

Physics

COLLEGE OF ENGINEERING, PUNE
F. Y. B. TECH.
(AS110) Physics II (E-GROUP: VIth to Xth Division)
END SEMESTER EXAM 2012-13
Spring Semester

Date: 26-04 -2013

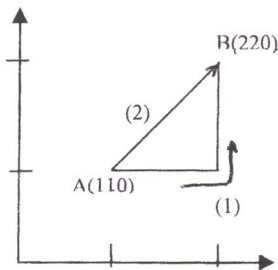
Academic Year: 2012-13

Time 10AM-1PM.

Max. Marks 50

- Instructions:** 1. **Solve any five questions.**
2. Figures to right hand indicate full marks.
3. Draw neat labeled diagrams wherever necessary.
4. Cell phones are not allowed in the exam hall.

- Q.1** (a) Define the divergence of a vector field. Explain the physical significance of divergence of a vector with derivation. 4M
(b) Explain the origin of band gap on the basis of E-K curve. 3M
(c) A dielectric slab of thickness 0.6cm and dielectric constant $k=5$ is placed between the parallel plates of capacitor of plate area 0.01 m^2 and separation 0.015 m. A potential difference of 150V is applied with no dielectric present. If the battery is connected and dielectric is inserted, find the three vectors E, D and P in dielectric. (Given $\epsilon_0=8.85 \times 10^{-12} \text{ C}^2/\text{N-m}^2$) 3M
- Q. 2** (a) Evaluate the temperature at which there is 1% probability that a state, with an energy 0.5eV above the Fermi energy, will be occupied by an electron. (Given Boltzmann constant $=1.38 \times 10^{-23} \text{ J/K}$) 4M
(b) Derive the expression for intrinsic conductivity and show that the graph of $\ln \sigma$ against $1/T$ is a straight line. 3M
(c) Assuming the Fermi function, derive the expression for the number of electrons per unit volume in the conduction band for a semiconductor. 3M
- Q.3** (a) Calculate line integral of function $\vec{V}=y^2 \vec{i}+2x(y+1) \vec{j}$ from the point A(110) to B(220) along the path (1) and (2) as in the fig. 4M



- (b) Derive the expression for curl of electric field in terms of time varying magnetic field. 3M
(c) Derive the energy expression for free electron confined in a solid box of length L. 3M

- Q.4** (a) Derive equation of continuity and explain its physical significance. 4M
 (b) Find the value of applied forward voltage for a p-n junction diode if $J_0 = 30 \mu\text{A}/\text{cm}^2$ and $J = 2 \text{A}/\text{cm}^2$ and $(e/kT) = 39$. 3M
 (c) Explain electric polarization of matter. Show that electric polarization is equal to surface charge density of induced charges. 3M

- Q.5** (a) Calculate the position of Fermi level E_f relative to the conduction level and the conductivity at 300K for germanium crystal containing 5×10^{22} arsenic atoms/ m^3 . Also calculate the conductivity if mobility of the electron is $0.39 \text{ m}^2 \text{ volt}^{-1} \text{ sec}^{-1}$.

(Given: $C = 2 \left[\frac{2\pi m_e^* k T}{h^2} \right]^{\frac{3}{2}} = 4.83 \times 10^{21}$ $kT = 0.026 \text{ eV}$) 4M

- (b) Explain magnetization versus magnetic field and susceptibility versus temp in diamagnetic, paramagnetic and ferromagnetic materials. 3M
 (c) Sketch and explain the energy band diagram of forward biased P-N junction. 3M
- Q.6** (a) Show that the curl of the linear velocity of any particle of rotating body is twice its angular velocity. 4M
 (b) A circular loop of radius 10cm is located in XY plane in a field \vec{B} given by $\vec{B} = (0.5 \cos 377t)(3\hat{j} + 4\hat{k})$. Determine the voltage induced in the loop. (Given $r = 0.1 \text{ m}$) 3M
 (c) Show that the surface integral of displacement vector over a closed surface is equal to the free charge enclosed within the surface. 3M