

M.D. UNIVERSITY, ROHTAK
SCHEME OF STUDIES AND EXAMINATION
B.TECH(FIRE TECHNOLOGY AND SAFETY)
SEMESTER 3rd AND 4th
Scheme effective from 2019-20



COURSE CODE AND DEFINITIONS

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar
TH	Theory
Pr	Practical

MAHARSHI DAYANAND UNIVERSITY, ROHTAK

Scheme of Examination for Semester III (Second Year)

B.TECH (FIRE TECHNOLOGY AND SAFETY) w.e.f. 2019-20

S N	Category	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Mark of Class work	TH	Pr	Tot al	
1	Basic Science Course	BSC-FT- 201G	Mathematics-III	3	1	0	4	4	25	75		100	3
2	Professional Core Courses	PCC-FT- 203G	Basics of Fire Science	3	0	0	3	3	25	75		100	3
3	Professional Core Courses	PCC-FT- 205G	Fire Service Hydraulics-I	3	1	0	4	4	25	75		100	3
4	Engineering Science Course	ESC-FT- 207G	Basics of Thermal Engineering	3	1	0	4	4	25	75		100	3
5	Professional Core Courses	PCC-FT- 209G	Automobile Safety	3	1	0	4	4	25	75		100	3
6	Professional Core Courses	PCC-FT- 211G	Fire Protection Workshop	0	0	2	2	1	25		25	50	3
7	Professional Core Courses	PCC-FT- 213G	Automobile Safety Lab	0	0	2	2	1	25		25	50	3
8	Engineering Science Course	ESC-FT- 215G	Basics Thermal Engineering Lab	0	0	2	2	1	25		25	50	3
9	Training	PT-FT- 217 G	Fire Ground Operation-I	0	0	2	2	1	25		25	50	3
TOTAL CREDIT								23				700	

Course code	BSC-FT- 201G				
Category	Basic Science courses				
Course title	Mathematics- III				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	1	0	4	
Course Objectives:	<ul style="list-style-type: none"> 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 				
Course Outcomes:	<p>By the end of this course the student will be able to:</p> <ul style="list-style-type: none"> To solve field problems in engineering involving partial differential equations To find roots of polynomial and transcendental equations using numerical methods and conduct numerical integration To deal with the Laplace transform, Linear Programming and their applications 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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.

SECTION-A

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)

SECTION-B

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.

SECTION-C

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 , 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.

SECTION-D

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:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publishing Company Limited
3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers
4. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand and Company
5. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI.
6. N. P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
7. C. L. Liu, Elements of Discrete Mathematics, Tata McGraw-Hill.
8. K. H. Rosen, Discrete Mathematics and its Applications, Tata McGraw-Hill.
9. J. L. Hein, Discrete Structures, Logic and Computability, Jones and Bartlett.

Course code	BSC-FT-203 G				
Category	Professional Core Courses				
Course title	Basics of Fire Science				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	0	0	3	
Course Objectives:	<ul style="list-style-type: none"> To study the basic of fire and combustion. To familiarize with the smoke, its characteristics, control and management. To know about detectors and fire alarm systems as per relevant standards (ISI). To know about different fire extinguishers, extinguishing media and fire protection equipments. 				
Course Outcomes:	<p>On successful completion of this course students will be able to</p> <ul style="list-style-type: none"> Demonstrate knowledge of fire, its cause and phases of fire. Prepare the emergency evacuation plan and can help occupants in emergency evacuating process. Apply suitable extinguishing media after identification of class of fire. Explain the methods of smoke management. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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.

Section-A

Introduction: Temperature, heat, specific heat, latent heat, ignition, types of ignition, sources, combustion, types of combustion- rapid, spontaneous, explosion, elements of fire, flash point, fire point, causes of fire, fire propagation (phases of fire), fire load, burning regimes estimates, fire plume, extreme fire behavior, reasons for major spread of fire, precautions against ignition, spontaneous ignition and combustion, range of inflammability.

Section-B

Product of Combustion: Flame, smoke, fire gases, toxicity of smoke, exposure to fire effluents, effect of fire effluents, quantitative analysis of fire effluents, acceptance criteria for life safety, volume of smoke, quality of smoke, visibility and obstruction, density of smoke, smoke movement.

Smoke Control and Management: Smoke control during building design, design principle of smoke management, method of smoke management, pressurization of protected escape routes, actual design of smoke control pressurization system, calculation of discharge rate of air blowers, effective leakage area, smoke extractors.

Section- C

Classification of buildings based on occupancy, Fire zone, Classification of Fire, Fire Extinguishers and other fire protection equipments for different occupancy classification as per NBC, Sprinkler System, Total Flooding System, Foam System, Fire Investigation, Fire Training and Education, Fire Safety Audits, Risk Assessment, Fire insurance.

Section-D

Classification of type of constructions according to fire resistance, General fire safety requirements applicable to all individual occupancies, Siting of detectors as per relevant standards (ISI), Selection and planning of alarm system as per relevant standards (ISI), General requirements and guidelines for the installation of fire detection and alarm system in buildings of different occupancy classification.

Emergency- Emergency Evacuation, Process of Emergency evacuation, Evacuation plan, Means of Escape.

Suggested Readings

1. Fire Safety in Buildings by V K Jain, New Age publishers, New Delhi
2. Principles of Fire Safety Engineering – A. K. Das (PHI Publishers).
3. Fundamentals of Fire Safety in Building Design by Dr. Than Singh Sharma, Aayush Publications, New Delhi
4. Handbook of Fire Technology by R.S.Gupta, Orient Longman Pvt. Ltd., Kolkata
5. Manual of Fire Safety by N. Sessa Prakash, CBS Publishers & Distributors Pvt. Ltd.
6. National Building Code (NBC) Part-4 Life and Safety (Latest Edition)

Course code	PCC-FT-205 G				
Category	Professional Core Courses				
Course title	Fire Service Hydraulics-I				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	1	0	4	
Course Objectives:	<ul style="list-style-type: none"> 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 				
Course Outcomes:	<p>On successful completion of this course students will be able to</p> <ul style="list-style-type: none"> Determine the capacity of various types of tanks under various conditions. Evaluate the effect on the pressure due to shape, size of container, weight, external force and directions. Apply Bernoulli's equation for different elements like Venturimeter, Orificemeter and Pitot tube. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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.

Section-A

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, density, specific gravity, pressure, relative density, vapour density, types of fluids, ideal and real fluids, continuum concept, Newtonian and non-Newtonian fluids, use of water in fire service.

Section-B

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, Basic equation of 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).

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

Section-C

Kinematics of fluid flow: Types of flow, steady and unsteady, uniform and non uniform, laminar and turbulent, Eulerian and Lagrangian description of fluid flow, stream line, 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.

Section-D

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), kinetic and momentum correction factors, Impulse momentum relationship and its applications, Problems.

Suggested Readings

1. Hydraulics and Fluid Mechanics : P.N.Modi, Dr. S.M. Seth
2. Hydraulic Mechanics and Hydraulics Machines : Dr. J.Lal
3. Manual of Fireman ship Book No.4
4. Fire-Fighting Hydraulics : Purington
5. Fire Service Hydraulics by Dr. G.C. Mishra

Course code	ESC-FT-207 G				
Category	Engineering Science courses				
Course title	Basics of Thermal Engineering				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	1	0	4	
Course Objectives:	<ul style="list-style-type: none"> • To familiarize with the basic concepts of thermodynamics, psychometric process and chart. • To study the different modes of heat transfer, ventilation system and heat control. • To study the basic concepts of Steam Power Generation, IC engines and calculation of different powers. 				
Course Outcomes:	<p>On successful completion of this course students will be able to</p> <ul style="list-style-type: none"> • Applied thermodynamics laws in engineering application. • Explain the modes of heat transfer. • Explain the ventilation and different air conditioning terms. • Determine the efficiency of boilers and their selection. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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.

Section-A

Thermodynamics: Introduction, thermodynamic equilibrium, properties, state, process, cycle, path, temperature, pressure, work, heat, energy, laws of thermodynamics, gas laws, entropy, enthalpy, Carnot cycle, properties of pure substance.

Heat Transfer: Introduction, modes of heat transfer, thermal conductivity, thermal insulation, Planck's law, Stefan Boltzmann law, total emissive power, concept of black body, grey body, absorption, reflection and transmission of radiation, heat exchangers.

Section-B

Ventilation and Heat control: Purpose and effects of ventilation and heat control, thermal environment and measurement, types of ventilation, consideration for ventilation, control of heat exposures, testing and maintenance of ventilation systems.

Refrigeration: Psychometric process and charts, DBT, WBT, DPT, Sensible heat factor, Cooling towers.

Section-C

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.

Draught: Definition, classification, chimney height and diameter, discharge efficiency loss.

Section-D

IC Engines: classification of IC engine, 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

1. Thermodynamics: An Engineering Approach by Yunus A Cengel and Michael A Boles, McGraw Hill Education
2. Engineering Thermodynamics by Dr. P.K.Nag, TMH Publication
3. Engineering Thermodynamics by Dr. C.P.Arora, TMH Publication
4. Internal Combustion Engines – V. Ganesan, TMH Publication
5. Heat Transfer – J.P. Holman, John Wiley & Sons, New York.

Course code	PCC-FT-209 G				
Category	Professional Core Courses				
Course title	Automobile Safety				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	1	0	4	
Course Objectives:	<ul style="list-style-type: none"> • To familiarize with Automobile and transmission system. • To study different components of automobiles and their mechanism. • To understand construction and working of fire vehicles. 				
Course Outcomes:	On successful completion of this course students will be able to <ul style="list-style-type: none"> • Identify the different parts of automobile. • Understand the process of combustion in S.I. & C.I. engines. • Demonstrate knowledge of operation and maintenance of transmission system. • Explain the construction and operation of fire fighting vehicles. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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.

Section-A

Introduction: Automobile, Types of Automobile, various system in automobiles, Engine Classification, construction, details of Engine Components, Combustion in S.I. Engines, Combustion in C.I. Engines, Study of fuel system components, Function of carburetors, construction details, diesel fuel feed systems, Carburetion and mass distribution of mixture, supercharging, fuel injection and injection sections.

Section-B

Transmission System: Components of transmission system, PTO.

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

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

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

Brakes: Types, Construction and Operation of Hydraulic, Pneumatic Brake Systems, Maintenance of Brakes.

Section-C

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

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

Electrical System: Ignition Systems, Magnet Ignition, Battery Ignition, Electronic Ignition, Merits and Demerits, Working, Self Starter, Dynamo voltage regulator, Battery construction, operation and maintenance, pollution, Air-pollution, Euro norms, Pollution Control techniques.

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

Section-D

Fire fighting vehicles

Fire bikes: Construction & Operation of Fire bikes.

Tenders: Construction & operation of fire tenders and trucks.

Fire Boats: Construction & Operation of Fire boats & other Water borne applications

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

Suggested Readings:

1. Automobile chassis and body construction, Operation and Maintenance by Wills H. Crouse.
2. Automobile Machines – Principles and Operations by W.H. Crouse.
3. Automobile Engine overhaul by A.W. Judge and Sir Issac Pitman.
4. Automobile Electrical Maintenances by A.W. Judge and Sir Issac Pitman.
5. Automobile Engineering by R.B. Gupta
6. Central Motor Vehicles (First Amendment) Rules, 2015 - India.

Course code	PCC-FT-211 G				
Category	Professional Core Courses				
Course title	Fire Protection Workshop				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiment

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.
4. To study different causes and phases of fire.
5. To study fire detection system.
6. To study different types of sprinkler system.
7. To study product of combustion.
8. To study different types of occupancies as per National Building Code of India(Latest Edition).
9. To study structural integrity under fire using standard methods of NFPA.
10. To study different types of hose fittings and their application.

Course code	PCC-FT-213 G				
Category	Professional Core Courses				
Course title	Automobile Safety Lab				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiment

1. To study working principles and operation of Automotive Engine Systems & Sub Systems.
2. To study working principles and operation of the Fuels supply systems:
3. To study of working principles and operation of Automotive Clutches.
4. To study of working principles and operation of the Automotive Transmission systems.
5. To study of working principles and operation of the Automotive Drive Lines & Differentials.
6. To study of working principles and operation of the Automotive Suspension Systems.
7. To study of working principles and operation of the Automotive Steering Systems.
8. To study of working principles and operation of the Automotive Tyres & wheels.
9. To study of working principles and operation of the Automotive Brake systems.
10. To study of working principles and operation of Automotive Emission / Pollution control systems.

Course code	ESC-FT-215 G				
Category	Engineering Science courses				
Course title	Basic Thermal Engineering Lab				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiment

1. To study working of 2 stroke and 4 stroke diesel engines.
2. To study working of 2 stroke and 4 stroke petrol engines.
3. To study different types of fuels along with their flash point, fire point and calorific values.
4. To study different modes of heat transfer.
5. To study the concept of black body and white body.
6. To study heat transfer through powder.
7. To study heat transfer through metal rods.
8. To study Fire tube boilers and Water tube boilers.
9. To find the indicated horse power (IHP) on multi-cylinder petrol engine/diesel engine by Morse Test.
10. To study different types of cooling towers.

Course code	PT-FT-217 G				
Category	Training				
Course title	Fire Ground Operation-I				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments

1. To study the history of drills.
2. To study the aim, principle, instruction method of drill.
3. To perform the positions of attention, stand at ease, stand easy, sizing, right dress, dismiss, step forward/backward march and side step.
4. To perform the position of march and pace, turning by numbers, mark time, the halt, marching in squad, quick march and the halt (on the move).
5. To perform the position of right (or left)- turn, changing direction by wheeling and changing steps on the march, forming file from single file and forming single file from file.
6. To study the tricks of parade inspection, how and whom to salute and perform the position of saluting.

MAHARSHI DAYANAND UNIVERSITY, ROHTAK

Scheme of Examination for Semester IV (Second Year)

B.TECH (FIRE TECHNOLOGY AND SAFETY) w.e.f. 2019-20

SN	Category	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)			Duration of Exam (Hours)	
				L	T	P			Marks of Class work	TH	Pr		Total
1	Humanities and Social science including Management courses	HSMC-FT-202G	Principles of Management & Organisation Behaviour	3	0	0	3	3	25	75	100	3	
2	Engineering Science Course	ESC-FT-204G	Basics of Safety Engineering	3	0	0	3	3	25	75	100	3	
3	Professional Core Courses	PCC-FT-206G	First Aid & Paramedics	3	1	0	4	4	25	75	100	3	
4	Professional Core Courses	PCC-FT-208G	Fire Service Hydraulics-II	3	1	0	4	4	25	75	100	3	
5	Professional Core Courses	PCC-FT-210G	Safety in Construction	3	1	0	4	4	25	75	100	3	
6	Professional Core Courses	PCC-FT-212G	First Aid & Paramedics Lab	0	0	2	2	1	25		25	50	3
7	Professional Core Courses	PCC-FT-214G	Fire Service Hydraulics Lab	0	0	2	2	1	25		25	50	3
8	Training	PT -FT-216 G	Fire Ground Operation-II	0	0	2	2	1	25		25	50	3
9	Mandatory Course	*MC-106 G	Environmental Science	3	0	1			25	75			4
TOTAL CREDIT								21				650	

Abbreviations: TH- Theory , PR- Practical

*MC-106 G is a mandatory non –credit course in which the students will be required passing marks in theory.

NOTE: At the end of 4th semester each student has to undergo Practical Training of 4/6 weeks in an Industry/ Institute/ Professional Organization/ Research Laboratory/ training centre etc. and submit typed report along with a certificate from the organization & its evaluation shall be carried out in the 5th Semester.

Course code	HSMC-FT-202 G				
Category	Humanities and Social Science including Management courses				
Course title	Principles of Management and Organizational Behavior				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives:	<ul style="list-style-type: none"> To make the students familiar with the basic concepts of management and organizational behavior along with their application for managing people at work. To understand the management concepts, applications of concepts in practical aspects of business and development of managerial skills. 				
Course Outcomes:	<p>On successful completion of this course students will be able to</p> <ul style="list-style-type: none"> Acquire knowledge of key principles of management and apply this knowledge to a real organizational setting. Diagnose problems, make effective decisions, influence others, optimize cross-functional teams and design reward systems. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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.

Section-A

Management: Introduction to Management concepts, Meaning and Characteristics of Management, Importance of Management, Development of Management thoughts, Principles of Management, Personnel Management, Functions of Personnel Management, Manpower Planning, Process of Manpower Planning.

Section-B

Planning: Introduction, Organizing and Organizational Structure, Steps in Planning Process, Scope and Limitations, Short Range and Long Range Planning, Flexibility in Planning, Characteristics of a sound Plan, Management by Objectives (MBO), Policies and Strategies, Scope and Formulation .

Decision Making: Techniques and Processes, Steps in Problem Solving and Decision Making, Bounded Rationality and Influences on Decision Making, Group Problem Solving and Decision Making.

Section-C

Organizing: Organization Structure and Design, Authority and Responsibility Relationships, Delegation of Authority and Decentralisation, Interdepartmental Coordination.

Organizational Behavior: Introduction, Historical development and basic concepts, understanding a social system, Establishing working relationships, Attitude, Perception, Personality and Individual Differences, Job Performance, Values, Attitudes and Beliefs, Stress Management,

Communication: Types, Process, Barriers, Making Communication Effective.

Section-D

Leadership: Leadership and Organizational Development, Supervision and Participation, Interpersonal and Communication problems within the organizations, Group Dynamics, Leadership, Styles, Approaches, Power and Politics.

Motivation: Human needs and motivating employees. Interpreting motivational models of Maslow, Herzberg, Vroom and Mc Clelland, Job satisfaction and work performance, Appraising and Rewarding Performance.

Suggested Books:

1. Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.
2. Organizational Behaviour by Stephen P. Robbins & Seema Sanghi- Pearson
3. Organizational Behaviour by L.M. Prasad-S Chand & sons
4. Principles and Practice of Management - R.S. Gupta, B.D.Sharma, N.S. Bhalla. (Kalyani Publishers)
5. Organisation and Management - R.D. Aggarwal (Tata Mc Graw Hill)
6. Principles & Practices of Management – L.M. Prasad (Sultan Chand & Sons)

Course code	ESC-FT-204 G				
Category	Engineering Science Courses				
Course title	Basics of Safety Engineering				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Objectives:	<ul style="list-style-type: none"> • To familiarise with the safety methodology, education and training for an organisation and environment. • To know the different types of accident and its preventive methods. • To study the rules of safety and safety management system. 				
Course Outcomes:	<p>On successful completion of this course students will be able to</p> <ul style="list-style-type: none"> • Apply the safety methods in an organisation where hazard will take place. • Understand the different types of accident and give the solution to minimise it. • Provide training and education regarding safety. • Review and evaluate safety management performance. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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.

Section-A

Safety: Introduction to safety, need for integration of health and environment safety, safety and productivity, fundamental of safety, important points for consideration of safety, general instructions for safety.

Safety Organization: Objectives, types and functions, safety committee, need, types, advantages, safety audits, types of audit, audit methodology, non conformity report, audit checklist and report, Safety in design and operations, inherent, engineered safety.

Section-B

Accident: Introduction, types of accidents, causes of accidents, principle of accident prevention, accident investigation, process of investigation, reporting, analysis, technique, Mort capital, multi event sequencing-TOR, theories of accident, onsite and offsite emergency response plan, cost of accident.

Section-C

Safety Education and Training: Importance, various training methods, effectiveness of training, behavior oriented training, communication, purpose, barrier to communication, creating awareness, domestic safety and training.

Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate, and safety “t” score, Safety surveys, Job Safety Analysis (JSA).

Section-D

Guiding principles of safety management to prevent accidents, role of all stakeholders, role of industry, management, labour, role of public authorities.

Safety Rules: Safety rules for industries (including management and labour) safety culture, safety policy, safety management system, safety reporting. Review and evaluation of safety management performance, collective responsibility of all nations.

Suggested Readings

1. Fundamentals of Industrial Safety & Health- K.U.Mistry, Siddharth Prakashan.
2. Safety Management- R.K. Mishra- AITBS Publishers.
3. N.V. Krishnan, Safety Management in Industry, Jaico Publishing House, 1997
4. Ronald P. Blake, Industrial Safety:, Prentice Hall, New Delhi, 1973
5. David L. Goetsch, Occupational Safety and health, Prentice Hall
6. Ted S. Ferry, Modern Accident Investigation and Analysis, John Wiley & Sons
7. Fire Safety in Buildings by V K Jain, New Age publishers, New Delhi
8. Fundamentals of Fire Safety in Building Design by Dr. Than Singh Sharma, Aayush Publications, New Delhi

Course code	PCC-FT-206 G				
Category	Professional Core Courses				
Course title	First Aid & Paramedics				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	1	0	4	
Course Objectives:	<ul style="list-style-type: none"> • To understand the basics of the first Aid. • To study human body and its various system like respiratory, circulatory, digestive and musculoskeletal system. • To familiarize with different medical conditions. • To understand different types of causalities handling and lifting techniques. 				
Course Outcomes:	On successful completion of this course students will be able to <ul style="list-style-type: none"> • Understand the first Aid and role of first Aid. • Explain about human body system. • Provide first Aid to any causality under different medical conditions. • To handle different causality and to explain different lifting techniques. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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.

Section-A

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.

Section-B

Human Body: Study of human body and its various systems such as Musculoskeletal system, Respiratory system, Circulatory system, Digestive 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.

Section-C

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, Child birth, Electric shock, Burn and its types, Rule of nine, Poisoning and its types, Bites-frost bite, Snake bite, Dog bite, Insect bite, Drowning and choking, Unconsciousness, Protection of body from winter dryness.

