



Gujarat Technological University

Program Name: Bachelor Of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE04013011

Subject Name: Fundamentals Of Wastewater Quality

w. e. f. Academic Year:	2024-25
Semester:	4
Category of the Course:	Professional Core Course

Prerequisite:	Knowledge of Fundamentals of analysis of water quality.
Rationale:	Wastewater quality parameters decides the type of treatment by which it will be treated to meet the standards for discharge of an environmental sink. Physical, Chemical and biological parameters of wastewater decide its quality which can be determined by use of standard methods for analysis of parameters.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Design and execute a proper wastewater sampling and preservation plan	5
CO-2	Explain the fundamental biochemical principles governing wastewater degradation	10
CO-3	Conduct and interpret standard chemical and organic analyses of wastewater.	55
CO-4	Explain principles of equilibrium, physical, and colloidal chemistry.	20
CO-5	Evaluate the sources and environmental impacts of metallic and non-metallic pollutants in wastewater.	10

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	Total no of hours per semester		Theory		Tutorial / Practical			
						ESE (E)	PA / CA (M)	PA/CA (I)	PBL (I)	ESE (V)	
45	0	30	45	120	4	70	30	20	30	50	200

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

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



Gujarat Technological University

Program Name: Bachelor Of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE04013011

Subject Name: Fundamentals Of Wastewater Quality

Content:

Sr. No.	Content	Total Hrs
1	Concepts of Sampling and Preservation of wastewater Selection of sampling location, planning of sampling, types of sampling, sampling frequency, sample container types and process of cleaning, and sample preservation methods.	3
2	Concepts of Biochemistry for wastewater treatment: Enzymes, cofactors, temperature relationship, pH, major and trace elements, biodegradation, biochemistry of carbohydrates, proteins and fats and oil, general biochemical pathways relevant to treatment.	5
3	Analysis of chemical parameters of wastewater: Methods of measurements as per standard methods for parameters: acidity, volatile solids, dissolved oxygen, and sulphate; and their sources, environmental significance, method of sample collection, application of data	10
4	Analysis of organic parameters of wastewater: Sources, environmental significance, method of sample collection, application of data, Methods of measurements as per standard methods for Chemical Oxygen Demand, Biochemical Oxygen Demand, Oil and Grease, Organic and Volatile acids, Organic nitrogen	12
5	Concepts of equilibrium chemistry, physical chemistry, and colloidal chemistry: Equilibrium chemistry: Equilibrium and Le Chartelier's principle, activity and activity coefficient, Ionization, Complex ions, Solubility product, Common Ion effect and Diverse Ion effect Physical chemistry: Binary mixtures, solution of solids in liquids, osmosis, dialysis, solvent extraction, basics of catalysis and adsorption Colloidal chemistry: General properties of colloids, colloidal dispersions in liquids and air	10
6	Non-Metallic and Metallic constituents in wastewater: Sources and environmental significance of cyanide, fluoride, nitrites, nitrates, phosphate, calcium, chromium, copper, Iron, lead, magnesium, manganese, potassium, zinc, cadmium, mercury, arsenic	5
Total		45



Gujarat Technological University

Program Name: Bachelor Of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE04013011

Subject Name: Fundamentals Of Wastewater Quality

Suggested Specification table with Marks (Theory): (For B.E. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	40	25	15	00	00

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. Chemistry for Environmental Engineering by Clair N. Sawyer and Perry L. McCarty, Tata McGraw – Hill publication
2. Quantitative Analysis by R.A. Day, Jr. and A.L. Underwood , Pearson publication
3. Standard Methods for Water and Wastewater Analysis, 23rd edition, by America public health association, American Water Works Association, Water Environment Federation
4. Handbook of Methods in Environmental Studies, Vol. 1: Water and Wastewater Analysis, S. K. Maiti

List of Experiments:

1. Determination of acidity in wastewater samples.
2. Determination of volatile suspended solids of wastewater samples by gravimetric method.
3. Determination of sulphates in wastewater samples.
4. Determination of DO in water/wastewater samples.
5. Determination of COD in wastewater samples by open reflux method.
6. Determination of BOD in wastewater samples by dilution method.
7. Determination of oil and grease from wastewater samples by solvent extraction method.
8. Determination of volatile acids from wastewater and sludge of anaerobic reactor distillation method.
9. Determination of Ammonical nitrogen from wastewater samples by K-Jeldahl distillation method.

