IPS ACADEMY- INSTITUTE OF ENGINEERING & SCIENCE, INDORE

(A UGC Autonomous Institute, affiliated to RGPV)

Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

Scheme of Examination as per AICTE Flexible Curricula

VIII Semester (**Scheme A)** Bachelor of Technology (B.Tech.)

[Fire Technology & Safety Engineering]

S. No	Course Type	Course Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory			Practical						
				End Sem	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1	PEC	FT03	Departmental Elective-III	60	25	15	-	-	100	3	-	-	3
2	IOC	FT02	Interdisciplinary Open Course-II	60	25	15	-	-	100	3	-	-	3
3	LC	FT17 (P)	Professional Fire Fighting Skills	-	-	-	60	40	100	-	-	4	2
4	PROJ	FT03(A)	Project Phase -II	-	-	-	60	40	100	-	-	16	8
			Total	120	50	30	120	80	400	6	-	20	
Total Academic Engagement and Credits										26			16

Departmental Elective-III, PEC-FT 03 (Any One Course): ** This can be either offered by the department or Student can earn the credit from online MOOC Course Minimum 12 Weeks, (AICTE/SWAYAM/ Other Relevant Online Learning Platform)

a) Safety in Construction
b) Industrial Safety Engineering
c) Explosions Hazards and Control

Interdisciplinary Open Course (IOC)-II, IO 02 (Any One Course) ** This can be either offered by the department or Student can earn the credit from online MOOC Course Minimum 12 Weeks, (AICTE/SWAYAM/ Other Relevant Online Learning Platform)

a) Emergency Communication System
b) Theory of Fire Propagation (Fire Dynamics)
c) Safety Practices in Chemical and Nuclear Industries

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Scheme of Examination as per AICTE Flexible Curricula

VIII Semester (**Scheme B)** Bachelor of Technology (B.Tech.)

[Fire Technology & Safety Engineering]

S. No	Course Type	Course Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory			Practical						
				End Sem	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1	PEC	FT03	Departmental Elective-III	60	25	15	-	-	100	3	-	-	3
2	IOC	IO 02	Interdisciplinary Open Course-II	60	25	15	-	-	100	3	-	-	3
3	LC	FT17 (P)	Professional Fire Fighting Skills	-	-	-	60	40	100	-	-	4	2
4	PROJ	FT03(B)	Internship and Project (Industry/Corporate/Academia)	-	-	-	60	40	100	-	-	16	8
			Total	120	50	30	120	80	400	6	-	20	
Total Academic Engagement and Credits										26			16

Departmental Elective-III, PEC-FT 03 (Any One Course): ** This can be either offered by the department or Student can earn the credit from online MOOC Course Minimum 12 Weeks, (AICTE/SWAYAM/ Other Relevant Online Learning Platform)

a) Safety in Construction
b) Industrial Safety Engineering
c) Explosions Hazards and Control

Interdisciplinary Open Course (IOC)-II, IO 02 (Any One Course) ** This can be either offered by the department or Student can earn the credit from online MOOC Course Minimum 12 Weeks, (AICTE/SWAYAM/ Other Relevant Online Learning Platform)

a) Emergency Communication System
b) Theory of Fire Propagation (Fire Dynamics)
c) Safety Practices in Chemical and Nuclear Industries

PEC-FT03 (A)	Safety In Construction	3L:0T:0P (03 hrs)	03 Credits

Course Objectives:
To learn and understand the latest safety and health regulations and the Indian Standards applicable to the construction industry.

Course Content:

Module 1 **(08 Hrs)**
BASIC PHILOSOPHY: Building Bye laws for Residential Area, Cinemas, Theatres, Multiplex, Auditorium etc., Drive-in-Cinemas, Gasoline Filling Station, Basic Philosophy and parameters governing in construction such as site planning and layout, safe access and good housekeeping, safety in use of construction machinery, structural soundness, structural safety, accident causes and its effect.

