Course Code	ESC-FE-201(P)					
Category	Engineering Science Course					
Course Title	**Fluid Mechanics Laboratory**					
Scheme and Credit	L	T	P	Credits	Semester - III	
	-	-	2	1		
Examination Scheme	Theory			Laboratory		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Normal background in basic engineering science, scalar and vector quantity and mathematics, up to second ordinary differential equations.					

Fluid Mechanics Laboratory

Laboratory Outcomes: The student will be able to

1. Calibrate flow measuring devices such as Venturimeter, orifice meter and v-notch
2. Verify Bernoulli's theorem.
3. To compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows;
4. To discuss and practice standard measurement techniques of fluid mechanics and their applications;

List of Experiments: -

1. Metacentric height calculation
2. Pressure Measurement.
3. Calibration of Venturimeter.
4. Calibration of Orifice Meter.
5. Calibration of Nozzle meter.
6. Determination of Reynolds number in pipe flow.
7. Determination of Coefficient of Velocity of Pitot tube.
8. Verification of Bernoulli's theorem
9. Calibration of Rectangular Notch
10. Calibration of Triangular Notch

Course Code	ESC-FE-202(P)					
Category	Engineering Science Course					
Course Title	Advanced Electrical Systems Laboratory					
Scheme and Credit	L	T	P	Credits	Semester - III	
	-	-	2	1		
Examination Scheme	Theory			Laboratory		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Basic Electrical Engineering.					

Advanced Electrical Systems Laboratory

Laboratory Outcomes: Upon successful completion of the course, the student will be able to:

1. Experimentally obtain the load characteristics of DC motors and generators.
2. Able to reflect the knowledge of network theorems to verify experimentally.
3. Control the speed of DC motors and test DC machines
4. Able to work in teams and will be aware of "do's and don'ts" while working with electrical networks and machines

List of Experiments:

1. Verification of Ohm's Law
2. Verification of KCL
3. Verification of KCL
4. Verification of superposition theorem
5. Verification of reciprocity theorem
6. Verification of Thevenin's theorem
7. Verification of maximum power transfer theorem
8. Determination of parameters of choke coil
9. Locus Diagrams of R-C and R-L circuits
10. Open circuit characteristics of separately excited generator.

Course Code	ESE-FE-203(P)					
Category	Engineering Science Course					
Course Title	Structural Mechanics Laboratory					
Scheme and Credit	L	T	P	Credits	Semester - III	
	-	-	2	1		
Examination Scheme	Theory			Laboratory		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Engineering Mechanics					

Structural Mechanics Laboratory Course Content

Laboratory Outcome: Upon successful completion of the course, the student will be able to:

1. Calibrate electronic sensors, operate a data acquisition system
2. Operate various types of testing machines, configure a testing machine to measure tension or compression behavior
3. Compute engineering values (e.g. stress or strain) from laboratory measures, analyze a stress versus strain curve for modulus, yield strength and other related attributes and identify modes of failure
4. Write a technical laboratory report

List of Experiments:

1. Study of strain measuring instruments mechanical, electrical types.
2. Tension test on metals
3. Hardness test on metals
4. Torsion test on metals
5. Impact test on metals
6. Transverse test on beams including deflections
7. Compression Test on Bricks & Stones
8. Measurement of static strains using electrical resistance gauges
9. Determining the various forces in beams using software.
10. Shear center
11. Tests on spring
12. Verification of Maxwell's reciprocal theorem on beams.
13. Bricks: Absorption Test, Dimension Test, Crushing strength, Efflorescence
14. Tiles: flooring-Transverse strength, water absorption, Abrasion test
15. Timber: Moisture content, strength, parallel and to grain-transverse strength
16. Notch Bar Test for toughness of metals
17. Fire endurance testing and calculation of fire resistance rating for usual materials and structural elements and assemblies
18. Consistency test of cement, fineness test of cement by dry sieving, soundness test of cement and initial and final setting time test of cement
19. Concrete mix design

20. Workability of concrete, compressive strength of concrete.
21. Buckling of column
22. Design of RCC members using software packages.

Note: Performance of at least eight experiments is compulsory in a semester.

Course Code	PCC-FE-201(P)					
Category	Program Core Course					
Course Title	Fire Ground Operations –III					
Scheme and Credit	L	T	P	Credits	Semester - III	
	-	-	5	2.5		
Examination Scheme	Theory			Laboratory		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Fire Ground Operations- I, Fire Ground Operations- II					

Course Objective: The student will be made

- To learn about the concepts of hose Standard Practices to provide system of work, which will enable crews to acquire the skills, knowledge and attitude to move onto standard practices.
- Hose standard practices are fundamental learning activities which should be conducted at a pace and practiced at a frequency to maintain competence.
- To learn about the concept and design of Hose construction.
- To learn about the Concept and design of different types of hose.
- Demonstrate the correct method of: Shipping a stand pipe, carrying hose, running cut lengths of hose, Connecting and disconnecting length of hose, Carrying the branch whilst running out hose, holding a branch, operating a branch, operating a hydrant, under running length of hose, making up length of hose, Giving appropriate words of command.

List of Experiments:

1. Hose Introduction (Delivery Hose, Suction Hose
2. Hose binding/ washing/storage
3. Types of Hose Roll: Coil roll, Figure of 8 roll, Flacking roll, Dutch roll.
4. Hose drill: Lifting, Lorrying, Carrying, Laying, Connect, Disconnect, Remove the king, Under running, Roll.
5. Testing
6. Rope construction
7. Types of ropes: Natural rope (a. Italian hemp, b. Manila, c. Sisal, d. Coir, e. Cotton, f. Jute) , Manmade rope(a. Synthetic, b. Nylon, c. Steel, d. Cara mandala)
8. Knots & Lines: Bend, Bight, Hitch, Running Part, running end, Seizing, Whipping, Standing part
9. Types of Knots & Lines: Over hand, figure of eight, Reep, Chair, Half hitch, Clove hitch, Rolling hitch, Timber hitch, Black wall hitch, Midship hitch, Waterman hitch, Slippery hitch, Draw hitch, Round turn hitch, Fisherman bend, Single sheet bend, Double sheet bend, Carrick bend, Sheep shank, Bow line, Running bow line, Bow line on the bight, Main harness, Multi thump
10. Lasing: Round lasing, diagonal, figure of eight, snake lasing

11. Hose Fitting: Types of hose fitting, Operation, Care and maintenance, Branch, Adaptor, Nozzle, Collecting heads, Hand control branch, TFT, Hose rams, First aid nozzle, Blank cap, Non-standard branch and miscellaneous

Course Outcomes: Course objectives are to be fulfilled. Students learn and become familiar with hose, hose fitting, ropes, knots and lines.

1. Understand the Fire types of hose
2. Understand the construction and types of rope.
3. Understand the different types of knots and lines in use fire ground
4. Understand the working in fire ground different types of hose fittings

Books Recommended: -

1. Fire Service Manual, HM Fire service manual
2. Fire Fighters Handbook, Delmar
3. Manual of firemanship

Course Code	PCC-FE-202					
Category	Program Core Course					
Course Title	Fire Service Hydraulics					
Scheme and Credit	L	T/A	P	Credits	Semester - IV	
	2	1	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Normal background in basic Fluid Mechanics, mass momentum equation, mathematics.					

Course Objectives: - The objective of this module is to understand the basic Principle of hydraulic machines and working procedure. To identify the parts of hydraulic system and its application in fire service, different types of pumps used in fire service. To calculate the hydraulic force, pressure, torque and power. Analyze the efficiency and performance of pumps and can able to draw a characteristic curve of the pump.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the hydraulic systems of various machines.
2. Apply basic principle of hydraulics in fire service.
3. Understand the relationship among Hydraulic Force, Pressure, Power, Torque and Efficiency of machines.
4. Calculate the capacity of Pumps.
5. Analyze the head or pressure losses in pipe flow system.

Fire Service Hydraulics Course Content

Unit I **(08 Hrs)**

Water Supply Analysis Overview – History, Consumption, Water Source, Treatment Process, Water Distribution System, Fire Hydrants system, Storage Tanks.
Basic Principles of Hydraulics – Pascal's Law and its application in machines, Hydraulic press, accumulator, intensifier, Hydraulic ram, lift, crane.

Unit II **(08 Hrs)**

Pressure Loss in pipes and Fittings, Hazen-Williams Formula, Moody chart. Flow through compound pipes, Equivalent pipes, flow through parallel pipes, flow through branched pipes, pipe networks. Power Transmission Through Pipeline: Condition for maximum power transmission through a given pipeline (single pipe).
Nozzle – Flow through nozzles, power transmitted through nozzle, condition for maximum transmission, nozzle reaction, relation between nozzle and pipe diameter

Unit III **(08 Hrs)**

Mass Momentum equation, Impact of Jet- Force exerted by jet on stationary flat plate, moving plate, hinged plate and curved plate.

Hydraulic Machines – Pelton wheel, Francis turbine and Kaplan turbines

Unit IV **(08 Hrs)**

Positive Displacement Pump, Reciprocating Pumps – Introduction, main parts of a reciprocating pump, working of a reciprocating pump, slip of reciprocating pump, Variation of velocity and acceleration in suction and delivery pipes due to acceleration of piston, effect of velocity on friction in suction and delivery pipe , introduction of air vessels, reciprocating & ejector primer.

Unit V **(08 Hrs)**

Centrifugal Pumps – Introduction, main parts of centrifugal pumps, Velocity Diagram, work done by centrifugal pumps on water, minimum speed for starting a centrifugal pump, multistage centrifugal pumps, priming of a centrifugal pump, model testing, cavitation, suction height, net positive suction head, capacity calculation, maintenance of pump.

Text Book/ Reference Book

1. Hydraulic Machines by K. Subramanya (2010) Mc Graw Hill.
2. Fluid Mechanics (SI Units) 3rd Edition by Yunus A. Cengel, (2015) Mc Graw Hill.
3. Fluid Mechanics and Hydraulics Machine 7th edition by R.K. Bansal (2012)
4. Fluid Mechanics and Fluid Power Engineering 2nd edition by D.S. Kumar Kataria Pub.
5. Basic Fluid Mechanics - C.P. Kothandaram& R. Rudramoorthy - New Age Pub.
6. Fluid Mechanics for Engineers - P.N. Chatterjee – Macmillan India Ltd.
7. A Handbook of Fire workmanship NFSC, Nagpur

Course Code	ESC-FE-205					
Category	Engineering Science Course					
Course Title	Heat and Mass Transfer					
Scheme and Credit	L	T/A	P	Credits	Semester - IV	
	2	1	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Normal background in basic of Thermodynamic, mathematics, up to second ordinary differential equations.					

Course Objectives: - The objectives of this course are to understand the mode of heat transfer system, law governing of conduction, convection and radiation to develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of particular systems and processes. As well, to gain experience in designing experiments for thermal systems like heat exchanger, condenser evaporator etc.

Course Outcome: - Upon successful completion of the course, the student will be able to:

1. Understand the basic laws of heat transfer.
2. Account for the consequence of heat transfer in thermal analysis of engineering systems.
3. Analyze problems involving steady state heat conduction and convection in simple geometries.
4. Develop solutions for transient heat conduction in simple geometries.
5. Analyze heat exchanger performance by using the method of log mean temperature difference.

Heat and Mass Transfer Course Content

Unit I **(08 Hrs)**

Introductory Concepts and Definitions: Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; variable thermal conductivity, Derivation for heat flow and temperature distribution in plane wall convective heat transfer coefficient; radiation heat transfer; combined heat transfer mechanism. Boundry conditions. Conduction: Derivation of general three dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems (No derivation)

Unit II **(08 Hrs)**

One dimensional conduction equations in rectangular, cylindrical and spherical coordinates for plane and composite walls. Overall heat transfer coefficient. Thermal contact resistance.

Critical thickness of insulation without heat generation, combine conduction, convection and radiation system and numerical. Thermal resistance concept & its importance.
Heat transfer in extended surfaces of uniform cross-section without heat generation, Long fin, short fin with insulated tip and without insulated tip and fin connected between two heat sources. Fin efficiency and effectiveness. Numerical problems.
One-Dimensional Transient Conduction: Conduction in solids with negligible internal temperature gradient (Lumped system analysis), Use of Transient temperature charts (Heisler's charts) for transient charts for transient conduction in semi-infinite solids. Numerical Problems.

Unit III **(08 Hrs)**

Force Convection: Concepts and Basic Relations In Boundary Layers theory: Flow over a body velocity boundary layer; critical Reynolds number; general expressions for drag coefficient and drag force; thermal boundary layer; general expression for local heat transfer coefficient; Average heat transfer Coefficient.
Natural Convection: Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Application of dimensional analysis for free convection physical significance of Grashoff number; use of correlations of free convection in vertical, horizontal and inclined flat plates, vertical and horizontal cylinders and spheres, Numerical problems.

Unit IV **(08 Hrs)**

Heat Exchangers: Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD, Effectiveness-NTU methods of analysis of heat exchangers. Numerical problems.
Condensation And Boiling: Types of condensation, Nusselt's theory for laminar condensation on a vertical flat surface; use of correlations for condensation on vertical flat surfaces, horizontal tube and horizontal tube banks; Reynolds number for condensate flow; regimes of pool boiling, pool boiling correlations. Numerical problems. Mass transfer definition and terms used in mass transfer analysis, Ficks First law of diffusion (no numericals).

Unit V **(08 Hrs)**

Radiation Heat Transfer: Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's law and Wein's displacement law. Radiation heat exchange between two parallel infinite black surfaces. two parallel infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle; Lambert's law; radiation heat exchange between two finite surfaces-configuration factor or view factor. Numerical problems.

Text Book / Reference Book

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

Course Code	ESC-FE-206					
Category	Engineering Science Course					
Course Title	Basic Electronics & Communication					
Scheme and Credit	L	T/A	P	Credits	Semester - IV	
	3	1	-	4		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Basic Electrical Engineering, Advanced Electrical Systems					

Course Objective: The objective of this module is to provide the basics of analog and digital electronics & communications for the understanding of fire and draw them together with some of the other fundamental topics required to synthesize knowledge of fire service communication.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the concepts of analog and digital electronic instruments
2. Analyze the basic fundamental operations of power electronic circuits
3. Demonstrate good comprehension working of analog communications systems
4. Identify and summarize the important features of digital communication systems
5. Understand the basic concepts of wireless communications

Basic Electronics & Communication Course Content

Unit I: Analog Electronics **(08 Hrs.)**

P-N junction diode; Simple diode circuits: clipping, clamping, rectifiers; Operational amplifier and its applications; Zener diode; BJT; FET; MOSFET; LED; photo diode and solar cell;

Unit II: Digital Electronics **(08 Hrs.)**

Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Logic simplification using K-map, Logic ICs, half and full adder/subtractor, code converters, multiplexers, decoders; Sequential circuits; Data converters;

Unit III: Power Electronics **(08 Hrs.)**

Thyristors – Silicon Controlled Rectifiers (SCR's); Basic theory of operation of SCR; Static and Dynamic characteristics of SCR; Turn on and turn off methods; series and parallel connections of SCR's; Introduction to Triac, GTO, IGBT; Introduction to AC-DC Converters, DC-DC Converters (Choppers), AC-AC Converters (AC Voltage Controllers) & Frequency Changers (Cyclo-Converters), DC-AC Converters (Inverters)

Unit IV: Analog Communications **(08 Hrs.)**

Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications.

