



B. Tech. with Minor in Industrial Safety

Offered by

Department of Chemical Engineering



1. Subject Code: 22CHT308 Course Title: Process Safety and Risk Management

2. Contact Hours: L: 3 T: 0 P: 0

3. Credits: 3 Semester: V

4. Pre-requisite: Nil.

5. Course Objective: To deliver a broad level of risk identification and management in process plant integrity management. Student will be able to recognize and evaluate occupational safety and health hazards in the workplace

6. Course Outcomes: On successful completion of the course students will be able to:

- i. Understand the fundamental principles underlying safety and risk management
- ii. Understand the toxicology, fire & explosion hazards
- iii. Establish expertise relevant to the practice of safety and risk management
- iv. Undertake a Hazard and Operability Study (HAZOP)

7. Details of Course:

Unit No.	Contents	Contact Hours
1.	Origin of process hazards, Laws Codes, Standards, Case Histories, Properties of Chemicals, Health hazards of industrial substances, Personal Protective equipment.	5
2.	Toxicology: Toxic materials and their properties, effect of dose and exposure time, relationship and predictive models for response, Threshold value and its definitions, material safety data sheets, industrial hygiene evaluation.	5
3	Fire and explosion: Fire and explosion hazards causes of fire and preventive methods. Flammability characteristics of chemical, fire and explosion hazard, rating of process plant. Propagation of fire and effect of environmental factors, ventilation, dispersion, purifying and sprinkling, safety and relief valves. Other Energy Hazards: Electrical hazards, noise hazard, radiation hazard in process operations, hazards communication to employees, plant management and maintenance to reduce energy hazards.	14
4	Risk Analysis: Component and plant reliability, event probability and failure, plant reliability, risk analysis, HAZOP, HAZAN,SIL, event and consequence analysis (vapour cloud modelling) Designing for safety, measurement and calculation of risk analysis.	8
5	Hazard Assessment: Failure distribution, failure data analysis, modelling for safety, safety training, emergency planning ad disaster management, case studies	8



8. Books:

(A) Text Books

S. No.	Authors / Name of Book / Publisher	Year of Publication
1.	Crawl D.A. and Louvar J.A., "Chemical Process Safety Fundamentals with Applications," 4 th Ed., Prentice Hall.	2020

(B) Reference Books

S. No.	Authors / Name of Book / Publisher	Year of Publication
1.	Lees, F. P., "Loss Prevention in Process Industries", Vol.1 and 2, 4 th Ed., Butterworth.	2012
2.	Wentz, C.A., "Safety Health and Environmental Protection," McGraw Hill.	1998



1. Subject Code: 22CHT304 Course Title: Industrial Regulations and Occupational Health Management

2. Contact Hours: L: 3 T: 0 P: 0

3. Credits: 3 Semester: V

4. Pre-requisite: Nil.

5. Course Objective:

- i. Regulations and statutory requirements relevant to health, safety and environment.
- ii. Promotion of occupational health and prevention of occupational diseases.

6. Course Outcomes: On successful completion of the course students will be able to:

- i. Appraise various acts and rules and use them for the development of safe and healthy working environment
- ii. Identify the need of ISO 14001 and ISO 45001 standards in an organization.
- iii. Formulate plans for the promotion of occupational health and prevention of occupational diseases
- iv. Analyse workplaces, equipment, and work postures to recognize ergonomics deficiencies and suggest solutions

7. Details of Course:

Unit No.	Contents	Contact Hours
1.	Factories act and rules, Workmen compensation act, Indian explosive act, Gas cylinder rules - SMPV Act, Indian petroleum act and rules, Environmental pollution act, Air Act, Water Act, Fly ash Rules.	10
2.	Manufacture, Storage and Import of Hazardous Chemical rules 1989, Indian Electricity act and rules. Overview of ISO 45001 and ISO 14001 Inflammable Substance Act, 1952, Building and other construction workers (Regulation of employment and conditions of service) Act, 1996 and The Central Rules, 1998. Ammonium Nitrate Rules, 2012.	10
3	Occupational Health and Toxicology: Concept and spectrum of health: functional units and activities of occupational health services, pre-employment and post-employment medical examinations, occupational related diseases, levels of prevention of diseases, notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax, lead-nickel, chromium and manganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc.) their effects and prevention: cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests. Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems.	10
4	Occupational Physiology: Man as a system component, allocation of functions, efficiency, occupational work capacity, aerobic and anaerobic	10



	work, evaluation of physiological requirements of jobs, parameters of measurements, categorization of job heaviness, work organization, stress-strain, fatigue, rest pauses, shift work, personal hygiene.	
--	--	--

