



# IPS ACADEMY- INSTITUTE OF ENGINEERING & SCIENCE, INDORE

(An Autonomous Institute)

## Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

Scheme of Examination as per AICTE Flexible Curricula

VI Semester Bachelor of Technology (B.Tech.)

**[Fire Technology & Safety Engineering]**

| S. No.                                | Subject Code | Subject Name                      | Maximum Marks Allotted |                |                  |           |                                   | Total Marks | Contact Hours per week |   |    | Total Credits |
|---------------------------------------|--------------|-----------------------------------|------------------------|----------------|------------------|-----------|-----------------------------------|-------------|------------------------|---|----|---------------|
|                                       |              |                                   | Theory                 |                |                  | Practical |                                   |             | L                      | T | P  |               |
|                                       |              |                                   | End Sem                | Mid Sem. Exam. | Quiz/ Assignment | End Sem   | Term work<br>Lab Work & Sessional |             |                        |   |    |               |
| 1                                     | PCC- FT601   | Paramedics                        | 70                     | 20             | 10               | 60        | 40                                | 200         | 2                      | 1 | 2  | 4             |
| 2                                     | PCC- FT602   | Computer Aided Risk Analysis      | 70                     | 20             | 10               | 60        | 40                                | 200         | 2                      | 1 | 2  | 4             |
| 3                                     | PCC- FT603   | Safety, Health & Environment Laws | 70                     | 20             | 10               | -         | -                                 | 100         | 4                      | - | -  | 4             |
| 4                                     | PEC- FT601   | Professional Elective III         | 70                     | 20             | 10               | 60        | 40                                | 200         | 3                      | - | -  | 3             |
| 5                                     | POEC-FT601   | Open Elective                     | 70                     | 20             | 10               | -         | -                                 | 100         | 3                      | - | -  | 3             |
| 6                                     | PCC- FT604   | Advance Fire Fighting             | -                      | -              | -                | 60        | 40                                | 100         | -                      | - | 4  | 2             |
| 7                                     | PROJ- FT607  | Internship                        | -                      | -              | -                | 60        | 40                                | 100         | -                      | - | 4  | 2             |
|                                       |              | Total                             | 350                    | 100            | 50               | 300       | 200                               | 1000        | 14                     | 2 | 12 | 22            |
| Total Academic Engagement and Credits |              |                                   |                        |                |                  |           |                                   |             | 28                     |   |    | 22            |

| Professional Elective Courses (PEC)-III          | Suggestive Professional Open Electives Courses from Humanities |
|--|--|
| PEC- FT601 (A) – Special Fire Hazards            | POEC- FT601 (A)- Stress Management                             |
| PEC- FT601 (B)- Safety in Petrochemical Industry | POEC- FT601 (B)- Business Communication                        |
|  | POEC- FT601 (C)- Language (German/ French)                     |
|  | POEC- FT601 (D)- Soft Skills & Interpersonal Communication     |

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**Fire Technology & Safety Engineering**

|                  |                   |                          |                   |
|------------------|-------------------|--------------------------|-------------------|
| <b>PCC-FT601</b> | <b>Paramedics</b> | <b>2L:1T:2P (05 hrs)</b> | <b>04 Credits</b> |
|------------------|-------------------|--------------------------|-------------------|

**Course Objective:**

1. To learn about the human body & its various system.
2. To learn about the handling of human casualty, its diagnosis & treatment.
3. To learn about the burn, shock and their types with paramedic care.

**Module 1** **(08 Hrs)**

**INTRODUCTION:** Definition; qualities of duties, tasks, Study of the human body and its various systems: Skeleton system, Digestive system, Respiratory system, Circulatory system, Central Nervous system & their functions, Practical study of this part to include demonstrations of the human body with structural details of its various parts as seen externally and examination of its internal functions such as pulse, breathing, movements of the chest and abdomen, movements of various joints of the body with structural changes in the body parts while making three movements.

**Module 2** **(08 Hrs)**

**CASUALTY HANDLING-I:** Including history taking, making of a diagnosis based on symptoms as Narrated by the casualty and signs as observed by the paramedic. Checking temperature pulse, respiration, blood pressure, swellings, discoloration of the skin, wounds, deformities etc/to confirm the diagnosis. Study of various types of burns and their complications in the indoor cases in burn ward in the local government hospitals. Study of maintenance of various charts related to such casualties and their importance.

