



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Chemical Engineering

Course / Subject Code : DI03005051

Course / Subject Name : Safety and Hazard Management

w. e. f. Academic Year:	2024-25
Semester:	3 rd
Category of the Course:	PCC

Prerequisite:	NA
Rationale:	Chemical Industries are known as the most dangerous and hazardous industries since long. Varieties of conditions are present in chemical industries which may lead to different type of industrial accidents. Bhopal MIC leak accident is a world-famous industrial accident which also happened in a chemical plant of Union Carbide Company in which thousands died and many got different diseases. Most of the industrial accidents are due to the human error or ignorance and responsible for the major losses to the industries and humanity. Use and handling of certain chemicals is also found to be dangerous as it may lead to health hazards. It is therefore essential for the technician to know about hazards, accidents, safe handling of chemicals, and operation of plant equipment and transportation of chemicals. Hence the course has been designed to develop this competency and its associated cognitive, practical and affective domain learning outcomes.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Explain basic concepts of Environment, Health & Safety	U
02	Explain Indian and International Safety standards	U
03	Explain hazard control method in chemical industries.	U
04	Explain hazard identification method & Risk assessment method.	U
05	Analyze case studies of industrial disasters	A

**Revised Bloom's Taxonomy (RBT)*



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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
UNIT I Basic Concepts of Environment, Health & Safety	1.1 Importance of Industrial Safety 1.2 Terminologies: a. Safety b. Pollution c. Exposure d. Severity e. Probability f. Hazard g. Risk h. Accident i. Unsafe Act and Unsafe Condition j. Near miss k. Aspect and Impact	5	14
UNIT II Indian and International Safety Standards	2.1 International standards: 2.1.1 ISO overview a. ISO 9001 b. ISO 14001 c. ISO 45001 d. ISO 50001 2.2 Indian Standards: 2.2.1 BIS overview a. IS 17893 (latest)- Work Permit System b. IS 15656 (latest) - Hazard identification and risk analysis - Code of practice c. IS 15394 (latest) - Fire Safety in Petroleum Refineries and Fertilizer Plants - Code of Practice	10	22
UNIT III Hazard Control Methods in Chemical Industries	3.1 Describe Chemical industrial Hazards a. Chemical hazard b. Electrical hazard c. Mechanical hazard d. Biological hazard e. Radiation hazard 3.2 Occupational diseases and their causes 3.3 Hazard control hierarchy	15	29



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	a. Elimination b. Substitution c. Engineering Controls Ventilation and lighting, Enclosure, Isolation d. Administrative Controls Work permit system, Lock Out Tag Out(LOTO) Management, Drills and table top exercises, Good Housekeeping- 5S, Color codes and symbols for safety in chemical plants e. Personal Protective Equipments (PPEs) 3.4 Fire hazards & their causes 3.5 Fire Triangle and Fire Extinguishment method 3.6 Classes of fire and respective suitable firefighting equipment 3.7 Fire extinguisher operation: PASS 3.8 Safety Data Sheet (SDS)		
UNIT IV Hazard Identification and Risk Assessment Methods	4.1 List out various Hazard Identification Methods. 4.2 Explain Hazard Identification Method: a. Hazard Operability Study (HAZOP) b. Hazard Identification and Risk Assessment (HIRA) 4.3 List out various Risk Assessment Methods 4.4 Explain Risk Assessment method: a. ETA: Event Tree Analysis b. FTA: Fault Tree Analysis	10	21
UNIT V Case Studies of Industrial Disasters	5.1 Significant National Industrial Disaster: Bhopal Gas Tragedy (1984, India) a. Introduction and Background b. Chronology of Events Leading to the Disaster c. Root Causes and Contributing Factors d. Consequences and Long-Term Effects e. Key Lessons Learnt 5.2 Significant International Industrial Disaster: Texas City Refinery Explosion (2005, USA) a. Introduction and Background b. Chronology of Events Leading to the Disaster c. Root Causes and Contributing Factors d. Consequences and Industry Impact e. Key Lessons Learnt	5	14
	Total	45	100



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Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
23	55	22	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

S. No.	Title of Book	Author(s)	Publication with Place, Year, and ISBN
1	Manual of Chemical Technology, Chemtech-I	D. Venkateswarlu, K. R. Upadrashta, K. D. Chandrasekaran	Chemical Engineering Education Development Centre, IIT Madras, 1975
2	Fundamentals of Industrial Safety & Health	Dr. K. U. Mistry	Siddharth Prakashan, Ahmedabad
3	Chemical Process Safety: Fundamentals with Application	Daniel A. Crowl, Joseph F. Louvar	3rd Edition, 2011, Prentice Hall, USA
4	Industrial Safety Management	N. K. Tarafdar, K. J. Tarafdar	Dhanpatrai and Co. Ltd., New Delhi, 1st Edition, 2012
5	Industrial Safety Management	L. M. Deshmukh	Tata McGraw Hill, New Delhi, 2006
6	Industrial Safety, Health & Environment Management	Sunil S. Rao, R. K. Jain	Khanna Publishers, New Delhi, 2006

(b) Open-source software and website:

1. <https://www.osha.gov>
2. <https://www.iso.org>
3. <https://www.bis.org.in>
4. <http://www.iffco.nic.in/applications/brihaspat.nsf>
5. <http://sp.ehs.cornell.edu/lab-research-safety/laboratory-safetymanual/Pages/ch8.aspx>



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Suggested Practical List:

Sr. No.	Practical/exercise
1	Prepare a chart of Indian and International Safety Standards
2	Identify different hazards in a given chemical plant
3	Identify chemical hazards in a given plant
4	Identify color codes for pipelines used for hazardous chemicals
5	Identify color codes for gas cylinders
6	Identify different safety symbols used in the chemical industry
7	Demonstrate Personal Protective Equipments (PPEs) for safety
8	Prepare a handout on safe handling practices for hazardous chemicals
9	Demonstrate Fire Triangle and Classes of Fire
10	Demonstrate construction and working of different fire extinguishers
11	Apply HAZOP (Hazard Operability Study) method using a case study
12	Apply Risk Assessment methods (FTA, ETA) for a chemical plant
13	Analyse a case study of an industrial disaster
14	Visit a chemical plant or an Institution and prepare a safety report

Suggested Activities for Students:

- 1 Study of Fire extinguishers / Visit of a nearby fire station
- 2 Study of personal protective equipments / visit to nearby industry
- 3 Preparation of Material Safety Data Sheet of hazardous materials
- 4 Visit to websites of reputed fire and safety equipment suppliers and study of features of their equipment/instruments/tools.

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