Section-D

Fractures: First aid for fractures or broken bones, Joints and its types, Bandages and slings, Handling of casualties, lifting technique and equipments, 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:

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

Course code	PCC-FT-208 G				
Category	Professional Core Courses				
Course title	Fire Service Hydraulics-II				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	1	0	4	
Course Objectives:	<ul style="list-style-type: none"> • 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 pump. • To know about sprinkler and its applications. 				
Course Outcomes:	<p>On successful completion of this course students will be able to</p> <ul style="list-style-type: none"> • Use water in fire protection service. • Calculate the discharge in various components. • Understand the functioning of pumps and primers. • To use sprinkler in fire protection services. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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.

Section-A

Water Supply & Hydrant System: Use of water in fire protection service, Properties of water, density, specific volume, specific gravity, latent heat of vaporization, viscosity, kinematics viscosity, Water supply analysis, types of water supply, hydrants, types of hydrant, hydrant gear and characteristics, inspection and testing of hydrants.

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 vane(s), jet propulsion of ships.

Section-B

Flow through Pipes and Fire Fighting Hoses: Flow measurement through pipes or ducts, through reservoirs, orifice, mouthpiece, through open channels, discharge over notches (triangular, rectangular, trapezoidal only), discharge from nozzles, hoses of different diameters, purpose and design of branch and nozzles, discharge coefficient, Hagen Poiseuille formula, equation for pipe flow, friction charts and their uses, losses in pipes and fittings, Water power, Brake power and efficiency.

Section-C

Pumps and Primers: Introduction, types of pumps, Ejector pumps, Reciprocating pump- principle, construction, working, Centrifugal pump- principle, construction and working, Jockey pump- construction and its working, Vehicle mounted fire pumps, Portable pump, Selection of pumps, maintenance and servicing of pumps, advantages and disadvantages, Terms- Duty point, Multistage, guide vanes, Pump operation and distribution of water on fire ground, pump power and efficiency, primers and their types.

Section-D

Sprinkler System Demand: Simple- side fed tree, interaction between flow and pressure in an operating sprinkler systems, mathematical relationship on basis of sprinkler system calculations, pressure balancing in performing head calculations for a simple- side fed tree sprinkler system, hydraulics of water supplies for automatic sprinkler system.

Suggested Readings

1. Hydraulics and Fluid Mechanics : P.N.Modi, Dr. S.M. Seth
2. Pump Selection and application: Tyler C. Riches.
3. Pump Operators, Handbook: I.S. University of Science and Technology.
4. Fire Pumps and Hydraulics: I.E. Ditts and T.M. Harris.
5. Hydraulic Mechanics and Hydraulics Machines : Dr. J.Lal
6. Manual of Fireman ship Book No.4
7. Fire-fighting Hydraulics : Purington
8. Fire Service Hydraulics by Dr. G.C. Mishra

Course code	PCC-FT-210 G				
Category	Professional Core Courses				
Course title	Safety in Construction				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	1	0	4	
Course Objectives:	<ul style="list-style-type: none"> • To introduce the safety issues in construction industry. • To familiarize with the needs of safety in material handling and equipment. • To study the Contract Labour Act and Central Rules in the Welfare and health provisions. • To study safety provisions in different constructions. 				
Course Outcomes:	<p>On successful completion of this course students will be able to</p> <ul style="list-style-type: none"> • Understand different safety issues in construction industry and during construction operations. • To know about safety in the use of construction equipments. • To know about Contract Labour Act and Central Rules. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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.

Section-A

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.

Section-B

Safety in Various Construction Operations: Excavation, under water works, under pinning & 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.

Section-C

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.

Section-D

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

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

Course code	PCC-FT-212 G				
Category	Professional Core Courses				
Course title	First Aid and Paramedics Lab				
Scheme and Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiment

1. To study the first aid kit.
2. To study Respiratory, Circulation and Nervous System.
3. To study Digestive and Excretory System.
4. To study and perform different techniques of Respiration (CPR).
5. To study various types of Bandages and Slings.
6. To study maintenance of various charts related to casualties.
7. To study of stretchers and its types.
8. To practice Handling of casualties, lifting and carrying.
9. To study different types of medical conditions.
10. To study accidents, investigations and reporting and record keeping.

Course code	PCC-FT-214 G				
Category	Professional Core Courses				
Course title	Fire Service Hydraulics Lab				
Scheme and Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiment

1. Measurement of pressure head by employing single and double column manometer.
2. To verify the Bernoulli's Theorem and to determine coefficient of discharge of an orifice meter and a Venturimeter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To study the constructional details and working of a Centrifugal Pump.
6. To study the constructional details and working of a Reciprocating Pump.
7. To study the constructional details and working of a Jockey Pump.
8. To study the different types of Sprinklers and their working.
9. To study Jet impact on flat and curved surfaces.
10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.

Course code	PT-FT-216 G				
Category	Training				
Course title	Fire Ground Operations -II				
Scheme and Credits	L	T	P	Credits	Semester-IV
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Drills based on the following

Saluting:

- Saluting with letter
- Saluting without letter
- Left direction saluting on marching position
- Right direction saluting on marching position
- Slow running march

Reporting procedure:

- Taking and Giving Charge

Hose drills:

- Lifting of hose
- Lowering of hose
- Laying of hose
- Rolling of hose

Hydrant drills:

- Hydrant drill (Three men)
- Hydrant drill (Four men)
- Make one line from two line (using collecting breeching)
- Make two line from one line (using dividing breeching)
- Connect three lines to a single output (using collecting head)

Course code	MC-106G				
Category	Mandatory Course				
Course title	Environmental Sciences				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	1	0	
Branches (B. Tech.)	Common For All Branches				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Unit-1

(2 lectures)

The Multidisciplinary nature of environmental studies. Definition scope and importance.

Unit-2 Natural Resources:

(8 lectures)

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-3 Ecosystems:

(6 lectures)

- * Producers, consumers and decomposers.
- * Energy flow in the ecosystem.

- * Ecological succession.
- * Food chains, food web and ecological pyramids.
- * Introduction, types, characteristic features, structure and function of the following eco-system:
 - a. Forest ecosystem.
 - b. Grass land ecosystem.
 - c. Desert ecosystem.
 - d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit-4 Bio diversity and its conservation

(8 lectures)

- * 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.
- * Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Unit-5 Environmental pollution:

(8 lectures)

Definition, causes, effects and control measures of:

- a) Air pollution
 - b) Water pollution
 - c) Soil pollution
 - d) Marine pollution
 - e) Noise pollution
 - f) Thermal pollution
 - g) 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.

Unit-6 Social issues and the Environment:

(7 lectures)

- * 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-7 Human population and the Environment.

(6 lectures)

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.

Unit-8 Field Work:

(Field work equal to 10 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 lopes, etc.

References

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8. Water in crisis, Pacific Institute for Studies in Dev. Environment & Security Stock holm Env. Institute, OxfordUniv.Press,473p.

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10. Global Biodiversity Assessment, Cambridge Uni. Press 1140p.
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21. Tridevi R. K.and P. K. Goal, Introduction to air pollution, Techno Science Publications(TR).
22. Wagner K.D.,1998,Environmental Management,W.B. Saundersco.Philadelphia,USA499p.
23. A text book environmental education G. V. S. Publishers by Dr. J. P. Yadav.

(M) Magazine (R) Reference (TB) Textbook

The scheme of the paper will be under:

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.

Exam. Pattern: In case of awarding the marks, the paper will carry 100 marks.

Theory: 75marks,

Practical/ Field visit:25marks.

The structure of the question paper will be:

Part-A: Short Answer Pattern	:	15 marks
Part-B:Essay Type with inbuilt choice	:	60 marks
Part-C:Field Work (Practical)	:	25 marks

Instructions for Examiners:

Part-A:Question No.1 is compulsory and will contain five short- answer type question of 3 marks each covering the entire syllabus.

Part-B: Eight essay type questions (within built choice) will be set from the entire syllabus and the candidate will be required to answer any four of them. Each essay type question will be of 15marks.

The examination of the regular students will be conducted by the concerned college/Institute. Each student will be required to score minimum 40% marks separately in theory and practical/Field visit. 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.

M.D. UNIVERSITY, ROHTAK

(NAAC Accredited 'A+' Grade)

SCHEME OF STUDIES AND EXAMINATION B.TECH (FIRE TECHNOLOGY AND SAFETY)

SEMESTER 5th AND 6th

Scheme effective from 2020-21

COURSE CODE AND DEFINITIONS:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar
TH	Theory
Pr	Practical

General Notes:

1. Mandatory courses are non credit courses in which students will be required passing marks in internal assessments.
2. Students will be allowed to use non programmable scientific calculator. However, sharing of calculator will not be permitted in the examination.
3. Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise. The choice of the students for any elective shall not be binding for the department to offer, if the department does not have expertise. To run the elective course a minimum of 1/3rd students of the class should opt for it.

Scheme of Studies and Examination
B.TECH (Fire Technology and Safety) – 5th Semester
w.e.f. 2020-21

S N	Category	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Dura tion of Exam (Hou rs)
				L	T	P			Interna l Assess ment	Ext ern al Ex ami nat ion	Pr	Total	
1	Professional Core Courses	PCC-FT- 301 G	Building Construction & Urban Planning	3	1	0	4	4	25	75		100	3
2	Professional Core Courses	PCC-FT- 303 G	Mechanics of Structure	3	1	0	4	4	25	75		100	3
3	Professional Core Courses	PCC-FT- 305 G	Passive Measures for Fire Safety	3	1	0	4	4	25	75		100	3
4	Professional Elective Courses	_____	Elective-I	3	0	0	3	3	25	75		100	3
5	Professional Elective Courses	_____	Elective -II	3	0	0	3	3	25	75		100	3
6	Professional Core Courses	PCC-FT- 307G	Mechanics of Structure Lab	0	0	2	2	1	25		25	50	3
7	Seminar	PR-FT- 309G	Industrial Seminar-I	0	0	2	2	1	50			50	3
8	Training	PR-FT - 311G	Fire Ground Operation-III	0	0	2	2	1	25		25	50	3
9	Mandatory Course	MC- 315-G	Essence of Indian Traditional Knowledge	2	0	0							3
TOTAL								21				650	

Note:

1. Choose any one from Elective-I
2. Choose any one from Elective-II

Scheme of Studies and Examination
B.TECH (Fire Technology and Safety) – 6th Semester
w.e.f. 2020-21

S N	Category	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Dura tion of Exam (Hou rs)
				L	T	P			Internal Assess ment	Ext ern al Exa min atio n	Pr	Total	
1	Professional Core Courses	PCC-FT- 302 G	Rescue Equipment and Techniques	3	1	0	4	4	25	75		100	3
2	Professional Core Courses	PCC-FT- 304G	Fire Protection and Salvage Operation	3	0	0	3	3	25	75		100	3
3	Professional Elective Courses	_____	Elective-III	3	0	0	3	3	25	75		100	3
4	Professional Elective Courses	_____	Elective-IV	3	0	0	3	3	25	75		100	3
5	Open Elective Courses	_____	Open Elective-I	3	0	0	3	3	25	75		100	3
6	Open Elective Courses	_____	Open Elective -II	3	0	0	3	3	25	75		100	3
7	Professional Core Courses	PCC-FT- 306 G	Computer Applications and CAD Lab	0	0	2	2	1	25		25	50	3
8	Training	PR-FT- 308 G	Fire Ground Operation-IV (Rescue Operations)	0	0	2	2	1	25		25	50	3
TOTAL								21				700	

NOTE:

1. At the end of 6th 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 an Industry/ Institute/ Professional Organization/ Research Laboratory/ Training Centre/ other building Occupancy etc. and submit typed report along with a certificate from the organization & its evaluation shall be carried out in the 7th Semester.
2. Choose any one from Elective-III
3. Choose any one from Elective-IV
4. Choose any one from Open Elective-I
5. Choose any one from Open Elective-II

Professional Elective Courses (Third Year)

Sr. No.	Course Code	Course Title	Total Contact Hrs	Credit
1	PEC-FTEL321	Fire Safety Codes and Standards	3	3
2	PEC-FTEL322	Nuclear Safety and Radioactive Materials	3	3
3	PEC-FTEL323	Fire Risk Calculations	3	3
4	PEC-FTEL324	Salvage Evaluation of Fire Situation	3	3
5	PEC-FTEL325	Special Hazards and Protection	3	3
6	PEC-FTEL326	Building Design and Drawing	3	3
7	PEC-FTEL327	Fire Modeling	3	3
8	PEC-FTEL328	Electrical Systems and Safety in Design	3	3
9	PEC-FTEL329	Safety in Petroleum and Petrochemical Industries	3	3
10	PEC-FTEL330	Design of Pipe, Pressure Vessels and Machine Elements	3	3

Open Elective Courses (Third Year)

Sr. No.	Course Code	Course Title	Total Contact Hrs	Credit
1	OEC-FTEL-331	Materials and Metrology	3	3
2	OEC-FTEL-332	Power Plant Engineering	3	3
3	OEC-FTEL-333	Computer Applications, and CAD-CAM	3	3
4	OEC-FTEL-334	Process Instrumentation and Control Engineering	3	3
5	OEC-FTEL-335	Operation Research	3	3
6	OEC-FTEL-336	Industrial Noise and Vibrations	3	3
7	OEC-FTEL-337	Engineering Economics	3	3
8	OEC-FTEL-338	Artificial Intelligence	3	3
9	OEC-FTEL-339	Environmental Engineering and Management	3	3
10	OEC-FTEL-340	Robotics and Robot Applications	3	3

Note: A Student can not choose the same subject as Professional Elective Courses and Open Elective Courses in Sem V and Sem VI

Course code	PCC-FT-301 G				
Category	Professional Core Courses				
Course title	Building Construction & Urban Planning				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	1	0	4	
Course Outcomes:	After completion of this course, students will be able to: <ul style="list-style-type: none"> Recall the types of occupancies according to National Building Code of India (NBC). Describe building bye laws and provisions of NBC in building construction, prevention and protection in relation to the various type of fire hazards in the buildings. Explain the topography, its importance in urban planning, housing units and building services. Calculate Floor Area Ratio, capacity, number and width of exit as per NBC. 				
Objectives:	<ul style="list-style-type: none"> To be familiar with National Building Code of India. To study various components of buildings, behaviour of building materials under fire fighting conditions. To familiarize with the urban planning, housing units and services. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Provisions of National Building Code of India (NBC), Introduction to building by laws, Classification of building based on occupancy, Classification of types of construction according to Fire Resistance, General exit requirements as per NBC, Planning of location and calculation of capacity, Number and width of exit as per NBC for different types of occupancy, Stairs, sizes layout and various kinds of Stairs in different kind of building, FAR terminology with different modes of construction in stone, timber, steel or RC details.

Unit-II

Walls, Stone, brick masonry walls and their construction, Fire walls and its types, Doors and windows, types and construction.

Roof, Fitched roofs, Various types of roof coverings, Types of roof frame in timber and steel, Roof construction details, Terrace roofs, drainage and water proofing.

Floors, timber floors, steel jointed floors, RCC floors and their modes of construction, floor paving, tiles, flag stones, concrete, terrace for different light and heavy duty uses in buildings.

Unit-III

Behaviour of building materials and elements of structure under fire fighting conditions, Fire hazards, Personnel hazard, Damage hazard, Fire precautions in relation to fire hazard, Grading of occupancies to damage hazard with reference to fire load and fire resistance of elements of structure, Problems of high rise buildings and their safety measures, Behavior of retardant structures under fire.

Unit-IV

Urban Planning, its objectives, Planning surveys, selection of site for urban growth, complexity and its impact on National development, Topography, Types of roads in urban areas, Types of housing

units, Detached, Semidetached, Group Housing, Multi story flats or apartments, Skyscraper, Group Ware Housing, Commercial complexes, layout of housing areas with consideration of site orientation.

Principle of building planning, Significance, Criteria under Indian conditions, Introduction of building services like Water Supply and Drainage, Electrification, Lightening and Staircase Fire Safety, Acoustics of buildings, Ventilation, Air conditioning, Thermal insulation.

References:

1. Building Construction by Sushil Kumar, (Standard Publishers & Distributors).
2. Town planning by S.C. Rangwala, Charotar Publishing House.
3. National Building Code of India by Bureau of Indian Standards, New Delhi (Latest Edition)
4. Fire Protection Engineering in Building Design by Jane I. Lataille.
5. Fundamentals of Industrial Safety & Health by K.U.Mistry, Siddharth Prakashan.
6. NFPA Manual
7. Introduction to Town Planning by Robert, Mnotype Publishers, latest edition.
8. Urban Growth and Development : A Problem approach by Andrews, Richard B., New York, Simmons Boardman, latest edition.

Course code	PCC-FT-303 G				
Category	Professional Core Courses				
Course title	Mechanics of Structure				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	1	0	4	
Course Outcomes:	After completion of this course, students will be able to: <ul style="list-style-type: none"> • Understand the theorems, laws and concepts related to force, friction, lifting machines, moment of inertia and centre of gravity. • Apply the laws, principles, theorems and concepts for solving the various problems related to beams, structures and machines performance. • Distinguish the forces, stresses, structures, lifting machines, beams under various loading conditions. • Determine the influence of forces, friction, loads in structures and beams. 				
Objectives:	<ul style="list-style-type: none"> • To understand the concepts of stress and strain, truss and frames, friction, center of gravity, shear force and bending moment of beams under different loading conditions. • To enable students to solve practical problems related to friction, lifting machines, shear force and bending moments. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

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

Force Systems: Coplanar and space force systems, Coplanar, concurrent and non-concurrent forces, Free body diagrams, Resultant and components of forces, concept of equilibrium, parallelogram law of forces, Equilibrium of two forces, super-position and transmissibility of forces, Newton's third law, triangle law of forces, parallelogram law, Lami's theorem.

Unit-II

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

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

Unit-III

Friction: Concept of friction, laws of friction, limiting friction and coefficient of friction, sliding friction and rolling friction, inclined plane.

Simple Lifting Machines: Concept of machine, mechanical advantage, velocity ratio and efficiency of a machine, their relationship, law of machine, simple machines (lever, wheel and axle, pulleys, jacks, winch crabs only).

Unit-IV

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

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

References:

1. Strength of Materials – G. H. Ryder - Macmillan, India
2. Strength of Materials– Andrew Pytel and Fredinand L. Singer, Addison – Wesley
3. Engineering Mechanics – Irving H. Shames, PHI Publication
4. Engineering Mechanics – Dr. D. S. Kumar, Kataria & Sons
5. Strength of Materials - S. Ramamrutham, Dhanpat Rai Publishing company
6. Mechanics of Materials – B.C. Punamia, Laxmi Publication

Course code	PCC-FT-305 G				
Category	Professional Core Courses				
Course title	Passive Measures for Fire Safety				
Scheme and Credits	L	T	P	Credits	Semester-V
	3	1	0	4	
Course Outcomes:	After completion of this course, students will be able to: <ul style="list-style-type: none"> • Understand site planning, protection for explosive, flammable material, fire wall. • Understand the layout of hazardous pipelines, selection of appropriate extinguishing devices, fire doors, escape routes and their planning, smoke extraction etc. • Apply the proper standards and rules in site planning, layout of hazardous pipelines, calculating fire loads etc. • Analyze the suitable extinguishing device after strategic planning, detailed case study for reducing life losses. 				
Objectives:	<ul style="list-style-type: none"> • To learn about the different passive measures of fire safety. • To study the site planning of various occupancies from the point of view of fire protection and safety. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Planning and construction of building, Site planning by considering the nature of the plant, Building, Equipment and process from the point of safety and fire protection, Protection where Corrosive, Explosive and easily Combustible materials are handled and processed, Fire wall and its types, Barricades etc. Fire Separation, Segregation and Isolation.

Unit-II

Layout of hazardous pipelines, vessels and equipments, Planning of strategic points and Selection of fire extinguishing devices

Fire doors, their resistance rating, Wire glass windows, Prevention of fire through roofs, Vertical cut off's, Exits guards and Guarding, Protection devices for lightening hazards.

Unit-III

Escape route, Escape route plan, Emergency exits, Components, Compartmentation, Smoke extraction system, Fire dampers, Fire rated smoke extraction ducts, Cable ducts, Vertical and horizontal opening, Steel protection and steel staircase enclosure, Fire escape enclosure, Glazing, Fire load and Fire rating.

Unit-IV

Housekeeping and management, Indoor housekeeping and Outdoor housekeeping, 5's of Housekeeping, Inspection and checklists, Housekeeping of specific industries, Detailed analysis of fire case studies, Especially those fires where large number of people were involved.

References:

1. Industrial Safety, Health & Environment management System by R.K. Jain & Sunil S. Rao, Khanna Publishers.
2. Fire Safety in Buildings by V.K. Jain, New Age International Publishers
3. Manual of Fire Safety by N Sessa Prakash, CBS Publishers and Distributors
4. Fire Protection and Prevention: The Essential Handbook Volume 1 & 2 by B.M. Sen, UBS Publishers
5. NFPA Manual

Course code	PCC-FT-307 G				
Category	Professional Core Courses				
Course title	Mechanics of Structure Lab				
Scheme and Credits	L	T	P	Credits	Semester-V
	0	0	2	1	
Class work	25 Marks				
Practical	25Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments

1. To draw shear force, bending moment diagrams for a simply supported beam under point and distributed loads.
2. To study the universal testing machine and perform the tensile test on UTM.
3. To perform compression & bending tests on UTM.
4. To perform the shear test on UTM.
5. To study the impact testing machine and perform the impact tests (Izod & Charpy).
6. To study the Brinell hardness testing machine & perform the Brinell hardness test.
7. To study the Rockwell hardness testing machine & perform the Rockwell hardness test.
8. To study the Vickers hardness testing machine & perform the Vickers hardness test.
9. To determine mechanical advantage and efficiency of single and double purchase winch crab.
10. To determine mechanical advantage and efficiency of simple and compound screw jack.

