

Indira Gandhi University, Meerpur, Rewari
SCHEME OF STUDIES AND EXAMINATION
B.TECH(FIRE TECHNOLOGY AND SAFETY)
SEMESTER 3RD AND 4TH
Scheme effective from 2019-20



COURSE CODE AND DEFINITIONS

Course Code	Definition
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

Seminar

Max.Marks-25

Every candidate will have to deliver a seminar of 30 minutes duration on a topic (not from the syllabus) which will be chosen by him / her in consultation with the teacher of the department. The seminar will be delivered before the students and teachers of the department. A three member committee (one coordinator and two teachers of the department of different branches) duly approved by the departmental council will be constituted to evaluate the seminar. The following factors will be taken into consideration while evaluating the candidate.

Distribution of marks will be as follows:

1. Presentation 10 marks
2. Depth of the subject matter 10 marks
3. Answers to the questions 05 marks

Indira Gandhi University, Meerpur, Rewari
Scheme of B.TECH Examination for Semester III (Second Year)
(FIRE TECHNOLOGY AND SAFETY) w.e.f. 2019-20

Sr. No.	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
			L	T	P			Mark of Class work	Theory	Practical	Total	
1	BSC-MATH-205	Mathematics-III	3	1	0	4	4	25	75		100	3
2	HSMC FT -201	Principles of Management & Organisation Behaviour	3	0	0	3	3	25	75		100	3
3	PCC-FT203	Fire Service Hydraulics-I	3	1	0	4	4	25	75		100	3
4	ESC-FT-205	Basics of Thermal Engineering	3	1	0	4	4	25	75		100	3
5	PCC-FT-207	Automobile Safety	3	1	0	4	4	25	75		100	3
6	LC-FT-209	Fire Protection Workshop	0	0	2	2	1	25		25	50	3
7	LC-FT-211	Automobile Safety Lab	0	0	2	2	1	25		25	50	3
8	LC-FT-213	Basics Thermal Engineering Lab	0	0	2	2	1	25		25	50	3
9	PT-FT-215	Fire Ground Operation-I	0	0	2	2	1	25		25	50	3
10		Seminar	-		-		1	-	-	-	25	
TOTAL CREDIT							23				700	

Indira Gandhi University, Meerpur, Rewari
Scheme of B.TECH (FIRE TECHNOLOGY AND SAFETY)
Examination for Semester IV (Second Year) w.e.f. 2019-20

Sr. No.	Course Code	Course Title	Hours per week			Total Contact hrs/week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
			L	T	P			Mark of Class work	Theory	Practical	Total	
1	BSC-FT-202	Basics of Fire Science	3	0	0	3	3	25	75		100	3
2	ESC-FT-204	Basics of Safety Engineering	3	0	0	3	3	25	75		100	3
3	PCC-FT206	First Aid & Paramedics	3	1	0	4	4	25	75		100	3
4	PCC-FT-208	Fire Service Hydraulics-II	3	1	0	4	4	25	75		100	3
5	PCC-FT-210	Safety in Construction	3	1	0	4	4	25	75		100	3
6	LC-FT-212	First Aid & Paramedics Lab	0	0	2	2	1	25		25	50	3
7	LC-FT-214	Fire Service Hydraulics Lab	0	0	2	2	1	25		25	50	3
8	PT-FT-216	Fire Ground Operation-II	0	0	2	2	1	25		25	50	3
9	*MC-106	Environmental Science	3	-1				25	75		-	3
10		Seminar	-		-		1	-	-	-	25	
TOTAL CREDIT							22				675	

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

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

Course code	BSC-MATH-2-205				
Category	Basic Science course				
Course title	Mathematics III (PDE, Probability & Statistics)				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	1	0	4	
Course Outcomes:	1. Understand the problem related to PDEs in engineering. 2. Analysis the statistical methods for experimental data.				
Objectives:	1. To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering. 2. To provide an overview of probability and statistics to engineers.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

SECTION-A

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation;

SECTION-B

Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.

SECTION-C

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

SECTION-D

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis – Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three

distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves.

Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances – Chisquare test for goodness of fit and independence of attributes.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Course code	HSMC-FT-201				
Category	Humanities and Social Science including Management courses				
Course title	Principles of Management and Organizational Behavior				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	0	0	3	
Course Outcomes:	<ol style="list-style-type: none"> 1. Acquire knowledge of key principles of management and apply this knowledge to a real organizational setting. 2. Enhance leadership skills and will be prepared to lead high-performing, successful firms in the future. 3. Diagnose problems, make effective decisions, influence others, optimize cross-functional teams and design reward systems. 				
Objectives:	<ol style="list-style-type: none"> 1. To make them familiar with the basic concepts of management and organizational behavior along with their application for managing people at work. 2. To understand the management concepts, applications of concepts in practical aspects of business and development of managerial skills. 3. To critically examine all management strategies of organizational behavior with reference to Indian organizations. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

Section-A

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

Section-B

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

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

Section-C

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

Organizational Behavior: Introduction, Historical development and basic concepts, understanding a social system, Establishing working relationships, Attitude, Perception, Personality and Individual Differences, Job Performance, Values, Attitudes and Beliefs, Stress Management, **Communication:** Types, Process, Barriers, Making Communication Effective.

Section-D

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

Motivation: Human needs and motivating employees. Interpreting motivational models of Maslow, Herzberg, Vroom, and McClelland. Job satisfaction and work performance. Appraising and rewarding performance.

Suggested Books:

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

Course code	PCC-FT-203				
Category	Professional Core Courses				
Course title	Fire Service Hydraulics-I				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	1	0	4	
Course Outcomes:	<ol style="list-style-type: none"> 1. Determine the capacity of various types of tanks under various conditions 2. Evaluate the effect on the pressure due to shape, size of container, weight, external force and directions 3. Explain the types of fluid and kinematics of fluid 4. To apply Bernoulli's equation for different elements like venturimeter, orifice and pitot tube. 				
Objectives:	<ol style="list-style-type: none"> 1. To measure the capacity of different types of tanks 2. To know about blood pressure and its effects 3. To understand the Kinematics of fluids 4. To be familiar with the Dynamics of fluids 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

Section-A

Measurements: Units of Measurements, System of measurements, Capacity of tanks, rectangular tank and square tank with flat base and sloping base, circular, spherical tank, elliptical tank, time of filling and emptying a tank.

Basics of Hydraulics: Concept of fluid and flow, properties of fluids, density, specific gravity, pressure, relative density, vapour density, types of fluids, ideal and real fluids, continuum concept, Newtonian and non-Newtonian fluids, use of water in fire service.

Section-B

Hydrostatics: Concept of pressure, Pressure head, Pascal's law, effect of shape and size of container on pressure, effect of specific weight on pressure, effect of external force on pressure in a vessel, direction of pressure in a vessel. Basic equation of fluid statics, Pressure variation in compressible and incompressible fluids, forces on submerged plane surfaces and curved surfaces. Fluid pressure and its measurement (Manometer and Bourdon pressure gauge).

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

Section-C

Kinematics of fluid flow: Types of flow, steady and unsteady, uniform and non uniform, laminar and turbulent, Eulerian and Lagrangian description of fluid flow; stream line, path line, streak line, stream tube, flow rate and continuity equation, one and two dimensional flow, velocity and acceleration at a point. Differential equation of continuity in cylindrical and polar coordinates, rotation, vorticity and circulation, stream and potential functions, flow net, Problems.

Section-D

Dynamics of fluid flow: Concept of system and control volume, one dimensional method for flow analysis, Euler's equation of motion, derivation of Bernoulli's equation for incompressible flow and its application (Venturimeter, Orificemeter, Pitot tube), kinetic and momentum correction factors, Impulse momentum relationship and its applications, Problems.

Suggested Readings

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

Course code	ESC-FT-205				
Category	Engineering Science course				
Course title	Basic of Thermal Engineering				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	1	0	4	
Course Outcomes:	<ol style="list-style-type: none"> 1. Applied thermodynamics laws in engineering application. 2. Explain the modes of heat transfer. 3. Explain the ventilation and different air conditioning terms. 4. Determine the efficiency of boilers and their selection. 				
Objectives:	<ol style="list-style-type: none"> 1. To familiarize with the basic concepts of thermodynamics, psychometric process and chart. 2. To study the different modes of heat transfer, ventilation system and heat control. 3. To study the steam power generation and draught system. 4. To understand the concept of IC engines and calculation of different powers. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

Section-A

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

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

Section-B

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

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

Section-C

Steam Generation and Powers: Introduction, classification of boilers, selection of a boiler, essentials of a good boiler, boiler mountings and accessories, boiler efficiency, heat losses in a boiler plant. **Draught:** Definition, classification, chimney height and diameter, discharge efficiency loss.

