



MACHAKOS UNIVERSITY

University Examinations 2023/2024

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND YEAR FIRST EXAMINATIONS FOR

BACHELOR OF SCIENCE IN MECHANICAL AND MANUFACTURING

ENGINEERING

EMM 211:INTRODUCTION TO MATERIAL SCIENCE

DATE: _____ **TIME:** _____

INSTRUCTIONS TO CANDIDATES

This paper contain five questions, answer question one and any other two questions.

QUESTION ONE [COMPULSORY] 30 MARKS

- a) (i) What is a thermal equilibrium diagram. (2 marks)
(ii) List three phenomena likely to occur when a liquid solution of an alloy cools (3 marks)
- b) Briefly explain lattice and basis as well as unit cell concept as applies to crystallography (7 marks)
- c) List properties of an engineering material which are associated with metallic bonding (4 marks)
- d) What are line defects. Differentiate between edge dislocation and screw dislocation (9 marks)
- e) Explain Hunds Rule of Maximum Multiplicity (5 marks)

QUESTION TWO 20 MARKS

- a) With the aid of neat sketches explain the following crystal structures of metals highlighting common metals whose structure take each form; BCC, FCC and HCP. (11 marks)
- b) Briefly explain periodic table and also describe groups, periods, blocks and periodic trends (9 marks)

QUESTION THREE 20 MARKS

- a) Briefly discuss modern atomic theory (quantum mechanical model) (4 Marks)
- b) With the aid of a neat sketch, explain the transformation that take place in alloy of 70% Nickel and 30% Copper heated to above melting temperatures and being cooled from above 400 °C until it reaches room temperatures. Include the microstructures. (10 marks)
- c) c) Determine the number of lattice points per cell in the cubic crystal systems. If there is only one atom located at each lattice point, calculate the number of atoms per unit cell. Assuming there is only one atom located at each lattice point, the number of atoms per unit cell would be 1, 2, and 4, for the simple cubic, body-centered cubic, and face-centered cubic unit cells, respectively. (6 marks)

QUESTION FOUR 20 MARKS

- a) Briefly discuss secondary bonds (12 marks)
- b) Briefly explain Aufbau principle and highlight its five key points (8 marks)

QUESTION FIVE 20 MARKS

- a) Briefly explain point defects and area / planar defects common in materials (12 marks)
- b) Differentiate between microstructure and macrostructure of materials (8 marks)