



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 j_s to the magnetic vector potential A :

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

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 .

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

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)