Menoufia University
Faculty of Eng., Shebin El-Kom
Mechanical Power Eng. Dept.
First Semester Exam.,2014-2015
Date of Exam: 20/01 / 2015

جامعة المنوفية

Renewable Energy and Environment
Code: *MPE 314B*
Year : *3rd Year*
Time Allowed : 3 hours
Total Marks : 85 marks

Notes: a) Exam in two parts, time for part one is 2 hrs and for part two is 1 hrs
b) Answer each part in separate section

Part one

Question (1) (16 Marks)

1.1 The use of renewable energy sources nowadays is considered necessary. Explain in detail (3 Marks)

1.2 Explain the following expression: environmental balance? (2 Marks)

1.3 Explain with sketch the characteristics and position of ionosphere layer? (2 Marks)

1.4 Discuss the relation between number of wind turbine blades and rotation torque? (2 Marks)

1.5 Explain with sketch the Propeller-type anemometer? (3 Marks)

1.6 A wind turbine rated at 100 kW having a rated wind speed of 7.7 m/s, a cut-in speed of 4.3 m/s, and a furling speed of 17.9 m/s. Determine the capacity factor and the monthly energy production in kilowatt hours (in a 30-day month) for sites where

a) $c = 5.0$ and $k = 1.6$
b) $c = 6.5$ and $k = 2.0$
c) $c = 8.0$ and $k = 2.4$

In which site will the cost of kW hr be minimum and why? (4 Marks)

Question (2) (17 Marks)

2.1 Prove that the chimney efficiency in solar chimney system η_c is

$$\eta_c = \frac{g\,H_c}{c_p\,T_o}$$

where g is the gravitational constant, H_c is the chimney height, c_p is the specific heat of air and T_o is the outside temperature. (3 Marks)

2.2 Why in pressure tube anemometer many number of perpendicular pair of tubes are required (2 Marks)

2.3 How can the horizontal axis wind turbines be classified according to wind direction? (2 Marks)

2.4 Explain with sketch the operation of Madras rotor (3 Marks)

2.5 How can laser anemometer be used for measuring wind speed? (3 Marks)

2.6 The height of solar chimney is 750 m. The diameter of the collector surrounding this chimney is 2200 m. The solar radiation intensity in location is 1000 W/m^2 . Find the electrical power output considering the efficiency of the collector 0.6, specific heat of air 1005 J/kg K, the ambient temperature 293 k and the efficiency of converting mechanical energy to electrical energy 0.8. If it is desired to reduce the height of chimney to 500 m instead of 750 m while the electrical power output remains constant, show and calculate how this can be done. (4 Marks)

Question (3) (17 Marks)

3.1 Explain the term 'passive yaw orientation' in the field of wind turbines? (2 Marks)

3.2 Describe with neat sketches the operation and components of a horizontal axis wind turbine? (3 Marks)

3.3 Show why for a large wind turbines the rotational speed is relatively low? (2 Marks)

3.4 Describe with sketch the forces acting on a movable wind turbine blade? What are the role of each force in the wind turbine operation and design? (3 Marks)

3.5 Show that the choice of the rated rotational speed of a certain turbine depends on the wind regime of a location? (3 Marks)

3.6 You are designing the low-speed shaft for a horizontal-axis turbine, which has to transmit 50 kW of mechanical power at a rotational speed of 95 r/min. Solid steel shafts are available in half-inch increments starting at 2 in. outside diameter. The recommended maximum shear stress is 55 MPa. What size shaft should you specify? If the length of this shaft is 2 m and the shear modulus G is 0.9 GPa. Find the following:

a) The total twist θ in the shaft
b) The total energy stored in the shaft (4 Marks)

End of part one, with best wishes

Dr. A. A. El-Haroun

Part:--Two

1)- Define the following:- (15 Marks)

A) The photovoltaic conversion of solar radiation. And estimate its max Efficiency.

