Exam Date & Time: 05-Dec-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

SEVENTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV 2023

Non-Conventional Energy Systems [MME 4078]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) Sketch and explain the construction and functioning of a solar beam radiation measuring instrument (3)

A)

B) Explain the solar space heating technique, providing a detailed sketch that illustrates the key components involved. (3)

C) Calculate monthly average hourly global and hourly diffuse radiation during the month of June on a horizontal surface at Mumbai (19.07° N, 72.8° E) with the given data. (4)

Time 11:30 PM to 12:30 PM (IST). The average number of sunshine hours per day is 10 ;

a = 0.27 b = 0.43 for Monthly average daily solar radiation. Klein's recommendation for the month of June is 11. For Monthly average hourly radiation;

a = 0.409+0.5016 sin (ω_s - 60)

b = 0.6609-0.4767 sin (ω_s - 60).

Equations required to do the calculation

$$\cos\theta = \sin\emptyset\,(\sin\delta\cos\beta + \cos\delta\cos\gamma\cos\omega\sin\beta) + \cos\emptyset\,(\cos\delta\cos\omega\cos\beta - \sin\delta\cos\gamma\sin\beta) + \cos\delta\sin\gamma\sin\omega\sin\beta$$

$$\delta = 23.45\,sin\left(\frac{360}{365}(284+n)\right)$$

$$\omega_s = \cos^{-1}(-\tan\varphi\tan\delta)$$

$$\text{LAT} = \text{Standard time} \pm 4(\text{Standard time longitude} - \text{longitude of location}) + (\text{Equation of time correction})$$

$$I_0 = I_{sc}\left(1 + 0.033cos\frac{360n}{365}\right) * (\sin\varphi\sin\delta + \cos\varphi\cos\delta\cos\omega)$$

$$H_0 = \frac{24}{\pi} I_{sc}\left(1 + 0.033cos\frac{360n}{365}\right) * (\omega_s\sin\varphi\sin\delta + \cos\varphi\cos\delta\sin\omega_s)$$

$$\frac{\overline{H_g}}{\overline{H_0}} = a + b\left(\frac{\bar{S}}{\overline{S_{max}}}\right)$$

$$\frac{\overline{H_d}}{\overline{H_g}} = 1.416 - 1.696 \left(\frac{\overline{H_g}}{\overline{H_0}}\right)$$

$$\frac{\overline{I_g}}{\overline{H_g}} = \frac{\overline{I_0}}{\overline{H_0}} (a + b\cos\omega)$$

$$\frac{\overline{I_d}}{\overline{H_d}} = \frac{\overline{I_0}}{\overline{H_0}}$$

2) Elaborate on the key considerations and criteria involved in the site selection process for the establishment of a wind energy conversion plant. (3)

A)

B) Differentiate the Drag type and Lift type wind turbine. (3)

C) Calculate the volume of cow dung based biogas plant to meet cooking requirement of 5 persons (230 l/d/person), and lighting of three 100 CP mantle lamps (120 l/h) for 3 h. Also calculate the required number of cows to run the plant if cow dung produced is 10 kg/day/cow and collection efficiency is 70 %, percentage of solid is 18% and production of gas from solid is 340 l/kg. (4)

3) Compare the conventional solar flat plate collector and Evacuated tube collector in the context of solar thermal energy systems. (3)

A)

B) Discuss the importance and challenges of the small-scale hydroelectric power plant (3)

C) In contrast to the Solar radiation energy measurement discuss the significance of (i) LAT (ii)Maximum day length (iii)Hour angle (iv) Declination angle (4)

4) Categories the geothermal reservoir and briefly explain the Hot dry rock resources (3)

A)

B) Explore and discuss the diverse applications of Ocean thermal energy conversion (OTEC) power generation. (3)

C) Derive the expression for the power output from the tidal power plant as a function of the tidal range. (4)

5) Differentiate the Thermoelectric and Thermionic power generation techniques. (3)

A)

B) Discuss the synergistic integration of Magnetohydrodynamics (MHD) and steam generation plants, elucidating the collaborative mechanisms and operational dynamics that contribute to the overall power generation process. (3)

C) (4)

Categories the various types of wave energy converters, and how do they differ in their designs and efficiency in harnessing wave energy for electricity generation.

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