**Module-3** **(08 Hrs)**

**CASUALTY HANDLING-II:** Study of specific injuries to body parts controlling their functions with external and internal injuries of head chest and abdomen including causes and consequences of external and internal bleeding. Paramedical care of various types of Casualties and their injuries such as wounds, burns, injuries of bones and joints, disturbances in vital function including cardiopulmonary resuscitation, artificial respiration by manual and instrumental methods, bandages, splints, correction of shock, arrest of bleeding, treatment of hyperpyrexia, use of anti/shock fluids and their administration, Observation and maintenance of such casualties.

**Module 4** **(08 Hrs)**

**CASUALTY HANDLING-III:** Casualty handling including observation, maintenance of observation charts, treatment administered, temperature-pulse-respiration records, application of suction, appropriate positioning of casualties affected by head injuries, chest injuries, abdominal injuries, bleeding, shock, asphyxia etc. Transportation of casualties on stretchers, across plain ground, through obstacles, stretcher drill, loading and unloading of casualties in stretchers and ambulances, Ambulance installations and their use in casualties during transportation etc.

**Module-5** **(08 Hrs)**

**CAUSALTY HANDLING-IV:** Casualties affected by heat and cold, drowning, poisoning, pressure, altitude, inebriations, sound, explosions, nuclear radiations etc. Prevention, protection of effects on human bodies and their paramedical care. Bites of animals such as snakes, dogs and various insects and their paramedical care.

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**Course Outcomes:**

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

1. Explain the various systems of human body.
2. Evaluate various parameter concerning to human causality during emergency.
3. Demonstrate respiratory and non respiratory first aid to human causality.
4. Carryout first aid to human causality affected by heat and cold burn.
5. Conduct first aid to human causality affected by head , chest and abdominal injuries.

**List of Text/Reference Books:**

1. Edward T Dickinson , Fire Service emergency care, , Braddy.
2. L.G Gupta & Abhitabh Gupta , First Aid, Jaypee Brothers.
3. Watson Jones Fractures and Joint Injuries :
4. Cantlie, James, First Aid to injured, St John Ambulance Association
5. First Aid Manual by Indian Red Cross Society

**List of Experiment:**

1. To measure the bleeding time and clotting time of healthy adult person using vrigid splints.
2. To calculate the victim dressing time using various type of bandage by first aid responder.
3. To calculate the body mass index of an adult person by using surgical height measuring scale with digital weighting machine.
4. To calculate the blood pressure of an adults person using mercury sphygmomanometer and stethoscope apparatus.
5. To calculate the scale of burn.
6. To perform and practice the different methods of handling and transportation of Victim.
7. To perform and practice the first aid treatment of Fractures in different part of human body.
8. To measure the working efficiency of human lungs with lung testing apparatus

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|------------------|-------------------------------------|--------------------------|-------------------|
| <b>PCC-FT602</b> | <b>Computer Aided Risk Analysis</b> | <b>2L:1T:2P (05 hrs)</b> | <b>04 Credits</b> |
|------------------|-------------------------------------|--------------------------|-------------------|

**Course Objective:**

1. To learn about the basic concept of risk and its management in an organization.
2. To teach about popular risk assessment method used in different types of industry.
3. To learn about application and limitation of hazard and operability study and failure mode effect analysis.
4. To learn about the collection application and types of accident data in different types of industries.
5. To learn about fire growth model and their application in calculating reliability index.

**Course Content:**

**Module 1** **(08 Hrs)**

**INTRODUCTION:** Concept of Risk, Definition, Accepted & impressed risk, Perception & Quantification Risk, Acceptance Criteria, ALARP, Cost benefit analysis, Component of risk, Strategies of risk control, Principles of risk management, Loss control, Degree of hazards, Elementary reliability Theory, Systems & accidents.

**Module 2** **(08 Hrs)**

**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, Event Tree Analysis (ETA), Quantification of event tree, Quantitative risk assessment, Criteria of risk acceptance, Types of consequences.

**Module 3** **(08 Hrs)**

**TECHNIQUES AND APPROACHES:** 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 follow up.

**Module 4** **(08 Hrs)**

**ACCIDENT DATA ANALYSIS:** Introduction, Type of accident & incident data, Collection of accident & incident data, Legal requirement to notify accident & incident, Use of accident & incident data, Accident, Incident, Risk assessment data, Use of Computer, Job safety analysis (JSA), Principle and procedure, Summary of risk assessment methods and comparison.

**Module 5** **(08 Hrs)**

**STOCHASTIC MODEL:** Fire growth model, description assumption, Scenario, Output variables, Stochastic input variables, Response surface for maximum temperature, Calculation of time to untenable conditions, Calculation of COHb value, Fatality caused by heat, logarithm of time untenable condition, Calculation of reliability index.

