A Reg. No. : | | | | | | | | | | |

Question Paper Code: 52004

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2018

Second Semester

Electrical and Electronics Engineering

15UPH204 – SOLID STATE PHYSICS

(Common to Biomedical Engineering)

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

PART A - (10 x 1 = 10 Marks)

1. If the mobility of electrons in a metal increases, the resistivity CO1- R

   (a) increases (b) decreases

   (c) remains constant (d) first increases and then decreases

2. In classical free electron theory, electrons constitute electron gas, obeying _____ under the equilibrium condition. CO1 -R

   (a)Maxwell– Boltzmann statistics (b) Bose Einsteins statistics

   (c) Fermi Dirac statistics (d) Zone theory

3. Conductivity of a semiconductor increases with CO2 -R

   (a) increase in temperature (b) decrease in temperature

   (c) constant temperature (d) increase in band gap

4. In terms of Hall coefficient, Hall mobility is given as CO2- R

   (a) $\mu = R_H \sigma$ (b) $\mu = R_{H/} \sigma$ (c) $\mu = R_H \rho$ (d) $\mu = R_H \tau$

5. Water is a _____ substance. CO3 -R

(a) paramagnetic (b) ferromagnetic

(c) diamagnetic (d) anti ferro magnetic

6. The cooper pair is CO3 -R

(a) two electrons moving in the same direction

(b) two electrons with resultant spin zero

(c) two electrons connected through bosons

(d) two electrons connected through a phonon

7. Ionic polarization CO4- R

(a) decreases with increase in temperature

(b) is independent of temperature

(c) increases with temperature

(d) first increases and then decreases with temperature

8. Which of the following is not a ceramic material CO4 -R

(a) Alumina (b) Mica (c) Boron carbide (d) Nitinol

9. The versatility of nanotechnology is due to CO5 R

(a) low density ratio (b) high surface to volume ratio

(c) low surface to volume ratio (d) high density ratio

10. As particle size is reduced to nano gold transforms from CO5 -R

(a) liquid to gas (b) solid to liquid (c) solid to gas (d) liquid to solid

PART – B (5 x 2= 10Marks)

11. State Wiedemann Franz law. CO1 -R

12. Distinguish between elemental and compound semiconductors. CO2- R

13. What are ferrites? Mention any one application of ferrites. CO3- R

14. Mention any two properties of ceramics. CO4- R

15. Why are nanoparticles chemically very active? CO5- R

PART – C (5 x 16= 80Marks)

16. (a) Obtain an expression for electrical conductivity for metals on the basis of classical free electron theory and calculate electrical conductivity of copper if the relaxation time is 2.5×10^{-14} s and electron density is 8.5×10^{28} m^{-3} CO1 -App (16)

Or

(b) (i) Define density of energy states in metals. Calculate carrier concentration in metals by deriving an expression for density of states. CO1 -App (10)

(ii) Obtain an expression for Fermi energy in terms of carrier concentration in metals. (6)

17. (a) (i) What is Hall effect? Obtain the expression for Hall coefficient in terms of current density and electronic charge. CO2 -App (8)

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(ii) Hall coefficient of certain silicon specimen was found to be -7.35×10^{-5} m^3C^{-1}. Determine the nature of the semiconductor, if the conductivity was 200 $\Omega^{-1}m^{-1}$. Calculate the density and mobility of the charge carriers CO2 -App (8)

Or

(b) Distinguish between CO2 -Ana (8)

(i) Direct and indirect bandgap semiconductor

(ii) Intrinsic and extrinsic semiconductors CO2 -Ana (8)

18. (a) (i) Classify ferromagnetic materials based on their spin. CO3 -Ana (8)

(ii) Distinguish between hard and soft magnetic materials. CO3 -Ana (8)

Or

	(b)	Show that superconductors are perfect diamagnet. Differentiate type I and type II superconductor. Why do we prefer Type II superconductors for making permanent magnets?	CO3 -Ana	(16)
19.	(a)	(i) What is meant by internal field in dielectrics? Obtain an expression for internal field experienced by an atom in a cubic structure using Lorentz method.	CO4 -U	(8)
		(ii) Assume ε_r as dielectric constant of the material and α_e as electronic polarisability, deduce Clausius Mosotti relation using the expression obtained above for internal field.	CO4- U	(8)
		Or		
	(b)	(i) Explain electronic polarizability in atoms and obtain an expression for electronic polarizability in terms of radius of the atoms.	CO4 -Ana	(10)
		(ii) Find out the average radius of the atom of an air molecule if the electronic polarisability of the atom in air molecule is 9×10^{-41} Fm^{-2}.	CO4 -Ana	(6)
20.	(a)	(i) Differentiate between top down and bottom up method of nanoparticle synthesis.	CO5- U	(8)
		(ii) Describe CVD method used for the synthesis of nanomaterials	CO5 -U	(8)
		Or		
	(b)	(i) What are nanophase materials? Describe any one method used for the synthesis of nanomaterials.	CO5 -U	(12)
		(ii) Mention the applications of nanomaterials.	CO5 -U	(4)