Section-D

IC Engines: classification of IC engine, indicator diagram, ignition system, brake power, horse power, indicated power, brake mean effective pressure, engine efficiency, testing of IC engines, heat balance sheet.

Fuels and combustion: Introduction, classification of fuels- solid, liquid, gas, basic chemistry, air fuel ratio, volumetric and weight analysis, calorific values.

Suggested Readings

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

Course code	PCC-FT-207				
Category	Professional Core Courses				
Course title	Automobile Safety				
Scheme and Credits	L	T	P	Credits	Semester-III
	3	1	0	4	
Course Outcomes:	<ol style="list-style-type: none"> 1. Identify the different parts of automobile. 2. Understand the process of combustion in S.I. & C.I. engines. 3. Demonstrate knowledge of operation and maintenance of transmission system. 4. Explain the construction and operation of fire fighting vehicles. 				
Objectives:	<ol style="list-style-type: none"> 1. To familiarize with Automobile and transmission system. 2. To understand different component of engines. 3. To study different components of automobiles and their mechanism. 4. To understand construction and working of fire vehicles. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

Section-A

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

Section-B

Transmission System: Components of transmission system.

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

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

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

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

Section-C

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

Steering Systems: Constructional details, types of steering gear box, steering geometry, caster, camber, king pin inclination, Effect of steering geometry on directional stability, Power steering

Electrical System: Ignition Systems, Magnet ignition, Battery Ignition, Electronic Ignition, Merits and Demerits, Working, Self Starter, Dynamo voltage regulator, Battery construction, operation and maintenance; pollution, Air-pollution, Euro norms, Pollution Control techniques. **Lubricating System:** Types, Components, Lubricating oil, Cooling System

Section-D

Fire fighting vehicles: Fire bikes: Construction & Operation of Fire bikes.

Tenders: Construction & operation of fire tenders and trucks.

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

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

Suggested Readings

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

Course code	LC-FT-209				
Category	Professional Core Courses				
Course title	Fire Protection Workshop				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiment

1. To determine the flashpoint and fire point of different fuels using Pensky-Marten apparatus.
2. To study different types of fire and its elements.
3. To study different types of extinguishing media.
4. To study different causes and phases of fire.
5. To study fire detection system.
6. To study different types of sprinkler system.
7. To study product of combustion.
8. To study different types of occupancies.
9. To study structural integrity under fire using standard methods of NFPA.
10. To study different types of hose fittings and their application

Course code	LC-FT-211				
Category	Professional Core Courses				
Course title	Automobile Safety Lab				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiment

1.To study working principles and operation of the following Automotive Engine Systems & Sub

Systems.

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

Course code	LC-FT-213				
Category	Engineering Science course				
Course title	Basic Thermal Engineering Lab				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiment

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

Course code	PT-FT-215				
Category	Training				
Course title	Fire Ground Operation-I				
Scheme and Credits	L	T	P	Credits	Semester-III
	0	0	2	1	
Class work	25 Marks				
Practical	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

List of Experiments

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

Course code	BSC-FT-202				
Category	Basic Science Course				
Course title	Basic of Fire Science				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	0	0	3	
Course Outcomes:	<ol style="list-style-type: none"> 1. Demonstrate knowledge of fire, its cause and phases of fire. 2. Prepare the emergency evacuation plan and can help occupants in emergency evacuating process. 3. Apply suitable extinguishing media after identification of class of fire. 4. Explain the methods of smoke management. 				
Objectives:	<ol style="list-style-type: none"> 1. To study the basic of fire and combustion. 2. To familiarize with the smoke, its characteristics, control and management. 3. To know about detectors and fire alarm systems as per relevant standards (ISI). 4. To know about different fire extinguishers, extinguishing media and fire protection equipments. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

Section-A

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

Section-B

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

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

Section- C

Classification of building- Classification of buildings based on occupancy; Fire zone; Classification of Fire, Fire Extinguishers and other fire protection equipments and system for different occupancy

classification as per NBC, Sprinkler System, total flooding system, foam system, fire investigation, Fire Training and Education, Fire Safety Audits, Risk Assessment, Fire insurance.

