards, and storage techniques for fire-fighting hoses, hydrant, extinguishers, ladders and ropes.	Level 2: Understand
CO2	Demonstrate the execution of extinguisher drills, hose and rope rolling methods, and ladder tests in simulated field conditions.	Level 3: Apply
CO3	Analyze the performance of an individual and team.	Level 4: Analyze
CO4	Assess the readiness, safety, and effectiveness of fire-fighting equipment through inspection and standard testing methods.	Level 5: Evalaute

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 perform Emergency Evacuation drills.

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

Course Code	**MC-201A**				
Category	Mandatory Courses				
Course Title	**Environmental Science**				
Scheme and Credits	L	T	P	**Credits**	Semester-
	2	0	1	-	
Course Objectives	The objectives of this course are • Create awareness of the multidisciplinary nature and importance of environmental studies, including the sustainable management and conservation of natural resources. • Develop an understanding of ecosystem dynamics, biodiversity, pollution types, and their impacts on environmental and human health. • Foster critical thinking on social, ethical, and legislative aspects of environmental protection, emphasizing the role of individuals and society. • Engage students in practical learning through fieldwork and case studies to apply environmental concepts for sustainable development and responsible citizenship.				
Practical/Field Visits	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				
Remarks	The subject of Environmental Studies will be included as a qualifying paper in all UG Courses and the students will be required to qualify the same otherwise the final result will not be declared and degree will not be awarded. The duration of the course will be 40 lectures. The examination will be conducted along with the semester examinations. 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 the detailed marks certificate of the students.				

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

CO	Skill Demonstrated	Level
CO1	Describe key concepts of environmental studies, types of natural resources, ecosystem structures, pollution types, major environmental laws, and human-environment interactions.	Level 1: Remember
CO2	Explain the interrelationships 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 preparedness, and sustainable practices in real-world and field-based environmental contexts.	Level 3: Apply
CO4	Analyze environmental problems, 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 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

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 ground water, 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 pesticide problems, Water logging, 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 are source, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources, equitable use of resources for sustainable life styles

Unit-II

Ecosystems: Producers, Consumers and Decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, Food web sand ecological pyramids**,** Introduction, types, characteristic features, structure and function of Forest ecosystem, Grass land ecosystem, Desert ecosystem and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Bio diversity and its conservation: Introduction, Definition, Genetic, Species and ecosystem diversity. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a mega-diversity nation, Hot-spots of biodiversity. Threats to biodiversity, habitat loss, poaching of wild life, man-wild life conflicts, Endangered and endemic species of India, In-situ and ex-situ conservation of biodiversity.

Unit-III

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

Solids 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, Earthquake, Cyclone and Landslides.

Social issues and the Environment: From unsustainable to sustainable development, Urban problems related to energy, Water conservation, Rain Water Harvesting, Watershed Management, Resettlement and Rehabilitation of People, its 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, Waste land reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wild life 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, Woman and Child Welfare Role of Information Technology in Environment and human health. Case Studies.

Field Work (Field work equal to10 lecture hours)- Visit to a local area to document environmental assets-river/forest/grassland/hill/mountain, Visit to a local polluted site-urban/Rural/Industrial/ Agricultural, Study of common plants, insects, 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, MA Pin 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	**PEC-FT-220A**				
Category	Professional Elective 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 impart fundamental knowledge of electrical conductors, wiring systems, and protective devices essential for fire safety. • To understand the causes and mechanisms of electrical fires and develop preventive strategies. • To familiarize students with electrical shock phenomena and safety protocols in different electrical environments. • To enable learners to identify hazardous zones and carry out failure investigations according to statutory requirements.				
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	Recall the classification, properties of conductors, wiring systems, and protective devices used in electrical safety systems.	Level 1: Remember
CO2	Explain the causes and mechanisms of electrical failures and fires, along with the functioning of protective devices such as MCBs, RCCBs, and relays.	Level 2: Understand
CO3	Apply safety procedures, wiring standards, and protection methods in electrical fire prevention and shock hazard mitigation.	Level 3: Apply
CO4	Analyze hazardous zones, investigate electrical failures and fires, statutory compliance and management roles in electrical fire safety.	Level 4: Analyze

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

Unit-I

Introduction: 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 earthing, 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	**PEC-FT-222A**				
Category	Professional Elective Course				
Course Title	**Industrial Psychology**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	3	0	0	3	
Course Objectives	• To learn the fundamental of industrial psychology and its applications in occupational health and safety management of an organization through appropriate Industrial Labour Legislations. • To explain the historical development, scope, and nature of occupational health psychology, emphasizing workplace safety, well-being, and environmental health. • To familiarize the students about various levels of psychological interventions targeted at improving physical, mental, and emotional well-being of employees in the workplace.				
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	Recall key concepts of Industrial Psychology and Occupational Health Psychology, such as workplace safety, stress, and occupational hazards.	Level 1: Remember
CO2	Explain the relationship between workplace stressors**,** health issues, and organizational policies for improving employee well-being.	Level 2: Understand
CO3	Apply psychological principles to design solutions for improving work-life balance, employee safety, mental health at work and reduce workplace bullying and violence.	Level 3: Apply
CO4	Analyze labour legislations and workplace issues like stress**,** bullying and violence and the effectiveness of interventions in improving employee health and safety.	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

Industrial Psychology: Definition, Nature and Background of I/O Psychology, Characteristics of I/O Psychologist, Ethics of I/O field.

