NON-CONVENTIONAL ENERGY (BIOT 4222)

Time Allotted : 3 hrs

Full Marks: 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and <u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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:
 - (i) With B20 Biodiesel, the "20" indicates the percentage of what?
 (a) Biodiesel fuel
 (b) Standard fuel
 (c) Energy
 (d) Calorific value.
 - (ii) Which biofuel has the highest motor octane number?
 (a) Unleaded gasoline
 (b) Methanol
 (c) Ethanol
 (d) Butanol.
 - (iii) What is the by-product of Biodiesel production?
 (a) Salt
 (b) Methanol
 (c) Polymer
 (d) Glycerine.
 - (iv) Which of the following supplies maximum amount of Hydrogen gas?
 (a) Natural gas
 (b) Anaerobic Digestion
 (c) Wastewater treatment
 (d) Electrolysis.
 - (v) How does electrolysis produce Hydrogen?
 (a) By running electricity to combine Hydrogen and water
 (b) By splitting water into Hydrogen and Oxygen and generating electricity
 (c) By passing electricity into water to split it into Hydrogen and Oxygen
 (d) By passing electricity into water to evaporate it into Hydrogen.
 - (vi) Which of the following is not a potential Biofuel?
 (a) Gasoline
 (b) Hydrogen Fuel Cells
 (c) Algae Biodiesel
 (d) None of these.
 - (vii) The main pretreatment steps in production of Bioethanol is
 (a) partial hydrolysis
 (b) liquefaction
 (c) saccharification
 (d) all the above.
 - (viii) The bacteria which are used to produce Biogas are(a) Aerobic(b) Facultative(c) Anaerobic(d) Pathogenic.

 $10 \times 1 = 10$

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- The process of collecting volatile components and condensing them to produce (ix) bio-oil is called
 - (a) Pyrolysis
 - (c) Distillation

- (b) Combustion
- (d) Condensation.
- (x) The principal organism for alcoholic fermentation is
 - (a) Saccharomyces cerevisiae
 - (c) Eschericia coli

(b) Aspergillus niger

(d) Penicillium notatum.

Group-B

- 2. Why is direct production of electricity better that the other two methods of (a) harnessing solar energy? [(CO1)(Remember/LOCQ)]
 - How much collector area would a 800 MW solar farm require if the individual (b) efficiencies of the collector system, turbine and generator are 40%, 25% and 80% respectively? [(CO1)(Compute/HOCQ)]
 - Differentiate between horizontal axis wind turbine and vertical axis wind (c) turbine. [(CO2)(Differentiate/IOCQ)]

3 + 6 + 3 = 12

- If you have a wind turbine with six blades, each 5 metres long, what distance 3. (a) does the tip of each blade travel in two full revolutions? [(CO6)(Remember/LOCQ)] [(CO6)(Understand/LOCQ)]
 - (b) What is tip speed ratio?
 - What is the role of molten salt in indirect production of electricity from Solar (c) energy? [(CO5)(Analyse/IOCQ)]
 - (d) Write a short note on any one type of vertical axis wind turbine.

[(CO6)(Remember/LOCQ)] 3 + 2 + 2 + 5 = 12

Group - C

- Show by a process flow chart the production of ethanol by alcoholic 4. (a) fermentation. [(CO4)(Understand/IOCQ)]
 - Define the terms saccharification and pyrolysis. [(CO2)(Understand/LOCQ)] (b) [(CO2)(Analysis/IOCQ)]
 - (c) Why is pretreatment required in Bioethanol production?

7 + (1 + 1) + 3 = 12

- Illustrate by a process flow chart the production of Biogas. Mention the typical 5. (a) composition of Biogas. [(CO2)(Understand/LOCQ)]
 - What are the different sources of Biomass used for production of Bioenergy? (b)

[(CO1)(Understand/LOCQ)]

(6+2)+4=12

Group - D

(a) Define the following terms in relation to transportation fuel. (i) Cetane number 6. (ii) Octane number (iii) Higher heating value. [(CO4)(Remember/LOCQ)]

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(b) Calculate energy content of 1 m³ of stoichiometric mixture of methane with air at 1 atmosphere pressure (101 kPa) and 298 K. LHV of methane is 50 MJ/kg.

[(CO4)(Calculate/HOCQ)] 6 + 6 = 12

- 7. (a) Name the method that is widely accepted for Biodiesel formation. Write down the chemical reaction for that process. [(CO4)(Analyse/IOCQ)]
 (b) Name the catalysts used for trans-esterification reaction and explain which
 - catalyst is better? [(CO3)(Analyse/IOCQ)]

6 + 6 = 12

Group – E

8. (a) Describe the steam reforming process of Hydrogen production.

[(C05,C06)(Illustrate/I0CQ)] How does alkaline electrolysis process produces Hydrogen?

> [(CO5,CO6)(Illustrate/IOCQ)] 6 + 6 = 12

9. (a) State the advantages of dark fermentation for biological Hydrogen generation. [(CO6)(Remember/LOCQ)]

(b) Explain the working principle of PEM as a method of Hydrogen fuel production. [(CO5)(Understand/LOCQ)]

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	46.87	40.63	12.50

Course Outcome (CO):

(b)

After the completion of the course students will be able to

- 1. Distinguish the different types of biomass and explain its uses.
- 2. Explain the conversion of biomass to clean fuels and also conversion of petrochemical substitutes to usefulproducts by physiochemical/fermentation processes.
- 3. Explain how ethanol and methane can be produced from biomass to produce bio-ethanol.
- 4. Describe how biopolymer and biosurfactants can be used for microbial recovery of petroleum.
- 5. Describe and understand how solar energy can be harnessed for useful purposes such as production of photovoltaic cells and for chemical storage purposes.
- 6. Analyze and understand how other renewable energy sources can be harnessed for other productive purposes.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.