



MACHAKOS UNIVERSITY

University Examinations for 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

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

SUPPLEMENTARY EXAMINATION

EMM 102: INTRODUCTION TO MATERIAL SCIENCE

DATE:

TIME:

INSTRUCTIONS:

1. This examination contains FIVE questions. Question ONE (1) is compulsory and carries 30 marks. All the other questions carry 20 marks each.
2. Answer question ONE and any other TWO questions
 1. a) i) Describe five mechanical properties of materials
ii) define the two measures of ductility (9 marks)
 - b) Explain briefly how the following factors affect the mechanical properties of metals:
 - i) grain size
 - ii) Atmospheric exposure (6 marks)
 - c) i) Define the term metal corrosion
ii) Differentiate between dry corrosion and wet corrosion

Examination Irregularity is punishable by expulsion

- iii) Distinguish between Electroplating and Dipping as used in corrosion control (9 marks)
 - d) Explain how the following material tests are carried out:
 - i) Ultrasonic test
 - ii) Magnetic particle test (6 marks)
- 2. a) With the aid of a suitable time temperature graph, describe the phase transformations that occur when pure iron is heated from room temperature to its melting point (7 marks)
- b) Briefly, Describe the following;
 - i) plain carbon steels
 - ii) Eutectoid steel
 - iii) hypo-eutectoid steels (5 marks)
 - c)
 - i) define the term **Heat Treatment**
 - ii) State three reasons for carrying out heat treatment
 - iii) Briefly, describe the process of normalising as used in heat treatment (8 marks)
- 3. a) Define the following terms:
 - i) Crystal
 - ii) space lattice
 - iii) Amorphous solids (5 marks)
- b) With the aid of suitable sketches, describe the following types of metallic structures
 - i) Body Centred Cubic
 - ii) Face Centred Cubic
 - iii) Hexagonal close packed (12 marks)
 - c) Give three differences between crystalline and amorphous solids (3 marks)
- 4. a)
 - i) Give a reason for conducting material testing
 - ii) Distinguish between Destructive tests and Non-Destructive Tests (5 marks)

b) Sketch a well labelled stress- strain graph for a mild steel specimen under tensile test when tested to destruction and describe four critical points of the graph (6 marks)

c) The following results were obtained from a tensile test experiment:

Original diameter=18mm

Gauge length=100mm

Load at limit of proportionality=74kN

Extension at limit of proportionality= 133×10^{-3} m

Load at yield point=96kN

Maximum load=130kN

Fracture load=78kN

Diameter at fracture=9.5mm

Determine the following:

i) Youngs modulus at limit of proportionality

ii) Yield stress

iii) Tensile strength

iv) Fracture stress (9 marks)

5. a) i) Identify two ores from which iron is mined

ii) With the aid of a neat diagram, describe the construction and working principle of a blast furnace (8 marks)

b) State the effect of the following impurities on iron:

i) silicon,

ii) phosphorous,

iii) sulphur and

iv) manganese (4 marks)

c) i) Distinguish between Thermoplastics and Thermosetting plastics

ii) The properties of rubber can be improved by the process of vulcanization. Explain (8 marks)