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**Course Outcome:**

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

1. Explain basic concept of risk and its management.
2. Apply Boolean algebra and cut sets in different risk assessment methods.
3. Demonstrate HAZOP study for a process industry or its distinguish part.
4. Analyze accident and incident data for risk assessment procedure in an organization.
5. Explain fire growth models and scenario for probable fire scenes.

**List of Text/Reference Books:**

1. Process Safety Analysis- An introduction, Bob Skelton, Gulf Publishing Company Houston, Texas.
2. Safety Analysis- Principles and Practices in Occupational Safety, Second Edition, Lar Harms- Ringadahl, CRC Press
3. Safety at work, John Channing , 8th Edition, Routledge Taylor & Francis Group Landon & New York.
4. Risk Analysis in Building Fire Safety Engineering, A M Hasofer, V R Beck, ID Bennetts, Elsevier.
5. Practical Hazops, Trips and Alarms, David Macdonald, Elsevier.

**List of Experiment:**

1. Calculation of individual risk and fatal accident rate as theoretical risk factor
2. Preparing the risk matrix for an organization.
3. Application of Hazard study methods to a raw gas holder.
4. Application of Hazop study on an oil vaporizer.
5. Application of Hazop study on ethylene oxide sterilizer.
6. Application of Fault tree analysis to a chemical reactor.
7. Determination of Safety Integrity level by using risk parameter chart for a given sample.
8. Determination of safety integrity level by using SIL class software with risk parameter chart.
9. Evaluation of preliminary safety instrumented system (SIS) design using SILclass software tool..

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|------------------|--|--------------------------|-------------------|
| <b>PCC-FT603</b> | <b>Safety, Health &amp; Environment Laws</b> | <b>4L:0T:0P (04 hrs)</b> | <b>04 Credits</b> |
|------------------|--|--------------------------|-------------------|

**Course Objectives:**

1. To teach the significance of Factories Act and Rules in Safety Engineering.
2. To learn the provisions related fire prevention and protection in different laws, related to Safety, Health & Environment.
3. To teach the provisions and rules related to pollution control in important legislations.
4. To learn the other important legislations from safety, fire prevention and protection point of view.
5. To learn the provisions related to fire prevention and protection in fire service act and rules

**Course Content:**

**Module 1** **(06 Hrs)**  
Objective, Definition, Application including chapter-IV, Chapter-IVA, Chapter-IX of Factories Act 1948 and Chapter IX, Chapter-X of M.P. Factories rules 1962, Madhya Pradesh Control of Industrial Major Accident Hazard Rules 1999..

**Module 2** **(06 Hrs)**  
Objective, Definition, Application & provisions related to safety, fire prevention and fire protection in Laws such as Indian Explosive Act 1884, Gas Cylinder Rules 2004, Static and Mobile Pressure Vessel Rules, Petroleum Act 1934 with Rules 2002, Calcium Carbide Rules 1987.

**Module 3** **(08 Hrs)**  
Objective, Definition, Application provisions and rules related to control of pollution in important legislation such as Water (Prevention and Control of Pollution) Act, Air (Prevention and control of pollution) Act, Environment (Protection) Act 1986 with MSIHC Rules, Chemical Accident (EPPR) Rules 1996

**Module 4** **(09 Hrs)**  
Objective, Definition, Application & provisions related to safety, fire prevention and fire protection in Other Important Legislations like-Boilers Act 1923, Electricity Act 2003 with rules, Dock workers (Safety, Health & Welfare) Act & Rules. Safety & Health provisions of Building & other construction workers (R.E.C.S.) Act 1986 and central rules 1998 and Mines Act.

**Module 5** **(05 Hrs)**  
Provisions related to fire prevention and protection in Delhi fire service Act2007 and Delhi fire service rules 2010, fire insurance assessment, Public liability insurance Act 1991 with Rules. Objective, Definition, Application, Provisions and Rules related to accidents, Occupational Diseases and Compensation in Employees State Insurance Act..

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**Course Outcome:**

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

1. Explain significance of Factories Act and Rules in Safety Engineering.
2. Explain provisions related fire prevention and protection in different laws.
3. Explain provisions and rules related to pollution control in important legislations.
4. Know other important legislations from safety, fire prevention and protection point of view.
5. Explain provisions related to fire prevention and protection in fire service act and rules..

