Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER– II(New course) • EXAMINATION (Remedial) – WINTER- 2015

Subject Code: 2722108 **Date: 09/12/2015**

Subject Name: Solar Energy Engineering

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)**	Derive the expression for height and solar swing angle for the compound parabolic concentrator with neat and clean sketch of Geometry.	**08**
	(b)	Explain in brief the concept of latent heat storage, its advantages and disadvantages. Discuss the various properties for latent heat storage material.	**06**
Q.2	**(a)**	Discuss the uncertainty in economic analysis for the solar energy device.	**05**
	(b)	A solar air heater is installed at location [26.3^o N, 73.0^o E] faces due south and tilted at 10° with horizontal. Determine the monthly mean beam radiation and global diffusion for the 13th April, 2015. Assume monthly mean of sunshine is 11 hrs. The value for the constant a and b for pageôs correlation is 0.33 and 0.45 respectively for the location. Take diffuse reflectance for no snow condition = 0.2.	**09**
		OR	
	(b)	(i) A surface is tilted at 35° and faces 10° west of south at location [28.58^o N, 77.2^o E]. Determine the Angle of incidence at 13 hrs 13 min on 19th September, 2015.	**07**
		(ii) Define (a) Solar Constant (b) Incident Angle.	**02**
Q.3	**(a)**	Derive the expression for the collector efficiency factor for the flat plate collector.	**07**
	(b)	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^{o}C at a flow rate of 0.0537 kg/s. The fluid has *Cp*= 3.26 kJ/kgŬC. The heat transfer coefficient inside the tube is 300 W/m^2 ^{o}C and the overall loss coefficient is 3.82 W/m^2 ^{o}C. The tube is made of stainless steel *(k* = 16 W/m ŬC*)* with a wall thickness of 5 mm. If the ambient temperature is 10°C, calculate the useful gain and exit fluid temperature.	**07**
		OR	
Q.3	**(a)**	Derive the expression for the collector efficiency factor, heat removal factor and instantaneous efficiency for the cylindrical parabolic collector.	**07**

	(b)	Calculate the overall loss coefficient, heat lost from top, heat loss from bottom, heat loss from side and over all heat loss for a flat plate collector with single glass covers with the following data: Size of absorber plate = 1.1 m x 2.2 m 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	**07**
Q.4	**(a)**	Explain the theory and working of solar desalination system with neat sketch.	**07**
	(b)	Explain in brief solar space heating system with air as a heat transfer medium with neat sketch.	**07**
		OR	
Q.4	**(a)**	Explain the working of solar powered absorption air-conditioning system with neat sketch.	**07**
	(b)	State the advantages of solar drying system. Explain the working principle of direct solar drying system with neat and clean sketch. Also state the limitation of direct solar drying system.	**07**
Q.5	**(a)**	(i) Define (1) Intercept factor (2) Area concentration ratio (3) Flux concentration ratio.	**03**
		(ii) Explain the solar thermal conversion system with neat sketch.	**04**
	(b)	Explain working of central power tower system with neat and clean sketch.	**07**
		OR	
Q.5	**(a)**	(i) Explain in brief optical performance of concentrating collector.	**03**
		(ii) Discuss in brief an application of solar pond.	**04**
	(b)	Explain the f ï chart method for estimating the thermal performance of active heating system uses liquid as working fluid.	**07**

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