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	PR-FT-309 G				
Category	Seminar				
Course title	Industrial Seminar-I				
Scheme and Credits	L	T	P	Credits	Semester-V
	0	0	2	1	
Class work	50 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Note: Industrial Seminar based on the training//project /certificate course/case study done after 4th semester.

Course code	PR-FT-311G				
Category	Training				
Course title	Fire Ground Operation-III				
Scheme and Credits	L	T	P	Credits	Semester-V
	0	0	2	1	
Class work	25 Marks				
Practical	25Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments

1. To study and perform rolling of Ropes.
2. To study and perform testing of Ropes.
3. To study different types of Ladders and their parts.
4. To study and perform rolling of Hoses.
5. To perform different Ladder tests
 - Round test
 - String test
 - Extension line test
6. To Perform different Hose tests
 - Suction hose test
 - Delivery hose test
 - Hose reel hose test
7. To study and perform extinguisher drill.
8. To perform foam drill with foam test.
9. To perform four men pump drill with pump test.
10. To perform six men pump drill with pump test.
11. To perform close water pumping drill.
12. To perform open water pumping drill.

At least 8 experiments to be performed from the above list. Other drills and tests can be performed as decided by department (time to time) depending upon the scope of course.

Course code	MC-315G			
Category	Mandatory Course			
Course title	Essence of Indian Traditional Knowledge			
Scheme and credits	L	T	P	Credits
	2	0	0	0

Course Contents

- Basic structure of Indian knowledge System: अष्टादशविद्या – वेद, उपवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थाप्य आदि) वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद) उपाङ्ग (धर्मशास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case studies

References

1. V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
2. Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan
3. Swami Jitatmanand, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan
4. Fritzo Capra, *Tao of Physics*
5. Fritzo Capra, *The Wave of life*
6. VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam
7. *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkata
8. GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, Vidyanidhi Prakashan, Delhi 2016
9. RN Jha, *Science of Consciousness Psychotherapy and Yoga Practices*, Vidyanidhi Prakashan, Delhi 2016
10. P B Sharma (English translation), *Shodashang Hridayan*

Course code	PCC-FT-302G				
Category	Professional Core Courses				
Course title	Rescue Equipment and Techniques				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	1	0	4	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Define different types of hydraulically and pneumatically operated tools and equipments used in emergency. • Describe small gears, application and working principles, Ladders its constructional features, their types, material and applications, ropes, tools, techniques and equipments and its types, materials and applications. • Examine breathing apparatus, various types of tenders and to calculate the capacity of the BA set in actual rescue operation. • Categorize and select suitable type of tenders, tools, techniques and equipments for different types of emergency situations. 				
Objectives:	<ul style="list-style-type: none"> • To familiarize with rescue equipments like hydraulic and pneumatic tools, electric power tools, ladders, ropes etc. • To study the various rescue techniques, PPEs, fire fighting vehicles, rescue vehicles and rescue operations. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Hydraulic and Pneumatic Tools: Hydraulic jack, Hydraulic cutter, Hydraulic expender, Hydraulic combi tools, Air lifting bags.

Electric Power Tools: Electric cutter, Electric saw, Chain saw etc.

Small gears: Small gears and their types.

Ladders: Applications and working principles of Ladders, constructional features, their types, materials and applications.

Ropes: Ropes, their types, materials and applications.

Unit-II

Rescue Techniques: Carriers and drags, One rescuers methods, Two rescuers methods, Multi-rescuers methods, Stretcher carry and different types of drags, Different types of knots, hitches and their applications in emergency.

PPE's- IS specification with types and testing for protection of head, Eye and face, Hand and arm, Foot and leg, Ear and body, Safety belt and Harness.

Unit-III

Fire Fighting and Rescue Vehicles: Emergency rescue tenders(ERT), Water tender, Foam tender, Multipurpose tender, Hydraulic platforms, Turntable ladder, Canteen van and ambulance.

Fire Extinguishers: Introduction, types and applications.

Rescue Operations: Rescue by ordinary means, Rescue from fire incidents, Rescue problems & their remedies, Rescue from high rise buildings, Major disasters like earth quake, Flood drought, Tsunami, etc.

Unit-IV

Respiratory Equipments: Respiratory physiology, Composition of air, Breathing, Breathing rate, B.A set- their types, Constructional features, Working principles and applications, Calculation of the capacity and time duration of the B.A. set.

Gas Masks: Introduction, their types, Constructional features, Working and applications.

Respirators and types: Canister type, Chemical cartridge type, Filter type, Compressed air Line type.

Reference:

1. Fire Safety in Buildings by V.K. Jain, New Age International Publishers
2. Safety Management by R.K. Mishra- AITBS Publishers.
3. Manual of Fire Safety by N Sessa Prakash, CBS Publishers and Distributors
4. Fire Protection and Prevention: The Essential Handbook Volume 1 & 2 by B.M. Sen, UBS Publishers
5. NFPA Manual
6. National Building Code of India by Bureau of Indian Standards, New Delhi (Latest Edition)

Course code	PCC-FT-304G				
Category	Professional Core Courses				
Course title	Fire Protection and Salvage Operation				
Scheme and Credits	L	T	P	Credits	Semester-VI
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> Recall the basic concepts of fire fighting, extinguishing media. Explain the hose and hose fittings, properties of extinguishing agents and salvage operation. Apply the principles, IS codes and standards for installation, care inspection and maintenance of portable fire extinguishers. Classify fire detection systems, alarms. 				
Objectives:	<ul style="list-style-type: none"> To learn about various fire fighting equipments. To evaluate right position for sitting of detector system. To learn the use of IS codes regarding fire protection. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Hose and Hose fittings: Detailed study of hoses, coupling, branches, branch holders, nozzles, breaching, adaptors, hose ramp, collecting heads, suction hose fittings, stand pipes, monitors.

Foam and foam making equipments: Types of foam, foam making equipments, practical considerations, care and maintenance, Hose reel hose - specifications and installation.

Unit-II

Extinguishing properties of Water, droplet size, heat absorbing capacity, surface tension, Extinguishing Properties of foam, expansion, concentration, bubble size, burn back resistance etc., Extinguishing properties of DCP, composition, particle size, radiation shielding, chain braking mechanism, Extinguishing Properties of CO₂, inert gas and extinguishing agent, FM 200, NOVEC 1230.

Description, working principle and operation methods of portable fire extinguishers, care, inspection and maintenance of portable fire extinguishers, performance criteria and testing of different types of fire extinguishers as per relevant Indian standard IS : 2190, extinguishing agents and their installation techniques.

Unit-III

Alarm Systems: Fire alarm system, classification of fire alarm system, components, testing and maintenance of fire alarm system, basic consideration for installation.

Detectors: Automatic fire detectors, heat detector, smoke detector, gas sensing fire detector, Radiant energy sensing detectors, detector installation, maintenance and testing.

Unit-IV

Salvage: Introduction, equipments-salvage sheets, other gears, procedure at fire- covering up, removal of water, reduction of water damage, reduction of smoke damage, removal of sheets, laying sawdust, drying off, fatal fires, etc. Procedure after the fire- repair of roofs, securing premises against entry.

References:

1. Industrial Safety, Health & Environment Management System by R.K. Jain & Sunil S. Rao, Khanna Publishers.
2. Fire Safety in Buildings by V.K. Jain, New Age International Publishers.
3. Manual of Fire Safety by N Sessa Prakash, CBS Publishers and Distributors.
4. Fire Protection and Prevention: The Essential Handbook Volume 1 & 2 by B.M. Sen, UBS Publishers.
5. Manual of Firemanship 6A, HMSO.

Course code	PCC-FT-306G				
Category	Professional Core Courses				
Course title	Computer Applications and CAD Lab				
Scheme and Credits	L	T	P	Credits	Semester-VI
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments

1. To study various commands used in Auto- CAD software.
2. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing, naming layers, setting line types for different layers using various type of lines in engineering drawing, saving the file with .dwg extension.
3. Layout drawing of a building using different layer and line colors indicating all Building details. Name the details using text commands, Make a title Block.
4. To make a Drawing of Line, arc, circle, ellipse, triangle etc.
5. To make a Drawing of a flange.
6. To make a Drawing of a bushing assembly.
7. To make an Isometric dimensioned drawing of a connecting Rod using isometric grid and snap.
8. To make different types of bolts and nuts with internal and external threading in Acme and square threading standards. Save the bolts and nuts as blocks suitable for insertion.
9. To make a quarter sectional isometric view of a cotter joint.
10. To study CNC Machine and perform operations CNC Milling and CNC Lathe.

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	PR-FT-308G				
Category	Training				
Course title	Fire Ground Operation-IV (Rescue Operations)				
Scheme and Credits	L	T	P	Credits	Semester-VI
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50Marks				
Duration of Exam	03 Hours				

List of Experiment

1. To practice different lift and carries.
2. To practice different types of knots using ropes.
3. To study different types of tenders (through industrial visits).
4. To study different types of Rescue tools and their applications.
5. To study different types of Power tools and their applications.
6. To Study different types of Fire Fighting Tools and their applications.
7. To study Personal Protecting Equipments and their uses.
8. To study B.A. Set , its technical specifications and to perform drill using B. A. Set.
9. To perform rescue drill using full body harness.
10. To perform drills on Rescue from well.
11. To perform drills on Rescue from confined space like tunnels.
12. To perform drills on Rescue from building.
13. To perform drills on Rescue from accidents/incident.

At least 8 experiments to be performed from the above list. Other drills and tests can be performed as decided by department (time to time) depending upon the scope of course.

Course code	PEC-FTEL-321				
Category	Professional Elective Courses				
Course title	Fire Safety Codes and Standards				
Scheme and Credits	L	T	P	Credits	Semester----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> Recall basics of various fire fighting equipments and appliances. Explain various IS codes and NFPA codes related to tenders, Hose Couplings, Fire Extinguishers, Ladders, portable and trailer pumps. Examine industrial fire prevention and protection enforcement. Outline codes concerning construction and design of buildings, temporary structures and pandals. 				
Objectives:	<ul style="list-style-type: none"> To familiarize with different IS codes and NFPA manuals. To understand the use of National Building Code of India, IS codes and standards, Building by laws and NFPA manuals. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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 Extinguishers IS: 940, 6234, 2878, 10204, 2171, 2190, 884, 3844, 636, 903, 944, and 6070.

Unit-II

Fire Tenders IS: 948, 950, 6067, 10460, 4989, 951, 957, 949, and 10993.

Unit-III

National Building Code-2016 (Part-4 Life and Safety).

NFPA: NFPA 704- Identification of hazard of materials for emergency response (NFPA Diamond), IS: 1024, NFPA 1983- Ropes, NFPA 1932- Ground Ladders.

Unit-IV

Code of practice for construction of temporary structures and pandals IS: 8758. Municipal bye-laws in relation to fire prevention, Industrial fire prevention and protection enforcement.

References:

1. Relevant Indian Standards (IS codes)
2. Relevant NFPA standards
3. Delhi Building Bye-Laws by V.K. Puri, A Jba Publication
4. Town Planning by S.C. Rangwala, Charotar Publishing house.
5. NBC, Bureau of Indian Standards.

Course code	PEC-FTEL-322				
Category	Professional Elective Courses				
Course title	Nuclear Safety and Radioactive Materials				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Describe radioactivity and its monitoring techniques. • Explain radioactive materials, its handling and storage, its waste, method of disposal, nuclear power stations and possible hazards. • Apply the fire fighting and rescue operation in nuclear power stations and its safety. • Analyze the major incidents/accidents, hazards at Nuclear Power Stations and other areas affected with radioactive materials. 				
Objectives:	<ul style="list-style-type: none"> • To learn the basic concept of radiation, its effects and its monitoring techniques. • To study various nuclear power stations and safety guidelines. • To evaluate the various hazards, incidents/accidents occurs in nuclear power stations and rescue technique during radiation hazard. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Radiation Terms: Radioactivity, Alpha, Beta, Gamma Rays, Ionizing Effect, Radiation Exposure, Biological Effects, Radiation Protection Factors, Radioactive Placard and Label Requirement, Fixed site Storage Vessels for Medical Isotopes, Radiation Monitoring Equipment- Geiger- Muller (GM) Counter, Pocket Chamber, Dosimeters, Survey meters, Radiation Detection, Devices.

Unit-II

Special Nuclear Materials: Radioactive Pyrophoric Metals- Uranium, Plutonium, Thorium with Fire Extinguishing guide lines.

Radioactive Material Emergency Response: Hazard Identification, Action Plan, Zoning, Managing the Incident, Assistance and Termination.

Radio Active Waste: Sources and characteristics of radioactive waste and their types, method of disposal, Handling and prevention of radiation emergencies and storage requirements of radioactive materials.

Unit-III

Nuclear Power Plant Safety: Different types of nuclear power plant, Overview and brief description of Pressurized Water Reactor (PWR), Boiling Water Reactor (BWR) and Pressurized Heavy Water Reactor (PHWR-CANDU), Components and equipments, Engineered safety features in each reactors, Nuclear power plant operating states and accident classification as per code of federal regulation, Large break LOCA typical sequence in nuclear power plant.

Fire fighting and rescue operations in the presence of radiation hazard at nuclear power station, Pre plan of Radiation incident.

Unit-IV

Dispersion of Radioactivity: Releases from Nuclear Power Plant, Phenomena of Releases, Diffusion of Radioactive Plume at different heights and temperature condition, Simple Evaluation Techniques, Special Case of Radioactive Iodine release, Biological Absorption and Remedial Plans.

Major Nuclear Power Plant Accidents: Case Studies, Causes and sequence of events, Consequences and follow up actions in Three Mile Island unit-2 Accident, Chernobyl Accident, Fukushima Station Accident and Davis Base Accident.

References:

1. Radioactive Materials, B. M. Rao, Himalaya Publishing House, latest edition
2. J. Misumi, B. Wilpert and R. Miller, Nuclear Safety: A Human Factors Perspective, Taylor & Francis.
3. Principles of Radiation Dosimetry, G. W. White, John Wiley and Sons, New York, latest edition
4. Radioactive Wastes, their Treatment and disposal, J. C. Collins, E. F. N. Spon Ltd., London.
5. Industrial Hygiene and Toxicology, F. A. Patty (Ed), Vols. I and II Interscience, New York
6. Gianni Petrangeli, Nuclear Safety, Elsevier, latest edition
7. John C. Lee and Norman J. McCormick, Risk and Safety Analysis of Nuclear Systems, Wiley, latest edition
8. Joe Varela, Hazardous Materials Handbook for Emergency Response, International Thomson Publishing.

Course code	PEC-FTEL-323				
Category	Professional Elective Courses				
Course title	Fire Risk Calculations				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course, students will be able to: <ul style="list-style-type: none"> • Define hazards, risks and their types. • Explain the concept of risk, hazard, explosion and fire. • Apply the different approach and assessment techniques to calculate fire risk. • Analyze the various process in Industries by using HAZOP, FMEA and other techniques. 				
Objectives:	<ul style="list-style-type: none"> • To learn various aspects of hazard identification. • To familiarize with risk assessment and accident investigation. • To understand the concept of risk assessment and risk reduction in various fields. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Risk: Definition, Accepted and imposed risk, Perception and qualification of risk, ALARP, Cost benefit analysis.

Hazards: Definition, types of hazards, Fire explosion and toxic gas release, Structure of Hazard Identification and Risk Assessment. Theories of Accident prevention, Principles of accident causation.

Unit-II

Basic Quantitative Risk Assessment (QRA): Principle of QRA, The Logic Tree Approach, Methodologies for Risk Analysis, Event Tree Analysis (ETA).

Computer aided risk Analysis: Related techniques and approaches

Safety in Design and Operation: Safety assurance in design, safety in operation, maintenance, organizing for safety, Accident investigation and reporting.

Unit-III

HAZOP: Introduction to HAZOP, Conducting a HAZOP study.

FMEA: Introduction to FMEA, Methodology of FMEA, criticality analysis, corrective action and follow up.

Unit-IV

Explosions and fires: Vapour Cloud Explosions (VCE), Unconfined Vapour Cloud Explosion (UVCE), confined explosions, dust collector, silos, Physical explosions, BLEVE, Fire extinguishing ball, Jet fire, Pool fire, Boil over. Major Accident Hazard (MAH) control, On-site and Off-site emergency plan.

References:

1. Industrial Hygiene & Chemical Safety by M.H. Fulekar, I.K. International
2. Lees F.P. Loss Prevention in the Process Industries second edition. Butterworths, London, latest edition.
3. Process safety analysis: An introduction by Bob Skelton.
4. An introduction to Risk Analysis by Robert E, Megill.
5. Safety sharing the experience B P process Safety series
6. Fire Safety Risk Assessment HM government.

Course code	PEC-FTEL-324				
Category	Professional Elective Courses				
Course title	Salvage Evaluation of Fire Situation				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Define salvage operation, fire loss, heat release rate and fire investigation. • Locate various items of equipments necessary in salvage operation. • Demonstrate Salvage operation in different type of occupancies and follow up action and investigation of different type of fire situations. • Analyze case studies of salvage operations performed in different type of occupancies and estimate heat release rate and fire losses. 				
Objectives:	<ul style="list-style-type: none"> • To learn about salvage operation and its planning stage. • To familiar with various salvage operation equipment and fire investigation. • To evaluate heat release rate and losses in fire and analyze case studies in various occupancies. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Salvage: Concept, procedure, considerations, salvage operation during fire and after fire, contract salvage and pure salvage, difficulties during in salvage operations, various equipments necessary in salvage operations.

Unit-II

Evaluation of fire situations: Fire loss calculations, Flame temperature measurement, Calculation for heat release rate, Salvage operation in different type of Occupancies like hotel, hospitals, departmental stores and basement godowns etc.

Unit-III

Follow up action and investigation of fire situation such as structural fire, Wild fire and automobile fire etc, Marine salvage operations.

Unit-IV

Case studies of Salvage operations in different type of Occupancy International Salvage convention

References:

1. Manual of Fireman ship, Part 6-A by H.M.S.O.

2. Report and Accounts by Fire Salvage Association of Liverpool limited.
3. The principles and practice of Fire salvage operation by fire salvage association.
4. Loss prevention in process of industries, Vol1, 2 & 3, Frank P. Lees.

Course code	PEC-FTEL-325				
Category	Professional Elective Courses				
Course title	Special Hazards and Protection				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Recall the basic of fire science and thermal engineering. • Describe the basic fire hazards in aircrafts, ships, high rise buildings and nuclear power plants. • Apply the basic fire fighting and evacuation strategies in aviation, marine, high rise buildings and nuclear power plants. • Analyze the level of possible hazards in aviation and marine system, high rise building and nuclear power plant for reducing accidents and improve safety. 				
Objectives:	<ul style="list-style-type: none"> • To understand the basic working of aviation and marine drive system. • To obtain the basic fire fighting operation technique in aircraft, cargoes, High Rise Building and Nuclear Power Station. • To access the various hazards occurs in aircraft and marine system, High rise building and nuclear power plant. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Aviation : Constructional features of an Air Craft, Types of Engines, Basic Fire-Hazards in Aircraft, Nature of Air Crashes, Emergency Landings including belly leading; Access to Fire Service Personnel and Escape of trapped persons problems, Types of Safety Belts, Ejection-Seats; and their methods of release; Rescue and Fires in Air Craft and methods of fire-fighting; Problems of fire-fighting. Hazards in Airport, Protection & Types of Hangers. Categorization of Air-Port, their extinguishing media and determination of the appliances for each category as per International Standard.

Unit-II

Marine Fire : The maritime environment, organizational role, vessel types, construction & systems of fire detection & suppression, cargo vessel hazards & safety. Incident strategies & tactics, training & planning, vessel fire incidents, Marine incidents & Rescue operations.

Unit-III

High rise buildings : Fundamentals of Fire Safe Building design, Life safety systems for high, rise structures, structural integrity during confinement of fire in building, Alarm signaling in high-rise building, Smoke movement in building, High-rise building with complex occupancy, Basic fire-fighting strategy.

Evacuation: Need of Evacuation plans in high rise buildings, Making of Evacuation Plans, types of Evacuation, Procedure of Evacuation.

Unit-IV

Nuclear Safety : Radiation and its types, Components of nuclear power plant , Nuclear Reactors, Radiation emergencies, Pre plan of radiation incident, Fire fighting and rescue operations in the presence of radiation hazard, Radiation Safety in Nuclear Power Plants. Nuclear waste management - Radioactive waste, Sources , characteristics and types, Handing of radioactive waste.

References:

1. Radioactive Materials by B.M. Rao, Himalaya Publishing House
2. Fire Safety in Buildings by V K Jain, New Age publishers, New Delhi
3. National Building Code of India, Bureau of Indian Standards, New Delhi (Latest Edition)
4. Fire protection handbook – NFPA, latest edition

Course code	PEC-FTEL-326				
Category	Professional Elective Courses				
Course title	Building Design and Drawing				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Describe various components of building . • Apply National Building Code in building planning. • Judge the necessity of provision of building services like fire safety and thermal insulation etc. • Evaluate and prepare the detailed drawing of various types of buildings. 				
Objectives:	<ul style="list-style-type: none"> • To understand the different types of building codes, building components. • To understand different modes of supply system inside the building. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

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

Unit-II

Building Planning - Provisions of National Building Code, Building bye-laws, open area, setbacks, FAR terminology, principle of architectural composition (unity, contrast, etc), principles of planning, orientation.

Building Services: Introduction of Building Services like water supply and drainage, electrification, ventilation and lightening and staircases, fire safety, thermal insulation, acoustics of buildings.