**List of Text/Reference Books:**

1. Factories Act 1948, M.P. Factories rules 1962
2. Indian Explosive Act 1884, Gas Cylinder Rules 2004
3. Petroleum Act 1934, Petroleum Rules 2002
4. Environment (Protection) Act 1986
5. Boilers Act 1923
6. M.P. C.I.M.A.H. Rules 1999
7. Delhi Fire Service Act 2007 with Rules 2010.
8. Employee State Insurance Act & Rules.
9. Building & other Construction workers, (R.E., C.S.) Act. 1996
10. Other Important Laws related to Health Safety and Environment.

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|---------------------|-----------------------------|--------------------------|-------------------|
| <b>PEC-FT601(A)</b> | <b>Special Fire Hazards</b> | <b>3L:0T:0P (03 hrs)</b> | <b>03 Credits</b> |
|---------------------|-----------------------------|--------------------------|-------------------|

**Course Objectives:**

To learn about the special locations for hazards such as aviation industry, marine and high-rise building with their control measures.

**Course Content:**

**Module 1**

**(08 Hrs)**

Constructional features of an Air Craft, Types of Engines, Basic Fire-Hazards in Aircraft, Nature of Air Crashes, Emergency Landings including belly leading; Access to Fire Service Personnel and Escape of trapped persons problems, Types of Safety Belts, Ejection-Seats; and their methods of release; Rescue and Fires in Air Craft and methods of fire-fighting; Problems of fire-fighting. Problems in dealing with Air Craft carrying ammunition, bombs nuclear weapons, Action to be taken in case of accidents involving Radio Active Cargo.

**Module 2**

**(08Hrs)**

Hazards in Airport, Protection & Types of Hangers, Refueling and Defiling in Air Cargo, Crash Fire Tender: Provision of Crash, Fire Tenders including Rapid Intervening appliances, Categorization of Air- Port, their extinguishing media and determination of the appliances for each category as per International Standard. B:.

**Module 3**

**(08 Hrs)**

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

**Module 4**

**(08 Hrs)**

**C:HIGH RISE BUILDINGS**

Fundamentals of Fire Safe Building design, Building and site planning for fire-safety, structural integrity during fire confinement of fire in building, Life safety systems for high, rise structures. Evacuation: Need of Evacuation plans in high rise buildings, Making of Evacuation Plans, types of Evacuation, Procedure of Evacuation.

**Module 5**

**(06 Hrs)**

Alarm signaling in high-rise building – Smoke movement in building – Residential highrise building- High-rise building with complex occupancy. Basic fire-fighting strategy. Study of model code of practice for high-rise building in metropolitan cities (Building Bye Laws)..



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**Course Outcome:**

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

1. Explain constructional features of air craft with safety measures.
2. Describe hazards and their protection in all category of airport.
3. Explain vessel plan, drawing and document used in marine.
4. Explain life safety systems in high-rise buildings.
5. Describe building bye laws in metropolitan cities.

**List of Text/Reference Books:**

1. Aero plane knowledge for Rescue Personnel by F. Engineering Division.
2. Fire Protection and Maintenance of Aircraft by N.F.P.A.
3. The Fire Hazards of Fuelling Aircraft in the Open by D.S.I.R., H.M.S.O. London.
4. I.C.A.O. Standard
5. Marine fire manual
6. High-Rise building fires and fire safety – N.F.P.A.
7. High-Rise Fire & Life Safety by B. Hagan
8. N.F.P.A.
9. National Building Code of India.

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|---------------------|---|--------------------------|-------------------|
| <b>PEC-FT601(B)</b> | <b>Safety in Petrochemical Industry</b> | <b>3L:0T:0P (03 hrs)</b> | <b>03 Credits</b> |
|---------------------|---|--------------------------|-------------------|

**Course Objectives:**

1. To learn the characteristics of crude oil and classification of petroleum products.
2. To learn about the refining process and its significance in safety.
3. To learn about petrochemical fire and emergency planning in potential fire hazard areas.
4. To teach the statutory provisions pertaining to refineries petrochemical plants and gas terminals

**Course Content:**

**Module 1** **(08 Hrs)**

**INTRODUCTION:** Crude oil, its properties & Characteristics, Classification of petroleum & its products, MSDS of crude oil, diesel, gasoline, kerosene, LPG, Natural Gas, naphtha, Ammonia, Benzene, toluene, Acetylene..

**Module 2** **(08 Hrs)**

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

**Module 3** **(06 Hrs)**

**FIRE PROTECTION & EMERGENCY PLANNING:** Major fire risks, design criteria for selection of fire water network, fire fighting installations such as hydrant, mobile water monitors, foam pourer, DCP fixed, subsurface injection & steam snuffing systems. Storage tanks protection. Use of various media in petroleum & gas fires such as water, foam, DCP.