Section-D

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

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

Suggested Readings

1. Fire Safety in Buildings by V K Jain, New Age publishers, New Delhi
2. Principles of Fire Safety Engineering – A. K. Das (PHI Publishers).
3. Fundamentals of Fire Safety in Building Design by Dr. Than Singh Sharma, Aayush Publications, New Delhi
4. Handbook of Fire Technology by R.S.Gupta, Orient Longman Pvt. Ltd., Kolkata
5. Manual of Fire Safety by N. Sessa Prakash, CBS Publishers & Distributors Pvt Ltd
6. National Building Code -2016 (NBC Part-4 Life and safety)

Course code	ESC-FT-204			
Category	Engineering Science Course			
Course title	Basics of Safety Engineering			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Course Outcomes:	<ol style="list-style-type: none"> 1. Apply the safety methods in an organisation where hazard will take place. 2. Understand the different type of accident and give the solution to minimise it. 3. Provide training and education regarding safety. 4. Review and evaluate safety management performance. 			
Objectives:	<ol style="list-style-type: none"> 1. To familiarise with the safety methodology, education and training for an organisation and environment. 2. To know the different types of accident and its preventive methods. 3. To study the rules of safety and safety management system. 			
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

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

Section-A

Safety - Introduction to safety, need for integration of health and environment safety, safety and productivity, fundamental of safety, important points for consideration for safety, general instruction for safety, safety organization, objectives, types and functions, safety committee- need, types, advantages, safety audits, types of audit, audit methodology, non conformity report, audit checklist and report, Safety in design and operations- inherent, engineered safety

Section-B

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

Section-C

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

Monitoring safety performance- frequency rate, severity rate, incidence rate, activity rate, and safety “t” score. Safety surveys, Job safety analysis (JSA).

Section-D

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

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

Suggested Readings

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

Course code	PCC-FT-206				
Category	Professional Core Courses				
Course title	First Aid & Paramedics				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	1	0	4	
Course Outcomes:	<ol style="list-style-type: none"> 1. Understand the first Aid and role of first Aid. 2. Explain about human body system. 3. Provide first Aid to any causality under different medical conditions. 4. To handle different causality and to explain different lifting techniques. 				
Objectives:	<ol style="list-style-type: none"> 1. To understand the basics of the first Aid. 2. To study human body and its various system like respiratory, circulatory, digestive and musculoskeletal system. 3. To familiarize with different medical conditions. 4. To understand different types of causalities handling and lifting techniques. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

Section-A

First aid: Introduction, Principles of first aid, First aid and resuscitation, Training in first aid, General rules of first aid, Role of first aider, Sequence of action on arrival at scene, First aid kit, Vital signs-A,B,C (Airway, Breathing, Circulation), Action in emergency, CPR, Artificial respiration.

Section-B

Study of human body and its various systems such as musculoskeletal system, Respiratory system, Circulatory system, Digestive system etc., Wounds and cases of wounds, Bleeding and its types, Control of bleeding, Injuries- first aid for various injuries, Head injuries, Chest injuries, Eye injuries and blindness.

Section-C

Medical conditions: Angina, Heart attack, Stroke, Diabetes mellitus, Hyperglycemia, Hypoglycemia, Seizures in adults and children, Fever meningitis, Fainting, Allergy, Headache, Migraine, Sore throat, Earache and toothache, Abdominal pain, Vomiting and diarrhea, Child birth, Electric shock, Burn and its types, Rule of nine, Poisoning and its types, Bites- frost bite, Snake bite, Dog bite, Insect bite, Drowning and choking, Unconsciousness, Protection of body from winter dryness.

Section-D

Fractures- First aid for fractures or broken bones, Joints and its types, Bandages and slings, Handling of casualties- lifting technique and equipments, Stretcher and its types, Ambulance- installation and use in casualties transportation, Dealing with minor illness,

Accidents: Accidents and its types, Accident reporting, Investigation and record keeping, Study of human casualty including medical history checking, Making of diagnosis report based on symptoms as narrated by the casualties and signs as observed by the paramedic, Checking.

Suggested Readings

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

Course code	PCC-FT-208				
Category	Professional Core Courses				
Course title	Fire Service Hydraulics-II				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	1	0	4	
Course Outcomes:	<ol style="list-style-type: none"> 1. Use water in fire protection service. 2. Calculate the discharge in various components. 3. Understand the functioning of pumps and primers. 4. To use sprinkler in fire protection services. 				
Objectives:	<ol style="list-style-type: none"> 1. To familiarize with water supply and hydrant system. 2. To determine the impact of jet on different types of vanes. 3. To determine the discharge through pipes and different fire fighting hoses. 4. To understand the construction and working of different types of pump. 5. To know about sprinkler and its applications. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

Section-A

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

Impact of free jets: Impulse–momentum principle, jet impingement on a stationary flat plate, inclined plate and a hinged plate, at the center of a stationary vane, on a moving flat plate, inclined plate, a moving vane and a series of vanes, Jet striking tangentially at the tip of a stationary vane and moving vane(s), jet propulsion of ships.

