M.Tech-Heat Power Engineering Sem III (Old & New Format) HPE 1112 - Solar and Wind Energy Utilisation Paper-I

P. Pages: 2 GUG/W/16/3839 Time : Three Hours Max. Marks: 70 Notes : 1. All questions carry marks as indicated. 2. Answer any five. Due credit will be given to neatness and adequate dimensions. 3. 4. Assume suitable data wherever necessary. 5. Diagrams and Chemical equation should be given wherever necessary. Use of slide rule, Logarithmic tables, Steam tables, Mollier's chart, Drawing 6. instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted. 7. Use of non-programmable calculator is permitted. What are the merits and demerits of solar photo voltaic systems? 6 1. a) Estimate the temperature rise of water in a 100 litre capacity thermosyphon solar water 8 b) heating system during a typical day of operation. Estimate also the electricity saved because of the use of solar water heater and the corresponding reduction in the monthly electricity bill. Why solar radiation received at the earth's surface is in an attenuated form? Explain. 2. 5 a) A flat plate solar thermal collector is installed on the roof of Hotel sunshine in New Delhi b) 9 (Latitude $\phi = 28.35^{\circ}$ N). The collector surface of $10m^2$ area is pointing towards south with angle of 30° with the horizontal. Calculate the angle of incidence of sunlight for second December at Local Apparent i) time of 9 am. The corresponding hour angle is 45°. With power density of 0.6 kw/m^2 , what is the power collection at the said time? ii) The water tank of the thermal system contains 1000 kg of water initially at 30°C. iii) What will be the temperature of water after one hour assuming constant power collection of (ii)? 3. a) Estimate the monthly average daily global and diffuse radiations on a horizontal surface at 8 Vadodara $(22^{\circ} 00' \text{ N}, 73^{\circ} 10' \text{ E})$ during the month of March, if average sunshine hours per day is 9.5. Explain the tracking system of a parabolic Dish collector. b) 6 What do you understand by Local Apparent Time? Calculate the Local Apparent Time 4. a) 6 corresponding to 1500 hours Indian standard Time on 1st August. Explain the construction of solar air heater & describe its main components. b) 4 Define the following associated with solar rays and the collector surface. 4 c) Angle of Incidence ii) Angle of Latitude i)

- 5. Explain the nature of atmospheric wind. 5 a) Explain the concept of solar Gel Pond. Give the advantages and disadvantages of it. 5 b) Explain wind turbine efficiency for various rotors with the help of a plot. 4 c) Find the electric power output of a three bladed propeller type wind machine operating at a 8 6. a) constant rotor speed of 20 rpm. The cut-in-speed, design speed and the cut-out speed of the machine are 14,36 and 90 kmph respectively. The mechanical efficiency of the wind machine is 93% and the generator efficiency is 97%. The machine is installed at a height of 60m from the ground and the diameter of its rotor is 62m. Plot the variation of the electrical power output with wind speed. Given $\varepsilon = 0.011$ and $\rho = 1.2 \text{ kg/m}^3$. b) Derive an expression for the power in a wind stream. 6 7. Calculate the main dimensions of the rotor of a multiblade wind machine operating at a 8 a) design wind speed of 25 kmph. The machine operates a water pump having a capacity of 5.1 m^3/h and a lift of 9m. A propeller wind machine has a rotor diameter of 60m. It is operating at a location having b) 6 a wind speed of 35 kmph and rotating at 20 rpm. Calculate theoretically the power which the machine can extract from the wind, if -Only wake rotation is considered. a) Both wake rotation and the effects of drag are considered for part (b), assume that the b) value of $\varepsilon = 0.012$. Describe various methods used to overcome the fluctuating power generation of a windmill. 8. 6 a) Discuss their merits and demerits. Write short notes on **any two** of the following: b) 8 Main considerations in a site selection for wind turbine. i) Wind power duration characteristics. ii)
 - iii) Control and monitoring system of a wind farm.
 - iv) Collector Heat Removal Factor.
