



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION 2013/2014

FIRST YEAR SECOND SEMESTER UNIVERSITY EXAMINATION FOR THE
BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2104 : INTRODUCTION TO MATERIAL SCIENCE

TIME: 2 HOURS
2013

SERIES: DECEMBER,

INSTRUCTIONS TO CANDIDATES

1. You are required to have the following for this examination;
 - Answer Booklet
 - Scientific Calculator
2. Answer **ANY THREE** Questions.
3. All questions carry EQUAL Marks.

This paper consists of FOUR papers printed.

Question ONE

(a) Explain the following types of materials and give an example of each:

- (i) Metals
- (ii) Ceramics
- (iii) Polymers
- (iv) Composites

(8 marks)

(b) Explain the following terms using an appropriate diagram:

- (i) Liquidus
- (ii) Solidus

(2 marks)

(c) Berytium (m.pt 1282°C) and Silicon (mp + f1414°C) are completely soluble as liquids but completely insoluble as solids. They form a eutectic at 1090°C containing 61% Silicon. Draw the equilibrium diagram and explain what happens when alloys containing:

- (i) 10% silicon
- (ii) 70% silicon solidify completely

(10 marks)

Question TWO

(a) Define the following:

- (i) Plasticity
- (ii) Toughness
- (iii) Brittleness
- (iv) Malleability

(6 marks)

(b) Explain the following testing methods:

- (i) Izod
- (ii) Brinell hardness

(10 marks)

(c) The following observation were made during a tensile test on a mild steel specimen 40 in diameter and 240mm long.

Yield point load = 161kN
Maximum load = 242kN
Length of specimen at fracture = 249mm

Calculate:

- (i) Yield point stress
- (ii) Percentage elongation

(4 marks)

Question THREE

(a) Define the following types of stresses:

- (i) Elastic stress
- (ii) Working stress
- (iii) Yield stress
- (iv) Ultimate stress

(6 marks)

- (b) Explain the working of a universal testing machine. **(4 marks)**
- (c) A mild steel rod of 12mm diameter was tested for tensile strength, with a gauge length of 60mm. The following were the observations.

Final length = 78mm

Final diameter = 7mm

Yield load = 34kN

Ultimate load = 61kN

Calculate:

- (i) Yield stress
- (ii) Ultimate tensile stress
- (iii) Percentage reduction
- (iv) Percentage elongation

(10 marks)

Question FOUR

- (a) Define a unit cell. **(2 marks)**

- (b) Sketch the arrangement of atoms in the following units and give an example of each:

- (i) Body centred cubic
- (ii) Face centred cubic
- (iii) Closed packed hexagonal

(9 marks)

- (c) Describe the following optical material properties:

- (i)** Transparent
- (ii)** Translucent
- (iii)** Opaque

(3 marks)

- (d) Describe the following electrical materials:

- (i) Conductor
- (ii) Semiconductor
- (iii) Insulator

(3 marks)

Question FIVE

- (a) Explain the miller indices. **(1 mark)**
- (b) Draw the planes (020), (120) and (220) in a face centred cubic structure. **(9 marks)**
- (c) Describe what the following defects in a crystal are and explaining using sketch how any two basic forms of defect occur in each:
- (i) Line defects
 - (ii) Surface defects
- (10 marks)**