

# Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

**AY 2023 -24**

## Course Information

<b>Programme</b>	M. Tech. (Mechanical Heat Power Engineering)
<b>Class, Semester</b>	First Year M. Tech., Sem II
<b>Course Code</b>	7OE504
<b>Course Name</b>	Waste to Energy
<b>Desired Requisites:</b>	

Teaching Scheme		Examination Scheme (Marks)			
<b>Lecture</b>	3 Hrs/week	<b>MSE</b>	<b>ISE</b>	<b>ESE</b>	<b>Total</b>
<b>Tutorial</b>	-	30	20	50	100
<b>Credits: 3</b>					

## Course Objectives

<b>1</b>	Understand the grave problem of urban solid waste disposal and methods to tackle this problem.
<b>2</b>	Understand and apply various energy conversion methods using biomass.
<b>3</b>	Study and analyze the biogas energy conversion process.
<b>4</b>	Study the Waste To Energy & Environmental Implications

## Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, students will be able to,

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
<b>CO1</b>	Describe various methods of conversion of waste to energy.	II	Understand
<b>CO2</b>	Examine various methods of energy generation using waste	III	Apply
<b>CO3</b>	Explain the environment considerations of WTE plants the combustion mechanisms of various fuels	IV	Analyse

Module	Module Contents	Hours
I	Introduction – Waste production in different sectors such as domestic, industrial, agriculture, post-consumer, waste etc. Classification of waste-agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous), Characterization of waste for energy utilization, Characterization of wastes, Waste to energy by incineration process, Incineration plant furnaces & boilers.	7
II	Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application. Manufacture of pyrolytic oils and gases, yields and applications.	6
III	Biomass Gasification: Gasifiers- Fixed bed system- Downdraft and updraft gasifiers, Fluidized bed gasifiers- construction and operation – Gasifier burner arrangement for thermal heating. Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation	7
IV	Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, construction and operation.	7
V	Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features Biochemical conversion - anaerobic digestion - Types of biogas Plants Applications - Alcohol production from biomass - Bio diesel production.	6
VI	Waste To Energy & Environmental Implications- Environmental standards for waste to energy plant operations and gas clean-up. Savings on non-renewable fuel resources. Carbon Credits: Carbon foot calculations and carbon credits transfer mechanisms.	6

## Text Books

1	S . P. Sukhatme, “ Solar Energy”, McGraw Hill Education, 3rd Edition,2015
2	Energy Technology- S. Rao and B. B. Parulekar, Khanna Publica
3	NIR Board 2004, Handbook on Biogas and its applications, NIIR, New Delhi.

<b>References</b>	
1	Annual Report 2006, Ministry of new and renewable energy, Government of India, New Delhi.
2	Energy Handbook, R. L. Loftness Van Nostrand Reinhold.
3	H. Shah et al., Integrated renewable energy for rural development, 1990, Tata Mc Graw Hill.
4	L.L. Anderson et al, Fuels from waste academic press, New york, 1977.
5	Rogoff, M.J. and Screve, F., "Waste-to-Energy: Technologies and Project Implementation", Elsevier Store
6	Young G.C., "Municipal Solid Waste to Energy Conversion processes", John Wiley and Sons
7	Harker, J.H. and Backhurst, J.R., "Fuel and Energy", Academic Press Inc.
8	EL-Halwagi, M.M., "Biogas Technology- Transfer and Diffusion", Elsevier Applied Science
9	Hall, D.O. and Overeed, R.P.," Biomass - Renewable Energy", John Willy and Sons
10	Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
11	Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
12	Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
13	Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
<b>Useful Links</b>	
1	<a href="https://nptel.ac.in/courses/103103206">https://nptel.ac.in/courses/103103206</a>
2	<a href="https://www.youtube.com/@wastetoenergyconversion2687">https://www.youtube.com/@wastetoenergyconversion2687</a>
3	<a href="https://archive.nptel.ac.in/courses/103/107/103107125/">https://archive.nptel.ac.in/courses/103/107/103107125/</a>

<b>CO-PO Mapping</b>						
	<b>Programme Outcomes (PO)</b>					
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>CO1</b>	1					
<b>CO2</b>					2	
<b>CO2</b>						3
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						