TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

EME 2103 : MATERIAL SCIENCE I

END OF SEMESTER EXAMINATION

SERIES: APRIL 2016

TIME: 2 HOURS

DATE: Pick Date May 2016

Instructions to Candidates
You should have the following for this examination
 -*Answer Booklet, examination pass and student ID*
This paper consists of **FIVE** questions. Attempt any THREE questions.
Do not write on the question paper.

Question ONE

(a) Draw neat sketches of unit cells of simple cubic, body centred cubic and face centred cubic structures. In each case calculate the number of atoms in the cells. (6 marks)

(b) Show that the atomic packing factor of a BCC crystal is 0.68. (6 marks)

(c) (i) State **FIVE** crystal systems

 (ii) For the following cells, state the coordination number.
 - Simple Cubic
 - Body Centred Cubic
 - Face Centred Cubic (8 marks)

Question TWO

(a)   A tensile test was conducted on a mild steel bar. The following data was obtained from the test:

Diameter of steel bar	= 16 mm
Gauge length of bar	= 80 mm
Load at proportionality limit	= 72KN
Extension at a load of 60KN	= 0.115 mm
Load at failure	= 80KN
Final gauge length of bar	= 104 mm
Diameter of load at failure	= 12 mm

Determine:-

(i)   Young's Modulus of Elasticity
(ii)   True breaking stress
(iii)   Percentage elongation
(iv)   Proportionality Limit   (10 marks)

(v)   Given the following data in hardness test of specimen. Calculate the hardness number. Assume diameter of ball indicator is 10 mm.   (10 marks)

Material	Type	Load Kgf	Impression (mm)
A	Brinell	500	4.6
B	Vickers	5	0.28

Question THREE

(a) With the aid of diagrams show the planes that belong to the cubic family set of   {100}.
                                                                                  (6 marks)

(b) On an FCC structure show the following directions (112), (101) and (001)
                                                                                  (3 marks)

(c) Calculate the largest diameter of an atom which could fit interstially in a copper crystal without distorting it. The edge length of the FCC unit cell of copper is 3.61 A.
                                                                                  (5 marks)

(d) Distinguish the following mechanisms.

(i) Creep Fracture
(ii) Fatigue Fracture
(iii)   Ductile
(vi)   Brittle   (6 marks)

Question FOUR

(a) (i) Outline **FOUR** important objectives of Heat Treatment.

   (ii) State **FOUR** heat treatment processes. (6 marks)

(b) Explain **THREE** major defects in a metal or alloy due to faulty heat treatment.

(6 marks)

(c) Briefly describe the following bonds.
   (i)   Metallic bond
   (ii)   Covalent bond
   (iii) Ionic bond (6 marks)

(d) For the bonds in (c) above, state whether or not they are directional. (2Marks)

Question FIVE

(a) (i) Describe the corrosion mechanism.
   (ii) State **THREE** different methods of preventing corrosion. (6 marks)

(b) (i) State Bragg's law
   (ii) Assuming first order reflection, calculate the interplaner spacing when a beam of X-ray of wavelength 1.54A° is directed towards the crystal at an angle 20.3° to the atomic plane.

(6 marks)

(c) Explain **THREE** types of crystal defects and for each provide an example.

(6 marks)

(d) Distinguish
   (i)   Malleability
   (ii)   Castability
   (iii) Weldability
   (iv) Machinability (2 marks)