TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
BTech. Mechanical Engineering
TMC 4213 : MATERIAL SCIENCE AND ENGINEERING I
END OF SEMESTER EXAMINATION (SCHOOL BASED)
SERIES: APRIL2017
TIME: 2 HOURS
DATE: Pick Date**Mar2017**

Instruction to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions.
All questions carry **EQUAL MAXIMUM** marks
Attempt any other **THREE** questions.
Maximum marks for each part of a question are as shown.
Do not write on the question paper.
Mobile phones are not allowed in the examination room.

Question ONE (20 Marks)

a) Define an element (2 Marks)
b) Define the following terms: Atom, Electron, Proton, Nucleus, Atomic number and Isobars. (6 Marks)
c) Give the comparison between ionic, covalent and metallic bonds (6 Marks)
d) Discuss briefly the general usefulness of the periodic table in reference to atomic structure (3 Marks)
e) State three (3) characteristics of molecular bonds (3 Marks)

Question TWO (20 Marks)

a) What do you understand by the terminology "smart (or intelligent) materials" (2 Marks)
b) List and discuss four factors which govern the selection of materials for design consideration in mechanical components (8 Marks)

c) Explain briefly the following electrical properties of metals: Resistivity, Conductivity, Temperature coefficient of resistance, Dielectric strength and Thermoelectricity (5 Marks)

d) Explain briefly the following mechanical properties of metals: Elasticity, Plasticity, Ductility, Malleability and Hardness (5 Marks)

Question THREE (20 Marks)

a) What are point, line and surface imperfections found in solid crystals? Illustrate these imperfections with suitable sketches (6 Marks)

b) In order to evaluate various mechanical properties, a steel specimen of 12.5 mm diameter and 62.5 mm gauge was tested in a standard tension test. Following observations were made during the test:
Yield load = 40.0 kN; Maximum load = 71.5 kN; fracture load = 50.5 kN; gauge length at fracture = 79.5 mm; strain at load of 20 kN = 7.75×10^{-4}
Determine:

i) Yield point stress (2 Marks)
ii) Ultimate tensile stress (2 Marks)
iii) Percentage elongation (2 Marks)
iv) Modulus of elasticity (2 Marks)
v) Fracture stress (2 Marks)
vi) Modulus of toughness (2 Marks)
vii) Percentage reduction in area (2 Marks)

Question FOUR (20 Marks)

a) List the purposes for which materials are tested (5 Marks)

b) What is fatigue failure? How is a fatigue test carried out? (5 Marks)

c) Explain the Brinell hardness testing of mild steel specimen (5 Marks)

d) What is creep? Draw a typical creep curve and explain the different stages of creep (5 Marks)

Question FIVE (20 Marks)

a) List the physical and mechanical properties of Aluminum (5 Marks)

b) How are the properties of Aluminum affected by the inclusion of:
i) Copper as alloying element, and (2 Marks)
ii) Silicon as alloying element (2 Marks)

c) What are the special properties of Plastics that make them useful engineering materials (5 Marks)

d) Discuss the effect on corrosion resistance of Copper by increasing additions of:
i) Zinc (2 Marks)
ii) Tin (2 Marks)
iii) Nickel (2 Marks)