Unit V: Digital Communications **(08 Hrs.)**

basics and fundamentals of the differences between the digital and analog communication system, critical aspects of a digital communication system, typical way of designing systems or typical way of layering architecturing, different components of digital communication system, the concept of layering and standardize interfaces. Different components of a communication system

Text Books / Reference Books:

1. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
2. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
3. Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.
4. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
5. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
6. R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.
7. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rd Edition, 2001
8. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited
9. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
10. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
11. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
12. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
13. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
14. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996
15. Principles of Mobile Communications by G. Stuber, Springer, 2nd ed..
16. Wireless Communications by A. Goldsmith, Cambridge
17. Introduction to Space Time Wireless Communications by A. Paulraj, Nabar and Gore
18. Space Time Wireless Communication Systems,by Bolskei, Gesbert, et al.
19. Satellite communications, 2nd edition, by T. Pratt, C. W. Bostian, J. E. Allnut, Publisher: John Willey and sons
20. Satellite Communications Systems: systems, techniques and technology, 5th edition, by G. Maral, M. Bousquet, Z. Sun, Publisher: John Willy and sons

Course Code	PCC-FE-203					
Category	Program Core Course					
Course Title	Fundamentals of Fire Engineering					
Scheme and Credit	L	T/A	P	Credits	Semester - IV	
	3	-	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Applied Mathematics, Energy & Environment, Applied Physics					

Course Objective: The objective of this module to develop understanding regarding the fire engineering science.

To learn the basic difference between fire prevention, fire protection and firefighting.
To understand the application of fire engineering in different industries.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the basic concepts of Fire Engineering
2. Analyze the basic fire prevention techniques
3. Demonstrate the fire protection techniques
4. Identify the fire-fighting techniques
5. Apply the concepts of fire engineering in industry

Fundamentals of Fire Engineering Course Content

UNIT- I: Fire Engineering Science **(8 Hours)**

Mathematics, Physical properties of matter, Mechanics, Heat, Heat transmission, Thermal expansion, Hydraulics, Chemistry of Fire, Electricity.

UNIT – 2: Fire Prevention **(8 Hours)**

Elements of Construction, Elements of Structure, Fixed Installations–Fire doors, Smoke Ceiling, compartmentation, pressurization, etc.,Fire Safety Practice, Fire Safety Management.

UNIT - 3: Fire Protection **(8 Hours.)**

Fire Alarm & Detection Systems, Fire Extinguishers, Fire Hose reels, Fire Hose Cabinets, Fire Hydrants, Fire Pumps, etc., Fire Sprinkler systems, Fire Suppression systems, Kitchen Fire Safety, etc.

UNIT-4: Fire Fighting **(8 Hours)**

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

UNIT-5: Application of Fire Engineering in different industries **(8 Hours)**

Oil and Gas industries, pharmaceuticals industries, Buildings, Fertilizer industries, Steel industries, Coal industries, Ports and Airports.

Text Book(s):

1. Elementary Fire Engineering Book – The Institution of Fire Engineers
2. Manual of Firemanship - HMSO

Course Code	PCC-FE-204					
Category	Program Core Course					
Course Title	Structural Fire Protection					
Scheme and Credit	L	T/A	P	Credits	Semester - IV	
	3	-	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Normal background in engineering and structural mechanics					

Course Objectives:

To learn the components of super structure of building.

To learn understand the concepts of fire severity and fire resistance and design concrete structure to resist the fire structure.

To understand fire and life safety requirements for building of specific occupancy.

Course outcomes: Upon completion of this course the student would be able to:

1. Interpret the intentions of code requirements for structural fire safety;
2. Understand the concepts of fire severity and fire resistance;
3. Estimate time–temperature curves for fully developed compartment fires;
4. Design concrete structures to resist fire exposure;
5. Understand the general life safety requirements applicable to all buildings and to plan, design and locate exits in buildings.

Structural Fire Protection Course Content

Unit I: **(08 Hrs.)**

Study of different kinds of components of super-structures, various common types of buildings with reference to relevant I.S.I. specifications, different types of walls, roofs and floors and their construction methods

Unit II: **(08 Hrs.)**

Fire safety in buildings, process of fire development, fire behaviour, human behaviour, fire detection and control system, fire resistance, fire design time, controlling fire spread, Compartmentation, defend in place theory, Testing and Inspection of Fire doors & Firestop system, building construction for fire safety

Unit III: **(08 Hrs.)**

Fire severity, fire resistance, equivalent fire severity, fire resistance test, fire resistance of assemblies – walls, floors, beams, columns, penetrations, Joints, fire doors, ducts and glasses, Design of structures exposed to fire - structural design at normal temperatures, loads, structural design in fire conditions, design equation, loads for fire design, structural analysis for fire design, material properties in fire, design of individual members exposed to fire, design of structural assemblies exposed to fire, Structural Steel Fire Protection.

Unit IV: **(08 Hrs.)**

Concrete structures - behaviour of concrete structures in fire, concrete materials in fire, spalling of cover concrete, concrete and steel reinforcing temperatures, mechanical properties of concrete at elevated temperatures, design of concrete members exposed to fire - continuous slabs and beams, axial restraint

Unit: V **(08 Hrs.)**

Classification of buildings based on occupancy and type of construction according to fire resistance as per NBC; Fire zone; General fire safety requirements applicable to all individual occupancies.

General exit requirements as per NBC: Internal staircases; horizontal exits; fire tower, ramps: fire lifts; external fire escape ladders; Planning of location and calculation of capacity. number and width of exit as per NBC for different occupancy classification.

Text Books / Reference Books:

1. Roytman, M. Ya .(1975). Principles of fire safety standards for building construction. Amerind Publishing Co. Pvt. Ltd., New Delhi
2. Butcher, E. G. and Parnell, A. C. (1983). Designing of fire safety. John Wiley and Sons Ltd., New York, U.S.A.
3. Jain, V.K. (2010). Fire safety in buildings (2nd Edition.). New Age International (P) Ltd., New Delhi.
4. Andrew H. Buchanan & Anthony K. Abu, Structural Design For Fire Safety (2nd Edition), John Wiley and Sons Ltd., New York, U.S.A.
5. Jay Wodward & Brij Bhushan Singh , Firestopping Book , International Code Council (ICC) Inc, USA & Hilti India Pvt Ltd.
6. Relevant IS & NFPA codes

Course Code	PCC-FE-202(P)					
Category	Program Core Course					
Course Title	Fire Service Hydraulics Laboratory					
Scheme and Credit	L	T/A	P	Credits	Semester - IV	
	-	-	2	1		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Normal background in basic Fluid Mechanics, mass momentum equation, mathematics.					

Fire Service Hydraulics Laboratory

Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the hydraulic system and its use.
2. Study various operating characteristics of Centrifugal pump and reciprocating pump.
3. Study various operating characteristics of Pelton turbine
4. Understand the performance of hydraulic turbine and pumps under different working conditions.
5. Calculate the output power, efficiency and performance of machines.

List of Experiment: -

1. Study of Hydraulic System.
2. Determination of the minor and major energy losses in pipe.
3. Performance characteristics of multi- stage Centrifugal pump.
4. Performance characteristics of a Reciprocating pump.
5. Study of axial flow pump.
6. Study of Francis turbine.
7. Study of Kaplan turbine.
8. Performance test on Pelton wheel turbine
9. Determination of force exerted by a jet of water on flat plate and curved plate.
10. Study of performance characteristic of a centrifugal blower.

Course Code	ESC-FE-205(P)					
Category	Engineering Science Course					
Course Title	Heat and Mass Transfer Laboratory					
Scheme and Credit	L	T/A	P	Credits	Semester - IV	
	-	-	2	1		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Normal background in basic of Thermodynamic, mathematics, up to second ordinary differential equations.					

Heat and Mass Transfer Laboratory Content

Outcomes: - At the end of the lab sessions, the student will be able to

1. Differentiate among Conduction, convection and radiation.
2. Perform the steady state conduction experiment to estimate thermal conductivity of Metal rod, composite wall etc.
3. Estimate the heat transfer coefficient in free and force convection to correlate the theoretical value.
4. Obtain variation of temperature of extended surface (Fin) under free and force convection
5. Perform the radiation experiment determine the surface emissivity of a test plate and Stefan-Boltzmann constant and compare with theoretical value.

List of Experiments

1. To determine the thermal conductivity of metal rod.
2. To determine the thermal conductivity of composite wall.
3. To determine the surface heat transfer coefficient for a heated vertical tube under natural convection.
4. To determine average heat transfer coefficient of an externally heated horizontal pipe under forced convection.
5. To determine efficiency and effectiveness of Metallic Fin
6. To verify the Stefen-Boltzmann constant for thermal radiation.
7. To measure the emissivity of the gray body (plate) at different temperature.
8. To find overall heat transfer coefficient and effectiveness of a heat exchanger under parallel and counter flow conditions.
9. Study of boiling (Critical Heat Flux apparatus) and Condensation of Heat Transfer.
10. To determine the heat transfer in lagged pipe apparatus.

Course Code	ESC-FE-206(P)					
Category	Engineering Science Course					
Course Title	Basic Electronics & Communication Laboratory					
Scheme and Credit	L	T/A	P	Credits	Semester - IV	
	-	-	2	1		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Basic Electrical Engineering, Advanced Electrical Systems					

Basic Electronics & Communication Laboratory

Laboratory Outcomes: Upon successful completion of the course, the student will be able to:

1. Design and test the basic electric components like diodes, transistors and zener diode
2. Understand the working of logic gates
3. Analyze the working of analog communications systems
4. Design the significant features of digital communication systems

List of Experiments:

1. To study the P-N junction diode characteristics and Zener diode characteristics
2. To identify the Input and output characteristics of transistor
3. To study and generate the sine wave, square wave and triangular wave with OP AMP function generator
4. To design and test the performance of integrator and differentiator circuits using Op-amp.
5. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, X-OR, X-NOR Gate
6. To Verify De-Morgan's First Law
7. To study of characteristics of an SCR
8. To study amplitude modulated wave using IC 1496
9. To perform the functioning of Frequency modulation & demodulation and also calculate the modulation index
10. To study FM wave propagation through Transmitter & Receiver

Course Code	PCC-FE-205(P)					
Category	Program Core Course					
Course Title	**Fire Ground Operations -IV**					
Scheme and Credit	L	T/A	P	Credits	Semester - IV	
	-	-	5	2.5		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Fire Ground Operations- I, II, III					

Course Objective: The student will be made

To learn about the concepts of Fire hydrant to get a branch to work using one line of a hydrant.
To add a length to a line of hose and advance the branch with a crew of four
To remove and replace a length from a line of hose.
To divide a line of hose into two using a dividing breeching.
To learn about the concept of Extinguishers and handling method.
To learn about the concept of ladders, carrying, peach, housing.
To learn about the concept of ladder, different types of rescue.
To learn about the concept of Practical firemanship, forcible entry, Survey, Salvage, Ventilation, Rescue and Firefighting.

Laboratory Outcomes: Course objectives are to be fulfilled. Students learn and become familiar with

Understand the types of Fire hydrant and operation care and maintenance
Understand the types of portable and trolley mounted extinguisher operation care and maintenance
Understand the different types of ladder use firefighting and rescue purpose
Understand the practical firemanship, hazardous associated with the rescue operation search of burning structure, victim removal, remove, drag and carry.

List of Experiments:

1. Hydrants
   Types of hydrants: Ball type, Sluice valve, Screw down, Piller and post
   Types of Valves, Types of hydrant fittings, Types of hydrant gear, Hydrant testing equipment
2. Hydrant Drill: 3 men hydrant drill (Add, remove, replace, dividing breaching, collecting breaching), 4 men hydrant drill (Add, remove, replace, dividing breaching, collecting breaching)

3. Hydrant test
4. Extinguishers: Classification of portable and trolley mounted extinguisher, Rating system of portable extinguishers for classes A, B and C., Limitations of portable extinguishers, Operation of portable extinguishers, Maintenance of portable extinguishers, Inspection requirement of portable extinguishers.
5. Extinguisher: Refilling and Testing method.
6. Extinguisher operating drill.
7. Ladders: Types of ladder: Hook ladder, Roof ladder,35 ft Aluminum extension ladder,45 ft Aluminum extension ladder, Trust type and non-trust type, Turn table ladder, Hydraulic platform, Snorkel,
8. Ladder: Parts, Functions, Types of mounted ladder apparatus, Types of ground ladders, care and maintenance, construction feature and specification
9. Ladder drill: Ladder carry, Ladder raising, Ladder housing, Clamping, Leg lock, Arm hold, Crutch hold, Fireman lift.
10. Ladders: Types of test: Acceptance test, Perform test, Deflection test, Swag test, Swing test, Round test, Rope test.
11. Different rescue techniques use ladder
12. Practical firemanship: Types of entry, Types of searching, Types of ventilation, Types of rescue
13. Practical firemanship: Room searching (1 man, 2 men), Staircase rescue, Smoke field rescue, Confinement rescue, Fire rescue, under debris rescue, under vehicle rescue, Improvise rescue technique.

Books Recommended: -

1. Fire Service Manual, HM Fire service manual
2. Fire Fighters Handbook, Delmar
3. Manual of firemanship

Course Code	PCC-FE-301					
Category	Program Core Course					
Course Title	**Fire Dynamics**					
Scheme and Credit	L	T/A	P	Credits	Semester -V	
	2	1	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Mathematics-I and II, Applied Chemistry, Engineering Thermodynamics, Heat and Mass Transfer.					

Course Objectives: The objective of this module is to provide the basic chemistry and physics necessary for the understanding of fire and draw them together with some of the other fundamental topics (in particular, heat and mass transfer) required to synthesize a knowledge of fire processes.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Apply the physical and chemical behavior of different combustible materials when exposed to fire conditions.
2. Interpret flammability limit diagrams and apply them in the context of the prevention and mitigation of gas/vapor explosions.
3. Evaluate the behavior of different burning flames and its structure
4. Apply the concept of compartment fire.
5. Analyze the production and movement of smoke in compartment

Fire Dynamics Course Content

Unit I: **(08 Hrs.)**

Fuels and the combustion process, the physical chemistry of combustion in fire, thermodynamics of combustion – stoichiometry, thermo chemistry, chemical equilibrium, analysis of the structure of the reaction zone and flame temperature.