Section-B

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

Section-C

Pumps and primers: Introduction, types of pumps, Ejector pumps, Reciprocating pump-principle, construction, working, Centrifugal pump- principle, construction and working, Jockey pump-construction and its working, Vehicle mounted fire pumps, Portable pump, Selection of pumps,

maintenance and servicing of pumps, advantages and disadvantages, Terms- Duty point, Multistage, guide vanes, Pump operation and distribution of water on fire ground, pump power and efficiency, primers and their types.

Section-D

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

Suggested Readings

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

Course code	PCC-FT-210				
Category	Professional Core Courses				
Course title	Safety in Construction				
Scheme and Credits	L	T	P	Credits	Semester-IV
	3	1	0	4	
Course Outcomes:	<ol style="list-style-type: none"> 1. Understand different safety issues in construction industry and during construction operations. 2. To know about safety in the use of construction equipments. 3. To know about Contract Labour Act and central rules. 				
Objectives:	<ol style="list-style-type: none"> 1. To introduce the safety issues in construction industry. 2. To familiarize with the needs of safety in material handling and equipment. 3. To study the Contract labour act and Central rules in the Welfare and health provisions. 4. To study safety provisions in different constructions. 				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

Section-A

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

Section-B

Safety in various construction operations: Excavation- under- water works- under-pinning & shoringLadders and Scaffolds- Tunneling- Blasting- Demolition- Pneumatic caissons- confined Space Temporary Structures. Indian Standards on construction safety- National Building Code Provisions on construction safety.

Section-C

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

Section-D

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

Applicability, Administration, Registration, Welfare Board & Welfare Fund, Training of Building workers, General Safety, Health & Welfare provisions, Penalties.

Suggested Readings

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

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

List of Experiment

1. To study the maintenance of first aid kit.
2. To study respiratory, circulation and nervous system.
3. To study digestive and excretory system.
4. To study and perform different techniques of respiration (CPR).
5. To study various types of bandages and slings.
6. Handling of casualties- lifting and carrying.
7. To study different types of medical conditions.
8. To study maintenance of various charts related to casualties.
9. To study of stretchers and its types.
10. To study accidents, investigations and reporting and record keeping.

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

List of Experiment

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

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

Drills based on the following

Saluting:

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

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

Hydrant drills

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

Environmental Sciences

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

Unit-1 The Multidisciplinary nature of environmental studies. Definition, scope and importance. (2 lecture)

Unit-2 Natural Resources:

Renewable and non-renewable resources: Natural resources and associated problems.

- a) Forest resources: Use and over-exploitation: deforestation, case studies. Timber extraction, mining dams and their effects on forests and tribal people.
- b) Water resources: Use and over-utilization of surface and groundwater, floods, drought, conflict over water, dams- benefits and problems.
- c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- d) Food resources: World food problems, changes, caused by agriculture and overgrazing, effects of modern agriculture,

fertilizer-pesticide problems, Waterlogging, salinity, case studies.

- e) Energy resources: Growing energy needs; renewable and non-renewable energy sources, use of alternate energy sources, case studies.

- f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- * Role of an individual in conservation of natural resources.
- * Equitable use of resources for sustainable lifestyles.

(8 lectures)

Unit-3 Ecosystems:

- * Producers, consumers and decomposers.
- * Energy flow in the ecosystem.
- * Ecological succession.
- * Food chains, food webs and ecological pyramids.
- * Introduction, types, characteristic features, structure and function of the following eco-system:
 - a. Forest ecosystem.
 - b. Grassland ecosystem.
 - c. Desert ecosystem.
 - d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) (6 lectures)

Unit-4 Biodiversity and its conservation

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

(8 lectures)

Unit-5 Environmental pollution:

Definition, causes, effects and control measures of:

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

- * Solids waste management: causes, effects and control measures of urban and industrial wastes.
- * Role of an individual in prevention of pollution.
- * Pollution case studies.
- * Disaster management: floods, earthquake, cyclone and landslides.

