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

Question Paper Code: 52004

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

Second Semester

Electrical and Electronics Engineering

15UPH204 – SOLID STATE PHYSICS

(Common to EIE and Biomedical Engineering)

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The average velocity acquired by the free electron of a metal in a particular direction during the application of electric field is called CO1- R

   (a) terminal velocity (b) drift velocity (c) escape velocity (d) critical velocity

2. The magnitude of Lorentz number is CO1- R

   (a) 2.44×10^{-8} (b) 2.44×10^{-8} W Ω K

   (c) 2.44×10^{-8} W Ω K^{-2} (d) 2.44×10^{-6} W Ω K^{-2}

3. Silicon is _____valent element. CO2- R

   (a) penta (b) hexa (c) tri (d) tetra

4. P – type semiconductor is formed by adding _____ impurity in a pure germanium crystal. CO2- R

   (a) divalent (b) trivalent (c) tetravalent (d) pentavalent

5. Diamagnetic material possess CO3- R

   (a) no induced dipoles even when external field is applied

   (b) induced dipoles along field direction

   (c) permanent magnetic dipoles

   (d) absence of permanent magnetic dipoles

6. Below transition temperature a super conducting material exhibits CO3- R

(a) zero resistance (b) zero resistance and diamagnetism

(c) zero resistance and paramagnetism (d) zero resistance and ferromagnetism

7. The unit for permittivity of free space is CO4- R

(a) dimensionless (b) H / m (c) m / H (d) tesla

8. The main constituents of ceramics are CO4- R

(a) silicon only (b) non –metallic solids only

(c) silicon - non metallic solids (d) silicon and ferrous alloys

9. In nanomaterials with decrease of size the inter atomic spacing CO5- R

(a) decreases (b) increases

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

10. The following is an example for bottom-up fabrication of nanoparticles CO5- R

(a) sol-gel method (b) ball milling (c) nanolithography (d) photolithography

PART – B (5 x 2= 10 Marks)

11. The electrical conductivity of copper at 300 K is 4.8 X 10^7 / Ω m and free electron density is 8.5 X 10^{28} / m^3. Compute the mean free collision time. (mass of the electron = 9.1 X 10^{-31} kg). CO1- App

12. Differentiate between elemental and compound semiconductors. CO2- Ana

13. The energy product is an important parameter in designing the permanent magnets. Reason out. CO3- Ana

14. Infer the significance of Clausius – Mosotti relation. CO4- R

15. Recognize two properties of nanomaterials. CO5- R

PART – C (5 x 16= 80Marks)

16. (a) (i) Based on the postulates of classical free electron theory, formulate a mathematical expression for electrical conductivity of metals CO1- U (12)

(ii) Recall four de-merits of classical free electron theory CO1- U (4)

Or

(b) (i) With necessary theory, deduce the expression for density of energy states CO1- U (12)

(ii) Using the classical expressions, verify Wiedemann – Franz law CO1- U (4)

17.	(a)	Mathematically show that for an intrinsic semiconductor the Fermi level is located exactly at the mid-point of the energy gap	CO2 U	(16)
		Or		
	(b)	Based on Hall effect, show that the Hall coefficient is positive for a P-type semiconductor. Also prove that the Hall coefficient is negative for N-type semiconductor.	CO2 U	(16)
18.	(a)	(i) Distinguish between para and ferromagnetic materials.	CO3- Ana	(8)
		(ii) Compare and contrast the hard and soft magnetic materials.	CO3- Ana	(8)
		Or		
	(b)	(i) Distinguish between Type – I & II superconductors.	CO3- Ana	(8)
		(ii) Explain any four properties of super conductors.	CO3- Ana	(8)
19.	(a)	(i) Compute the internal field for a cubic crystalline structure	CO4- U	(10)
		(ii) Abstract the frequency and temperature dependence of polarization	CO4- U	(6)
		Or		
	(b)	(i) Classify the three types of ceramic materials.	CO4- U	(8)
		(ii) Explain the manufacturing of a ceramic material by slip casting method.	CO4- U	(8)
20.	(a)	Explain the fabrication of nanoparticles by physical and chemical vapor deposition techniques.	CO5- U	(16)
		Or		
	(b)	(i) Illustrate the synthesis of nanomaterials by ball milling technique	CO5- U	(10)
		(ii) List six applications of nanomaterials.	CO5- U	(6)

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