Total number of printed pages = 3

19/2nd Sem/PGET 2108

2022

SOLAR PV ENERGY

Full Marks – 100

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer any *five* questions.

1. (a) Write the properties of semiconductor. 5

   (b) What is energy level ? 5

   (c) The band gap for GaAs is 1.43 eV. Calculate the optimum wavelength (in μm) of light for photovoltaic generation in a GaAs cell. 5

   (d) Write the equation of Fermi level for n-type and p-type material. 5

2. (a) Draw and discuss the solar cell characteristics. 5

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(b) Calculate the maximum power and electrical efficiency of solar cell at an intensity of 200 W/m^2. 5

$V_{max} = 0.14\,V$; $I_{max} = 6\,mA$; $A_c = 4\,cm^2$.

(c) Derive the equation of maximum power of solar cell. 10

3. (a) Derive the equation of Fermi level for intrinsic semiconductor. 5

(b) What is 'four quadrant operation' of an inverter ? 5

(c) A solar cell of area $4\,cm^2$ receives solar radiation with photons of 1.8 eV energy having an intensity of $200\,W/m^2$. Measurements show open circuit voltage of 0.24 V, short circuit current of 10.24 mA. Current at maximum power is 6.5 mA. The efficiency of the cell is 1.1%. Calculate the voltage at maximum power. Also calculate the fill factor. 10

4. (a) An Si sample is doped with 1×10^{17} atoms/cm^3 phosphorous atom. If the intrinsic carrier concentration for Si is 1×10^{10} atoms/cm^3, calculate the minority hole concentration (in atoms/cm^3) at room temperature. 5

(b) What is modulation ratio ? 5

(c) Draw and discuss the IGBT characteristics. 10

5. (a) Discuss PWM scheme of single-phase full bridge inverter. 10

(b) In the full-bridge inverter circuit $V_d = 300\,V$, $m_a = 0.8$, $m_f = 39$ and fundamental frequency is 47 Hz. Calculate the rms value of the fundamental frequency voltage and some of the dominant harmonics in the output voltage V_o = if a PWM bipolar voltage switching scheme is used. 10

6. (a) What is step-up (Boost) converter ? 5

(b) Two solar modules are connected in parallel having voltage rating of 12 V each and with a current capability of 3.5 A each respectively. What will be the output in terms of voltage and current ? 5

(c) Discuss PWM in three-phase voltage source inverter. 10