Unit-III

Design and Drawing of Building - Design and preparation of detailed drawings of various types of buildings like residential building, institutional buildings and commercial buildings, detailing of doors, windows, ventilators and staircases etc.

Unit-IV

Perspective Drawing - Elements of perspective drawing involving simple problems, one point and two point perspectives, energy efficient buildings.

References:

1. Malik & Meo; Building Design and Drawing

2. Shah, Kale & Patki; Building Design and Drawing; TMH
3. Gurucharan Singh & Jgdish Singh Building Planning, Design and Scheduling

Course code	PEC-FTEL-327				
Category	Professional Elective Courses				
Course title	Fire Modeling				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Describe basic simulation approaches. • Use the various simulation approaches while designing a building to reduce the effect of fire. • Apply the different models in investigating fire • Analyze various simulation results and simulation models using tables, graphs, web interfaces. 				
Objectives:	<ul style="list-style-type: none"> • To familiarize with different types simulation and modeling. • To analyze with simulation result using different types of graphs, tables, web interfaces and validation of model. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Simulations: Basic Model Forms, Basic Simulation Approaches, Handling Stepped and Event-based Time in Simulations, Discrete versus Continuous Modeling, Numerical Techniques, Sources and Propagation of Error.

Dynamical, Finite State, and Complex Model Simulations: Graph or Network Transitions Based Simulations, Actor Based Simulations, Mesh Based Simulations, Hybrid Simulations.

Converting to Parallel and Distributed Simulations: Partitioning the Data, Partitioning the Algorithms, Handling Inter-partition Dependencies.

Probability and Statistics for Simulations and Analysis: Introduction to Queues and Random Noise, Random Variates Generation, Sensitivity Analysis.

Unit-II

Simulations Results Analysis and Viewing Tools: Display Forms: Tables, Graphs, and Multidimensional Visualization, Terminals, X and MS Windows, and Web Interfaces, Validation of Model Results, Index notation, matrix operations, Thermodynamics, equation of state, chemical and phase equilibrium, Droplet mass, momentum, and energy transfer, Taylor series, order of accuracy, Numerical time integration, explicit and implicit methods, Finite difference methods, stability restrictions, Lax equivalence theorem, Derivation of mass, momentum, and energy equations Pressure Poisson equation, projection methods, Scalar transport schemes, Godunov's theorem.

Unit-III

Time-splitting methods for source terms, Non-dimensional forms of the governing equations, Compressible and low-Mach Number formulations Velocity divergence constraint for low-Mach Number flows, Thermal radiation, discrete ordinates method, Beer's law.

Turbulence Theory: vortex dynamics, Kolmogorov, Batchelor, power spectra, 2 DNS, length scale requirements, parallel computing, estimating cost, RANS, turbulence models, statistical correlations, LES, subgrid closures, Itering, energy spectrum, Nyquist limit, aliasing.

Unit-IV

Turbulent boundary layers, grid design, mesh quality metrics Models for the mean chemical source term (turbulent combustion) Extinction, ignition, under-ventilated combustion, toxic products (CO, soot) Pyrolysis, ame spread, Fire suppression, Model validation and uncertainty quantification (model input and output).

References:

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

Course code	PEC-FTEL-328				
Category	Professional Elective Courses				
Course title	Electrical Systems and Safety in Design				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course, students will be able to: <ul style="list-style-type: none"> Recall the basics of electrical engineering. Describe the terminologies related to electrical fires like electrical equipment failure, protection devices, electric shock etc. Apply the suitable approach to use protection devices for reducing electrical fires and failures. Investigate the different conditions and reasons of electrical fires. 				
Objectives:	<ul style="list-style-type: none"> To learn about fire protection devices. To evaluate reasons behind different Electrical Fires. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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.

Unit-II

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.

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

Unit-III

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.

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

Unit-IV

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.

References:

1. Electrical Wiring Estimating and Costing by S.L. Uppal, Khanna Publishers.
2. Electricl Fires and Failures by A.A. Hattangadi, TMH Publishers.
3. Electricity Fire Risk by G.S. Hoges.
4. NFPA Manual.
5. J.P. Handbook.

Course code	PEC-FTEL-329				
Category	Professional Elective Courses				
Course title	Safety in Petroleum and Petrochemical Industries				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Describe the properties, storage and handling methods of petroleum products. • Explain safety measures for accidents arising during handling and transportation of petroleum product like LPG, CNG, Gasoline, etc. • Apply rules and regulations provided by statutory bodies for safety in petrochemical industries. • Analyze the properties and use of different types of fire-fighting installations like hydrant, mobile water monitors, foam pourer, etc. 				
Objectives:	<ul style="list-style-type: none"> • To familiarize with different types of petroleum products, their properties and methods of their preparations in industries and OISD. • To know more about the refining process of petroleum like cracking, distillation and safety associated with it. • To understand different types of fire using different petroleum products viz. Gasoline, Naphthalene, LPG, and CNG. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Crude oil :- Introduction, properties & characteristics, Classification of petroleum & its products, MSDS of crude oil, diesel, gasoline, kerosene, LPG, Natural Gas, Naptha, Ammonia, Benzene, toluene, Acetylene.

Refining Processes: Primary Distillation, catalytic cracker, polymerization, reforming, steam cracking, sulphur recovery, Lubricating oil treating. Process units such as desalter, ADU, VDU, FCC, hydrocracker, catalytic reformer etc. Storage tanks & its types. Layout of Refineries, simplified flow diagram of a typical refinery.

Unit-II

Fire Protection and Emergency Planning :- Major fire risks, Use of various media in petroleum & gas fires such as water, foam, DCP. Design criteria for selection of fire water network, fire fighting installations such as hydrant, mobile water monitors, foam pourer, DCP fixed, subsurface injection & steam snuffing systems, Storage tanks protection.

Unit-III

Fighting Refinery and Petrochemical Fires : Potential fire hazards, precautionary measures in case of non-ignited releases, oil & gas leaks, Fire fighting facilities for depots, terminals, onshore offshore drilling platforms and pipelines for transportation of petroleum products & gases.

Fighting Gas Terminal Fires: Fire fighting in case of BLEVE, LPG hazards, Spillage, vehicle using LPG & CNG as a fuel, Fire fighting facilities at LPG bottling plant, water injection into LPG vessel(water bottoming).

Unit-IV

Oil Industry Safety Directorate(OISD) : 105, 116, 117, 244. Petroleum and natural gas regulatory board(PNGRB) drafts. Application of advance technologies used in refineries and petrochemical plants such as SCADA, SAP and various simulation modeling.

Statutory provisions pertaining to refineries, petrochemical plants and gas terminals.

References:

1. Fire Service Manual (Volume 2) Fire Service Operations - Petrochemical Incidents
2. Manual of Firemanship, Part 6-A by H.M.S.O.
3. Oil Industry Safety Directorate (OISD) Norms & Rules
4. Petroleum & Natural Gas Regulatory Board (PNGRB) drafts
5. Loss prevention in Process of Industries, Vol 1,2, & 3 by Frank P. Lees.
6. NFPA Manuals

Course code	PEC-FTEL-330				
Category	Professional Elective Courses				
Course title	Design of Pipe, Pressure Vessels and Machine Elements				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: 1. Recall the basic principles of design. 2. Describe the various types of stresses involved in thick & thin cylinders for safety purpose. 3. Apply the mathematical fundamentals and factor of safety for the design of pressure vessels, pipes and other machine elements. 4. Analyze the various parameters including FOS for designing of pressure vessels pipes and other machine elements.				
Objectives:	1. To understand the designing of pressure vessels, pipes and machine elements like couplings, nuts, bolts etc. 2. To evaluate stresses and other parameters for designing of pressure vessels, pipes and other machine elements for safe working.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Fundamentals of Design: Principle of design, limits, fits and standardization, Theories of failure under static and dynamic loading, Factor of safety, S-N curve for ferrous material and non ferrous material.

Unit-II

Piping design: Introduction to piping Codes and Standards, bends, tees, bellows and valves, types of piping supports and their behaviour, Flow diagram, Piping layout and piping stress analysis, Flexibility factor and stress intensification factor, Design of piping system as per B31.1 piping code.

Unit-III

Design of Pressure vessel: General theory of membrane stresses in vessel under internal pressure and its application to shells (cylindrical, conical and spherical) and end closures. Bending of circular plates and determination of stresses in simply supported and clamped circular plate. Thermal stresses, Stress concentration in plate having circular hole due to bi-axial loading.

Introduction to ASME codes for pressure vessel design, Pressure vessel and related components' design using ASME codes; Supports for short vertical vessels, Stress concentration at a variable thickness transition section in a cylindrical vessel; Design of nozzles.

Unit-IV

Design of Transmission Elements: Spur, helical, bevel and worm gears; belt and chain drives.

Design of Springs: Leaf Spring, Helical Spring, Flat Spiral Spring.

Design of Joints: Threaded fasteners, pre-loaded bolts and welded joints, Analysis and applications of power screws and couplings, Analysis of clutches and brakes.

References:

1. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; latest edition
2. Bhandari, V.B., Design of Machine Elements, Latest Edition, TMH Publishers
3. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, latest edition
4. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, latest edition
5. Spottes, M.F., Design of Machine elements, Prentice-Hall India, latest edition
6. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, latest edition

Course code	OEC-FTEL-331				
Category	Open Elective Courses				
Course title	Materials & Metrology				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Identify crystal structures for various materials and understand the defects in such structures. • Understand the basics of limit, fit and tolerance, material properties of ferrous alloys. • Analyze the various heat treatment processes and various properties of iron and steel. • Evaluate the hardness, tensile strength and creep. 				
Objectives:	<ul style="list-style-type: none"> • To familiarize with various type of material and their properties. • To Know the various types of defects in materials. • To know various processes used for materials properties modifications. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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 to Manufacturing Processes and their Classification.

Engineering Materials: General Properties and Applications of Engineering Materials, Mild Steel, Medium Carbon Steel, High Carbon Steel, High Speed Steel and Cast Iron, Effect on material properties by adding the alloying elements, Crystal imperfection.

Unit-II

Failures of metals: Failure analysis, fracture, process of fracture, types of fracture, fatigue, characteristics of fatigue, fatigue limit, mechanism of fatigue, factors affecting fatigue.

Creep & Corrosion: Definition and concept, creep curve, mechanism of creep, impact of time and temperature on creep, creep fracture, creep testing and prevention against creep. Corrosion: Mechanism and effect of corrosion, prevention of corrosion.

Unit-III

Measurement and Metrology : Limit, fit (clearance fit, transition fit and interference fit) and tolerance, allowance, fundamental deviation, principle of gauge (hole and shaft basis), linear measurement (Vernier caliper, Micrometer etc.) and angular measurement (Bevel protector, Sine bar).

Unit-IV

Heat Treatment: Principles, purpose, classification of heat treatment processes, annealing, normalizing, stress relieving, hardening, tempering, carburizing, nitriding, cyaniding, flame and induction hardening. Allotropic transformation of iron and steel, Properties of austenite, ferrite, pearlite, martensite, iron carbon equilibrium diagram, TTT diagram, concept of tension test, hardness test(BHN, VHN, RHT), impact test(IZOD and CHARPY test), creep test

References:

1. Workshop Technology Vol. I &II by Hazra & Chaudhary, Asian Book Comp.
2. Process and Materials of Manufacture by Lindberg, R.A. Prentice Hall of India
3. Principles of Manufacturing Materials and Processes by Campbell, J.S. McGrawHill.
4. Manufacturing Science by Amitabha Ghosh & Ashok Kumar Malik, East-West Press.
5. Elements of Material Science and Engineering by VanVlack, Wesley Pub. Comp.
6. Material Science by Narula, Narula and Gupta. New Age Publishers

Course code	OEC-FTEL-332				
Category	Open Elective Courses				
Course title	Power Plant Engineering				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Recall basics of thermodynamics, power generation cycles, nuclear fission and fusion processes. • Describe conventional and non conventional sources of energy, nuclear power plant, hydro electric power plant. • Explain the principles of operation for different power plants and their economics. • Show energy auditing for the energy consumption of industries. 				
Objectives:	<ul style="list-style-type: none"> • To provide an overview of power plants and the associated energy conversion issues. • To understand the energy data from industries and carry out energy audit for energy savings. • To understand importance of non conventional sources of energy and their economic utilization. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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: Types of energy, Energy resources and their availability, Conversion of various forms of energy, Conventional and Non-conventional sources, Need for Non-Conventional Energy based power generation.

Energy Management: General Principles of Energy Management, Energy Management Strategy.

Energy Audit: Need, Types, Methodology and Approach.

Unit-II

Introduction: Types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants.

Hydro Electric Power Plants : Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.

Unit-III

Steam Power Plants: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator.

Non-Conventional Energy sources: Basic principle, site selection of Solar energy power plant, photovoltaic technologies, PV Systems and their components, Wind energy power plant, Bio energy plants, Geothermal energy plants and tidal energy plants.

Unit-IV

Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled. Advantages and limitations, nuclear power station, waste disposal. Power Plant Economics: load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, inputoutput put curves, efficiency, heat rate, economic load sharing, Problems.

References:

1. Power Plant Engineering : P.K. Nag Tata McGraw Hill latest Edition
2. Power Plant Engg. : M.M. El-Wakil McGraw Hill latest edition
3. Non-conventional energy resources- Shobhnath Singh, Pearson.
4. Soni, Gupta, Bhatnagar: Electrical Power Systems – Dhanpat Rai& Sons
5. NEDCAP: Non Conventional Energy Guide Lines
6. G.D. Roy :Non conventional energy sources

Course code	OEC-FTEL-333				
Category	Open Elective Courses				
Course title	Computer Applications and CAD-CAM				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Understand the basics, importance and necessity of Computer Applications and CAD Software. • Explain Transformation, Computer applications, Group Technology, FMS, CAPP. • Demonstrate the knowledge of computer and its applications in design. • Apply the CAD/CAM programming and coding for operation on CNC Machines. 				
Objectives:	<ul style="list-style-type: none"> • To learn about Computer Aided Design and Computer Added Manufacturing. • To understand the applications of computer, basic concept of transformation, Automation and numerical control. • To make familiarization with Group Technology, FMS and CAPP. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Computer Applications: Evolution of Computers, Generation of Computers, Classification of Computers Analog Digital and Hybrid Computers, Classification of Computers according to size, Super Computers, Mainframe Computers, Personal Computers (Different Types) and Terminals (Different Types), Characteristics of Computers, Block Diagram of a Digital Computer, types of OS.

MS Windows, and its various elements of application windows title bar, menu bar, maximize and close buttons, borders and corners, scroll bars, windows icon, folder icons, dialog box and its items, starting Microsoft windows, searching the files, copying the files, disk clean up, deleting unnecessary files

Unit-II

Introduction: Introduction to CAD, CAM, CIM, Design Process, Importance and Necessity of CAD, Applications of CAD, Hardware and Software requirement of CAD, Basics of geometric and solid modeling, coordinate systems.

Transformations: Introduction, transformation of points and line, 2-D rotation, reflection, scaling and combined transformation, homogeneous coordinates, 3-D scaling, shearing, rotation, reflection and translation, combined transformations (No Numericals).

Unit-III

Automation and Numerical Control: Introduction, fixed, programmable and flexible automation, types of NC systems, MCU and other components, NC manual part programming, coordinate systems, G & M codes, Part program for simple parts, computer assisted part programming.

Group Technology: Part families, part classification and coding, production flow analysis, Machine cell design, Advantages of GT.

Unit-IV

Flexible Manufacturing Systems: Introduction, FMS components, types of FMS, FMS layouts, planning for FMS, advantages and applications.

Computer Aided Process Planning: Conventional process planning, types of CAPP, Steps in variant process planning, planning for CAPP.

References:

1. CAD/ CAM by Groover and Zimmer, Prantice Hall.
2. CAD/ CAM Theory and Practice by Zeid, McGraw Hill
3. Numerical Control and Computer Aided Manufacturing by Kundra, Rao & Tiwari, TMH.
4. CAD/CAM (Principles, Practice & Manufacturing Management) by Chirs Mc Mohan & Jimmie Browne, Published by Addison- Wesley.

Course code	OEC-FTEL-334				
Category	Open Elective Courses				
Course title	Process Instrumentation and Control Engineering				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to : <ul style="list-style-type: none"> • Recall fundamentals of measurement, define error, precision and accuracy. • Describe various flow, temperature, humidity and pressure measuring instruments, • Explain various feedback and response instruments viz. Open loop, close loop, time response system etc. • Analyze various measuring, feedback and response instruments used in process control. 				
Objectives:	<ul style="list-style-type: none"> • To study the flow measuring instrument. • To know the open loop, closed loop and response system. • To analyze instrumentation and control system. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Elements of measurement : Fundamental standards, Quality of measurement, Meaning of measurement, Errors in measuring instruments, Precision and accuracy, Calibration principle, Static and dynamic characteristics of measuring instruments.

Measurement of temperature: Bimetallic and pressure thermometers, Thermocouples, Resistance thermometers, Pyrometry, Calibration. Pressure and vacuum measurement -Manometers, Measuring element, Absolute pressure measurement, Static accuracy of pressure gauges.

Unit-II

Flow measurement: Orifice installation, Pitot tube, Area flow meters, Open channel meters. Level measurement - Direct method, Measurement of level in open and pressure vessels, Measurement of pH and humidity. Recording Instruments, Indicating and signaling instruments, Signal transmission and codes.

Unit-III

Open loop and Close loop systems - Transfer function, block diagram representation of mechanical, thermal and liquid level systems.

Transient response analysis, Time response of first and second order system for impulse and step inputs, Effect of damping factors on transient response, Characteristics of proportional, integral, derivative, PI, PD and PID controllers, Frequency response method of analysis, polar plot, Bode Plot.

Unit-IV

Introduction to stability, Definition via impulse response function, Routh-Hurwitz stability criterion, Nyquist stability criterion, Control system components, error detectors, modulators and demodulators, Hydraulic controllers, Pneumatic controllers, PLC.

Introduction to computer control in chemical process industry, Comparison between discrete data, digital and analogue control systems.

References:

1. D Patranabis, Principles of Industrial Instrumentation, Second Edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi, latest edition
2. George Stephanopolous, Chemical Process Control: An Introduction to Theory and Practice, Prentice Hall of India Pvt. Ltd, latest edition
3. Eckman D P, Industrial Instrumentation, Wiley Eastern Ltd, New Delhi, latest edition
4. Ogata, K., Modern Control Engineering, Prentice Hall, latest edition
5. Benjamin C. Kuo., Digital Control Systems, Oxford University Press, latest edition
6. Stefani R.T, Shahian B, Savant J.C and Hostetter G. H, Design of Feedback Control Systems, Oxford University Press, latest edition

Course code	OEC-FTEL-335				
Category	Open Elective Courses				
Course title	Operation Research				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Identify operational research model from the verbal discussion of real system. • Describe operation research and its applications. • Apply the mathematical tools and simulation models that are needed to solve optimization problem. • Analyze the result and proposed recommendations in language understandable to decision making process in management engineering. 				
Objectives:	<ul style="list-style-type: none"> • To familiarize students with the basic concepts, models and statements of the operations research theory. • To evaluate the optimum cost in various operations research models. • To analyze various decision making process in certainty, uncertainty and risk environment. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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, Role of operations research in decision-making, applications in industry. Concept on O.R. model building, Types & methods.

Linear Programming (LP): Programming definition, formulation, solution- graphical, simplex Gauss-Jordan reduction process in simplex methods, BIG-M methods computational, problems.

Unit-II

Deterministic Model: Transportation model-balanced & unbalanced, north west rule, Vogel's Method, least cost or matrix minimal, Stepping stone method, MODI methods, degeneracy, assignment, traveling salesman, problems.

Advanced Topic of LP: Duality, PRIMALDUAL relations-its solution, shadow price, economic interpretation, dual-simplex, post optimality & sensitivity analysis, problems.

Unit-III

Waiting Line Models: Introduction, queue parameters, M/M/1 queue, performance of queuing systems, applications in industries, problems.

Project Line Models: Network diagram, event, activity, defects in network, PERT & CPM, float in network, variance and probability of completion time, project cost- direct, indirect, total, optimal project cost by crashing of network, resources leveling in project, problems.

Unit-IV

Simulation: Introduction, design of simulation, models & experiments, model validation, process generation, time flow mechanism, Monte Carlo methods- its applications in industries, problems.

Decision Theory: Decision process, SIMON model types of decision making environment- certainty, risk, uncertainty, decision making with utilities, problems.

References:

1. Operation Research by TAHA, PHI, New Delhi.
2. Principle of Operations Research by Ackoff, Churchman, Arnoff, Oxford IBH, Delhi.
3. Operation Research by Gupta & Sharma, National Publishers, New Delhi.
4. Quantitative Techniques by Vohra, TMH, New Delhi
5. Principles of operation Research (with Applications to Managerial Decisions) by H.M.Wagner, Prentice Hall of India, New Delhi.
6. Operation Research by Sharma, Gupta, Wiley Eastern, New Delhi.

Course code	OEC-FTEL-336				
Category	Open Elective Courses				
Course title	Industrial Noise and Vibrations				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to : <ul style="list-style-type: none"> • Explain the merits and demerits of vibrations, sound and noise happened in industries. • Calculate the natural frequency and other response of a system/machine operating under vibratory conditions. • Apply the different methods and techniques to reduce vibrations, noise and sound up to accepted level. • Analyze the mathematical model of a linear vibratory system to determine its response. 				
Objectives:	<ul style="list-style-type: none"> • To learn the importance of vibrations, sound and noise in context of an industry. • To write the differential equation of motion of vibratory systems having single or multiple degree of freedom. • To understand the basic concepts, techniques and laws that can be used for reduction of vibrations, sound and noise up to accepted level. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Fundamentals of Vibrations: Introduction, Causes, Effects, Merits and Demerits , Types of Vibrations, SHM, Addition of harmonic motions, Beats Phenomenon, Work done by harmonic force on harmonic motion, Harmonic series.

