

# 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 7<sup>th</sup> and 8<sup>th</sup>

#### 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 1/3<sup>rd</sup> students of the class should opt for it.

**Scheme of Studies and Examination**  
**B.Tech (Fire Technology and Safety) – 7<sup>th</sup> 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)			
		<b>TOTAL CREDIT</b>						<b>21</b>				<b>750</b>	

**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**

<b>Sr. No.</b>	<b>Code</b>	<b>Subject</b>
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**

<b>Sr. No.</b>	<b>Code</b>	<b>Subject</b>
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) – 8<sup>th</sup> 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
		<b>TOTAL CREDIT</b>						<b>21</b>				<b>750</b>	

**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 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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	<b>MC-317G</b>				
Category	Mandatory Course				
Course title	<b>Constitution of India</b>				
<b>Scheme and Credits</b>	L	T	P	<b>Credits</b>	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 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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 2<sup>nd</sup> Edition by James G. Quintiere, CRC Press
- NFPA Manuals
- Relevant IS Standards
- National Building Code of India (Latest Edition)

Course code	<b>PEC-FT-425G</b>
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Category	Professional Elective Courses				
Course title	Fire Service Communication and Mobilizing				
Scheme and Credits	L	T	P	Credits	Semester 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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 sight 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.

Course code	<b>OEC-FT-435G</b>
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Category	Open Elective Courses				
Course title	Tribology and Maintenance				
Scheme and Credits	L	T	P	Credits	Semester 7 <sup>th</sup>
	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 7 <sup>th</sup>
	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 8 <sup>th</sup>
	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	<b>HSMC-FT-404G</b>				
Category	<b>Humanities and Social Sciences including Management Courses</b>				
Course title	<b>Applied Psychology and Ethical Science</b>				
<b>Scheme and Credits</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>	<b>Semester 8<sup>th</sup></b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	
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. Berraian (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 8 <sup>th</sup>
	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 8 <sup>th</sup>
	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 8 <sup>th</sup>
	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 8 <sup>th</sup>
	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 8 <sup>th</sup>
	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 8 <sup>th</sup>
	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 8 <sup>th</sup>
	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 8 <sup>th</sup>
	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 7 <sup>th</sup>
	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, Heat 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 8 <sup>th</sup>
	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 – setting 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 outside, 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 8 <sup>th</sup>
	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 2<sup>nd</sup> 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 8 <sup>th</sup>
	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 8 <sup>th</sup>
	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 8 <sup>th</sup>
	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 8 <sup>th</sup>
	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 8 <sup>th</sup>
	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.