III B. Tech II Semester Regular Examinations, June-2022
RENEWABLE ENERGY SOURCES
(**Common to** ME, ECE, CSE, IT, AME)

Time: 3 hours   Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
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UNIT-I

1. a) Explain the working of Pyrheliometer with a neat circuit diagram [8M]
    b) List the advantages of Solar energy and also explain the indirect forms of Solar energy. [7M]

(OR)

2. a) Explain the following terms w.r.t Solar radiation geometry: [8M]
       (i)   Angle of latitude
       (ii)   Declination angle
       (iii) Zenith Angle
       (iv)   Hour angle
    b) Calculate the angle of incidence on a horizontal plane surface at Kolkata, at 14:00 hrs (IST), on March 21, in a leap year. The longitude and latitude of Kolkata are 88° 20'E and 22° 32'N respectively. The standard longitude of IST is 81° 44'E. [7M]

UNIT-II

3. a) Draw and explain the P-V characteristics of a Solar Cell. [7M]
    b) A PV system feeds a dc motor to produce 1 hp power at the shaft. The motor efficiency is 85%. Each module has 36 multi-crystalline silicon solar cells arranged in 9 × 4 matrix. The cell size is 150mm × 150mm and cell efficiency is 15%. Calculate the number of modules required in the PV array. Assume global radiation incident normally to the panel as 2 kW/m². [8M]

(OR)

4. a) Explain in detail about the Solar cell mismatch in a module and effect of shadowing on a Solar module. [8M]
    b) Distinguish between Solar Cell, module and an Array. [7M]

UNIT-III

5. a) What are the advantages of presenting the wind data in the form of a wind rose? [7M]
    b) Explain the following terms w.r.t wind Power: [8M]
       (i)   Wind shear
       (ii)   Gradient height,
       (iii) Planetary boundary
       (iv)   Ekman layer

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(OR)

6. a) With a neat sketch of a VAWT, explain the functions of its main components. [8M]

   b) A HAWT is installed at a location having free wind velocity of 20 m/s. The 70 m diameter rotor has three blades attached to hub. Find the rotational speed of the turbine for optimal energy extraction. [7M]

UNIT-IV

7. a) What is the source of tidal energy? What is the minimum tidal range required for a practical tidal plant? [6M]

   b) Estimate the power available from a proposed micro hydro scheme at a site having a small stream with 120 litres per second flow at a head of 35 m. Assume density of fresh water as 1000 kg/m^3 and overall efficiency of the whole system as 60 %. [9M]

(OR)

8. a) List the advantages and disadvantages of Tidal energy. [6M]

   b) List and explain the various tidal energy conversion schemes. [9M]

UNIT-V

9. a) Explain the process of production of biogas from biomass. What are the main advantages of anaerobic digestion of biomass? [7M]

   b) Explain the following types of geothermal resources:
      (i) Geo- pressured   and   (ii) magma [8M]

(OR)

10. a) Explain the various technologies of harnessing the geothermal energy. [8M]

    b) Explain the operation of proton-exchange membrane fuel cell (PMFC) with a neat diagram. [7M]

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UNIT-I

1. a) Explain the working of Pyranometer with a neat circuit diagram. [8M]
    b) Explain the term Solar time or Local Apparent time in detail. [7M]

(OR)

2. a) Explain the following terms w.r.t Solar radiation geometry: [8M]
     (i) Solar Azimuth angle
     (ii) Tilt angle
     (iii) Angle of incidence
     (iv) Solar day length
    b) For New Delhi (28° 35'N, 77° 12'E), calculate the zenith angle of the sun at 2:30 P.M. on 20 February 2015. The standard IST latitude for India is 81° 44'E. [7M]

UNIT-II

3. a) List the advantages and disadvantages of Solar PV systems over conventional power systems. [6M]
    b) Define the term Fill factor and explain its significance. [5M]
    c) Explain the following Solar cell design considerations: [4M]
    (i) Short circuit current   and   (ii) Open circuit voltage

(OR)

4. a) Explain the effect of irradiance and temperature on a Solar cell. [7M]
    b) How can you maximize the Solar PV system output and also explain the concept of load matching. [8M]

UNIT-III

5. a) Explain the concept behind origin of winds and what are the forces responsible for determining the speed and direction of global winds? [5M]
    b) Explain the following terms: [10M]
     (i) free and relative wind velocities,
     (ii) drag and lift forces, solidity and
     (iii) pitch angle and chord.

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(OR)

6.   a)   Derive the expression for maximum axial thrust experienced by a wind turbine and also find the condition for such operation.   [8M]

    b)   Following data were measured for a HAWT: [7M]
Speed of wind = 22 m/s at 1 atm and 27 °C, Diameter of rotor = 85 m, Speed of rotor = 45 rpm. Calculate the torque produced at the shaft for maximum output of the turbine.

