QP Code: R253B097 | Reg. No | | | | | | | | | | | AY 24

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET University)

M. Tech. (Third Semester - Regular) Examinations, December – 2025

24MBTOE23001 – Waste to Energy

(Biotechnology and Chemical Engineering)

Time: 2 hrs | Maximum: 60 Marks

Answer ALL questions

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions	CO #	Blooms Level
a. What is pyrolytic gas? Mention its major components.	CO1	K3
b. What is the difference between combustion and gasification?	CO2	K2
c. What is the typical temperature range for gasification?	CO4	K2
d. What type of equipment is used for direct combustion of biomass?	CO5	K1
e. Classify biomass resources into two major categories.	CO6	K2

PART – B **(10 x 5 = 50 Marks)**

Answer ***ALL*** the questions	Marks	CO #	Blooms Level
2. a. Describe in detail the characteristics and composition of Municipal Solid Waste (MSW). Discuss how MSW can be utilized as a potential energy source	5	CO1	K1
b. Describe the construction and working of an anaerobic digester. Explain the factors influencing biogas production.	5	CO1	K2
(OR)			
c. Explain the different types of agro-based, forest-based and industrial wastes used as fuel, and compare their calorific values.	5	CO1	K2
d. Evaluate the environmental impacts of using incinerators, gasifiers, and digestors for waste-to-energy conversion	5	CO1	K2
3.a. Explain the principle of biomass gasification. Discuss the chemical reactions involved and the factors that influence gasification efficiency	5	CO2	K3
b. Describe the major components of a biomass gasifier system. Explain the importance of air supply, fuel feed, ash handling, throat, and grate design.	5	CO3	K4
(OR)			
c. Explain how producer gas can be used in an engine–generator system to produce electrical power. Describe gas cleaning, cooling, and conditioning requirements.	5	CO3	K3
d. Explain equilibrium and kinetic considerations in gasifier operation. Discuss how temperature, residence time, and reaction kinetics affect producer gas composition	5	CO2	K4
4.a. Compare fixed-bed and fluidized-bed gasifiers with reference to design, fuel flexibility, tar levels, gas quality, and suitability for different capacities	5	CO4	K2
b. Explain the effect of different gasifying agents (air, oxygen, steam, or air-steam mixture) on the producer gas composition and calorific value.	5	CO4	K3

(OR)

c.	With neat diagrams, explain the design and operation of an updraft gasifier. What are its advantages, limitations, and applications?	5	CO4	K4
d.	Illustrate the working of a downdraft gasifier. Discuss why downdraft gasifiers are preferred in applications requiring low tar producer gas.	5	CO4	K2
5.a.	Biogas is often referred to as a "renewable substitute for conventional gaseous fuels. "Explain this statement by analysing the composition, calorific value, physical characteristics, and combustion behaviour of biogas.	5	CO5	K2
b.	How do these properties influence burner efficiency and application suitability?	5	CO5	K3

(OR)

c.	Examine the various biomass conversion processes available for energy generation..	5	CO5	K2
d.	Compare biochemical and thermochemical conversion pathways with respect to feedstock requirements, energy yields, reaction conditions, and end-use applications	5	CO5	K3
6.a.	Critically compare thermochemical and conversion processes with respect to feedstock quality, product forms, process complexity, environmental impacts, and energy efficiency.	5	CO6	K4
b.	Suggest suitable combinations of these methods for decentralized rural energy systems.	5	CO6	K3

(OR)

c.	Examine the various technologies available for converting urban solid waste into useful energy, Assess the challenges faced by Indian cities in adopting waste-to-energy systems.	5	CO6	K3
d.	Compare their environmental footprints, energy recovery efficiencies, land requirements, and policy implications.	5	CO6	K2

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