Undamped Free Vibration: Equations of motion, Natural frequency, Newton's Method, D'Alemberts Principle, Energy method, Rayleigh's method, Simple pendulum, Compound pendulum, Floating and immersed body.

Unit-II

Damping: Introduction, Equation of motion, Critical damping, Underdamping, Overdamping, Logarithmic decrement, Types of Damping, Viscous damping, Coulomb damping, Hysteresis damping, Slip damping.

Forced Vibrations: Introduction, Equation of motion with harmonic force, Excitation due to unbalance, rotating and reciprocating unbalance, Transmissibility, Whirling of Shaft.

Unit-III

Multi Degrees of Freedom System: Introduction, Equation of Motion, Influence coefficients, Dunkerley's method, Rayleigh's method, Holzer's method, Matrix method, Matrix Iteration method, Stodola's method.

Vibrations Control: Vibrations measuring Instruments, Vibration isolation, Frequency measuring instruments, Vibration absorbers, Centrifugal vibration absorber, Torsional vibration absorber, Vibration dampers, Lanchester damper, Houdaille damper.

Unit-IV

Noise: Introduction, Nature and types of noise, Non Auditory effect of noise, Auditory effects of noise, Noise Standards and limits, Noise Measurement, Hazardous noise explosion, Day Night Noise Level, Noise Sources and control.

Sound: Sound level, Subjective response to sound frequency , human response to sound, Sound pressure human response, Decibel Scale, Relation among sound power, Sound intensity & sound pressure level, Octave band analysis.

References:

1. Mechanical Vibration & Noise by A.G. Ambekar, PHP Publication
2. Mechanical Vibration by G.K. Grover, Nen Chand & Bros.
3. Theory of Vibrations with Applications by W.T. Thomson, Pearson Publication
4. Mechanical Vibrations by J.K. Narwal, VEI Publications
5. Mechanical Vibrations by S.S. Rao, Pearson Publications
6. Vibrations and Noise for Engineers by Kewal Pujara, Dhanpat Rai & Co.

Course code	OEC-FTEL-337				
Category	Open Elective Courses				
Course title	Engineering Economics				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Define the basic terminologies of economics. • Describe the basics laws of economics and their practical applications in various situations. • Determine the relationship between demand and supply, their effect on cost. • Discuss the different features of market, GST, VAT, GATT etc. 				
Objectives:	<ul style="list-style-type: none"> • To understand laws of economics and their practical application in market. • To evaluate the market according to the highest profit. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Definitions of Economics, Nature of Economic problems, Production possibility curve Economic laws and their nature. Relation between Science, Engineering, Technology and Economics.

Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility, its practical applications and importance.

Unit-II

Demand: Meaning, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, measurement of elasticity of demand, factors effecting elasticity of demand, practical importance & applications of the concept of elasticity of demand. Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale.

Unit-III

Cost: Fixed cost, variable cost, average cost, marginal cost, money cost, real cost opportunity cost. Shape of average cost, marginal cost, total cost etc. in short run and long run. Meaning of Market, Types of Market, Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets).

Unit-IV

Supply and Law of Supply, Role of Demand & Supply in Price Determination and effect of changes in demand and supply on prices. Nature and characteristics of Indian economy (brief and elementary introduction), Privatization - meaning, merits and demerits, Globalisation of Indian economy - merits and demerits, Elementary Concepts of GST, VAT, GATT & TRIPS agreement.

References:

1. Principles of Economics: P.N. Chopra (Kalyani Publishers).
2. Modern Economic Theory – K.K. Dewett (S.Chand)
3. A Text Book of Economic Theory Stonier and Hague (Longman's Landon)
4. Micro Economic Theory – M.L. Jhingan (S.Chand)
5. Micro Economic Theory - H.L. Ahuja (S.Chand)
6. Modern Micro Economics : S.K. Mishra (Pragati Publications)
7. Economic Theory - A.B.N. Kulkarni & A.B. Kalkundrikar (R.Chand & Co.)
8. Indian Economy: Rudar Dutt & K.P.M. Sundhram

Course code	OEC-FTEL-338				
Category	Open Elective Courses				
Course title	Artificial Intelligence				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to : <ul style="list-style-type: none"> • Describe artificial intelligence and neural network. • Understand expert system life cycle and fuzzy logic. • Apply the concepts of artificial intelligence using prolog. • Analyze the problem as a state space, graph, heuristics and game based techniques to solve them. 				
Objectives:	<ul style="list-style-type: none"> • To become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning. • To investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models. • To explore the current scope, potential, limitations and implications of intelligent system. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Foundational issues in intelligent systems: Foundation and history of AI, AI problems and techniques, AI programming languages, Introduction to LISP and PROLOG, problem spaces and searches, blind search strategies, Breadth first- Depth first- heuristic search techniques Hill climbing, best first- A * algorithm AO* algorithm, game tree, Min max algorithms, game playing, alpha beta pruning.

Unit-II

Knowledge representation issues, predicate logic- logic programming, semantic nets, frames and inheritance, constraint propagation, representing knowledge using rules, rules based deduction systems.

Unit-III

Reasoning under uncertainty, review of probability, Baye's probabilistic interferences and Dempster shafer theory, Heuristic methods, symbolic reasoning under uncertainty, Statistical reasoning, Fuzzy reasoning, Temporal reasoning, Non monotonic reasoning.

Unit-IV

Planning, planning in situational calculus, representation for planning, partial order planning algorithm, learning from examples, discovery as learning, learning by analogy, explanation based learning, neural nets, genetic algorithms, Principles of Natural language processing, rule based systems architecture, Expert systems, knowledge acquisition concepts, AI application to robotics, and current trends in intelligent systems.

References:

1. Artificial Intelligence: A Modern Approach,. Russell & Norvig. Prentice Hall.
2. Artificial Intelligence, Elain Rich and Kevin Knight, TMH.
3. Artificial Intelligence-A modern approach, Staurt Russel and peter norvig, PHI.
4. Artificial intelligence, Patrick Henry Winston: Addition Wesley latest edition

Course code	OEC-FTEL-339				
Category	Open Elective Courses				
Course title	Environmental Engineering and Management				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Understand the impact of humans on environment and environment on humans. • Identify and value the effect of the pollutants on the environment, atmosphere, water and soil. • Apply strategies to control, reduce and monitor pollution. • Select the most appropriate techniques for the treatment of water, waste water, solid waste and contaminated air. 				
Objectives:	<ul style="list-style-type: none"> • To reduce the various types of pollution from our daily life. • To make our environmental management system effective. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Air pollution: - Sources of air pollution, effects of air pollution, classification of pollutants, Atmospheric transport of pollutants-wind profiles, atmosphere stability, inversion, turbulence, dispersion and diffusion of air pollutants, Gaussian plume dispersion model, Principles and techniques of ambient air and stack emission monitoring, Particulate matter control equipment working principles of gravity settlers, cyclones, wet scrubbers, fabric filters and electrostatic precipitators, Gaseous control methods- an overview of absorption, adsorption and combustion method, Biological methods for VOC and odour control.

Unit-II

Waste water: Physical, chemical and biological characteristic, Effects of pollutants on water quality and aquatic life, Physical unit operations in waste water treatment, flow equalization, sedimentation, and flotation, Biological unit processes, kinetics of microbial growth.

Aerobic treatment systems: working principle and design parameters of trickling filter, activated sludge process, and rotating biological contactor.

Anaerobic treatment systems: mechanism of anaerobic process, low rate and high rate digesters, working principle and applications of anaerobic filters.

Unit-III

Solid Wastes: Environmental, aesthetic and health risk, Sources, quantities and composition of solid wastes, Storage, collection and transportation of urban solid waste, disposal options- sanitary landfills, composting and its variations, anaerobic digestion, incineration and pyrolysis, Vermi composting, Recovery alternative, Monitoring of solid wastes.

Hazardous Wastes: definition and classification, health and environmental effects, treatment, disposal and management of hazardous wastes, legal frame work for hazardous waste management in India.

Unit-IV

Environmental Management in Industries: - Principles and requirements of ISO 14001 EMS, Environmental auditing and auditing for waste minimization, Environmental impact, assessment description of the environmental setting, prediction and assessment of impacts, methods of impact analysis, Indian scenario, public participation in environmental decision making strategies for pollution prevention, recycle and reuse, cleaner technologies.

Life cycle assessment: Principle and methodology, concept of Industrial ecology, Clean development mechanism (CDM) - carbon trading.

References:

- 1.Environmental Pollution Control Engineering by C.S. Rao, New Age International (P) Ltd Publishers, latest edition.
2. Wastewater Treatment by M.N. Rao and A.K. Dutta, Oxford & IBH, Publishing Co. Pvt. Ltd, New Delhi, latest edition.
3. Handbook of solid waste Disposal and Management by Pavani, J. L
4. Waste Water Engineering: Treatment, Disposal, Reuse by Metcalf and Eddy Inc.
5. Environmental Impact Assessment by Canter. L.W
6. Environmental Engineers Handbook (latest Ed.) by Liu,

Course code	OEC-FTEL-340				
Category	Open Elective Courses				
Course title	Robotics And Robot Applications				
Scheme and Credits	L	T	P	Credits	Semester-----
	3	0	0	3	
Course Outcomes:	After completion of this course students will be able to: <ul style="list-style-type: none"> • Define the basic concept of industrial robotics and the main components of robotics technologies. • Describe the robot drive system, various robot end effectors, various sensors used in robotics. • Explain the implementation of modern tools like robots in industries and artificial intelligence. • Analyze the various movements of robots and design the robot program. 				
Objectives:	<ul style="list-style-type: none"> • To study different types of sensors in robotics. • To know about the control system and components of robotics. • To Mess up artificial intelligence with robotics for their future scopes. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Fundamentals of Robotics/Fundamentals of Robot Technology, Programming and Applications:

Introduction-Automation and Robotics, brief history of Robotics, the Robotics Market and the Future Prospects, Robot Anatomy, Work Volume, Robot Drive Systems, Control Systems, Precision of Movement, End Effectors, Robotic Sensors, Robot Programming and Work Cell Control, Robot Application

Control Systems and Components : Basic control systems concepts and models, Controllers, Control System Analysis, Robot Sensors and Actuators, Velocity Sensors, Actuators, Power Transmissions Systems

Unit-II

Robot End Effectors: Types of End Effectors, Mechanical Grippers, Other Types of Grippers, Tools as End Effectors, Robot/End Effectors Interface, Considerations in Gripper Selection and Design

Sensors in Robotics: Transducers and Sensors, Sensors in Robotics, Tactile Sensors, Proximity and Range Sensors, Miscellaneous Sensors and Sensor Based System, Uses of Sensors in Robotics

Unit-III

Artificial Intelligence: Introduction, Goals of All Research, All Techniques, All and Robotics, Robotic Paradigms

Material Transfer and Machine Loading/Unloading: General Considerations in Robot Material Handling, Material Transfer Applications, Machine Loading and Unloading, Spot Welding, Continuous Arc Welding, Spray Coating, Other Processing Operations using Robots

Unit-IV

Robotics Technology of the Future and Future Applications: Robot Intelligence, Advanced Sensor Capabilities, Tele-presence and Related Technologies, Mechanical Design Features, Mobility, Locomotion and Navigation, The Universal Hand, Systems Integration and Networking, Characteristics of Future Robot Tasks, Future Manufacturing Applications of Robots, Hazardous and Inaccessible Non-Manufacturing Environments, Service Industry and Similar Applications.

References:

1. Industrial Robotic Technology – Programming and Applications by M.P. Groover et. Al., McGrawhill
2. Robotics for Engineers by Y. Koren, McGrawhill
3. Robots Modeling Control and Applications with Software by P.G. Ranky and C.Y. Ho, Springer Verlag Berlin

Maharshi Dayanand University, Rohtak

(A State University established under Haryana Act No. XXV of 1975)

(NAAC Accredited 'A+' Grade)

Scheme of Studies and Examination

B.Tech (Fire Technology and Safety)

Semester 7th and 8th

Scheme effective from 2021-22

Course code and definitions:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar
TH	Theory
PR	Practical

General Notes:

1. Mandatory courses are non-credit courses in which students will be required passing marks in internal assessments.
2. Students will be allowed to use non programmable scientific calculator. However, sharing of calculator will not be permitted in the examination.
3. Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise. The choice of the students for any elective shall not be binding for the department to offer, if the department does not have expertise. To run the elective course a minimum of 1/3rd students of the class should opt for it.

Scheme of Studies and Examination
B.Tech (Fire Technology and Safety) – 7th Semester
w.e.f. 2021-22

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Internal Assessment	External Examination	Practical	Total	
1	Professional Core Courses	PCC-FT-401G	Fire Laws	3	0	0	3	3	25	75		100	3
2	Humanities and Social Sciences including Management Courses	HSMC-FT-403G	Disaster Mitigation and Management	3	0	0	3	3	25	75		100	3
3	Professional Core Courses	PCC-FT-405G	Safety and Risk Management	2	1	0	3	3	25	75		100	3
4	Professional Elective Courses	-	Professional Elective-V	3	0	0	3	3	25	75		100	3
5	Open Elective Courses	-	Open Elective-III	3	0	0	3	3	25	75		100	3
6	Professional Core Courses	PCC-FT-407G	Chemical Engineering Lab	0	0	2	2	1	25		25	50	3
7	Professional Core Courses	PCC-FT-409G	MATLAB Programming Lab	0	0	2	2	1	25		25	50	3
8	Project	PROJ-FT-411G	Project-I	0	0	6	6	3	25		25	50	3
9	Seminar	PCC-FT-413G	Industrial Seminar-II	0	0	2	2	0	25		25	50	3
10	Practical Training	PT-FT-415G	Fire Ground Operation-V	0	0	2	2	1	25		25	50	3
11	Mandatory Courses	MC-417G	Constitution of India	2	0	0	0	0	0		Refer Note:1 (Grading)		
TOTAL CREDIT								21				750	

Note: 1 The students will be awarded grades A, B, C & F in Evaluation of Constitution of India. A student who is awarded 'F' grade is required to repeat.

Excellent: A; Good : B; Satisfactory: C; Not Satisfactory: F.

Note:

1. Choose any one from Professional Elective-V
2. Choose any one from Open Elective-III

Professional Elective – V

Sr. No.	Code	Subject
1	PEC-FT-419G	Industrial, Rural and Forest Development
2	PEC-FT-421G	Fire and Smoke Dynamics
3	PEC-FT-423G	Fires in Common Commercial Goods -I
4	PEC-FT-425G	Fire Service Communication and Mobilizing
5	PEC-FT-427G	Safety Provisions and Precautions in Industry

Open Elective – II

Sr. No.	Code	Subject
1	OEC-FT-429G	Environment Protection and Waste Management
2	OEC-FT-431G	Safety Engineering and its Industrial Applications
3	OEC-FT-433G	Transportation Engineering and Safety
4	OEC-FT-435G	Tribology and Maintenance
5	OEC-FT-437G	Total Quality Management

Scheme of Studies and Examination
B.Tech (Fire Technology and Safety) – 8th Semester
w.e.f. 2021-22

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Internal Assessment	External Examination	Practical	Total	
1	Professional Core Courses	PCC-FT-402G	Design & Installation of Detection and Fire Fighting Systems	3	0	0	3	3	25	75		100	3
2	Humanities and Social Sciences including Management Courses	HSMC-FT-404G	Applied Psychology and Ethical Science	2	0	0	2	2	25	75		100	3
3	Humanities and Social Sciences including Management Courses	HSMC-FT-406G	Industrial Hygiene and Occupational Health Safety	3	0	0	3	3	25	75		100	3
4	Professional Elective Courses	-	Professional Elective-VI	3	0	0	3	3	25	75		100	3
5	Open Elective Courses	-	Open Elective-IV	3	0	0	3	3	25	75		100	3
6	Professional Core Courses	PCC-FT-408G	Design & Installation of Detection and Fire Fighting Systems Lab	0	0	2	2	1	25		25	50	3
7	Professional Core Courses	PCC-FT-410G	Industrial Hygiene Lab	0	0	2	2	1	25		25	50	3
8	Project	PROJ-FT-412G	Project-II	0	0	6	6	3	25		25	50	3
9	Seminar	PCC-FT-414G	Seminar	0	0	0	2	1	50			50	3
10	Practical Training	PT-FT-416G	Fire Ground Operation-VI	0	0	2	2	1	25		25	50	3
TOTAL CREDIT								21				750	

Note:

1. Choose any one from Professional Elective-VI
2. Choose any one from Open Elective-IV

Professional Elective – VI

Sr. No.	Code	Subject
1	PEC-FT-418G	Fire Service Operations
2	PEC-FT-420G	Fire and Arson Investigation
3	PEC-FT-422G	Structure's Behavior under Fire
4	PEC-FT-424G	Practical Firemanship
5	PEC-FT-426G	Fires in Common Commercial Goods -II

Open Elective – IV

Sr. No.	Code	Subject
1	OEC-FT-428G	Entrepreneurship
2	OEC-FT-430G	Safety in Mines
3	OEC-FT-432G	Environment and Sustainable Development
4	OEC-FT-434G	Cyber Laws and Ethics
5	OEC-FT-436G	Industrial Engineering and Safety Management

Course code	PCC-FT-401G				
Category	Professional Core Courses				
Course title	Fire Laws				
Scheme and Credits	L	T	P	Credits	Semester 7th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Factories Act 1948: Definitions, Health safety provisions relating to Hazardous processes, Working hours for adults, Employment of young person, Safety committee, Duties of safety officer & qualifications, Reporting of accidents, Emergency action plan, Onsite and offsite emergency plan, Confined space entry, Occupational Safety and Health Act (OSHA).

Unit – II

Indian Explosive Act 1884 and Rules 1940, Gas cylinder rules 2004, Static & mobile pressure vessel rules, Boiler Act 1923, Calcium carbide rule 1987, Latest Act (If any).

Unit – III

Environment (Protection) Act 1986, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act. MSIHC Rules. Disaster Management Act and Rules, Bhopal Gas Leak Disaster Act 1985, Mines Act.

Unit – IV

Fire prevention legislation, Fire Insurance Assessment, Public Liability Act 1991, Dock workers (Safety, health & Welfare) Act. Brief introduction of NFPA Manuals and Standards.

References:

- Factories Act - 1948
- Fundamentals of Industrial Safety & Health by Dr. K.U.Mistry, Siddharth Prakashan.
- Industrial Safety, Health & Environment management System by R.K. Jain & Sunil S. Rao, Khanna Publishers.
- The Bhopal Gas Leak Disaster Act, 1985
- All other relevant Acts and rules
- NFPA Manuals

Course code	HSMC-FT-403G				
Category	Humanities and Social Sciences including Management Courses				
Course title	Disaster Mitigation and Management				
Scheme and Credits	L	T	P	Credits	Semester 7th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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, Classification of Disaster, distinguished features of natural disaster, Disaster management plan, disaster zoning for natural calamities, zoning for earthquakes, wind load and flood plain zoning, considerations in disaster management, disaster preparedness, social preparation, community participation and organization, disaster mitigation, reconstruction and rehabilitation, objective and scope of disaster management plan, Structure of disaster management system, Constitution of disaster management groups, Needs and resources to tackle disaster.

Unit – II

Pre-disaster preparedness: Pre-disaster actions, advance preparedness, Post disaster response and recovery stage, damage assessment, control of emergencies.

Organization consideration: Damage control organization, Disaster mitigation measures and sustainable development, emergency preparedness at local level, awareness and preparedness for emergencies at local level (APELL)-the process and its partners.

Unit – III

Emergency planning : On-site and off-site emergency plan, need of plan, possible approach objectives of emergency plan, On-site emergency planning, formulation of the plan and emergency services, Identification of resources, actions and duties, emergency procedure mock drills, Off-site emergency planning, objectives and elements of off-site plan, role of administrative machinery, role of major hazard works management, role of the local authority.

Unit – IV

Natural Hazards: Potentially hazardous natural phenomena, earthquakes, landslides, flooding, cyclones, hazards in arid and semi-arid areas, nature of the hazard, hazard management activities, disaster mitigation, natural hazard prediction, applications of remote sensing and GIS in disaster management.

Components of a major hazard control system: Identification of major hazard control installations, purpose and procedures, safe operation of major hazard installations, mitigation of

consequences, reporting to authorities, Implementation of major hazard control systems, group of experts, training, checklists, inspection, evaluation of major hazards, information to the public, manpower requirements, sources of Information.

References:

- Major Hazard Control - a Practical Manual, ILO, Geneva
- UNEP, Paris: APELL-A Process for responding to technological accidents, A Handbook, Industry & Environment Office, 1998
- Oil spill Response: The National Contingency Plan - Institute of Petroleum, London,
- Disaster Mitigation and Management Strategies by Maj. Gen. A.K. Chaturvedi, V.K. Jain and Himadri Phukan by G.B.Books
- Natural Hazard Risk Assessment and Public Policy: Anticipating by Petak, W.J, Springer.
- Space Technology for Sustainable Development by U.R. Rao, McGraw-Hill Education – Europe.
- Accident Prevention Manual for Business and Industry, Vol. I- N. Safety Council, USA.

