Code : 104302

B.Tech 3rd Semester Exam., 2020
(New Course)

ELECTRICAL AND ELECTRONIC MATERIAL

Time : 3 hours   Full Marks : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are **NINE** questions in this paper.

(iii) Attempt **FIVE** questions in all.

(iv) Question No. 1 is compulsory.

1. Choose the correct option/Answer the following (any seven) :   2×7=14

   (a) Fermi energy level

   (i) is the top most filled energy level at 0 K temperature

   (ii) is the top most filled energy level at 0°C temperature

   (iii) separates valance **band** and conduction band

   (iv) None of the above

   (b) Electronic bands are formed due to

   (i) split up of energy levels

   (ii) satisfy Pauli's exclusion principle

   (iii) the shift in energy levels

   (iv) All of the above

   (c) Ferroelectric domains in a material represent

   (i) region of randomly-oriented dipoles inside a ferroelectric material

   (ii) region of oriented dipoles in a similar direction

   (iii) region of randomly-oriented grains

   (iv) region of oriented grains

   (d) What are the conditions for a physical entity to be eligible for the particle?

   (i) It should have momentum

   (ii) It should have mass

   (iii) Any one of its variables should be discreet

   (iv) All of the above

   (e) In a direct bandgap semiconductor

   (i) the two points of intersection of a vertical line with the E-K curve of both valance band and conduction band are at the same momentum

   (ii) the two points of intersection of a vertical line with the E-K curve of both valance band and conduction band are having the same wave vector

(iii) the K value of the lowest point of the conduction band is equal to the K value of highest point of valance band

(iv) the transitions of electrons take place directly

(v) All are correct

(f) The shape of E-K diagram of the conduction band and valance band is

(i) horizontal

(ii) vertical

(iii) parabolic

(iv) None of the above

(g) Which of the following methods is used to produce the sound of frequency more than 20 kHz?

(i) Magnetostriction method

(ii) Piezoelectric method

(iii) Inverse Piezoelectric method

(iv) Ultrasonic interferometer

(h) An intrinsic semiconductor is

(i) free-electron free

(ii) defect free

(iii) dopant free

(iv) All of the above

(i) What is dielectric resonance?

(j) What is a Cooper pair?

2. (a) Represent graphically the electron occupancy of allowed energy bands for an insulator, metal, semi-metal and semiconductor. Explain clearly the difference between a semi-metal and semiconductor.

(b) Describe a technique for measuring the effective mass of electrons and holes.   7+7

3. (a) What do you understand by conductivity? Consider the conductivity of a semiconductor, $\sigma = en\mu_n + ep\mu_h$. Will doping always increase the conductivity, where, e is unit electronic charge, n is electron concentration and μ_n (μ_h) is electron (hole) mobility?

(b) What is pyroelectricity? What are its direct and converse effects?   7+7

4. (a) What is meant by dielectric constant? Explain the origin of electronic polarization.

(b) What are paramagnetic materials? Explain the spin paramagnetism with typical electronic configurations. How susceptibility varies with temperature for a paramagnetic material?   7+7

5. (a) Explain the Hall effect with suitable example.

   (b) What is Fermi-Dirac statistics? How the Fermi-Dirac function varies with temperature?   7+7

6. (a) What is a hole in semiconductor? Explain the movement of hole in semiconductors.

   (b) Consider a p-type Si crystal that has been doped uniformly with B with a concentration of $10^{15}\,cm^{-3}$. We wish to convert this to an n-Si with a conductivity $25\,\Omega^{-1}\,cm^{-1}$ within 10 percent. What is the donor concentration we need?   6+8

7. (a) What are degenerate and non-degenerate semiconductors? Explain with suitable energy band diagram.

   (b) Explain the process of getting electronic grade silicon with suitable diagram.   7+7

8. (a) How mirror finished wafer is prepared?

   (b) Explain theory of low-temperature superconductors.   7+7

9. (a) What is a PCB core made of ? What are the techniques used for patterning a PCB?

   (b) Explain the process of creating a via in PCBs.   7+7

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