Module 2 **(08 Hrs)**
WORKING AT HEIGHT: Fall protection in construction, OSHA 3146, Requirement for working at height, Work permit system, Height pass, Salient Features of safety and health in the Building & other Construction Workers (Regulation of employment and conditions of service) Act. 1996 and Central Rules 1998 IS & NB codes)

Module 3 **(06 Hrs)**
SAFETY IN DEMOLITION OPERATIONS: Planning & permit, Precautions prior to demolition, Protection of public, Precautions during demolition. Sequence of demolition operations from safety point of view, Safety measures with respect to building materials including cement, lime, timber, steel, glass, paints, varnishes, and petroleum products

Module 4 **(08 Hrs)**
SAFETY IN CONSTRUCTION OPERATIONS I : Underground works Excavation, drilling & blasting, trenching, strutting, piling & safety in using and operation machinery and equipment relating to above components. Above ground works, Scaffolding, Centering, Frame work, Ladders, Concreting wall and floor openings, staircases and railings. Structural steel work including welding, cutting erection, Safety in use of related machinery equipments,

Module 5 **(08 Hrs)**
SAFETY IN CONSTRUCTION OPERATIONS II : Under water operations, River draining, well sinking, Caissons, under water concreting, Cofferdams & special operation connected with irrigation works, Use of related machinery and equipments, Movement of Materials & personnel, Heavy/Long items, Railway wagons, Motor trucks, Vehicles and Hazardous materials, High rise building, bridges, roads, railways, asphalting, pneumatic caissons, electrical, installations & lifts, safety in prevention and protection at work site including collapsing of structures

Course Outcome:

At the end of this course student will be able to:

1. Understand philosophy and parameters governing in construction Industry.
2. Demonstrates the working at height operation and apply applicable rules and act in Indian scenarios.
3. Explain safety in demolition operations involved with construction industry.
4. Understand safety in construction operation specifically underground works excavation**.**
5. Understand safety in construction operation specifically under water operations.

List of Text/Reference Books:

1. Hinze, J.W. (1997) Construction Safety, Prentice Hall
2. Mac Collum, D.V. (1995) Construction Safety Planning, John Wiley & Sons
3. Reese, C.D. & Eidson, J.V. (2006) Handbook of OSHA Construction Safety and Health, Taylor & Francis.
4. Lingard, H. & Rowlinson, S. (2005) Occupational health and Safety in Construction Project Management, Spon Press.
5. Holt, A.S.J. (2005) Principles of Construction Safety, Wiley-Blackwell Publishers
6. MacCollum, D.V. (2007) Construction Safety Engineering Principles, McGraw Hill Publishers
7. Bhattacharjee, S.K. (2011) Safety Management in Construction, Khanna Publishers
8. Li, R.Y.M. & Poon, S.W. (2013) Construction Safety, Springer Publishers Few IS Codes & journal papers
9.Fulman, J.B., 1979 Construction Safety, Security & Loss Prevention, John Wiley and Sons,

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New Scheme & Syllabus Based on AICTE Flexible Curricula **(B. Tech)**
Fire Technology & Safety Engineering

PEC-FT03 (B)	Industrial Safety Engineering	3L:0T:0P (03 hrs)	03 Credits

Course Objectives:
To impart knowledge on different facets and aspects of engineering systems safety, focusing on tools, techniques and methodologies needed for prevention of occurrences of unsafe operations and accidents under different industrial settings.

Course Content:

Module 1 **(06 Hrs)**
INTRODUCTION: Key concept- Hazard, System, Accident, Safety and Risk. System Safety Concept, Objectives System as Design Parameters System Life Cycle- Concept, Phases-Defination, Development, Production and Deployment

Module 2 **(08 Hrs)**
SYSTEM SAFETY IMPLEMENTATION: Policy and Procedures, Product Assurance Organization, System Safety Program Plan (SSPP), Elements of System Safety Program Plan, System Interfacing, Human Engineering-Design of Work Places, Causes of Errors, Procedural Safety Guards.

Module 3 **(06 Hrs)**
SAFETY EVALUATION TOOL: Probability laws, Measures of Central Tendency and Dispersion, Methods of Safety Analysis-Correlation, Regression, Analysis of Variance, Contingency Table.

Module 4 **(08 Hrs)**
HAZARD ANALYSIS: Elements of Hazard Analysis-Hazard Severity, Hazard Likelihood, Hazard Probability, Hazard Control, Hazard Index, Hazard Control Design Criteria, Preliminary Hazard Analysis, System Hazard Analysis.

