GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-III

Course Title: Environmental Chemistry-I
(Course Code: 4331301)

Diploma programme in which this course is offered	Semester in which offered
Environmental Engineering	Third

1. 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.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competencies:

- **Perform the different test to assess the quality of fresh & waste water.**
- **To select proper process or equipment for different tests for chemical and biological analysis.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

a) Identify the Physical, chemical and biological parameters of water and wastewater.
b) Prepare distilled water and standard solutions for testing of water and waste water
c) Carryout tests of water and wastewater for various physical, chemical and biological parameters using suitable instruments.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA*	ESE	CA	ESE	
3	-	2	4	30	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'*.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Familiarization of Laboratory and Calibration of Instruments and Glass wares	I	08
2	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	20
3	Determination of pH of water and waste water samples	II	02
4	Determination of Turbidity of water samples.	II	02
5	Gravimetric Analysis (i) Determination of Solids of water and wastewater samples (ii) Determination of Sulphate of water and waste water samples (iii) Determination of Oil and Grease of waste water samples	III	08
6	Volumetric Analysis (i) Determination of Alkalinity of wastewater samples (ii) Determination of Chloride of water and wastewater samples (iii) Determination of Hardness of water samples (iv) Determination of Chemical Oxygen Demand (COD),Biochemical Oxygen Demand (BOD) ofwaste water samples	III	14
7	Determination of Fluoride of water samples	III	02
			Total: 28

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

ii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency..*

iii.

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
	For PrOs 1 to 7	
1	Identification of Glassware and Equipment to perform various test	10
2	Prepare experimental setup accurately	10
3	Observe and record readings accurately	40
4	Calculate results accurately	20
5	Interpret results and their conclusions	10
6	Submission for progressive assessment on time	10
7	Viva Voce	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	• UV Spectrophotometer • Onsite Water Testing kit • Flame photometer • pH meter • Turbidity meter • B.O.D. Incubator • C.O.D. Digester • TDS meter • Chemical testing glasswares	2 to 7

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfill the development of this competency.

a) Work as a team member/ individual.
b) Follow ethical practices.
c) Follow safe practice on site and in laboratory.
d) Practice of environmental friendly methods and processes.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit – I **Elements of Water pollution**	1a. Know the Quality of fresh water and waste water	1.1 Basic information related to Physical, Chemical and Biological Parameters. 1.2 Causes of environmentalpollution. 1.3 Health effects on living organisms.
Unit – II **Fundamentals of Analysis**	2a. Identify the Laboratory wares and instruments 2b. To prepare Reagent water	2.1 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 2.2.Method of preparing distilled water and Standard solutions 2.3 Standard methods of analysis-Gravimetric, Volumetric, Colorimetry, Turbidimetry, Nephelometry 2.4 Process involved in analysis like Precipitation, Filtration, Drying and Desiccation 2.4 Expression of results
Unit– III **Testing of Chemical parameters**	3a.Analyse the chemical parameters 3b.Compare results with standards	3.1 pH 3.2 Alkalinity 3.3 Chloride 3.4 Hardness 3.5 Fluorides 3.6 Solids 3.7 Sulphate 3.8 Dissolve Oxygen 3.9 Chemical Oxygen Demand (COD) 3.10 Oil and Grease Other waste water parameters

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit– IV **Testing of Physical, and Biological parameters**	4a. Calculate the Physical and Biological parameters 4b. Compare results with standards	4.1 Turbidity 4.2 Total solid 4.3. Total dissolve solid 4.4 Total suspended solid 4.5 Biochemical Oxygen Demand (BOD)

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Elements of Water pollution	02	02	02	02	06
II	Fundamentals of Analysis	16	05	07	08	20
III	Testing of Chemical parameters	18	05	10	15	30
IV	Testing of Physical, and Biological parameters	06	04	04	06	14
Total		**42**	**16**	**23**	**31**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

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) Properties of Insecticides, Pesticides and Rodenticide and its effects on soil. Give seminar on any relevant topic.
f) Prepare chart of Process of metabolism occur in Plant and Animal body

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed five.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

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.

13. SUGGESTED LEARNING RESOURCES

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
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.

S. No.	Title of Book	Author	Publication with place, year and ISBN
4	Standard Methods	_	International
5	Environmental Chemistry	P.S.Sindhu	New Age international . Pub. New Delhi
6	Relevant BIS Codes	_	Bureau of IndianStandards

14. SOFTWARE/LEARNING WEBSITES

Qualitative and Quantitative analysis softwares

a) www.gpcb.gov.in

b) www.gwssb.org

c) www.cpcb.nic.in

d) www.neeri.res.in

15. PO-COMPETENCY-CO MAPPING

Semester II	Civil Engineering Drawing (Course Code:4320601)									
	POs and PSOs									
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning	PSO 1	PSO 2	PSO 3 (If needed)
Competency	i. Perform the different test to assess the quality of fresh & waste water. ii. To select proper process or equipment for different tests for chemical and biological analysis.									
Course Outcomes CO1: Identify the Physical, chemical and biological parameters of water and wastewater	3	3	-	3	3	-	2	3	3	-
CO2: Prepare distilled water and standard solutions for testing of water and waste water	3	-	3	3	3	-	2	3	3	-
CO3: Carryout tests of water and wastewater for various physical, chemical and biological parameters using suitable instruments.	3	-	3	3	3	-	2	3	3	-

Legend: '**3**' for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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