GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2023 (COGC-2023)
Semester-VI

Course Title: Other Environmental Pollution
(Course Code: **4361306**)

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

1. RATIONALE

This course aims to provide students with an in-depth understanding of various types of environmental pollution other than air and water pollution. It covers sources, effects, monitoring, and mitigation strategies for noise pollution, soil pollution, thermal pollution, light pollution, and radiation pollution.

2. COMPETENCY

The course content should be taught and with the aim to develop required skills in students so that they are able to acquire following competencies.

- **Monitor and measure noise pollution, soil pollution, thermal pollution, light pollution, and radiation pollution.**

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) Understand the concept and significance of different types of environmental pollution.
b) Explore the sources and effects of noise, soil, thermal, light, and radiation pollution.
c) Develop skills for monitoring and measuring these pollutants.

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	
2	0	0	2	30	70	0	0	100

(*): 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-Not Applicable

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			
			Total:

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..*

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-Not Applicable

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		

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 **Introduction to Environmental Pollution**	1a. Explain Pollution and its types 1b. Describe the Impacts of pollution on environment and human health	1.1 Definition of pollution 1.2 Types of pollution: air, water, noise, soil, thermal, light, and radiation pollution, Plastic pollution, e-waste pollution 1.3 Impacts of pollution on environment and human health
Unit – II **Noise Pollution**	2a. Identify parameters and sources of noise pollution 2b. Monitor noise using noise monitoring instruments 2c. Interpret noise monitoring data	2.1 Parameters and Sources of Noise Pollution 2.2 Introduction to noise monitoring instruments: sound level meters, noise dosimeters, and noise monitoring software 2.3 Principles of sound measurement and calibration of monitoring equipment 2.4 Techniques for measuring and recording noise levels in different environments- urban, industrial, residential, and recreational areas 2.5 Interpretation of noise monitoring data in relation to noise standards and guidelines 2.6 Understanding noise exposure levels and their effects on human health and well-being
Unit– III **Thermal Pollution**	3a. Summarize Sources and causes of thermal pollution 3b. Describe Effects of thermal pollution on aquatic ecosystems 3c. Explain Monitoring and assessment of thermal pollution	3.1 Sources and causes of thermal pollution 3.2 Effects of thermal pollution on aquatic ecosystems 3.3 Monitoring and assessment of thermal pollution 3.4 Thermal pollution control measures

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
	3d. Describe Thermal pollution control measures	
Unit– IV **Light and Radiation Pollution**	4a. Summarize Sources and types of Light and radiation pollution 4b. Identify Effects of Light and radiation pollution on human health and the environment 4c. Describe Light and radiation pollution assessment and monitoring techniques 4c. Describe Radiation pollution control and safety measures	4.1 Sources and types of Light and radiation pollution 4.2 Effects of Light and radiation pollution on human health and the environment 4.3 Light pollution assessment and monitoring 4.4 Radiation monitoring techniques 4.5 Radiation pollution control and safety measures

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	Introduction to Environmental Pollution	04	04	07	03	14
II	Noise Pollution	12	07	10	04	21
III	Thermal Pollution	06	04	07	03	14
IV	Light and Radiation Pollution	06	07	10	04	21
Total		**28**	**22**	**34**	**14**	**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) Review and analysis of real-life case studies on various types of environmental pollution
b) Application of knowledge to propose mitigation strategies for specific cases
c) Undertake micro-project.

d) Give seminar on any relevant topic.

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 Six.***

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) Use a mobile application to measure and map noise pollution levels in different areas. Compare it with Noise level meter and check accuracy of app. Prepare a report on findings.
b) Prepare a report on effects of thermal pollution on aquatic ecosystems.
c) Design and prototype a light pollution shield that can be attached to streetlights or outdoor fixtures. The project should focus on minimizing upward light emissions to reduce light pollution while maintaining adequate illumination.
d) Measure radiation at various locations in and around your study place using mobile application (for e.g. GammaPix) and report readings and hotspots. Include ill effects of radiation pollution and its remedies.
e) Conduct a field study to evaluate the effectiveness of different noise barriers in reducing noise pollution. Measure noise levels on both sides of barriers and analyze the data and prepare report.

f) Measure skyglow caused by light pollution by mobile app (for e.g. 'Loss of the night app'). Prepare report including the impact of artificial light on the night sky and propose measures to reduce skyglow.
g) Measure radon gas levels in indoor spaces using mobile app (for e.g. 'Airthings Wave'). Radon is a radioactive gas that can contribute to indoor air pollution. Prepare report including effects and remedies of radon pollution.
h) Design and build noise barriers using upcycled or recycled materials. This project not only addresses noise pollution but also promotes sustainable and eco-friendly practices in environmental engineering.
i) Develop an educational campaign to raise awareness about light pollution.
j) Set up a small-scale experiment to test the effectiveness of different soil bioremediation techniques in removing pollutants. Focus on using microbes or plants to break down contaminants in the soil.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Text Book on Environmental Pollution and Control	HS Bhatia	JDM PUBLISHERS & DISTRIBUTORS (1 January 2022) ASIN : B0B6RV577F
2	Environmental Noise Control: The Indian Perspective in an International Context	Naveen Garg	Springer Nature Switzerland AG; 1st ed. 2022 edition (1 April 2022) ISBN-13 : 978−3030878276
3	Radiation and Thermal Pollution	V.K. Prabhakar	Anmol Publisher (1 December 2004) ISBN-13 : 978-8126109289
4	Light Pollution: Responses and Remedies	Bob Mizon	Springer; 2nd ed. 2012 edition (24 June 2012) ISBN-13 : 978−1461438212

14. SOFTWARE/LEARNING WEBSITES

a) www.gpcb.gov.in
b) https://cpcb.nic.in/about-namp/www.neeri.res.in
c) www.Nptel.ac.in
d) https://moef.gov.in/moef/index.html

15. PO-COMPETENCY-CO MAPPING

Semester II	Environmental Audit and Legislation (Course Code:4361300)									
	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** Environmental planning & deisgn	**PSO 2** Environmental Impact Assessment	**PSO 3** (If needed)
Competency	i. Monitor and measure noise pollution, soil pollution, thermal pollution, light pollution, and radiation pollution.									
Course Outcomes a) Understand the concept and significance of different types of environmental pollution.	3	3	-	-	3	-	2	3	3	-
b) Explore the sources and effects of noise, soil, thermal, light, and radiation pollution.	3	3	3	-	3	-	2	3	3	-
c) Develop skills for monitoring and measuring these pollutants.	3	3	3	2	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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