KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

EMM 102: INTRODUCTION TO MATERIAL SCIENCE

DATE: Wednesday 14th December 2011 **TIME: 11.00a.m – 1.00p.m**

INSTRUCTIONS: Answer any Three Questions. All Questions Carry Equal Marks

1. (a) Briefly describe the following new materials:
   i. Biomaterials
   ii. Hydrogels
   iii. Graphene
   iv. Nanocomposites (8 Marks)
   (b) Write short notes on the following with regard to ceramics: super-conduction, thermal shock and maximum service temperature (6 Marks)
   (c) Describe THREE types of steel, stating their carbon content and uses (6 Marks)

2. (a) Briefly describe at least FIVE classes of materials by bond types (5 Marks)
   (b) Briefly describe the THREE types of composites (6 Marks)
   (c) (i) In the Pb-Sn system, determine the fraction of β-phase in an alloy of 80% Sn at 184°C.
   (ii) In the Pb-Sn system calculate the alloy composition at which the fraction of total α is 2.5 times the fraction of the phase at 182°C (Refer for Figure 4 (a)) (9 Marks)

3. (a) Describe the process of full annealing and spheroidization (4 Marks)
   (b) (i) Describe the process edge dislocation (3 Marks)
   (ii) In a certain crystal the Burger's rector for an edge dislocation is 2.5×10^{-10} m. calculate the force per unit length in the dislocation when a shear stress of 350 N/ cm^2 is applied. (4 Marks)

(c) Briefly describe the following methods of corrosion protection: Metallic coating, non-metallic coating and cathodic protection (9 Marks)

4. (a) Briefly describe the FOUR classes of solids according to crystal structure (4 Marks)

(b) Consider a cube with an edge length of a units and a plane intercepts the x, y, z axes at **1.5a**, **0.5a** and **a** respectively. Find the miller indices of the plane. (4 Marks)

(c) Briefly describe the process of sintering

(d) Using the Condon-Morse curve, illustrate how materials can be judged as brittle or ductile (6 Marks)

5. (a) Briefly describe the extrusion process in the manufacture of plastics (6 Marks)

(b) Describe THREE classes of metals with regard to their magnetism (6 Marks)

(c) Why is non-destructive testing carried out. Give FOUR reasons (4 Marks)

(d) Sketch an illustration of the face–centered cubic (f c c) structure and the simple cubic structure of crystals (4 Marks)