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Reg. No.....

THIRD SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2021

(CBCSS)

Physics

PHY 3C 11—SOLID STATE PHYSICS

(2019 Admission onwards)

Time : Three Hours Maximum : 30 Weightage

General Instructions

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

Section A

8 Short questions answerable within 7.5 minutes.
Answer **all** *questions, each question carries weightage* 1.

1. What are symmetry operations ? Name the symmetry elements of a crystal.
2. What are the different types of bonding in the crystal and mention its characteristics ?
3. The one-dimensional monoatomic lattice acts as a low-pass filter. Explain.
4. What is Wiedemann -Franz law ?
5. What is Hall effect ? Give the expression for Hall co-efficient as predicted by free electron theory.
6. Explain the origin of the diamagnetism.
7. Distinguish between pyroelectric and piezoelectric materials.
8. What is the importance of high temperature superconductors ? Give one example with transition temperature.

(8 × 1 = 8 weightage)

Turn over

Section B

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

9. What are the short comings of Einstein's theory of lattice specific heat ? Explain Debeye's theory lattice specific heat.

10. Discuss with necessary theory the Kronig-Penny model and show how energy bands are formed solids.

11. Distinguish between ferromagnetism and anti-ferromagnetisms. Describe the Neel model of ferromagnetism.

12. Explain Meisner effect. Describe London equations and discuss how do they help in explaining superconducting state.

(2 × 5 = 10 weightage)

Section C

7 problems answerable within 15 *minutes.*
(Answer any **four** *questions, each carry weightage* 3.

13. Silicon crystallizes in the diamond cubic structure. The radius of silicon atom is 0.1176 nm atomic weight and density of silicon are 28.09 and 2.3×10^3 kg/m^3. Give me the number of present in a unit cell.

14. If Einstein's temperature of a material is 157 K, find the value of C_v for the material at 3 cal/mol/K using Einstein's formula. Also calculate Einstein's frequency.

15. Find the relaxation time and mean free path of conduction electron in copper. For copper of the free electron 8.5×10^{28}/m^3, resistivity 1.69×10^{-8} ohm-m and average velocity of 1.154×10^5 m/s.

16. Helium gas contains 2.7×10^{25} atoms/m^3 and dielectric constant of He atom NTD is 1.0 Calculate the electric polarizability of He atom.

17. A paramagnetic material has 1028 atoms/m^3 . Its susceptibility at 350 K is 2.8×10^{-4} susceptibility at 300 K.

18. A superconducting tin has a critical temperature of 3.7 K at zero magnetic field and a of 0.0306 T at 0K. What is the critical field at 2K ?

19. A beam of X-rays of wavelength 0.842Å is incident on a crystal at a glancing angle of the first order Bragg reflection occurs. Calculate the glancing angle of the third order

(4 × 3 = 12