

**PERIYAR UNIVERSITY**

**SALEM – 636 011**

**PERIYAR INSTITUTE OF DISTANCE EDUCATION (PRIDE)**

**DIPLOMA IN FIRE AND SAFETY**

**ONE YEAR**



**REGULATION AND SYLLABUS**

**(Effective from the Academic Year 2014 - 2015)**

## ACADEMIC ELIGIBILITY FOR ADMISSION

Diploma in Fire and Safety: +2 (10 + 2 Stream) , Diploma, Any Graduates

**DURATION OF COURSE:** One Year

**COURSE OF STUDY AND SCHEME OF EXAMINATIONS:**

Sl.No	Title of the Subject	Duration	Maximum Marks
1.	Industrial Fire Protection System	3 Hours	100
2.	Fire Engineering and Science	3 Hours	100
3.	Risk Management and Hazard Control System	3 Hours	100
4.	Industrial Safety	3 Hours	100
5.	Environmental Safety	3 Hours	100
6.	Construction Safety	3 Hours	100
7.	Emergency Planning & First Aid	3 Hours	100
8.	Project Work	15 Days	100
Total Marks			800

**PASSING CRITERIA:** The candidates shall be declared to have passed the examination, if they secured not less than 40 marks in each examination.

**QUESTION PAPER PATTERN:**

### **THEORY**

Duration : 3 Hours

Maximum Marks : 100

Part – A (5 x 5 = 25 Marks)

Answer any 5 Questions

(Eight Questions to be asked)

1, 2, 3, ....8.

Part – B (5 x 15 = 75 Marks)

Answer any 5 Questions

(Eight Questions to be asked)

1, 2, 3, ....8.

### **PROJECT WORK**

Project report containing 50 - 100 pages is to be submitted at the end of the course and the report to be valued for 100 Marks.

# 1. INDUSTRIAL FIRE PROTECTION SYSTEM

## Unit I Fire Prevention and Protection

Sources of ignition fire triangle – principles of fire extinguishing –active and passive fireprotection systems – various classes of fires – A, B, C, D, E – types of fire extinguishers –fire stoppers – hydrant pipes –hoses –monitors –fire watchers –layout of stand pipes –fire station

## Unit II Fire Detection System and Accessories

Addressable & Non Addressable systems – Communication devices - Fire alarms and sirens – maintenance of fire trucks – foam generators – escape from fire rescue operations –fire drills –first aid for burns. Hose, Types of hose and its Characteristics, Frictional loss, Material used, Causes and prevention of mildew, shock & rubber acid - Care and maintenance, Types of hose fittings, Couplings, Component parts of inter locking couplings, Suction coupling wrenches, Branches, nozzles and branch holders.

## Unit III Industrial Fire Protection Systems

Sprinkler – hydrants – standpipes – special fire suppression systems like deluge and emulsifier, selection criteria of the above installations, reliability, maintenance, evaluation and standards – alarm and detection systems. Other suppression systems –CO<sub>2</sub> system, foam system, Dry Chemical Powder (DCP) system, halon system –need for halon replacement –smoke venting. Portable extinguishers –flammable liquids –tank farms –indices of inflammability-fire fighting systems.

## Unit IV Explosion Protecting Systems

Principles of explosion - detonation and blast waves - explosion parameters – Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure - explosion venting - inert gases, plant for generation of inert gas- rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO<sub>2</sub>) and halons- hazards in LPG, ammonia (NH<sub>3</sub>), sulphur dioxide (SO<sub>2</sub>), chlorine (Cl<sub>2</sub>) etc

## Unit V Hydraulic System

Pumps, primers, tenders and water relay, Introduction, definition, Different types of pumps, Different types of primers, Working principle of various pumps primers, Maintenance and trouble shooting, Testing of pumps, Advantages and disadvantages, Water relay system, Open circuit system, Closed circuit system.

## Text Book

1. “Fire Prevention and fire fighting”, Loss prevention Association, India.

