Name: Enrolment No:	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Solar Thermal Technologies **Semester: II**
Program: M. Tech. - REE **Time 03 hrs.**
Course Code: EPEC 7016 **Max. Marks: 100**

SECTION A

S. No.		Marks	CO
Q 1	Briefly explain "solar green house".	4	CO3 CO4
Q 2	Briefly explain Advanced Solar Cooker.	4	CO4
Q 3	Write short note on 'Black Chrome' - selective surface.	4	CO3
Q 4	Explain the term 'aperture' and 'intercept factor'.	4	CO5
Q 5	For a collector with a top loss coefficient of 3.79 W/m^2-K. Calculate overall loss coefficient using following data: Back insulation thickness = 8 cm Insulation conductivity = 0.05 W/m-K Side insulation thickness = 4 cm Size absorber plate = 1.90 m x 0.9 m Height of collector casing = 0.16 m	4	CO4

SECTION B

Q 6	Determine the collector area to supply 200 litres per day, hot water at a temperature of 65°C, for a family at a location, where average radiation intensity available is 6 kWh/m^2. The temperature of supply water to the bottom of storage tank is 15°C. Collection efficiency may be assumed to be 30%.	10	CO4
Q 7	With the help of diagram, explain the working of Natural circulation solar water heater (pressurized).	10	CO2 CO4
Q 8	With help of diagram, discuss following situations for using a thermal energy storage: (I) Buffer storage (ii) Diurnal storage (iii) Annual storage	10	CO3
Q 9	Give a neat diagram of a central tower receiver power plant and explain its operation.	10	CO5

SECTION-C			
Q 10	Find the days of the year on which the sun is directly overhead at 12:00 (LAT) at Pune (18°32').	**20**	**CO1**
Q 11	The temperature rise (ΔT) of air through a vertical south-facing unglazed tran-spired collector (UTC) is found to satisfy the following empirical relation: $\Delta T = 0.03I_T + 3.0$ for an air flow rate of 36 $m^3/h\text{-}m^2$ of UTC. I_T is the total solar radiation incident on UTC in W/m^2; ΔT is in °C. Assuming this relation to be valid, calculate the efficiency of a vertical south-facing UTC for the following data: Location: New Delhi (28°35' N, 77°12' E) Date: December 10 Time: 10:47 h (LAT) Global solar radiation on horizontal surface: 543 W/m^2 Diffuse solar radiation on horizontal surface: 144 W/m^2 Reflectivity of the surrounding surface: 0.2. <u>Air data</u>: Air flow rate = 36 $m^3/h\text{-}m^2$ of UTC $C_p = 1005\, J/kg.K$ $\rho = 1.165\, kg/m^3$	**20**	**CO2**

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SECTION A

S. No.		Marks	CO
Q 1	Briefly explain Evacuated tube collector.	**4**	**CO4**
Q 2	Explain the term 'Solar Constant' and give its value.	**4**	**CO1**
Q 3	Write short note on 'Cermets' - selective surface.	**4**	**CO3**
Q 4	Explain the term 'concentration ratio' and 'acceptance angle'.	**4**	**CO5**
Q 5	A solar air heater is used for heating ambient air in a particular application. The characteristic parameters of the air heater are $FR(\tau\alpha)av = 0.63$, $F_RU_l = 6.2$ W/m^2-K.If the solar flux incident on the plane of the collector is 705 W/m^2, calculate the useful heat gain rate.	**4**	**CO4**

SECTION B

Q 6	Determine the size of the heating array from the following factors : i. The daily heating needs of a home during the heating season are 100 kW-hr/day. ii. The available daily insolation on the array is 4 kW-hr/m^2 day. iii. Also assume that each panel has an area of 1.5 m^2, an efficiency of 50 per cent, and that one third of the heating will come from auxiliary heaters.	**10**	**CO4**
Q 7	With the help of diagram, explain the working of forced circulation solar water heater.	**10**	**CO2** **CO4**
Q 8	With the help of diagram explain arrangements of spaces and tubes in container for latent heat storage.	**10**	**CO3**
Q 9	With the help of diagram, explain the working of low temperature power generation cycle using liquid flat plate collector.	**10**	**CO5**

SECTION-C

Q 10	Determine the sunset hour angle for Allahabad (longitude 81°58´E, latitude 24°25 ´N) for following dates: January 1, March22, july15.	**20**	**CO1**
Q 11	The following observations were recorded in experiments on a single pass solar air heater and on a double pass solar air heater with a porous medium: Inlet air temperature = 26 ℃ Outlet air temperature = 40 ℃ (single pass air heater) = 47 ℃ (double pass with process medium), Air flow rate = 0.033 Kg/s, Collector length = 1.8 m, Collector width = 0.7 m, Location = Jodhpur (16° 18′ N , 73° 01′ E¿ Day = March 16, Time = 9:42 h (LAT), Tilt of collector = latitude of the place = 26°18' N, Azimuth angle of collector = 0°, Global solar radiation on horizontal surface = 640 W/m^2, Diffuse solar radiation on horizontal surface = 160 W/m^2, Reflectivity of the surrounding surface = 0.2 a) Calculate values of efficiency for the above two cases b) When porous medium is removed, the outlet air temp. in the double pass heater is recorded to be 44 ℃. Calculate the value of efficiency for this situation also. Comment on the values obtained.	**20**	**CO2**