Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, DECEMBER 2023

RENEWABLE ENERGY [ELE 4086]

REVISED CREDIT SYSTEM

Time: 3 Hours

09 December 2023

Max. Marks: 50

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Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

Q No **Questions**

- Marks How does the sunshine recorder differ from the Pyrheliometer and 1A Pyranometer, explain the measurement of day length with its 3 neat figure 1B Determine the monthly average daily global horizontal irradiance at Vadodara (22⁰ N) during the month of March 16, if the average 4 sunshine hours per day is 9.5 (given: $Isc=1367 \text{ w/m}^2$). 1C Calculate the angle made by the beam radiation with the normal to the flat plate collector on May 1 at 9.00 A.M. The collector is 3
- located in New Delhi (28° 35' N), at an angle of 36° with the horizontal and is pointing due south.
- 2A Justify that a Flat plate collector can be used to absorb both diffused & direct beam radiation to heat the water with its neat diagram, and list out its advantages & disadvantages
- 2B Explain how to generate electric power using the central receiver 3 collector with the help of its neat diagram.
- 2C Describe the working principle of a basic photovoltaic system for 3 power generation with the help of a block diagram and explain each component's working. Mention its applications.
- A house has the following electrical appliance usage: 3A
 - Four 18-watt fluorescent lamps with electronic ballast i. used 2 lamps switched on 4 hours per day & remaining 2 lamps working for 2 hours per day
 - Two fans with 60 watts each are used for an average of ii. 6 hours daily.

iii. One 75-watt refrigerator that runs 24 hours daily with a compressor running 12 hours and off 12 hours.

The system will be powered by a 12 Vdc, 110 Wp PV module. Determine

- a. The power consumption demands.
- b. Size the PV panel
- c. Inverter sizing
- d. Battery sizing
- 3B Develop an expression for maximum power and maximum axial thrust produced by windmills with the help of neat wind pressure & velocity waveforms.

3C Wind at 1 standard atmospheric pressure and 15^o C has a velocity of 20 m/s calculate:

- i. Total power and power density
- ii. Max power and power density
- iii. Power density and total power, when the η is 30%.

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- iv. Torque at max η
- v. Max axial thrust.

Given turbine diameter=150 m, the turbine operating speed is 60 rpm at max η

- 4A Compare and discuss the continuous & batch-type biogas plants, and describe the biogas generation with their neat diagrams. 3
- 4B Explain the Problems related to the Biogas plants & also explain why biogas plants are not very successful in India
- 4C A Community Biogas plant is to be designed for the cooking & and lighting needs of a village comprising 70 families. The quality of waste (cow manure) fed to the digester daily is 950 kgs, retention time is 40 days & density of slurry is 1090 kg/m³. Calculate the minimum working volume of the digester. Also, calculate the actual volume of the digester, which should be 10% more to provide some empty space at the top for proper displacement of the gas, considering the actual volume. Calculate the height and diameter of the digester.
- 5A Justify, how the drawbacks of the closed & open cycle are overcome by a hybrid cycle of OTEC power plant with a neat diagram
- 5B Compare and explain different schemes of tidal power plants with their neat diagrams.
- 5C A single basin type tidal power plant has a $25 \times 10^6 \text{ m}^2$ basin area. The tide has a range of 10 m. The turbine however stops operating when the head on it falls below 2 m, Calculate the energy generated in one filling process in kwh if the turbine generator efficiency is 75% (Take sea water density =1025 kg/m³)

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