## References

1. Gupta, R.S., “Hand Book of Fire Technology” Orient Longman, Bombay 1977.
2. DinkoTuhtar, “Fire and explosion protection”
3. “Accident Prevention manual for industrial operations” N.S.C., Chicago, 1982.
4. Derek, James, “Fire Prevention Hand Book”, Butter Worths and Company, London, 1986.

## 2. FIRE ENGINEERING AND SCIENCE

### Unit I Physics of Fire

History of fire service - Basic physics - Units – Measurement system - Force, resultant force - Laws of force - Laws of motion - Mass and weight, work, power, energy Law of conservation of energy - Mechanics – rest and motion - Distance and displacement -Speed and velocity

### Unit II Chemistry of Fire

Fire properties of solid, liquid and gases -fire spread -toxicity of products of combustion -theory of combustion and explosion –vapour clouds –flash fire –jet fires –pool fires –unconfined vapour cloud explosion, shock waves -auto-ignition –boiling liquid expanding vapour explosion.

### Unit III Characteristics of Fire

Energy changes - Effects of heat on matter - Combustion - Temperature - Specific heat capacity - Catalyst – Neutralization – Sublimation - Heat of decomposing - Chemical reaction - Exothermic reaction and endothermic reaction - Transmission of heat - Flash and fire point - Ignition temperature - Flammables and combustible chemicals - Spontaneous combustion - Triangle of combustion - Tetrahedron fire - Spread of fire.

### Unit IV Regulations for Safety and Environment

Factories act and rules - Indian explosive act - Gas cylinder rules - SMPV Act - Indian petroleum act and rules. Environmental pollution act - Overview of OHSAS 18000 and ISO 14000

### Unit V Case Studies

Flixborough - Mexico disaster - Pasadena Texas - Piper Alpha - Peterborough - Bombay Victoria dock ship explosion – Bhopal Gas Tragedy.

### References

1. Derek, James, “Fire Prevention Hand Book”, Butter Worths and Company, London, 1986.
2. Gupta, R.S., “Hand Book of Fire Technology” Orient Longman, Bombay 1977.
3. “Accident Prevention manual for industrial operations” N.S.C., Chicago, 1982.
4. Dinko Tuhtar, “Fire and explosion protection”

### **3.RISK MANAGEMENT AND HAZARD CONTROL SYSTEM**

#### **Unit I Introduction**

Introduction, hazards, hazard monitoring , different stages of process life time – Hazard reduction approaches and inherent safety review-Selection of hazard evaluation techniques - Factors influencing the selection of hazard evaluation techniques - decision making process - hazard review for management changes - combined hazard review - hazard evaluation - Risk issues.

#### **Unit II Hazard Evaluation Techniques - Non Scenario Based**

Checklist analysis, safety review,relative ranking,preliminary hazard analysis (PHA),fire explosion and toxicity index (FETI)

#### **Unit III Hazard Evaluation Techniques - Scenario Based**

Fault Tree Analysis& Event Tree Analysis –what-if analysis/checklist analysis-hazard operability studies (HAZOP) -Failure Mode and Effect Analysis (FMEA)

#### **Unit IV Risk Management System**

Emergency preparedness –Emergency Plans & Staff Training - Safety Management and legislation - Functions of safety management - Factories Act 1948 - Workmen compensation Act 1923.

#### **Unit V Instrumentation**

Applications of Advanced Equipment and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyzer (TGA), Accelerated Rate Calorimeter (ARC), Principles of operations, Controlling parameters, Applications, advantages.Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitiveness Test, Impact Sensitiveness Test(BAM) and Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test.

#### **Reference Books**

1. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council, UK
2. Hazop and Hazon, by Trevor A Klett, Institute of Chemical Engineering.
3. “Guidelines for Chemical Process Quantitative Risk Analysis”, second edition, Centre for Chemical Process safety, AIChE, 2000
4. Guidelines for Hazard Evaluation Procedures, Third Edition, Centre for Chemical Process safety, AIChE 2008

## **4.INDUSTRIAL SAFETY**

### **Unit I Electrical Hazards**

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications of excess energy-current surges-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arc-ignition energy-Lightning, hazards, lightning arrestor, installation –earthing, Specifications, earth resistance, earth pit maintenance.