Unit II: **(08 Hrs.)**

Limits of Flammability, including flammability diagrams: their measurement and interpretation, Thermal theory of the limits. The structure of a premixed flame, Heat losses from premixed flames, Measurement of burning velocities. Introduction to diffusion flame, structure of diffusion flame, Gaseous jet flame, burning of condensed phases, burning of droplet clouds, diffusion flame height.

Unit III: **(08 Hrs.)**

Steady Burning of Liquid and Solid Fuels:
Burning of liquids, Burning of solids. Simple thermal model for the steady burning of liquids and solids. Measurement of the rate of heat release using oxygen depletion calorimetry. Combustion efficiency.

Ignition of liquids and solids
Classification of liquids. Flash points and their relationship to flammability limits. The wick effect and its relevance to the ignition of high flashpoint liquid pools. Application of the concepts of flash point and fire point to the ignition of solids. Spread of Flame in solid.

Unit IV **(08 Hrs.)**

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 behavior, Temperatures achieved in full-developed fire, Fire resistance and fire severity, Methods of calculating fire resistance, Projection of flames from burning compartments, Spread of fire from a compartment.

Unit V **(08 Hrs.)**
Description of smoke, Smoke Production, average plum temperature, volumetric plump flow, Hazard of smoke, Principal of smoke movement, Flow through openings, Stack Effect, Influence of floor and partition, Wind effect, Smoke management, Computational tool for design.

Text Books/Reference Books/Standards:

1. Dougal Drysdale, "An Introduction to Fire Dynamics", Third Edition, Wiley Publisher
2. "Enclosure Fire Dynamics" by Bjorn Karlsson, James Quintiere, Taylor & Francis publishers.
3. Fundamentals of Fire Phenomena - Quintiere, J. G., John Wiley & Sons, Chichester, UK, 2006.
4. Fundamentals of Combustion- D. P. Mishra, PHI Learning Pvt. Ltd., New Delhi, 2010.
5. An Introduction to Combustion- Turns, S. R, McGraw-Hill, New York, USA, 2012.
6. Fire Protection Handbook, Volume-II, 20th Edition.

Course Code	ESC-FE-301					
Category	Engineering Science Course					
Course Title	Automobile Engineering					
Scheme and Credit	L	T/A	P	Credits	Semester -V	
	3	-	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Applied Physics, Applied Chemistry, Engineering Mechanics, Basics of Mechanical Engineering, Thermodynamics, Basic Electrical Engineering					

Course Objective: The student will be made to learn

1. Anatomy of Automobile, working of IC Engine, Engine components
2. Fuel supply system, Lubrication and cooling systems
3. The functioning of clutches and Gear box
4. Basic concept of the Transmission system and Brakes
5. Working of steering, suspension and wheels

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Illustrate working concepts of Internal Combustion Engines, combustion process
2. Categorize the basic components of fuel system and electric system in the vehicle.
3. Appraise the Power transmission system in fire fighting vehicle.
4. Design of tyre, brake and Steering system.
5. Summarize Safety and stability of the vehicle

Automobile Engineering Course Content

Unit I **(08 Hrs.)**

Introduction to Automobile, Components, Chassis and Frame: Layout of chassis, conventional frames, frameless constructions, vehicle dimensions Engines: Engine Classification, Terminology, construction, details of Engine Components. Combustion in S.I. Engines, Combustion in C.I. Engines, Four Stroke Petrol Engines & Diesel Engines, Two Stroke Petrol Engines & Diesel Engines.

Unit II **(08 Hrs.)**

Fuel supply systems for petrol engines – concept of carburetion, simple carburetor, Multi point Fuel Injection. Fuel supply systems for diesel engines, fuel feed pump, fuel injection pump, Fuel Injector, Engine cooling and lubrication systems.

Vehicle Electrical system: Ignition Systems: Functions and requirements, Battery Ignition, components, working, Magneto Ignition Battery construction, operation, Alternator, Battery and charging systems, Electrical components (Lighting system on vehicle, siren, PA system, tank/foam level indicator, electrical, light mast, etc.)

Unit III **(08 Hrs.)**

Power transmission System: Clutch: Function, requirements of a clutch system. Types of Clutches. Gear Box: Function & Necessity of transmission, types of transmission system. Power Take Off (PTO), Types of PTO (Engine PTO, Transmission PTO, Side PTO, Splitshaft PTO, Sandwich PTO), Propeller shaft, universal joint, Two-wheel Drive, Four-wheel Drive. Differential – Need and types.

Unit IV **(08 Hrs.)**

Wheels and Tyres: Types of wheels, wheel dimensions, Tyre, Desirable tyre properties

Brakes: Principle, braking requirement, Types, drum and disc brakes comparison, mechanical, hydraulic & pneumatic brakes, Anti Braking System (ABS)

Steering systems: Function and principle, steering geometry, steering gear mechanism, power steering.

Unit V **(08 Hrs.)**

Automotive safety, active and passive safety measures, Stability Calculations – Weight composition, Centre of Gravity, Side Tilt Angle, Turning Speed, Kerb angle, Approach and departure angle, Turning Circle, Climb angle. Driver and Crew Safety, Operation of fire vehicles, Preventive Maintenance- Chassis & Superstructure.

Introduction to Electric and Hybrid Vehicles: Invention of Hybrid Automobile, Key Features of Hybrid Automobile, Early Hybrid Vehicles, Woods Gas-Electric Car, Hybrid Automobiles.

Text Books / Reference Books/ Standards:

1. Automobile Engineering Vol. I & II, Kirpal Singh, Standard Publishers.
2. Automobile Engineering Vol. I, II & III, P. S. Gill, Kataria and Sons
3. Automotive Mechanics, Joseph Heitner, East West Press.
4. Automobile Engineering, R.K.Rajput, Laxmi Publications.
5. Automobile Engineering R.B. Gupta, Satya Prakashan New Delhi
6. Course in Automobile Engineering, Sharma R. P, Dhanpat Rai and Sons.
7. Automobile Engineering, Ramakrishna, PHI Learning Pvt. Ltd.
8. Automobile Mechanics, Crause, W.H., Tata McGraw Hill. 8
9. Automotive Engines, Srinivasan S., Tata McGraw Hill.
10. Motor Vehicle Technology, J.A. Dolan, Heinemann Educational Books.
11. Automobile Engineering, K.K. Jain, R.B. Asthana, Tata McGraw Hill.

Course Code	ESC-FE-302					
Category	Engineering Science Course					
Course Title	Instrumentation and Control					
Scheme and Credit	L	T/A	P	Credits	Semester-V	
	2	1	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Basic Electrical Engineering, Advanced Electrical Systems, Basics of Electronics and Communications					

Course Objective: The objective of this Instrumentation and Control refer to the analysis, measurement, and control of industrial process variables using process control instruments and software tools such as temperature, pressure, flow, and level sensors, analyzers, electrical and mechanical actuators, Human-Machine Interfaces (HMI), Piping and Instrumentation Diagram (P&ID) systems, automated control systems and more.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Elucidate the basic laws governing the operation of electrical measuring instruments and measure electrical quantities like voltage, current and power.
2. Explain the time and frequency measurement techniques for digital meters.
3. Apply principles for measurement in non-electrical quantities and understand the concept of Digital Storage oscilloscopes.
4. Understand the classical control systems in time and frequency domain
5. Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators)

Instrumentation and Control Course Content

Unit I: Electrical Instrumentation **(08 Hrs.)**

Error analysis, Measurement of voltage, current, power, energy and power factor

Unit II: Electronic Instrumentation **(08 Hrs.)**

Digital voltmeters and multimeters, Phase, Time and Frequency measurement; Oscilloscopes.

Unit III: Instrumentation Measurements **(08 Hrs.)**

Instrument transformers, Bridges and Potentiometers.

Unit IV: Control Systems **(08 Hrs.)**

Basics of control systems, transfer function models, feedback control: open-loop and closed-loop systems, benefits of feedback,

Unit V: Design of Controllers **(08 Hrs.)**

Introduction to Proportional controller (P), Integral controller (I), Proportional and Integral controller (PI), Proportional and Derivative Controller (PD), Proportional, Integral and Derivative Controller (PID).

Text Books / Reference Books/ Standards:

1. William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, McGrawHill (2005).
2. T.S.Rathore, Digital measurement Techniques, Narosa Publishing house, 1996.
3. S.K. Singh, Industrial Instrumentation and Control, 3rd edition, McGraw-Hill (2008).

4. Seborg, D.E., Edgar, T.F., Mellichamp, D.A. "Process Dynamics and Control", 2nd edition, John Wiley (2003).
5. Stephanopoulos, G. "Chemical Process Control: An Introduction to Theory and Practice", Pearson Education (1984).
6. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
7. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.
8. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
9. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009
10. R.T. Stefani and G.H. Hostetter, "Design of feedback Control Systems", Saunders College Pub, 1994.
11. J. J. D'Azzo and C. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill, 1995.
12. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 200
13. Thomas G. Beckwith, Roy D. Marangoni, John H. LienhardV , Mechanical Measurements (6^{th} Edition) 6th Edition, Pearson Education India, 2007
14. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York,1999
15. David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press

Course Code	PCC-FE-302					
Category	Program Core Course					
Course Title	**Fire Protection**					
Scheme and Credit	L	T	P	Credits	Semester -V	
	2	1	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Fundamentals of chemistry, Thermodynamics and Structural Fire Protection					

Course Objectives: The objective of this module is to provide the basic knowledge of the fire protection system, industrial fire, fire resistance tests, plant layout, and flammable liquid storage system.

Course Outcome: Upon successful completion of the course, the student will be able to:

1. Analyze the fire detection and alarm system.
2. Describe the Automatic Sprinkler System.
3. Illustrate the Water Spray Protection.
4. Devise the carbon dioxide and clean agent application systems.
5. Analyze the Fire-Fighting Foams.

Fire Protection Course Content

Unit I **(08 Hrs.)**

Fire Alarm System, Automatic Fire Detectors, Notification Appliances, Fire Alarm System Interconnections, Gas and Vapor Detection Systems and Monitors

Unit II **(08 Hrs.)**

Principles of Automatic Sprinkler System Performance, Automatic Sprinklers, Automatic Sprinkler Systems,

Unit III **(08 Hrs.)**

Water Spray Protection, Ultra-High-Speed Water Spray System, Water Mist Fire Suppression Systems, Standpipe and Hose Systems,

Unit IV **(08Hrs.)**

Carbon Dioxide and Application Systems, Chemical Extinguishing Agents and Application Systems, Clean Agents and Systems, Applications of Gaseous Agents to Special Hazards Fire Protection, Explosion Prevention and Protection

Unit V **(08Hrs.)**

Uses and Limitations of Fire-Fighting Foams, Types of Foam, Guidelines for Fire Protection with Foams, Delivering Foam from Fire Vehicles, Combined Agent or Twinned Equipment, Medium and High Expansion Foam Generating Equipment and Systems,

Course Code	HSMC-FE-301					
Category	Humanities and Social Sciences Including Management Courses					
Course Title	**Fundamentals of Management**					
Scheme and Credit	L	T	P	Credits	Semester -V	
	3	-	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	No					

Course Objective:

To familiarize the students with the basic concepts and principles of management, Management Information system

Solve specialized linear programming problems like the transportation and assignment problems

Learn the basic concept of Project and Project management

Understand the functions of materials management

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Demonstrate effective management skill by knowing the various functions of management.
2. Understand clearly about organization structure.
3. Analyze the making skills by the effective resource management techniques
4. Demonstrate the usage of network techniques by using PERT and CPM as per the suitability
5. Apply the management skills of purchasing procedures

Fundamentals of Management Course Content

Unit I **(08 Hrs.)**

Definition of Management, Science or Art, Administration, Managerial skills, Managerial Objectives, Difference between policies, goals and objectives, Evolution and development of Management thought, Levels of management, Functions of Management, Industrial ownership - Sole proprietorship, partnership, joint stock company, co-operative society, public and private sector enterprises.

Unit II **(08 Hrs.)**

Concept of organization, Organization structure, organization chart, Types of Organization, Group dynamics, Organization of Fire Service, Duties of different level of commands. Discipline and leadership in Fire Service.

Management Information system (MIS), Need, objectives and functions of MIS, Difference between data and information, Need for information, Qualities of good information, Information as an Organization resource, Information categories, Application of MIS

Unit III **(08 Hrs.)**

Operation research, Liner programming formulations, Algebraic method, Graphical method, Transportation problem – North west corner method, Minimum cost method, Vogel's Approximation Method and Modified Distribution Method, Assignment problem.

Unit IV **(08 Hrs.)**

Introduction, Network techniques, Terms related to network planning methods, Programme Evaluation and Review Techniques (PERT), Critical Path Method (CPM), smoothing, application of network techniques.

Unit V **(08 Hrs.)**

Materials management, Purchasing, purchasing techniques, Purchasing procedure, store records, physical verification of stores, Inventory, Inventory control, Inventory classification, Inventory management, Economic order Quantity (EOQ), Inventory analysis

Text Books / Reference Books/ Standards:

1. Stephen P. Robbins & Mary Coulter-Management, Prentice Hall (India) Pvt. Ltd
2. Harold Koontz & Heinz Weihrich - Essentials of managemen, Tata McGraw Hill
3. O.P.Khanna- Industrial Engineering and Management, P. Khanna, Dhanpatrai publications Ltd.
4. S.C. Sharma & T.R. Banga - Engineering Management (Industrial Engineering & Management)/, Khanna Book Publishing Co. (P) Ltd., Delhi
5. JAF Stoner, Freeman R.E and Daniel R Gilbert - Management, Pearson Education, 6th Edition
6. P.K.Gupta&D.S.Hira - Operations Research, S.Chand& Company Ltd, New Delhi
7. Kenneth C. Laudon and Jane P. Laudon, ""Management Information Systems", Eighth Edition, Pearson Education
8. K.Shridhara Bhat, "Materials and Logistics Management", Himalaya Publishing House, Mumbai

Course Code	PCC-FE-303					
Category	Program Core Course					
Course Title	**Fire Laws**					
Scheme and Credit	L	T	P	Credits	Semester -V	
	2	-	-	2		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Structural fire protection, Fundamental of fire engineering					

Course Objectives: The objective of this module is to provide the basic knowledge of the law, Fire Safety Legislation & Inspection and Court of Laws.