UNIT-IV

7.   a)   Explain various types of turbines considered for use in micro hydro resources.   [8M]

    b)   Explain and prove how the tidal power is directly proportional to the area of basin and square of the tidal range.   [7M]

(OR)

8.   A single basin type tidal power plant has a basin area of 3 km^2. The tide has an average range of 15 m. Power is generated during ebb cycle only. The turbine stops operating when the head on it falls below 4 m. Calculate the average power generated by the plant in single emptying process of the basin if the turbine generator efficiency is 0.75. Estimate the average annual energy generation of the plant.   [15M]

UNIT-V

9.   a)   Explain the process of gasification of solid bio-fuels? What are its main applications?   [8M]

    b)   Discuss the various methods and procedures to explore and develop geothermal resources.   [7M]

(OR)

10.   a)   List and explain the factors affecting the performance of biogas digester.   [8M]

    b)   Explain the operation of Phosphoric Acid Fuel cell with a neat diagram.   [7M]

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UNIT-I

1. a) Explain the following terms w.r.t Solar Energy: [8M]
   (i) Beam radiation
   (ii) Diffuse radiation
   (iii) Global radiation
   (iv) Air mass
   b) Explain the salient points of the Solar radiation data.   [7M]

(OR)

2. Calculate the angle of incidence of beam radiation on a plane surface, tilted by 40° from horizontal plane and pointing 30° west of south located at Mumbai at 1:30 PM (IST) on 15th November. The longitude and latitude of Mumbai are 72° 49'E and 18° 54'N respectively. The standard longitude for IST is 81° 44'E.   [15M]

UNIT-II

3. a) Draw and explain the equivalent circuit of a Solar Cell for an ideal as well as practical circuits and also give the significance of Series and Shunt resistances in a Solar cell.   [7M]
   b) Explain the significance of MPPT in a Solar PV System and how it can be achieved.   [8M]

(OR)

4. a) List and explain the various Energy losses that influence the parameters of a Solar cell.   [8M]
   b) Explain the various Solar PV applications in detail.   [7M]

UNIT-III

5. a) Explain the factors affecting the distribution of wind energy on the surface of earth.   [7M]
   b) Derive an expression for energy available in the wind.   [8M]

(OR)

6. a) With a neat sketch of a HAWT, explain the functions of its main components.   [8M]
   b) Calculate the rotor radius for a wind turbine operating at wind speed of 8 m/s to pump water at a rate of 4 m^3/h with a lift of 6 m. Also calculate the angular velocity of the rotor. Some useful data is also given here with: Water density = 1000 kg/m^3, g = 9.8 m/s^2, water pump efficiency = 60%, efficiency of rotor to pump = 85%, power coefficient= 0.3, tip speed ratio=1, air density = 1.2 kg/m^3.   [7M]

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UNIT-IV

7. a) List the present trends in micro hydropower development? [6M]

   b) A micro-hydro power station for 80 kW has a head of 25 m. At an efficiency of 82%for turbine-generator unit, calculate the required flow of water, assume the load factor as 100%. [9M]

(OR)

8. a) Explain how the tides are originated and give its uses in power generation [7M]

   b) What are the main advantages and disadvantages of OTEC system? And explain the various technologies available for OTEC. [8M]

UNIT-V

9. a) What are the main advantages in use of biogas? What are its main constituents and explain them? [8M]

   b) Evaluate the environmental aspects of geothermal energy in detail [7M]

(OR)

10. a) Compare the relative performances of a floating drum and fixed dome type biogas plants. [8M]

    b) Give the classification of Fuel Cells based on: [7M]
       (i) the type of electrolyte
       (ii) the types of fuel and oxidant and
       (iii) operating temperature.

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UNIT-I

1. a) Explain the following terms w.r.t Solar Energy: [8M]
        (i)   Solar constant
        (ii)   Extraterrestrial radiations
        (iii)   Terrestrial radiations
        (iv)   Solar Irradiation
    b) What is a Sun shine recorder and explain its working and   [7M]
        significance of it?

(OR)

2. a) What is solar time and why it is different from standard clock   [6M]
        time of the country?
    b) Calculate the number of day light hours (sunshine hours) in   [9M]
        Srinagar on January 1 and July 1. The latitude of Srinagar is
        35° 05'N.

UNIT-II

3. a) Draw and explain the I-V characteristics of a Solar Cell.   [7M]
    b) List and explain the various specifications that need to be   [8M]
        considered for a typical Solar module.

(OR)

4. a) Give the classification of Solar cells and explain them in brief.   [8M]
    b) What do you mean by balance of System in a PV Panel? Give   [7M]
        its necessity and explain them in detail.

UNIT-III

5. a) List and explain the factors that have led to accelerated   [5M]
        development of the wind power.
    b) A propeller type wind turbine has following data: [10M]
        Speed of free wind at a height of 12 m = 14 m/s, Air density =
        1.226 kg/m³, α= 0.14, Height of tower = 120 m, Diameter of
        rotor = 85 m, Wind velocity at the turbine reduces by 15 %
        Generator efficiency = 82%. Find: (i) Total power available in
        wind, (ii) Power extracted by the turbine, (iii) Electrical power
        generated, (iv) Axial thrust on the turbine, (v) Maximum axial
        thrust on the turbine.

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(OR)

6. a) Using Betz model of a wind turbine, derive the expression for power extracted from wind. What is the maximum theoretical power that can be extracted and under what condition? [10M]

    b) Explain the variation of power output of a wind turbine with tip speed of the rotor. [5M]

UNIT-IV

7. a) Explain with a neat layout of a typical micro hydro plant. [7M]

    b) What do you mean by Wave Energy and list the advantages of wave power and also list the main difficulties encountered in the development of wave power? [8M]

(OR)

8. a) List relative advantages and limitations of floating and shore based OTEC plants? [8M]

    b) Water is pumped rapidly from the ocean into the basin at high tide to give an increased water level of 1.5 m in a tide power basin. If tidal range is 8 m and the efficiency of pump/generator system is only 60%, find the energy gain due to use of pumping. [7M]

UNIT-V

9. a) Explain the process of photosynthesis. [7M]

    b) What are the merits and demerits of geothermal energy? [8M]

(OR)

10. a) Explain the various energy extraction technologies used with hydrothermal resources. [8M]

    b) List the advantages and disadvantages of Fuel cell. [7M]

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