



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
BTech. Mechanical Engineering
TMC 4224 : MATERIAL SCIENCE AND ENGINEERING II
END OF SEMESTER EXAMINATION (SCHOOL BASED)
SERIES: AUGUST2017
TIME: 2 HOURS
DATE: Pick DateAug2017

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)

- Some of the methods used for steel manufacture include steel making and iron making. Explain and show how these methods for steel manufacture can be used to produce a wide variety of steel forms. (6 Marks)
- How are the properties of carbon and low alloy steels affected by inclusion of:
 - Silicon as an alloying element. (2 Marks)
 - Manganese as an alloying element. (2 Marks)
 - Phosphorus as an alloying element. (2 Marks)
 - Chromium as an alloying element. (2 Marks)
- What are the special properties of plastics that make them useful engineering materials? (6 Marks)

Question TWO (20 Marks)

- List and discuss the important differences between welding the carbon or low alloy structural steels and the austenitic stainless and nickel alloys. (10 Marks)

b) A base for a special machine tool will weigh 635 kg if made as a gray iron casting. Pattern cost will be \$450, and the foundry has quoted a price of \$1.32 per kilogram for making the casting. If the part is made as a weldment, it will require 363 kg of steel costing \$0.31 per kilogram. Cutting, edge preparation and setup time will require 30 hours at a rate of \$10.00 per hour for labor and overhead. Welding time will be 55 hours at an hourly rate of \$9.50. Ninety-one kilograms of electrode will be required costing \$0.37 per kilogram.

- i) Which method of fabrication will be more economical if only one part is required? (5 Marks)
- ii) What number of parts will be required for welding and casting to break even? (5 Marks)

Question THREE (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 an alloying element. (2 Marks)
 - ii) Silicon as an alloying element. (3 Marks)
- c) List and discuss five different types of corrosion present in stainless steel material and the steps that need to be implemented to prevent corrosion. (10 Marks)

Question FOUR (20 Marks)

- a) What are the four basic steps which are usually involved in making products by powder metallurgy? (4 Marks)
- b) What is green strength in powder metallurgy and why is it important? (2 Marks)
- c) List six advantages of powder metallurgy process. (6 Marks)
- d) What are the major disadvantages of the powder metallurgy process? (4 Marks)
- e) What are some guidelines for good powder metallurgy design? (4 Marks)

Question FIVE (20 Marks)

- a) Why do most welding failures in steel components originate in the heat-affected zones? (6 Marks)
- b) What distinguishes a jig from a fixture? (2 Marks)
- c) What six basic factors should be considered in designing jigs and fixtures? (6 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)