Course code	PCC-FT-405G				
Category	Professional Core Courses				
Course title	Safety and Risk Management				
Scheme and Credits	L	T	P	Credits	Semester 7th
	2	1	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Hazards and Risks: Hazards, Types of hazards - fire, explosion and toxic gas release, Structure of hazard identification and risk assessment. Identification of Hazards : Inventory analysis, Fire and explosion hazard rating of process plants -The Dow Fire and Explosion Hazard Index, The Mond Index, Plant layout and unit hazard rating, Preliminary hazard analysis, Introduction to HAZOP, conducting a HAZOP study, computerized reporting systems, HAZOP of batch process, Extensions of HAZOP, What If analysis, Case studies.

Unit – II

Plant Availability and Process Reliability: Methods of improving plant availability, MTBF and MTTF, reliability function, failure rate, bathtub curve, probability relationships, simple reliability estimation.

Estimation of frequency of occurrence of a Hazard: The logic tree approach, set theory and Boolean algebra, application to probability, Boolean manipulation. Job Safety Analysis (JSA), Fault tree analysis - logic symbols, minimal cut set, logic gates, Fault Tree quantification. Event tree analysis, Event tree construction, advantages and disadvantages of ETA, Failure Mode and Effect Analysis (FMEA) - methodology, criticality analysis, corrective action and follow-up.

Unit – III

Quantification of Risk: QRA, Vulnerability analysis, accepted and imposed risk, perception of risk, risk indices, individual risk and societal risk, acceptance criteria for risk, ALARP, Presentation of measures of risk - risk contour, F-N curve, Individual risk and societal risk.

Human Reliability Analysis (HRA): Factors leading to human error, Characteristics of HRA techniques, Technique for Human Error Rate Prediction (THERP), Accident Sequence Evaluation Program (ASEP), Techniques using expert judgment, Operator Action tree (OAT).

Unit – IV

Consequence Modelling, Gas dispersion, Toxicity, Explosions and fires, Human factors, the role of the operator, control room design, human Error assessment method, application of HAZOP to human reliability, Safety in Design and operation.

References:

- Process safety analysis: An introduction by Bob Skelton, The Institution of Chemical Engineers.
- An introduction to Risk Analysis by Robert E, Megill, Pennwell Books, U.S.
- Risk Assessments Questions and answered a practical approach by Pat Perry, ICE Publishing.
- Safety sharing the experience B P process Safety series, Institution of Chemical Engineers
- Fire Safety Risk Assessment, HM government.

Course code	PCC-FT-407G				
Category	Professional Core Courses				
Course title	Chemical Engineering Lab				
Scheme and Credits	L	T	P	Credits	Semester 7th
	0	0	2	1	
Class work	25 Marks				
Practical Exam	25 Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

List of Experiment

1. To study the characteristics of LPG gas and handling of LPG gas cylinders.
2. To study different chemicals causing fire or explosions.
3. To study different Fire extinguishing media and do practice to extinguish fire.
4. To study hazard communication standard: labels and pictograms (OSHA).
5. To study hazardous materials and their handling.
6. To study waste management of radioactive materials.
7. To study and practice the reactions of different chemicals.

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

Course code	PCC-FT-409G				
Category	Professional Core Courses				
Course title	MATLAB Programming Lab				
Scheme and Credits	L	T	P	Credits	Semester 7th
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

List of Experiment

1. To study different types of files.
2. To study general commands.
3. To practice simple calculations.
4. To create and work with arrays.
5. To plot simple graphs.
6. To write and execute a script file.
7. To write and execute a function file.
8. To practice symbolic computation.
9. To study and practice 2-D plots.
10. To study and practice 3-D plots.

At least 8 experiments to be performed from the above list. Other experiments can be performed as decided by department (time to time) depending upon the scope of course.

Course code	PROJ-FT-411G				
Category	Project				
Course title	Project-I				
Scheme and Credits	L	T	P	Credits	Semester 7th
	0	0	6	3	
Internal Project Marks	25 Marks				
External Project Marks	25 Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

The students expected to take up a project under the guidance of teacher from the college. The project must be based on Fire Technology and Safety Engineering problems, which can be extended up to the full semester. The students may be asked to work individually or in a group normally not more than four –six students in a group (If any large/big projects occurs then strength of students increases as per guide supervision). Viva- voce must be based on the preliminary report submitted by students related to the project.

Course code	PCC-FT-413G				
Category	Seminar				
Course title	Industrial Seminar-II				
Scheme and Credits	L	T	P	Credits	Semester 7th
	0	0	2	1	
Internal	25 Marks				
External	25 Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

- 1) Assessment of Industrial Seminar-II, undergone at the end of VI semester, will be based on case study, seminar, viva-voce, report and certificate of practical training obtained by the student from the Industry/ Institute/ Professional Organization/ Research Laboratory/ training centre/Software etc. with the prior approval of the Director/Head of Department/ Principal.

Course code	PT-FT-415G				
Category	Practical Training				
Course title	Fire Ground Operation-V				
Scheme and Credits	L	T	P	Credits	Semester 7th
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

List of Experiment

1. Management of Standard Practices
 - To mount the appliance with a crew of four.
 - To mount the appliance with a crew of five.
2. Foam Standard Practices
 - To get a foam making branch to work with a crew of four.
 - To get an Inline foam Generator to work with a crew of five (one delivery)
 - To get an In line foam generator to work with a crew of five (two deliveries)
 - To get an in line variable Inductor to work with a crew of five (one delivery)
3. Hydrant/Hose Standard Practices
 - To replace a burst length of hose with a crew of four.
 - To divide a length of hose in to two using dividing breeching with a crew of five.
 - To remove a dividing breeching from a line of hose with a crew of five.
4. Pump Standard Practices
 - To get a pump to work from a hydrant using soft suction with a crew of five (two deliveries)
 - To get a ground monitor to work with a crew of five.
 - To get a portable pump to work from open water with a crew of five (two deliveries).
5. Techniques
 - To effect a rescue using rope and associated equipments with a crew of three.
 - To effect a rescue using five personnel, an extension ladder, rope and associated equipment.
 - To define and implement the nine main protocols required to ensure the safe extrication of casualty from an entrapment situation.
 - To define and operate the one meter and two meter safe working area around a motor vehicle involved in a road traffic accident.
6. Method of command
7. Practice of command
8. Reporting Procedure
9. Ladders Drills
9. Rescue Drills

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

Course code	MC-317G				
Category	Mandatory Course				
Course title	Constitution of India				
Scheme and Credits	L	T	P	Credits	Semester-VII
	2	0	0	0	

MC-317G is mandatory non-credit course in which the students will be awarded grades.

Note: 1 The students will be awarded grades A, B, C & F in Evaluation of Constitution of India. A student who is awarded 'F' grade is required to repeat.

Excellent: A; Good : B; Satisfactory: C; Not Satisfactory: F.

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT-I

Philosophy of Indian Constitution: Salient features of Indian Constitution, Preamble, and Nature of Indian Constitution, Procedure for amendment of the Constitution.

UNIT-II

Federal structure and distribution of legislative and financial powers between the Union and the States

UNIT-III

Organs of Governance: President – Qualification and Powers of the President, Governor Qualification and Powers of Governor, Parliament: Composition, Qualifications and Disqualifications, Judiciary: Appointment, Tenure and Removal of Judges.

UNIT-IV

Fundamental Rights: Origin and development of Fundamental rights, Need for fundamental rights. Introduction to Right to equality, Right to freedom, Right against exploitation, Right to freedom of religion, Cultural and Education rights and Fundamental duties.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956. The examination of the regular students will be conducted by the concerned college/Institute internally.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S.N. Busi, Dr. B.R. Ambedkar framing of Indian Constitution, latest Edition
3. M.P. Jain, Indian Constitution Law, Lexis Nexis, latest edition
4. D.D. Basu, Introduction to Constitution of India, Lexis Nexis, latest edition.

Course code	PEC-FT-419G				
Category	Professional Elective Courses				
Course title	Industrial, Rural and Forest Development				
Scheme and Credits	L	T	P	Credits	Semester 7th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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 Development:- Requirement of development feasibility behind industrial development and development with concept of zoning.

Unit – II

Hazards in industry based on planning requirements of zoning, internal planning, location of units within the premises capacity of storage area and finished products.

Unit – III

Concept of Rural development, economy & growth of rural area & its hazards.

Unit – IV

Basic concept of Forest Development: Topography, climate for forest development, types of forest, habitat within the forest, conservation of forest.

Forest Hazards: Hazard within the forest, exposure hazard due to forest fire, environmental pollution. Fire risk analysis of rural, forest and industrial development.

References:

- Rural Leadership Emerging Trends by A.S. Malik.
- Rural Housing Schemes and Policies: A study by C. Gangaiah & G. Rajesh kumar
- Rural-Urban Disparities in Maharashtra by S.S.P. Sharma & U.H. Kumar
- Forest Fire Fighting Fundamentals: by U.S. Department of Agriculture, Forest Service
- NFPA Codes & standards
- Industrial Fire Protection Engineering – Robert G. Zalosh
- National Fire Protection Association Handbook
- HydroCarbon Processing Unit Volume I, II

Course code	PEC-FT-421G				
Category	Professional Elective Courses				
Course title	Fire and Smoke Dynamics				
Scheme and Credits	L	T	P	Credits	Semester 7th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit - I

Fire Science and Combustion: Fuels and the combustion process, The physical chemistry of combustion in fire.

Heat Transfer and Aerodynamics: Summary of the heat transfer equations, Conduction, Convection, and Radiation.

Unit - II

Limits of Flammability and Premixed Flames: Limits of Flammability, The structure of a premixed flame, Heat losses from premixed flames, Measurement of burning velocities, Variation of burning velocity with experimental parameters.

Diffusion Flames and Fire Plumes: Laminar jet flames, Turbulent jet flames, Flames from natural fires, Some practical applications.

Steady Burning of Liquid and Solid Fuels: Burning of liquids, burning of solids.

Unit - III

Ignition: The Initiation of Flaming Combustion: Ignition of flammable vapour/air mixtures, Ignition of liquids, Pilot ignition of solids, Spontaneous ignition of combustible solids, Surface ignition, Extinction of flame.

Spread of Flame: The phenomenology of flame spread, Theoretical models of flame spread, Spread of flame through open fuel beds, Applications. Spontaneous Ignition within Solids and Smouldering Combustion: Spontaneous ignition in bulk solids, Smouldering combustion, Glowing combustion.

Unit - IV

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

The Post-Flashover Compartment Fire: Regimes of burning, Fully-developed fire behaviour, Temperatures achieved in fully-developed fire, Fire resistance and fire severity, Methods of calculating fire resistance, Projection of flames from burning compartments, spread of fire from

a compartment.

The Production and Movement of Smoke: Production and measurement of smoke, Smoke movement, Smoke control systems.

References

- NFPA Hand book
- An Introduction to Fire Dynamics by Dougal Drysdale
- SFPE Hand Book for Fire Protection Engineering, NFPA
- Smoke Movement in buildings by J.H. McGuire "Fire Tech.3 (1967)
- NFPA 204M, Guide for Smoke & Heat Venting
- Rates of Production of Hot Gases in Roof Venting Experiments by P.L. Hinkley

Course code	PEC-FT-423G				
Category	Professional Elective Courses				
Course title	Fires in Common Commercial Goods-I				
Scheme and Credits	L	T	P	Credits	Semester 7th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Fat and Wax Fires: Nature and properties of fats and waxes, Fat fires in kitchens, Causes and types of fire, Fire fighting techniques – small fires, larger fires, Fat fires in manufacture and storage, Solid fat fire, Liquid fat fires, flowing Wax fires, Industrial processes and hazards, The production of fat – general, refining, hydrogenation, general hazards, Fat splitting- construction, process, principal hazards, Soap manufacture, Margarine manufacture.

Fires in Fibrous Materials: Introduction, Characteristics of different fibre, Industrial processes involving fibre – worsted and woollen manufacture and storage, cotton spinning, weaving and knitting, rayon manufacture, jute spinning and weaving, flax manufacture, lace manufacture, textile warehouse, clothing factories, cordage works, hat manufacture, bedding manufacture, upholstery, brush making.

Unit – II

Fires in Fuels: Introduction, Coal and Coke, Nature and properties, Fires in coal stack, Fires in coke stacks, Fires in slag heap, Fires in made up ground, Fires in pulverized coal, Colliery surface installations, Petrol and fuel oils, Characteristics of fuel involved, Fires in tar distilleries, Fires in benzol recovery plant, Fires in oil burning installations, Fires in road and rail trucks, Fires in motor vehicles, Fires in petrol filling stations and garages, Liquefied petroleum gases, Characteristics, Domestic use of LPG, Bulk storage of LPG, LPG Pipelines safety consideration, Marking of pipe lines, Pipeline accident, Fire fighting.

Unit – III

Fires in Grain, Hops and their derivatives: Introduction, Nature and properties of grain and hops, Industrial processes and risks in grain, Grain silos – construction, fire fighting, Flour mills – layout, special features and risks, fixed fire protection, fire fighting, Bakeries – risks, fixed fire protection, fire fighting, Starch works – process, fire fighting, Distilleries, Industrial processes and risks in hops, Oast houses or hop kilns – construction and processes, Maltings, Breweries – processes and risks, fire fighting.

Unit – IV

Fires in Animal and Vegetable Oils: Introduction, Varieties of animal and vegetable oils – Fatty oils (animals), Fatty oils (vegetable) – non drying, semi drying, drying, Essential oils (vegetable), Nature, properties, risks and fire fighting of oils, Industrial processes and seed crushing mills, Building, Process, Risks and causes of fire, Fixed fire protection, Fire fighting.

References:

- National Building Code of India (Latest Edition)
- Principles of Fire Behavior 2nd Edition by James G. Quintiere, CRC Press
- NFPA Manuals
- Relevant IS Standards
- National Building Code of India (Latest Edition)

Course code	PEC-FT-425G
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Category	Professional Elective Courses				
Course title	Fire Service Communication and Mobilizing				
Scheme and Credits	L	T	P	Credits	Semester 7th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit – I

Fire Service Control Room and Watch Room: Introduction, Control rooms, General requirements and considerations – general requirements, centralization problems, administrative system implications, safeguard against breakdown, Watch rooms, The station ground, The turn out area, The telephone call area.

Roles and Responsibilities of Fire personnel: Introduction to the Fire Department, Roles and Responsibilities of fire personnel.

Unit – II

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

Unit – III

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

Call-out Systems: Firemen's call bell system, Fire sirens – siren installations, maintenance and testing, war emergency use, Radio pocket alerting system – general description, the transmitter, the pocket alerter, the home battery charger, alerter transmitter battery chargers, Public address call out systems, Methods of controlling call out systems – local control, remote control.

Unit – IV

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

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

References:

- Manuals of Firemanship.
- HMSO Fire Service Manual Volume 1.
- Relevant NFPA Manual and IS codes.

Course code	PEC-FT-427G				
Category	Professional Elective Courses				
Course title	Safety Provisions and Precautions in Industry				
Scheme and Credits	L	T	P	Credits	Semester 7th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Safety during Construction Projects: Introduction and Stages in Construction Projects, Responsibilities, Safety during receiving, unloading, shifting and storage, Safety guideline for Storage, General Safety Facilities at Construction Sites, Interface between Civil and Erection Works, Oil sump for Power Transformers, Manual Handling, Carrying Piling etc of material and equipment, Mechanical Handling of material and equipment, Working at a Height, Scaffolds and Ladders, Protection from Fall, Stage wise internal handing over procedure, Final handing over to Owners Trained Operation Staff, Site Organization during Construction, Field Quality and Safety, Responsibility of Field Quality Manager, Hazards due to Poor Field Quality, Field Quality and Safety Interface, Field Quality Procedures, Significance of Field Quality During Construction.

Unit – II

Safety Management of Plant during Commissioning: Introduction, Principles of Safety Management, Terms and Definitions, Management's Safety Policy, Safety Organization, Safety Auditing, Management's Response, Training and Supervision, Economic Aspects, Annual ReportS, Motivation to Managers and Supervisors, Motivation to Employees, Operation and Maintenance Procedure, Observance of Safety during Pre-commissioning and Commissioning of Plant, Commissioning Procedures, General Safety Rules for Commissioning, Safety Clearance Notice (SCN) before energizing, Safety Precautions during Plant Energizing, Observation and Trial, Handing Over, Safeguards for Operators Safety.

Unit – III

Safety Management of Plant during Maintenance: Safety Management in Operation and Maintenance, Safety Aspect in O & M of electrical plant, equipment, Types of Maintenance and Safety Process, Electrical Maintenance, Preventive Maintenance, Interface between Preventive Maintenance and Safety.

Unit – IV

Safety Procedures through Inspection, Testing and Repairing Program (IT&RP), Safety Precautions during Maintenance, Maintenance Schedule, Planning of Maintenance, Maintenance Zone, Procedure of Fault Investigation, Causes of failure of Electrical Equipment, Failure of Circuit Breaker, Trouble shooting in substation equipment, Failure of main conducting circuit, insulation system, Failure of Solid Insulating Materials, Electrical failure modes of Solid Insulators, Control room facilities for fault investigation, Associated Safety Systems in Electrical Installations, Earthing equipment and earthing system, Functional requirements for earthing system, Description of an earthing system, Fencing, Procedure of laying earthing mat.

References:

- Fundamental of Industrial Safety and Health by Dr. K.U. Mistry, Siddharth Prakashan
- Industrial Safety, Health Environment and Security by Basudev Panda
- Industrial Safety Management by L M Deshmukh, TMH
- Industrial Safety, Health and Environment Management Systems by R. K. Jain , Sunil S. Rao by Khanna Publishers.
- Industrial Safety and Maintenance Management by M. P. Poonia, S. C. Sharma, Khanna Publishers.
- Relevant IS Codes and Safety Manuals

Course code	OEC-FT-429G
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Category	Open Elective Courses				
Course title	Environment Protection and Waste Management				
Scheme and Credits	L	T	P	Credits	Semester 7th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit – I

Air Pollution: Air Pollution Management, Measurement and Modeling, Air Pollution control Technology & method, Equipment Selection, Equipment design, Particulate emission control, Sources corrective methods, Air quality monitoring and Management concept.

Unit – II

Water Pollution: Management concepts of water pollution, characteristics of waste water, standards of pollution parameters methodology of waste water treatment, Water Treatment process, Sedimentation, Coagulation and flocculation, Filtration, Advanced water Treatment processes, industrial water pollution Management.

Unit – III

Solid and Hazardous Waste Management & Risk Analysis: sources, Classification and composition of MSW (Municipal Solid Waste), Waste Minimization of MSW, Thermal treatment (Combustion) of MSW, Hazardous Waste Transport & Treatment facilities, Treatment system for hazardous waste & handling of treatment plant residues.

Unit – IV

Environmental Management System: EMS in Industries, Principles and requirements of ISO 14001 EMS, Environmental auditing & Auditing of waste minimization. Environment Impact Assessment, Environmental Management Plan. EIA, EMP and Environmental Auditing Environmental Impacts, Evaluation of Impact.

References:

- Environmental Management Handbook by Marcel Dekker.
- Environmental Management Handbook for Hydrocarbon Processing Indus; James B. Well
- Environmental Safety and Health Engineering by Gayle wood side and Dianna Koeurek
- Hazardous Waste Management by J.M. Goel
- Perspectives in Nuclear Toxic and Hazardous Waste by Kadambari Sharma.
- Water Pollution, Cases Effects and Control by P.K. Goel

Course code	OEC-FT-431G				
Category	Open Elective Courses				
Course title	Safety Engineering and its Industrial Applications				
Scheme and Credits	L	T	P	Credits	Semester 7th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Material Handling and Mechanical Hazards: Principles of Material handling, Material characteristics.

Major Equipments Categories: Positioning equipment, Conveyors and Automatic Guided vehicles,

Mechanical Injuries: Safe guards and their requirement, Point of operation for guards and devices. Sensing devices for guards- mechanical limit switches and non mechanical actuation, Guard locking systems and devices, Sensor for motion detection, Presence sensing devices- Trip devices, Mechanical trip switches, Trip wires, Pressure sensing mats, Edge detections, Opto electronic presence detector, Light curtains, Control devices for safety.

Unit – II

Hazards and Control at different Levels: Causes and kind of falls, Walking and slipping, Impact and acceleration hazards, Lifting and standing hazards, Forklift safety. Lockout- tagout, log-in procedure, Loto hardware, Energy isolation release from lockout or tagout, Special procedure. Confined space entry- Identification and hazards, Confined space entry procedure and permits, Duties and responsibilities of entrants, Attendants and rescue team, Hot work procedure and permits. Behavior based Safety

Unit – III

Pressure Hazards and Vessel Testing: Pressure hazard sources, Boilers and pressure hazard, High temperature water hazard, Hazard of unfired pressure vessels, Measurement and reduction of pressure hazards. Pressure vessels definition, Classification and grading, Examination intervals and principles, Defect and failure, Pressure testing, Types of pressure test, Safety precaution in pressure and hydraulic testing, Leak testing and detection, Leak location methods and leak rate.

Unit – IV

Emergency Planning: Safety in industries involving hazardous processes- types of hazards in chemical industries, Introduction, Onsite Emergency planning, Developing Emergency plan, Essential function and Nominated personnel, Off-site Emergency planning, Emergency Incidents and emergency Scenarios – case studies.

Industrial Hazards and Control: Hazards and their control in the manufacture of articles from refractory materials, hazards in solvent extraction plants and their control, safety in industries,

manufacturing rayon by viscose process, hazards and their control in fertilizer industries, hazards and their control in LPG bottling plants.

Reference:

- Loss Prevention in the Process Industries, Third Edition by Sam Mannan, Lees', Volume-2 section-19 & 24.
- Practical Guide to Occupational Health and Safety by Paul A. Erickson, Academic Press
- Occupational Safety and Health for Technologist, Engineers and Manager- Third edition, by David L. Goetsch. Prentice- Hall Inc.
- Fundamentals of Industrial Safety & Health, by Dr. K.U. Mistry, Siddharth Prakashan.

