



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Minor/Hons. Program

Level: UG

Branch: Minor/Hons. Waste Technology

Course / Subject Code: BE050AB011

Subject Name : Advanced Industrial Waste Treatment Technology

w. e. f. Academic Year:	2026-2027
Semester:	5
Category of the Course:	Core Courses

Prerequisite:	A good understanding regarding the industrial wastewater and environmental impacts is required.
Rationale:	The main objective of this subject is to study the advancement in industrial waste treatment technology. This subject provides knowledge regarding the different processes involved in the treatment of industrial wastewater coming from the different industries.

Course Outcome:

After Completion of the Course, Student will able to:

Sr. No	Course Outcomes	Marks % Weightage
CO-01	To understand the industrial scenario in of water usage India, wastewater generation, toxicity and environmental impact point of view.	25
CO-02	To understand the various treatment methods of industrial wastewater treatment.	27
CO-03	To analyze the various features of common effluent treatment plant, zero effluent discharge, reuse and/or disposal of wastewater including RO rejects.	21
CO-04	To understand the industrial manufacturing processes along with the aspects of wastewater generation with possibilities of waste reduction at source.	27

Teaching and Examination Scheme:

Teaching Scheme (in Hours)					Total Credits L+T+(PR/2)	Assessment Pattern and Marks					Total Marks
L	T	PR	PBL*	TH	C	Theory		Tutorial / Practical			
						ESE (E)	PA (M)	PA(I)	PBL (I)	ESE (V)	



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45	30	00	45	120	04	70	00	00	30	50	150
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* 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.	Industries & Environment: Industrial scenario in India - Industrial activity and Environment - Uses of water by industry - Sources and types of industrial wastewater - Industrial wastewater and environmental impacts - Industrial wastewater generation rates, characterization and variables - Toxicity of industrial effluents.	11	25
2.	Treatment of Industrial Wastewater: Role of unit processes in wastewater treatment chemical coagulation – Chemical precipitation for improved plant performance, chemical oxidation – Neutralization –Chemical Storage.	12	27
3.	Management of Treatment Plants: Individual and Common Effluent Treatment Plants - Joint treatment of industrial wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse - Industrial reuse - Disposal on water and land - Residuals of industrial wastewater treatment - Management of RO rejects. Advanced treatment methods: Plasma-Activated Water (PAW) Treatment, Microbial Electrolysis Carbon Capture (MECC), AI-Driven Smart Treatment Optimization, Ozone Micro-Nanobubble Technology	10	21
4.	Practical Application in Industries: Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for textiles, electroplating, pulp and paper, petroleum refining, pharmaceuticals, sugar and distilleries, fertilizers and thermal power plants.	12	27



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	Total	45	100
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Suggested Specification Table with Marks (Theory):

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

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

- 1) Wastewater Engineering: Treatment and Reuse, Metcalf & eddy; McGraw Hill Book Company, 4th Ed, 2002.
- 2) Environmental Pollution and Control engineering, Rao C. S. -Wiley Eastern Limited, India, 1993.
- 3) Water Treatment Plants: Planning, Design & Control, S R Qasim, Technomic Pub. Co., 1999.
- 4) Industrial Water Pollution Control, Eckenfelder W.W.; McGraw Hill Book Company, 3rd Ed, 2000.
- 5) Environmental Engineering, Kiely G.; McGraw Hill Book Company, 1998.
- 6) Pollution control in process industries, S.P. Mahajan TMH., 1985.
- 7) Waste water treatment, M.Narayana Rao and A.K.Datta, Oxford and IHB publ. New Delhi.
- 8) Industrial Pollution Control and Engineering, Swamy AVN, Galgotia publications, 2005.
- 9) Environmental Engineering (Vol. II) - Sewage disposal and Air pollution, S.K Garg & Rajeshwari Garg, Khanna Publishers, 27th Edition, 2013.
- 10) Environmental Engineering and Sanitation: Joseph A. Salvato, John Wiley & Sons, 4th Ed. 2003.
- 11) Water Supply and Sanitary Engineering, Birdie and Birdie, Dhanpatrai and Sons, 1996.
- 12) Environmental engineering (Vol. I) - Water Supply Engineering S.K Garg & Rajeshwari Garg, Khanna Publishers, 23rd Edition, 2013.

(b) Open-source software and website:

- 1) Reference to NPTEL lectures can be made for a better understanding regarding the waste water treatment.
- 2) NPTEL (SWAYAM – India) Courses: Industrial Wastewater Treatment, Environmental Engineering, Website: <https://nptel.ac.in>



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- 3) Wastewater Treatment & Process Simulation-EPA SWMM (Storm Water Management Model), Use: Flow modeling, pollutant transport, treatment system analysis, Website: <https://www.epa.gov/water-research/storm-water-management-model-swmm>.

