INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

WASTE TO ENERGY								
III Semester: STE								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
BSTE31	**Elective**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: NIL								

I. COURSE OVERVIEW:

Waste to Energy focuses on sustainable conversion of solid and liquid waste into usable forms of energy through advanced technologies and integrated waste management strategies. This course provides an overview of waste characterization, treatment processes, and energy recovery methods in line with national and international environmental standards. It emphasizes efficiency, environmental safety, and sustainability by integrating modern thermal, biochemical, and thermo-chemical technologies for power generation and fuel production. Topics include sources and classification of wastes, waste collection and segregation, incineration, gasification, pyrolysis, anaerobic digestion, landfill gas recovery, and emission control systems. The course also covers techno-economic analysis, policy frameworks, and case studies of successful waste-to-energy projects, ensuring resource recovery, circular economy adoption, and reduction of environmental pollution for long-term energy security.

II. COURSE OBJECTIVES:

The students will try to learn:

I. **The fundamentals of waste generation, classification, and characterization, and their significance in sustainable energy recovery and environmental protection.**
II. **Various waste-to-energy conversion processes such as incineration, gasification, pyrolysis, and anaerobic digestion, including their efficiency, emission characteristics, and technological requirements.**
III. **Principles of energy recovery, material recycling, and pollution control using modern thermal, biochemical, and thermo-chemical technologies in line with environmental standards.**
IV. **Case studies of maintenance, rehabilitation, and seismic retrofitting projects for identifying effective practices, challenges, and strategies in extending structural life cycles.**

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1 Identify the different sources and types of solid waste by the properties of municipal solid waste for segregation and collection of waste.
CO 2 Evaluate biochemical and thermo-chemical waste-to-energy conversion processes for their efficiency and applicability.
CO 3 Apply principles of densification, heat recovery, and energy recovery from waste plastics to improve the efficiency of power plants for energy production.
CO 4 Analyze energy recovery from biogas and landfill gas for environmental benefits.
CO 5 Evaluate waste management activities including collection, segregation, transportation, and siting of centralized for sustainable operations.
CO 6 Utilize techno-economic analysis, industry-specific applications, and policy frameworks for feasibility, optimize performance and integrate waste-to-energy systems

IV. COURSE CONTENT:

MODULE –I: WASTE SOURCES & CHARACTERIZATION (9)

Waste production in different sectors such as domestic, industrial, agriculture, postconsumer, waste etc. Classification of waste, agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous). Characterization of waste for energy utilization. Waste Selection criteria.

MODULE -II: TECHNOLOGIES FOR WASTE TO ENERGY (9)

Biochemical Conversion – Energy production from organic waste through anaerobic digestion and fermentation. Thermo-chemical Conversion – Combustion, Incineration and heat recovery, Pyrolysis, Gasification; Plasma Arc Technology and other newer technologies.

MODULE -III: ENERGY PRODUCTION FROM SOLID WASTES (9)

Densification of solids, efficiency improvement of power plant and energy production from waste plastics. Densification of solids: principle, advantages, and disadvantages.

Efficiency improvement of power plants: principle, advantages, and disadvantages; Energy production from waste plastics: principle, advantages, and disadvantages; Applications of waste plastics in energy generation.

MODULE -IV: THERMO-CHEMICAL CONVERSION (9)

Biogas production, land fill gas generation and utilization, thermo-chemical conversion: Sources of energy generation, gasification of waste using gasifies briquetting, utilization and advantages of briquetting, environmental benefits of bio-chemical and thermo- chemical conversion, comparison of various thermo-chemical conversion.

MODULE -V: E-CENTRALIZED AND DECENTRALIZED WASTE TO ENERGY PLANTS (9)

Waste activities, collection, segregation, transportation and storage requirements. Location and Siting of 'Waste to Energy' plants. Industry Specific Applications, In-house us, sugar, distillery, pharmaceuticals, Pulp and paper, refinery and petrochemical industry and any other industry. Centralized and Decentralized Energy production, distribution and use. Comparison of Centralized and decentralized systems and its operations.

V. TEXTBOOKS:

1. Nicholas P Cheremisinoff, "*Handbook of Solid Waste Management and Waste Minimization Technologies*", An Imprint of Elsevier, New Delhi, 2003.
2. Paul Breeze, "*Energy from Waste*", An Imprint of Elsevier, New Delhi, 2018.
3. P Aarne V esilind, William A Worrell and Debra R Reinhart, "*Solid Waste Engineering*", 2nd Edition 2002.

VI. REFERENCE BOOKS:

1. Challal, D S, "*Food, Feed and Fuel from Biomass*", IBH Publishing Co. Pvt. Ltd., 1st Edition, 1991.
2. C Y Were Ko-Brobby and E. B. Hagan, "*Biomass Conversion and Technology*", John Wiley & Sons, 1st Edition, 1996.
3. C Parker and T Roberts, "*Energy from Waste*", An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985.
4. KL Shah, "*Basics of Solid and Hazardous Waste Management Technology*", Prentice Hall, Reprint edition, 2000.

VII. ELECTRONICS RESOURCES:

1. https://www.e-waste Management: From waste to Resource Klaus Hieronymi, Ramzy Kahnat, Eric williams Tech. &Engg, 2013.
2. https://www.What is the impact of E-waste: Tamara Thompson.
3. https://www. E-waste poses a Health Hazard: Sairudeen Pattazhy.

VIII. MATERIAL ONLINE:

1. Course Outline Description
2. Tutorial Question Bank
3. Assignments
4. Model Question Paper – I
5. Model Question Paper - II
6. Lecture Notes
7. Early Lecture Readiness Videos
8. Power point presentation