

**AGRICULTURAL AND FOOD ENGINEERING DEPARTMENT
INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR**

Full Marks - 30

Time - 2 h

Date of Examination : 23.02.11 AN

Spring Semester : 2010-2011

Course : M.Tech. (Farm Machinery & Power)

Subject No. : AG60002

Subject Name : Alternative Energy Sources

No. of Students : 17

Instruction : ANSWER ALL QUESTIONS.

1. (a) Briefly discuss the processes involved in methane production from cowdung slurry. (2.5)
- (b) It is proposed to use biogas in a farmer's family (4 adult members and two children) at Kharagpur for both cooking and lighting using one standard biogas stove and one lamp, respectively. The lamp is to be lighted for 5 hours in the evening. The farmer has two pairs of bullocks, one pair of hybrid cows and one calf. (2+3+2)
 - (i) Decide the suitable size of Deenbandhu model biogas plant required for meeting the farmer's requirement.
 - (ii) Decide the major dimensions (upper dome radius and lower concave radius) of the suggested size of biogas plant.
 - (iii) Calculate the total energy available from the biogas plant. Assume heating value of biogas as 4713 kcal/kg with a density of 0.98 kg/m³, efficiency of stove as 60% and efficiency of lamp as 20%.
2. Discuss the process followed for making biodiesel from vegetable oils. Briefly describe the various factors affecting this process. (5)
3. A 10.5 kW, 4stroke single cylinder diesel engine with a bore and stroke of 87.5 mm and 110 mm, respectively is to be run at a rated speed of 1500 rpm using producer gas and diesel in dual fuel mode. (1.5+2.5+3)
 - (i) Suggest the modification required if any to run the existing diesel engine.
 - (ii) Decide the quantity of producer gas required, if stoichiometric ratio for air and producer gas is 1:1. Pressure and temperature inside intake manifold of diesel engine is 84450 Pa and 30 °C, respectively.
 - (iii) Decide the throat diameter and height of wood chamber of the downdraft gasifier. Assume specific weight of producer gas = 1.1 kg/m³, 2.3 kg of producer gas is obtained from 1 kg of wood chips and bulk density of wood chips = 167 kg/m³ at 10% moisture content.

Hearth diameter, mm	h/d_h	$100 \times A_m/A_n$	No. of nozzles
60	1.34	7.8	3
80	1.2	6.4	5
100	1.0	5.5	5

4. With a schematic diagram, propose a suitable power generating system for a remote rural village of 25 house holds, where plenty of biomass is available. Each household will be supplied with a maximum of 200 W of electrical power. Discuss the advantage of this system and also derive expression for the efficiency of the proposed system. (4)
5. Write short notes on (4.5)
 - (a) Hearth load
 - (b) Flexi model biogas plants
 - (c) Ethanol production from lignocellulosic biomass

XXXXXXXXXX