GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Environmental Engineering

Course / Subject Code : DI03013041

Course / Subject Name : Environmental Chemistry - I

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

Prerequisite:	Basic Engineering science, Applied Chemistry
Rationale:	This course will help the diploma environmental engineering students to understand the effect of various chemicals on air, water and soil and the way they impact environment and health of living beings. By acquiring the basic knowledge of analysis of these chemicals which appear as pollutants, the students will be able to find solution to mitigate their effects. This course also introduces them to various kinds of analytical technics like classical, colorimetry, electrochemical, chromatography and spectrophotometry. By acquiring the basic knowledge of analytical techniques, they can choose appropriate methods to determine the quantity of various parameters and presence of heavy metals in water and waste water. Quantifying the pollutants will help in choosing appropriate treatment methods.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Prepare standard solutions for testing of water and waste water after Identifing the Physical, chemical and biological parameters of water and wastewater.	R,U, &A
02	Carry out proper sampling for chemical analysis	R,U, &A
03	Carryout tests of water and wastewater for various physical, chemical and biological parameters using suitable instruments.	R,U, &A
04	Identify appropriate method of instrumental analysis from Chromatography and Mass spectrometry methods of chemical Analysis	R,U, &A
05	Analyze data using statistical methods	R,U, &A

**Revised Bloom's Taxonomy (RBT)*

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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Fundamentals of Analysis** Basic information related to Physical, Chemical and Biological Parameters. Causes of environmentalpollution. Laboratory wares:Types and Uses, Cleaning solutions Methods of Cleaning laboratory wares, Calibration of laboratory wares and importance Instruments used in Environmental Engg. Field, Types Uses and Importance of instruments, Calibration of instruments Method of preparing distilled water and Standard solutions Standard methods of analysis-Gravimetric, Volumetric, Colorimetry, Turbidimetry, Nephelometry Process involved in analysis like Precipitation, Filtration, Drying and Desiccation Expression of results	10	20
2.	**Sampling for Analysis** Sampling methods: Systematic, Random, nonstatistical, stratified, haphazard, continuous monitoring Types of sample: Grab & composite samples, Solid Phase extractors Water sample preservation by refrigeration, acidification, addition of preservatives and use of proper container Precautions to be taken while transportation of samples. Types of error, detection limits	06	15
3.	**Testing of Physical, Chemical and Biological parameters** Classical methods of analysis : Volumetric analysis, gravimetric analysis, titration	12	25

	Standard procedure for analysis of physical parameters like Turbidity, color, taste odor and temperature Standard procedure for analysis of chemical parameters like pH, Alkalinity, Chloride, Hardness, Total solid, Total dissolve solid, Total suspended solid, Fluorides,Sulphates, Dissolved Oxygen, Chemical Oxygen Demand (COD), Oil and Grease Standard procedure for analysis of biological parameters like Biological Oxygen demand and Chemical Oxygen demand		
4.	**Advanced methods of testing** Lambert's law, Beer's law, Color comparison tubes, Photo electric colorimeter Absorption spectrophotometry, atomic absorption and emission analysis, atomic emission techniques Gas chromatography, high performance liquid chromatography, Ion chromatography Other instrumental analysis like X-ray analysis and nuclear magnetic resonance spectroscopy	12	25
5.	**Errors and Treatment of statistical data** Rounding numerical data Total solid Definitions: Mean, median, standard deviation, accuracy and precision, normal distribution Standard error of the mean, Confidence interval, confidence limits Instrument detection limit and method detection limit	05	15
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
30	**50**	**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:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Environmental Chemistry	B.K.Sharma and S.H.Kaur	Goel Publication House,Meerut

S. No.	Title of Book	Author	Publication with place, year and ISBN
2	Environmental Chemistry	A.K.De.	New Age international Pub. New Delhi
3	Chemistry for Environmental Engineering	C.N.Sawyer and P.L.Mc Carty	Mc Graw Hill ltd.
4	Standard Methods	_	International
5	Environmental Chemistry	P.S.Sindhu	New Age internationalPub. New Delhi
6	Relevant BIS Codes	_	Bureau of IndianStandards
7	Handbook of Water and Wastewater Analysis	Kanwaljit Kaur	Atlantic Publishers and Distributors

(b) Open source software and website:

a) www.gpcb.gov.in
b) www.gwssb.org
c) www.cpcb.nic.in
d) www.neeri.res.in
e) www.Nptel.ac.in

Suggested Course Practical List:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Preparation of Primary standards like, (i) 0.25 $NK_2Cr_2O_7$ (ii) 0.1 M $CaCO_3$ (iii) 0.0282 N Nacl (iv) 0.02 N Na_2CO_3 Preparation of Secondary standards like, (i) 0.25N FAS (ii) 0.1 M EDTA (iii) 0.0282 N $AgNO_3$ (iv) 0.02 N NaOH	I	02
2	Collection, Labelling and preservation of samples by proper sampling procedure	II	02
3	Determination of pH, Turbidity, Dissolved Oxygen, salinity and conductivity	III	02
4	Gravimetric Analysis (Any Two)	III	04

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
	Determination of Total solid, Total dissolve solid, Total suspended solid, of water and wastewater samples Determination of Sulphate of water and waste water samples Determination of Oil and Grease of wastewater samples		
5	Volumetric Analysis (Any Two) Determination of Alkalinity of wastewater samples Determination of Chloride of water and wastewater samples Determination of Hardness of water samples Determination of Chemical Oxygen Demand (COD),Biochemical Oxygen Demand (BOD) ofwaste water samples	III	06
6	Determination of Ammonical Nitrogen, Organic Nitrogen and Fluoride by spectrophotometer	IV	08
7	Determination of Sodium and Potassium using Flame photometer	IV	04
8	Examples on errors and treatment of statistical data	V	02
			Total: 30

List of Laboratory/Learning Resources Required:

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	• Sampling containers • Refrigerator • Magnetic stirrer • UV Spectrophotometer • Flame photometer • pH meter • Distillation Assembly • Turbidity meter • TDS meter • Chemical testing glasswares	1 to 8

Suggested Project List:

a) **Analysis of river/lake water sample:** Collect sample from nearby river and perform analysis of drinking water parameters as per Indian standards.

b) **Analysis of Various Industrial waste water sample:** Collect sample from nearby Industry and perform analysis of waste water parameters as per GPCB standards.

c) Study various industries and select the sampling methods best suited for Dairy Industry, Pesticide Industry, Textile industry, Paper Industry, Oil refining industry etc. and prepare report based on observation.
d) Study and prepare report on preservation of samples for various parameter analysis
e) Compare various methods of analysis used for various parameters and list their merits and demerits and suitability for Indian conditions
f) Study and prepare report on best practices and waste minimization in laboratories

Suggested Activities for Students:

a) Preparation of chart of Inorganic and Organic chemicals used in food.
b) List out the Toxic materials used in food.
c) List different types of manure and its chemical content with its atomic weight.
d) Prepare chart on Different methods of finding pH of the sample.
e) Preparation of chart of various methods to analyze different forms of Nitrogen
f) Preparation of chart of various methods to analyze Fluoride
g) Study and List the effects of Nitrogen and Phosphorus in water and waste water
h) Undertake micro-project.
i) Give seminar on any relevant topic.

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