

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING (05) POLLUTION CONTROL & SAFETY MANAGEMENT SUBJECT CODE: 2160504 B.E. 6th SEMESTER

Type of course: Chemical Engineering

Prerequisite: Environmental Science

Rationale: The Course focuses on types of pollution, its effects and control methodology along with industrial law and acts. Safety management part includes engineering principles and methods required for safety in Industries. This course would educate students to identify and assess hazards in any stage of operation, to quantify and manage them as well.

Teaching and Examination Scheme:

| Teaching Scheme | | | Credits C | Examination Marks | | | | | | Total Marks |
|-----------------|---|---|--------------|-------------------|-----|---------|-----------------|-----------|---|----------------|
| L | T | P | | Theory Marks | | | Practical Marks | | | |
| | | | ESE (E) | PA (M) | | ESE (V) | | PA (I) | | |
| | | | PA | ALA | ESE | OEP | | | | |
| 3 | 0 | 0 | 3 | 70 | 20 | 10 | 0 | 0 | 0 | 100 |

Content:

| Sr. No. | Content | Total Hrs | % Weightage |
|-----------|---|--------------|-------------|
| A. | Pollution Control | | |
| 1 | Environmental Protection: Concept of environment and ecology, various natural cycles in environment and ecology, effect of human activities on environment and ecology. Various types of environmental pollution in general and in chemical and allied industry in particular, sources and causes of environmental pollution, effect of pollution on environment, environmental impact assessment and Environment Impact Statement, methodologies for environmental pollution prevention (including process technology up gradation, development, Invention etc.), control, abatement and treatment and waste disposal. Rules, regulations, laws etc. regarding environmental protection, pollution prevention and control, waste disposal etc. Role of government, semi/quasi govt. and voluntary organizations. Current trends and topics | 18 | 33 |
| 2 | Industrial Laws and Act: Introduction to Industrial laws, Industries Factory act, Energy audit, Environment Audit, Trade union, Labour laws and acts. Industrial Electricity rules, Industrial Dispute Acts, Workmen compensation Act, ESIC Act, Payment and Wages act, Minimum Wages act, Payment of Bonus act, Recent trends and practices in Safe industrial practices | 08 | 15 |

| | | | |
|-----------|---------------------------|--|--|
| B. | Safety Management: | | |
|-----------|---------------------------|--|--|

| | | | |
|----|--|----|----|
| 1. | Safety Management: Development of safety movement, Need for safety 1. General Introduction Historical Background and Growth of Safety Science, Aims of Safety Science, Safety and the Organization, safety audit 2. Basic Concepts of Safety Science. Hazard, Risk, Nature of the accident process, Use of Engineering Fundamentals in safety science. 3. Risk Assessment & Hazard Identification Checklist procedure, Preliminary hazard analysis, What if analysis, Failure mode effect analysis, Hazard and operability (HAZOP) studies, Hazard analysis techniques: Fault tree analysis, Event tree analysis, General outline of DOW index, Risk estimation and management, Major hazard control | 10 | 19 |
| 2. | 4. Fault and Event Tree Analysis for Risk Prediction 5. Source Models Models of Accidental Release of Toxic/Flammable liquids and vapors, Models of flow of liquids and vapors through pipes. 6. Dispersion Models: Mathematical Models for prediction of Dispersion patterns for toxic/flammable materials released into atmosphere, various types of "plume" and "puff" models of dispersion. 7. Nature of fires and explosion Calculation of Blast damage due to over-pressure, prevention of fires and explosions. 8. Control of Major Chemical Hazards, Emergency Control and disaster planning, On-site and Off-site emergency preparedness. 9. Introduction to various personal protective equipments 10. Instruments for safety : Pressure safety valve, Rupture disc , Interlocks etc. | 18 | 33 |

Suggested Specification table with Marks (Theory):

| Distribution of Theory Marks | | | | | |
|------------------------------|---------|---------|---------|---------|---------|
| R Level | U Level | A Level | N Level | E Level | C Level |
| 30 | 20 | 10 | 05 | 05 | -- |

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

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Frank P Lees, "Loss Prevention in Process Industries" Volume 1, 2 & 3
2. Industrial Organization and Economics by T.R. Banga & S.C. Sharma
3. "Chemical Process Safety, Fundamentals with Applications", Second Edition by Daniel A. Crowl & Joseph F. Louvar Published by Prentice Hall, Inc. ISBN 0-13-018176-5
4. Environment Engineering by Metcalf and Eddy
5. Environmental Pollution Control Engineering By C.S.Rao

Course Outcome:

After learning the course the students should be able to:

1. Know about types of pollution, its sources, effects and control methodology and thereby environmental protection.
2. Be aware of the Industrial Laws and Act.
3. Know about environmental impact assessment and EIS.
4. Discuss methodology for environmental audit and safety audit.
5. Be aware of the factors that can lead to an accident.
6. Learn different methods of hazard analysis and control of hazards.
7. Discuss source models, dispersion models, fires and fire prevention, explosions and explosion prevention, pressure relief systems, runaway reactions and risk analysis as they apply to chemical process safety, and be able to solve corresponding problems.
8. How to characterize different types of fire and explosions and its control

List of Tutorials:

Students can select any type of industry and learn an existing process used for waste water treatment and can suggest modifications in process to improve efficiency of treatment. Each group is expected to analyze the process of manufacturing of the specific chemical assigned to his/her group, with a special emphasis on safety issues. In addition, each group will be expected to give a power point presentation during last week of semester. The presenter will be selected randomly just prior to the presentation.

List of Open Source Software/learning website:

Softwares:

- PollutionTech - Air Pollution Control Software
- Safety Management Software, MSDS Software, CSafe, DR software's ChemGes, Periscope software, [MAUS OHS Planning software](#) (Occupational, Health & Safety Planner), [CINTELLATE](#)
- Students can refer to video lectures available on the websites including NPTEL.
- Students can refer to the CDs which are available with some reference books for the solution of problems using softwares. Students can develop their own programs for the solutions of problems.
- Websites: www.safetyforlife.com.au, SmartOHS.com.au

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.