Course Outcome: Upon successful completion of the course, the student will be able to

1. Identify the list of various standards, codes, byelaws, and bill.
2. Understand the general Principles of Law of Evidence and Criminal Procedure.
3. Understand the Court of Laws and to learn various court procedure.
4. Study the existing Fire Preventive Legislation in Industries.
5. Understand the existing Fire legislation at state level.

Fire Laws Course Content

Unit I **(06 Hrs.)**

Introduction, The Law & Fire Service, Indian Judicial System, The Law Suit Process, General Principles of Law of Evidence and Criminal Procedure, Code and Code Enforcement, Doctrine of Sovereign Immunity. List of various standards, codes, byelaws, bills to be covered.

Unit II **(06 Hrs.)**

The doctrine of Sovereign immunity, Governmental liability in India with reference to the Indian Constitution, General Principles of Law of Evidence and Criminal Procedure (Relevant Provisions only), Code and code enforcement, Standards and the Law.

Unit III **(06 Hrs.)**

Court of Laws Introduction, Procedure in Law Courts, Summoning witnesses, Preparation of cases, Formalities in appearing before the court of Presiding Officer, Methods of giving evidence, Importance of Fire Reports, Perjury, Structures of some related sections of the Indian Penal Code.

UNIT IV **(06 Hrs.)**

Fire Safety Legislation & Inspection: Acts, Rules and Regulations pertaining to existing Fire Preventive Legislation in Industries.

1. Petroleum Act
2. Petroleum Rules
3. Gas Cylinder Rules
4. Explosive Rules
5. Explosive Act

6. Factories Act
7. Static Mobile Pressure Vessel Rules (Unfired)
8. PNGRB Regulations
9. BOCW Act
10. Indian Electricity Act
11. Manufacture Storage & Import of Hazardous Chemical Rules
12. Indian Boiler Act
13. Dock Workers (Safety, Health & Welfare)

Unit V **(06 Hrs.)**

1. Disaster Management Act
2. Model Fire Service Bill
3. Water Pollution Act
4. Environment Protection Act
5. Central Motor Vehicle Rules

Text Books / Reference Books/ Standards:

1. I.P.C. Indian Penal Code, C.P.C., R.P.C.
2. All relevant acts, rules & regulations.

Course Code	PCC-FE-301(P)					
Category	Program Core Course					
Course Title	**Fire Dynamics Laboratory**					
Scheme and Credit	L	T/A	P	Credits	Semester -V	
	-	-	2	1		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Mathematics-I and II, Applied Chemistry, Engineering Thermodynamics, Heat and Mass Transfer.					

Fire Dynamics Laboratory

Laboratory Outcomes:
The fire dynamics laboratory course will consist of experiments illustrating the principles of combustion and flame formation and propagation. The students will learn to:

1. Measure the flash point and fire points of fuels.
2. Understand various characteristics of ignition and fire propagation in combustible solids and liquid fuels.
3. Measurement of various flame characteristics like flame speed, flame height, limiting oxygen concentration and limits of flammability.
4. Analyse the product of combustion.

List of Experiments: Upon successful completion of the course, the student will be able to:

1. Measurement of flashpoint and fire point for pure liquids and liquid blends. Use Pensky-Martens Closed Cup Apparatus (or equivalent) and the Cleveland Open Cup Apparatus.
2. Determination of Heat release rate of various solid and liquid fuels in cone calorimeter.
3. Determination of limiting oxygen index of various solid fuels with help of LOI apparatus.
4. Determination of calorific value of solid fuels with the help of bomb calorimeter.
5. Study of ignition of combustible solids exposed to radiant heat with the help of cone calorimeter. (Measure time to ignition as a function of heat flux: deduce critical heat flux; relationship between t_{ig} and $k\rho c$; observe behaviour of the solid during pre-ignition stage (does it char, melt, bubble, etc.)
6. Study of ignition of combustible liquid fuels exposed to radiant heat with the help of cone calorimeter. (Measure time to ignition as a function of heat flux: deduce critical heat flux; relationship between t_{ig} and $k\rho c$.
7. Measurement of fundamental burning velocity of gas/air mixtures using the cone angle method.
8. Determination of rate of burning and flame height of liquid pools.
9. Smoke and toxic gases measurement from combustible materials with the help of FTIR analysis in cone calorimeter.

Course Code	ESC-FE-301(P)					
Category	Engineering Science Course					
Course Title	Automobile Engineering Laboratory					
Scheme and Credit	L	T/A	P	Credits	Semester -V	
	-	-	2	1		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Applied Physics, Applied Chemistry, Engineering Mechanics, Basics of Mechanical Engineering, Thermodynamics, Basic Electrical Engineering					

Automobile Engineering Laboratory

Laboratory Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the Construction, working and other details about Internal Combustion Engines used in automobiles, cooling and lubrication systems
2. Understand different types of clutches, Gear boxes and Brakes
3. Understand the steering mechanism
4. Understand the working of Ignition systems

List of Experiments:

1. Demonstration of Internal Combustion Engine
2. Demonstration of Carburetor
3. Demonstration of Clutches
4. Demonstration of Gear box
5. Demonstration of Brakes
6. Demonstration of Steering Mechanism
7. Demonstration of engine cooling and Lubrication system
8. Demonstration of Ignition system
9. Performance study of Diesel Engine test rig

Course Code	ESC-FE-302 (P)					
Category	Engineering Science Course					
Course Title	Instrumentation and Control Laboratory					
Scheme and Credit	L	T	P	Credits	Semester - V	
	-	-	2	1		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Basic Electrical Engineering, Advanced Electrical Systems, Basics of Electronics and Communications					

Instrumentation and Control Laboratory

Laboratory Outcomes: Upon successful completion of the course, the student will be able to:

1. Apply the fundamentals of instrumentation in measurements and calibration of electrical instruments.
2. Identify the digital instrument for the measurement of given parameters.
3. Demonstrate the use of oscilloscopes for electrical parameter measurement.
4. Classify the use of recorder and function generator for the specified parameter.

List of Experiments:

1. Demonstrate the AC Servo speed torque characteristics measurement unit
2. Solve the position control system
3. Use the first and second order control system trainer
4. Articulate the potentiometer as error detector
5. Conclude the half wave, full wave and bridge rectifier circuits on AC ripple at different loads
6. Grade the Kelvin's double bridge
7. Demonstrate the Wein's bridge oscillator
8. Solve the Colpitts's oscillator
9. Articulate the thermistor characteristics apparatus
10. Use the temperature measurement and control using RTD sensor
11. Conclude the DC servo motor characteristics and transfer function
12. Use the Hartley oscillator
13. Use the Schering bridge

Course Code	PCC-FE-304(P)					
Category	Program Core Course					
Course Title	Fire Ground Operations -V					
Scheme and Credit	L	T/A	P	Credits	Semester -V	
	-	-	5	2.5		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Fire Ground Operations- I, II, III, IV					

Laboratory Outcomes: Upon successful completion of the course, the student will be able to:

1. Study to minimize the loss of property during firefighting.
2. Analyze the firefighting salvage methods.
3. Understand the pumps in firefighting with the help of various water sources.
4. Understand the collecting of water from various sources and supply to the firefighting site.

List of Experiments:

1. Salvage: Types of salvage: Before, During, After. Types of salvage sheet: Canvas, Synthetic. Salvage drill, Salvage sheet folding, Maintenance of tool and equipment used in salvage.
2. Pumps: Types of pumps: Light pump (900 LPM), Large pump (2300 - 2700 LPM), Heavy pump (3200 - 3600 LPM), Extra heavy pump (4000 - 4500 LPM), Plunger pump, Bucket pump, Force pump, Floating pump, Portable pump (270 – 450 LPM), Trailer pump
3. Pumps: Pump drill: Using Trailer Pump (TP) & Portable Pump: Dividing, Collecting, Use of 5-way valve, With water bowser,
4. Pump: Acceptance and performance test, Pump output test, Vacuum test, Deep lift test, Consumption test, Suction test, Casing test, Electric cable installation and testing.
5. Water relay: Open circuit, Close circuit, Collecting pumping, Dam lorry, Portable dam, collapsible dam, Bulk water carrier (Bowser), Water distribution system, Rural water supply

Text Books/Reference Books/Standards:

1. Fire Service Manual, HM Fire service manual
2. Fire Fighters Handbook, Delmar
3. Manual of foremanship

Course Code	PCC-FE-305					
Category	Program Core Course					
Course Title	**Fixed Fire Fighting Installations**					
Scheme and Credit	L	T/A	P	Credits	Semester -VI	
	2	1	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Fluid Mechanics, Fire Service Hydraulics, Advanced Electrical systems, Instrumentation and Control.					

Course Objective: The student will be able to

1. Learn about the concept and design of Hydrant system installations
2. Learn about the concept and design of Sprinkler system installations
3. Learn about the concept and design of Spray system installations
4. Learn about the Concept and design of mechanical foam installations
5. Learn about the Concept and design of CO_2 and DCP installations

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the working fire alarm and detection system
2. Apply the concepts and working of Hydrant systems
3. Describe the concepts and working of Sprinkler& Spray systems
4. Analyze the concepts and working of Foam Installations system
5. Understand the concepts and working of CO_2 and DCP systems

Fixed Fire Fighting Installation Course Content:

Unit I **(08 Hrs.)**

Design and installation of automatic Detection and Alarm system: Fire Alarm circuit design and control panel. Initiating device circuit's classification, Initiating device circuits classification, Alarm verification features, Signaling line circuits, Fire alarm control panel, Hardwired and multiplex fire alarm systems, Fire alarm system plan, calculating battery capacity.Inspection, Testing and Maintenance of Automatic Sprinkler Systems as per relevant national and international standards

Unit II **(08 Hrs.)**

Design and installation of the Automatic sprinkler system: standard automatic sprinkler system design, sprinkler system component and types, determine system types and configuration, Area protected, Branch line, maximum allowable distance between sprinkler. Hydraulic calculation of sprinkler systems, Sprinkler K- factor calculation. Testing and Maintenance of Automatic Sprinkler Systems as per relevant national and international standards.

Unit III **(08 Hrs.)**

Design and installation of the Water spray system: Types of water spray system, Transformer Hazard, extinguishment and control mechanics, transformer protection design procedure , water spray piping design, Inspection, Design of Water Mist Fire Suppression Systems. Testing and Maintenance of Systems as per relevant national and international standards

Unit IV **(08Hrs.)**

Design and installation of the carbon dioxide system: CO_2 storage, types of the carbon dioxide system, limitation of CO_2 System, Design procure of CO_2 System, total flooding CO_2 system design procedure numerical calculations

Dry chemical and wet chemical extinguish system design: Dry chemical system component, Types and application of dry chemical system. Testing and Maintenance of Systems as per relevant national and international standards,

Unit V **(08Hrs.)**

Design and installation of the low expansion foam system design: Expansion ration, component of the foam, types of foam system, proportioning methods, seal protection of floating roof tank, subsurface injection low expansion foam system calculation. Dike protection low expansion foal system, foam system for aircraft hangar & truck loading rack protection. High expansion foam system design: Application, Design of high expansion foam system, components, determine the foam quantity, discharge rate, number of the generator required numerical.

Test Books/Reference Books/Standards:

1. Fire Service Manual, HM Fire service manual Vol -I
2. The Economics of Fire Protection, G.Ramachandran, E &FN SPON
3. Fire Protection and Prevention the essential handbook , B.M.Sen, UBS Publishers Distributors Pvt Ltd.
4. Fundamental of Fire Safety in the Building Design by Dr, Than singh Sharma.
5. NFPA-13, 20, 22
6. NBC-2016 Part 4

Course Code	PCC-FE-306					
Category	Program Core Course					
Course Title	Paramedics					
Scheme and Credit	L	T/A	P	Credits	Semester -VI	
	2	1	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	----					

Course Objective: To Provide primary medical aid, Paramedics are typically utilized as emergency care practitioners on ambulances or on first response emergency vehicles. Opportunities for more specialized employment of experienced paramedics exist in areas such as cruise ship medical departments, off-shore oil drilling platforms, helicopter or fixed wing medical transport and hyperbaric oxygen chambers.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1) Identify and locate on the body the following topographic terms: medial, lateral, proximal, distal, superior, inferior, anterior, posterior, midline, right and left, mid-clavicular, bilateral, and mid-axillary
2) Define Emergency Medical Services systems.
3) Explain the need to determine scene safety.
4) Demonstrate basic life support skills designed to preserve life.
5) Identify potential scene safety threats, and when necessary, intervene using fundamental crisis intervention techniques.

Paramedics Course Content:

UNIT I **(08 Hrs.)**

Introduction to Emergency Medical Services (EMS) systems, specific statutes and regulations in your state regarding the EMS system, importance of body substance isolation (BSI), Structure and Function of Human Body Basic, Medical & Ethical Issues. Structure and Function of Human Body Basic- Topographic terms: medial, lateral, proximal, distal, superior, inferior, anterior, posterior, midline, right and left, mid-clavicular, bilateral, and mid-axillary, Baseline Vital Signs and SAMPLE History.

UNIT II **(08 Hrs.)**

Basic Life Support- Principles of basic life support, Fundamentals of early defibrillation. Bio Medical Waste Management- disposal of bio-medical waste, colour coding, types of containers, transportation of waste, etc, Airway- adequate breathing and inadequate breathing, Trauma (Bleeding and Shock), Trauma (Soft Tissue Injuries and Burns), Trauma (Musculoskeletal Care), Trauma (Injuries to The Head and Spine), Trauma (Abdominal & Genital injuries).

UNIT III **(08 Hrs.)**

Patient Assessment (Scene Size up), Patient Assessment (Initial Assessment), Patient Assessment (Focused History & physical exam Trauma patients), Patient Assessment (Focused History & physical exam medical patients), Patient Assessment (Detailed Physical Exam), Operations (Ambulance Operations), Operations (Gaining Access), Mass casualty incident.

UNIT IV **(08 Hrs.)**

Medical (Respiratory Emergencies), Medical (Cerebrovascular Emergencies), Medical (Diabetes/ Altered Mental Status), Medical (Allergies), Medical (Environmental Emergencies), Medical (Behavioural Emergencies), Medical (Pediatric Emergencies), Medical (Geriatric Emergencies), Medical (Gynecologic/ Obstetric Emergencies), Medical (Abdominal Emergencies), Medical (Poisoning/Overdose), Oxygen therapy.

UNIT V **(08 Hrs.)**

Lifting and Moving Patients, body mechanics, guidelines and safety precautions that need to be followed when lifting a patient, safe lifting of cots and stretchers, correct and safe carrying procedures on stairs, guidelines for pushing and pulling, Stretcher: Wheeled Ambulance, Portable Ambulance, Scoop, Basket, flexible, etc., Stair chair, long spine board.

