M.Tech. (Energy Sc. & Technology) 2nd. Semester 2018

Solar Thermal Energy Systems

Time 3 hr. Full Marks 100

PART – I
(50 marks)
Answer ***any three*** questions
Two marks for systemic answers
Use separate Answer scripts for each part

1. (a) Explain the reason why the incident solar radiation at the surface of the earth is different from the actual radiation received from the sun outside the atmospheric boundary layer. 04

   (b) Define

   i. Profile Angle.

   ii. Equation of time correction

   iii. Solar Azimuth angle 05

   (c) State and explain the An-isotropic Sky model mathematically. Explain the phenomena of Horizon Brightining 07

2. (a) A solar collector is located at 24^0 N latitude and is inclined at an angle of 20^0 and is placed 15^0 due south east. Determine the angle subtended by the solar beam with normal to the flate plate collector on 15st April at 10 am.

   [Given Cos θ = Sin ϕ ($\sin\delta \cos\beta + \cos\delta \cos\gamma \cos\omega \sin\beta$) + $\cos\phi$ ($\cos\delta \cos\beta \cos\omega - \sin\delta \cos\gamma \sin\beta$) $+\cos\delta \sin\beta \sin\gamma \sin\omega$] 08

   (b) With standard notation show that

$$\frac{T_{fo} - T_a - \frac{S}{U_l}}{T_{fi} - T_a - \frac{S}{U_l}} = \exp\left(-\frac{A_c U_l F'}{\dot{m} C_p}\right)$$ 08

3. (a) State and Explain the term Critical Radiation Level for a flat plate collector and express it in the mathematical form.. 06

   (b) With standard notation show that

$$q'_{fin} = (W - D)\, F\, [S - U_l (T_b - T_a)$$ 07

   (c) Discuss what happens if fluid flow is stopped in a flat plate collector system. 03

4. (a) For a flat plate collector system discuss the impact of the properties of materials used and its impact on the collector performance. 04

   (b) Discuss the term "Selective Surface" as used for solar thermal applications. Also explain the term Transmittance - Absorptance product. 04

   (c) With a neat sketch describe the test setup for system performance testing of ETC based system as per MNRE guidelines 08

MASTER OF TECHNOLOGY IN ENERGY SCIENCE & TECHNOLOGY EXAMINATION, 2018

(2^{nd} Semester)

SOLAR THERMAL ENERGY SYSTEMS

Time: Three hours Full Marks: 100

Use a separate Answer- Script for each part

PART-II (50 marks)

Answer ***any three*** from the following questions (two marks for neatness). [16X3 +2 = 50]

1. (a) What is concentrating collector? Explain its advantages and disadvantages.

(b) What is Maximum concentration ratio for circular and linear concentrator?

(c) With standard notations for a parabolic trough collectors with a cylindrical tube receivers, show that the collector efficiency factor can be given by ;

$$F' = \frac{1/U_L}{\frac{1}{U_L} + \frac{D_o}{h_{fi} D_i} + \left(\frac{D_o}{2k} \ln \frac{D_o}{D_i}\right)}$$

[4 + 2 + 10]

2. (a) What do you understand by CPC? What is truncated and non-truncated CPC. With a neat sketch explain a non-truncated CPC.

(c) State and explain the followings;

(i) Cumulative solar savings (CSS) and Life cycle savings (LCS)

(ii) Net present value (NPV)

(iii) Payback period

(iv) Return on investment (ROI)

[(2+2+4) + 8]

3. (a) Explain how the energy balance on a non-stratified water storage tank can be used to predict its temperature as a function of time.

(b) What is the use of f-Chart Method? Explain.

[10 + 6]

4. What is stratified energy storage tank? What are the approaches for temperature prediction of a stratified energy storage tank for a solar water heating system? Explain one of the approaches.

[2+2+12]