2017/ODD/08/21/PHY–303/083

PG Odd Semester (CBCS) Exam., December—2017

PHYSICS

(3rd Semester)

Course No. : PHYCC–303

(Solid State Physics)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **five** question, selecting **one** from each Unit

UNIT—I

1. *(a)* What is crystal lattice? How does it differ from crystal? What are the seven crystal lattice types? 2+6=8

(b) Derive Bragg's equation by using Von Laue treatment. 6

2. *(a)* How will you determine lattice parameter by using powder diffraction method? 8

(b) Write short notes on *(i)* atomic scattering factor and *(ii)* reciprocal lattice. 3+3=6

UNIT—II

3. *(a)* What are different types of bonding in solids? Explain them briefly. 7

(b) Derive the expression for Madelung constant of a simple cubic ionic crystal. 7

4. *(a)* Derive van der Waals-London interaction for two identical inert gas atoms. 6

(b) Write short notes on any *two* of the following : 4×2=8

(i) Dispersion relation

(ii) Hybridization

(iii) Quantization of lattice vibration

UNIT—III

5. *(a)* Discuss the failure of free-electron theory of Drude-Lorentz model with reference to calculated values of electronic specific heat and Lorentz number. 3+3=6

(b) Using Sommerfeld model for one-dimensional case, show that $E_0 \quad \frac{1}{3} NE_F$. 8

6. *(a)* What is Fermi energy? Discuss the Fermi-Dirac distribution function at various temperatures. 1+3=4 *(b)* Write short notes on any *two* of the following : 5×2=10

(i) Bloch theorem

(ii) Brillouin zones

(iii) Effective mass

UNIT—IV

7. *(a)* Find an expression for density of electrons in the conduction band for an intrinsic semiconductor. What are assumptions made regarding E_c and E_v? 6

(b) Show that for an intrinsic semiconductor, the Fermi energy should be situated at the middle of the forbidden band. 4

(c) Discuss *I-V* characteristic of *P-N* junction with reference to forward bias, reverse bias and breakdown of *P-N* junction. 4

8. *(a)* Discuss how you will determine the types of a semiconductor in the Hall-effect experiment. Even though the magnetic field across the sample is made zero, sometimes voltage is seen to be developed across the voltmeter. Explain. 4+2=6

(b) Write short notes on any *two* of the following : 4×2=8

(i) Extrinsic semiconductor

(ii) Fermi level

(iii) Rectifier equation

UNIT—V

9. *(a)* What is superconductor? What are type–I and type–II superconductors? What is the isotopic effect of superconductor? 1+3+3+2=9

(b) Explain Meissner effect on the basis of London equation. 5

10. *(a)* Describe qualitative idea of BCS theory of superconductivity. 6

(b) Write short notes on any *two* of the following : 4×2=8

(i) DC Josephson effect

(ii) Flux quantization in superconducting ring

(iii) Energy gap in superconductors

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