8. Books:

(A) Text Books

S. No.	Authors / Name of Book / Publisher	Year of Publication
1.	<i>Encyclopedia of Occupational Health and Safety</i> , Vol. I & II, International Labour Organisation, Geneva.	1985
2	McCormick, E.J. and Sanders, M.S., <i>Human Factors in Engineering and Design</i> , 5 th Ed., Tata McGraw-Hill.	1996
3	The Factories Act 1948, Madras Book Agency, Chennai.	2000
4	The Environment Act (Protection), Commercial Law Publishers (India) Pvt. Ltd., New Delhi.	1986
5	Explosive Act, 1884 and Explosive rules, 1883 (India), 10 th Ed., Eastern Book company, Lucknow.	2002



1. Subject Code: 22CHT351

Course Title: Industrial Pollution Control

2. Contact Hours: L:3 T:0 P:0

3. Credits: 3 Semester: VI

4. Pre-requisite: Nil.

5. Course Objective: To understand the important issues and their control principles of industrial pollution.

6. Course Outcomes: Upon completion of this course, the students will be able to:

- i. Gained knowledge of the Environmental legislation and standards
- ii. Analyze/design of suitable treatment operation for wastewater
- iii. Model the atmospheric dispersion of air pollutants and design of air pollution control devices
- iv. Analyze the characteristics of solid waste, its handling & management

7. Details of Course:

Unit No.	Contents	Contact Hours
1.	Industrial pollution, Different types of wastes generated in an industry, Legislation, standards for water and air, Environmental regulatory legislations and standards	6
2.	Wastewater Treatment: Identification, quantification and analysis of wastewater, Classification of different treatment methods into physico-chemical and biochemical techniques, Physicochemical methods, General concept of primary treatment, Liquid-solid separation, Neutralization and flocculation, Disinfection, Biological methods, Concept of aerobic digestion, Design of activated sludge process, Concept of anaerobic digestion, Biogas plant layout, Different unit operations and unit processes involved in conversion of polluted water to potable standards.	16
3.	Air Pollution Control: Sources and classification of air pollutants, nature and characteristics of gaseous and particulate pollutants, pollutants from automobiles. Air pollution meteorology, plume and its behavior and atmospheric dispersion, control of particulate emissions by gravity settling chamber, cyclones, wet scrubbers, bag filters and electrostatic precipitators. Control of gaseous emissions by absorption, adsorption, chemical transformation and combustion.	10
4.	Solid Waste Management: Analysis and quantification of hazardous and non-hazardous wastes, Treatment and disposal of solid wastes, Land filling, Leachate treatment, Incineration.	8



8. Books:

(A) Text Books

S. No.	Authors / Name of Book / Publisher	Year of Publication
1	Peavy, H. S., Rowe, D. R., Tchobanoglous, G., "Environmental Engineering"; McGraw Hill.	1985
2	Masters, G.M., Introduction to Environmental Engineering and Science, 3 rd Ed. Prentice Hall.	1991
3	Metcalf & Eddy, Inc., "Wastewater Engineering: Treatment and Reuse", 4 th Ed., Tata McGraw Hill, New Delhi.	2003

(B) Reference Books

S. No.	Authors / Name of Book / Publisher	Year of Publication
1	De Nevers, N., "Air Pollution Control Engineering", 2 nd Ed., McGraw-Hill.	1999
2	Mahajan, S. P., "Pollution Control in Process Industries," Tata McGraw-Hill, New Delhi.	1985
3	Modi, P. N., "Sewage Treatment and Disposal and Waste Water Engineering," Vol. II, 17 th Ed. Standard Book House, Delhi.	2020



- 1. Subject Code: 22CHT355** **Course Title: Process Engineering and Plant Design**
2. Contact Hours: L: 3 T: 0 P: 0
3. Credits: 3 Semester: VI
4. Pre-requisite: Nil.
5. Course Objective: To provide comprehensive knowledge of various process parameters and economics involved in the development of process and plant design.
6. Course Outcomes: Upon completion of this course, the students will be able to:
- Understand the concepts of engineering and economics for chemical plant design and optimization
 - Synthesize a process flow sheet for recycle structure
 - Calculate different costs involved in a process plant
 - Perform breakeven analysis and optimum design of a process
7. Details of Course:

