Date: 10.10.2019   Time : (3 Hours)   Total Marks: 100

N.B. (1) All questions are compulsory.
      (2) Figures to the right indicate marks for respective sub questions.
      (3) Use of **Non-programmable** calculators is **allowed.**
      (4) Draw **neat labeled diagrams** wherever **necessary.**
      (5) Symbols used have their usual meaning

Q.1) [A] Choose correct alternative in each of the following.   (12)
      (i) The relations between probabilities of stimulated absorption and emission were given by ___
           (a) Einstein   (b) Planck
           (c) Bhor   (d) Fermi
      (ii) The refractive index of core of optical fiber is ____

           (a) Larger than that of Cladding material.   (b) Equal to that of Cladding material.
           (c) Smaller than that of Cladding material.   (d) None of the above.

      (iii) The number of atoms per unit cell for SC lattice is __

           (a) 8   (b) 1

           (c) 6   (d) 4

      (iv) For fcc structure lattice parameters are ___

           (a) $a = b = c,\ \alpha \neq \beta \neq \gamma = 90°$ (b) $a \neq b \neq c,\ \alpha = \beta = \gamma = 90°$

           (c) $a = b = c,\ \alpha \neq \beta = \gamma = 90°$ (d) $a = b = c,\ \alpha = \beta = \gamma = 90°$

      (v) The resistivity of semiconductor increases with ___
           (a) Rise in temp   (b) Fall in temp
           (c) Remains unchanged   (d) None of these
      (vi) Materials suitable as transformer core are ___
           (a) High resistivity & large Hysteresis   (b) High resistivity & Low Hysteresis
           (c) Low resistivity & large Hysteresis   (d) Low resistivity & large Hysteresis

      [B] Answer in One Sentence   (3)
      (i) What is fiber optics?
      (ii) Define Primitive cell.
      (iii) Define magnetic flux density.

      [C] Fill in the blanks   (5)
      (i) In graded index fiber the refractive index varies in the ____ direction.
      (ii) The process by which population inversion is achieved in LASER is called _____
      (iii) The coordination number for bcc lattice is ___

      (iv) In _____ semiconductor, the impurity added to an intrinsic semiconductor is trivalent.

(v) Property of inducing magnetic field opposite to the applied magnetic field _____

Q.2) [A] Attempt **any ONE** of the following. (8)
  (i) What is acceptance angle of an optical fiber? Derive the relationship between acceptance angle and refractive index of fiber core and cladding.
  (ii) Discuss holography as an application of laser.

[B] Attempt **any ONE** of the following. (8)
  (i) Explain the following factors affecting the acoustics quality of building.
      a) Reverberation Time b) Echelon effect c) focusing.
  (ii) Explain the following properties of LASER in brief
  a)intensity   b)directionality   c) monochromaticity d) coherence

[C] Attempt **any ONE** of the following. (4)
  (i) The volume of a room is 600 m^3.The wall area of the room is 220m^2 ,the floor area is 120 m^2 and the ceiling area is 120m^2.The average sound absorption coefficient, (i)for the wall is 0.03; (ii) for the floor is 0.06 and (iii) for the ceiling 0.80. Calculate the average sound absorption coefficient and the reverberation time.
  (ii) Explain (i) Spontaneous Emission (ii) Stimulated Emission.

Q.3) [A] Attempt **any ONE** of the following. (8)
  (i) Explain the following concepts with reference to crystal __
  a) Lattice points and Space lattice   b) Crystal lattice and Single crystal
  c) Unit Cell   d) Atomic radius   e)Atomic packing factor
  (ii) a) Obtain the relation between density and lattice constant of a crystal structure.
      b) What is the atomic radius for fcc structure of Aluminium ? Use atomic weight of Al is 26.98.Density of Aluminium structure is 2700 kg/m^3

[B] Attempt **any ONE** of the following. (8)
  (i) a) Explain with the help of neat labeled diagram simple cubic structure
      b) Draw the planes (011) and (111) in simple cubic lattice
  (ii) a) Explain fcc structure with the help of neat labeled diagram.
      b) Determine lattice constant of copper possessing fcc cubic structure.
      Atomic radius of copper is 3.28 $A°$
[C] Attempt **any ONE** of the following. (4)
  (i) Find the Miller Indices for the plane whose intercepts (i) 1,-3 and ∞.
  (ii)1,∞ and 1.(iii)2,4 and 6 (iv) 0,1and 2 on X,Y and Z axis respectively.
  (ii) Find the interplanar spacing for (321) and (111) in simple cubic structure having lattice constant 4.28 $A°$

Q.4)   [A]   Attempt **any ONE** of the following.   (8)
(i)   a) Mention any four important characteristics semiconducting materials and any two applications.
(ii)   b)What is ferromagnetism? Explain hysteresis curve of ferromagnetic materials on the basis of domain theory.

[B]   Attempt **any ONE** of the following.   (8)
(i)   a) Explain the phenomenon of reflection, absorption and transmission takes place when light interacts with matter.
(ii)   b) Write a note on (i) piezoelectric materials (ii)ferroelectric materials

[C]   Attempt **any ONE** of the following.   (4)
(i)   A metal wire has a resistance of 2.25 Ω at 0° C. If its temperature coefficient of resistance is $3.8 \times 10^{-3}/°C$, find the resistance of wire at 55°C.
(ii)   Find the relative permeability of ferromagnetic materials if a magnetic field of strength 220A/m produces magnetization of 3300 A/m on it.

Q.5)   Attempt **any FOUR** of the following.   (20)
(i)   What is LASER ? Write its industrial and medical applications.

(ii)   Calculate the acceptance angle and critical angle of an optical fiber with core refractive index 1.55 and cladding refractive index 1.51.(refractive index of air is 1)

(iii)   What are Miller indices ?Draw the planes with Miller indices (112) ,(001).Show the direction in simple cubic structure,

(iv)   Lead has a fcc structure .Its atomic radius is 1.746 $A°$.Determine the lattice constant and the spacing (i)(220), (ii) (020) planes of lead.
(v)   What do you mean by pyroelectric materials? Give the applications of pyroelectric materials.
(vi)   Write a note on a) Anti-ferromagnetism b) ferrimagnetism

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