



**IPS Academy, Institute of Engineering & Science**  
(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)  
**Fire Technology & Safety Engineering Department**

**Honor's in Risk Assessment and Process Safety**  
(To be offered to the students of Fire Technology & Safety Engineering Department)

S. No	Semester	Subject Code	Subject Name	Contact Hours per week			Total Credits
				L	T	P	
1.	V	HOFTRS 501	Safety Management	4	0	0	4
2.	VI	HOFTRS 601	Risk Assessment and Management	4	0	0	4
3.	VII	HOFTRS 701	Chemical Process Safety	4	0	0	4
4.	VIII	HOFTRS 801	Process Utility and Safety	3	0	0	3
			<b>Total</b>	15	0	0	15
			<b>Total Academic Engagement and Credits</b>	<b>15</b>			<b>15</b>



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<b>HOFTRS 501</b>	<b>Safety Management</b>	<b>4L:0T:0P (04 hrs)</b>	<b>04 Credits</b>
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**Course Objective:**

1. Demonstrate knowledge and skills in the area of Basic Concepts and Techniques of Safety Management.
2. To understand the components of Safety Audit and Audit methodologies with relevant Government Agencies.
3. To understand the fundamentals of Accident Investigation and Reporting with its relevance in Accident Prevention.
4. To familiarize with different Accident Indices for Safety Performance monitoring.
5. To understand the importance of Safety Education and Training needs of an Organization.

**Module 1**

**(08 Hrs)**

**CONCEPTS AND TECHNIQUES:** History of Safety movement, Evolution of modern safety concept, General concepts of management, Planning for safety for optimization of productivity, Quality and safety, Line and staff functions for safety, Budgeting for safety, Safety policy. Incident Recall Technique (IRT), Disaster control, Job safety analysis, Safety survey, Safety inspection, Safety sampling, Evaluation of performance of supervisors on safety.

**Module 2**

**(08 Hrs)**

**SAFETY AUDIT – INTRODUCTION:** Components of safety audit, Types of audit, Audit methodology, Non conformity reporting (NCR), Audit checklist and report, Review of inspection, Remarks by government agencies, Consultants, Experts, Perusal of accident and safety records, Formats, Implementation of audit Indication, Liaison with departments to ensure coordination, Check list, Identification of unsafe acts of workers and unsafe conditions in the shop floor.

**Module 3**

**(08 Hrs)**

**ACCIDENT INVESTIGATION AND REPORTING:** Concept of an accident, Reportable and non reportable accidents, Reporting to statutory authorities, Principles of accident prevention, Accident investigation and analysis, Records for accidents, Departmental accident reports, Documentation of accidents, Unsafe act and condition, Domino sequence, Supervisory role, Role of safety committee, Cost of accident.

**Module 4**

**(08 Hrs)**

**SAFETY PERFORMANCE MONITORING:** Recommended practices for compiling and measuring work injury experience, Permanent total disabilities, Permanent partial disabilities, Temporary total disabilities, Calculation of accident indices, Frequency rate, Severity rate, Frequency severity incidence, Incident rate, Accident rate, Safety “t” score, Safety activity Rate, Problems.

**Module 5**

**(08 Hrs)**

**SAFETY EDUCATION AND TRAINING:** Importance of training, Identification of training needs, Training methods, Programs, Seminars, Conferences, Competitions, Method of promoting safe practice motivation, Communication, Role of government agencies and private consulting agencies in safety training, Creating awareness, Awards, Celebrations, Safety posters, Safety displays, Safety pledge, Safety incentive scheme, Safety campaign, Domestic Safety and Training.

**Course Outcome:**

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

1. Apply adult learning theory to safety training methodology.
2. Conduct accident investigations and Accident Data Analysis.
3. Anticipate, recognize, evaluate, and develop control strategies for hazardous conditions at Work practices.

**List of Text/Reference Books:**

1. Heinrich H.W. Industrial Accident Prevention McGraw - Hill Company, New York,1980.
2. Krishnan N.V. Safety Management in Industry Jaico Publishing House, Bombay,1997.
3. Lees, F.P., Loss Prevention in Process Industries Butterworth publications, London, 2nd Edition, 1990.
4. John Ridley, Safety at Work, Butterworth and Co., London, 1983.
5. Dan Petersen, Techniques of Safety Management, McGraw- Hill Company, Tokyo, 1981.
6. Relevant India Acts and Rules, Government of India.
7. Relevant Indian Standards and Specifications, BIS, New Delhi.
8. Blake R.B., Industrial Safety Prentice Hall, Inc., New Jersey, 1973.
9. Safety and Good House Keeping, N.P.C., New Delhi, 1985.
10. Accident Prevention Manual for Industrial Operations, N.S.C.Chicago, 1982.
11. Journal by Insurance company surveyors and loss assessors – Mumbai – published by Insurance companies



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<b>HOFTRS 601</b>	<b>Risk Assessment and Management</b>	<b>4L:0T:0P (04 hrs)</b>	<b>04 Credits</b>
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**Course Objective:**

To understand and learn the identification, analysis, and prioritization of risks; as well as the coordinated treatment of risk to prevent, minimize, monitor, and control the probability and/or impact of undesirable events and consequences.