Unit No.	Contents	Contact Hours
1.	Process Design and Development: Design considerations; Hierarchy of process design, the nature of process synthesis and analysis; Development of a conceptual design and finding the best flowsheet: input information and batch versus continuous, Input/output structure of the flowsheet; Recycle structure of the flowsheet; Separation system; Heat Exchanger Networks.	12
2.	Plant Design: Process design development and general design considerations.	8
3.	Process Economics: Economic feasibility of project using order-of-magnitude cost estimates, plant and equipment cost estimation, product cost estimation.	8
4.	Cash Flows: Time value of money, investment, costs, sales, profits, taxes, depreciation.	6
5.	Profitability Analysis: Rate of return, payback period, discount rate of return, net present worth, internal rate of return, comparing investment alternatives.	6



8. Books:

(A) Text Books

S. No.	Authors / Name of Book / Publisher	Year of Publication
1	Douglas, James M., "Conceptual Design of Chemical Processes", McGraw-Hill, International Editions (Chemical Engineering Series), New York, USA.	1988
2	Peters, Max S., K.D. Timmerhaus and R.E. West, "Plant Design and Economics for Chemical Engineers", (5 th Ed.), McGraw-Hill International Editions (Chemical Engineering Series), New York, USA.	2017
3	Mahajani, V.V., "Chemical Project Economics", Macmillan Indian Ltd., New Delhi, India.	2005

(B) Reference Books

S. No.	Authors / Name of Book / Publisher	Year of Publication
1	Biegler, L.T., I.E. Grossmann and A.W. Westerberg, Systematic Methods of Chemical Process Design, Prentice Hall (Pearson Education), New Jersey, USA	1997
2	Smith, R. Chemical Process Design and Integration. John Wiley & Sons, West Sussex, England.	2005



1. Subject Code: 22CHT401
Control

Course Title: Fire Engineering and Explosion

2. Contact Hours: L:3 T:0 P:0

3. Credits: 3 Semester: VII

4. Pre-requisite: Nil.

5. Course Objective: Principles of fire and explosion and characteristics of various materials, design of fire prevention and suppression systems.

6. Course Outcomes: Upon completion of this course, the students will be able to:

- i. Explain the physics and chemistry of fire.
- ii. Identify the class of fire and suitable extinguishing method to suppress that.
- iii. Outline the main principles and practices of fire and explosion prevention and protection.
- iv. Describe the behavior of structural materials, buildings and building contents in a fire.
- v. State and comply with the relevant statutory and regulatory requirements in fire and explosion safety.

7. Details of Course:

Unit No.	Contents	Contact Hours
1.	Physics and Chemistry of Fire: Fire properties of solid, liquid and gases, fire spread, toxicity of products of combustion, combustion characteristic, flash point, fire point, ignition temperature, LFL, UFL, flame propagation. Flames, diffusion flame, pyrolysis, premixed flame. Glowing combustion, Smouldering, Deep-seated fire. theory of combustion and explosion, properties of explosive, propellant, vapour clouds, flash fire, jet fires, pool fires, unconfined vapour cloud explosion, shock waves, auto-ignition, boiling liquid expanding vapour explosion, case studies: Flixborough, Mexico disaster, Pasedena Texas, Piper Alpha, Peterborough, and Bombay Victoria dock ship explosions.	8
2.	Fire Prevention and Protection: Sources of ignition, fire triangle, principles of fire extinguishing, active and passive fire, protection 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, fire alarms and sirens, maintenance of fire trucks, foam generators, escape from fire rescue operations, fire drills, notice-first aid for burns, Emergency rescue techniques in high rise buildings, chemical industries, and oil and gas industries. Safety requirements for Hot work in oil and gas industry.	8
3.	Industrial Fire Protection Systems: Sprinkler, hydrants, stand pipes, special fire suppression systems like deluge and emulsifier, selection and design criteria of the above installations, reliability, maintenance, evaluation and standards, alarm and detection systems. Other	8



	suppression systems – CO ₂ system, foam system, dry chemical powder (DCP) system, halon system, Inergen, FM200, Novec – need for halon replacement, smoke venting. Portable extinguishers, flammable liquids, tank farms indices of inflammability, fire fighting systems. Fire tender-Operations, Equipment and maintenance- Overview of NFPA.	
4.	Building Fire Safety: Objectives of fire safe building design, Fire load, fire resistant material, and fire testing, structural fire protection, structural integrity, concept of egress design, exists, width calculations, fire certificates, fire safety requirements for high rise buildings, snookers.	5
5	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 ₂) and halons-hazards in LPG, ammonia (NH ₃), sulphur dioxide (SO ₂), chlorine (Cl ₂) etc.	8

