UNIVERSITY OF GHANA

BSc. ENGINEERING
SECOND SEMESTER EXAMINATIONS: 2016/2017
DEPARTMENT OF BIOMEDICAL ENGINEERING
BMEN 204: INTRO. TO STRUCTURE AND PROPERTIES OF MATERIALS (2 credits)

INSTRUCTIONS:

ANSWER ALL QUESTIONS

TIME ALLOWED: TWO (2) HOURS

1.   (a) Describe the structures of the following materials:
    i.   Metals
    ii.   Ceramics
    iii. Polymers   [9 marks]

   (b) Why do we have to study the structure of a material?   [4 marks]

   (c) Outline any two methods by which each of the materials in (a) is processed.

                                                                    [12 marks]

2.   (a) Distinguish among the following bonds:
    i.   Covalent
    ii.   Ionic
    iii. Metallic
    iv.   Hydrogen
    v.   van der Waals forces   [10 marks]

   (b) Diamond and Graphite are two carbon forms of covalent networks? Explain with
       illustrations why they exhibit different properties.   [8 marks]

   (c) In sodium crystal, the equilibrium distance between ions is $r_o = 2.81$ Å and Madelung
       constant, $\alpha_m = 1.748$ and taking $n=9$. Calculate the potential energy per ion-pair.

                                                                    [6 marks]

Examiner: BO Asimeng, PhD   1/2

3. (a) What is the significance of interplanar spacing in crystals? Sketch the following crystal planes (100), (110) and (111) and Show that in simple cubic structure, the interplanar spacing are in the ratio 1: 0.71: 0.58.   .   [13 marks]

    (b) X-rays of wavelength 1.5418 Å are diffracted by (111) planes in a crystal at an angle $30°$ in the first order. Calculate the interatomic spacing.   [6 marks]

    (c) Metallic iron changes from BCC to FCC at $910°$ and the corresponding atomic radii vary from 1.258 Å to 1.292 Å. Calculate the percentage volume change during this structural change.   [10 marks]

4. (a) Describe how:
         i.   x-rays are produced from the atom   [4 marks]
         ii.   the structure of a crystal is determined by X-ray diffraction.   [4 marks]

    (b) Explain why X-rays are used for crystal diffraction studies?   [4 marks]

    (c) Explain the Laue method and Debye-Scherrer method of analysing the structure of a crystal.   [10 marks]