Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER IV (NEW) – EXAMINATION – SUMMER - 2017

Subject Code: 2743901 **Date:03/05/2017**

Subject Name: Biomass Energy Conversion

Time:02:30PM-05:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of Enthalpy of Formation data book is permissible after verification.**

Q.1 **(a)** A biomass ($C_6H_{12}O_6(s)$) at 25°C, 0.1 MPa pressure is burnt with 200 % excess air at 25°C, 0.1 MPa pressure. Determine the irreversibility (per kg of fuel) if reaction takes place adiabatically and the each product of combustion leaves at 0.1 MPa pressure and at adiabatic flame temperature with surrounding temperature of 25 °C. Enthalpy of formation for biomass ($C_6H_{12}O_6(s)$) = -1271 kJ/mol. Entropy for biomass ($C_6H_{12}O_6(s)$) = 209.2 J/mol-K. Take temperature 1000 K and 1200 K for iteration. **08**

(b) Design a biogas plant for a dairy industry for the following data:
No. of animals = 1313, Average dung production = 13.13 kg per animal per day
Retention period = 22 days, Roof area factor = 1.13, Roof volume factor = 1.09
Charge density = 990 kg/m^3, Digestion factor = 0.49. **06**

Q.2 **(a)** A biomass ($C_6H_{10}O_5$) supplied to the combustion Chamber at 25°C and air enters from compressor at 127°C. It is determined that 90% of carbon in fuel burns to form CO_2 and remaining 5% burns to form CO. The temperature of the product is limited to 727°C. Estimate the air-fuel ratio on mass basis and the excess air. Enthalpy of formation for biomass ($C_6H_{10}O_5$) = -963000 J/mol. Assume adiabatic process. **08**

(b) Explain in brief the governing equations for the catalytic liquefaction process. **06**

OR

(b) Explain in brief types of bio-gasification process. Draw the layout of gasification process for low, medium heat value gas and liquid fuel. **06**

Q.3 **(a)** Write a short note on Municipal sewage sludge – a source of biomass energy. **07**

(b) Explain in brief concept of Energy Farm, its design parameter and layout. **07**

OR

Q.3 **(a)** Explain in brief method of data analysis for forestry and agriculture residue. **07**

(b) Define physical conversion process. Write a short note on size reduction physical conversion process. **07**

Q.4 **(a)** Explain PERC liquefaction process with neat and clean process diagram. **07**

(b) Define biochemical conversion process. Discuss the kinetic factor influencing efficiency of methane formation. **07**

OR

Q.4 **(a)** Explain in brief chemistry of gasification process. **07**

(b) Define anaerobic digestion. Write a short note on H_2- producing bacteria. **07**

Q.5	**(a)**	Explain process flow description of biogas plant design and construction with neat lay out.	**09**
	(b)	Explain in brief factors to be considered for the digester design.	**05**

OR

Q.5	**(a)**	Explain in brief ethanol recovery with neat and clean layout.	**08**
	(b)	Discuss factors affecting generation of biogas (1) pH (2) Carbon – Nitrogen ratio (3) Temperature (4) Seeding (5) Nutrient (6) Diameter to depth ration	**06**

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