### **Unit II Building Fire Safety**

Objectives of fire safe building design, Fire load, fire resistant material and fire testing – structural fire protection –structural integrity –concept of exit design -exists width calculations -fire certificates –fire safety requirements for high rise buildings –snookers.

### **Unit III Storages and Transportation**

General consideration, petroleum product storages, storage tanks and vessel-storages layout segregation, separating distance, secondary containment-venting and relief, atmospheric vent, pressure, vacuum valves, flame arrestors, fire relief-fire prevention and protection-LPG storages, pressure storages, layout, instrumentation, vaporizer, refrigerated storages-LNG storages, hydrogen storages, toxic storages, chlorine storages, ammonia storages, other chemical storages-underground storages-loading and unloading facilities-drum and cylinder storage-ware house, storage hazard assessment of LPG and LNG Hazards during transportation –pipeline transport

### **Unit IV Workshop Safety**

Hand tools and Power tools - Safety while using Grinding stone - Welding and gas cutting safety – Identification of Dangerous points - Lubrication Safety-Safety in Cold Forming and Hot Working of Metals.

### **Unit V Safety Inspections**

Safety Audit- Safety Survey - Plant safety inspection - Safety tour - Safety samplings - What is 5s – How to implement 5s – Benefits of implementing 5s standard - What is safety budget – Direct cost – indirect cost- Safety Equipment's & their budget preparation

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1. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council, UK
2. Hazop and Hazon, by Trevor A Klett, Institute of Chemical Engineering.
3. “Guidelines for Chemical Process Quantitative Risk Analysis”, second edition, Centre for Chemical Process safety, AIChE, 2000
4. Guidelines for Hazard Evaluation Procedures, Third Edition, Centre for Chemical Process safety, AIChE 2008

## 5. ENVIRONMENTAL SAFETY

### Unit I Air Pollution

Classification and properties of air pollutants –Pollution sources –Effects of air pollutants on human beings, Animals, Plants and Materials -automobile pollution hazards of air pollution-concept of clean coal combustion technology -ultra violet radiation, infrared radiation, radiation from sun-hazards due to depletion of ozone -deforestation-ozone holes-automobile exhausts-chemical factory stack emissions-ChloroFluoro Carbon(CFC).

### Unit II Water Pollution

Classification of water pollutants-health hazards-sampling and analysis of water-water treatment -different industrial effluents and their treatment and disposal –advanced wastewater treatment -effluent quality standards and laws-chemical industries, tannery, textile effluents-common treatment.

### Unit III Hazardous Waste Management

Hazardous waste management in India-waste identification, characterization and classification-technological options for collection, treatment and disposal of hazardous waste-selection charts for the treatment of different hazardous wastes-methods of collection and disposal of solid wastes-health hazards-toxic and radioactive wastes incineration and verification - hazards due to bio-process-dilution-standards and restrictions –recycling and reuse.

### Unit IV Environmental Measurement and Control

Sampling and analysis –dust monitor –gas analyser, particle size analyser – pH meter –gas chromatograph –atomic absorption spectrometer. Gravitational settling chambers-cyclone separators-scrubbers-electrostatic precipitator -bag filter –maintenance -control of gaseous emission by adsorption, absorption and combustion methods-Pollution Control Board-laws.

### Unit V Pollution Control in process Industries

Pollution control in process industries like cement, paper, petroleum-petroleum products – textile – tanneries-thermal power plants –dyeing and pigment industries -eco-friendlyenergy.

### References

1. Rao, CS, “Environmental pollution engineering:”, Wiley Eastern Limited, NewDelhi, 1992.
2. S.P.Mahajan, “Pollution control in process industries”, Tata McGraw Hill Publishing Company, New Delhi, 1993.
6. Varma and Braner, “Air pollution equipment”, Springer Publishers, Second Edition.

