

AGRICULTURAL AND FOOD ENGINEERING DEPARTMENT
INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Date of Examination : 26.04.10 FN

Full Marks - 50

Spring Semester : 2009-2010

Time - 3 h

Course : M.Tech. (Farm Machinery & Power) &
4th yr. B. Tech.(Hons.)

Subject No. : AG60002/AG40012

Subject Name : Alternative Energy Sources

No. of Students : 15+1

Instruction : ANSWER ALL QUESTIONS.

1. (a) What is Bourger's law? Derive expressions for transmissivity based on absorption for a glass cover system used in flat plate solar cooker only. How it is different for water in case of a solar pond? (5)
- (b) What do you mean by collector heat removal factor? Derive expression for useful energy gain in case of flat plate collector. (6)
2. (a) A cylindrical parabolic collector is to be used in a place having latitude 28.58° N and longitude 77.20° E. Determine the beam radiation that would fall on one square meter of the aperture plane of this collector at 10.30 h (LAT) on June 10 for the tracking mode II. The value of I_b at 10.30 h is 495 W/m^2 . (3)
- (b) Discuss briefly about latent heat of storage system for thermal energy. (3)
3. (a) What is solidity of a wind mill? Derive expression for maximum fraction of power which can be extracted from wind theoretically by a horizontal axis drag type wind mill and how it is different from horizontal axis windmill with aerofoils. (6)
- (b) Calculate the chord and setting angle at three different positions along the blade of a 6-bladed rotor with the following data:
Rotor diameter = 2.74 m; Design tip speed ratio = 2;
Maximum lift coefficient = 1.1; Design angle of attack = 4°
Show the variation of chord length and setting angle with rotor radius and explain how these parameters are approximated in manufacturing the blades to reduce the wastage of materials. (6)
- (c) Discuss the factors that reduce the maximum attainable power coefficient in a horizontal axis windmill. (3)
4. Discuss the working principle of a solar cell and plot its current and voltage characteristic. (4)
5. A farmer uses an electrically operated 1 kW pump for lifting water. Because of frequent failure in supply of electricity he wishes to run it using solar energy. Propose a suitable system in detail (including set-up arrangement) by which he can run the same pump with solar energy. Assume any other data if required. (3)

6. Discuss briefly the advantages and disadvantages of using biodiesel as an alternate fuel in diesel engine. (3)
7. Determine the dimensions of a 2 m³ 40 HRT Deenbandhu model biogas plant for producing biogas with cow dung slurry as feedstock. (4)
8. What type of gasifier is recommended for getting producer gas to run an I. C. engine? What modifications are required for utilizing producer gas in S. I. engine? Compare the performance of S. I. engine when operated with producer gas and petrol. (4)

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$$\cos\theta = \sin\delta \cdot \sin(\varphi - \beta) + \cos\delta \cdot \cos\omega \cdot \cos(\varphi - \beta), \text{ where } \beta = \text{slope}$$

$$\cos\theta_z = \sin\varphi \cdot \sin\delta + \cos\varphi \cdot \cos\delta \cdot \cos\omega$$

For tracking mode II, Angle of incidence, $\cos\theta = (1 - \cos^2\delta \cdot \sin^2\omega)^{1/2}$