UNIVERSITY OF GHANA

SECOND SEMESTER EXAMINATIONS: **2012/ 2013**

LEVEL **200**: BACHELOR OF SCIENCE IN ENGINEERING

BMEN 204: **Introduction to Structure and Properties of Materials** (2 Credits)

Total Marks: **100**. Time allocation: **2** Hours

Attempt all questions.

1. (a) **Enumerate** the various **types** of bonds occurring in crystals and **describe** briefly the characteristics of any **two** of the bonding mentioned.

[10 marks]

(b) **What** is hybridization? **Explain** how hybridization occurs in carbon? [5 marks]

(c) (i) **What** is lattice energy of crystal ?

(ii) **Calculate** the binding energy of NaI of which the nearest neighbour distance is 0.324 nm. **Express** the energy in eV and also in KJ / kmol. Madelung constant for NaI = 1.748 and n = 9.5

[10 marks]

2. (a) (i) **What** is a unit cell?

(ii) **Describe** with **neat** sketches the **arrangement** of atoms in BCC, FCC and HCP lattices. **Show by calculation** that a FCC structure is always **more** closely packed than a BCC structure.

[14 marks]

(b) **Name** the **type** of structure associated with the following metals:
(i) Iron (ii) Copper (iii) Aluminium (iv) Magnesium (v) Diamond [5 marks]

(c) Molybdenum has BCC structure and density of 10.2×10^3 kg / m^3. **Calculate** its atomic radius. The atomic weight of molybdenum is 95.94 and Avogadro's number is 6.02×10^{23} atoms / mol.

[6 marks]

3. (a) (i) What is Miller indices? What is its significant?
   (ii) Draw the following planes and direction in FCC structure
   (001), (111), [110], [101]
   (iii) Calculate the number of atoms per mm^2 surface area for (111) plane for aluminium with a lattice constant, a = 4.049 Å. [10 marks]

   (b) (i) Draw clear sketches illustrating what is meant by an edge dislocation and a screw dislocation
   (ii) Define Burgers vector and illustrate it on the sketch of an edge dislocation drawn in (i) above
   (iii) Outline three effects of imperfections on material properties [8 marks]

   (c) (i) Describe briefly how X-rays are produce from the atom ? Why is it used in diffraction studies?
   (ii) Differentiate between Laue method and Debye Scherer powder method of analyzing crystal in terms of the type of specimen and film used, and the nature of image formed.

   [7 marks]

4. (a) What is meant by allotropy? Discuss the term with particular reference to iron and Show the importance of allotropy to the selection of engineering materials.

   [10 marks]

   (b) Explain the following microstructures
   (i) Ferrite
   (ii) Austenite
   (iii) Martensite [9 marks]

   (c) Outline three factors that affect structure of solids? [6 marks]