M.Sc.-I/Physics-103C/18

M.Sc. 1st Semester Examination, 2018

PHYSICS

Course Title : Solid State Physics-I & Electronics-I

Paper : PHYS103C

Course ID : 12453

Time: 2 Hours **Full Marks: 40**

The figures in the right hand side margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Unit – I

1. Answer *any three* questions: 2×3=6

(a) Obtain the Miller indices of a plane which intercepts at a, $b/2$, $3c$ in a simple cubic unit cell. Draw a heat diagram showing the plane. 2

(b) Copper has fcc structure and its atomic radius is 0.1278 cm. Calculate the density. Take the atomic weight of copper as 63.5. 2

(c) What is exchange field in ferromagnetic material? Write down Curie-Weiss law and graphically plot it. 2

(d) Draw the Acoustical branch and optical branch within 1st Brillouin Zone for a lattice with two different kind of atoms. 2

(e) What is Phonon? Show that number of Phonons in a solid is not conserved. 2

2. Answer *any two* questions: 4×2=8

(a) Discuss Langevin's classical theory for a diamagnetic substance and hence deduce the diamagnetic susceptibility under spherically symmetric charge distribution. 2+2=4

(b) Show that the dissociation energy of a NaCl molecule is 4.5 eV. 4

(c) Calculate packing factor of Dimond cubic structure. Compare the packing factor of Dimond structure and FCC structure. 4

(d) Derive the dispersion relation for the lattice vibration of monoatomic structure under harmonic approximation. 4

3. Answer *any one* question: 6×1=6

(a) (i) Why does simple grating can not be used for X-ray diffraction?

(ii) Derive Lave equations. Hence find Bragg's law for crystal diffraction. 2+4=6

(b) Considering the quantization of magnetic moments for a paramagnetic substace

(i) Derive the expression of the net magnetization along the direction of the applied field;

(ii) Derive the expression for the effective Bohr magnetor under normal magnetic flux and ordinary temperature. 3+3=6

Unit – II

1. Answer *any three* of the following: 2×3=6

(a) Why fourth quadrant in I – V characteristics used for operation of a solar cell? 2

(b) State the law of mass action. 2

(c) Write down the equation for temperature dependence on carrier concentrations. 2

(d) Prove the Einstein relation for either carrier type at equilibrium. 2

(e) What are the advantages of active filters over passive filters? 2

2. Answer *any two* questions: 4×2=8

(a) State the Nyquist criterion for stability. Prove that the Nyquist plot is a circle. 4

(b) Sketch the idealized characteristics for the following filter types:

(i) Low pass

(ii) High pass

(iii) Band pass

(iv) Band-rejection 4

(c) Set up a 4-bit counter type ADC and discuss the performance of it. 4

(d) For a certain D-MOSFET, I_{DSS} = 10 mA, and $V_{GS(off)}$ = –8V

(i) Is this an *n*-channel or a *p*-channel?

(ii) Calculate, I_D at V_{GS} = –3V

(iii) Calculate, I_D at V_{GS} = +3V 1+1½+1½=4

3. Answer *any one* of the following: 6×1=6

(a) Describe the five steps involved in fabricating a monolithic IC, assuming you already have a substrate (must give figure for each step). 6

(b) Describe epitaxial growth and photo etching processes. Write the four advantages of ICs. 6

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