## **6.CONSTRUCTION SAFETY**

### **Unit I Accidents Causes and Management Systems**

Problems impeding safety in construction industry-causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accident –construction regulations, contractual clauses –Pre contract activities, preconstruction meeting - design aids for safe construction –permits to work –quality assurance in construction - compensation –Recording of accidents and safety measures –Education and training

### **Unit II Hazards of Construction and Prevention**

Excavations, basement and wide excavation, trenches, shafts –scaffolding , types, causes of accidents, scaffold inspection checklist –false work –erection of structuralframe work, dismantling – tunnelling –blasting, pre blast and post blast inspection –confined spaces –working on contaminated sites –work over water -road works –power plant constructions –construction of high rise buildings.

### **Unit III Working at Heights**

Fall protection in construction OSHA 3146 –OSHA requirement for working at heights, Safe access and egress –safe use of ladders-Scaffoldings , requirement for safe work platforms, stairways, gangways and ramps –fall prevention and fall protection , safety belts, safety nets, fall arrestors, controlled access zones, safety monitoring systems –working on fragile roofs, work permit systems, height pass –accident case studies.

### **Unit IV Construction Machinery**

Selection, operation, inspection and testing of hoistingcranes, mobile cranes, tower cranes, crane inspection checklist -builder's hoist, winches, chain pulley blocks –use of conveyors -concrete mixers, concrete vibrators –safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps, welding machines, use of portable electrical tools, drills, grinding tools, manual handling scaffolding, hoisting cranes –use of conveyors and mobile cranes – manual handling.

### **Unit V Safety in Demolition Work**

Safety in demolition work, manual, mechanical, using explosive -keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition.

### **References**

1. Hudson, R.,”Construction hazard and Safety Hand book, Butter Worth’s, 1985.
2. JnatheaD.Sime, “Safety in the Build Environment”, London, 1988.
3. V.J.Davies and K.Thomasin “Construction Safety Hand Book” Thomas Telford Ltd., London, 1990.
4. Handbook of OSHA Construction safety and health charles D. Reese and James V. Edison



## **7. EMERGENCY PLANNING & FIRST AID**

### **Unit I On site Emergency Planning**

On-site Emergency Plan- Emergency Alarm System - Emergency Control Room - Key personnel  
Emergency Control Program

### **Unit II Off-site Emergency Plan**

Mutual Aid Scheme Emergency Evacuation- Security and Media management

### **Unit III Hazard Communication**

Safe Handling of hazardous substance- Material Safety Data Sheet (MSDS) - Use of hazardous and  
Toxic substance - Storage and Handling - Transportation of Hazardous substance

### **Unit IV First Aid**

Introduction- Action at Emergency. Principles of First Aid- Shocks : Electrical Shock - Artificial  
Respiration - Cardio Pulmonary Resuscitation – Choking Fainting - Poisoning - Open Wounds -  
Control of bleeding - Burns and Scalds - Heart Attack - Resuscitation. Disorder of respiratory  
system. Disorder of Circulation.

### **Unit V Wound & Bleeding.**

Disorders of consciousness - Bone, Joint & Muscle injury - Burns & Scalds - Effect of heat & cold -  
Foreign bodies – Poisoning - Dressing & Bandages - Handling & transport of injured - Emergency  
First Aid.

### **Reference Books**

1. Methodologies for Risk and Safety Assessment in Chemical Process Industries, Commonwealth Science Council, UK
2. Hazop and Hazon, by Trevor A Klett, Institute of Chemical Engineering.
3. “Guidelines for Chemical Process Quantitative Risk Analysis”, second edition, Centre for Chemical Process safety, AIChE, 2000
4. Guidelines for Hazard Evaluation Procedures, Third Edition, Centre for Chemical Process safety, AIChE 2008