

## ENERGY FROM WASTE

<b>VII Semester: CE</b>								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AEE551	Elective	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
<b>Contact Classes:45</b>		<b>Tutorial Classes: 15</b>		<b>Practical Classes: Nil</b>			<b>Total Classes: 60</b>	

### **COURSE OBJECTIVES:**

**The course should enable the students to:**

- I. Understand the principles associated with effective energy management and to apply these principles in the day to day life.
- II. Develop insight into the collection, transfer and transport of municipal solid waste.
- III. Explain the design and operation of a municipal solid waste landfill.
- IV. Evaluate the main operational challenges in operating thermal and biochemical energy from waste facilities and device key processes involved in recovering energy from wastes.

### **COURSE OUTCOMES (COs):**

- CO 1: Identify different sources of solid waste and characteristics of municipal solid waste.
- CO 2: Classify the methods in disposal of solid waste and the emission of gases, leach ate from landfills.
- CO 3: Understand Biochemical conversion of biomass for energy application, Bioenergy systems and process integration.
- CO 4: Illustrate sources of thermo chemical energy generation and understand Biochemical conversion of biomass for energy application
- CO 5: Understand the global scenario of environmental concerns and health hazards by the generation of E-waste.

### **COURSE LEARNING OUTCOMES (CLOs):**

1. Apply the knowledge about the operations of Waste to Energy Plants.
2. Understand physical and chemical analysis of municipal solid wastes and apply them for a management system that will be set up.
3. Analyze the various aspects of Waste to Energy Management Systems.
4. Design a compost facility, incineration facility and make site selection for a landfill.
5. Explain the hierarchical structure in solid waste management and a requirement for an integrated solution.
6. Use Geographical Information System for landfill site selection that takes place in Solid Waste Management Plan.
7. Collect required data for a Solid Waste management Plan and edit the collected Data set up Solid Waste Management Plan.
8. Understand Biochemical conversion of biomass for energy application, Bioenergy systems and process integration.
9. Discuss Thermo chemical conversion of Biomass for energy application.
10. Understand the concept of bio-mass Briquetting and its advantages.
11. Evaluate the subject from the technical, legal and economical points by learning of all terms related to general solid waste management.
12. Use multiple criteria decision making systems for an optimum and sustainable integrated solid waste managementsystem based on entire data.
13. Apply the knowledge in planning and operations of waste to Energy plants.

14. Examine the technical points that are required to set up a solid waste management system.
15. Apply the legal legislation related to solid waste management.
16. Encourage students to organize recycling events and waste audit.
17. Discuss the growth of electrical and electronics in waste to energy industry in India.
18. Summarize government regulations on E-waste management
19. Explain need for stringent health safeguards.
20. Understand need for stringent health safeguards and environmental protection laws of India.

<b>UNIT - I</b>	<b>INTRODUCTION TO WASTE AND WASTE PROCESSING</b>	<b>Classes: 08</b>
Solid waste sources solid waste sources, types, composition, properties, global warming; Municipal solid waste: Physical, chemical and biological properties, waste collection and, transfer stations, waste minimization and recycling of municipal waste, segregation of waste, size reduction, managing waste, status of technologies for generation of energy from waste treatment and disposal aerobic composting, incineration, furnace type and design, medical waste / pharmaceutical waste treatment technologies, incineration, environmental impacts, measures to mitigate environmental effects due to incineration .		
<b>UNIT - II</b>	<b>WASTE TREATMENT AND DISPOSAL</b>	<b>Classes: 10</b>
Land fill method of solid waste disposal land fill classification, types, methods and sitting consideration; Layout and preliminary design of landfills: Composition, characteristics, generation, movement and control of landfill leach ate and gases, environmental monitoring system for land fill gases.		
<b>UNIT - III</b>	<b>BIO-CHEMICAL CONVERSION</b>	<b>Classes: 09</b>
Energy generation from waste bio-chemical conversion: Sources of energy generation, anaerobic digestion of sewage and municipal waste, direct combustion of MSW-refuse derived solid fuel. Industrial waste, agro residues and anaerobic digestion.		
<b>UNIT - IV</b>	<b>THERMO-CHEMICAL CONVERSION</b>	<b>Classes: 10</b>
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.		
<b>UNIT - V</b>	<b>E-WASTE MANAGEMENT</b>	<b>Classes: 08</b>
E-waste: E-waste in the global context: Growth of electrical and electronics industry in India, environmental concerns and health hazards; Recycling e-waste: A thriving economy of the unorganized sector, global trade in hazardous waste, impact of hazardous e-waste in India; Management of e-waste: E-waste legislation, government regulations on e-waste management, international experience, need for stringent health safeguards and environmental protection laws of India.		

**Text Books:**

1. Nicholas P Cheremisinoff, —Handbook of Solid Waste Management and Waste Minimization Technologies, An Imprint of Elsevier, New Delhi, 2003.
2. P Aarne Vesilind, William A Worrell and Debra R Reinhart, —Solid Waste Engineering, 2<sup>nd</sup> edition 2002.
3. M Dutta , B P Parida, B K Guha and T R Surkrishnan, —Industrial Solid Waste Management and Landfilling practice, Reprint Edition New Delhi, 1999.
4. Rajya Sabha Secretariat, —E-waste in India: Research unit, Reprint Edition, June, 2011.
5. Amalendu Bagchi Design, —Construction and Monitoring of Landfills, John Wiley and Sons, New York,
6. M. L. Davis and D. A. Cornwell, —Introduction to environmental engineering, International Edition, 2008.
7. C. S. Rao, —Environmental Pollution Control Engineering, Wiley Eastern Ltd. New Delhi, 1995.
8. S. K. Agarwal, —Industrial Environment Assessment and Strategy, APH Publishing Corporation, New Delhi, 1996.

9. Sofer, Samir S. (ed.), Zaborsky, R. (ed.), —Biomass Conversion Processes for Energy and Fuels, New York, Plenum Press, 1981.
10. Hagerty, D. Joseph; Pavoni, Joseph L; Heer, John E., —Solid Waste Management, New York, Van Nostrand, 1973.
11. George Tchobanoglous, Hilary Theisen and Samuel Vigil Prsl: Tchobanoglous, George Theisen, HillarVigil,
12. Samuel, —Integrated Solid Waste management: Engineering Principles and Management issues, New York, McGraw Hill, 1993.

#### **Reference Books:**

1. C Parker and T Roberts (Ed), —Energy from Wastel, An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985.
2. KL Shah, —Basics of Solid and Hazardous Waste Management Technology, Prentice Hall, Reprint Edition, 2000.
3. M Datta, —Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997.
4. G Rich et.al, Hazardous, —Waste Management Technology, Podvan Publishers, 1987.
5. AD Bhide, BB Sundaresan, —Solid Waste Management in Developing Countries, INSDOC, New Delhi, 1983.

#### **Web References:**

1. [https://www.e-waste Management: From waste to Resource Klaus Hieronymi, RamzyKahnat, Eric williams Tech. & Engg.-2013 \(Publisher: Earthscan 2013](https://www.e-waste Management: From waste to Resource Klaus Hieronymi, RamzyKahnat, Eric williams Tech. & Engg.-2013 (Publisher: Earthscan 2013)
2. <https://www.What is the impact of E-waste: Tamara Thompson>
3. <https://www. E-waste poses a Health Hazard: SairudeenPattazhy>

#### **E-Text Books:**

1. <https://www.unep.org>
2. <https://www.outledge.com>
3. <https://www.bookdepository.com>
4. <https://www.ecoactiv.com>