

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

B. E. (E.E.P.) F.T. (Rev) Examination
End Semester Examination

EE 454: Solar Thermal & PV Technology (Elective)

Time: Three Hours

12 3 NOV 2016

Max Marks: 60

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

N.B:-

1. Attempt **any five** questions
 2. Every Question carries 12 marks each
 3. Assume suitable data if necessary and state it clearly
 4. Use of **programmable calculator is not allowed**
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- Q.1 (a) Explain the central receiver power tower system using Sterling engine (6)
- (b) Two dissimilar PV modules are subjected to the same irradiances & temperatures. The short circuit current of the first module $I_1 = 3$ A & the open circuit voltage $V_1 = 24$ V, The short circuit current of the Second module $I_2 = 2$ A & the open circuit voltage $V_2 = 16$ V (6)
- i) if the two modules are connected in series calculate the combined short circuit current & combined open circuit voltage
- ii) if the two modules are connected in parallel calculate the combined short circuit current & combined open circuit voltage
- Q.2 (a) What will be the angle of incidence in Mumbai in the afternoon (LAT) on 1st November on horizontal plane? Assume $\phi = 19.12$ (6)
- (b) Draw equivalent circuit & explain P-V & I- V curves under standard test condition for solar cell (6)
- Q.3 (a) Explain construction & principle of operation of any two types of thin film solar cells (6)
- (b) A solar cell having area 1 cm^2 receives solar radiations with photons of 1.78 eV energy having an intensity of 0.876 mW/cm^2 . Measurement shown open circuit Voltage of 0.66 V/cm^2 , short circuit current of 9 mA/cm^2 & the maximum current is 50% of short circuit current. The efficiency of the cell is 22%. Calculate the Maximum voltage that the cell can give & its fill factor (6)
- Q.4 (a) Discuss the use of solar energy for heating purposes. How can solar-Thermal energy be used to supply potable drinking water in environmentally difficult places? (6)
- (b) The black body radiations at a given temperature T, follows a law $\frac{\partial P}{\partial f}$ is zero at $f=0$, $\frac{\partial P}{\partial f}$ grows linearly with f to a value of $1\text{ W/m}^2/\text{T Hz}$ at 500 T Hz, from 500 T Hz it decreases linearly to zero at 1000 T Hz. P is the power density & f is the frequency (6)

- Calculate i) Total power density of the radiation ii) What is the value of band gap of the photovoltaic material that results in the maximum theoretical efficiency exposed to above radiations
- Q.5 (a) Explain following configurations of grid connected PV systems (6)
 i) centralized inverter ii) string inverter iii) Integrated module iv) single stage system v) two stage system vi) multi stage system
- (b) A photovoltaic cell is exposed to radiations of uniform spectral power density covering the range from 400 to 600 T Hz. outside this range there is no radiation. the total power density is 2000 W/m^2 . assuming 100% quantum efficiency calculate short circuit current of solar pv cell having an active area of 100 cm^2 (6)
- Q.6 (a) Explain one node analysis of a flat plate collector having two glass covers & used for water heating. state the assumptions you make (6)
- (b) Two pv cells each with an effective area 10 cm^2 are exposed to biochromatic radiations having power densities of 500 Watt/m^2 in narrow bands one around 430 T Hz & other 600 T Hz. first cell has band gap energy of 1 eV & second has 2 eV. The reverse saturation current is 10 nA. If they operate at 300^0K . Calculate the open circuit voltage of each cell (6)
- Q.7 (a) Explain following configurations of collectors for water heating purpose (6)
 i) Flat plate collector type A,B &C
 ii) Parabolic concentrator collector
- (b) Choose correct alternative from given options (6)
 i) Function of bypass diode in solar panel is to
 a) block load current b) provide path to load current
 c) block reverse saturation current d) none of these
- ii) If two dissimilar Solar PV systems are connected in series
 a) total voltage is sum of two output voltages & total output current is lowest output
 b) total voltage is difference of two output voltages & total output current is highest output
 c) total voltage is lowest of two output voltages & total output current is sum of output
 d) total voltage is highest of two output voltages & total output current is difference output
- iii) Solar PV systems can be:
 a) Connected to the power grid b) used to sell power to the grid
 c) A standalone source of electricity d) all of the above
- iv) Standard for utility interface of residential & intermediate PV system is
 a) IEEE-1547.1 b) IEEE-929-2000 c) IEC-61727 d) All of these
- v) Visible spectrum have energy radiations
 a) up to 3.5 eV b) < 3.5 eV c) < 1.5 eV d) > 3.5 eV
- vi) The best electrical property of solar cell is
 a) it has good light absorbing capacity b) it has high carrier life
 c) it has high conductivity d) both b & c