

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER IV (OLD) – • EXAMINATION – SUMMER 2016

Subject Code: 743901

Date: 04/05/2016

Subject Name: Solar and Photovoltaics

Time: 10:30 am to 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) Define the following terms: **07**
(i) Irradiance (ii) Solar constant (iii) Insolation
(iv) Radiosity (v) Emissive power (vi) Earth's equator
(vii) Meridian
(b) Discuss the advantages and limitations of solar energy systems. Also, list the applications of solar photovoltaic systems. **07**
- Q.2** (a) Calculate the sun's zenith and azimuth angles at 9 am, solar time on September 1, 2015 at a latitude 23° N. **07**
(b) Explain the construction and working of a solar cell. Also, discuss the Voltage (V)-Current (I) characteristics of a solar cell. **07**
- OR**
- (b) Define maximum power, filling factor and efficiency of a solar cell. Given the $V_{oc} = 0.24$ V, $I_{sc} = -10$ mA, $V_m = 0.14$ V, $I_m = -6.5$ mA, Incident solar radiation = 100 W/m^2 and Area of solar cell = 4 cm^2 , calculate maximum power, filling factor and efficiency of a solar cell. **07**
- Q.3** (a) Write short note on 'solar radiation on an inclined surface'. **06**
(b) Define and explain the following terms: **08**
(i) Latitude angle (ii) hour angle (iii) Declination angle
(iv) Altitude angle
- OR**
- Q.3** (a) Calculate the values of beam radiation, diffuse radiation and reflected radiation for an inclined surface facing due south, titled at 30° with horizontal at 10 am for a location with latitude $20^\circ 51'$ on January 1. Take reflectivity = 0.2. If total radiation on a horizontal plane is 2.5 MJ/m^2 per hour and the hourly diffuse radiation fraction is 0.37, calculate the ratio of total radiation on the tilted surface to that on horizontal surface. **07**
(b) Why 'orientation and sun tracking' systems are required for focusing collector systems. Explain different 'orientation and sun tracking' systems. **07**
- Q.4** (a) Determine Local Apparent Time and declination at Ahmedabad (Latitude $23^\circ 00'$ N, Longitude $72^\circ 40'$ E) at 14:30 IST on Dec, 15, 2015. Also, calculate sunset hour angles and day length. (Consider Time correction = $-5 \text{ min } 13 \text{ sec}$ and standard meridian for local time zone = 82.5° .) **07**
(b) Explain with neat sketches different focusing or concentrating collectors. **07**

OR

- Q.4 (a)** Write energy balance equation of a flat plate collector. An evacuated tube collector is working under the following conditions: **07**

The intensity of solar radiation on the collector surface = 760 W/m^2

The collector fluid inlet temperature = 43°C

The ambient air temperature = 26°C

Effective optical efficiency = 0.77

Effective heat loss coefficient = $1.65 \text{ W/m}^2\text{-K}$

Mass flow rate of water = 0.017 kg/s-m^2

Isobaric specific heat of water = 4187 J/kg-K

Calculate outlet temperature of water, stagnation temperature and useful heat output.

- (b)** List the solar radiation measuring instruments. Explain any one in detail. **07**

- Q.5 (a)** Explain Solar water distillation systems. **07**

- (b)** Derive the expression for maximum power output and efficiency of a solar cell. **07**

OR

- Q.5 (a)** State the importance of energy storage systems. Explain different energy storage systems. **07**

- (b)** Explain working of solar chimney with neat sketch. List its advantages and limitations. **07**
