

Government College of Engineering, Aurangabad
(An Autonomous Institute of Government of Maharashtra)

M. E. (E.P.S. &E.M.D.) F.T. (Rev) Examination
End Semester Examination

EE 549: Solar Energy Systems (Elective)

17 DEC 2016

Time: Three Hours

Max Marks: 60

"Verify the course code and check whether you have got the correct question paper"

N.B:-

1. Attempt **all** questions
2. Question No. 1 carries 12 marks and remaining questions carries 16 marks each
3. Assume suitable data if necessary and state it clearly
4. Use of programmable calculator is not allowed

- Q1. a) Explain the concept of solar pond & solar still (6)
b) What is the theoretical efficiency of a photovoltaic cell with a 2.5 Volt band gap when exposed to 1000 Watt/m² solar radiations through a filter having the following transmittance characteristics "Pass without attenuation all wavelengths between 600 & 1000 nM. Reject all else" (6)
- Q2. Solve any two from following
- a) Why grid connected PV systems are popular? State & explain its major design parameters (8)
- b) Estimate the monthly average daily global radiations on the horizontal surface at Aurangabad (19.52 N, 75.19 E) during the month of March. If the average sunshine hours per day is 8.2 Assume a=0.26 & b=0.49 (8)
- c) A 70 Watt load will operate seven days a week on top of mountain with 12 Volt battery set. calculate number of batteries required and the cost of batteries. the batteries are charged from solar photovoltaic system. Determine the actual array size. Assume efficiency of battery as 80%. If there are six sunless days (8)
- Q3. Solve any two from following
- a) Explain the impact of shading on solar cell & derive the expression for output voltage under these conditions (8)
- b) The Sun radiates roughly like a 6000⁰ K black body. When the power density of such radiations is 1000 Watt/m², the total photon flux is 4.46 X 10²¹ Photons/m²/second. Almost exactly half of these photons have energy equal or larger than 1.1 eV. Consider a small Silicon PV cell with 100 cm² area. When 2 V of reverse bias is applied, the resulting current is 30 nA. Assuming 100% quantum efficiency Calculate i) short circuit current ii) open circuit voltage iii) maximum power the cell (8)

- can deliver to load iv) efficiency of cell
- c) Two PV cells each with an effective area of 10 cm^2 are exposed to biochromatic radiations having power densities of 500 Watt/m^2 in narrow bands one around 430 THz & other around 600 THz . One cell has a band gap energy of 1 eV & other has 2 eV . The reverse saturation current is 10 nA . If they operate at 300° K Calculate the short circuit currents & open circuit voltages of each cell (8)
- Q4. Solve any two from following
- a) Explain construction & principle of operation of any two types of thin film solar cells (8)
- b) With the aid of neat sketch explain liquid following collectors for solar water heating system (8)
- i) Flat plate collector type A, B & C
- ii) Serpentine absorber type collector
- c) Calculate efficiency & peak power of a silicon solar cell operating at 25° C with short circuit current of 2.3 Amp. & operating under standard illumination of 1 Sun insolation. The area of cell is 100 cm^2 , Fill factor is 75% and Reverse saturation current is 10^{-10} A also calculate efficiency & peak power at 35° C (8)