

**NON-CONVENTIONAL ENERGY  
(BIOT 4282)**

Time Allotted : 3 hrs

Full Marks : 70

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

**Group – A  
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The bacteria which are used to produce biogas are
    - (a) aerobic
    - (b) facultative
    - (c) anaerobic
    - (d) pathogenic.
  - (ii) The principal organism for alcoholic fermentation is
    - (a) Saccharomyces cerevisiae
    - (b) Aspergillus niger
    - (c) Eschericia coli
    - (d) Penicillium notatum.
  - (iii) A biogas can have the following composition
    - (a) Methane- 45%, CO<sub>2</sub>-45%, N<sub>2</sub>- 8%, H<sub>2</sub>S- 1.5%, H<sub>2</sub>- 0.5%
    - (b) Methane- 65%, CO<sub>2</sub>-25%, N<sub>2</sub>- 8%, H<sub>2</sub>S- 1.5%, H<sub>2</sub>- 0.5%
    - (b) Methane- 25%, CO<sub>2</sub>-65%, N<sub>2</sub>- 8%, H<sub>2</sub>S- 1.5%, H<sub>2</sub>- 0.5%
    - (c) Methane- 50%, CO<sub>2</sub>-50%, N<sub>2</sub>- 8%, H<sub>2</sub>S- 1.5%, H<sub>2</sub>- 0.5%.
  - (iv) When the wind speed doubles the power available to a wind generator
    - (a) increases by a factor of eight
    - (b) decreases by a factor of two
    - (c) decreases by a factor of two
    - (d) increases by a factor of eight.
  - (v) Which of the following is not an example of non-conventional energy?
    - (a) Nuclear energy
    - (b) Solar energy
    - (c) Gasoline
    - (d) Geothermal energy.

- (vi) All biofuels are made from:  
 (a) corn (b) animal fat  
 (c) biological ingredients (d) silver.
- (vii) A fuel cell is used to convert chemical energy into  
 (a) mechanical energy (b) solar energy  
 (c) electrical energy (d) potential energy.
- (viii) What chemical reaction makes biodiesel?  
 (a) polymerization (b) fermentation  
 (c) sublimation (d) transesterification.
- (ix) Biodiesel is also called what?  
 (a) methyl ester (b) glycerin  
 (c) vegetable oil (d) alcohol.
- (x) The burning of which fuel would reduce the build up of carbon dioxide in the atmosphere?  
 (a) ethanol (b) diesel  
 (c) methane (d) hydrogen.

**Group - B**

2. (a) What do you understand by the term "non-conventional energy"? What are the different forms of non-conventional energy?  
 (b) A home in Phoenix requires 85 kWh of heat on a winter day to maintain a constant indoor temperature of 20°C. The average solar radiation in winter is 6.5kWh/m<sup>2</sup>.day. The average temperature of the hot fluid be 60°C. (i) How much collector surface area does it need for an all solar heating system that has 50% efficiency?  
 (ii) What should be the capacity of the storage tank to provide the required energy?  
**(2 + 2) + (4 + 4) = 12**
3. (a) What is a photovoltaic cell?  
 (b) Explain the working of a photovoltaic cell.  
 (c) Why is it important to know tip speed ratio of a wind turbine?  
 (d) If you have a wind turbine with three blades, each 4m long, what distance does the tip of each blade travel in one full revolution?  
**2 + 5 + 2 + 3 = 12**

**Group - C**

4. What are the different processes by which biogas can be produced? Explain any one in detail.  
**(2 + 10) = 12**
5. (a) How is bioethanol produced commercially?  
 (b) What is the composition of biogas?  
**10 + 2 = 12**

**Group - D**

6. A fuel contains by mass 88% carbon, 8% H<sub>2</sub>, 1% Sulphur and 3% ash (silica).  
 (i) Calculate the stoichiometric air required.  
 (ii) If the air supplied is 20% excess more than stoichiometric value, find the analysis of the dry products by mass.  
**(6 + 6) = 12**
7. (a) Methane is burned with 18 % excess air in respect of volume. Determine the carbon dioxide percentage in the flue gas on dry basis.  
 (b) Define the following terms for a fuel (i) Flammability limits (ii) Adiabatic Flame temperature.  
**8 + 4 = 12**

**Group - E**

8. (a) Describe the steam reforming process of hydrogen production.  
 (b) Write short note on cryogenic storage of hydrogen.  
**6 + 6 = 12**
9. (a) Write down the advantages and disadvantages of compressed hydrogen as hydrogen storage method.  
 (b) Describe the process of in-direct photolysis for biohydrogen production. Mention the chemical reactions involved in this process.  
**6 + 6 = 12**