Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – IV • EXAMINATION – SUMMER • 2013

Subject code: 743901 Date: 14-05-2013

Subject Name: Solar and Photovoltaics

Time: 10:30 am – 01:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Explain working of a PV solar cell with neat sketch. **07**

(b) Explain solar zenith angle, solar altitude and solar azimuth angle with neat sketches. **07**

Q.2 **(a)** Define ósolar declination angleô. Write the maximum and minimum values of solar declination angle and corresponding days in a leap year. Calculate the solar declination angle ŭ on July 19, 2013. **07**

(b) Calculate the local solar time and declination at Bhopal (Latitude 23º 15ô N, Longitude 77º 30ô E) at 12:30 IST on Aug, 8, 2013. Also, calculate sunrise, sunset hour angles and day length. (Consider Time correction = ī 5 min 40 sec and standard meridian for local time zone = 82.5º.) **07**

OR

(b) Determine number of daylight hours in for a place having Latitude 34º 05ô on 5th Jan 2013 and 5th Jul 2013. Is it possible to have a day without sunrise on the earth? Explain. **07**

Q.3 **(a)** Explain sun as source of energy with relevant data? List the reasons for solar energy loss when light travels from outer space to earth? **07**

(b) Calculate the azimuth angle of the day at 2.00 pm IST on June 8, 2013 for location having Latitude 23º 2ô N and Longitude 72º 4ô E. (Consider Time correction = 1 min 15 sec and standard meridian for local time zone = 82.5º.) **07**

OR

Q.3 **(a)** Define óSolar Constantô. Considering the Sun and Earth to be equivalent to two spheres in space, from the data given below, calculate approximately the solar constant outside the Earthôs atmosphere ($W\text{-}m^{ī 2}$) and energy received by the Earth: Diameter of the Sun = 1.39×10^{9} m, Diameter of the Earth = 1.27×10^{7} m, Sun-Earth distance = 1.496×10^{11} m, Sunôs equivalent black body temperature = 5777 K. **07**

(b) Write principle of operation of solar ponds. Explain working of solar pond with neat sketch. **07**

Q.4 **(a)** Describe the procedure for thermal analysis of solar flat plate collector. **07**

(b) Explain in brief life cycle analysis of solar energy systems. **07**

OR

Q.4 **(a)** Explain the terms top loss, bottom loss and edge loss with reference to solar flat plate collector. **07**

(b) Classify different types of solar cells based on (i) type of active material used (ii) thickness of active material and (iii) junction structure. Draw manufacturing flow diagram for single crystal silicon cell. **07**

Q.5 **(a)** Differentiate between different types of solar water heating based on collector-storage and circulation type. If it is required to raise temperature of a 500-liter tank water from the room temperature by 10 °C. Calculate the solar power **07**

required assuming 6 peak sun hours in a day.(Specific heat of water = 1.16 kWh/°C /m^3)

(b) Define ófill-factorô and ócfficiencyô of a PV cell. Calculate the fill factor, maximum power and cell efficiency of the cell at an intensity of 200 W-m^{-2}, given V_{oc} = 0.24 V; I_{sc} = ī 9 mA; V_{max} = 0.14 V; I_{max} = ī 6 mA; A_C = 4 cm^2. **07**

OR

Q.5 **(a)** Define ópacking factorô of a PV module. Calculate size of a PV panel required to provide power for lifting 1000 liters of water per day to an over-head tank placed at a height of 10 meters. Assume 4 hours of good insolation over a day. Motor, power conditioner unit and PV panel each have 80% efficiency. **07**

(b) Explain working of solar chimney with neat sketch. Write its advantages and disadvantages. **07**

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