

NATIONAL OPEN UNIVERSITY OF NIGERIA
University Village, NnamdiAzikiwe Expressway, Plot 91, Cadastral Zone, Jabi, Abuja
FACULTY OF SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCE

JANUARY/ FEBRUARY 2018 EXAMINATION

COURSE CODE: PHY307

COURSE TITLE: Solid State Physics 1

COURSE UNIT: 2 units

TIME: 2 hours

INSTRUCTION: Answer Question 1 and any other three (3) questions

- Q1. a) Define the following
- i) crystalline solid ii) lattice iii) crystal structure iv) Bravais and non-Bravais lattice. (6 Marks ; 1.5 Mark each)
- b) Prove that the only allowed rotation axis in a two dimensional Bravais lattice are two-, three-, four- and six-folds. (9 Marks)
- c) What are rules for Miller indices? (6 Marks)
- d) Sketches the following planes (100), $(\bar{1}00)$, (200), (1 1 0), (111), (222) (6 Marks)
- Q2. a) State Bragg's law of diffraction and give two geometrical facts that is necessary for the derivation of the law. (7 Marks)
- b) Electrons are accelerated to 750 V and are reflected from a crystal. The first maximum occurs when glancing angle is 10° . Determine the interplanar spacing of the crystal. (8 Marks)
- Q3. a) Briefly explain the Laue method as one of the experiment for the determination of crystal structure. (7 Marks)
- b) X-ray powder photograph of a cubic material with a wavelength of 15.42 nm is taken. In the photograph lines are observed at angles 19.25° , 22.38° , 32.58° , 39.15° , 41.26° , 49.59° , 56.08° and 58.36° . Determine the lattice constant and the nature of the cubic material. (8 Marks)

- Q4. a) Briefly explain ionic bonding. (8 Marks)
b) Show that the Madelung for one-dimensional chain is $\alpha = 2\ln 2$. (7 Marks)

- Q5. a) What are the conditions for the validity of Cauchy relations in cubical crystals which are elastically isotropic? (7 Marks)
b) Show that the velocity of a longitudinal wave in the $[111]$ direction of a cubic crystal is given by $v_s = \left[\frac{1}{3\rho} (C_{11} + 2C_{12} + 4C_{44}) \right]^{\frac{1}{2}}$ where all symbols have their usual meanings. (8 Marks)