GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Chemical Engineering

Subject Code: BE05005051

Subject Name: Industrial Pollution Control and Management

w.e.f. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Elective Courses - 1

Prerequisite:	-
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.

Course Outcome:

After Completion of the Course, Students will be able to:

No	Course Outcomes	% of Weightage
01	Identify sources, types of pollutants and determine their impact on the environment, related laws and standards	15
02	Understand sampling, measurement and appropriate control and management of various types of waste	20
03	Interpret and apply environmental laws, regulations, and auditing frameworks to ensure industrial compliance and effective pollution control management.	25
04	Evaluate cleaner production methodologies and principles of green chemistry to design resource-efficient waste minimization strategies for sustainable industrial development.	40

Teaching and Examination Scheme:

Teaching/Learning Scheme in hrs/semester					Total Credits	Assessment Pattern and Marks					Total Marks
						Theory		Practical			
L	T	P	PBL*	TH	TH/30	ESE (E)	PA (M)	PA (I)	PBL(I)	ESE (V)	
45	0	30	15	90	3	70	30	20	30	50	200

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

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

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	Importance of environmental pollution control, Environmental Legislation & Regulations, Industrial pollution emissions & Indian standards for ambient air, noise and water emission and effluents, Water (prevention & control of pollution) act, Air (prevention & control of pollution) act. Environmental audit: Definition and concepts, Introduction to ISO and ISO 14000.	2	7
2	**Water pollution** Classification of sources and effect of water pollutant on human being and ecology, Sampling, measurement and standards of water quality, Determination of organic matters: DO, BOD, COD, and TOC. Mathematical model for BOD, Re-oxygenation and de-oxygenation in natural purification process. **Determination of inorganic substances**: nitrogen, phosphorus, trace elements, alkalinity. **Physical characteristics**: suspended solids, dissolved solids, color and odour, Bacteriological measurements. **Primary treatment**: pre-treatment, settling tanks and their sizing. **Secondary treatment**: micro-organisms growth kinetics, aerobic biological treatment, activated sludge process, evaluation of biokinetic parameters, trickling filters, rotating biological contractors, anaerobic treatment, sludge treatment and disposal. **Tertiary treatment**: Advanced methods for removal of nutrients, suspended and dissolved solids, Advanced biological systems, Oxidation	15	22

Unit No.	Content	No. of Hours	% of Weightage
	methods (Chemical Oxidation – Chlorine/Hypochlorite/Chlorine Dioxide, Hydrogen Peroxide, Hydroxyl Radical, Oxygen (Atomic and Molecular) and Ozone, Catalytic Oxidation - Fenton's Reagent (H_2O_2 + Ferrous Ion), Photo Catalysis (UV + TiO_2), Supercritical Water Oxidation), Recovery of materials from process effluents.		
3	**Air pollution** Air pollutants sources, classification and characterization of air pollutants, effect on health, vegetation & materials, types of inversion, behavior and fate of air pollutants, Meteorological aspects of air pollutants: Temperature lapse rate & stability, wind velocity & turbulence, plume behavior, measurement of meteorological variables, wind rose diagrams, Plume Rise, estimation of effective stack height and mixing depths. Development of air quality models-Gaussian dispersion model **Sampling**: Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants (like PM2.5, PM10, SOX, NOX, CO, NH_3) **Air pollution control**: Source correction methods for air pollution control, Cleaning of gaseous effluents, Particulate emission control, Equipment, system and processes for particulate pollutants and gaseous pollutants.	10	27
4	**Solid Waste Management and noise pollution:** source and type based classification, Factors influencing waste generation and health, **Solid waste characteristics**: generation rates, components, moisture content, density, proximate and ultimate analysis and energy content, S**olid waste collection & transportation**: haul – container system, stationary container system, layout of collection routes, transfer stations, **Solid waste processing and recovery**: recovery of materials for recycling, manufacturing of solid waste products, energy recovery**, Disposal of solid**	13	22

Unit No.	Content	No. of Hours	% of Weightage
	wastes: land filling methods, aspects of landfill implementation, sanitary landfill equipment E-waste management rules, plastic waste, biomedical waste, solid waste management in rural areas and recent advances in solid waste management. **Noise pollution**: generation, control and management.		
5	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	9

Sustainability alignment: This course addresses the different weightage of SDG 6 (Clean Water and Sanitation), SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action) by applications of Industrial Pollution Control and Management subject knowledge essential for industrial operations.

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	35	40	15	---	---

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze; E: Evaluate and 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. 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.

List of Experiments:

1. Standardization of 0.01M EDTA solution by using 0.01N $CaCO_3$.
2. To determine the hardness of water.
3. To determine the content of chlorides in the given water sample/waste water sample.
4. To determine the concentration of Total Solids in the sample.
5. To determine the Chemical Oxygen Demand (COD) of a given sample.
6. To determine the BOD of a given sample.
7. To determine the concentration of RESIDUAL CHLORINE in the given water sample.
8. To determine total dissolved solids in the given sample.
9. To determine the efficiency of a cyclone separator for separation of dust particles from mixtures.
10. Study of adsorption of dye from aqueous solution on any adsorbent (e.g. activated carbon) and examine the validity

Major Equipment:

BOD incubator, COD incubator, Cyclone separator

Open Source Software/learning website:

1. PollutionTech - Air Pollution Control Software
2. Students can refer to video lectures available on the websites including NPTEL
3. Students can refer to the CDs which are available with some reference books for the solution of problems using software.
4. Websites: www.safetyforlife.com.au , SmartOHS.com.au
5. https://www.cpcb.nic.in/PollutionControlLaw.pdf

List of suggested activities for Problem Based Learning:

Sr. No.	Description	No. of hours	Total Hrs.
1	Assignment writing. Numerical based assignment is preferable.	5 assignments of 1h each.	5
2	Discussion on research paper based on relevant subject. Summarize research paper and evaluation critical parameters	2 research papers can be included. Each one has 5h	10
3	Complex problem solving of real world problem	Study of the problem and solution finding using pollution control knowledge	5
4	Industrial exposure to observe and provide tentative solutions on environment/ health/ any other issue	Duration (5h) for industrial exposure Problem identification and tentative solution (5h)	10
Max. Hours to be allotted			15

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