GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering
Level: PG
Subject Code: ME03000071
Subject Name: Waste to Energy

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

Prerequisite:	Fundamentals of Renewable Energy, Power Systems, Basic Thermodynamics,
Rationale:	The growing challenges of waste management and energy demand necessitate sustainable solutions like waste-to-energy (WTE) conversion. This course provides a comprehensive understanding of various waste types and their potential for energy recovery. It covers thermal, biological, mechanical, and electrochemical conversion methods, equipping students with the knowledge to analyze and implement energy recovery technologies efficiently. With a strong emphasis on power electronics and grid integration, students learn about inverters, converters, and control mechanisms essential for WTE systems. Additionally, the course addresses environmental impact, economic feasibility, and policy frameworks, preparing students to evaluate and design WTE projects that align with sustainability goals. By integrating theoretical knowledge with real-world case studies, this syllabus enables students to develop skills in analyzing, evaluating, and applying innovative solutions for waste management and renewable energy production, contributing to a greener and more sustainable future.

Course Outcomes:

The students will be able to

Sr. No.	**CO statement**	**Marks % weightage**
CO-1	Explain the principles of waste-to-energy conversion, including waste classification, generation, and management strategies.	20
CO-2	Analyze thermal and biological conversion technologies such as incineration, gasification, anaerobic digestion, and landfill gas recovery for energy production.	30
CO-3	Evaluate the role of power electronics and grid integration in waste-to-energy systems for efficient energy utilization.	30
CO-4	Assess the environmental, economic, and policy aspects of waste-to-energy projects, including emission control, financial viability, and regulatory frameworks.	20

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE Viva (V)	PA (I)	
3	0	0	3	70	30	-	-	100

Content:

Sr. No.	Content	Total Hrs.	% Weightage
1	**Introduction to Waste-to-Energy (WTE)** Overview of waste generation and management, Classification of waste: Municipal, agricultural, industrial, biomedical, and e-waste, Need for waste-to-energy conversion, Conversion devices – Incinerators, gasifiers, digestors, Global and Indian waste-to-energy scenario	6	15
2	**Thermal Conversion Technologies** Incineration: Principles, types, efficiency, and environmental concerns, Gasification: Process, gasifier types, syngas composition, and utilization, Pyrolysis: Mechanism, products (bio-oil, biochar, syngas), and applications Plasma arc gasification and its applications	9	20
3	**Biological Conversion Technologies** Anaerobic digestion: Biogas production, digester types, and efficiency, Landfill gas recovery: Process, collection methods, and power generation, Bioethanol and biodiesel production from organic waste, Microbial fuel cells for electricity generation	9	15
4	**Mechanical and Electrochemical Conversion** Mechanical processing for energy recovery, Refuse-derived fuel (RDF) and its applications, Electrochemical conversion: Hydrogen production from waste, fuel cells, and applications	6	15
5	**Power Electronics and Grid Integration** Role of electrical engineering in waste-to-energy systems, Power electronics in WTE: Inverters, converters, and controllers, Grid integration of WTE power plants, Case studies of waste-to-energy power plants in India	6	20
6	**Environmental, Economic, and Policy Aspects** Environmental impact and emission control technologies, Economic feasibility and financing models of WTE projects, Government policies, regulations, and incentives for WTE in India, Case studies of successful WTE projects worldwide	6	15

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**	**-**

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

Note: This specification table shall be treated as a general guideline for students and teachers. The actualdistribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990
2. Breeze, P. (2018). *Waste-to-Energy: Technologies and Project Implementation*. Elsevier.
3. Kishore, V. V. N. (2010). *Renewable Energy Engineering and Technology: Principles and Practice*. The Energy and Resources Institute (TERI).
4. Klass, D. L. (1998). *Biomass for Renewable Energy, Fuels, and Chemicals*. Academic Press (Elsevier)
5. Billinton, R., & Allan, R. (2013). *Electric Power Grid Reliability Evaluation*. Springer.
6. Rashid, M. H. (2017). *Power Electronics Handbook*. Elsevier.
7. Rand, T. (2000). *Environmental and Economic Assessment of Waste-to-Energy Systems*. World Bank Publications.

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