(8 lectures)

Unit-6 Social issues and the Environment:

- * From unsustainable to sustainable development.
- * Urban problems related to energy.
- * Water conservation, rainwater harvesting, watershed management.
- * Resettlement and rehabilitation of people: its problems and concerns case studies.
- * Environmental ethics: Issues and possible solutions.
- *
Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- * Wasteland reclamation.

- * Consumerism and waste products.
- * Environment Protection Act.
- * Air (Prevention and Control of Pollution) Act.
- * Water (Prevention and Control of Pollution) Act.
- * Wildlife Protection Act.
- * Forest Conservation Act.
- * Issues involved in enforcement of environmental legislation.
- * Public awareness. (7 lectures)

Unit-7 Human population and the Environment.

Population growth, variation among nations. Population explosion - Family Welfare Programme.
Environment and human health.
Human Rights.
Value Education.
HIV/AIDS.
Woman and Child Welfare
Role of Information Technology in Environment and human health.
Case Studies. (6 lectures)

Unit-8 Field Work:

- * Visit to local area to document environmental assets - river/forest/grassland/hill/mountain.
- * Visit to local polluted site - urban/Rural/Industrial/Agricultural.
- * Study of common plants, insects, birds.
- * Study of simple ecosystems - pond, river, hillslopes, etc. (Field work equal to 10 lecture hours).

References

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2. Bharucha, Frach, The Biodiversity of India, MA pin Publishing Pvt. Ltd. Ahmedabad-380013, India, E-mail: mapin@icenet.net (R).
3. Brunner R.C. 1989, Hazardous Waste Incineration, Mc. Graw Hill Inc. 480p.
4. Clark R.S., Marine pollution, Slanderson Press Oxford (TB).
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M. T. 2001, Environmental Encyclopedia, Jaico Pub. House, Mumbai 1196p.
6. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
7. Downto Earth, Centre for Science and Environment (R).
8. Gleick, H.P., 1993. Water in crisis, Pacific Institute for Studies in Development, Environment & Security Stockholm Env. Institute, Oxford Univ. Press, 473p.
9. Hawkins R.E. Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R).
10. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge Uni. Press 1140p.
11. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p.
12. Mackinney, M.L. & Schoch, R.M. 1996, Environmental Science systems & solutions, Web enhanced edition. 639p.
13. Mhaskar A.K., Mayyer Hazardous, Tekchno-Science Publications (TB).
14. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB).
15. Odum, E.P. 1971, Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.
16. Rao M.N. & Datta, A.K. 1987 Waste Water Treatment. Oxford & TBH Publ. Co. Pvt. Ltd. 345p.
17. Sharma, B. K. 2001, Environmental Chemistry, Goal Publ. House, Meerut.
18. Survey of the Environment, The Hindu (M).
19. Townsend C., Harper J. and Michael Begon. Essentials of Ecology, Blackwell Science (TB).
20. Trivedi R. K., Handbook of Environmental Laws, Rules, Guidelines, Comliances and Standards, Vol. I and II Enviro Media (R).
21. Tridevi R. K. and P.K. Goal, Introduction to air pollution, Techno Science Publications (TR).
22. Wagner K. D., 1998, Environmental Management, W.B. Saundersco. Philadelphia, USA 499p.
23. A text book environmental education G.V.S. Publishers by Dr. J.P. Yadav.
(M) Magazine
(R) Reference
(TB) Textbook

The scheme of the paper will be under:

The subject of Environmental Studies will be included as a qualifying paper in all UG Courses and the students will be required to qualify the same otherwise the final result will not be declared and the degree will not be awarded.

The duration of the course will be 40 lectures. The examination will be conducted along with the semester examinations.

Exam. Pattern: In case of awarding the marks, the paper will carry 100 marks. Theory: 75 marks, Practical/Field visit: 25 marks. The structure of the question paper will be:

Part-A: Short Answer Pattern : 15 marks Part-
B: Essay Type within built choice : 60 marks Part-
C: Field Work (Practical) : 25 marks Instructions for Examiners:

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

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

The examination of the regular students will be conducted by the concerned college/Institute. Each student will be required to score minimum 40% marks separately in theory and practical/Field visit. The marks in this qualifying paper will not be included in determining the percentage of marks obtained for the award of degree. However, these marks will be shown in the detailed marks certificate of the students.