Total No. of Printed Pages: 3

**SUBJECT CODE NO:- B-2034**
**FACULTY OF SCIENCE & TECHNOLOGY**
**B.Sc. S.Y. (Sem-IV)**
**Examination November/December- 2022**
**Physics Paper- XII**
**Solid State Physics**

[Time: 1:30 Hours]                                                                 [Max. Marks:50]

Please check whether you have got the right question paper.

N.B                    1. Attempt all questions.
                       2. Use of logarithmic table and electronic pocket calculator is allowed.

Q.1    a) Explain symmetry operations. Explain rotational symmetry and why crystal cannot have      10
          fivefold symmetry.

       b) Explain in detail Vander Waal's bond and hydrogen bond with suitable examples.             10

**OR**

       a) Derive the expression for density of modes in three dimension.                             10

       b) What is electrical conductivity? Derive an expression for electrical conductivity.         10

Q.2    a) What are Miller indices? How they are determined?                                          05

       b) Lead has a face centre cubic structure with an atomic radius of 1.746 Å. Find the spacing  05
          of (2 2 0) plane

       c) What are the merits and demerits of Einstein's Theory of specific heat capacity?           05

       d) The Einstein temperature of carbon (diamond structure) is 1850k. Calculate highest lattice 05
          frequency involved in a Debye theory. ($K_B = 1.38 \times 10^{-23}$ J/k, h $= 6.63 \times 10^{-34}$ JS)

**OR**

       a) Calculate the value of Madelung constant for one dimensional linear chain of NaCl          05

       b) Calculate the band length $\varepsilon_0$ for a stable configuration of two atoms having m=3 and n=10.   05

       c) Explain the importance of Hall Effect.                                                     05

       d) The Hall coefficient of a certain silicon specimen was found to be $-7.35 \times 10^{-5} m^3 c^{-1}$    05
          from $100^0$k to $400^0$k. Determine the density of the sample.

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Q.3   Attempt all                                                                                                      10

1)   Atomic radius of simple cubic (SC) cell is

a)   $\frac{a}{2}$                     b)   $\frac{a\sqrt{3}}{4}$                     c)   $\frac{a}{2\sqrt{2}}$                     d)   $\frac{a\sqrt{3}}{8}$

2)   A two dimensional square lattice has -------- rotational symmetry.

a)   2-fold                b)   4-fold                c)   0-fold                d)   5-fold

3)   In a crystal, the miller indices of a given plane is 3:2:1. What are the intercepts?

a)   1a, 2b, 3c          b)   2a, 1b, 3c          c)   2a, 3b, 6c          d)   3a, 2b, 1c

4)   Vander Waal's bonds are ------------

a)   very weak bond                          b)   Very strong bond

c)   very very strong bond                   d)   Does not exists

5)   The first Brillouin zone extended from

a)   $\frac{-4\pi}{a}$ to $\frac{4\pi}{a}$                          b)   $\frac{-2\pi}{a}$ to $\frac{3\pi}{a}$

c)   $\frac{-3\pi}{a}$ to $\frac{3\pi}{a}$                          d)   $\frac{-\pi}{a}$ to $\frac{\pi}{a}$

6)   At very low temperature specific heat varies as, -----------

a)   $\frac{1}{T}$                     b)   $\frac{1}{T^3}$                     c)   $T^3$                     d)   T

7)   If the Debye's temperature of metal is 450k, the Debye's frequency is

a)   $10^{13}$ Hz          b)   $10^2$ Hz          c)   $10^{23}$ Hz          d)   10 Hz

8)   If Y is the young's modulus and ९ be the density of string, then the velocity of wave along
     the string is ---------

a)   $V_s = \frac{९}{y}$                     b)   $V_s = \frac{y}{९}$                     c)   $V_s = \sqrt{y/९}$          d)   $V_s = \sqrt{९/y}$

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9) If Hall coefficient is positive, then the material is called

    a) Insulator                     b) P-type semiconductor

    c) n-type semiconductor         d) conductors

10) The electrical conductivity $\sigma$ =----------

    a) $\dfrac{ne^2\lambda v}{2K_B T}$                   b) $\dfrac{ne^2\lambda v}{4K_B T}$

    c) $\dfrac{ne^2\lambda v}{6K_B T}$                   d) $\dfrac{ne^2\lambda v}{8K_B T}$

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