DEPARTMENT OF PURE AND APPLIED SCIENCE

OCTOBER/NOVEMBER 2019 EXAMINATIONS

COURSE CODE: **PHY 307**
COURSE TITLE: **SOLID STATE PHYSICS I**
CREDIT UNIT: **2**
TIME ALLOWED: **(2 HRS)**

INSTRUCTION: *Answer question 1 and any other three questions*

QUESTION 1

a. Briefly explain transition temperature   (3mks)
b. Differentiate between type I and type II superconductors   (4mks)
c. Explain the term semiconductor   (3mks)
d. Briefly explain the concept of electrodynamics   (3mks)
e. Solid Argon(Ar) has an Fcc structure with cubic lattice constant a = 5.26A atomic mass $M_{AR}=6.67 \times 10^{-26}$kg and a Debye temperature $\theta_D=92^{o}$K

 (i) Estimate the phonon velocity using the young modulus of Ar,$C_{11}=1.6 \times 10^{9}$N/m^2 (4mks)

 (ii)Using the expression k=1/3Cvl in which C is the phonon heat capacity per unit volume. Find the

  thermal conductivity, k(in $jm^{-1}s^{-1}k^{-1}$) of a 1mm^3 crystal of Ar at 1°k assuming the phonon
  scattering occurs only at the boundaries of the sample   (4mks)

f. State mathematically the Schrodinger's equation in three dimensions. What is the implication of the equation to the energy of atoms.   (4mks)

QUESTION 2

a Briefly explain the free electron model   (4mks)

b(i) What is Fermi distribution function f(E)   (2mks)

b(ii) If f(E) = 1, E<E_f and f(E) = 0 when E>E_f at T=0°k Explain   (2mks)

c (i) Briefly explain the Mathieson rule   (4mks)

c (ii)Distinguish between metals and insulators in terms of electric field, valence electrons and

  energy bands.   (3mks)

QUESTION 3

a. Briefly explain the term Miller indices.   (5mks)

b. If the x, y, z intercepts are 2, 1 and 3 respectively, calculate the Miller indices showing the necessary steps   (5mks)

c. State five general principles of Miller indices   (5mks)

QUESTION 4

a. What are simple lattices?   (4mks)

b. State 5 elementary properties of simple lattices   (5mks)

c. Calculate the resistance of a wire when a current of 2 amps passes through a wire of potential difference 10 V. If the resistivity is 5ohm -meter. What is the conductivity?   (6mks)

QUESTION 5

a. Differentiate between 1st and 2nd Brillouin zones.   (4mks)

b. How do we go from Fermi surfaces for free electrons to Fermi surfaces in the presence of a weak crystal potential   (5mks)

c. Point out how Fermi surfaces are represented in alkali, Noble, cubic divalent metals, trivalent metals   (6mks)