GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Minor/Hons. Program

Level: UG

Branch: Minor/Hons. Forensic Structural Engineering

Subject Code: BE050AU021

Subject Name: Safety in Chemical Industry

w. e. f. Academic Year:	2026-27
Semester:	5
Category of the Course:	Core Courses

Prerequisite:	A good understanding regarding basics of fire occurrence, material and energy balance.
Rationale:	The main objective of this subject is to study different safety aspects in chemical industry. In depth study of hazardous chemicals and how to handle those chemicals under precautions. Storage of hazardous chemicals, volatile hydrocarbons. It also provides conceptual background of chemical reaction leading to risk and unsafe environment.

Course Outcomes: Students will be able to

Sr. No.	CO statement	Marks% weightage
CO-1	Explain the need of safety in chemical industries	10%
CO-2	Summarize the storing and handling of chemicals and different control measures	20%
CO-3	Explain process hazards and application of appropriate control measures	25%
CO-4	Choose different methods for the safe transfer of chemicals	15%
CO-5	Explain about the inspection, testing and maintenance	15%
CO-6	Compare control measure for chemical reactive natures	15%

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA (I)	PBL (I)	ESE (V)	
45	0	30	45	120	04	70	0	0	30	50	150

Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBAmanual.

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, PA = Progressive Assessment, ESE = End-Semester Examination

Content:

Sr. No.	Content	Total Hrs
1	**Introduction**: Need of safety in chemical industry, Types of chemical industries, Process flow chart and its importance for safety inspection, Types of Chemical Hazards: Hazards due to material (property), unloading and transfer, process, vessel or equipment, utility, pollution, fire, explosion, toxic release, packing and loading etc. Appropriate control measures), Medical examinations and health records for workers employed in hazardous processes, Hazard Communication System. Classification of chemicals as solid, liquid, gases, explosive, reactive, toxic, radioactive, corrosive etc. Criteria for sitting and safe layout of chemical plants, , Statutory provisions, Information to Workers about Safety Manual, Factory Inspectorate, District Authorities and the public. Information to surrounding hospitals, Instrumentation for safe plant operations.	**8**
2	**Storage Hazards and Controls**: Receiving, Storing and Handling of Chemicals, Safe unloading procedure to storage tank, Prevention of overflow, pressure, temperature and process flow, Types of gauges and valves for the vessel, its inlets and outlets, Need of remote and auto control valves, Safety measures for storage tanks of Acids, Alkalis, Chlorine, Ammonia, LPG and Ethylene oxide, Safety measures for storage of flammable liquids/solvents, gases and radioactive substances, Safety of storing and using gas cylinders, color coding, marking and ensuring safe connection of cylinder and testing of safety fittings.	**7**
3	**Process Hazards and its Controls**: Safe design of process vessels and their fittings. Material of construction and lining depending on type of chemical and its process, Hazards and controls in Unit Processes and Unit Operations including, exothermic or runaway reaction, solvent distillation, toxic reaction and other hazardous processes evolving gas, dust, vapor etc. Use of, trips, alarms, interlocks, auto controls and other instruments. Safety features of DCS control room, Laboratory Safety. Sampling and analysis, Monitoring and control of hazardous exposures. Comparison with permissible limits and inference. Implementation of control measures.	**8**
4	**Chemical Reaction hazards**: Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self – heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermo chemical screening, Stability and sensitivity tests, Hazard prediction by thermodynamic calculations, Prevention and control of explosions and detonations – diluting a release, purging and inerting, venting, explosion relief, flame arrestors, explosion suppression.	**9**

5	**Safe Transfer of Chemicals**: Safe transfer of chemicals by pipelines within and outside, installations, above and underground, Safety of pipelines, Work permit while opening or repairing pipelines of hazardous contents, Color coding, earthing, bonding and testing of pipelines, Transfer in closed system or vacuum with appropriate controls and with the use of PPE, Safety during the operation of valves and fittings. Safety precautions for transporting hazardous/toxic/flammable/ explosive/radioactive substances by all modes, training to drivers and safety checklists for transport vehicles.	**7**
6	**Inspection, Testing and Maintenance**: Inspection techniques for plants, storage and reaction vessels, Checklists for routine inspection, preventive and break down maintenance, Testing, Certification and records in prescribed Forms, Compliance of Codes and statutory provisions. Causes, Inspection and prevention of Corrosion, erosion. Safe start up and shut down procedures, Emergency shutdown, Use of work permit or checklist.	**6**
	TOTAL	**45**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**15**	**20**	**10**	**15**	**0**

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Arendt and Lorenzo (2000), Evaluating Process Safety in the Chemical Industry, New York: CCPS
2. King et al. (1998) King's safety in the process industries, London: Wuerz Publishing Ltd..
3. Ray Sinnot& Gavin Towler, Chemical Engineering Design, 5th Edn, Butterworth – Heinmann, Coulson & Richardson series.

List of Practicals/Tutorials:

1. Preparation and compilation and study of Material safety data sheet (MSDS)
2. To study calibration of various instruments like pressure (Dead weight pressure gauge tester), thermocouple & RTD calibration
3. To study calibration of different flow meters
4. To study safe process design of (a) Storage tank (b) Reaction vessel (incorporating runaway reaction)
5. To study sampling and analysis of various hazardous exposure using Air sampling technique
6. To prepare safety checklist for handling and transportation of flammable compounds.

7. To study Hazard and operability studies (HAZOP)
8. To study puff and plume dispersion

List of Open Source Software/learning website:

Reference to NPTEL can be made for a better understanding regarding safe process design, PFD analysis, and analysis of blast threat zone..

List of suggested activities for Problem Based Learning:

Sr. No.	Description	No. of Hours	Total Hrs.
1	Technical Video based learning related to the subject	Duration of video: 5h Report preparation: 5h	**10**
2	Assignment writing Numerical based assignment is preferable.	5 assignments of 4h each.	**20**
3	Videos on Industrial safety/Disaster Management aspects based on subject	Duration of video: 5h Report preparation: 5h	**10**
4	Poster/chart PowerPoint preparation on technical topics	Duration:6 h	**6**
5	Self-learning on-line course	Minimum duration of the course should be 10h.	**10**
6	Discussion on research paper based on relevant subject	5 research paper: 20h	**20**
7	Group Discussion on emerging/trending technical topics based on subject	Duration: 1 h each	**1**
8	Annotated Video Explanation of Concept / Problem	10h (Preparation * Recording + Submission)	**10**
9	Online Technical Quizzes/Simulations	Multiple quizzes summing up to 10h	**10**
		Max. Hours to be allotted	**45**

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