Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER–IV • EXAMINATION– WINTER • 2015

Subject Code: 743901 **Date: 05/12/2015**

Subject Name: Solar and Photovoltaics

Time: 2:30 PM TO 5:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of solar energy data book after verification.**

Q.1	**(a)**	Explain the principle of photo-voltaic with neat sketch.	**07**
	(b)	Explain in brief the principle of semiconductor.	**07**
Q.2	**(a)**	Explain in brief evaluation of carbon credit of solar energy system.	**07**
	(b)	Explain the thermal losses from the flat plate collector with neat sketch and write down the energy balance equation for flat plate collector.	**07**
		OR	
	(b)	(i) Explain the trasmissivity based on absorption.	**03**
		(ii) Find the transmissivity for the following cover system: Material : Glass Number of Covers = 2 Thickness of each cover = 9 mm Refractive index of glass relative to air = 1.5 Extinction coefficient of glass = 13 m^{-1} Angle of incidence = 45°	**04**
Q.3	**(a)**	Explain the theory and working of solar desalination system with neat sketch.	**07**
	(b)	(i) Find tilt factor for beam radiation on 15th February for a surface inclined at an angle of 30° towards the equator at 10:00 a.m. for a location having latitude = 29° 51' N and longitude = 77° 59' E. (ii) If 0.25 of the total solar radiation are diffused and 0.75 are the beam radiations. Estimate the value of correction factor for direct and diffuse radiation (R) assuming that the diffuse component is uniformly incident on the surface from the sky and ground.	**07**
		OR	
Q.3	**(a)**	Explain the working principle of indirect solar drying system with neat and clean sketch. Also state the advantages of solar drying system.	**06**
	(b)	A solar water heating system is installed at location having latitude = 26.63^o N and longitude = 72.93^o E with collector inclined at 25° facing due south. Determine the instantaneous radiation available at the collector at 1:00 p.m. on 21st August, 2015 using ASHRE model.	**08**
Q.4	**(a)**	Explain the testing procedure for the solar air heater with neat sketch.	**06**

(b) Calculate the overall heat transfer coefficient for the receiver of a cylindrical parabolic concentrating collector system. The receiver consists of a selectively-coated absorber tube with one glass cover around it. The following data is given: **08**

Absorber tube, inner diameter = 7.5 cm, outer diameter = 8.1 cm,
Glass cover, inner diameter = 14.4 cm, outer diameter = 15 cm,
Emissivity of absorber tube surface = 0.15,
Emissivity of glass = 0.88, Mean Temperature of absorber tube = 170° C,
Ambient temperature = 25° C, Wind velocity = 4 m/sec, Temperature attained by glass cover is 42° C.

OR

Q.4 **(a)** Explain any three tracking Modes for the cylindrical parabolic concentrator. **06**

(b) Calculate the performance parameters of a conventional solar air heater with the following data: **08**

Length of absorber plate = 2.0 m, Width of absorber plate = 1.0 m
Spacing between absorber plate and bottom plate = 1.5 cm
Air flow rate = 200 Kg/h, Air inlet temperature = 50° C,
Ambient temperature = 20° C, Solar flux incident on collector face = 950 W/m^2,
Average transmissivity- absorptivity product = 0.85,
Top Loss coefficient = 6.2 W/m^2 K, Bottom Loss coefficient = 0.8 W/m^2 K
Emissivity of absorber plate and bottom plate = 0.95
Assume mean fluid/air temperature = 55° C
Assume very small difference of temperature between absorber plate and bottom plate. Neglect heat loss from the sides. Properties of air at 55° C are: ρ = 1.077 Kg/m^3, C_p=1.005 KJ/Kg–K, μ=19.85 x 10^{-6} N-s/ m^2, k = 0.0287 W/m-K. All Notations have their usual meanings. Use relations, N_u=0.0158 x $R_e^{0.8}$.

Q.5 **(a)** (i) Explain the attenuation of beam radiation with neat sketch. **04**

(ii) Define (1) Latitude (2) Longitude. **02**

(b) Determine the overall heat loss coefficient, heat loss from top, heat loss from bottom, heat loss from side for a single glass cover with the following specifications: **08**

Size of absorber plate = 1 m x 2 m
Absorber plate-to-cover spacing = 25mm
Absorber Pate emissivity = 0.95
Glass cover emissivity = 0.85
Ambient temperature = 27°C
Mean plate temperature =100°C
Collector tilt = 45°
Wind velocity = 3.0 m/sec
Back insulation thickness = 7 cm
Side insulation thickness = 4 cm
Thermal Conductivity of insulation = 0.09 W/m K

OR

Q.5 **(a)** (i) Explain with neat sketch (1) Altitude angle (2) Surface Azimuthal angle. (3) Zenith angle **04**

(ii) Define Tilt factor for (1) beam radiation (2) diffuse radiation (3) reflected radiation. **03**

(b) Derive an expression for the heat removal factor for the solar flat plate collector. **07**

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