GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Branch: Chemical Engineering (Green Technology and Sustainability Engineering)

Course/Subject Code: BE04044031

Course/Subject Name: Pollution Control & Safety Management

W. E. F. Academic Year:	2024-25
Semester:	4
Category of the Course:	Professional Core

Prerequisite:	Basic Concepts of chemistry and environmental science.
Rationale:	This course is intended to familiarize students with the concepts of various traditional and modern pollution control methods along with identifying various pollutants and prevalent industrial laws and acts pertaining to safety, health and environment under Indian context. This course would enable students to identify and assess hazards in any stage of operation, to quantify and manage them as well.

Course Outcome:

After Completion of the Course, Student will able to:

Sr. No.	CO statement	Marks % weightage
CO-1	To understand the impact of engineering solutions in a global and societal context	20
CO-2	To understand and apply appropriate control and preventive measures for different types of pollution	35
CO-3	To identify major process and health hazards and apply hazard analysis techniques for risk assessment	20
CO-4	To acquire knowledge about the various environmental and safety standards and legislations	25

Teaching and Examination Scheme:

Teaching /Learning Scheme in Hours Per Semester					Total Credits = TH/30	Examination Marks					Total Marks
						Theory Marks		Practical Marks			
L	T	P	TW/SL	TH	04	ESE (E)	PA (M)	ESE (V)	TW/ SL	PA (I)	
45	0	30	45	120		70	30	30	NA	20	150

Course Content:

Sr. No.	Content	Total Hrs
1	**Introduction:** Impact of man on the environment; ecological systems and pollution, hydrologic and nutrient cycles. 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.	5
2	**Air pollution:** Classification and properties of air pollutants, Emission sources, behavior and fate of air pollutants with special reference to chemical reactions in atmosphere, reactions at the earth's surface, photochemical smog etc., air pollution meteorology (generation, transportation and dispersion of air pollutants). Outlines of industrial air pollution control and particulate control equipment: selection, design and performance analysis; cyclone separator, fabric filters, gravity settling chambers, ESPs, wet scrubbers. Control of gaseous emissions Stack sampling and analysis of air pollutants.	7
3	**Water pollution:** Sources and classification of water pollutants, Physico-chemical characterization of wastewater, water quality standards, Industrial water pollution management: Wastewater treatment processes; Pretreatment, primary and secondary treatment processes. Advanced wastewater treatment processes. Design of sedimentation tanks and biological treatment processes.	6
4	**Solid waste management:** Sources and classification, public health aspects, methods of collection, potential methods of disposal: sanitary landfill, incineration, composting, recovery and recycling.	4
5	Introduction to Material Safety Data Sheet (MSDS), Sources of exposure, exposure evaluation, exposure-hazard control, Fire and explosion: types of fire, detonation and deflagration, UVCE and BLEVE, Regulatory bodies and regulations; Safety by design sizing of specific devices such as, safety release valves, vents, flare systems; Instrumentation for safety - specific devices such as alarms, interlocks, shutdown systems, 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.	7
6	Rules, regulations, laws etc. regarding environmental protection, pollution prevention and control, waste disposal etc. Standards and legislation EIA, EIS and EMP. Air and water pollution management through waste minimization. Industrial air pollution management, Role of government, semi/quasi govt. and voluntary	7

	organizations. Industries Factory act, concept of energy audit, environment Audit.	
7	Safe industrial practices, Development of safety movement, Need for safety-general introduction, historical background and growth of safety science, basic concepts of safety audit	**4**
8	Concept of Cleaner Production(CP), End of Pipe Solution, Good House Keeping checklist, CP Methodology, Barriers and Drivers in cleaner production, Principles of sustainable developments, Principles of green chemistry, atom economy, waste prevention and minimization of waste generation.	**5**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
14	**26**	**23**	**7**	**0**	**0**

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

Reference Books:

1. Environmental Pollution Control Engineering by C.S.Rao, New Age International Publishers, New Delhi.
2. Wastewater Engineering: Treatment & Reuse by Metcalf and Eddy, McGraw Hill Publication
3. Pollution control in process industries, S P Mahajan, Tata McGraw Hill Publishing Company, New Delhi
4. HAZOP and HAZAN by Trevor Kletz, 4th Edition, Institution of Chemical Engineers, IChemE, UK

List of experiments:

(At least 10 experiments are to be performed)

1. Characterization of a given sample of wastewater by determining its pH, conductivity, TDS, TSS.
2. To find out the quantity of Dissolved Oxygen (DO) present in the given water sample by Winkler's method.
3. Determination of acidity, alkalinity & hardness of a given sample of water or wastewater.
4. To determine Biochemical Oxygen Demand (BOD) exerted by the given wastewater sample.
5. To find out Chemical Oxygen Demand (COD) of the given wastewater sample.
6. Determination of total residual chlorine in a given water sample.
7. To determine the color intensity of the dye contaminated wastewater using spectrophotometer.
8. Determination of composition of volatile organic compounds dissolved in water by using (i) Refractometer or (ii) Karl-Fisher Apparatus.
9. Determination of efficiency of cyclone separator for separation of dust particles from mixtures.
10. Separation of mixture of dyes using thin layer chromatography.

11. Separation of metallic ions by paper chromatography.
12. Characterization of municipal solid waste (physical and chemical).
13. Preparation/compilation and study of MSDS of certain chemicals used in your laboratory.
14. Demonstration of portable fire extinguisher and other personal protective equipments used in the laboratories

Open source software and website:

1. Students can refer to video lectures available on the websites including NPTEL
2. Students can apply PollutionTech - Air Pollution Control Software Safety Management Software, MSDS Software, CSafe, DR software's ChemGes, MAUS OHS Planning software (Occupational, Health & Safety Planner), CINTELLATE
3. Students can visit following websites: www.safetyforlife.com.au https://www.cpcb.nic.in/PollutionControlLaw.pdf

Activities suggested under Problem Based learning:

Sl. No.	Name of the activity	No. of hours	Total Hours
1.	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h	10
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h	10
3.	Assignment writing.	5 assignments of 2h each.	10
4.	Self learning on-line course	Minimum duration of the course should be 10h.	10
5.	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h	10
6.	Poster/chart/power point preparation on technical topics		6
7.	Group Discussion on emerging/trending technical topics based on subject		1 hr each

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