Suggested Course Practical List: (Minimum 6 experiments need to be performed)

List of Laboratory/Learning Resources Required:

- 1) Determination of pH of wastewater.
- 2) To determine the colour intensity of dye contaminated water by using spectrophotometer.
- 3) Determination of turbidity of wastewater sample.
- 4) To study the adsorption of dye from aqueous solution on any adsorbent
- 5) Determination of electrical conductivity of wastewater.
- 6) Determination of total solids, volatile solids and fixed solids of wastewater
- 7) Determination of total hardness of given wastewater sample
- 8) To study membrane separation technique by micro filtration

Major Equipments :

PH meter, spectrophotometer, conductivity meter etc.

Suggested Project List:

Sr. No	Name of the Project	Description / Objective
1	Characterization of Industrial Wastewater from a Selected Industry	To analyse physico-chemical parameters and toxicity of industrial wastewater and compare with CPCB standards.
2	Design of Chemical Treatment System for Industrial Wastewater	To design coagulation, precipitation, and neutralization units for effective wastewater treatment.
3	Performance Evaluation of an Industrial Effluent Treatment Plant (ETP)	To assess treatment efficiency, operational issues, and compliance with discharge norms.



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4	Comparative Study of Individual ETP and CETP	To compare treatment performance, cost, and environmental benefits of ETP and CETP systems.
5	Zero Liquid Discharge (ZLD) System Assessment in Industries	To study the design, operation, and challenges of ZLD systems including RO and evaporators.
6	Industrial Wastewater Reuse and Recycling Planning	To evaluate treated wastewater quality and propose reuse options in industries.
7	Management of RO Rejects and Treatment Residuals	To study handling, minimization, and disposal of RO reject and sludge from ETPs.
8	Wastewater Treatment Flow Sheet for Textile Industry	To develop a complete treatment flow sheet based on wastewater characteristics and pollution load.
9	Treatment of Electroplating Wastewater for Heavy Metal Removal	To design and evaluate treatment schemes for toxic metal removal.
10	Source Reduction and Cleaner Production in Industries	To identify pollution prevention measures to reduce wastewater generation at source.

Suggested Activities for Students:

Sr. No	Name of the Activity	No. of Hours	Evaluation Criteria
1	Technical Video-Based Learning on Industrial Pollution & Environment	10 (Video: 5 h + Report: 5 h)	Quality of report/presentation, understanding of industrial–environment interaction
2	Study of Industrial Water Use and Wastewater Generation in India	6 (Study: 3 h + Report: 3 h)	Data interpretation, relevance to Indian industrial scenario
3	Identification of Sources and Types of Industrial Wastewater	6 (Study: 3 h + Assignment: 3 h)	Concept clarity, completeness of classification



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4	Industrial Wastewater Characterization (Case Study)	8 (Data analysis: 4 h + Report: 4 h)	Accuracy of analysis, interpretation, documentation
5	Toxicity Assessment of Industrial Effluents (Literature-Based)	6 (Study: 3 h + Report: 3 h)	Understanding of toxicity concepts, critical analysis
6	Design of Chemical Coagulation and Precipitation System	8 (Design: 5 h + Report: 3 h)	Correctness of design calculations and methodology
7	Study of Chemical Oxidation and Neutralization Processes	6 (Study: 3 h + Report: 3 h)	Conceptual understanding, application relevance
8	Performance Evaluation of an Effluent Treatment Plant (ETP)	8 (Study: 4 h + Report: 4 h)	Treatment efficiency assessment, compliance analysis
9	Case Study on Common Effluent Treatment Plant (CETP)	6 (Study: 3 h + Presentation: 3 h)	Understanding of CETP operation and benefits
10	Study of Zero Liquid Discharge (ZLD) Systems	6 (Study: 3 h + Report: 3 h)	Process understanding, practical applicability
11	Assessment of Treated Industrial Wastewater for Reuse	6 (Analysis: 3 h + Report: 3 h)	Water quality evaluation and reuse feasibility
12	Study of RO Reject and Sludge Management in Industries	6 (Study: 3 h + Report: 3 h)	Practical understanding, regulatory awareness
13	Preparation of Industrial Wastewater Treatment Flow Sheet (Any One Industry)	8 (Flow sheet: 4 h + Report: 4 h)	Technical accuracy, completeness, applicability