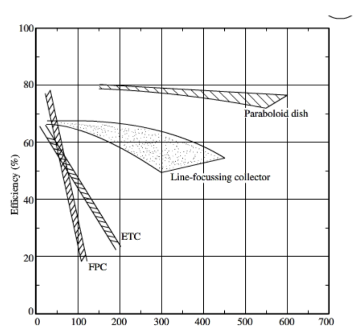
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2018

Course: Solar Thermal Technologies (EPEG 7016) **Semester: II**
Program: M. Tech. - Renewable Energy Engineering
Time: 03 hrs. **Max. Marks: 100**

SECTION A

S. No.		**Marks**	**CO**
Q 1	Derive an expression for solar day length.	**4**	**CO1**
Q 2	Discuss material aspect of individual parts of liquid flat plate collector.	**4**	**CO2**
Q 3	Discuss the criteria use for judging the suitability of thermochemical reaction for solar energy application.	**4**	**CO3**
Q 4	With the help of schematic diagram, explain the working of solar thermal water pump.	**4**	**CO5**
Q 5	Compare the relative merits of and demerits of LiBr – water and aqua – ammonia vapour – absorption-cooling system.	**4**	**CO4, CO5**
	SECTION B		
Q 6	With the help of diagram, discuss basic features of pyrheliometer.	**10**	**CO1**
Q 7	Calculate total radiation falling on a flat plate collector, facing due south, tilted at 30^o with horizontal, at a location in a city, with latitude 28^{o}51' on January 1 at 12 noon (solar time). The reflection coefficient of ground is 0.2. Given I_b = 549.22 W/m^2 and I_d = 107.6 W/m^2.	**10**	**CO2**
Q 8	Estimate the collector area required for a 80 MW line focusing solar thermal power plant producing electricity for 8 hours every day. The collector is operating at a temperature of 400°C. Make following assumptions: 1..The Rankine cycle has an efficiency of 0.36. 2.The electrical generator efficiency is 0.96. 3.The solar insolation during a typical day is 6 kWh/m^2.  **Fig. 2.6** *Efficiency of various types of collectors as a function of operating temperature (Adapted from Gehlisch et al. [1] and Rabl [2])*	**10**	**CO5, CO6**
Q 9	Design a central receiver system using a molten salt as a heat transfer fluid.	**10**	**CO4, CO6**

SECTION-C			
Q 10	Describe followings for a thermochemical storage for a solar application a) Criteria used for judging the suitability of a thermochemical reaction b) Schematic representation of a thermochemical reaction c) Thermochemical storage reactions, temperatures of forward and reverse reaction and energy stored	**20**	**CO3**
Q 11	A cylindrical parabolic focussing collector is used for heating a thermic fluid (Cp = 2.2 kJ/kg-K) which enters with a temperature of 160°C. The concentrator has an aperture of 1.6 m and a length of 2.8 m. The absorber tube has an inner diameter of 2.6 cm and outer diameter of 3.0 cm and has a concentric glass cover around it. Given that: Specular reflectivity of concentrator surface: 0.82 Intercept factor: 0.91 $(\alpha\tau)$b: 0.8 Beam radiation incident normally on aperture plane: 550 W/m^2 Diffuse radiation incident on aperture plane: 150 W/m^2 Overall loss coefficient: 9.5 W/m^2-K Convective heat transfer coefficient on inside of absorber tube: 325 W/m^2-K Ambient temperature: 27°C Mass flow rate of fluid: 360 kg/h Calculate the useful heat gain rate, the exit temperature of the fluid and the instantaneous efficiency. **OR** A cylindrical parabolic collector is used in New Delhi ($28°35'N, 77°12'E$). Estimate the beam radiation falling on aperture plane of this collector (LAT) on June10 for the tracking mode - I for following: (i) from 06:00 to 07:00 h (ii) from 16:00 – 17:00 h For tracking mode I, $\cos\theta = \sin^2\delta + \cos^2\delta\cos\omega$	**20**	**CO2, CO5**

Time (h)	I_b (W/m²)	Time (h)	I_b (W/m²)
0630	110	1230	523
0730	240	1330	495
0830	333	1430	445
0930	424	1530	322
1030	495	1630	220
1130	550	1730	118