Test Books/Reference Books/Standards:

1. Cunningham's Manual of Practical Anatomy
2. Hamilton, Boyal and Messmani: Human Embryology
3. Morri's Human Anatomy
4. Bainddbridge and Mainsions: Principles of Physiology, Essentials of Human Physiology
5. McDowell: Halliburton's Handbook of Physiology and Biochemistry
6. Parson: Biochemistry in Relation to Human Physiology
7. Burns: Introduction to Biphysics
8. Findlay: Physical Chemistry for students of Medicine
9. Boyg: Text book of Pathology
10. Wintrobe: Haematology
11. Ghosh: MateriaMedica
12. Burn: Practical Pharmacelogy

Course Code	PCC-FE-307					
Category	Program Core Course					
Course Title	Fire Modelling					
Scheme and Credit	L	T/A	P	Credits	Semester -VI	
	2	1	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Fluid Mechanics, Physics, Thermodynamics, Basic Electrical Engineering					

Course Objective: The student will be made

1. To learn about the stiffness method and derive the spring element question
2. To learn about the plane stress and strain matrix equation
3. To learn about the using heat and Mass transfer concepts in fire modelling
4. To study different types fire scenarios and models
5. To learn about the evacuation models and human behavior in fire

Course Outcome: Upon successful completion of the course, the student will be able to:

1. Apply the Fire Modelling methods and different types of software to be used
2. Illustrate the plane stress-strain theory
3. Devise the Heat and mass transport using the finite element method
4. Develop the different types of fire situations and modelling
5. Design the Principles and practice of evacuation modeling

Fire Modelling Course Content

UNIT I **(08 Hrs.)**

Introduction, definition of the stiffness matrix, derivation of the stiffness matrix for a spring element, spring assemblage, assembling the total stiffness matrix by superposition (direct stiffness method), boundary conditions, potential energy approach to derive spring element equations.

UNIT II **(08 Hrs.)**

Introduction, basic concepts of plane stress and plane strain, derivation of the constant-strain triangular element stiffness matrix and equations, derivation of the Linear-Strain Triangular Element Stiffness, Matrix and Equations, finite element solution of a plane stress problem, Practical Considerations in Modeling.

UNIT III **(08 Hrs.)**

Introduction, derivation of the basic differential equation, heat transfer with convection one-dimensional heat transfer with mass transport, finite element formulation of heat transfer with mass transport by Galerkin's method; Thermal Stress- Formulation of the Thermal Stress Problem and Examples

UNIT IV **(08 Hrs.)**

Approaches to fire modeling, open and compartment fire behaviour, zone models, field models, detector models, egress model, concept of design fire, heat release rate of a fire, height and size of a flame, flow of hot gases in a room, temperatures in the hot gas layer and in the room. Simulation of Burner Fire, Air Movement, Smoke layer height and heat flow through a door, Room fire using software.

UNIT V **(08 Hrs.)**

Principles and practice of evacuation modeling (PPEM), building evacuation models, theory of occupant behavior during building fires, RSET-models that are commonly used in guidelines and regulations, describe different theories of human behaviour in fire (e.g. role-rule model, affiliation, social influence, affordances, help in emergencies, panic, etc.), basic assumptions behind evacuation models (space representation, modeling methods, uncertainties, verification and validation) and understand their main strengths and limitations, use of evacuation models for the simulation of evacuation scenarios.

Test Books/Reference Books/Standards:

1. A first course in the finite element method by Logan, D. L., Cengage Learning.
2. The finite element method: its basis and fundamentals. Elsevier.
3. Finite element procedures. Klaus-Jurgen Bathe.
4. Fundamentals of heat and mass transfer. John Wiley & Sons.
5. Heat and mass transfer by Karwa, R, Springer Nature.
6. Introduction to mathematical fire modeling. CRC Press.
7. Computational fluid dynamics in fire engineering: theory, modelling and practice. Butterworth-Heinemann.
8. Tunnel fire dynamics. Springer.
9. SFPE handbook of fire protection engineering. Springer.
10. SFPE Guide to Human Behavior in Fire, Springer.
11. Fire Dynamics Simulator Technical Reference Guide

Course Code	PCC-FE-308						
Category	Program Core Course						
Course Title	Fundamentals of Industrial Safety and Health						
Scheme and Credit	L	T/A	P	Credits	Semester -VI		
	2	1	-	3			
Examination Scheme	Theory				Practical		
	Int	Uni	Total		Int	Uni	Total
	30	70	100		-	-	-
Pre-requisites (if any):	Fundamentals of Fire Engineering						

Course Objective: The objective of this module is to understand the need & importance of safety in Industries, different types of accidents and their preventions.

Course Outcome- Upon successful completion of the course, the student will be able to:

1. Develop management skills and understand basic functioning of Safety, Health & Environment Management.
2. Acquire the Knowledge, Skill and Mechanism of functioning of machines, tools and safe use of the same,
3. Apply the concept of prevention and control of fire, explosion, and unintended release of flammable / toxic gases and imminent harm to health, community, property and environment.
4. Acquire the knowledge of effective management of Environmental practices system to protect the Environment.
5. Recite the skills and techniques for preventing accidents and minimizing losses and Acquire knowledge of interaction of man and machine to maintain Hygiene and Health while working to prevent exposure to dangers.

Fundamentals of Industrial Safety and Health Course Content:

Unit I **(08 Hrs.)**

Industrial Safety Management: Introduction, Role of Management in Industrial Safety, Organising for safety, Directing Safety, Communication, National Policy on SHE at Workplace, Safety- Education and Training, Employee Participation in Safety, Behaviour Based Safety (BBS), Conflict & Frustration, Management Information System (MIS), Accident Prevention.

Unit II **(08 Hrs.)**

Safety in Engineering Industries:
Machine Operation and Guarding, Safety in the use of Machines, Safety in the use of Machines, Hand Tools and Power Tools, Hazards at Workplace, Material Handling and Storage: Manual and Mechanical, Plant Layout Design and Housekeeping, Boiler Operations, Thermal Fluid Heaters Operations, Electrical Hazards at Workplace, Static Electricity, Lightning arrestors, Introduction to safety aspects in Engineering Industries, Hazards at workplace, Safety in Textile industry, Agro-Industry/ Sugar Industry, Docks Operations, Destructive Testing, Non Destructive Testing and Heat Treatment, Safety in IT and Electronic Industry and Service Sector.

Unit III **(08 Hrs.)**

Construction Safety:
Safety in Construction Industry, Types of Construction Activity, General Safety Measures, Special works, Project management in constructions safety, Special precautions for works of engineering construction, Safety in Demolition Operations

Chemical and Process Safety Management:
Process Safety Management (PSM), Enhancing safety in chemical industries, Unit operations and process hazards, safe handling of chemicals, Safety in plant operation and maintenance, pressure vessels, pressure system hazards and controls, corrosion causes and protection.

Unit IV **(08 Hrs.)**

Environment Management:
Environment Management System, Concept of Common Effluent Treatment Plant (CETP), Environmental Important Regulations, Environmental Monitoring, Waste Management, Global Warming, Energy Conservation, Sustainability Reporting.

Unit V **(08 Hrs.)**

Quality Control in Occupational Safety & Health:
Safety appraisal & control techniques, Permit to Work systems, Accident/ Incident/ Near-miss/ Dangerous occurrence reporting, investigations, Major Accident Hazards (MAH) Control System, Emergency Preparedness and Response Plans

Industrial Hygiene and Occupational Health:
Ventilation and Heat Stress, Industrial Lighting & Illumination, Noise and Vibration, Industrial Hygiene, Personal Protective Equipment, Occupational Health, Occupational Health Hazards & Occupational Diseases, Introduction to Ergonomics, Physiology at Work.

Test Books/Reference Books/Standards:

1. Industrial Safety 3rd edition Roland Patton Blake Prentice-Hall, 1963
2. Industrial Safety 1977 Jack W. Boley Gulf Publishing Company, Book Division
3. Petroleum acts
4. MSIHC
5. Factory Acts
6. State Factory Rules
7. Gas Cylinder rules

Course Code	PCC-FE-309					
Category	Program Core Course					
Course Title	Fire Codes & Standards					
Scheme and Credit	L	T	P	Credits	Semester -VI	
	3	-	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Fire Laws, Fire Ground Operations, Fire Protection and Structural Fire Protection					

Course Objectives: The objective of this module is to understand the Fire Codes and their standard basic needs and importance. Study different types of code for the fire equipments, building industries, and safety equipment.

Course Outcome: Upon successful completion of the course, the student will be able to:

1. Identify the various codes and standards for operational firefighting equipment & system.
2. Illustrate about the personal protective equipment and describe the need and process of implementation.
3. Analyze the various codes & standard for the fire fighting appliances.
4. Interpret the various codes & standard for the industrial fire protection.
5. Apply the various codes & standard for the municipality & state life safety.

Fire Codes & Standards Course Content

Unit I Fire Fighting Equipment & Systems **(08 Hrs.)**

Indian/International Specifications and Technical parameters of Fire Equipments like Fire Extinguishers, Fire Pumps, Hose & Hose Fittings, Hose Reel, Hydrants, Monitors, Small & Special Gears, Fire Detection & Alarm System, Ladders, Automatic Sprinkler System, Water Mist System, Gas Suppression System, Foam and Foam Making Equipment's etc.

Unit II Personal Protective Equipment **(08 Hrs.)**

Code, Standard and specification concerning to safety of firefighting personnel like Helmet, Safety Belts, Eye Protectors, Ear Protectors, Gloves, Safety Shoes, Breathing Apparatus, Fire Suits, Safety gears and other devices.

Unit III Firefighting Appliances **(08 Hrs.)**

Indian/ International Code & Standard for various Fire Fighting Appliances like Water Tenders (Type A, B & X), Crash Fire Tender (CFT), Emergency Rescue Tender (ERT), Dry Chemical Powder Tender (DCP) , Small Foam Tender, Hose Laying Lorry, Towing Tender, Hydraulic Platform, Turn Table Ladder (TTL), HAZMAT and Control Van for fire brigade etc.

Unit IV Industrial Fire Protection Codes & Standard **(08 Hrs.)**

Code, Standard and byelaws concerning Industrial life safety & fire protection measures like Petrochemical, Construction, Fertilizer, Steel, Mines, Ports, Airport etc.

Unit V Municipal & State Life Safety Codes and Standard **(08 Hrs.)**

Code, Standard and byelaws concerning Municipal and State life safety & fire protection measures.

Test Books/Reference Books/Standards

1. NBC, B.I.S, DIN, EU, B.S., UL, FM Code & Standards, EN. Standards C.E.
2. DGMS, Director General of mines. Safety and mines regulations.
3. All relevant standards specification, codes and practice National & International Stand

Course Code	PCC-FE-310					
Category	Program Core Course					
Course Title	Fire and Life Safety Audit					
Scheme and Credit	L	T	P	Credits	Semester -VI	
	2	-	-	2		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Fundaments of Fire Engineering, Fire Laws					

Course Objective:

1. To understand the fire and life safety challenges in buildings and industries and approaches to addressing the same.
2. To become aware of important past incidents causing major loss of lives & properties and damage to environment, and their impact with respect to the legislations and environment.
3. To become familiar with current fire & safety engineering and management concepts and practices followed.
4. To understand the concept involved in standards to determine fire load.
5. To learn about all applicable legislations in fire and life safety.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Illustrate the approaches for addressing fire and safety challenges.
2. Describe about the concept involved in standards to determine fire load.
3. Analyze the knowledge on process of fire & Life Safety audit.
4. Apply the knowledge on methodology of conducting Fire & Life Safety Audit.
5. Create the fire & life safety audit check list.

Fire & Life Safety Course Content:

Unit I **(06 Hrs.)**

Challenges to safety in built environment, types of hazards likely to cause harm (fire, burns, electric shock, falls), natural disasters, fatalities involving hazardous environments. Important Case studies involving major incidents and their subsequent effect on safety outlook, Approach to addressing Fire & safety challenges, concept of industrial fire & life safety - need, nature and importance. Focus on Human resource, and concept of importance of 'man' as central theme in safety. Fundamentals of structurally safe building design, codes and standards for the built environment, systems approach to fire safe building design, Prescriptive and performance-based building designs.

Unit II **(06 Hrs.)**

Standard for determination of fire load for use in structural fire protection design - fire load density – distributed fire loads – localized fire loads. Determination of calorific value by Bomb calorimeter, Calorific values of common materials - solid fuels, hydrocarbons, polymers, common solids, foodstuffs, properties, higher & lower calorific values, Comparison of calorific values of various solid, liquid and gaseous fuels.

Unit III **(06 Hrs.)**

Classification of building based on occupancy, Classification of industrial & non industrial occupancies into different degree of hazards, General requirements of all individual occupancies, Life safety – general exit requirements, occupant loads, capacities of exists – horizontal exit allowance, arrangement of exit, number of exits, doorways, corridors and passageways, internal staircase, protected escape routes, external stairs, horizontal exits, fire tower, fire lifts, emergency and escape lighting, fire detection and warning.

Unit IV **(06 Hrs.)**

Need of audit, types of inspection, standard activities for audit, procedures – pre-audit preparation & meeting – opening meeting, verification of information – cross verification at site, writing audit report–report content – submission of report – advantages, specific limitations, closing meeting, Components of fire & life safety audit, audit model, audit process, organizational strength and recommendations for improvement, audit report and action planning, Standardization & quality assurance.

Unit V **(06 Hrs.)**

IS 14489:2018 - OVERSEAS INDUSTRIAL TECHNICAL, ISO 9001, ISO 140001 and ISO 450001, OISD 145, Checklist for Audit and Inspection

Test Books/Reference Books/Standards

1. Cote, Arthur, Section 1, Fire protection Handbook, 20th Edition, NFPA
2. Dr. Than Singh Sharma, Fundamentals in building design.
3. National Building code of India 2016, Part-4, BIS
4. "Industrial Fire Protection Handbook", R.Craig Schrool – 2002.
5. NFPA 557 Standard for Determination of Fire Load for Use in Structural Fire Protection Design
6. "Fire safety management", 3rd edition – Danial E.Della Giustina – 2014.
7. "A hand book of fire technology", R. S. Gupta – 2010
8. Chales D. Reese (2017) Occupational Health and Safety management.
9. L M Deshmukh (2007) 'Industrial Safety management'.

