QJ-5331

M. Sc. (Sem.- III) Examination, December-2023

PHYSICS

Paper – 3.3

PHY-303 : Solid State Theory

Time allowed : Three Hours

Maximum Marks : 70
Min. Pass Marks : 28

Note : This question paper contains three sections as under :

Section-A ***Max. Marks-10***

This section shall have 01 compulsory question comprising 10 questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark and total marks of this section will be 10. This section will be compulsory in the paper.

Section-B ***Max. Marks-25***

This section will carry 25 marks with equally divided in to five long answer type questions (answer about in 250 words) and examiners are advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.

Section-C ***Max. Marks-35***

Will carry 35 marks with five long answer type questions comprising one compulsory question (question no. 7) of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions.

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SECTION - A

1 Answer the following questions : 10

(i) What is Bravais Lattice ?

(ii) Define Structurer Vector.

(iii) Define Origin of Bandgap.

(iv) Define Meissner effect.

(v) What is the isotope effect ?

(vi) Define the K.P. method.

(vii) Discuss the various classification of types of superconductors.

(viii) What do you mean by Augmented Plane Wave ?

(ix) Explain the meaning of various stress components.

(x) What is multi-tin potential ?

SECTION - B

UNIT - I

2 Show that the number of orbitals in any energy band is 2N, where N is the number of Primitive cells in the Specimen. 5

OR

3 Define the density of states and obtain the expression for the density of free electron states. 5

UNIT - II

4 Show that for a cubic isotropic substance, there are only two moduli of elasticity. 5

OR

5 What do you mean by Elastic waves ? Discuss the propagation of elastic waves in [110] direction for a cubic crystal and determine the velocity for longitudinal and transverse components of the wave. 5

UNIT - III

6 What do you mean by DC and AC Josephson tunneling ? Discuss your answer by considering as insulator sandwiched between two different bandgap superconductors – obtain the expression current density. 5

OR

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7 The Meissner effect does not account for the flux penetration observed in thin films. How do London's equations account for it ? Hence, find out the expression for London penetration depth in such a case.

5

UNIT - IV

8 Vacant orbitals in a band are commonly called holes. A hole acts in applied electric and magnetic fields as if it has a positive charge +e. Give the reasons.

5

OR

9 Obtain the expression for the carrier concentration, concentration in semiconductors and calculate the impurity conductivity *n* case of *n*-type and *p*-type semiconductors.

5

UNIT- V

10 Write a short note on "Molecular Dynamics Simulation".

5

OR

11 Discuss the theory of Linear combination of atomic orbitals and obtain the necessary expressions for the energy eigen values.

5

SECTION - C

12 (a) Discuss effective mass in semiconductors and obtain the expression for it.

4

(b) Discuss Kronig-Penny Model.

6

(c) What are Vaccum gauges ? Discuss the working of hot cathode gauges for measurement of low vaccum.

5

13 Find an Expression of the London equation in superconductivity and define penetration depth.

10

14 What is the recombination mechanism ? Discuss the Schokely-Read theory.

10

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15 (a) Write a note on Photoconductivity. 5

(b) Write a note on Hartee Fock's theory. 5

16 (a) Write a note on "BCS theory of Superconductivity". 5

(b) Write a note on "Bloch Functions". 5

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