Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER IV (NEW) – • EXAMINATION – WINTER 2016

Subject Code: 743901 **Date: 26/10/2016**

Subject Name: Solar and Photovoltaics

Time:02:30 pm to 05:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Prove that maximum power for solar cell is product of fill factor (F.F.), open circuit voltage (V_{oc}) and light generated current (I_L).	**07**
	(b)	Define Solar Cell. Explain the different types of solar cell in brief.	**07**
Q.2	**(a)**	Derive an expression for (i) reflectivity (ii) transmissivity based on reflection and refraction for two component system.	**07**
	(b)	(i) Discuss (1) Payback time (2) Solar saving.	**02**
		(ii) For non-solar process, using fuel only, calculate the present worth of fuel cost over eight years if the first year's cost is Rs. 1200, it inflates at 10% per year for 3 years and then it inflates at 6% per year. The market discount rate is 8% per year.	**05**
		OR	
	(b)	Define economic figure of merit for solar system. Explain the process of optimization of economic figure of merit.	**07**
Q.3	**(a)**	A solar water heating system is installed at location (26.63^0N, 72.93^0E) with collector inclined at 25^0 facing due south. Determine the instantaneous radiation at 1:00 P.M. on 21st August, 2015 using ASHRE model.	**08**
	(b)	Explain in brief (i) top loss coefficient (ii) bottom loss coefficient (iii) side loss coefficient.	**06**
		OR	
Q.3	**(a)**	A flat plate collector is tilted at latitude angle facing due south at shillong (25.57^0N, 91.88^0E). Determine the monthly mean of global, beam and diffuse radiation for the tilt surface on 13th December, 2015 at 11:30 a.m. Take average sunshine hour is 10.Take a = 0.22 and b = 0.57. Consider no snow condition.	**09**
	(b)	Define (i) Solar constant (ii) Diffuse radiation (iii) Solar azimuth angle (iv) Inclination angle (v) Solar altitude	**05**
Q.4	**(a)**	Derive an expression for collector efficiency factor and heat removal factor for CPC.	**08**
	(b)	Explain in brief description and construction of solar pond.	**06**
		OR	
Q.4	**(a)**	Derive an expression for collector efficiency factor and heat removal factor for air heater.	**09**
	(b)	Explain in brief working of passive water heating system with neat sketch.	**05**

Q.5 **(a)** Calculate the overall loss coefficient, heat lost from top, heat loss from bottom, heat loss from side, over all heat loss and for a flat plate collector with two glass covers with the following data: **09**

Flux incident on the top cover of collector = 860 W/m^2

Solar flux absorbed in absorber plate = 600 W/m^2

Size of absorber plate = 1.1 m x 2.2 m

Spacing between first and second glass cover = 5 cm

Spacing between absorber plate and first glass cover = 6 cm

Absorber plate emissivity = 0.93, Glass cover emissivity = 0.83

Collector tilt = 22° , Mean absorber plate temperature = 78° C

Ambient air temperature = 22° C, Wind speed = 2.7 m/sec

Back insulation thickness = 9 cm, Side insulation thickness = 5 cm

Thermal Conductivity of insulation = 0.05 W/m K. Use McAdams correlation.

(b) Explain in brief working of passive water heating system with neat sketch. **05**

OR

Q.5 **(a)** A cylindrical parabolic concentrator with width 2.5m and length 10m has an absorbed radiation per unit area of aperture of 430 W/m^2. The receiver is a cylinder with an emittance of 0.31 and is surrounded by an evacuated glass cylindrical envelope. The absorber has a diameter of 60 mm, and the transparent envelope has an outer diameter of 90mm with a thickness of 4 mm. The collector is designed to heat a fluid entering the absorber at 155.2^oC at a flow rate of 0.0537 kg/s. The fluid has Cp= 3.26 kJ/kg◦C. The heat transfer coefficient inside the tube is 300 W/m^2 ^oC and the overall loss coefficient is 3.82 W/m^2 ^oC. The tube is made of stainless steel (k = 16 W/m ◦C) with a wall thickness of 5 mm. If the ambient temperature is 10^oC, calculate the useful gain and exit fluid temperature. **08**

(b) Explain in brief working of direct solar drying system with neat sketch. **06**

****