

**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) *Escherichia coli* (d) *Penicillium notatum*.
- (iii) A biogas can have the following composition:
 (a) CH₄- 45%, CO₂-45%, N₂- 8%, H₂S- 1.5%, H₂- 0.5%
 (b) CH₄- 65%, CO₂-25%, N₂- 8%, H₂S- 1.5%, H₂- 0.5%
 (c) CH₄- 25%, CO₂-65%, N₂- 8%, H₂S- 1.5%, H₂- 0.5%
 (d) CH₄- 50%, CO₂-50%, N₂- 8%, H₂S- 1.5%, H₂- 0.5%.
- (iv) Example of indirect-gain passive solar system is
 (a) heliostat (b) trombe wall
 (c) parabolic trough collectors (d) none of the above.
- (v) The electron have to overcome which of the following types of energy to conduct electricity?
 (a) valence band energy (b) conduction band energy
 (c) band gap energy (d) all of the above.
- (vi) Which of the following is not a biochemical process?
 (a) Transesterification (b) Combustion
 (c) Composting (d) Fermentation.
- (vii) Which of the following is a disadvantage of most of the renewable energy sources?
 (a) Highly polluting (b) High waste disposal cost
 (c) Unreliable supply (d) High running cost

- (viii) What chemical reaction makes biodiesel?
 (a) Fermentation (b) Sublimation
 (c) Polymerisation (d) Trans-esterification.
- (ix) Fuel cells are
 (a) carbon cell (b) hydrogen battery
 (c) nuclear cell (d) chromium cell.
- (x) What is a byproduct of producing biodiesel?
 (a) Salt (b) Polymer
 (c) Glycerine (d) Methanol.

Group - B

2. (a) Why is direct production of electricity better than that of the other two methods of harnessing solar energy?
 (b) How much collector area would a 800MW solar farm require if the individual efficiencies of the collector system, turbine and generator are 40, 25 and 80% respectively?
5 + 7 = 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. (a) How is biogas produced by anaerobic digestion?
 (b) What is the composition of a typical biogas?
10 + 2 = 12
5. (a) What is silviculture? What are the different types of silviculture practised? Which type of silviculture is best for production of bioenergy and why?
 (b) Describe the process of production of ethanol by alcoholic fermentation.
(1 + 3 + 2) + 6 = 12

Group - D

6. (a) Define the following parameters related to transport fuel quality:
(i) Octane number (ii) Cetane number (iii) HHV.
- (b) Write down the process and chemical reaction of trans-esterification for biodiesel production.

$$(2 + 2 + 2) + 6 = 12$$

7. A fuel contains by mass 88% carbon, 8% H₂, 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.

$$(8 + 4) = 12$$

Group - E

8. What is fuel cell? What are the uses of fuel cell? Name two organisms which can produce biohydrogen.

$$(6 + 4 + 2) = 12$$

9. (a) Write down the advantages and disadvantages of compressed hydrogen as hydrogen storage method.
(b) Describe the process of direct photolysis for biohydrogen production.
(c) Name two metal hydrides which have potential for hydrogen storage.

$$4 + 6 + 2 = 12$$