COLLEGE OF ENGINEERING, PUNE

F.Y.B. TECH.

(AS102) Physics II (E-GROUP: VIth to Xth Division)

END SEMESTER EXAM 2011-12

Spring Semester

Date 8-05 -2012

Academic Year 2011-12

Time 9AM-12Noon.

Max. Marks 50

Instructions: 1. All questions are compulsory.
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.

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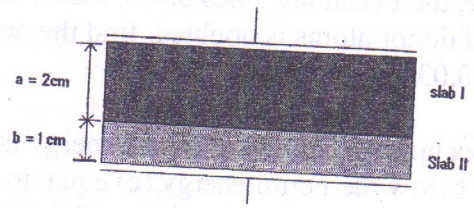
1) a) Define the curl of a vector field. Explain the physical meaning of curl of a vector and derive expression for curl of vector field. 6M

b) A parallel plate capacitor of area 0.5 m^2 and plate separation 3cm is filled with two dielectric slab as shown in fig. The thickness of upper slab is 2cm with dielectric constant 6 and lower slab is of thickness 1cm and with dielectric constant 12. If a potential of 200V is applied to the capacitor, find (a) Polarization $\vec{P}$, (b) Electric displacement $\vec{D}$ and (c) Electric field $\vec{E}$. 4M



OR

c) Show that the surface integral of displacement vector over a closed surface is equal to the free charge enclosed within the surface. 4M

2) a) Check the divergence theorem using function 4M

$\vec{V} = y^2\hat{i} + (2xy + z^2)\hat{j} + 2yz\hat{k}$ and the unit cube bounded by the planes x = 0, x = 1, y = 0, y = 1, z = 0, z = 1

b) Prove that magnetic monopole does not exist. 3M

c) Discuss with proper diagram variation of carrier concentration with temperature in n-type semiconductor. 3M

3) a) Assuming the Fermi function, derive the expression for the number of electrons and holes per unit volume in the conduction and valence band respectively for a semiconductor. 6M

PTO

b) Derive the expression for curl of magnetic induction in terms of time varying electric field. 4M

OR

c) 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 = 0.1m) 4M

4) a) Derive the expression for magnetic vector potential. 4M

b) A Si bar 0.1cm long and 100 μm^2 in cross section area is doped with $10^{17} cm^{-3}$ Phosphorus. Find the current passing through Si bar at 300 K, with 10 V applied across it. Mobility of electrons is $700 cm^2$/V-sec. Charge on electron, $e = 1.6 \times 10^{-19}$C. Neglect the contribution of minority charge carriers. 4M

c) Derive an expression for built-in potential barrier for P-N junction at equilibrium. 2M

5) a) Derive the relation: $\vec{P} = \varepsilon_0 (k-1)\vec{E}$ 3M

b) In an n-type semiconductor, the Fermi level lies 0.4eV below the conduction band. If the concentration of donor atoms is doubled, find the new position of the Fermi level. (Assume kT = 0.03eV) 4M

c) What is the probability of occupancy for a state whose energy is (a) 0.1 eV above the Fermi energy, (b) 0.1ev below the Fermi energy,(c) equal to Fermi energy. (Assume temp 800K and Boltzmann constant $k = 8.62 \times 10^{-5} eV/^0K$) 3M

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