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Name.................................

Reg. No.............................

THIRD SEMESTER M.A./M.Sc./M.Com. DEGREE (REGULAR) EXAMINATION NOVEMBER 2020

(CBCSS)

Physics

PHY 3C 11—SOLID STATE PHYSICS

(2019 Syllabus Year)

Time : Three Hours

Maximum : 30 Weightage

General Instructions

1. *In cases where choices are provided, students can attend all questions in each Section/Part.*
2. *The minimum number of questions to be attended from the Section/Part shall remain same.*
3. *There will be an overall ceiling for each Section/Part that is equivalent to maximum weightage of the Section/Part.*

Section A

Eight *Short questions answerable within 7½ minutes.*
Answer all questions, each carry weightage 1.

1. Explain the concept of Miller Indices and mention important features of Miller Indices.

2. Discuss the crystal structure of NaCl.

3. What are the basic assumptions on which the Debye theory is based ?

4. What are the limitations of free electron model in explaining Hall coefficient of metals ?

5. Distinguish between direct and indirect bandgap semiconductors. Give examples.

6. Briefly explain the concept of magnons in ferromagnetic materials.

7. What is superconductivity ? Discuss the type I and type II superconductors.

8. What is isotopic effect in superconductivity ?

(8 × 1 = 8 weightage)

Section B

Four *essay questions answerable within 30 minutes.*
Answer any two questions, each carry weightage 5.

9. Discuss the vibrations of a linear diatomic lattice. Obtain the dispersion relation and differentiate between the optical and acoustical branches.

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10. Explain how bands are formed in solids. Discuss the essential features of the behavior of elec in a periodic potential using Kroning-Penny model.

11. Discuss Landau theory of ferroelectric phase transitions.

12. Discuss DC and AC Josephson effect and explain their importance.

$(2 \times 5 = 10$ weigh

Section C

Seven *problems answerable within 15 minutes.*

Answer any **four** *questions, each carry weightage 3.*

13. Find the inter-planar spacing for (321) plane in a simple cubic lattice with lattice con 4.2×10^{-8} cm.

14. Compute the cut-off frequency for a linear monoatomic lattice of interatomic distance 3×10^{-1} if the velocity of sound is 3×10^3 m/s.

15. Calculate the Fermi energy at absolute zero of sodium metal if its atomic radius 1.86 Å.

16. A solid dielectric has electronic polarizability of 10^{-40} Fm^2. If the internal electric field be a Lor field. Find the dielectric constant of the material [Given density $= 3 \times 10^{28}$ atoms/m^3.]

17. Copper has an FCC structure and the atomic radius is 0.1278 nm. Calculate the inter pl spacing for (111)-planes.

18. Find the order of magnitude of the exchange integral of a ferromagnet having curie tempera 727° C. What is the internal field ? [Given $\mu_B = 9.3 \times 10^{-21}$ ergs/gauss].

19. For a superconductor the critical field at 0 K is 6.39×10^4 A/m and the critical temperature for magenetic field is 7.18 K. What is the critical field for the material at 4 K ?

$(4 \times 3 = 12$ weight