Course code	OEC-FT-433G				
Category	Open Elective Courses				
Course title	Transportation Engineering and Safety				
Scheme and Credits	L	T	P	Credits	Semester 7th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Railway Engineering: Permanent way- Components: Rails- Functions, Requirements, Defects, Rail joints and Fastenings, Check and guard rails, Coning of wheels, Creep of rails: Sleepers- Functions, Requirements, Types, Density; Ballast- Functions, Requirements, Types. NBC- Part 4 safety in underground railways platforms

Unit – II

Railway Operation & Control: Points and crossings, Turn-out, Types of Railway tracks, Points- Station Yards and Marshalling Yards, Signaling and interlocking, Principles of track circuiting, Control of train movement by centralized traffic control system, Railway Accidents & Safety.
Rapid Transit Railways: Types, merits & demerits.

Unit – III

Highways: Classification of highways, urban road patterns, Typical cross-section of roads, Definition of various cross sectional elements- Requirements & factors controlling alignment of roads, Basic geometric design of streets and highways, basic geometric design, stopping and overtaking site distances.

Harbors & Dock Engineering: water transportation, classification of harbors, accessibility and size, ports, Indian ports, layout of ports, break water, facilities(in brief) for docking, repairs, approach, loading and unloading, storing and guiding.

Unit – IV

Traffic Characteristics: Various traffic studies and their applications, Traffic signals, Classification of signals, Carriage-way markings, Traffic islands, Highway intersections, Principles of highway lighting, Accident prevention, Investigation and reduction, Road Accidents, Regulatory measures for traffic management, Physical methods of traffic control, Traffic Calming, Safety Audit, Intelligent Transport System.

References:

- Transportation engineering by A.K. Upadhyay, KATSON Books
- Highway engineering by S.K. Khanna & CEG Justo, Nem Chand & Bros.
- Transportation Engineering by C. Jotin Kisty & B. Kent Lal, PHI Publications
- Railway Engineering by S.C. Rangwala
- Highway Engineering by S.K. Khanna and C.E.G. Justo.
- Traffic Engineering and Transport Planning by L.R. Kadiyali.
- Traffic Engineering Design : Principles and Practice by M.Slinn, Guest & Mathews.

Category	Open Elective Courses				
Course title	Tribology and Maintenance				
Scheme and Credits	L	T	P	Credits	Semester 7th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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 Tribology, Tribology in Design, Tribology in Industry, Economic Aspects of Tribology, Tribological Parameters Like Friction, Wear and Lubrication, The Topography of Engineering Surface.

Friction: Introduction, Empirical Laws of Friction, Kinds of Friction, Causes of Friction, Theories of Friction, Measurement of Friction, Friction of Metals, Ceramic Materials, Polymers, Rolling Friction, Laws of Rolling Friction, Relation Between Temperature and Friction, Stick-Slip, Prevention of Stick-Slip, Consequences of Friction.

Unit – II

Wear: Types of Wear, Various Factors Affecting Wear, Theories of Wear, Wear Mechanisms Measurement of Wear. Wear Regime Maps, Alternative Form of Wear Equations. Lubricated and Unlubricated Wear of Metals, Materials Used in Different Wear Situations.

Lubrication: Fundamentals of Viscosity and Viscous Flow, Principle and Application of Hydrodynamic Lubrication, Elastodynamic Lubrication, Boundary and Solid Lubrication, Types of Lubricants, Properties of Lubricants, Effect of Speed and Load on Lubrication, Frictional Polymers, Lubrication in Metal Working, Rolling, Forging, Drawing and Extrusion.

Unit – III

Maintenance: Introduction, Objective of maintenance, maintenance policies and philosophies, maintenance concept, maintenance management & terotechnology, relationship with other functional areas, importance of maintenance, elements of good maintenance, economics of maintenance, training and safety aspects in maintenance, corrective preventive and predictive maintenance.

Unit – IV

Condition Based Maintenance: Objectives, what to monitor, when to monitor, principles of CBM, condition based maintenance techniques, manual inspections, performance monitoring, vibration monitoring, current monitoring, steps in implementation of CBM, benefits of CBM.

RCM & TPM: RCM logic, maintenance and RCM, benefits of RCM, total productive maintenance (TPM), introduction, key supporting elements of TPM, methodology, evaluation and benefits.

References:

- Introduction to Tribology by B. Bhushan, John Wiley & Sons, Inc, New York, 2002
- Handbook of Tribology: Materials Coatings and Surface Treatments” by B.Bhushan, B.K. Gupta, McGraw-Hill,1997
- Principles of Tribology by Halling J McMillan Press Ltd.,1978
- Engineering Tribology by Prasanta Sahoo, PHI Learning.
- Maintenance Planning and Control by Higgin L.R., Mc Graw Hill Book Co, 1900.
- Maintenance Planning and Control by Kelly Anthony, East West Press Private Ltd, New Delhi, 1991.
- Maintainability principle and practices by Blanchard B.S. and Lowey E.E. McGrawHill
- Practical NOT by Raj B. Jaya Kumar T and Thavasimulyi K., Narora Publishing House, New Delhi, 1996.
- Engineering Maintenance Management by Niebel Benjamin W. Marcel Dekher, 1994.

Course code	OEC-FT-437G				
Category	Open Elective Courses				
Course title	Total Quality Management				
Scheme and Credits	L	T	P	Credits	Semester 7th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Concept of quality, quality as the basis of market competition, historical review, quality philosophy of deming, juran, cross by etc., obstacles, integrating productivity and quality.

Organization of quality, quality council, total quality culture, quality leadership, quality awards, total employee involvement, quality circles, attitude of top management, executives and workers, operators responsibility of quality, causes of operator's errors, motivation.

Unit – II

Introduction to TQM, models for TQM. TQM implementation, advantages of TQM, obstacles to TQM, TQM in the service sector. Concepts of quality function deployment, cause and effect diagram, SWOT analysis, continuous improvement, PDCA cycle, supplier partnership, supplier certification, Pareto diagram, Scalier diagram, Benchmarking, Taguchi's quality engineering, failure mode and effect analysis, total productive maintenance, introduction to JIT, JIT quality management, SQC, SPC, DPR, KAIZEN, Six Sigma concept.

Unit – III

Introduction to ISO 9000 Series of Standards, Other quality systems, Implementation, Documentation, Internal Audits', Registration, Closing Comments.

Unit – IV

Beyond ISO 9000 horizon, Introduction to ISO 14000, series standards, Concepts of ISO 14001, EMS benefits, ISO 10011- 10014, quality systems

References:

- Total Quality Management by Bosterfied El Al., Pearson Education India, 2001.
- The Essence Of Total Quality Management: By Johan Bank, Prentice Hall Of India 2000.
- Managing For Total Quality by Logothelis, Prentice Hall Of India, 2000.
- Total Quality Management by Sundra Raju, Tata Mcgraw Hills Publishing Company, 1997.

Course code	PCC-FT-402G				
Category	Professional Core Course				
Course title	Design & Installation of Detection and Fire Fighting Systems				
Scheme and Credits	L	T	P	Credits	Semester 8th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Grouping of Fixed-Fire-fighting Installations, Provisions of First Aid Fire- Fighting Arrangements, External Hydrants.

Rising Mains: Down Corner, Dry- rises, Wet- rises and specification of each type, their relevant code of Practice.

Unit – II

Water Supply & Hydrants System: Grading, Requirement of water supply. Total requirement of water for different hazards, designing of Fire Hydrant System for different occupancies. Provision and applicable standards of water based system

Sprinklers System: Types of Sprinklers system and their specifications. Designing of HVWSS/MVWSS. Hazard classification and Standard for the installation of Sprinklers. Drenchers, Rules for spacing Sprinklers and drencher's heads.

Unit – III

Different types of foam, Low expansion, Medium expansion and High expansion foam, their special application, advantage and disadvantage of various types and the storage of foam concentrates, Mechanical Foam installation, Methods of application. Top application Base injection, Subsurface injection, Foam inlets and Risk for which foam is used, Premix foams, Installation characteristics of foam, Determination of foam compound for fire-fighting in oil tanks (OISD-116).

Installations involving carbon dioxide and dry chemical powder: Their special features, characteristics, designing, arrangements, operation, extinguishing action, risk and specifications.

Unit – IV

Design, calculation and installation of fire pumping system based on standard norms and procedure. Cost analysis, installation, testing and commissioning of water based fixed fire fighting systems.

Fire Alarm & Detection System: Working principle of smoke detectors, heat detectors, Flame detectors & optical beam type detectors, their designing, Calculations, Testing and Maintenance.

References:

- Industrial Safety, Health & Environment management System by R.K. Jain & Sunil S. Rao, Khanna Publishers.
- Fire Safety in Buildings by V.K. Jain, New Age International Publishers
- Manual of Fire Safety by N Sesha Prakash, CBS Publishers and Distributors
- Fire Protection and Prevention: The Essential Handbook Volume 1 & 2 by B.M. Sen, UBS Publishers
- Relevant IS codes and Manuals.

Course code	HSMC-FT-404G				
Category	Humanities and Social Sciences including Management Courses				
Course title	Applied Psychology and Ethical Science				
Scheme and Credits	L	T	P	Credits	Semester 8th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Psychology as a Science of behavior, Biological basis of behavior: Central and the Peripheral nervous system. Motivational basis of behavior: biological, psychological and social motives. Behavior of fire-fighter & fire-victims from the psychologist's view point.

Psychology of learning : Fire-fighting skills as learned behaviour; Principles of learning useful in the training of fire-fighting personnel, learning values and attitudes required in a successful fire-fighter; Fire-fighting as risk-taking behaviour; Calculated-as-irratic risk-taking' Need for assessing risk-taking tendency in fire-personnel.

Unit – II

Fire-site as a social situation : victims, Spectators and fire personnel as its constituents, Human factors in occurrence of fire e.g. age, gender, education, social status and in mode of escape; General characteristics of behaviour under panic; Characteristics of crowd behaviour; General considerations in handling the spectators and the victims, without lowering efficiency.

Fire-fighting as interactional situation; Importance of effective communication among the interacting elements; Fire-fighting as a team-work, significance of communication in the team members, ways of effective communication of information, Use of signs and signals and their perceived effectiveness.

Unit – III

Characteristics of behavior under psychological stress, Stressful aspects of the fire situation, Adapting to the stress without breaking down; Management of self and others under stress.

Towards a better functioning of self and others in fighting operations; Planning activities during the no-fire-fighting periods, Recent techniques for improving personal functioning: Transactional analysis, sensitivity training, national-emotive education.

Unit – IV

Concept of Culture and Civilization, Applied Humanities and Social Engineering, Socio-Legal Awareness: Right to Information(RTI), Public Interest Litigation (PIL), Intellectual Property Rights(IPR) & Patents, Lokpal and Lokayukta. Meaning and Scope of Industrial Psychology and Industrial Sociology. Fatigue, Selection and Training of Workers, Motives for Work in Industry. Transactional Analysis.

Professional Ethics, Fundamental Rights and Directive Principles, Role of Bureaucracy in Modern Society, Works Organization: Power, Authority and Status System; Formal and Informal Organization.

References:

- A History of World Civilizations – J.E. Swain
- A New Look into Social Science – Shabbir, Sheikh and Dwadashiwar
- An Introduction to Psychology by Morgan and King.
- An Introduction to Sociology – Vaidya Bhushan and Sachadeva
- Foundations of Psychology-Edited by Borine, Longfela and Weld.
- Handbook of Social Psychology by K. Young
- Human Resource Development and Management – Dr. A. M. Sheikh
- Industrial Psychology – Haire Mason
- Industrial Psychology by Tiffin Joseph, New York
- Practical Psychology by F.K. Berraien (New York Macmillan Co.)
- Psychology and Effective behaviour by Coleman, J.C.
- The Psychology of Adjustment by Lawrence Shaffer and Edward Soban Jr.
- Theory and Problems of Social Psychology by Krech and Crutchfield.

Course code	HSMC-FT-406G				
Category	Humanities & Social Sciences Including Management Courses				
Course title	Industrial Hygiene and Occupational Health Safety				
Scheme and Credits	L	T	P	Credits	Semester 8th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit – I

Chemical Hazards: Introduction, Dangerous properties of chemicals, dust, gases, fumes, mists, vapors and smoke. Exposure evaluation and air sampling, There sold limit values, Chlorine Exposure effects, Personal monitoring.

Chemical processes and safety: Storage, Transport and handling of hazardous chemicals, Industrial ventilation, Natural ventilation, Opening in the work area.

Unit – II

Physical hazards: Improper illumination, Thermal radiation, ultraviolet radiation, ionizing and non ionizing radiation, Preventive and control measures, Noise Measurement, Noise-control techniques, Noise Survey, Vibration, its effect and isolation.. Thermal stress, heat balance, heat-stress, heat disorders, control measures.

Work Physiology: Classification of workload. Work capacity and man- Job alignment. Fatigue, Physiological tests diet and exercise for work stress control. Ergonomics, Application of ergonomics in safety and health management, methods of reducing postural strain.

Unit – III

Occupational Health: Common occupational diseases such as silicosis, asbestosis, and toxicity related to lead, nickel, chromium, and manganese. Causation of diseases and its effects. Methods of prevention. Compensation of occupational diseases. Occupational dermatitis, occupational cancers, Medical examination of workers, occupational health centre, health records, fundamentals of first aid.

Unit – IV

Non Respiratory Personal Protective Devices: Head protection, Ear protection, Face and Eye protection, Head protection, Feet protection, Body protection, Supply, use, care and maintenance of personal protective equipment. Requirements under safety laws.

Respiratory Personal Protective Devices: Classification of hazards, Selection of respirators, Instructions in use of breathing apparatus. Supply, Training for use, care & maintenance of breathing apparatus.

References:

- Occupational Health & Safety in Manufacturing Industries – M K Potty.
- Diseases of Occupation – D. Hunter.
- Code of Practice for Hazardous goods by NFPA
- Handbook of occupational Health & Safety NSC Chicago 1982
- Encyclopedia of Occupational Health & Safety Vol I & II I.L.O. Geneva 1985.
- Human Factors in Engineering & Design Tata McGraw-Hill 1982

Course code	PCC-FT-408G				
Category	Professional Core Courses				
Course title	Design & Installation of Detection and Fire Fighting Systems Lab				
Scheme and Credits	L	T	P	Credits	Semester 8th
	0	0	2	1	
Class work	25 Marks				
Practical Exam	25 Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

List of Experiment

1. To study the general requirements of different types of occupancy as per NFPA 101-Life Safety Code.
2. To study the fixed DCP installation as per NFPA Code 17.
3. To study the Fire Fighting Properties of Foam Concentrate - (a) Fuel Tolerance (b) Burn back resistance (c) Induction Ratio (d) Fluidity (e) Film Formation.
4. To study the CO₂ Total Flooding System as per IS specification.
5. To calculate the requirement of foam concentrate for fire fighting in a cone roof tank.
6. To calculate requirement of foam concentrate for fire fighting in floating roof tank
7. To study different types of detectors.
8. To study conventional and non-conventional type fire alarm systems.

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

Course code	PCC-FT-410G				
Category	Professional Core Courses				
Course title	Industrial Hygiene Lab				
Scheme and Credits	L	T	P	Credits	Semester 8th
	0	0	2	1	
Class work	25 Marks				
Practical Exam	25 Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

List of Experiment

1. Demonstration and calibration of Air sampling equipment.
2. Sampling and estimation of gases in the work environment by colorimetric method.
3. Sampling and estimation of solvent vapours in the work environment.
4. Sampling and estimation of dust-gravimetric method.
5. Noise level measurement - Sound level meter, Octave filter set
 - a) Measurement of sound pressure level in db A and db linear
 - b) Frequency analysis of noise.
6. Measurement of illumination level.
7. Study of lungs models.
8. Study of occupational diseases with photographic models.
9. Demonstration of medical laboratory equipment.
10. Thermal stress analysis.

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

Course code	PROJ-FT-412G				
Category	Project				
Course title	Project-II				
Scheme and Credits	L	T	P	Credits	Semester 8th
	0	0	6	3	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

The students expected to take up a project under the guidance of teacher from the college. The project must be based on Fire Technology and Safety Engineering problems, which can be extended up to the full semester. The students may be asked to work individually or in a group normally not more than four –six students in a group (If any large/big projects occurs then strength of students increases as per guide supervision). Viva- voce must be based on the preliminary report submitted by students related to the project.

Course code	PCC-FT-414G				
Category	Seminar				
Course title	Seminar				
Scheme and Credits	L	T	P	Credits	Semester 8th
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

Seminar based on case study related to any Major Fire Incident/Disaster/Recent Developments in the field of Fire and Safety. Seminar Topics to be decided by concerned Department.

Course code	PT-FT-416G				
Category	Practical Training				
Course title	Fire Ground Operation-VI				
Scheme and Credits	L	T	P	Credits	Semester 8th
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	3 Hours				

Practice of

- Drills,
- Tests,
- Commands,
- Fire and Rescue Operations,
- Knots,
- Lift and Carries,
- Full body Harness,
- Tenders
- Emergency Evacuation Drill
- Fitness Training
 - Yoga
 - Meditation
 - Physical training
- . Emergency Communications

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

Course code	PEC-FT-418G				
Category	Professional Elective Courses				
Course title	Fire Service Operations				
Scheme and Credits	L	T	P	Credits	Semester 8th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Fires in Rural Areas: Fires on heaths, moors and peat lands, Fires in forest and woodlands, Single tree fire, Harvesting fires, Fires in stored crops, Fires in barns and farm buildings, Fires in thatch, Water in rural fire fighting, Gears used in rural fire fighting, Miscellaneous suggestions to fire officer.

Gas Industry and Fires in Gas Works: Introduction, Gas producing plant, Coal gas plant, Oil gasification plant, Oil storage tanks, Gasholders, Fire, explosion and toxic hazard, Fixed fire protection equipment, Fire fighting at gas board premises Distribution system, National gas transmission system, Area board's transmission systems, Final Distribution, Safety precautions, Fires involving pipelines and gas mains, Fires in premises using gas.

Fires in Dust: Introduction, Dust explosion, Nature and behavior, Causes, Hazardous industries, Prevention measures Precautions when fighting fires, other characteristics of fires in dust, Smouldering fires in dust.

Unit – II

Electricity and the Fire Service: Introduction, Short circuit, Protective devices, Protection against earth leakage, Wiring system for consumer installation, Electrical hazards and safeguards, Failure of installation, Overheating of cables and equipment, Ignition of flammable gases and vapours, Static electricity, Electric shock, Minimum distance for safe approach, Use of rubber gloves, Removing persons from electric wiring, Fire fighting 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, Common electrical terms.

Metal fires: Introduction, Characteristics and hazards of metal – metals in general, metal dust, liquid Metals, Fighting metal fires – techniques of extinction, personal hazards, Industrial

processes and risk, Engineering works –construction, process and risks, fixed fire protection, fire fighting, special hazards in furnaces, salt baths, pickling plants, de-greasing plant, cutting and welding, engine test beds, Foundries– Processes and risks in pattern shop, foundry, fettling shop, fire fighting, Electro plating works – construction, processes and risks, fixed fire protection, fire fighting, special hazards.

Unit – III

Aircraft Incidents: Introduction, Design and construction of fixed wing civil aircraft, Military aircraft, Rotary wing aircraft, Legislative framework, airports and emergency procedures, Incidents on airport, Incident off airport, Rescue techniques, Special hazards in aircraft incident, Liaison and training, Safety, Aeronautical terms.

Marine Incidents: Introduction, Ship construction, Ship board fire protection, Factors relevant to marine incidents, Stability, Fighting ship fires in port, Incident at sea, Dangerous substances on ship and in port areas, Inland waterways, Other marine risks, Training and safety, Terminology.

Unit – IV

Petrochemical and Oil Refinery Incidents: Introduction, Characteristics of mineral oils, Refining process, Storage tanks, Layout of refineries, Fire protection and emergency planning, Fighting petrochemical fires, Liquefied natural gas, Liquefied petroleum gas, Safety, Terminology.

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 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.

References:

- Fire Service Manual: Vol. 2: Fire service operations
- IS Manuals
- NFPA Manuals

Course code	PEC-FT-420G				
Category	Professional Elective Courses				
Course title	Fire and Arson Investigation				
Scheme and Credits	L	T	P	Credits	Semester 8th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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 Nature and Behaviour of Fire: Elements of Combustion, Flaming and Glowing Fire, Explosive Combustion, Heat Transfer, Sequence of Room Fire, Effects of Environmental Conditions, Combustion Properties of Liquid & Gaseous Fuels.

Combustion Properties of Solid Fuels: Pyrolysis, Papers, Plastics, Paints, Metals, Coals, Flame Colour & Smoke production. Source of Ignition: Primary Igniter, the role of services and appliances instarting fire (Gas lines, Gas Appliances, L.P. Gas, Electricity). The role of hot & burning fragments in kindling fire, lightening, spontaneous combustion, electric light bulb.

Unit – II

Structure fire & their Investigation: Elements of building construction, General principles of fire behaviour, Investigative information during suppression, Examination of structure fire scene, Documenting the fire scene.

Grass and Wild Fires, Automobile Motor Vehicle and Ship Fires. Electrical causes of Fire: Basic Electricity, Wiring systems, Ignition by Electrical means. Investigation of Electrical-related fire: Post – Fire Indicator, Laboratory Examination. Clothing & Fabric Fire, Explosion & Explosive Combustion, Chemical Fire & Hazardous Material.