**Module 4** **(08 Hrs)**

**FIGHTING REFINERY & PETROCHEMICAL FIRES:** Potential fire hazards, precautionary measures in case of non-ignited releases, oil & gas leaks. Fire fighting facilities for depots, terminals, onshore, off-shore drilling platforms, and pipelines for transportation of petroleum products & Gas. Fighting Gas terminal fires: - Fire fighting & procedures in case of BLEVE, LPG hazards, spillage, vehicles using LPG & CNG as a fuel. Fire fighting facilities at LPG bottling plants. Water Injection into LPG vessel (water bottoming).

**Module 5** **(08 Hrs)**

**STATUTORY PROVISIONS:** Pertaining to refineries, petrochemical plants & gas terminals, Oil Industry Safety Directorate (OISD), Petroleum Act 1934, Petroleum Rules 2002, Petroleum & Natural Gas Regulatory Board (PNGRB) drafts, Explosive Act 1884, Explosive Rules 1983 and Gas cylinders Rules 2004. Application of advance technologies used in refineries & petrochemical plants such as SCADA, SAP and various simulation modeling.

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**Course Outcome:**

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

1. Explain hazardous characteristics of petroleum product and refining process.
2. Apply fire protection systems in potential fire hazards area in oil and gas industry.
3. Present statutory provisions pertaining to refineries, petrochemicals plants and gas terminals.
4. Explain various fire fighting strategies in case of BLEVE, LPG hazards and spillage.
5. Demonstrate the knowledge about statutory provision pertaining to refineries, petrochemical plants and gas terminals.

**List of Text/Reference Books:**

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

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|------------------|------------------------------|--------------------------|-------------------|
| <b>PCC-FT604</b> | <b>Advance Fire Fighting</b> | <b>0L:0T:4P (04 hrs)</b> | <b>02 Credits</b> |
|------------------|------------------------------|--------------------------|-------------------|

**Course Objective:**

To learn and teach about the basic firefighting equipment/apparatus installed in a factory and practice associated incident management strategies to control fire and other emergency situations.

**Course Content:**

**Module 1** **(06 Hrs)**

**PUMPS TYPES AND APPLICATION:** Fire water pump characteristics, main and stand by fire pumps, booster fire water pumps, water mist fire water pumps, jockey pumps

**Module 2** **(06 Hrs)**

**PUMP INSTALLATION, PIPING ARRANGEMENT AND ACCESSORIES:** Typical installation, pump separation, multiple pump installation. Pressure and flow control valves, Flow measurement. Fire sprinklers protection.

**Module 3** **(06 Hrs)**

**FIREWATER PUMP CONTROLLER:** Controller power supplies, Firewater pump acceptance and flow testing- Safety precautions, Periodic performance test, weekly testing, Basic test procedure

**Module 4** **(06 Hrs)**

**MANAGING INCIDENTS:** Incident Command Development- Fire ground command, Responsibilities and function of command, Establishing command, Command staff, General staff function, Post incident review

**Module 5** **(06 Hrs)**

**FIRE ATTACK AND FIRE STREAMS:** Sizing up incidents- Lloyd Layman's size up process, Determining fire flow- Kimball rule of thumb, Action plan development – Incident and tactical priorities, scene safety. Solid Streams- Horizontal and Vertical reach, stream penetration, Non solid fire streams- Velocity Flow nozzle reaction.

**Course Outcomes:**

At the completion of this course, students will be able to:

1. Demonstrates pumping arrangements and their layouts in a standard pump house.
2. Familiar with pump installation and piping accessories of water based installation.
3. Carry periodic test related to power supply and flow testing.
4. Develop Incident command for managing major fires.
5. Apply water streams based on fire scenarios.

**List of Text/Reference Books:**

1. Fire Fighting Pumping System at Industrial facilities- Dennis P. Nolan.
2. Fire Officer Principles and Practice- NFPA.
3. Fire Department Hydraulics- Evgene Mahoney.

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|-------------------|-------------------|--------------------------|-------------------|
| <b>PROJ-FT601</b> | <b>Internship</b> | <b>0L:0T:4P (04 hrs)</b> | <b>02 Credits</b> |
|-------------------|-------------------|--------------------------|-------------------|

Internship- credits can be earned through successful completion of credit based MOOC's Courses available on SWAYAM platform (MHRD) at respective UG level specialized in fire, safety, environment and hygiene related domain.