NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PURE AND APPLIED SCIENCES
2020_1 SEMESTER EXAMINATION

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) Define crystal? (4marks)
(b) What are Miller's indices? (4marks)
(c) What is the meaning of cohesive energy of crystal? (3.5marks)
(d) State Pauli's exclusion principle. (3.5marks)
(e) What is superconductivity? (3.5 marks)
(f) Define critical current. (3.5 marks)
(g) How many atoms per unit cell are there in the FCC crystal structure? (3 marks)

QUESTION 2

(a) What is a lattice? (3 marks)
(b) Differentiate between metals and insulators. (9 marks)
(c) Define the reciprocal space lattice. (3 marks)

QUESTION 3

(a) What is the difference between primitive and non primitive cells? (4.5 marks)
(b) With the aid of a table, explain the seven crystal systems and their Bravais lattices (10.5 marks)

QUESTION 4

(a) What do you understand by the term critical field? (3 marks)
(b) The London equation for simple superconductor is a phenomenological equation relating the supercurrent js to the magnetic vector potential A:

$$j_s = \frac{-n_e e^2}{m_e c} \boldsymbol{A}$$

where m_e is the electron mass. Using the appropriate Maxwell equation, show how the above equation leads to Meissner effect. (12 marks)

QUESTION 5

The reciprocal lattice corresponding to a unit cell described by the primitive crystal-lattice vectors a_1, a_2 and a_3 has a unit cell defined by the vectors b_1, b_2 and b_3 given by the following equations, when the volume of the crystal unit cell is set to V.

$$b_1 = \frac{a_2 x\, a_3}{V}, b_2 = \frac{a_3 x\, a_1}{V}, b_3 = \frac{a_1 x\, a_2}{V} \quad a3\, V$$

This corresponds to the definition of the reciprocal lattice as a function of the crystal lattice. Show the crystal lattice as a function of the reciprocal lattice. (15 marks)