Total No. of Questions – [4] Total No. of Printed Pages - 2

G.R. No.	

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F. Y. B.TECH. (COMMON) (SEMESTER - I)

COURSE NAME: Engineering Physics

Paper Code: U117-105A (T2)

(2017 PATTERN)

Time: [1 Hour] [Max. Marks: 30]

(*) Instructions to candidates:
1) **Answer Q.1 OR Q.2, Q.3 OR Q.4**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed**
4) **Use suitable data where ever required**

Q1) a) Starting from the expressions $E_F = E_{Fi} + kTln\left(\frac{N_D}{n_i}\right)$ and $E_F = E_{Fi} - kTln\left(\frac{N_A}{n_i}\right)$, derive an expression for built-in (or barrier) potential V_{bi} for a p-n junction diode. [6]

b) Given density of states $g_c(E) = \frac{4}{\sqrt{\pi}}\left[\frac{m_e^*}{2\pi\hbar^2}\right]^{3/2}(E - E_c)^{1/2}$ for $E \geq E_c$, derive the expression for number of electrons in the conduction band $n = N_c e^{\frac{(E_F - E_c)}{kT}}$ where, $N_c = 2\left[\frac{m_e^* kT}{2\pi\hbar^2}\right]^{3/2}$ [6]

c) Calculate the probability of finding an electron 0.3 eV above the Fermi energy E_F at T = 450K. Given Boltzmann's constant k = 8.6×10^{-5} eV/K. [4]

OR

Q2) a) Draw the Fermi-Dirac distribution function for temperatures T = 0 K, T_1 and T_2 where $T_2 > T_1 > 0$ K. Discuss the physical significance of the temperature dependence of Fermi-Dirac distribution function. [6]

b) Starting from the expressions $n = N_c e^{\frac{(E_F - E_C)}{kT}}$ and $p = N_v e^{\frac{(E_v - E_F)}{kT}}$, obtain an expression for Fermi energy in an intrinsic semiconductor and show that it lies at the centre of the forbidden band if $m_e^* = m_h^*$. Given $N_c = 2\left[\frac{m_e^* kT}{2\pi\hbar^2}\right]^{3/2}$ and $N_v = 2\left[\frac{m_h^* kT}{2\pi\hbar^2}\right]^{3/2}$. [6]

c) Using ideal diode equation, calculate the current for applied voltage V_A = +0.5V at 300K. Given k/e = 8.6×10^{-5} eV/K and I_0 = 10^{-10}A. [4]

Q3 a) Starting from ideal diode equation, write the expressions for I-V characteristics for solar cell in dark and illuminated by light. Derive I_{sc} and V_{oc} from the equation for a solar cell. Draw the I-V characteristics curve for a solar cell and label it. [6]

b) Draw schematically, (a) I-V characteristics for two solar cells connected in series and (b) I-V characteristics for three solar cells connected in parallel. Draw I-V characteristics for single solar cell in these graphs for reference. [4]

c) The short circuit current for a solar cell is 8 A, and reverse saturation current is 2.5×10^{-8} A. Calculate V_{oc} at 350K. Given, k/q = 8.6×10^{-5} eV/K. [4]

OR

Q4 a) Discuss the merits and demerits of solar photovoltaic system. [6]

b) Discuss four parameters of a battery suitable for storing electrical energy generated by a solar photovoltaic system. [4]

c) 12 solar cells are connected in series in a solar panel. Two such solar panels are connected in parallel in a solar array. Each solar cell has V_{oc} = 0.59V and I_{sc} = 3A. Calculate the V_{oc} and I_{sc} of the array. [4]