



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Minor/Hons. Program

Level: UG

Branch: Minor/Hons. Green Technology and Sustainability Engineering

Course / Subject Code: BE040AS011

Subject Name: Introduction to Green Technology

w. e. f. Academic Year:	2025-2026
Semester:	4 <sup>th</sup>
Category of the Course:	Core Courses

<b>Prerequisite:</b>	Student should have basic knowledge of environment and pollution
<b>Rationale:</b>	This course is designed to have in-depth knowledge about environment and various types of pollutions. It also focuses on principles of green technology. It emphasizes on substitution of conventional toxic, hazardous material by less toxic, green material. Study of different environment friendly processes helps to reduce the harmful effects on the environment.

### Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Explain the principles of green chemistry and engineering.	10
CO-2	Classify various waste material and explain methods for its minimization.	20
CO-3	Outline types of pollutions and its mitigation techniques	30
CO-4	Design processes which are benign and environmentally viable.	20
CO-5	Design and modify processes and products to make them green, safe and economically acceptable.	

### Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	TH		Theory		Tutorial / Practical			
						ESE (E)	PA (M)	PA (I)	PBL (I)	ESE (V)	
45	00	30	45	120	4	70	00	00	30	50	150

\* **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



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## Content:

Sr. No.	Content	Total Hrs
1.	The twelve Principles of Green Chemistry and green engineering with examples, Sustainable Development Goals (SDGs)	05
2.	Green chemistry metrics- atom economy, E factor, reaction mass efficiency and other green chemistry metrics, application of green metrics analysis to synthetic plans.	05
3.	Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.	04
4.	Pollution – types, causes, effects and abatement .	06
5.	Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy efficient design of processes- photo, electro and sono chemical methods, microwave assisted reactions.	06
6.	Green reagents and catalysis in green synthesis.	04
7.	Designing green processes- safe design, process intensification, in- process monitoring.	04
8.	Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention.	06
9.	Industrial case studies.	05
<b>TOTAL</b>		<b>45</b>

## Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	25	25	20	10	-

**R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

## Reference Books:

- 1) Green Chemistry- An introductory text - M. Lancaster, RSC
- 2) Green chemistry metrics - Alexei Lapkin and David J.C. Constable (Eds), Wiley publications
- 3) Environmental chemistry - Stanley E Manahan, Lewis Publishers

## List of Tutorials:

- 1) Tutorial on the Twelve Principles of Green Chemistry and Engineering with practical examples from industry.
- 2) Green Chemistry Metrics Calculations
- 3) Identification and Classification of Industrial Wastes – Source analysis and minimization techniques.



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- 4) Design Exercise on Environmentally Benign Processes – Use of alternate solvents and energy-efficient methods.
- 5) Catalyst Selection and Green Reagents – Comparison of conventional vs. green catalysts in synthesis
- 6) Safe and Sustainable Process Design – Concept of process intensification and in-process monitoring.
- 7) Industrial Case Study Discussion – Review of a green manufacturing or waste recycling process.

### List of Open Source Software/learning website:

- 1) <https://www.unep.org/>
- 2) <https://www.iea.org/>
- 3) <https://www.epa.gov/>
- 4) <https://moef.gov.in/>

### List of suggested activities for Problem Based Learning:

No.	Description	No. of hours	Total hours
1.	Students will have to undergo industrial visit related to any one of the contents mentioned in syllabus and submit the report for the same	Visit = 5h, Report preparation = 5h Total = 10h	10
2.	Students will have to undergo technical video based learning related to subject and have to present it or prepare a report of that learning	Duration of video = 5 hrs Report Preparation = 5hrs	10
3.	Students will have to submit assignment work assigned to them.	5 assignments of 2h each.	10
4.	Discussion on research paper based on relevant subject. Summarize research paper and evaluation critical parameters	3 research papers can be included. Each one has 5h	15
5.	Student have to undergo an on-line course	Minimum duration of the course should be 10h.	10
6.	Students will have to prepare poster, chart or PowerPoint presentation on technical topic related to subject content	Poster/Chart/Power point preparation and presentation	10
7.	Students will have to prepare Working/non-working model on technical topics	For each model 10 h duration	10
8.	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 5h	10
<b>Maximum Hours to be allotted</b>			<b>45</b>

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