**Module 1 (06 Hrs)**

**INTRODUCTION:** Fundamentals of Risk, Risk Planning, Consult with Employees, Long Term and Short Term, Audiences, Situations, and Purposes, Cross-Cutting Risk Communication Approaches, Assessment and Management Process and the Systems Approach.

**Module 2 (10 Hrs)**

**IDENTIFICATION AND ANALYSIS:** Historical data, comparative analysis, and checklists, Taxonomy based, risk breakdown structure, HHM, SWOT, root cause analysis, influence diagram, Expert/ user/ stakeholder-based elicitation (Delphi, brainstorming, interview), Scenario-based, experience based, objective-based analysis, Preliminary Hazard Analysis (PHA) Hazards and Operability Analysis (HAZOP), Job Safety Analysis (JSA), Failure Modes and Effects Analysis (FMEA), Fault Tree Analysis (FTA), Event Tree Analysis (ETA), Decision Trees, Cause-Consequence Analysis (CCA).

**Module 3 (08 Hrs)**

**ASSESSMENT TOOLS:** Risk Probability and Impact Assessment, Risk Index and Risk Ranking, Risk Matrix, EV Analysis, Sensitivity and Tradeoff Analysis, Modeling and Simulation, Risk Attitude and Risk Tolerance, As Low As Reasonably Practicable (ALARP).

**Module 4 (08 Hrs)**

**RISK MANAGEMENT:** Avoidance, Separation, Reduction, Transfer, Acceptance Detection, Control, Response and Recovery, Performance Monitoring.

**Module 5 (08 Hrs)**

**RELEVANT APPLICATION:** Training and Education, ISO3100, Quality and Reliability, Supply Chain Risk Management, Project Risk Management, Positive Risk/ Opportunities Management, Risk and TOC.

**Course Outcomes:**

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

1. Examine features of risk/safety management systems.
2. Conduct job safety analysis and carry out risk assessment.
3. Recommend and implement risk controls.
4. Utilize accident theory as an investigative tool in accident causation.
5. Examine various approaches to safety auditing, to be able to make appropriate choices.
6. Use a case study approach to accident investigation and reporting

**List of Text/Reference Books:**

1. Lawrence R Jauch and William F. Glueck, "Safety at Work" McGraw Hill Book Co. New York.
2. Regina E. Lundgren and Andrea H. McMakin, "Risk Communication: A Handbook for Communicating Environmental, Safety, and Health Risks", 5th Ed Publisher: IEEE Press / Wiley (2013) ISBN: 9781118456934



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<b>HOFTRS 701</b>	<b>Chemical Process Safety</b>	<b>4L:0T:0P (04 hrs)</b>	<b>04Credits</b>
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**Course Objectives:**

To understand and learn the important technical fundamentals of chemical process safety with basics of safety.

**Course Content:**

**Module 1**

**(08 Hrs)**

**INTRODUCTION:** Safety, Hazards and Risk, Elements of process safety management, Features and characteristics of a management system for process safety, Process Safety, Inherent Safety, Hazard Identification, Risk Assessment, Safety and Accident Loss Statistics, OSHA incidence rate, Fatal accident rate(FAR), Fatality rate.

**Module 2**

**(08Hrs)**

**RISK MANAGEMENT AND CONTROL MEASURES:** Hazardous substance rules 1986, Factories Act 1948, EPA rules, Class Label Nature of Accident, Introduction of Four significant disasters of world Flixborough, Seveso, Bhopal, Jaipur Accident Types of Chemical Plant Causes of over pressurization Heat of Reaction Adiabatic Temperature Rise Arrhenius relationship Thermal runaway Phi factor Heat loss (changes with scale) Reagent accumulation Onset temperature (exothermic events) Safety factors (for thermal hazards data) Safety factors and Consideration.

**Module 3**

**(08 Hrs)**

**TOXICOLOGICAL STUDIES:** Toxic, Toxicant and Toxin, Routes and Effects of Exposure Type of Toxic Effect, Entry Routes for Toxicants and Methods for Control, Dose-Response Relationships Dose Versus Response Dose Limit Values Measures of Toxicity: Median Lethal Dose LD50, Median Lethal Concentration LC50, Targeted Organ, Excretion, Metabolism, Biotransformation, Toxicological Disease Process, Modeling Concepts, Selection of Models, Toxic Load response relation, Dose-infection models Hit-Theory Models.

