



**NATIONAL OPEN UNIVERSITY OF NIGERIA**  
**PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA**  
**FACULTY OF SCIENCES**  
**DEPARTMENT OF PHYSICS**  
**2025\_1 EXAMINATION**

**COURSE CODE:** **PHY407**  
**COURSE TITLE:** **SOLID STATE PHYSICS II**  
**CREDIT UNIT:** **3**  
**TIME ALLOWED:** **(3 HRS)**  
**INSTRUCTION:** *Answer question 1 and any other three questions*  
**QUESTION 1**

(a) Explain what is meant by dielectric materials with examples	<b>(8marks)</b>
(b) Define electric susceptibility	<b>(5marks)</b>
(c) Describe the term diamagnetic substances with examples	<b>(7marks)</b>
(d) Define point defects	<b>(5marks)</b>

**QUESTION 2**

- (a) State and explain the three parts of total polarisability of an atom **(5marks)**
- (b) Write the expression for electronic polarizability and define its terms **(4mark)**,
- (c) Calculate the electronic Polarization of argon atom. Giving  $\alpha_{\text{roentgen}} = 1.0024$  at  $NTP$  and  $N = 2.7 \times 10^{25} \text{ molecule m}^{-3}$ . **(6marks)**

**QUESTION 3**

- (a) Write the Langevin equation and define its terms **(5marks)**,
- (b) Write the Weiss field expression and define the terms **(4marks)**,
- (c) A paramagnetic sample shows a net magnetization of  $0.8 Am^{-1}$ , when placed in an external magnetic field of strength  $0.8T$  at a temperature  $5k$ . When the same sample is placed in an external magnetic field of  $0.4T$  at a temperature of  $20k$ , what is the magnetization? **(6marks)**,

**QUESTION 4**

- (a) (i) What is a diamagnetic material? Give one example **(2mark)**,  
(ii) If water is boiled at  $373\text{ K}$ , what is the change in diamagnetic susceptibility of water? **(3marks)**,
- (b) Write the expression for the magnetic susceptibility and define its terms **(4mark)**,
- (c) A magnetic material has a magnetization of  $2200\text{ A/m}$  and flux density  $0.0033\text{ weber/m}^2$ . Calculate the magnetization force and the relative permeability of the material **(6marks)**,

**QUESTION 5**

- (a) List the causes of defects in solids **(4mark)**,
- (b) (i) Explain how line defect is formed **(2mark)**,  
(ii) State how grain size can be quantified **(3mark)**,
- (c) Explain the edge dislocation of a particle in a lattice **(6mark)**,