Major Equipment:

- pH meter
- Hot plate for sample digestion
- Hot air oven, Aerator
- Muffle furnace
- DO meter
- COD Soxhlet apparatus with reflux tubes
- BOD incubator



Gujarat Technological University

Program Name: Bachelor Of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE04013011

Subject Name: Fundamentals Of Wastewater Quality

- Kjeldhal distillation apparatus

List of Open Source Software/learning website:

US EPA <https://www.epa.gov/> , MOEF&CC <https://moef.gov.in/>, NPTEL <https://archive.nptel.ac.in/>, Virtual Lab <https://ee1-nitk.vlabs.ac.in/List%20of%20experiments.html> , <https://ee2-nitk.vlabs.ac.in/List%20of%20experiments.html>

List of suggested activities for Problem Based Learning:

Sr. No.	Name of the activity	No. of hours	Evaluation Criteria
1	APHA Standard Methods Review & Summary — Each student reads assigned methods for 2 wastewater parameters (e.g., COD, BOD) and prepares a summary with flow diagrams.	Duration=5 hrs	Based on the report submitted.
2	Sampling and Preservation of Wastewater: Create a detailed flowchart of the entire sampling process, from selecting the site to proper container cleaning and sample preservation for various parameters.	Duration=5 hrs	Based on the report submitted.
3	Case Study Analysis — Study a real wastewater pollution incident in India (e.g., CPCB case reports) and present pollution sources, parameters, and impacts.	Duration=10 hrs	Based on the report submitted. The report should contain observations and calculations of laboratory data.
4	Virtual Lab Experiments — Use NPTEL / vlab.co.in to perform 3 online wastewater quality tests and prepare a stepwise SOP with screenshots.	Duration of virtual lab : 3 hrs SOP preparation: 3 hrs	Based on the report submitted
5	Instrument Visit Report — Visit an environmental lab of SPCB/Water Supply Board/ industry (common effluent treatment plant / sewage treatment plant) /and prepare a report.	Visit = 5hrs, Report preparation = 3hrs Total = 8hrs	Based on the report submitted. The report should contain observations and calculations of laboratory data.
6	Pollutant Profile Assignment — Select one chemical parameter (e.g., ammonia, phosphate, phenol), research its sources, environmental effects, and removal methods; submit a technical write-up.	Duration=10 hrs	Based on the report submitted. The report should contain observations and calculations of laboratory data.
7	Numerical Problem Solving Set — Solve 10 numerical problems covering equilibrium	Duration=5 hrs	Based on online MCQ test based on Numericals



Gujarat Technological University

Program Name: Bachelor Of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE04013011

Subject Name: Fundamentals Of Wastewater Quality

	chemistry, oxygen demand, and solids calculations.		
8	Mini Field Sampling Project — Collect grab samples/Composite Samples from 2 local wastewater sources, measure at least 2 in-field parameters (pH, temperature, DO) using portable meters, and report data.	Duration=5 hrs	Based on the report submitted. The report should contain observations and calculations of laboratory data.
9	Poster Presentation / Infographic — Prepare a visual summary on “Wastewater Quality Parameters & Environmental Impact” for display in class.	Duration=5 hrs	Based on poster/chart preparation and presentation skills
10	Mock-drill for chemistry laboratory safety using Institute firefighting facilities	Duration = 6 hrs	Based on participation certificate
11	Participation in Workshop/seminar related to Environmental Engineering	Duration = 6 hrs	Based on participation certificate
12	Self-learning through online courses (NPTEL) related to subjects	Duration=10 hrs	Multiple choice questions based Assessment
