

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

B.Tech Degree 7th semester (S,FE) Exam April 2025 (2019 Scheme)

**Course Code: MET445****Course Name: RENEWABLE ENERGY ENGINEERING****Max. Marks: 100****Duration: 3 Hours****PART A***Answer all questions, each carries 3 marks.*

- |    |  | Marks |
|----|--|-------|
| 1  | List any three factors that resulted in the enhanced interest (globally) for renewable energy over the last decade?  | (3)   |
| 2  | Define the following solar angles: a) Declination angle, b) Solar zenith angle, and c) Azimuth angle.  | (3)   |
| 3  | Discuss any three important factors that affect the efficiency of photovoltaic cells?  | (3)   |
| 4  | List any three types of concentrating solar collectors intended for solar thermal applications.  | (3)   |
| 5  | Discuss about the importance of yaw control mechanism in horizontal axis wind turbines.  | (3)   |
| 6  | Define tip-speed ratio (TSR) and power coefficient of a wind turbine.  | (3)   |
| 7  | What do you mean by Hot Dry Rock (HDR) systems or Enhanced Geothermal systems (EGS).   | (3)   |
| 8  | List any three advantages and disadvantages of Ocean Thermal Energy Conversion (OTEC) systems.   | (3)   |
| 9  | Even though the combustion of biomass results in the liberation of CO <sub>2</sub> , biomass is considered a more environmental-friendly fuel compared to fossil fuel, why? How does moisture content in biomass affect the useful thermal output during direct combustion of biomass? | (3)   |
| 10 | Define the terms 'net present value' and 'payback period' of investments.  | (3)   |

**PART B***Answer any one full question from each module, each carries 14 marks.***Module I**

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|----|---|-----|
| 11 | a) List and elaborate any four steps that might be possible in the next 10 years to improve the sustainability of energy use in Kerala? | (8) |
|    | b) Explain the greenhouse effect. List any two greenhouse gases and discuss their impact on the environment.                            | (6) |

**OR**

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|----|---|-----|
| 12 | a) Define the following terms: i) Renewable energy; ii) Diffuse radiation; iii) Solar constant; iv) Air mass.                               | (8) |
|    | b) How does a pyranometer measures solar irradiance? Describe how a pyranometer can be used to measure diffuse horizontal irradiance (DHI). | (6) |

**Module II**

- 13 a) Explain with suitable sketches, the working of any solar thermal system utilizing concentrated solar power (CSP) for producing electricity. (8)  
 b) With a neat sketch, describe the principle of operation of a solar pond. (6)

OR

- 14 a) Differentiate between sensible heat storage and latent heat storage. Supplement your answers with suitable examples. (6)  
 b) Describe the working of a solar photovoltaic cell. Also, discuss its performance characteristics. (8)

**Module III**

- 15 a) What is the Betz limit? Derive an expression for the Betz limit. (14)

OR

- 16 a) With a neat sketch/block diagram, describe in detail the various components of a horizontal axis wind turbine (HAWT). (10)  
 b) The average wind speed at a particular location is 7 m/s. Calculate the maximum amount of power that can be extracted using a 3 bladed HAWT rotor. The diameter of the circle swept by the rotating blades is 80 m. Assume the air density to be  $1.205 \text{ kg/m}^3$ . (4)

**Module IV**

- 17 a) Describe the working of a closed-cycle OTEC plant, with a neat sketch. Also discuss the possibility of using OTEC plants for sea water desalination. (8)  
 b) With a neat sketch, explain the working of a vapour dominated geothermal power plant. (6)

OR

- 18 a) What are the major factors that govern the quantum of wave energy? Describe the working of any one type of wave-energy harvesting device with a neat sketch. (10)  
 b) Classify geothermal regions based on the temperature gradient. (4)

**Module V**

- 19 a) What is Anaerobic digestion of biomass? With the help of a neat sketch, discuss the working of a fixed-dome type (Janata model) biogas plant. (7)  
 b) Differentiate between updraft and downdraft gasifiers. Which one does have higher moisture and tar content in the producer gas. Why? (7)

OR

- 20 a) Due to increased demand, the management of a company is considering to purchase a new equipment to increase its production and revenues. The initial cost of the equipment is 15 lakhs, the useful life of the equipment is 10 years and the company's maximum desired payback period is 4 years. The inflow and outflow of cash associated with the new equipment is given by:  
 Annual cash inflows (from sales) = 25 lakhs  
 Annual cash outflows:  
 Cost of raw material = 13 lakhs;  
 Salary expenses = 6 lakhs;  
 Maintenance cost = 1 lakh.  
 Should the company purchase the new equipment? Use payback method for solving the above problem. (10)  
 b) Differentiate between simple payback period and discounted payback period. (4)

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