

UG 5th Semester Examination 2021

PHYSICS (Honours)

Paper Code : DC-12

Quantum Mechanics and Applications

[CBCS]

Full Marks : 25

Time : Two Hours

The figures in the margin indicate full marks.

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

1. Answer any **five** of the following questions. 5×2=10
- (a) Write down two important characteristics of the ferrites. Define Neel temperature for them.
- (b) Assuming that the potential energy of two particles in the field of each other is given by
- $$U(r) = -\frac{A}{r} + \frac{B}{r^9}$$
- where A and B are constants. Show that for stable configuration, the energy of attraction is 9 times the energy of repulsion.
- (c) What is the importance of a reciprocal lattice over a direct lattice in connection with the crystal structure analysis?
- (d) Explain why some metals have positive Hall constant (R_H).
- (e) For aluminium, the Debye temperature θ_D is 400K. Show that its molar specific heat (C_V) at constant volume at a temperature of 40K is 0.467 cal. Take $R = 2.0 \text{ cal mole}^{-1}$.
- (f) What are the main characteristics of a Type I superconductor?
- (g) If the lattice parameter for a fcc crystal is 2.14 *Angstrom*, find the atomic radius.
2. Answer any **three** of the following questions. 3×5=15
- (a) Deduce Clausius-Mosotti relation for an isotropic polarized dielectric. 5
- (b) (i) The molecular weight of rock salt (a SC crystal) is 58.5. Its density is $2.16 \times 10^3 \text{ kg m}^{-3}$. Taking Avogadro number = 6.02×10^{26} per kilo-mole, calculate the grating space d_{100} of rock salt.
- (ii) The second order diffraction of X-rays by the above rock salt takes place for a glancing angle of 26° . Calculate the wavelength of the X-rays used. 4+1

(c) Find the magnetizing force of a magnetic material having a magnetization 3380 A m^{-1} and flux density (B) $0.0048 \text{ Wb. m}^{-2}$. Hence show that the relative permeability of the material is 8.68.

3+2

(d) Derive an expression for the density of electrons in conduction band of an intrinsic semiconductor. What is the corresponding value of hole density in the valence band at 0 K ?

4+1

(e) (i) Write down Curie's law for magnetic susceptibility of a paramagnetic gas. What is the modified form of the law for solids and liquids? Why does this modification arise?

(ii) Distinguish between ferromagnetism and anti-ferromagnetism.

(1+1+1)+2