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First mid Semester Examination-2019.

Second semester 2019, Subject-Physics, (Semiconductor optoelectronics.), Branch-E.C.E.

Full marks-20. Time - $1\frac{1}{2}$ hours.

Answer five (question no.1 is essential and any four of the remaining questions) questions.

All question carry equal marks.

1. **Answer any four of the following multiple choice questions.**

   I. The density of states in the conduction band is given by

   (a) $M_c \frac{2^{\frac{1}{2}}}{\pi^2}\left\{\frac{m_n^*}{\hbar^2}\right\}^{\frac{3}{2}}(E-E_c)^{\frac{1}{2}}dE$ (b) $M_c \frac{2^{\frac{1}{2}}}{\pi^2}\left\{\frac{m_n^*}{\hbar^2}\right\}^{\frac{3}{2}}(E-E_c)^{\frac{3}{2}}dE$

   (c) $M_c \frac{2^{\frac{1}{2}}}{\pi^2}\left\{\frac{m_n^*}{\hbar^2}\right\}^{\frac{3}{2}}(E_c-E)^{\frac{1}{2}}dE$ (d) None of the above.

   Where terms have usual meaning.

   II. Which of the following material is not suitable for making LED

   (a) GaAs (b) InGaAsP (c) Si (d) GaAlAs

   III. Light emission from an LED is modulated by

   (a) Applied voltage (b) Derive current (c) Illumination (d) None of the above

   IV. In no applied bias condition the built in potential barrier for a p-n junction is given by

   (a) $\frac{kT}{e}\ln\left(\frac{N_A N_D}{n_i^2}\right)$ (b) $\frac{kT}{e}\ln\left(\frac{n_i^2}{N_A N_D}\right)$ (c) $\frac{e}{kT}\ln\left(\frac{N_A N_D}{n_i^2}\right)$ (d) None of the above

   V. In relaxation time approximation the current density is given by

   (a) $J_x=\frac{e^2\varepsilon_x n}{m_e^*}\tau_e$ (b) $J_x=\frac{m_e^*}{e^2\varepsilon_x n}\tau_e$ (c) $J_x=\frac{e^2\varepsilon_x n}{m_e^*\tau_e}$ (d) None of the above

   VI. At the Fermi energy level the Fermi Dirac distribution function F(E) has the value

   (a) 4/4 (b) 3/4 (c) 2/4 (c) 1/4.

2. **Describe in detail the structure of the planar LED and DomeLED.**
3. **Discuss the radiative recombination mechanism in semiconductors.**
4. **Derive an expression for the density of states in a semiconductor.**
5. **Discuss the optical effect and band gap modification in semiconductor.**
6. **Derive the expression for built in potential in an unbiased p-n junction.**
7. **Write notes on any two of the following (a) E-k diagram (b) metal-semiconductor junction (ohmic) (c) Carrier transport (d) LED.**