8. Books:

(A) Text Books

S.No.	Authors / Name of Book / Publisher	Year of Publication
1	Derek, James, "Fire Prevention Hand Book", 9 th Ed., Butter Worths and Company, London.	2016
2	Gupta, R.S., "Hand Book of Fire Technology" 2 nd Ed., Orient Longman, Bombay.	1993
3	Council Safety National, "Accident Prevention manual for industrial operations" 3 rd Ed., N.S.C., Chicago.	2008

(B) Reference Books

S.No.	Authors / Name of Book / Publisher	Year of Publication
1	Dinko Tuhtar, "Fire and explosion protection" 3 rd Ed.	2007



1. Subject Code: 22CHT451

Course Title: Disaster Management

2. Contact Hours: L:3 T:0 P:0

3. Credits: 3 Semester: VIII

4. Pre-requisite: Nil.

5. Course Objective: Principles and elements of disaster management and emergency preparedness, control measures to mitigate the effects of industrial disasters.

6. Course Outcomes: Upon completion of this course, the students will be able to:

- i. Describe the elements of disaster management practices
- ii. Develop on-site and off-site emergency plans for hazardous industries and coordinate the implementation of the same
- iii. Conduct environmental impact assessment for sustainable development
- iv. Demonstrate countermeasures for natural and man-made disasters.

7. Details of Course:

Unit No.	Contents	Contact Hours
1.	Philosophy of Disaster management, Introduction to Disaster mitigation, Hydrological, Coastal and Marine Disasters, Atmospheric disasters, Geological, meteorological phenomena, Mass Movement and Land Disasters, Forest related disasters, Wind and water-related disasters deforestation, Use of space technology for control of geological disasters, Master thesis.	8
2.	Technological Disasters, Case studies of Technology disasters with statistical details Emergencies and control measures-APELL-Onsite and Offsite emergencies, Crisis management groups, Emergency centers and their functions throughout the country, Softwares on emergency controls, Monitoring devices for detection of gases in the atmosphere, Right to know act.	8
3.	Introduction to Sustainable Development, Bio Diversity, Atmospheric pollution, Global warming and Ozone Depletion, ODS banking and phasing out, Sea level rise, El Nino and climate changes, Eco-friendly products, Green movements, Green philosophy, Environmental Policies, Environmental Impact Assessment, case studies-Life cycle.	8
4.	Offshore and onshore drilling-control of fires, Case studies, Marine pollution and control Toxic, hazardous & Nuclear wastes, state of India's and Global environmental issues carcinogens, complex emergencies, Earthquake disasters, the nature, extreme event analysis, the immune system, proof and limits.	8
5	Environmental education, Population and community ecology, Natural resources conservation, Environmental protection, and law, Research methodology and systems analysis, Natural resources conservation, Policy initiatives and future prospects, Risk assessment process, assessment for different disaster types, Assessment data use, destructive	8



	capacity, risk adjustment, choice-loss acceptance-disaster aid-public liability insurance, stock taking and vulnerability analysis, disaster profile of the country, national policies, objectives and standards physical event modification, preparedness, forecasting and warning, land use planning.	
--	---	--

8. Books:

(A) Text Books

S.No.	Authors / Name of Book / Publisher	Year of Publication
1	Gilbert, M. Masters, Introduction to Environmental Engineering and Science, 3 rd Ed. Pearson.	2006
2	Miller, G. Tylor, Environmental Science, 13 th Ed. Brookes-Cole.	2010

(B) Reference Books

S.No.	Authors / Name of Book / Publisher	Year of Publication
1	R. Sivakumar, Principles of Environmental Science and Engineering, 2 nd Ed., Vijay Nicole Imprints.	2005