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

| G.R. No. | |
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Paper code - 127-105A (T2)

**MARCH 2018 / IN - SEM (T2)**

**F. Y. B.TECH. (COMMON) (SEMESTER - II)**

**COURSE NAME :Engineering Physics(2017 PATTERN)**

**COURSE CODE: ES10175A**

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 wherever required**

Q1 (a) Define Fermi level for a semiconductor. What is Fermi-Dirac probability distribution function? Explain the terms used in it. Show that the probability of finding an electron with energy $E_F+\Delta E$ is equal to the probability of absence of an electron with energy $E_F-\Delta E$. [6]

(b) Draw the energy level diagram for an unbiased p-n junction diode at equilibrium. Explain the formation of built in potential on the basis of charge re-distribution in both regions. Derive the expression for built in potential ($V_{bi}$) for a p-n junction diode. [6]

(c) Find $E_F-E_{Fi}$ for an n-type semiconductor if the doping concentration is $N_D = 2.1\times10^{15}$ /cm$^{-3}$. Given $n_i = 2.4\times10^{13}$ /cm$^{-3}$ at 300K. Boltzmann constant $k = 8.6\times10^{-5}$ eV/K. How far is $E_F$ from $E_c$ if the band gap is 0.7 eV for Ge? [4]

OR

Q2 (a) 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 an expression for electron density 'n' in the conduction band. [6]

(b) Starting from the expression for current through a diode, obtain expressions for current in forward and reverse bias. Explain with help of band diagram, I-V characteristics for a diode. [6]

(c) Find the probability of finding an electron 0.15eV above and 0.15eV below the Fermi energy at 300K, Given, $k = 8.6\times10^{-5}$ eV/K. [4]

Q3 (a) Starting from the ideal diode equation, obtain expressions for short circuit current $I_{sc}$ and open circuit voltage $V_{oc}$. Give the expression for fill factor. Explain the terms in it and its significance using the I-V characteristics. [6]

(b) Explain the functions of bypass diode and blocking diode while connecting solar panels in an array. [4]

(c) A Si solar cell typically has reverse saturation current density $J_0 = 1\times10^{-12}$ A/cm$^2$. Such a Si solar cell with an area of 275 cm$^2$ is illuminated by sunlight of intensity $P_{solar}$ = 1000W/m$^2$. Short circuit current $I_{sc} = I_L = 4.2$ A. If the fill factor FF of the cell is 0.65, then calculate efficiency of the solar cell at 27°C. [4]

OR

Q4 (a) Define and explain the following battery parameters: (i) battery capacity (ii) depth of discharge (iii) C-rating. [6]

(b) Explain use of anti-reflection coating and surface texturing to enhance efficiency of a solar cell. [4]

(c) Four solar cells are connected in series in a row. Seven such rows are connected in parallel to form an array. Calculate open circuit voltage $(V_{oc})_{array}$ and short circuit current $(I_{sc})_{array}$ for the array. Given, $V_{oc}$ = 0.6 V and $I_{sc}$ = 1 A for a single solar cell. [4]