

KATHMANDU UNIVERSITY  
End Semester Examination  
August, 2018

AUG 24 2018

Level : B.E.  
Year : III  
Time : 2 hrs. 30 mins.

Course : CHEG 315  
Semester: II  
F. M. : 40

SECTION "B"

[4Q × 5 = 20 marks]

Attempt *ANY FOUR* questions.

1. Discuss how the p-n junction is formed and write down its role in photocurrent generation in silicon solar cell (with figure illustration).
2. Discuss the general design criteria and method for solar cell construction process.
3. Discuss the heat balance equation (with figure illustration) for solar thermal collector. In particular, derive the useful energy considering net heat loss.
4. Give the process and energetics of bio-gas production.
5. A flat plate collector made in Nepal of size 1.8 m\*1.2 m has a loss resistance  $r_L = 0.13 \text{ m}^2\text{KW}^{-1}$  and a plate transfer efficiency  $\eta_{pf} = 0.9$ . The glass cover has transmittance  $\tau = 0.9$  and the absorptance of the plate is  $\alpha = 0.8$ . Water enters at a temperature  $T_1 = 40 \text{ }^\circ\text{C}$ . The ambient temperature  $T_a = 20 \text{ }^\circ\text{C}$  and the irradiance in the plane of the collector is  $G = 900 \text{ Wm}^{-2}$ .
  - a) Calculate the flow rate needed to produce a temperature rise of  $4^\circ\text{C}$ .
  - b) Suppose the pump continues to pump at night, when  $G = 0$ . What will be the temperature fall in each passage through the collector?[Hint: The useful power per unit area is  $q_u = (\rho c Q/A)(T_2 - T_1) = \eta_{pf}[\tau \alpha G - (T_p - T_a)/r_L]$

SECTION "C"

[20 marks]

Attempt *ALL* questions.

6. From the following table, calculate individual Watt-hr consumptions for a residential family and verify the daily energy consumption is of 2741 W-h from following devices. Design a PV system to fulfil the energy needs for that particular family. [Hint: find out the inverter rating, the system voltage, sizing of batteries and perform the sizing of the PV module]. [7]

Load	Watts	Hr/Day	Number	Watt-Hr
CFL	9	5	5	
Fan	60	8	2	
TV	28 (LED)	2	1	
Computer	250	3	2	

7. a) Write down the working principle of high rate farm digester for use in mid-latitude (climate where heating of reactor is necessary). [3.5]  
b) Calculate [3.5]  
(i) The volume of biogas digester suitable for the output of four cows.  
(ii) The power available from the digester. Retention time is 14 days, temperature 30 °C, dry matter consumed 2 kgd<sup>-1</sup>, biogas yield 0.24 m<sup>3</sup>kg<sup>-1</sup>, burner efficiency 0.8, methane proportion 0.7.
8. a) Discuss the process for matching supply and demand of using geo-thermal energy. [3]  
b) Explain the extraction techniques of geo-thermal energy. [3]

OR

Calculate the initial temperature and heat content per square kilometer above 40 °C of an aquifer of thickness 0.5 km, depth 3 km, porosity 5%, under sediments of density 2700 kg m<sup>-3</sup>, specific heat capacity 840 Jkg<sup>-1</sup>K<sup>-1</sup>, temperature gradient 30 °C km<sup>-1</sup>. Suggest a use for the heat if the average surface temperature is 10 °C.