

TM142450C

Reg. No: .....

Name: .....

**M. Sc. DEGREE (C.S.S.) EXAMINATION, APRIL 2017**  
**Supplementary (2014 Admission)**  
**SEMESTER II – PHYSICS**  
**PHY2CMP – CONDENSED MATTER PHYSICS**

**Time: Three Hours**

**Maximum Weight: 30**

**PART A**

**I Answer any six questions. Each question carries a weight of 1**

1. Plot the first three Brillouin zones for a 2D square lattice.
2. What are degenerate and non degenerate states?
3. What is the temperature dependence of mobility of charge carries in a semiconductor?
4. Distinguish between Peltier and Seebeck effects
5. Define reciprocal lattice
6. Write down the dispersion relation for phonons in a diatomic crystal
7. Write a short note on thermal conductivity of solids
8. How do you classify ferromagnetic materials
9. Explain the domain structure in ferromagnetic materials
10. Discuss the which distinguish a nanomaterial from its bulk counterpart

**(6x1=6)**

**PART B**

**II Answer any four questions. Each question carries a weight of 2**

11. Calculate the glancing angle on the plane (100) of a cube of rock salt with  $a=2.81 \text{ \AA}$ , corresponding to second order diffraction maximum for the x-rays of wavelength  $0.71 \text{ \AA}$ .
12. The Fermi energy of copper is 7 eV. Calculate the Fermi momentum, De Broglie wavelength and Fermi velocity of an electron in copper
13. A copper wire of cross sectional area  $5 \times 10^{-2} \text{ cm}^2$  carries a current of 50 A. Assuming one electron per atom calculate the density of free electrons and the drift velocity
14. The Debye temperature of diamond is 2000K. Calculate the mean velocity of sound in diamond given the density and atomic mass of diamond as  $3500 \text{ Kg m}^{-3}$  and 12 amu respectively. If the interatomic spacing is  $1.54 \text{ \AA}$ , estimate the frequency of the dominant mode of lattice vibration
15. Discuss the flux quantization of a super conducting ring
16. Derive the expression for density of states in a quantum well

**(4x2=8)**

## PART C

### III Answer all questions. Each question carries a weight of 4

17. (a) Describe the x-ray diffraction experiment and derive an equation for the diffraction intensity

OR

(b) On the basis of free electron theory, derive an expression for electrical and thermal conductivity of metals and hence establish the Wiedemann Franz law

18. (a) How does the zone theory explain the conducting and insulating behavior of metals? Discuss the problem of electron moving in a periodic potential and explain the formation energy band gap.

OR

(b) Prove the Bloch theorem and explain the reduced zone scheme. Explain the significance of effective mass of electron

19. (a) Describe the phonon dispersion relation in a two-atom basis. Differentiate between optical and acoustical branches

OR

(b) Discuss the Einstein's model of specific heat. Also discuss the successes and failures of this model

20. (a) Discuss the Curie law for paramagnetism. How can you explain the susceptibility of iron group of ions on the basis of this model?

OR

(b) What is Josephson tunneling? Discuss the d.c. Josephson effect in a superconductor

**(4x4=16)**