Course Code	PCC-FE-305 (P)					
Category	Program Core Course					
Course Title	Fixed Fire Fighting Installations Laboratory					
Scheme and Credit	L	T/A	P	Credits	Semester -VI	
	-	-	2	1		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Fluid Mechanics, Fire Service Hydraulics, Advanced Electrical systems, Instrumentation and Control					

Laboratory Outcomes: Upon successful completion of the course, the student will be able to:

1. Study about the working of fire alarm and detection system
2. Study about the concepts and working of Hydrant systems
3. Study about the concepts and working of Sprinkler& Spray systems
4. Study about the concepts and working of Foam Installations system
5. Study about the concepts and working of CO_2 and DCP systems

List of Experiments:

1. Study of Fire Detection & Alarm system
2. Study of the pump house
3. Study of performance test – hydrant and sprinkler pumps
4. Study of performance test – Diesel engine pump
5. Study of Hydrant system
6. Study of Risers
7. Study of Deluge valve system
8. Study of discharge density measuring system
9. Study of water mist system
10. Study of CO_2 flooding system

Course Code	PCC-FE-306 (P)					
Category	Program Core Course					
Course Title	Paramedics Laboratory					
Scheme and Credit	L	T/A	P	Credits	Semester -VI	
	-	-	2	1		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Fluid Mechanics, Fire Service Hydraulics, Advanced Electrical systems, Instrumentation and Control					

Laboratory Outcomes: Upon successful completion of the course, the student will be able to:

1. Describe the importance of high-quality CPR and its impact on survival
2. Describe all of the steps of the Chains of Survival and apply the BLS concepts of the Chains of Survival
3. Recognize the signs of someone needing CPR
4. Perform high-quality CPR for adults, children, and infants
5. Describe the importance of early use of an AED and demonstrate its use

List of Experiments:

1. Perform adult BLS – Chest Compression – Mouth to Mouth ventilation – Mouth to Mask ventilation
2. Demonstrate the control of Bleeding and Shock
3. Perform Patient assessment at the site
4. Perform the pre-hospital treatment of Soft Tissue Injury and Burns
5. Perform the pre-hospital treatment of Musculo skeletal injuries
6. Perform the pre-hospital treatment of Injuries to head and spine Description
7. Perform the pre-hospital treatment of Obstetrics/Gynecology emergencies
8. Perform the pre-hospital treatment of Infants, Neonates and Children
9. Demonstrate the application of skills in Mass Casualty Incident
10. Demonstrate the pre-hospital treatment of Cardiovascular Emergency
11. Demonstrate the application of Automated External Defibrillators (AED)
12. Demonstrate the application of oxygen therapy
13. Demonstrate the application of different bandages and slings
14. Demonstrate the application of different splints and cervical colors
15. Demonstrate the stretcher and ambulance drills

Course Code	PCC-FE-307(P)					
Category	Program Core Course					
Course Title	Fire Modelling Laboratory					
Scheme and Credit	L	T	P	Credits	Semester -VI	
	-	-	2	1		
Examination Scheme	Theory			Laboratory		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Fluid Mechanics, Physics, Thermodynamics, Basic Electrical Engineering					

Laboratory Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the using different types of software to solve the problem.
2. Understand the MATLAB and Python language
3. Understand the CPM and PERT methods
4. Solving the problem in ABAQUS
5. Using the Pyro SIM Sofware for Simulation

List of experiments:

1. Linear programming problem to be solved by using Excel solver, Matlab/Python and must be verified by manual calculations.
2. Transportation problem to be solved by using Excel solver, Matlab/Python and must be verified by manual calculations.
3. Assignment problem to be solved by using Excel solver, Matlab/Python and must be verified by manual calculations.
4. Development of CPM and PERT chart using Microsoft Project.
5. Analysis of a truss using ABAQUS and verification by hand calculation.
6. Analysis of a portal frame using ABAQUS and verification by hand calculation.
7. Analysis of 2D FEM problem using ABAQUS and verification by hand calculation.
8. Modeling heat conduction problem in PyroSIM.
9. Simulation of Burner Fire using PyroSIM.
10. Modeling Smoke Movement in Atrium of Building in PyroSIM.
11. Evacuation modelling of High Rise Building using PathFinder.
12. Evacuation modelling of Subway Station using PathFinder.

Course Code	PCC-FE-311					
Category	Program Core Course					
Course Title	Fire Ground Operations VI					
Scheme and Credit	L	T	P	Credits	Semester -VI	
	-	-	5	2.5		
Examination Scheme	Theory			Laboratory		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Fire Ground Operations I, II, III, IV and V					

Laboratory Outcomes: Upon successful completion of the course, the student will be able to:

1. Identify and use the Foam & Foam making Equipment
2. Explain the types of Water Tender & drill
3. Demonstrate the Special appliance working procedure on ground
4. Demonstrate the types B. A. set and its use in fire fighting

List of Experiments:

1. Foam & Foam making Equipment: Part identification and specification: FB-2, FB-10,FB-5X,FB-10X,MFG-5A,MFG-10A,Inline inductor, High expansion electric foam generator, Turbine. Care and maintenance, Foam fixed installation
2. Foam & Foam making Equipment: Foam drill: FB-2 (Knap sack tank), FB-10 (Inline inductor),MFG and other latest technology (High expansion foam generator), Fixed foam installation.
3. Water Tender: Water tender drill with hose real, hose ladder, 4 men, 5 men and 6 men drill hydrant and open source. Rescue with appliance drill, Foam tender drill
4. Special appliance: Combined tender, A, B, X water tender (Different capacity), Crash tender, Panther, DCP tender, Foam tender, Hose laying lorry, Hazmat van, TTL, Snorkel, Hydraulic platform, Mobile communication van, Mobile canteen, Mobile break down, BA van, Ambulance, Crane
5. B.A set: Types of BA set: Cannister, Open circuit, Closed circuit, Trolley mounted, BA van. Types of cylinder, Types of back plate, Face mask, Accessory, DSU, tally board, air line, guide line, baco jacket, short line, personnel line, head torch.
6. B.A set: BA set refilling, Installation, Donning Procedure, BA drill, BA Testing

Test Books/Reference Books/Standards

1. Fire Service Manual, HM Fire service manual
2. Fire Fighters Handbook, Delmar
3. Manual of firemanship

Course Code	PCC-FE-401					
Category	Program Core Course					
Course Title	Fire and Arson Investigation					
Scheme and Credit	L	T/A	P	Credits	Semester-VII	
	2	1	-	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Applied Physics; Applied Chemistry; Basics of Civil & Mechanical Engineering; Basics of Electrical Engineering; Fundamentals of Fire Engineering.					

Course Objective: The objective of this module is to describe the role of fire investigators in their determination of the origin, cause, and development of a fire or explosion and discuss the levels of confidence as they apply to expert opinions in fire and explosion investigations.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Apply the basic concepts of arson and describe the typical findings
2. Analyze the most common fire investigation procedure
3. Elucidate the ignition sources for fire investigation
4. Articulate the most common causes of electrical and mechanical fires
5. Develop the case studies of the structural and wild land fires

Fire and Arson Investigation Course Content

Unit I: **(08 Hrs.)**

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, Mythology of arson investigations: development and promulgation of myths, alligatoring, crazed glass, depth & location of char, lines of demarcation, sagged furniture springs, spalling, fire load, low burning and holes in the floor, the angle of V, time and temperature.

Unit II: **(08 Hrs.)**

Fire pattern development: Flammability, Compartment fire, plume pattern development, ventilation-generated pattern, penetration through floors, Types of patterns.

Fire investigation Procedure: Null hypothesis, Negative corpus methodology, Planning the investigation, Initial survey, Documentation, Reconstruction, Inventory, avoiding spoliation, origin determination, Evidence collection and preservation, Fatal fire, Hypothesis development and testing, Reporting Procedure, Record keeping.

Unit III: **(08 Hrs.)**

Analysis of Ignitable Liquid Residues: Evolution of separation techniques, analytical techniques, standard methods. Isolation the residue. Analyzing the isolated ignitable liquid residue: Identification of the gasoline, distillates and other class of the product. Evaluation of Ignition sources.

Unit IV: **(08 Hrs.)**

Basic electricity fires, causes of electrical fires, protection devices, Overcurrent and short circuit, ignition sources by electrical means, electrical service distribution, electrical fire investigations on various electrical appliances, laboratory investigations on electrical fires.

Fuel tanks, connections, injection systems, vehicle fuels, typical operating pressures of vehicle fuels, engine fuel system fires, considerations for fire investigations on automobiles, vehicle arson, protocol for fire vehicle examination, exterior examination.

Unit V: **(08 Hrs.)**

Structure fire & their investigation: elements of building construction, general principals of fire behavior, investigative information during suppression, examination of structure fire scene, documenting the fire scene. Sources of Error in fire investigation.

Case Studies: Electric Fire, Chemical Fire, Gas, Structure & wild land fires, Heater Fire. Industrial Fire, Automobile Fire, Lighting Fire, Fluorescent light fire, Dryer Fire. Report writing.

Text Books/Reference Books/Standards:

1. NFPA 921: Guidelines for fire and explosion investigation (Quincy, MA: National Fire Protection Association, 2008) pt. 3.5.59, 2011, pt. 3.3.6.2
2. NFPA 1033: Standard for Professional Qualifications for Fire Investigator, (Quincy, MA: National Fire Protection Association, 2009)
3. Fire and Arson Investigation Paperback – Import, 1 November 2006 by Russell Chandler
4. Practical Fire and Arson Investigation (Practical Aspects of Criminal and Forensic Investigations) 2nd Edition by David R. Redsicker, John J. O'Connor
5. Kirk's Fire Investigation by Jhon D. DeHaan
6. Arson Investigation by Thomas J. Bouquard

Course Code	PCC-FE-402						
Category	Program Core Course						
Course Title	Fire Risk Assessment						
Scheme and Credit	L	T/A	P	Credits	Semester -VII		
	3	-	-	3			
Examination Scheme	Theory				Practical		
	Int	Uni	Total		Int	Uni	Total
	30	70	100		-	-	-
Pre-requisites (if any):	Fire Protection; Fire and life safety audit; Fundamentals of industrial safety and Health.						

Course Objectives: To learn the various techniques for hazard identification, reliability analysis, estimation of frequency of occurrence of hazards, consequence analysis, risk quantification and human reliability analysis.

Course Outcomes: Upon completion of this course the student would be able to:

1. Infer the basic concept of risk and its management.
2. Apply Boolean algebra and cut sets in different risk assessment methods.
3. Interpret the HAZOP study for a process industry or it's distinguished part.
4. Analyze accident and incident data for risk assessment procedure in an organization.
5. Apply the probability of occurrence of an event using fault tree and event tree analysis

Fire Risk Assessment Course Content

Unit I **(08 Hrs.)**

Basic risk concepts, General Principles of fire risk assessment, Formal Definition of Risk, terminologies, Risk Assessment and Management, Causal Scenario, Risk-Aversion Mechanisms, Accident-Causing Mechanisms, safety quantification, safety by design, System Safety, Hazards, Mishap, and Risk. Fire Risk Scenarios, Fire Protection Measures as Fire Barriers, Qualitative and semi- quantitative risk assessment techniques, Hazardous area classification study.

Unit II **(08 Hrs.)**

Measurement and evaluation of Safety performance: Indian standard IS-3786 and its salient features, definition of terminology used-Accident, incident, near miss incident, dangerous occurrence, disabling (lost-time), injury, non-disabling injury, reportable lost-time injury, non-reportable lost-time injury, days of disablement (lost time).

Safety Performance Indicators: Frequency rate, weighted frequency rate, severity rate, incidence rate, frequency-severity index, safe-T-score, fatal accidents frequency rate. Classification of industrial accidents and special cases according to IS-3786.

Unit III **(08 Hrs.)**

Study of IS 15656 (2006): Hazard identification and risk analysis. Risk Assessment: Introduction, Basic quantitative risk assessment (QRA), Principles of QRA, Probability theory, set theory and Boolean algebra, Use of Boolean algebra and cut sets, Combination of frequencies, Logic tree approach, Fault Tree Analysis (FTA), Principles and Symbol and Procedure of FTA, bow tie, Event Tree Analysis (ETA), Quantification of event tree, Qualitative risk assessment, Criteria of risk acceptance, Types of consequences. consequence analysis methodologies and source models.

Unit IV **(08 Hrs.)**

Introduction to HAZOP, conducting a HAZOP study, Computerized reporting system, HAZOP of batch process, Extension of HAZOP, Application of HAZOP to human reliability, Failure mode and effect analysis (FMEA), Methodology of FMEA, critically analysis, Corrective action and preventive action and follow up. stages of process plant and risk analysis

Unit: V **(08 Hrs.)**

Quantification of risk: Vulnerability analysis, accepted and imposed risk, perception of risk, risk indices, individual risk and societal risk, acceptance criteria for risk, as low as reasonably practicable (ALARP), Presentation of measures of risk-risk contour, F-N curve. Calculation of 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).

Text Books/Reference Books/Standards:

1. Hazard Analysis Techniques for System, Clifton A. Ericson, A John Wiley & Sons, Inc., Publication
2. An Introduction to Reliability and Maintainability Engineering, Charles E. Ebeling, McGraw Hill.
3. Probabilistic Risk Assessment and Management for Engineers and Scientists (Second Edition), Hiromitsu Kumamoto, E. J. Henley-IEEE Press (1996)
4. Quantitative Risk Assessment in Fire Safety, Ganapathy Ramachandran and David Charters, Spon Press

Course Code	PCC-FE-403					
Category	Program Core Course					
Course Title	Special Hazards					
Scheme and Credit	L	T/A	P	Credits	Semester - VII	
	3	0	0	3		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Fire Protection, Fire Dynamics, Heat & Mass Transfer.					

Course Objectives: The aim of this course is to understand, analyze, and mitigate special hazards in aircrafts, helicopters, ships, trains, nuclear reactors and natural disasters.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Identify specific hazards on passenger / cargo aircraft, helicopters, ships and trains.
2. Assess specific hazards on passenger / cargo aircraft, helicopters, ships and trains.
3. Classify specific hazards at airports, helipads, shipyards and railway stations.
4. Analyze specific hazards at airports, helipads, shipyards and railway stations.
5. Evaluate specific hazards in nuclear reactors and natural disasters.

Special Hazards Course Content

Unit I **(08 Hrs.)**

Structural features of aircraft and helicopters: basic fire hazards, air crash nature, emergency landings including belly leading etc., firefighters' access and prevention of trapped person problems, types of safety belts, ejection-seats, etc. & their release methods, emergency response strategies, aircraft & helicopter carrying ammunition, bombs, nuclear weapons, etc. rescue and firefighting issues. Hazards in airport: Protection of hanger, refueling &unloading in air cargo, provision of crash fire tenders including rapid intervening appliances, categorizations of airports, their extinguishing media, determination of the appliances for each category as per international standard. Case Studies.

Unit II **(08 Hrs.)**

Hazards in shipyard & port: Constructional features of passenger and cargo ship, shipyard & port hazards and fire protection measures, preventive measures and strategic management. Fire protection facilities for ports handling hydrocarbons (OISD-STD-156). Case Studies.
Hazards in trains: Structural features of passenger, goods train, yard, tunnels and railway station, accidents, preventive measures and strategic management. Case Studies.

