



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Chemical Engineering (Green Technology and Sustainability Engineering)

Subject Code: BE05044041

Subject Name: Waste to Energy

W. E. F. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Elective Course - 2

Prerequisite:	Basic Concepts of fermentation, combustion, incineration and heat pyrolysis, gasification & anaerobic digestion.
Rationale:	The objective of the course is to provide insights into waste management options by reducing the waste destined for disposal and encouraging the use of waste as a resource for alternate energy production. This course is designed to provide an understanding of the various aspects of Waste to Energy. The various sources of waste generation is analysed with a focus on its potential for energy production. The need for characterization of wastes will be discussed along with the existing norms for waste utilization for alternate energy source. Various Technological options available for the production of energy from waste will be delineated along with economics of using alternate sources. Case studies will be discussed to provide a better understanding of the concepts of “Waste to Energy” in the Indian context.

Course Outcome:

After Completion of the Course, Student will be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Explain waste characterization and energy recovery through incineration.	14
CO-2	Describe gasification and pyrolysis processes for energy production.	18
CO-3	Analyze energy generation from wastes using densification, plastics conversion, and anaerobic digestion.	20
CO-4	Explain microbial fuel cells, fermentation, and anaerobic digestion for bioenergy production.	17
CO-5	Describe biodiesel production through transesterification.	14
CO-6	Explain algal biomass cultivation and energy production from algae.	17



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Teaching and Examination Scheme:

Teaching /Learning Scheme in Hours Per Semester					Total Credits = TH/30	Examination Marks					Total Marks
L	T	P	PBL*	TH	03	Theory Marks		Practical Marks			
						ESE (E)	PA (M)	ESE (V)	PBL	PA(I)	
45	0	0	45	90		70		30	0	30	
											150

Course Content:

Sr. No.	Content	Total Hrs
1	Characterization of wastes, Energy production from wastes through incineration, incineration	6
2	Energy production from wastes through gasification, Syngas utilization, Energy production from wastes through pyrolysis, gasification, Pyrolysis	9
3	Densification of solids, Efficiency improvement of power plant, Energy production from waste plastics, Gas clean up, Energy production from organic wastes through anaerobic digestion, Design of anaerobic digester	10
4	Introduction to Microbial fuel cells, Energy production from organic wastes through fermentation, anaerobic digestion, fermentation	8
5	Energy production from wastes through transesterification, transesterification	6
6	Cultivation of algal biomass and treatment of waste water, Energy production form algal biomass	6

Sustainability alignment:

This course addresses SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation and Infrastructure), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action) by developing sustainable waste-to-energy technologies, renewable energy production methods, and environmentally responsible waste management practices.



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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	15	15	5	5	0

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

Reference Books:

1. Waste to Energy by S. Syngellakis.
2. Waste-to-Energy: Technologies and Project Implementation by Marc J. Rogoff, Francois Screve.
3. Waste-to-Energy: Advanced Cycles and New Design Concepts for Efficient Power Plants by Lisa Branchini.
4. Waste to Sustainable Energy: MFCs – Prospects through Prognosis by Durga Madhab Mahapatra, Lakhveer Singh.

Open source software and website:

Students can refer to video lectures available on the websites including NPTEL.

Activities suggested under self learning:

Sl. No.	Name of the activity	No. of hours	Total Hours
1.	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h	10
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h	10
3.	Assignment writing	5 assignments of 2h each.	10
4.	Self learning on-line course	Minimum duration of the course should be 10h.	10
5.	Poster/chart/power point preparation on technical topics		6
6.	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h	10
7.	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	
