M. Sc. Physics Examination, 2022

(2nd Year, 2nd Semester)

Condensed Matter Physics (II)

Paper – 407

Time : Two hours Full Marks : 40

Use separate answer script for each group.

Group – A

Answer ***any two*** questions.

1. a) Distinguish between Frenkel defects and Schottky defects. How does an Alkali halide crystal show colour if it has vacancy defect?

   b) If E_f is the average energy to create a Frenkel defect find out the number of Frenkel defects in a KCL crystal, when the total number of sites per unit volume is N. 5+5

2. a) What is Exciton? Discuss about its properties.

   b) Find out the energy and momentum of exciton inside a material whose dielectric constant is ε.

   c) Explain how exciton has been detected from experiment. 3+5+2

3. a) Distinguish between the properties of a solid crystal and liquid crystal.

b) What do you mean by the "order parameter" (OP)? Show that the OP for liquid crystal is in-between zero and one.

c) Describe the magnetic properties of a liquid crystal. 3+5+2

Group – B

Answer ***any two*** questions.

1. i) What is the upper critical field of a superconductor?

   ii) Explain the idea of flux quantization in a superconducting ring.

   iii) Using Josephson current explain the superconducting quantum interference in a network made of two Superconductor-Insulator-Superconductor (SIS) junctions. 2+5+3

2. i) Derive the Ginsburg-Landau equations associated with the phase transition of a superconductor in terms of the flux quanta, London penetration depth and coherence length.

   ii) What is the isotope effect in a superconductor? Using the Feynmann diagram explain the idea of electron-phonon coupling necessary for the formation of Cooper pairs. What is the possible BCS spin wave function suitable for a low-T_c superconductor. 5+2+2+1

3. What is the exchange integral in one dimensional ferromagnetic spin chain? How do you explain the existence of the spin wave related to the similar spin arrangement? Draw necessary diagram. Derive an equation for the angular frequency as a function of wave vector of magnon quasiparticle associated with the one dimensional ferromagnetic spin chain. 1+2+7