



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMM 107: ENGINEERING MATERIALS II

DATE: 21/5/2019

TIME: 8.30-10.30 AM

INSTRUCTIONS:

Answer question one and any other two questions

QUESTION ONE (30 MARKS)

- a) Using appropriate diagrams, describe the slow cooling of a hypoeutectoid alloy from the γ -austenite region. (6 marks)
- b) Calculate the quantities of proeutectoid α -ferrite, pearlite, eutectoid α -ferrite and cementite in 1 kg of a 0.3% C steel at 722°C assuming equilibrium conditions. (4 marks)
- c) List 2 uses of 2XXX (Al-Cu) Al alloys (2 marks)
- d) Name 4 types of bronzes (2 marks)
- e) Titanium has many desirable mechanical properties. Why is it only used in specialized applications? (1 mark)
- f) Highlight 2 advantageous properties of Nickel alloys (2 marks)
- g) Differentiate between thermoplastics, thermosets and elastomers (3 marks)
- h) Name 3 common properties of ceramics (3 marks)
- i) Giving examples, name 4 industries where composites are used (4 marks)
- j) Differentiate between pitting, crevice and intergranular corrosion (3 marks)

QUESTION TWO (20 MARKS)

- a) Using a diagram, describe the production of pig iron in a blast furnace (8 marks)
- b) Explain the following two methods used to harden steels
 - i. Carburizing (3 marks)

- ii. Nitriding (3 marks)
- c) Highlight the 3 types of stainless steels and their uses (6 marks)

QUESTION THREE (20 MARKS)

- a) Using an appropriate diagram, describe the electrolytic reduction of alumina (from the Bayer process) to pure aluminium (6 marks)
- b) Other than the production of aluminium, where else is alumina from the Bayer process used? (3 marks)
- c) Name 3 properties that make brasses important copper alloys (3 marks)
- d) Why is alloying copper with bismuth and antimony disadvantageous? (1 mark)
- e) List 4 classifications of Ti alloys and name an application of each category (4 marks)
- f) Where are nickel-based super alloys used? (3 marks)

QUESTION FOUR (20 MARKS)

- a) Name 4 properties of synthetic polymers that have accelerated their use for engineering purposes (4 marks)
- b) Using sketches, differentiate between isotactic, syndiotactic and atactic morphology in polymers (6 marks)
- c) Describe how crystallinity occurs in polymers (5 marks)
- d) What is corrosion? (1 mark)
- e) Explain 4 ways in which corrosion may be prevented (4 marks)

QUESTION FIVE (20 MARKS)

- a) List the 6 groups of ceramic materials (3 marks)
- b) Name 5 types of common glasses and their uses (5 marks)
- c) Refractories are used to line furnace. What 3 properties makes them ideal for this application? (3 marks)
- d) What is a composite material? (1 mark)
- e) The resulting properties of composites depend on 3 factors. List them (3 marks)
- f) A unidirectional continuous fibre-reinforced composite consists of 45% glass fibre of $E = 70 \text{ GPa}$ by volume. The fibres are embedded in a polyester resin ($E = 3.5 \text{ GPa}$). Calculate:
 - i. The modulus of elasticity in the longitudinal direction (2 marks)
 - ii. The load carried by each of the two phases when a load of 12 KN is applied to the composite (3 marks)