Unit – III

Laboratory Services: General Fire Evidence, Identification of Charred or Burned Materials & Documents, Failure Analysis-Forensic Engineers, Evaluation of Appliances & Wiring, Miscellaneous Laboratory Test. Identification of Volatile Accelerants: Gas Chromatography, Sample Handling, Extraction of Volatile Accelerants, Identification of Volatiles. Chemical Incendiaries Non-Fire-Related Criminal Evidence: Fingerprints, Blood, Impression Evidence, Trace Evidence.

Unit – IV

Fire Related Deaths: Pathological and Toxicological examination, Destruction of the body, effect of fire, other pathological findings, carbon monoxide asphyxiations, other toxic cases. Arson as a Crime: The crime of arson motive, the arson set, deductions from the interpretation of evidence (Analytical reasoning, Elimination of Accidental and Natural Causes). Other Investigative Topics: Arson Law, Elements of Proof, Sources of Information, Chain of evidence, Report writing, Courtroom Testimony.

References:

- NFPA Handbook
- Fire Investigation by John D. DeHaan, Paul L. Kirk
- Arson Investigation by Thomas J. Bowguard, Charles C Thomas Pub Ltd
- Fire & Arson Investigation by Russell K. Chandler, Delmar Cengage Learning.

Course code	PEC-FT-422G				
Category	Professional Elective Courses				
Course title	Structure's Behavior under Fire				
Scheme and Credits	L	T	P	Credits	Semester 7th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Buildings: General collapse information, General causes of collapse and its types, Constructive terms of building design-Arch, Beam and its types, Buttress, Deck, Façade, Fire cut beam, Girder gusset plate, types of wall, Lintel joist, suspended ceiling and braced frame construction. Types of loads and methods of application, Hierarchy of structural framing and zone of danger.

Unit – II

Fire Effects on Building: Effect of Fire, Natural ventilation, Smoke movement in buildings, Smoke movement in tall buildings, Stack effect, Wind effects, Influence of openings in tall buildings, Smoke shaft, Smoke control during building design, Control of smoke spread, Mechanical ventilation, Pressurization system and their types, Design of smoke control pressurization system for a building.

Analysis of Structural Damage: Wall collapse- Masonry wall, Concrete wall and wood frame walls. Roof collapse- Sloping peak roof, Timber truss roof, Flat roof and steel roof, Stairway collapse, Floor collapse-Terrazzo floor, wooden I beam, Precast concrete slabs, Column collapse.

Unit – III

Post Fire Analysis: Post fire analysis and fire protection to buildings Rain roof, Fire Retarding compartmentation, fire fact sheet, the fire diagram and fire photographic documentation, Fire planning and design, Confinement of fire site planning access to fire fighting appliances, Contribution of external walls and roof covering, Aspects of internal planning, reduction of fire spread, Concept of compartments and types, Construction of compartments, Space and circulation, Principles and types of fire and roof venting, Effect of wind on roof vent, Industrial building ventilation.

Unit – IV

Building Construction and Hazards: Five standard types of building construction and their collapse hazards. Time temperature grading curves, Head balance for an enclosure during a fire, Fire severity and factors controlling fire severity, Thermal properties of wall fixtures &

geometrical properties of a room compartment, Thermal insulation heat transfer and radiation, Calculation of fire resistance of a compartment, fire spread within, outside and between the buildings, Flames outside buildings, Reduction of risk of fires explosions.

References:

- Collapse of Burning Buildings: A guide to fire ground safety, Vincent Dunn, Penn Well Corporation.
- Fundamentals of Fire Safety in Building Design by Dr. Than Singh Sharma, Aayush Publications, New Delhi
- Building Construction for the Fire Service, Glenn. P Corbeti, Jones & Bart
- Fire Safety Design and Concrete, Longman Group UK Limited, T Z Harmathy.
- Structural Firefighting: Strategy and Tactics, 3rd Edition, Bernard J. "Ben" Klaene, National Fire Protection Association.
- Fire Safety Engineering Design of Structures, J.A. Purkiss, Butterworth Heinemann.
- Fire Safety in Buildings by V K Jain, New Age publishers, New Delhi.
- National Building Code (NBC) (Latest Edition)

Course code	PEC-FT-424G				
Category	Professional Elective Courses				
Course title	Practical Firemanship				
Scheme and Credits	L	T	P	Credits	Semester 8th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Practical Fire Fighting: Introduction, Preliminary, The Fireman, Before the fire, Turn out, Proceeding to a fire, Action on arrival, Arrival at an incident, Searching for the fire, Uses of fire extinguishing media, Fighting the fire, General considerations, Working in smoke, heat or darkness, Preventing fire spread Explosion risks, Dangerous fumes, Collapse of building, Dealing with occupants of premises, Evacuation of premises, Dealing with various types of fire, One room fires, Chimney fires, Hearth fires, Fires in skirting etc., Fires in fume ducts, Roof fires, Basement and underground building fires, Fires in high rise buildings and complex areas, Fires involving radioactive substances, Fires on motorways.

Methods of Entry into Buildings: Introduction, Forcible entry, Doors, Methods of securing doors, Hinges, Fanlights, Windows, Other openings on ground level, Other, openings above ground level, Authorized entry into special premises, Cutting away –wood works, plaster, brickwork, removing roof coverings, working on roof, dangers on entry.

Unit – II

Control at a Fire: Introduction, Officership, Officer in charge of the first appliance – before the fire, on arrival, Officer in charge of the first attendance – general considerations, estimating assistance, message, covering the rear of the building for rescue work, getting water on to the fire, position of the appliances, shutting off services, use of breathing apparatus, refrigeration, ventilation system, Setting up a control point – arrival of a senior officer, use of junior and specialist officers, main and advance control points, crews in reserves, auxiliary control points, use of control points, Other control matters – assistance from non brigade personnel, dealing with crowds, consequential fires, relief's, supplies, Bringing the fire under control – surrounding the fire, large jets, use of dams, influence of the wind, preventing fire spread, ramps and bridges, moving in branches, persons injured, leaving the fire ground.

Unit – III

Accidents on Motorways and Major roads: General, Design of motorways, patrol of motorways, Calls to incidents, Police accident procedure, Safety precautions, Operational procedure, Rescue techniques, Making up

After the Incident: Introduction, The end of an incident, Victims of fire – handling bodies, Final extinguishment of the fire – scaling down operations, damping down and turning over, checking for fire pockets, Protective measures – avoiding unnecessary damage, closing up premises, utility services and structural safety, fixed fire fighting installations, advice to occupiers, Restoring operational availability – leaving the fire ground, on return to station, Giving information, Legal proceedings – giving evidence, inquests.

Unit – IV

Chemical Decontamination: General, Chemical incidents – dealing with chemical incidents, the initial decontamination procedure, The decontamination team – mobilization, composition of the team, assistance to the team, the team's equipment, The decontamination zone – sitting the zone, establishing the zone, The full decontamination procedure (basic) – control, carrying out the decontamination procedure, personnel wearing breathing apparatus, Decontamination in special circumstances – decontamination of clothing and equipment away from the incident, persons not wearing protective clothing, injured persons, Liaison with other bodies, Record keeping

Ventilation at Fires: Introduction, Nature and behaviour of smoke – smoke explosions, The value of ventilation – preventing and reducing damage, preventing fire spread, assisting firemen, When to ventilate, Types of ventilation – the principle of ventilation, ventilation from top, ventilation from side, How to ventilate – ventilation from inside, ventilation from out side, Practical applications of ventilation – single storey buildings, mechanical ventilation systems, basements, projecting shops, theaters and cinemas etc.

References:

- Manual of Firemanship, Practical FiremanShip-I.
- Manual of Firemanship, Practical FiremanShip-III.
- NFPA Manuals.
- Relevant IS Codes.
- Fire Safety in Buildings by V K Jain, New Age publishers, New Delhi.

Course code	PEC-FT-426G				
Category	Professional Elective Courses				
Course title	Fires in Common Commercial Goods-II				
Scheme and Credits	L	T	P	Credits	Semester 8th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Paint and Varnish Fires: Introduction, Nature and properties of – paint, varnish, enamel, lacquer, cellulose lacquer and enamel, metallic paints, fire retardant paints, bituminous paint, Fire and other hazards: Fire hazards of liquid paints, Flammability of dried paint coatings, Fighting paint and varnish fires, Personal hazards, Spontaneous ignition, Paint spraying and dipping processes and hazards in paint and varnish manufacture, Carbon black and bone black – nature, properties, fire fighting.

Unit – II

Plastic Fires: Introduction, Nature, properties and risks of plastic generally, Characteristics of plastic, Classification of plastic, Raw materials and composition, Burning characteristics, Personal hazard, Manufacturing process and risks, Manufacture of plastic materials generally – buildings, processes, risk, fire fighting, Fabrication of plastic products generally – buildings, process, risks, fire fighting, Cellulose nitrate and cellulose acetate plastics – manufacturing and fire fighting.

Unit – III

Refrigeration Plant Risk: Introduction, Refrigeration plants, Principles of refrigeration, Parts of refrigeration plant, Methods of refrigeration, Accidents involving refrigeration plants, Fires involving refrigeration plants, Fires in cold stores, Characteristics of building, Risks, Fixed fire protection, Fire fighting

Fires in Resins and Gums: Introduction, Varieties of resins and gums – natural and synthetic resins, hard and soft resins and gums, origins of resins and gums, Nature, properties risks involved and fire fighting, Linoleum, Oilcloth and tarpaulin manufacture

Unit – IV

Rubber Fires: Introduction, Nature and properties of rubber, Industrial processes and risk, Rubber manufacture, Manufacture of rubber articles, Materials used, Risks Fixed fire protection, Fire fighting.

Sugar Fires: Introduction, Nature and properties of sugar – physical and chemical, burning characteristics, risks involved, fire fighting, Industrial processes and hazards, Cane sugar refining – processes, fire risks and special hazards, fixed fire protection, fire fighting, Beet sugar manufacture – processes, risks, Coca, chocolate and confectionery manufacture – construction, processes, fire fighting.

References:

- National Building Code of India (Latest Edition)
- Principles of Fire Behavior 2nd Edition by James G. Quintiere, CRC Press
- NFPA Manuals
- 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

Course code	OEC-FT-428G				
Category	Open Elective Courses				
Course title	Entrepreneurship				
Scheme and Credits	L	T	P	Credits	Semester 8th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Entrepreneurship: Concept and Definitions; Entrepreneurship and Economic Development; Types of Entrepreneurs; Factor Affecting Entrepreneurial Growth – Economic, Non-Economic Factors; Entrepreneurship Development Programmes; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs; Manager Vs. Entrepreneur, types of entrepreneurs, Entrepreneurial myths.

Unit – II

Opportunity Identification and Product Selection: Entrepreneurial Opportunity Search & Identification; Criteria to Select a Product; Conducting Feasibility Studies; Sources of business ideas, launching a new product; export marketing, Methods of Project Appraisal, Project Report Preparation; Project Planning and Scheduling. Sources of finance for entrepreneurs

Unit – III

Small Enterprises and Enterprise Launching Formalities: Definition of Small Scale; Rationale; Objective; Scope; SSI; Registration; NOC from Pollution Board; Machinery and Equipment Selection, Role of SSI in Economic Development of India; major problem faced by SSI, MSMEs – Definition and Significance in Indian Economy; MSME Schemes, Challenges and Difficulties in availing MSME Schemes.

Unit – IV

Role of Support Institutions and Management of Small Business: Director of Industries; DIC; SIDO; SIDBI; Small Industries Development Corporation (SIDC); SISI; NSIC; NISBUD; State Financial Corporation SIC; Venture Capital : Concept, venture capital financing schemes offered by various financial institutions in India, Legal issues – Forming business entity, considerations and criteria, requirements for formation of a Private/Public Limited Company,

References:

- Entrepreneurship for Scientists and Engineers by Kathleen R. Allen, Pearson Publications.
- Entrepreneurship by Rajeev Roy, Oxford University Press, 2011.
- Innovation and Entrepreneurship by Drucker.F, Peter, 2006, Harper business.
- Entrepreneurship by Robert D Hisrich, Mathew J.Manimala, Michael P. Peters, Dean A. Shepherd ,Tata Mc-graw Hill Publishing.
- Entrepreneurial Development by S.Khanka, S. Chand & Co.
- Small-Scale Industries and Entrepreneurship, Vasant Desai, Himalaya Publishing House, Delhi.
- Entrepreneurship Management -Cynthia, Kaulgud, Aruna, Vikas Publishing House, Delhi.
- Entrepreneurship Ideas in Action- Cynthia L. Greene , Cengage Learning, 2011

Course code	OEC-FT-430G				
Category	Open Elective Courses				
Course title	Safety in Mines				
Scheme and Credits	L	T	P	Credits	Semester 8th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Opencast Mines: Causes and prevention of accident from: Heavy machinery, belt and bucket conveyors, drilling, hand tools, pneumatic systems, pumping, water, dust, electrical systems, fire prevention. Garage safety, accident reporting system-working condition-safe transportation, handling of explosives.

Underground Mines: Fall of roof and sides-effect of gases-fire and explosions, water flooding, warning sensors, gas detectors occupational hazards, working conditions, winding and transportation.

Unit – II

Tunnelling: Hazards from: ground collapse, inundation and collapse of tunnel face, falls from platforms and danger from falling bodies. Atmospheric pollution (gases and dusts), trapping, transport, noise, electrical hazards, noise and vibration from, pneumatic tools and other machines, ventilation and lighting, personal protective equipment.

Unit – III

Risk Assessment: Basic concepts of risk-reliability and hazard potential, elements of risk assessment, statistical methods, control charts, appraisal of advanced techniques, fault tree analysis, failure mode and effect analysis, quantitative structure, activity relationship analysis, fuzzy model for risk assessment.

Unit – IV

Accident Analysis and Management: Accidents classification and analysis, fatal, serious, minor and reportable accidents, safety audits recent development of safety engineering approaches for mines, frequency rates, accident occurrence investigation, measures for improving safety in mines, cost of accident, emergency preparedness, disaster management.

References:

- Safety in Mines, B.K. Kejriwal, Lovely Prakashan, Dhanbad, 2001.
- DGMS Circulars-Ministry of Labour, Government of India press, L.C. Kaku, Lovely Prakashan
- Mine Health and Safety Management, Michael Karmis, Society for Mining, Metallurgy, and Exploration, 2001.

Course code	OEC-FT-432G				
Category	Open Elective Courses				
Course title	Environment and Sustainable Development				
Scheme and Credits	L	T	P	Credits	Semester 8th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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 Pollution: Introduction of bacteriological quality, Water quality, Wastewater treatment, Sustainable development of water resources, Need to conserve water, Environmental Legislations for multipurpose river valley/hydroelectric projects, Provisions/ legal Framework in constitution of India.

Unit – II

Environmental Guidelines for Power Plants: Environmental guidelines for thermal power plants, site selection, Environmental Impact Statement (EIS), Environmental management of thermal power stations.

Environmental Appraisal Procedure: Environmental management plans for multipurpose River valley / hydroelectric projects.

Unit – III

Sustainable Developments and Protection of Atmosphere: Introduction of issues for achieving Sustainable development, optimal resource utilization for sustainable development, Sustainable cities, Sustainable transportation systems, Sustainable construction activities, Sustainable mining technology.

Unit – IV

Sustainable Future: The requirement of sustainable future, Energy conservation, A step forward for sustainable future, Efficient energy management in industries, Bio methanation of municipal solid wastes, Removal of volatile organic compounds by bio filtration, development and Atmosphere protection.

References:

- Strategic Management in Developing Countries. Austin, James and Tomas Kohn.,The Free Press.

- The Handbook of Economic Sociology.. D'Arcy, David., Princeton University Press, Russel Sage Foundation ,New York.
- Transcript of broadcast, Dec. 5, 2002, "In Houston, a Treasure of Exiled Afghan Art," National Public Radi.
- The Triple Bottom Line for 21st Century Business Oxford, Elkington, John.Cannibals with Forks, Capstone Publishing, October 1997.
- "The Institutional Context of Multinational Activity." In Organization Theory and the Multinational Corporation, 2nd edition., Guillen, Mauro and Sandra L. Suarez., New York: St. Martin's Press, 2002.
- Concepts of Environmental Management for Sustainable Development" by M C Dash,I K International Publishing House Pvt. Ltd.
- The Age of Sustainable Development" by Jeffrey D Sachs and Ki-moon Ban,Columbia University Press.
- Environmental Ecology, biodiversity And Climate Change: Towards Sustainable Development" by H M Saxena, Rawat Pubns.

Course code	OEC-FT-434G				
Category	Open Elective Courses				
Course title	Cyber Laws and Ethics				
Scheme and Credits	L	T	P	Credits	Semester 8th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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

Cyber Crime : Definition and Origin of the Word, Cyber Crime and Information Security, Who are Cyber Criminals, Classification of Cyber crimes, E-mail Spoofing, Spamming, Cyber Defamation, Internet Time Theft, Salami Attack, Salami technique Data Diddling, Forgery, Web Jacking, Newsgroup Spam, Industrial Spying, Hacking, Online Frauds, Pornographic Offenders, Software Piracy, Computer Sabotage Email Bombing, Computer Network Intrusion, Password Sniffing, Credit Card Frauds, Identity Theft. The Legal Perspectives, The Cyber Crime Indian Perspectives, The Cyber Crime And Indian ITA 2000/2001, Hacking and Indian Laws, Global Perspective on Cyber Crime, Cyber Crime and extended Enterprise, Cyber Crime Era : Survival Mantra for Netizens.

Unit – II

Cyber Offenses : How Criminals plan them, Categories of Cyber Crimes.

How Criminal Plans the Attack : Active Attacks, Passive Attacks, Social Engineering, Classification of Social Engineering,

Cyber Stalking : Types of Stalkers, Cyber Cafe and Cyber Crimes, Botnets , Attack Vectors, Cyber Crime and Cloud Computing.

Unit – III

Cybercrime: Mobile and Wireless Devices, Proliferation of Mobile and Wireless devices, Trends in Mobility, Credit card Frauds in Mobile and wireless devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organization Security policies and Measures in Mobile Computing Era.

Tools and Methods used in Cybercrime: Proxy server and Anonymizers, Phishing, password cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Dos and Ddos Attacks, SQL Injection, Buffer Overflow, An Attacks on Wireless Networks.

Unit – IV

Understanding Computer Forensics: Digital forensic Science, Need for Computer Forensic, Cyber Forensic and digital Evidence and rules of Evidence, Forensics Analysis of E-Mail, Digital Forensic Life Cycle.

Cyber Security: Organizational Implications: Web Threats for Organization , Security and Privacy Implications, Social Media Marketing: Security risk for organizations, Incident handling: An Essential Component of Cyber Security, Intellectual Property in the Cyberspace, The Ethical Dimensions of Cybercrime, The Psychology, Mindset and skills of Hackers and the Other criminals.

References:

- Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives By Nina Godbole, Sunit Belapur, Wiley.
- Understanding Cybercrime: Phenomena and Legal Challenges Response, ITU 2012.
- Information Security policies and procedures: A Practitioners Reference, Thomas R. Peltier ,2nd Edition Prentice Hall, 2004.
- Cyber Security and Global Information Assurance: Kenneth J. Knapp, ,Threat Analysis and Response Solutions, IGI Global, 2009.
- Information Security Fundamentals, Justin Peltier and John blackley, Thomas R Peltier, 2nd Edition, Prentice Hall, 1996.
- Cyber law: the Law of the Internet, Jonathan Rosenoer, Springer-verlag, 1997.
- Cyber Security Essentials, James Graham, ,Averbach Publication T and F Group.

Course code	PEC-FT-436G				
Category	Open Elective Courses				
Course title	Industrial Engineering and Safety Management				
Scheme and Credits	L	T	P	Credits	Semester 8th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 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 Engineering: Objectives, Method study, Principle of motion economy, Techniques of method study - Various charts, THERBLIGS, Work measurement – various methods, time study PMTS, determining time, Work sampling.

Productivity & Workforce Management: Productivity, Definition, Various methods of measurement, Factors affecting productivity, Strategies for improving productivity, Various methods of Job evaluation & merit rating, Various incentive payment schemes, Behavioral aspects, Financial incentives.

Unit – II

Manufacturing Cost Analysis: Fixed & variable costs, Direct, indirect & overhead costs, & Job costing, Recovery of overheads, Standard costing, Cost control, Cost variance Analysis -Labour, material, overhead in volume, rate & efficiency, Break even Analysis, Marginal costing & contribution.

Unit – III

Concepts and Techniques: History of Safety movement, Evolution of modern safety concept, General concepts of management, Planning for safety for optimization of productivity, Quality and safety, Line and staff functions for safety, Budgeting for safety, Safety policy. Incident Recall Technique (IRT), Disaster control, Job safety analysis, Safety survey, Safety inspection, Safety sampling, Evaluation of performance of supervisors on safety.

Unit – IV

Safety Audit: Components of safety audit, Types of audit, Audit methodology, Non conformity reporting (NCR), Audit checklist and report, Review of inspection, Remarks by government agencies, Consultants, Experts, Perusal of accident and safety records, Formats, Implementation of audit indication, Liaison with departments to ensure coordination, Check list, Identification of unsafe acts of workers and unsafe conditions in the shop floors.

References:

- Safety Management by R.K. Mishra, AITBS Publishers.
- Industrial Safety, Health & Environment management System by R.K. Jain & Sunil S. Rao, Khanna Publishers.
- Industrial Engineering and Organization Management by S.K. Sharma, Kataria and Sons.
- Industrial Safety Prentice Hall, Inc.,Blake R.B., New Jersey, 1973.
- Safety and Good Housekeeping, N.P.C., New Delhi, 1985.
- Accident Prevention Manual for Industrial Operations, N.S.C.Chicago,National Safety Council 1982.
- Industrial Engineering and Management by O.P. Khanna, Dhanpat Rai Publications.