Module 5 **(06 Hrs)**
FAULT TREE ANALYSIS: Fault Tree Symbology -Event and Logic Symbol, Fault Tree Synthesis, Cut Set Development, Fault tree Quantification-Fault Rate, Mean down Time, Un Reliability, Common Cause Analysis

Course Outcome:
At the end of this course student will be able to:
1. Know key concept and terminology of system safety.
2. Develop system safety program plan for a given system.
3. Calculate probability as safety evaluation tool for a given sample of accident data.
4. Explain hazard analysis techniques and its application for a given system.
5. Apply fault tree analysis technique to given set of parameters for assessment of accident root cause.

List of Text/Reference Books:

1. System Safety Engineering Management, Harilde.Roland and Brain Moriarty, John Willey & Sons.
2. Safety Analysis, Lars Harms-Ringdahl CRC Press.
3. Probabilistic Risk Assessment for Engineering and Scientists, Komamoto and Henley, IEEE Press, 1995.
4. Industrial Accident Prevention, Heinrich et al., McGraw Hill, 1980.
5. Techniques for safety management - A systems approach, Petersen D, ASSE 1998.

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New Scheme & Syllabus Based on AICTE Flexible Curricula **(B. Tech)**
Fire Technology & Safety Engineering

PEC-FT03 (C)	Explosion Hazards & Control	3L:0T:0P (03 hrs)	03 Credits

Course Objectives:

To understand and learn simple modeling of blast waves derived from energy release in explosions, predictions for the damage caused by explosions and methods of ensuring safety.

Course Content:

Module 1 **(08 Hrs)**
INTRODUCTION: Loud Bang and Disruption Blast Wave in an Explosion; Prediction from Dimensional Considerations Typical Examples of Explosions and Classification Theory of Blast Waves Shock Hugoniot and Rayleigh Line Properties behind Constant Velocity Shock Blast waves; Concentration of Mass at Front, Snow Plow Approximation.

Module 2 **(08Hrs)**
BLAST WAVE IMPACT : Characteristics of Blast Waves Decay of a Blast Wave, Sach's Scaling Overpressure and Impulse in the near and Far Field Missiles, Fragments and Shrapnel, Craters Interaction of Blast with Objects and Structures Reflection and Transmission of Blast Waves, Impedance Amplification of Reflected Blast waves, Spall, Damage to Organs, Mushroom Cloud.

Module 3 **(08 Hrs)**
EXPLOSION ENERGY: Energy Release in an Explosion Energy Release in a Chemical Reaction, Standard Heats of Formation Stoichiometry, Equivalence Ratio and Heat Release in Fuel-rich and Oxidizer-rich Compounds Energy release calculations, Higher and Lower Calorific Values, Internal Energy of Formation Rate of Energy Release Concentration, Activation Energy, Energy Release Profile Thermal Theory of Explosions Application of Thermal Theory and Inferences.

Module 4 **(08 Hrs)**
EXPLOSION MODELING: Modeling of Rate of Energy Release Role of Chain carriers in an explosion Fire and Combustion Combustion and Explosions Case Histories of explosions involving Volatile Liquids Detonations Introduction to Detonations Structure of Detonation Realizable States in a Detonation One Dimensional Model of a Detonation Case Histories of explosions Involving Detonation or Quasi-Detonation.

Module 5 **(08 Hrs)**
EXPLOSION TYPES: Different Types of Explosions Explosions in Confined and Unconfined Geometries Dust Explosion I Dust Explosion II Physical Explosions Rupture of Cryogenic Storage Vessels and Pressure Vessels Condensed Phase Explosions Condensed Phase Explosives based on Hydrocarbons Condensed Phase explosives and their Properties TNT Equivalence and Yield of an Explosion Quantification of damages in an Explosion.

Course Outcome:
At the end of this course student will be able to:
1. Know concept of blast wave belongs to different types of explosions.
2. Calculate the impact of blast wave on objects and building structure.
3. Understand the fundamentals of explosion energy and rate of energy release.
4. Develop one dimensional model of a detonation involving volatile liquids.
5. Have knowledge of explosion types and their properties.