**Module 4**

**(08 Hrs)**

**SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES:** Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief- relief valve sizing calculations- storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation- pipe line transport- safety in chemical laboratories. Safety provisions like level and flow indicators- alarms, trips- protection and stills, columns and towers from lightening- colour coding for pipe lines and cylinders.

**Module 5**

**(08 Hrs)**

**SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS:** Properties of Chemicals MSDS Material Safety data Sheet, Operational Activities and Hazards Standard operating procedures, Effects of pressure, temperature, flow rate and humidity on operations Condition monitoring- control valves- safety valves- pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

**Course Outcome:**

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

1. At the end of this course student will be able to:
2. Know about elements of process safety management.
3. Understand the risk management and control measures through past accidents.
4. Explain the chemical toxicology with different Disease Process, Modeling.
5. Demonstrates the safety measures in STORAGE and handling of chemicals and gases capacity
6. Explain operational safety in chemical process plant.

**List of Text/Reference Books:**

1. Crowl D.A. and Louvar J.F., Chemical Process Safety: Fundamentals with Applications.
2. Lees F.P. Lee's Loss Prevention in Process industries: Hazard Identification, Assessment and control
3. Kletz T, What Went Wrong - Case Histories of Process Plant Disasters: How They Could Have Been Avoided



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<b>HOFTRS 801</b>	<b>Process Utility and Safety</b>	<b>3l:0T:0P (03 Hrs)</b>	<b>03 Credits</b>
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**Course Objective:**

1. To gain knowledge about different process utilities used in the chemical Process industry.
2. To understand issues related to hazards & safety in chemical industry.

**Course Content:**

**Module 1**

**(08 Hrs)**

**Process Utilities:** Various process utilities, their role and importance in chemical plant, Water, compressed air, steam, heat transfer fluids, vacuum, refrigeration, venting, flaring and pollution abating

**Water Utilization:** Sources of water and their characteristics; Treatment storage and distribution of water; water for use in boilers, cooling purposes, drinking and process; Reuse and conservation of water; Water resource management.

**Module 2**

**(08 Hrs)**

**Steam Generation and Utilization:** Steam generation and its application in chemical process plants, distribution and utilization; Design of efficient steam heating systems; Types of boilers and their operation, Selection and sizing of boilers; waste heat boilers, Steam generation by utilizing process waste heat using thermic fluids, Steam economy, Steam condensers and condensate utilization Expansion joints, flash tank design, steam traps their characteristics, selection and application, waste heat utilization; Lagging, selection and thickness.

**Module 3**

**(10 Hrs)**

**Compressors, blowers and Vacuum Pumps:** Compressors, blowers and vacuum pumps and their performance characteristics; Methods of developing vacuum and their limitations, material handling under vacuum, Piping systems; Lubrication and oil removal in compressors and pumps. Air filters, Air and gas leakage. Inert gas systems, compressed air for process, Instrument air, Pneumatic control and conveying, Refrigeration and HVAC fundamentals.

**Insulation:** Importance of insulation for meeting the process requirement, insulation materials and their effect on various material of equipment piping, fitting and valves etc. insulation for high intermediate, low and subzero temperatures, including cryogenic insulation.

**Module 4**

**(06 Hrs)**

**Economic Aspects of Safety:** Operational safety-commissioning, safe start-up and safe shut-down of equipment such as, distillation column, furnace, reactor, pumps and compressors.

**Module 5**

**(08 Hrs)**

**Control of Process:** Control of process, Prevention of hazardous deviation in process variables, e.g. pressure, temperature flow by provision of automatic control systems- interlocks, alarms, trips together with good operating practices and management.

**Safety Regulations:** Regulations and legislation, Risk management routines and tackling disaster, Safety Procedures and Designs Process Safety Hierarchy, Process Safety Strategies, Managing Safety, Safety Reviews and Accident Investigations, Designs for Process Safety, Inherently Safer Designs.



**Course Outcome:**

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

1. Calculate the requirements of water and air and their applications as utilities.
2. Calculate the steam requirement and its applications as utility.
3. Demonstrate compressors, blowers and vacuum pumps.
4. Understand economic aspects of safety.
5. Evaluate and apply the various risk assessment methods in industries.

**List of Text/Reference Books:**

1. Nordell Eskel, "Water Treatment for Industrial and Other Uses", Reinhold Publishing Corporation, New York.1961
1. Crowl D.A. & Louvar J.F. "Chemical Process Safety: Fundamentals with Applications". New Jersey: Prentice-Hall.1989
2. Goodall P. M., "The Efficient Use Of Steam" IPC Science and Technology.1980
3. Lees F. P., "Loss Prevention in Process Industries 3 volume set" Butterwort Heinemann, Oxford. 1996