E Sem VIII / Mech/ c-scheme/ Nov 25 / 18.11.25

Duration: 3hrs

[Max Marks:80]

op code.

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(1/2)

N.B. : (1) Question No 1 is Compulsory.
    (2) Attempt any three questions out of the remaining five.
    (3) All questions carry equal marks.
    (4) Assume suitable data, if required and state it clearly.

1. **Attempt ANY FOUR questions of the following.** [20]

  a. Describe the current scenario of non-conventional energy sources of the India.
    Define the following angles with a neat sketch.

  b. (i) Surface azimuth angle (ii) Solar declination angle (iii) Zenith angle
    (iv) Solar altitude angle

  c. State the working principle of Solar Photovoltaics.

  d. State the factors considered for site selection to install wind power plant.

  e. Discuss the different methods of hydrogen production and storage.

2.a. Illustrate the working principle of KVIC biogas plant with the neat sketch. [10]

  b. Calculate the monthly average value of solar radiation on a horizontal surface located in [10]
    Ahmedabad (22°00'N, 73°10'E) for May 28. Average solar day hours are 10.5.
    Angstrom's constants are; a =0.28, b = 0.48 (Assume I_{sc} =1353 W/m^2)

3. a. Illustrate the working principle of single & double basin tidal system with neat sketch. [08]
  b. Describe the working principle of natural circulation solar water heater system. [08]
  c. Differentiate between the vertical and horizontal axis wind turbine. [04]

4. a. Wind at 1 bar 20 °C has a velocity of 12 m/s. Calculate: [10]
    i) Total power density in wind stream
    ii) Maximum power density
    iii) A reasonable obtainable power density
    iv) Total power produced if rotor diameter is 60 m and its runs at 50 rpm
    v) The torque and the axial thrust produced at maximum efficiency of 35%.

  b. Describe the working principle of vapour dominated geothermal power plant. [06]

  c. Calculate the sunset hour angle and day length at a location, latitude 28.6 °N on June 28. [04]

5.a. State Betz coefficient and derive the ideal maximum theoretical efficiency equation for [10]
    the horizontal axis wind turbine.

  b. Following data is given for a family biogas digester; C.V. of methane = 26 MJ/m^3, Burner [10]
    efficiency = 70 %, Number of cows = 7, Retention period = 20 days, Temperature of
    fermentation = 30 °C, Dry matter collected/cow/day = 2 kg, Density of matter in the fluid
    in the digester = 50 kg/m^3, Biogas yield = 0.2 m^3/ kg of dry input, Methane production
    in Biogas = 0.7. Determine volume of Digester and power available from biogas digester.

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6.a. Discuss types of fuel cells briefly. [08]

b. Solar thermal power plant system installation is expected to minimize the plant's annual [08] energy bill by Rs. 18 lacs. If the capital cost of new solar thermal power plant installation is Rs. 92 lacs and the annual operating and maintenance cost is 5 lacs. Determine,
(a) The expected payback period for the proposed project.
(b) The initial rate of return / return on investment.

c. State the significance of solar space heating and cooling. [04]

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