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

DEPARTMENT OF PURE AND APPLIED SCIENCE

September, 2020 EXAMINATIONS

COURSE CODE: **PHY 407**

COURSE TITLE: **SOLID STATE PHYSICS II**
CREDIT UNIT: **3**
TIME ALLOWED: **(2½ HRS)**

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

QUESTION 1

(a) Differentiate between diamagnetic, paramagnetic and ferromagnetic materials   **(6 marks)**

(b) Define saturation magnetisation   **(2 marks)**

(c) What is Curie point?   **(3 marks)**

(d) Define domain wall   **(3 marks)**

(e) What two sequential steps are involved in the principle of Nuclear Magnetic Resonance?

      (4 marks)

(f) List four unusual characteristics of ferromagnetic resonance   **(4 marks)**

QUESTION 2

(a) What is dielectric? Give two examples of a dielectric material   **(4 marks)**

(b). Explain four properties of a dielectric material   **(8 marks)**

QUESTION 3

What is the effect of a dielectric on the following parameters of parallel plate capacitor?

(i) Potential difference **(4 marks)** (ii) the charge **(4 marks)** (iii) the electric field **(4 marks)**

QUESTION 4
(a) Define dipole relaxation time   **(3 marks)**   and the relaxation frequency   **(3 marks)**

(b) A paramagnetic gas at room temperature (T = 300 K) is placed in an external uniform magnetic field of magnitude B = 1.5 T; the atoms of the gas have magnetic dipole moment $\mu = 1.0\mu_B$. Calculate (i) the mean translational kinetic energy K of an atom of the gas **(3 marks)** and (ii) the energy difference ΔU_B between parallel alignment and antiparallel alignment of the atom's magnetic dipole moment with the external field. **(3 marks)**

QUESTION 5

A compass needle made of pure iron (density 7900 kg/m^3) has a length L of 3.0 cm, a width of 1.0 mm, and a thickness of 0.50 mm. The magnitude of the magnetic dipole moment of an iron atom is $\mu_{Fe} = 2.1\times 10^{-23}$ J/T. If the magnetization of the needle is equivalent to the alignment of 10% of the atoms in the needle, what is the magnitude of the needle's magnetic dipole moment $\vec{\mu}$? ($N_A = 6.02 \times 10^{23}$; molar mass of Fe = 55.847 g/mol) **(12 marks)**

QUESTION 6

(a) Explain (i) the edge dislocation **(5 marks)** and (ii) Screw dislocation in crystals **(5 marks)**

(b) What is a line defect? **(2 marks)**