GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Environmental Engineering
Subject Code: BE03013031
Subject Name: Fundamentals of Water Quality Analysis

w.e.f. Academic Year:	2024-25
Semester:	3
Category of the Course:	Professional Core Course

Prerequisite:	Knowledge of chemistry
Rationale:	Value of water quality parameters decides whether the application of water is fit or not for a specific purpose. Physical, Chemical and biological parameters of water decides its quality which can be determined by use of standard methods for analysis of parameters.

Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcomes
01	Understand the use and calibration of glassware & instruments for accurate analysis of water quality
02	Prepare standard solutions using general chemistry concepts
03	Understand the standards and criteria of water quality.
04	Analysis of water quality parameters by volumetric and gravimetric analysis
05	Analysis of water quality parameters by instrumental analysis

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA/ (I)	PBL (I)	ESE (V)	
45	0	60	15	120	04	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	Familiarization with lab ware and instruments: Use of Glass ware, Plastic ware and measuring instruments used in analysis of water and wastewater quality, calibration of lab ware and instruments used in analysis of water quality, cleaning procedures for Glassware and Plastic ware.	**2**	**6**
2	General Chemical concepts: Concentration system: Molar, Molal , Normal and weight percentage Valency, oxidation state and Bonding, balancing of complex oxidation and reduction reactions, gas laws and its applications, units of expression of results and their interrelationships, precision and accuracy.	**4**	**10**
3	Preparation of standard solutions: Relationship of atomic, molecular, formula and equivalent weights and solutions , Requirements of primary standards, Secondary Standards and their standardization procedure.	**3**	**7**
4	Volumetric and Gravimetric Analysis: Sampling Techniques, Principles and applications of Quantitative analysis: Precipitation, filtration, Drying, Desiccation, Principles and applications of Volumetric analysis, stoichiometric calculations in Quantitative analysis and Volumetric analysis	**4**	**10**
5	Standards and criteria for water quality: Need of standard methods for analysis of water and wastewater quality, Drinking water quality standards, guideline for quality of irrigation water, Primary Water Quality Criteria for Bathing Waters, Designated Best Use Water Quality Criteria, water quality index	**3**	**7**
6	Instrumental Analysis: Beer's and Lambert's Law and its applications, working principle and measurment of : turbidity meter, nephelometer, pH meter and Conductivity meter	**7**	**10**

7	Analysis of water quality parameters: Sources, environmental significance, method of sample collection, application of data, methods of measurements as per standard methods for pH, Solids, Hardness, Alkalinity, Chlorides, Sulfates, Sodium adsorption ratio, salinity.	**22**	**50**
	Total	**42**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	30	30	20	-	-

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. Chemistry for Environmental Engineering by Clair N. Sawyer and Perry L. McCarty
2. Quantitative Analysis by R.A. Day, Jr. and A.L. Underwood
3. Standard Methods for Water and Wastewater Analysis by AWWA
4. Handbook of Methods in Environmental Studies Water and wastewater analysis by S.K.Maiti (Volume-I)

(b) Open sources of software and website: US EPA, MOEF&CC, NPTEL, Virtual Lab

Suggested Course Practical List:

1. Familiarization with labware in instruments used in environmental engineering laboratory
2. Calibration of different glass wares & Instruments (pH meter and Weigh balance)
3. Preparation of primary and secondary standards solutions and its standardization
4. To determine pH of given water and wastewater samples.
5. To Determine Total solids (TS), Total suspended solids (TSS) and Total dissolved solids (TDS) for given water and wastewater samples.
6. To determine Total Hardness , Calcium Hardness and magnesium hardness from given water samples
7. To determine Alkalinity (Phenolphthaleine and Methyl orange Alkalinity) from given water samples.
8. To determine Chloride from given water and wastewater samples.
9. To determine sulphates of given water and wastewater samples.
10. To determine Sodium adsorption ratio of given water and wastewater samples.

11. To determine salinity of given water and wastewater samples.
12. To determine Turbidity of given water samples.
13. To determine conductivity of given water and wastewater samples.

List of Laboratory/Learning Resources Required:
pH meter, Hot air oven, TDS meter, conductivity meter, weight balance, nephelometer, Magnetic stirrer, vacuum filtration assembly, AR Grade Chemicals for Standard Methods

Suggested Activities for Students: Analysis of River Water Quality and Compare With Standards**.**

- **List of suggested activities for Problem Based Learning:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Laboratory Visit- pollution parameters analysis laboratory of State Government/Central Government/Gujarat Pollution Control Board/Water Supply Board	Visit = 5hrs, Report preparation = 3hrs Total = 8hrs	Based on the report submitted. The report should contain observations and calculations of laboratory data.
2.	Technical Video based learning related to subjects offered during semester	Duration of video : 5hrs Report preparation : 5hrs Total = 10hrs	Multiple choice questions based Assessment
3.	Explore applications of Water GeM, Sewer GeM, EPANET Software	Duration=5 hrs	Based on report preparation using Software input data.
4.	Secondary data compilation and its analysis related to pollution/environment attributes from relevant International/Central/State Government Websites	Duration=5 hrs	Technical Presentation of data using statistical methods in form of report/presentation
5.	Preparation of working/Nonworking model for flow measuring devices	Duration=10 hrs	Based on project display considering technical aspects
6.	Poster presentation on laboratory practices, firefighting systems, water supply systems, sewerage systems	Duration=5 hrs	Based on poster/chart preparation and presentation skills
7	Survey related to water demand of	Duration=5 hrs	Based on data collection and

	residential area/ institutional area/commercial area/hospitals, survey on water distribution system	Report preparation = 5hrs Total=10 hrs	its report presentation
8	Mock-drill for chemistry laboratory safety using Institute firefighting facilities	Duration=5 hrs	Based on Active participation student
9	Participation in Workshop/seminar related to environmental engineering	Duration = 6 hrs	Based on participation certificate
10	Preparation of technical report from reference book on given topic	Duration=5 hrs	Based on Report preparation
11	Assignments/numericals related to subject	Duration=10 hrs	Based on submission of given assignments
12	Self-learning through online courses related to subjects	Duration=10 hrs	Multiple choice questions-based Assessment

Note:

- All the suggested activities should be related to the subject.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity.
- Rubrics for the evaluation can be prepared by the faculty.
- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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