B) Explain With sketch The Multi-Stage Flash Distillation.

c) Compare between the solar wind power plant and the solar drying systems, using suitable sketch.

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2)-Calculate:- (10 Marks)

A) The zenith angle

B) the top heat loss coefficient for a flat plate collector having two glass cover is installed in Tanta at 14:00 on 5/9/2014.,with the following data:

Azimuth angle	- 30 ° ,	Collector tilt	45 °
Plate to cover spacing	3 Cm ,	Ambient air and sky temperature	35 C°
Wind speed	5 m/sec ,	Back insulation thickness	4 Cm
Insulation conductivity	0.07W/m.c ,	Mean plate temperature	100 C°
Cover temperature	53 C°	Plate emittance	95 %
Latitude angle for Tanta		30.48°	

1. $\delta = 23.45\ \sin[360\ \frac{284+n}{365}]$

2. $\cos\theta = [(\sin\delta\ \sin\phi\ \cos\beta) - (\sin\delta\ \cos\phi\ \sin\beta\cos\gamma) + (\cos\delta\cos\phi\ \cos\omega\cos\beta) + (\cos\delta\sin\phi\ \cos\gamma\cos\omega) + (\cos\delta\sin\beta\sin\gamma\sin\omega)]$

3. $\sin\alpha = [\sin\phi\ \sin\delta + \cos\delta\cos\omega\cos\phi]$

4. $\cos Hs = [-\tan\phi\ \tan\delta]$

5. $\cos\theta z = \sin\delta\sin\phi + \cos\delta\cos\phi\ \cos\omega$

6. $Td = 2/15\cos^{-1}\ (-\tan(\emptyset - \beta)\tan\delta)$

7. $m(o,\alpha) = \sqrt{1129 + (614\sin\alpha)^2} - 614\sin\alpha$

8. $m(z,\alpha) = [P(z)/P(o)]\ .m(o,\alpha)$

9. $Tat = 0.5(\ e^{-0.65m(z,\alpha)} + e^{-0.095m(z,\alpha)}\ )$

10. $Ib = I\ sc * Tat$

11. $Ihd = 11.356\ (0.78 + 1.07\alpha + 6.17cc)$ $(kJ/hr\ .m^2)$

12. $I\,Tt = (IhdThd - \frac{Ihd}{\sin\alpha})\cos\theta$

13. $\tau pn = (1-p)/\{1 + (2no. -1)p\}$

14. $(p) = [\sin(\varphi - \theta)/\sin(\varphi + \theta)]^2 + [\tan((\varphi - \theta)/\tan(\varphi + \theta)]^2$

15. $(\tau a) = e^{-(ec\ .\Delta g)}$

16. $\tau = (no.)\cdot \tau a \cdot \tau pn$

17. $\tau\cdot k = \tau\cdot kp/\varepsilon_{n=0}^{\infty}(1-kp)\rho d = \frac{\tau.kp}{1-(1-kp)\rho d}$

18. $qa = \tau k.I\,Tt$

19. $\cos\theta z = (\sin\delta \sin\emptyset) + (\cos\delta \cos\emptyset \cos\omega)$

20. $\epsilon_c = 0.8$

21. $\epsilon_p = 0.95$

22. $h_{r.p.c} = \sigma \cdot \frac{(T_p^2 + T_c^2)(T_p + T_c)}{(1/\epsilon p) + (1/\epsilon c) - 1}$

23. $h_{r.c.s} = \epsilon_c \cdot \sigma \cdot (T_c^2 + T_s^2)(T_c + T_s)$

24. $h_{p.c} = \frac{1.14\ \Delta t^{0.31}}{L^{0.7}}$

25. $h_w = 5.7 + 3.8\,Vw$

26. $Ut = \left(\frac{1}{h_{p.c} + h_{r.p.c}} + \frac{1}{h_w + h_{r.c.s}}\right)^{-1}$