NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH, APPLIED SCIENCES AND NATURAL RESOURCES

DEPARTMENT OF NATURAL AND APPLIED SCIENCES

QUALIFICATION : BACHELOR OF SCIENCE	
QUALIFICATION CODE: 07BOSC	**LEVEL:** 7
COURSE CODE: SSP701S	**COURSE NAME:** SOLID STATE PHYSICS
SESSION: JULY 2022	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

SUPPLEMENTARY/SECOND OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	Prof Dipti R. Sahu
MODERATOR:	Dr Zivayi Chiguvare

INSTRUCTIONS
1. Answer all five questions. 2. Write clearly and neatly. 3. Number the answers clearly.

PERMISSIBLE MATERIALS

Non-programmable Calculators

THIS QUESTION PAPER CONSISTS OF 3 PAGES (Including this front page)

Question 1 **[20]**

1.1 Distinguish the Lattice energy and cohesive energy. (4)

1.2 In a crystal whose primitives are 0.12nm, 0.18nm and 0.2 nm, a plane (231)' has an intercept of 0.12 nm on the x-axis. Find the intercept on the y and z axes. (6)

1. 3 (a) Calculate the next neighbour's distance in a body centred cubic crystal (5)

(b) In a body centred cubic lattice, find the ratio of the nearest neighbour's distance to the next neighbour's distance. (5)

Question 2 **[20]**

2.1 How are dispersion bonds formed in a molecular solid? (4)

2.2 How do you identify Ionics, covalent and metallic bonds in solids (6)

2.3 Draw and explain energy vs interatomic distance curve. Compare it with force vs interatomic distance graphs (10)

Question 3 **[20]**

3.1 What causes phonons in lattice vibration? Which crystals exhibit optical phonon modes? (4)

3.2 If the velocity of sound in a solid is of the order 10^3 m/s, compare the frequency of the sound wave with $\lambda = 20$ Å for (i) a monoatomic system and (ii) acoustic waves and optical waves in a diatomic system containing two identical atoms (M=m) per unit cell of interatomic spacing 2.2 Å. (6)

3.3 What is lattice specific heat? Drive heat capacity of solid crystalline substances at room temperature is 3 R. (10)

Question 4 **[20]**

4.1 Explain the terms: a) Drift velocity b) Relaxation time c) Mean free path d) Mean collision time for free electrons. (4)

4.2 The density and atomic weight of Cu are 8900 $kg.m^{-3}$ and 63.5. The relaxation time of electrons in Cu at 300K is 10^{-14}s. Calculate the electrical conductivity of copper. (6)

4.3 Derive Ohm's law based on Drude's Free Electron Theory? (10)

Question 5 **[20]**

5.1 On the basis of band structure how solids are classified? (4)

5.2 The Hall coefficient of certain silicon specimen was found to be -7.35×10^{-5} m^3 C^{-1} from 100 to 400 K. Determine the nature of the semiconductor. If the conductivity was found to be 200 $^{-1}$ m^{-1}. Calculate the density and mobility of the charge carrier. (6)

5.3 What is an energy band? Why does the Fermi level in an intrinsic semiconductor lie in the middle of the energy gap? (10)

Given fundamental constants

Speed of light = $3x10^8$m/s
Planck constant = $6.626 x10^{-34}$ Js
Mass of electron= 9.1×10^{-31} kg
Charge of electron = 1.6×10^{-19} C
Avogadro's number= 6.022×10^{23}/mole
Boltzmann Constant =1.38×10^{-23} JK^{-1}

----------**END**----------