Unit III **(08 Hrs.)**

Storage Standards, Occupancy Characteristics, Hazards Associated with Occupancy, Operational Hazards and Fire Prevention Practices, Life Safety Considerations, Building Construction, Affecting Hazardous Conditions, Automatic Sprinkler Protection, Supplemental Fire Protection, Special Storage Facilities, Warehouse Fire-Fighting, Operations and Pre-Incident Planning Outdoor Storage.

Unit IV **(08 Hrs.)**

Hazards in nuclear reactors: A study on layout & planning, accidents, mitigation measures and strategic management of a nuclear center. Natural disasters: Types of natural disasters, disasters, prevention measures and strategic management. Case Studies.

Unit V **(08 Hrs.)**

Transportation fire safety: passenger vehicle fires, fire safety and commercial vehicle, MSDS, HAZCHEM code, Placard, TREM card, IS-13694 Fire safety in Iron and Steel Industries. IS-15394 fire safety in Petroleum refineries and fertilizers plants. Hazards in Pharmaceutical industries, Coal based industries, thermal power plants (IS 3034:1983), rocket propellant. Case Studies.

Text Books/Reference Books/Standards:

1. SEPE Handbook of Fire Protection Engineering, 5th Edition, Morgan J. Hurley.
2. Fire Protection Detection, Notification, and Suppression, 2nd Edition, Robert C. Till and J. Walter Coon.
3. OISD-STD-156
4. IS:13694
5. IS:15394

Course Code	PEC-FE-401- Nuclear Reactors and Safety					
Category	Program Elective Course					
Course Title	Nuclear Reactors and Safety					
Scheme and Credits	L	T/A	P	Credits	Semester -VII	
	2	-	-	2		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Fire Protection; Fixed Fire Installations; Fire Codes and Standards.					

Course Objectives: -The course will provide you with an overview of nuclear reactor plant safety design topics, including basic concepts relating to regulatory requirements, reactor plant safety analysis, reactor protection systems, plant procedural structure, and emergency planning.

Course Outcomes: - Upon successful completion of the course, the student will be able to:

1. Students will be able to recognize and recall the basics of nuclear reactor terminology, definitions, and concepts associated with reactor physics and theory and technology of nuclear power plant.
2. Describe concepts relating to nuclear plant protection systems.
3. Illustrate the history of events in nuclear reactor and facilities
4. Describe reactor plant emergency procedure concepts.
5. Nuclear safety regulation in India.

Nuclear Reactors and Safety Course Content

UNIT I **(06 Hrs)**

Energy sources, Nuclear Power, Production, medical and Societal, applications of radiation, nuclear fuel cycle, Basic Physics of Nuclear Reactors: Atomic Structure, isotopes, Radioactivity, half-life, Basics of fission reaction, Moderation, Criticality, Decay heat, Reactivity and Feedback, Breeding. Nuclear Reactor Types, Components of Nuclear Reactor, Present Reactor Types, Generation IV Concepts, Radiation sources and Protection, Radiation and its units, Natural, background and man-made Radiation, Biological Effects, Exposure limits and protection, Sources of radiation, shielding.

UNIT II **(06 Hrs)**

Safety Principles, Safety objectives, Defence in depth philosophy, Multiple barriers, Radwaste management, Levels of defence, Redundancy, Diversity Principles, Event analysis, core inventory, emergency response, Safety Approach, Deterministic approach- Design Basis, Events & Beyond Design Basis, Events, Acceptance Criteria, Probabilistic approach- Fault tree, event tree, failure rates.

UNIT III **(06 Hrs)**

History of Events in Nuclear reactors and facilities, INES Scale, TMI, Chernobyl, Fukushima, Windscale, Thorp Reprocessing, Kshtym, Vandellos, Tokaimura, NRX, David Besse, Enrico Fermi, Narora Fire, Monju and FBTR Sodium Leak, Radiation over exposures in Industry and Medical applications. Analysis of Some Events in NPP, Heat transfer and Fluid flow prediction, validation, Safety set points, Safety actions for events, Spurious opening of Pressurizer valve, in a PWR, LOCA analysis Indian, PHWR, Station Blackout without Reactor Trip, FBTR

UNIT IV **(06 Hrs)**

Quality Assurance, Quality Assurance Plan, materials, Design, Fabrication, Maintenance, Surveillance, In Service Inspection, Training & Qualification, Quality Audit, Siting of Nuclear plants, Site evaluation Stages, Site Rejection Criteria, Earthquake, Geological criteria, Meteorological considerations, Flooding, Tsunami, Shoreline erosion, chemical explosion, Radiological, impact study, Radioactivity path ways to humans, environmental Impact study.

UNIT V **(06 Hrs)**

Safety Regulation In India, Atomic Energy Regulatory Board, functions, safety Documents, Safety Review of site, design, regulatory inspections, safety review for PFBR, Koodankulam, Regulatory review of operating plants, Licensing stages, licensing of operating personnel, Training simulator, safety up-gradation Review after TMI Chernobyl, Review after Fukushima, safety review for decommissioning, Safety Review of Radiation Facilities, medical X-ray units, Gamma irradiators Safety Practices in India.

Text Books/Reference Books/Standards:

1. Vaidyanathan. G., Nuclear Reactor Engineering (Principles and Concepts), S. Chand & Company, New Delhi, 2013.
2. Jacques LIBMANN, Elements of Nuclear Safety, Les Editions de Physique 1996.
3. Nuclear Power Reactor Safety. By E.E. Lewis. John Wiley and Sons, Inc., New York (1977). 630 pp
4. Gianni Pietrangelo, Nuclear Safety, Butterworth Heinemann, 2006,488 pp.
5. NPTELWEB COURSE on Nuclear Reactor Technology, K.S. Rajan, 2013

Course Code	PEC-FE-402					
Category	Program Elective Course					
Course Title	Chemical Process Safety					
Scheme and Credit	L	T/A	P	Credits	Semester - VII	
	2	0	0	2		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Applied Chemistry; Fire Protection					

Course Objectives: The aim of this course is to understand, analyze, and mitigate special hazards in the chemical process plants.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Analyze the effects of release of toxic substances
2. Assess the industrial hygiene characteristics
3. Identify the methods of prevention of fires and explosions.
4. Understand the methods of hazard identification and preventive measures.
5. Assess the risks using fault tree diagram.

Chemical Process Safety Course Content

Unit I **(06 Hrs.)**

Safety and accident loss statistics, risk management and hazardous substance rules
Toxicology: Introduction, routes and exposure, elimination, responses, treatment, dose response relationship, dose response and threshold, predictive models and extrapolation.

Unit II **(06 Hrs.)**

Industrial hygiene: Regulations, identification, and evaluation, noise vibration and radiation, industrial hygiene control. Introduction to source model, source model for gas, source models for pool boiling.

Unit III **(06 Hrs.)**

Fire and explosions: Introduction, flammability characteristics, explosion and its classification, fire extinguishers. Designs to prevent fire and explosions: Static electricity, general design methods to prevent fire, sprinklers.

Unit IV **(06 Hrs.)**

Introduction to reliefs, types of reliefs, relief scenario, relief sizing. Hazard identification: Introduction, hazard identification methods, HAZOP, safety reviews, and risk assessment

Unit V **(06 Hrs.)**

Reviews of probability theory; Event trees: Quantitative risk analysis, cause consequence analysis and layer of protection analysis, bow-tie analysis. Accident research: Introduction, accident causation theories, accident investigation procedure, process safety management, personal protective equipment's, safety laws and regulations.

Text Books/Reference Books/Standards:

1. D.A. Crowl and J.F. Louvar, Chemical Process Safety (Fundamentals with Applications), Prentice Hall,2011.
2. R.K. Sinnott, Coulson & Richardson's Chemical Engineering, Vol. 6, Elsevier India, 2006.

Course Code	PEC-FE-403						
Category	Program Elective Course						
Course Title	Occupational Health & Hygiene management						
Scheme and Credit	L	T/A	P	Credits	Semester -VII		
	2	-	-	2			
Examination Scheme	Theory				Practical		
	Int	Uni	Total		Int	Uni	Total
	30	70	100		-	-	-
Pre-requisites (if any):	Paramedics						

Course Objectives: The objective of this course is to develop and understanding of occupational health and hygiene in working environment. An analyze workplaces to identify occupational hazards- formulate solutions to control occupational hazards- collaborate with others in their respective organizations to minimize occupational hazards.

Course Outcomes: Upon successful completion of the course, the student will be able to

1. Define occupational health & hygiene condition.
2. Identify the physical hazards
3. Understand the philosophy about chemical hazard
4. Develop confidence for training & workers regarding occupational diseases.
5. Understand the risk factor in handling hazardous material.

Occupational Health & Hygiene management Course Content

Unit I **(06 Hrs)**

Occupational Health: Definition, Scope of occupational health safety, identify the element of work environment, role of occupational Health safety and hygiene service Programs, Occupational Health Organization (DGFASLI, DGMSOSHA, ILO, WHO), Introduction to Hazards: Identify the occupational health safety and hygiene hazards in workplace.

Unit II **(06 Hrs)**

Physical Hazards: Physical hazards. Improper illumination, Thermal radiation, ultra violet radiation, ionizing and non ionizing radiation. Preventive and control measures. Noise-Measurement, Noise-control techniques – Noise Survey, vibration. Thermal stress, heat balance, heat-stress, heat disorders, control measures.

Unit III **(06 Hrs)**

Chemical hazards. Dangerous properties of chemicals, dust, gases, fumes, mists, vapors and smoke. Exposure evaluation and air sampling, threshold limit values. Chlorine Exposure effects. Personal monitoring. Introduction to chemical processes and safety. Storage, Transport and handling of hazardous chemicals. Industrial ventilation. Natural ventilation. Opening in work area.

Unit IV **(06 Hrs)**

Occupational Health and Disease: 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 center, health records, fundamentals of first aid.

Unit V (06 Hrs)

Personal Protective Equipments: Non respiratory personal protective devices: Head protection, Ear protection. Face and Eye protection. Head protection. Feet protection. Body protection. Supply, use, care maintenance of personal protective equipments. Requirements under safety laws. Respiratory personal protective devices: classification of hazards. Selection of respirators. Instructions in use of breathing apparatus.

Text Books/Reference Books/Standards:

1. Principles of Occupational Health and Hygiene: An introduction- 2nd Edition by Sue Reed, Dino Pisaniello, Geza Benke, Kerrie Burton
2. Diseases of occupation – 7th edition by D. Hunter.
3. Dangerous properties of Industrial materials- 12th edition by Irvin.
4. Human Factors in Engineering & Design -7Th edition by Tata McGraw-Hill 1982
5. Industrial and Occupational Health by SK Haldar.
6. Code of Practice for Hazardous goods by NFPA
7. Encyclopedia of occupational Health & Safety Vol I & II I.L.O. Geneva 1985.
8. Handbook of occupation Health & Safety NSC Chicago 1982
9. Safety, Health and Environment Hand Book -2019 Govt. of India.
10. International Occupational Hygiene Association (IOHA) 1987.

Course Code	PEC-FE-404						
Category	Program Elective Course						
Course Title	Disaster Management						
Scheme and Credit	L	T/A	P	Credits	Semester -VII		
	2	-	-	2			
Examination Scheme	Theory				Practical		
	Int	Uni	Total		Int	Uni	Total
	30	70	100		-	-	-
Pre-requisites (if any):	Fundamentals of Management						

Course Objectives:

1. To provide students an exposure to disasters, their significance and types
2. To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
3. To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
4. To enhance awareness of institutional processes in the country and

Course Outcome: Upon successful completion of the course, the student will be able to:

1. Identify the types of disaster and basic terms used in disaster management.
2. Analyze the risk and vulnerability analysis.
3. Illustrate Disaster Preparedness and Response Preparedness.
4. Plan the post disaster management.
5. Study the disaster management in India.

Disaster Management Course Content

Unit I **(06 Hrs)**

Introduction to Disaster; Different Types of Disaster; Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides etc.; Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures (Building and Bridge), War & Terrorism etc. Causes, effects and practical examples for all disasters.

Unit II **(06 Hrs)**

Risk and Vulnerability Analysis; Risk: Its concept and analysis, Risk Reduction, Vulnerability: Its concept and analysis, Strategic Development for Vulnerability Reduction, Impact of disaster (Including social, economic, political, environmental, health, psychosocial, etc.)

UNIT III **(06 Hrs)**

Disaster Preparedness: Concept and Nature, Disaster Preparedness Plan, Prediction, Early Warnings and Safety Measures of Disaster. Role of Information, Education, Communication, and Training, Role of Government, International and NGO Bodies. Role of IT in Disaster Preparedness Role of Engineers on Disaster Management.

Response Preparedness: Disaster Response: Introduction, Disaster Response Plan, Communication, Participation, and Activation of Emergency Preparedness Plan. Search, Rescue, Evacuation and Logistic Management. Role of Government, International and NGO Bodies. Relief and Recovery

UNIT IV **(06 Hrs)**

Reconstruction and Rehabilitation as a Means of Development. Damage Assessment. Post Disaster effects and Remedial Measures. Creation of Long-term Job Opportunities and Livelihood Options, Disaster Resistant House Construction. Sanitation and Hygiene. Education and Awareness. Dealing with Victims' Psychology. Long-term Counter Disaster Planning. Role of Educational Institute.

UNIT V **(06 Hrs)**

Hazard and Vulnerability profile of India Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness, DM Act and Policy, Other related policies, plans, programmes and legislation)

Text Books/Reference Books/Standards:

1. Andharia J. Vulnerability in Disaster Discourse, JTCDM, Tata Institute of Social Sciences Working Paper no. 8, 2008.
2. Carter, Nick 1991. Disaster Management: A Disaster Manager's Handbook. Asian Development Bank, Manila Philippines.
3. Govt. of India: Disaster Management Act 2005, Government of India, New Delhi.
4. Gupta Anil K, Sreeja S. Nair. 2011 Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi
5. Kapur, Anu & others, 2005: Disasters in India Studies of grim reality, Rawat Publishers, Jaipur
6. Dr. Mrinalini Pandey Disaster Management Wiley India Pvt. Ltd.

Course Code	OEC-FE-401					
Category	Open Elective Course					
Course Title	Robotics					
Scheme and Credit	L	T/A	P	Credits	Semester -VII	
	2	-	-	2		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Instrumentation and Control					

Course Objectives: The objective of this course is to impart knowledge about industrial robots for their control and design. Select a robotic system for given application.

