

Centre for Rural Development and Technology, IIT Delhi
Anaerobic Digestion and Biogas Energy Systems (RDL735)

Major Examination; II Semester of 2022-2023

Date: 07 May 2023; Time: 11:00 AM – 01:00 PM

Duration: 2.0 h		Maximum Marks: 40.0
Q1.	Describe the processes of biochemical conversion of biomass to energy. How the hydrolysis impacts the product yield.	5.0
Q2.	A biogas reactor is operating on cattle dung in daily feeding mode and is having a working volume of 1000 L. The total solids (TS) and volatile solids (VS) contents in the substrate is 10%, and 8%, respectively. The hydraulic retention time (HRT) of the biogas plant is 30 days. Calculate the following parameters: (1) Daily feeding rate, (2) Daily mass of input total solids, volatile solids, and water which is being fed to the digester, (3) How much biogas production can be produced from this plant.	5.0
Q3.	What happens if the OLR in the anaerobic digester is kept high than the normal feeding rate?	3.0
Q4.	Describe the dual fuel operation of a diesel engine with biogas. What changes are required in operation of diesel engine for 100% use of biogas?	4.0
Q5.	Describe the fundamental of the water scrubbing-based biogas upgradation and bottling system along with various components of the system.	5.0
Q6.	A biogas plant is operating on paddy straw (feeding rate is 10.0 tonne containing of 75% TS and 85% VS of TS, and 15% ash) and is producing 4000 m ³ of biogas per day with a methane and carbon dioxide contents of 55% and 40%, respectively. Calculate the following parameters: (1) Mass of methane and carbon dioxide which is being produced on daily basis; (2) Density of biogas (kg/m ³), (3) Calorific values of biogas, (4) Wobbe Index of biogas, (5) Specific biogas and methane productions on TS and VS basis. If the biogas is upgraded to a methane content of 95% and 5% carbon dioxide level. What will be the (6) Density of upgraded biogas (kg/m ³), (7) Calorific values of upgraded biogas, (8) Wobbe Index of upgraded biogas. If the produced biogas is used for power generation via three phase 415 V, 1.5 kA, PF 0.95 for a period of 8 hours/day, then calculate following (9) Rating of power generation and total amount of energy generation from the power generation system, and (10) Specific biogas and methane consumption of the engine.	10.0
Q7.	What is the difference between volatile mass conversion efficiency and energy conversion efficiency of the anaerobic digestion process?	3.0
Q8.	Describe the method of biogas storage. If a CNG cylinder is having 45 L of volume and the biogas is compressed to a pressure of 220 bar, then determine the total volume, mass, and energy stored in the cylinder. Assume methane and carbon dioxide contents as 95% and 5% (v/v) respectively.	5.0

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