List of Text/Reference Books:

1. Baker, W.E., Explosions in Air, University of Texas Press, Austin, 1973
2. Ramamurthi, K. Explosions and Explosion Safety, McGraw Hill, New Delhi, 2011
3. Crowl, D. A. and Louvar, J.F., Chemical Process safety, Prentice Hall, NJ, 2002
4. Stull, D.R., Fundamentals of Fire and Explosion, AIChE Monograph Series, Vol. 73, No. 10,1977
5. Kinney G. F. and Graham K. J., Explosive Shocks in Air, Springer, Berlin, 1985
6.Cooper P. W. and Kurowski S.R., Introduction to the Technology of Explosives, Wiley-VCH,New York, 1966

IOC-IO2 (C)	**Emergency Communication System**	**3L:0T:0P (03 hrs)**	**03 Credits**

Course Objective:

1. To learn about the concept of telecommunication and modulation technique.
2. To learn about the internal communication of fire services and their types.
3. To learn about role of transducer in instrument and their Classification.
4. To learn about analog to digital, digital to analog conversion techniques.
5. To learn about the wireless voice centric communications and their design.

Course Content:

Module 1 **(08 Hrs)**

INTRODUCTION TO TELECOMMUNICATIONS: Communications Principles & Systems, Analog and Digital Communications, Mobile and Cellular communications, Satellite and Terrestrial Communications, Practical and Ideal Channels: Distortion & Noise Effects, Overview of transmission media used, Concept of Modulation: Baseband and Pass band Transmission, Amplitude, Phase & Frequency Modulation Techniques (AM/PM/FM).

Module 2 **(08 Hrs)**

INTERNAL COMMUNICATION OF FIRE SERVICES: Internal communication of fire services- Endorsement and memorandum, Reports and circular, Managerial communication, Agendas, Oral and written communication, Fire services radio system and their types- Wireless local loop, Cordless Phone, RFID, Portable Radios, Mobile Radios, Base/Fixed Station Radios, and Repeaters.

Module 3 **(08 Hrs)**

CLASSIFICATION OF TRANSDUCERS: Transducer: Classification of Transducers, Strain Gauge, Displacement Transducer- LVDT (Linear Variable Differential Transformer), Temperature Transducer- RTD (Resistance Temperature Detector), Thermistor, Thermocouple, Piezo Electric Transducer, Optical Transducer- Photo emissive, Photo conductive, Photo Voltaic, Photo- diode Photo Transistor.

Module 4 **(08 Hrs)**

DIGITAL MEASUREMENT AND INSTRUMENT: Advantage of Digital instrument over Analog Instrument, DAC (Digital Analog Converter), Variable resistive type, R-2R ladder type, Binary ladder, Weighted Converter using Op-amp and Transistor, ADC (Analog to Digital Converter) - Ramp Technique, Dual slope.

Module 5 **(08 Hrs)**

WIRELESS VOICE CENTRIC COMMUNICATIONS: Mobile and Cellular Telecommunications, Concept of cells, frequency reuse & handoffs, Channel transmission mechanisms: LOS, Reflection, Refraction, Diffraction & Scattering, 1G/2G/3G voice oriented wireless technology.

Course Outcome:

At the end of this course student will be able to:

1. Know the basic idea of modulation technique.
2. Explain the basic idea of internal communication of fire services and their types.
3. Understand the basic idea of differentiate between the types of transducers available.
4. Analyze and design digital to analog converter & analog digital converter.
5. Demonstrate wireless voice centric communications and their design.

List of Text/Reference Books:

1. Simon Haykins, Communication System, John Willy
2. Singh &Sapre, Communication System, TMH
3. H.S. Kalsi, Electronics Instrument, TMH.
4. K. Sawhney, Instrumentation & Measurement, Dhanpat Rai & Co.
5. Wireless Communication and Networking – William Stallings, PHI, 2003.

LC-FT17 (P)	**Professional Fire Fighting Skills**	**0L:0T:4P (04 hrs)**	**02 Credits**

Course Objective:
To command, practice and conduct squad and fire fighting drills associated with national fire service.

Course Content:
1. To command, practice and conduct different appliance drills used in fire service.
2. To command, practice and conduct hose drills associated with fire service.
3. To command, practice and conduct different types of hydrant drills.
4. To command, practice and conduct different types of ladder drills.
5. To command, practice and conduct different types of BA set drills.
6. To command, practice and conduct different types of trailer pump drills.
7. To command, practice and conduct different types of emergency evacuation drills.
8. To command, practice and conduct different types of first aid fire fighting appliances drills.

Course Outcome:
At the end of this course student will be able to:

1. Command, practice and conduct squad and fire fighting drills associated with fire service.

List of Text/Reference Books:

1. AFS – Drill Manual
2. Drill manual for Fire Services of India by Govt. of India.
Fire Fighters Skill drill manual by NFPA.