Course Outcome: Upon successful completion of the course, the student will be able to:

1. Illustrate the importance of robotics in our daily life
2. Identify different components of robotics
3. Analyze the kinematic and dynamics with simulation.
4. Design control laws for a robot.
5. Study the mechanical and electrical hardware for a real prototype of robotic device.

Robotics Course Content

Unit I **(06 Hs)**

Introduction to Robotics, Types and components of a robot, Classification of robots, closed-loop and open loop control systems. Kinematics systems; Definition of mechanisms and manipulators, Social issues and safety.

Unit II **(06 Hrs)**

Robot Kinematics and Dynamics Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Jacobian, Singularity, and Statics Dynamic Modelling: Equations of motion: Euler-Lagrange formulation

Unit III **(06 Hrs)**

Sensors and Vision System Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc. Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations Vision applications in robotics.

Unit IV **(06 Hrs)**

Robot Control Basics of control: Transfer functions, Control laws: P, PD, PID Non-linear and advanced controls

Unit V **(06 Hrs)**

Robot Actuation Systems, Control Hardware and Interfacing Embedded systems: Architecture and integration with sensors, actuators, components, Programming for Robot Applications.

Text Books/Reference Books/Standards:

1. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.
2. Ghosal, A., "Robotics", Oxford, New Delhi, 2006.
3. Niku Saeed B., "Introduction to Robotics: Analysis, Systems, Applications", PHI, New Delhi.
4. Mittal R.K. and Nagrath I.J., "Robotics and Control", Tata McGraw Hill.
5. Mukherjee S., "Robotics and Automation", Khanna Publishing House, Delhi.
6. Craig, J.J., "Introduction to Robotics: Mechanics and Control", Pearson, New Delhi, 2009

Course Code	OEC-FE-402					
Category	Open Elective Course					
Course Title	Cyber Security					
Scheme and Credit	L	T	P	Credits	Semester -VII	
	2	0	0	2		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Basic knowledge of Computers; Basic knowledge of networking and Internet; Hands on Windows operating system					

Course Objectives: The course has been designed to give students an extensive overview of cyber security issues, tools and techniques that are critical in solving problems in cyber security domains. The course aims at providing students with concepts of computer security, cryptography, digital money, secure protocols, detection and other security techniques.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Design and implement appropriate security technologies and policies to protect computers and digital information.
2. Identify & Evaluate Information Security threats and vulnerabilities in Information Systems and apply security measures to real time scenarios
3. Identify common trade-offs and compromises that are made in the design and development process of Information Systems
4. Develop policies and procedures to manage enterprise security risks.
5. Evaluate and communicate the human role in security systems with an emphasis on ethics, social engineering vulnerabilities and training.

Cyber Security Course Content

Unit I **(06 Hrs)**

Cyber Security Concepts Essential Terminologies: CIA, Risks, Breaches, Threats, Attacks, Exploits. Information Gathering (Social Engineering, Foot Printing & Scanning). Open Source/ Free/ Trial Tools: nmap, zenmap, Port Scanners, Network scanners. Cryptography and Cryptanalysis Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security, Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec. Open Source/ Free/ Trial Tools: Implementation of Cryptographic techniques, OpenSSL, Hash Values Calculations MD5, SHA1, SHA256, SHA 512, Steganography (Stools)

Unit II **(06 Hrs)**

Infrastructure and Network Security, Introduction to System Security, Server Security, OS Security, Physical Security, Introduction to Networks, Network packet Sniffing, Network Design Simulation. DOS/ DDOS attacks. Asset Management and Audits, Vulnerabilities and Attacks. Intrusion detection and Prevention Techniques, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.
Open Source/ Free/ Trial Tools: DOS Attacks, DDOS attacks, Wireshark, Cain &abel, iptables/ Windows Firewall, snort, suricata, fail2ban

Unit III **(06 Hrs)**

Cyber Security Vulnerabilities& Safe Guards Internet Security, Cloud Computing &Security, Social Network sites security, Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Authorization, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, IT Audit, Authentication. Open Web Application Security Project (OWASP), Web Site Audit and Vulnerabilities assessment. Open Source/ Free/ Trial Tools: WinAudit, Zap proxy (OWASP), burp suite, DVWA kit.

Unit IV **(06 Hrs)**

Malware Explanation of Malware, Types of Malwares: Virus, Worms, Trojans, Rootkits, Robots, Adware's, Spywares, Ransom wares, Zombies etc., OS Hardening (Process Management, Memory Management, Task Management, Windows Registry/ services another configuration), Malware Analysis. Open Source/ Free/ Trial Tools: Antivirus Protection, Anti Spywares, System tuning tools, Anti
Phishing.

Unit V **(06 Hrs)**

Security in Evolving Technology Biometrics, Mobile Computing and Hardening on android and ios, IOT Security, Web server configuration and Security. Introduction, Basic security for HTTP Applications and Services, Basic Security for Web Services like SOAP, REST etc., Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.
Open Source/ Free/ Trial Tools: adb for android, xcode for ios, Implementation of REST/ SOAP web services and Security implementations.

Text Books/Reference Books/Standards:

1. William Stallings, Computer Security: Principles and Practices, Pearson 6 Ed, ISBN 978-0-13-335469-0
2. Nina Godbole, Sunit Belapure , Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiely India Pvt.Ltd, ISBN- 978-81-265-2179-1
3. Bruice Schneier, Applied Cryptography- Protocols, Algorithms and Source code in C, Algorithms, Wiely India Pvt Ltd, 2nd Edition, ISBN 978-81-265-1368-0.
4. CK Shyamala et el., Cryptography and Security, Wiley India Pvt. Ltd, ISBN-978-81-265-2285-9.
5. Berouz Forouzan, Cryptography and Network Security, TMH, 2 edition, ISBN -978-00-707-0208-0.
6. Mark Merkow, Information Security-Principles and Practices, Pearson Ed., ISBN- 978-81-317-1288-7.

Course Code	OEC-FE-403					
Category	Open Elective Course					
Course Title	Internet of Things					
Scheme and Credit	L	T/A	P	Credits	Semester -VII	
	2	0	0	2		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Sensors, System Integration, Cloud and Network Security					

Course Objectives: The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand internet of Things and its hardware and software components.
2. Interface I/O devices, sensors & communication modules.
3. Analyze the remotely monitor data and control devices.
4. Develop real life IoT based projects.
5. Apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis

Internet of Things Course Content

Unit I **(06 Hrs)**

Introduction to IoT -Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.

Unit II **(06 Hrs)**

Elements of IoT Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

Unit III **(06 Hrs)**

IoT Application Development Solution framework for IoT applications- Implementation of Device integration,

Unit IV **(06 Hrs)**

Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.

Unit V **(06 Hrs)**

IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation

Text Books/Reference Books/Standards:

1. Vijay Madisetti, Arshdeep Bahga, Internet of Things, "A Hands on Approach", University Press
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
4. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
5. Adrian McEwen, "Designing the Internet of Things", Wiley
6. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill

Course Code	OEC-FE-404					
Category	Open Elective Course					
Course Title	Artificial Intelligence					
Scheme and Credit	L	T/A	P	Credits	Semester -VII	
	2	-	-	2		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	30	70	100	-	-	-
Pre-requisites (if any):	Basic Programming in Python; Data Structures					

Course Objectives: The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects.

Course Outcomes: Upon successful completion of the course, the student will be able to

1. Build intelligent agents for search and games
2. Solve AI problems through programming with Python
3. Learning optimization and inference algorithms for model learning
4. Design and develop programs for an agent to learn and act in a structured environment.

Artificial Intelligence Course Content

Unit I **(06 Hrs)**

Introduction Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree.

Unit II **(06 Hrs)**

Search Algorithms Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search.

Unit III **(06 Hrs)**

Probabilistic Reasoning Probability, conditional probability, Bayes Rule, Bayesian Networks-representation, construction and inference, temporal model, hidden Markov model.

Unit IV **(06 Hrs)**

Markov Decision process MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.

Unit V **(06 Hrs)**

Reinforcement Learning Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning.

Text Books/Reference Books/Standards:

1. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill
2. Trivedi, M.C., "A Classical Approach to Artifical Intelligence", Khanna Publishing House,Delhi.
3. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011
4. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" , 3rd Edition,Prentice Hall

Course Code	PROJ-FE-401					
Category	Project					
Course Title	Mini Project					
Scheme and Credit	L	T/A	P	Credits	Semester - VII	
	-	-	5	2.5		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	50	50	100
Pre-requisites (if any):						

Objectives: To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

Course Outcomes: Upon successful completion of the course, the student will be able to

1. Identify Fire engineering problems reviewing available literature.
2. Identify appropriate techniques to analyze complex Fire engineering problems.
3. Apply engineering and management principles through efficient handling of project have a clear idea of his/her area of work and they are in a position to carry out the work in a systematic way

Mini Project Content

The student works on a topic relevant to Fire Engineering under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the Supervisor. The student will be evaluated based on the report and the viva-voce examination by a team of examiners including one external examiner.

Guidelines:

1. The mini-project is a team activity having 3-7 students in a team.
2. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.
3. Mini Project should cater to a small system required in laboratory or real life.
4. After interactions with Project guide and based on comprehensive literature survey/need analysis, the student shall identify the title and define the aim and objectives of mini-project.
5. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
6. The student is expected to exert on design, development and testing of the proposed work
7. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.
8. The tutorial sessions should be used for discussion.

Course Code	PCC-FE-404					
Category	Program Core Course					
Course Title	Fire Ground Operations-VII					
Scheme and Credit	L	T/A	P	Credits	Semester - VII	
	-	-	5	2.5		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	25	25	50
Pre-requisites (if any):	Fire Ground Operations-I, II, III, IV, IV, V					

Course Objective: The objective of this course is to understand the Personnel Protective Equipment, usage & storage, Small and special gears usage and the performance of Recuse and Tactical exercise.

Course Outcomes: Upon successful completion of the course, the student will be able to

1. Define personal protective ensembles. Identify and demonstrate donning and doffing of PPE.
2. Identify, select and make use of various small gears and special gears.
3. Perform rescue drill as per the standard technique.
4. Demonstrate rope rescue techniques in different emergent situations.
5. Demonstrate stretcher drill and ambulance drill as per standard.

Fire Ground Operations-VII Course Content

1. **Personnel Protective Equipment (PPE)**: Introduction, I Types of PPE – Fireman's Entry suit, Fire Proximity suit, Wild-land suit, Sewer suit, Disposable suit, Chemical suit. Donning and doffing of PPE, Storage of PPE

2. **Small and special gears**: Introduction, Type of small gear, Forcible entry, Firefighting, Breaking, Cutting, Removing, Lifting, Lightning, Small and special gear operation and care and maintenance. Technical search, Snake eye camera, Victim location camera, Remote receive camera, Miscellaneous, Special tools, Electrical, Hydraulic, Pneumatic, Water pressure, Drone, Delsa, Pneumatic air lifting, Operation, care and maintenance of small and special gears.

3. **Rescue Drill**: Introduction, Rope rescue: High rise, Flood area, Drainage, Well, Glacier, Arial, Construction bridge. Aerial rescue (Simulating Helicopter) using Hydraulic platform/Chopper/Derrick, Vehicle/Rail Accident Extrication techniques, Man and animal rescue.

4. **Tactical Exercise**: Confinement place, Forcible entry rescue, Firefighting in Rigs, hazardous material, Different types of oil and gas storage fire.

Text Books/Reference Books/Standards:

1. Fire Service Drill Book, GoI, MHA Publication
2. Fire Service Manual, HM Fire service manual
3. Fire Fighters Handbook, Delmar
4. Manual of Firemanship

Course Code	MC-FE-401					
Category	Mandatory Course (Audit)					
Course Title	Summer Internship					
Scheme and Credit	L	T/A	P	Credits	Semester - VII	
	-	-	-	Audit		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	50	-	50
Pre-requisites (if any):	-					

Mandatory Course (Audit) Course Content

1. The Industrial/Practical Training shall carry 50 marks and shall be evaluated at the end of semester.
2. At the end of the Industrial/Practical training/internship/Summer Project, the student shall submit a certificate from the organization where the student has undergone training and a brief report about the training.
3. The evaluation will be made based on this report, presentation and a Viva-Voce Examination conducted internally by a three-member Departmental Committee constituted by Director, NFSC. The scheme of Evaluation of marks is provided below.

Internship/Industrial Training			
Evaluation			
Report	Presentation	Viva	Total
20	20	10	50

Course Code	PROJ-FE-402					
Category	Project					
Course Title	Industrial Training and Attachment					
Scheme and Credit	L	T/A	P	Credits	Semester - VIII	
	-	-	20	10		
Examination Scheme	Theory			Practical		
	Int	Uni	Total	Int	Uni	Total
	-	-	-	200	300	500
Pre-requisites (if any):	Fire Ground Operations – I to VII					

The object of **Industrial Training and Attachment** is to enable the trainee to extend further the investigative study taken up, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a supervisor from the college alone or jointly with a supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the trainee(s) in R&D work and technical leadership.

Course Outcomes: Upon successful completion of the course, the student will be able to

1. Illustrate the generic requirements of a Fire Marshal
2. Initiate emergency procedures and promote a positive response from others
3. Identify fire safety hazards and risks in the workplace and report deficiencies
4. Analyse the availability of fire safety resources and equipment
5. Apply the correct firefighting equipment relative to its contents, capacity and limitations and operate it safely in the event of fire

The **Industrial Training and Attachment** to normally include:

1. In depth study of the topic assigned in the light of the Report prepared;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the College.
8. Final Seminar Presentation before a college committee.

भारत सरकार
गृह मंत्रालय
राष्ट्रीय अग्निशमन सेवा महाविद्यालय
राजनगर, नागपुर-440013

Government of India
Ministry of Home Affairs
National Fire Service College
Rajnagar, Nagpur-440013

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NO. NFSC/ACAD-BE/102(K)/2021 DATED:- 07/ 07 /2022

To,

The Board of Studies,
Fire Engineering (Ad-Hoc)
Faculty of Science and Technology
R.T.M. Nagpur University, Nagpur.

Subject: Submission of B. Tech Fire Engineering Course (CBCS) scheme and syllabus to BOS-Fire Engineering of Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU).

Dear Sir/Madam,

I have the honour to mention that the National Fire Service College conducting the B. Tech-Fire Engineering (CBCS) course affiliated to Rashtrasant Tukadoji Maharaj Nagpur University (RTMNU), Nagpur under the Board of Studies (BOS)-Fire Engineering in the Faculty of Science & Technology, RTMNU, Nagpur.

2. In view of the above, it is hereby submitted the overall scheme and syllabus content regarding the B. Tech-Fire Engineering (CBCS) course for your necessary information and action.

Yours faithfully,

(R.S. CHAUDHARI)
DIRECTOR