NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES

DEPARTMENT OF PURE AND APPLIED SCIENCE

2020_2 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. State Bragg's law of diffraction and give two geometrical facts that are necessary for the derivation of the law. (5mks)

b. An X-ray diffractometer recorder chat for an element which has a cubic crystal structure shows diffraction peaks at the following 2θ:40, 58,73,86.8,100.4 and 114.7. The wavelength of the incoming X-ray used was 1.540Å. Determine the:

i. Type of the cubic structure possessed by the element (6mks)
ii. Lattice constant of the element (6mks)

c. Prove that the reciprocal lattice vectors as defined by: (8mks)
$A = 2\pi \frac{b\times c}{a,b\times c}; B = 2\pi \frac{c\times a}{a,b\times c};\ C = 2\pi \frac{a\times b}{a,b\times c}$ satisfy:

$$A.B \times C = \frac{8\pi^3}{a.b \times c}$$

QUESTION 2

Define the following terms:

i.Vacancies (3mks)
ii.Crystal Imperfection (3mks)
iii Dislocation (3mks)
iv. Plane defect (3mks)
v. Superconductors (3mks)

QUESTION 3

a. What is a Point group and Point Operation (6mks)

b. Explain the phenomena of X-Ray Scattering by atom (4mks)
c. List three effects which contribute to the binding of solids **AND** two effects which prevent the collapse of the solids: (5mks)

QUESTION 4

a. Describe the Hall effect (5mks)

b. Define Crystal binding and mention the types of crystal bonding (5mks)

c. Explain why the electrical conductivity of semiconductors increase with rise in temperature? (5mks)

QUESTION 5

Match the type of unit cell given in Column I with the features given in Column II.

Column I	Column II
A. Primitive cubic unit cell	**1.** Each of the three perpendicular edges compulsorily have the different edge length *i.e.*, $a \neq b \neq c$
B. Body centred cubic unit cell	**2.** Number of atoms per unit cell is one
C. Face centred cubic unit cell	**3.** Each of the three perpendicular edges compulsorily have the same edge length *i.e.*, $a=b=c$
D. End centred orthorhombic unit cell	**4.** In addition to the contribution from the corner atoms the number of atoms present in a unit cell is one
	5. In addition to the contribution from the corner atoms the number of atoms present in a unit cell is three

(15mks)