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SUBJECT CODE NO:- 2034
FACULTY OF SCIENCE AND TECHNOLOGY
B.Sc. S.Y (Sem-IV)
Examination March/April-2022 (To Be Held In June/July-2022)
Physics Paper- XII
Solid State Physics

[Time: 01:53 Hours]

[Max. Marks: 50]

- N.B Please check whether you have got the right question paper.
- 1) Attempt all questions.
 2) Use of logarithmic table and electronic pocket calculator is allowed.
- Q.1 a) What are Miller indices? Write the procedure for finding Miller indices \bar{U} a given plane with example. 10
 b) Explain in detail the formation of covalent bond and metallic bond. Give properties of each. 10
- OR
- a) Using Einstein model, derive the expression for the specific heat of a solid. 10
 b) State Hall Effect. Derive an expression for Hall Coefficient. 10
- Q.2 a) Obtain an expression for interplanar spacing in cubic crystal. 05
 b) In a tetragonal lattice $a=b=0.25\text{nm}$ and $c=0.18\text{nm}$. Deduce the lattice spacing between (111) planes. 05
 c) What are the assumptions of Debye theory of lattice heat capacity in solids? 05
 d) Debye temperature of an unknown solid is 1500 K. Compute the highest vibrational frequency of the solid at 30K. 05
- OR
- a) Define cohesive energy and determine its value for crystals of inert gases. 05
 b) If the potential energy functions is expressed as $U(r) = \frac{-\alpha}{r^6} + \frac{\beta}{r^{12}}$ Show that the intermolecular distance r_0 for which the potential energy is minimum is given by $\left(\frac{2\beta}{\alpha}\right)^{1/6}$ 05
 c) Write short note on thermal conductivity. 05
 d) Find the Fermi energy in copper on the assumption that each copper atom contributed one free electron to the electron gas. The density of copper is $8.94 \times 10^3 \text{ kg/m}^3$ and its atomic mass is 63.5μ . 05
- Q.3 Attempt all questions. 10
- 1) In tetragonal crystal system the angle
 a) $\alpha = 90 \neq \beta \neq \gamma$ b) $\beta = 90 \neq \alpha \neq \gamma$
 c) $\alpha = \beta = \gamma = 90$ d) $\alpha = \beta = \gamma \neq 90^\circ$

- 2) Crystal structure of material is
- A combination of points and space
 - A combination of lattice and a motif
 - Dependent on motif
 - Determined by arrangement of points in space.
- 3) A primitive unit cell
- Always has one formula unit
 - Has at least one formula unit but never more than two
 - Has at least one formula unit
 - Always has more than two formula units
- 4) Metallic bonding has following attributes
- Electrons are delocalized
 - Bonds are non-directional in nature
 - Free electrons from clouds
 - All above
- 5) The bond energy magnitudes in ascending order can be expressed as
- Vander waals \rightarrow Hydrogen bond \rightarrow Metallic bond \rightarrow Ionic bond
 - Hydrogen bond \rightarrow Vander waals \rightarrow Metallic bond \rightarrow Ionic bond
 - Vander waals bond \rightarrow Hydrogen bond \rightarrow Ionic bond \rightarrow Metallic bond
 - Hydrogen bond \rightarrow Vander waals bond \rightarrow Ionic bond \rightarrow Metallic bond
- 6) The expression $C_V = 3R$ represents
- Debye's law
 - Dulong and petit's law
 - Planck's law
 - Wien's law
- 7) Which of the following is Debye temperature?
- $\Theta_D = \frac{\hbar w_D}{K_B}$
 - $\frac{\hbar^2 w_D}{K_B}$
 - $\frac{\hbar w_D}{K_B}$
 - $\frac{\hbar w_D^2}{K_B}$
- 8) At low temperature, C_V of solid is proportional to
- T^2
 - T^3
 - T^6
 - $T^{1/2}$
- 9) Wideman and Franz ratio is $\frac{\kappa}{\sigma} =$
- $3 \left(\frac{K_B}{e}\right)^2 T$
 - $2 \left(\frac{K_B}{e}\right)^2 T$
 - $4 \left(\frac{K_B}{e}\right)^2 T$
 - $\left(\frac{K_B}{e}\right) T$
- 10) The Hall coefficient R_H is
- $R_H = ne$
 - $R_H = n + e$
 - $R_H = 1/ne$
 - $R_H = ne/2$