Occupational Health Psychology and Workplace Hazards: Introduction, Accident and Safety, Infectious Disease Exposure, Loud Noise, Musculoskeletal Disorders, Harmful Substance Exposure, Workplace bullying, Workplace Violence, Work Schedule, Risk factors in the physical work environment, Individual antecedents of safety performance and workplace accidents and injuries, Situational antecedents of safety performance and workplace accidents and injuries, workplace mistreatment, workplace incivility.

Unit-II

Interventions and Strategies in Occupational Health Psychology: Primary Interventions to improve work–life balance, secondary interventions to improve work–life balance, tertiary interventions to improve work–life balance, primary interventions to improve physical health and safety, secondary interventions to improve physical health and safety, tertiary interventions to improve physical health and safety, primary interventions to improve psychological health and well-being, secondary and tertiary interventions to improve psychological health and well-being, work family conflict.

Unit-III

Emerging Trends in Occupational Health Psychology: Mental Health, Physical Health, Aggression in the Workplace, Organizational Climate and Leadership.

Occupational Stress: Introduction, Process, Job stressors- Role Ambiguity and Role Conflict, Workload, Social stressors, Organizational Politics, Control, Machine Pacing, Demand and Control Model, Burn-out.

Unit-IV

Industrial Labour Legislation: Labour Legislations in India, Principles of Labour Legislation, Social Justice, Social Equity, National Economy, Classification of Labour Laws, Purpose, Legislature, Period of Enactment, The Factories Act -1948, Main Provisions of the Act, Health and Hygiene (sec 11-20), Safety Provisions (sec 21- 41).

Suggested Readings

- Industrial and Organizational Psychology- Research and Practice by Paul E. Spector, Wiley India Edition.
- Work Psychology: Understanding Human Behavior in Organizations by John Arnold, Ray Randall, and Paul Patterson, Tata McGraw-Hill Education (India).
- Occupational Health Psychology: Work, Stress, and Health by Irving B. Weiner and Paul L. Perrewé, Wiley India Pvt. Ltd.
- Handbook of Occupational Health Psychology" edited by Irving B. Weiner, Taylor & Francis India
- World Health Organization (WHO) - Occupational Health (www.who.int)
- National Institute for Occupational Safety and Health (NIOSH) (www.cdc.gov/niosh)
- The Factories Act-1948
- Labour Law in India (2012) by C. K. Johri

Course Code	**PEC-FT-224A**				
Category	Professional Elective Course				
Course Title	**Chemical Process Safety**				
Scheme and Credits	L	T	P	**Credits**	**Semester-IV**
	3	0	0	3	
Course Objectives	• To develop foundational understanding of process safety culture, risk perception, and regulatory frameworks in industrial operations. • To equip students 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	40 Marks				
End Semester Examination	60 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

COs	**Skills Demonstrated**	**RBT Level**
CO1	Define key terms and principles related to process safety, toxicology, industrial hygiene, and hazard mitigation frameworks.	Level 1: Remember
CO2	Explain the fundamentals of risk analysis, fire/explosion prevention, toxicant exposure control, and process safety strategies.	Level 2: Understand
CO3	Apply hazard identification and control techniques, safety procedures, and relief system designs to industrial safety scenarios.	Level 3 : Apply
CO4	Analyze real-world case histories to assess failures in process safety systems and recommend improvements in safety design and strategy.	Level 4: Analyze

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

Unit-I

Introduction: 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	NPTEL (IIT Roorkee)
Unit-II	Introduction, Routes & Exposure	https://www.youtube.com/watch?v=jZvgAUYtS_Y	NPTEL (IIT Roorkee)
	Dose Response Relationship	https://www.youtube.com/watch?v=IxRvsiZkZQ0	NPTEL (IIT Roorkee)
	Dose Response and Threshold Dose: Predictive models and Extrapolation	https://www.youtube.com/watch?v=_Ut_1L2JlQA	NPTEL (IIT Roorkee)
Unit-III	Designs to prevent Fire and Explosion: Inerting and Purging	https://www.youtube.com/watch?v=PaBDQ-lOGRM	NPTEL (IIT Roorkee)
	Sprinkler Systems	https://www.youtube.com/watch?v=ZKsqIPM810M	NPTEL (IIT Roorkee)
Unit-IV	Introduction to Reliefs	https://www.youtube.com/watch?v=Cs8DQ_9f5qM	NPTEL (IIT Roorkee)
	Type of Reliefs	https://www.youtube.com/watch?v=Q-4601m2zag	NPTEL (IIT Roorkee)