MOST IMPORTANT QUESTIONS(second sem 2018)

1. Give seven crystal system and fourteen space lattice in crystal structure. Calculate packing factor for SCC, BCC, and FCC lattices.
2. Describe short notes on the structure of NaCl and diamond crystals.
3. Lead of FCC with an atomic radius r = 1.74Å. Find the spacing of (321), (222) and (111) planes. Find its ratio i.e $d_{321}:d_{222}:d_{111.}$
   (using formula $d_{hkl} = a / \sqrt{(h^2 + k^2 + l^2)}$ first calculate d_{321} ,d_{222} ,d_{111} and then find ratio and $a = 4r/\sqrt{2}$)
4. (a). deccribe Bragg's spectrometer. How can we determine the crystal structure using bragg's spectrometer.
   (b). In Bragg's reflection of x- rays, a reflection was found at 30^0 glancing angle with lattice planes of spacing 1.87Å. if this is a second order reflection, calculate the wavelength of x- rays.($2d \sin\theta = n\lambda$, according to numerical, $\theta = 30^o$ and d = 1.87 Å and n=2)
5. Write the procedure to find the miller indices.Find the miller indices of a set of parallel planes which make intersect at the ratio 2a:5b on the X-Y axes and are parallel to Z axes.
   (Hint: first take reciprocal of intercepts and then multiplied by LCM then we get miller indices. If any intercept is parallel to axes it takes ∞)
6. In a SCC, find the ratio of intersects on 3-d axes by (123) plane.
7. ***(a)*** *Obtain the expression for internal field with in dielectrics. By using this equation, also derive Claussius and Mosotti equation.*
   (b) find the polarization P in a homogeneous isotropic dielectric material of refractive permeability 4,when dielectric displacement density $D = 2 \times 10^{-8}$ C/m^2. Hint:[$P = (\varepsilon_r - 1)\varepsilon_o E = (\varepsilon_r - 1)D/\varepsilon_r$]
   (c) The atomic weight M and density ρ of sulphur are 32 and 2.08 gm/cm^3 respectively. The electronic polarizability of the atom is 3.2×10^{-40} F-m^2. If sulphur solid has cubic symmetry, what will be the relative permittivity ε_r? ($n = N_A . \rho / M$). Given Avogadro number N_A is 6.02×10^{26}.
   [hint: $(\varepsilon_r - 1)/(\varepsilon_r + 2) = \frac{n\alpha}{3\varepsilon_o} =]$
8. *Discuss langavin's theory of diamagnetic material. Prove that diamagnetic susceptibility is negative and free from temperature.*
9. Derive expression for polarizability in atom is
   $$\alpha_e = \varepsilon_o(\varepsilon_r - 1)/N$$
   And electronic displacement is given by
   $$\mathbf{x = 4\varepsilon_o \pi R^3 E / Ze.}$$
10. (a). If the earth receives 2 cal min^{-1} cm^{-2} solar energy, what are the amplitudes of electric and magnetic fields of radiation? (hint : first cal is converted into jule and min into sec and cm into m.i.e $P = EH = 2 \times 4.2 \times 10^4 / 60 = 1400$ Jm^{-2}sec^{-1} and E/ H = 376. Calculate E and H).
    (b). Assuming that all energy from a 1000 w lamp is radiated uniformly, calculate the average values of intensities of electric and magnetic field of radiation at a distance of 2m from the lamp. [also P= EH = power / area = $1000/4\pi(2)^2$ and E/H =376, calculate E and H].

    (c). find attenuation constant (α) ,phase constant (β), propagation constant (γ), skin depth (δ) for damp soil at 10^6 Hz given that for damp soil $\mu_r = 1$, $\varepsilon_r = 48$, and conductivity $\sigma = 20$ S/m. (Hint: skin depth $\delta = \sqrt{\frac{2}{\omega\sigma\mu}} = \sqrt{\frac{1}{\pi f \sigma \mu_o \mu_r}} = \frac{1}{\alpha} = \frac{1}{\beta}$, Progation constant $\gamma = \alpha + i\beta$)

11. *Derive the expression for comption shift.explain why comption shift is not observed with visible light.*
12. Deduce four Maxwell's equations. Explain the concept of displacement current and show what is the need to modify the ampere's law. Write physical significance of each Maxwell's equations.

13. Derive e.m wave equation for free space. Prove that e.m wave in free space move with the velocity
    $\mathbf{c = 1\backslash \sqrt{\mu_o \varepsilon_o}} = 3.0 \times 10^8$ m/sec.
14. *What is poynting vector? Derive the formula and explain the physical meaning of each term.(or in other words discuss the work energy theorem for flow of energy in e.m waves)*
15. *What do you mean by a nanotube? Discuss the different types of nano tubes. Write fabrication of CNT. Write their uses.*
16. (a) *Give silent feature of BCS THEORY. Explain meissner's effect. Show in superconducting state, material behave as perfect diamagnetic materials (i.e. susceptibility χ is -1).*
    (b) A superconducting material have a critical temperature of 3.7 K in zero magnetic field of 0.306 tesla at 0 K. find the critical field at 2 K. (hint: $H_C(T) = H_C(0)[1 - (T^2/ T_C^2)]$
    (c) the penetration depth λ of Hg at 3.5 K is about 750 A. find penetration depth at 0 K. given T_c for Hg is 4.153 K. $[\lambda(T) = (1 - \{T/T_c\}^4]^{-1/2}$
17. Define retaintivity and coarcivity in hysteresis curve. Show that hysteresis loss is equal to area of hysteresis curve.
18. What do you mean by Fermi level. Prove Fermi level in intrinsic semiconductor lies midway the forbidden band

    i.e $E_F = (E_C + E_V)/ 2$.
19. Short notes on:
    (a) Polar and non polar dielectrics.
    (b) Synthesis of bucky ball.
    (c) Shin depth
    (d) Frequency dependence of dielectric constant
    (e) Type 1^{st} and type 2^{nd} superconductors.
    (f) On the basic of this theory differentiate metal, semiconductor and insulators with neat diagrams.
    (g) Transverse nature of e.m waves