TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
SPECIAL/SUPPLEMENTARY EXAMINATION FOR:
BTech. Mechanical Engineering
TMC 4224 : MATERIAL SCIENCE AND ENGINEERING II
END OF SEMESTER EXAMINATION (SCHOOL BASED)
SERIES: DECEMBER2017
TIME: 2 HOURS
DATE: Pick Date**Dec2017**

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) What are five important properties of metal powders that will influence the properties of products made from them? (5 Marks)
b) What are the four general categories of the powder metallurgy parts? (4 Marks)
c) Why is it desirable to have uniform thickness in a powder metallurgy product? (2 Marks)
d) What is the difference between impregnation and infiltration? (4 Marks)
e) What are some guidelines for good powder metallurgy design? (5 Marks)

Question TWO (20 Marks)

a) State the six basic classifications of stainless steel. (3 Marks)
b) List the mechanical properties of ferritic stainless steel. (4 Marks)
c) List the mechanical properties of duplex stainless steel. (4 Marks)
d) List and discuss the important differences between welding the carbon or low-alloy structural steels and the austenitic stainless and nickel alloys. (9 Marks)

Question THREE (20 Marks)

a) List and discuss four factors which govern the selection of materials for design consideration in mechanical components. (6 Marks)
b) Discuss the methods of production of:
   i) Malleable cast iron. (3 Marks)
   ii) White cast iron. (3 Marks)
c) A base for a special machine tool will weigh 650 kg if made as a gray iron casting. Pattern cost will be $500, and the foundry has quoted a price of $2.32 per kilogram for making the casting. If the part is made as a weldment, it will require 387 kg of steel costing $0.91 per kilogram. Cutting, edge preparation and setup time will require 25 hours at a rate of $8.00 per hour for labor and overhead. Welding time will be 65 hours at an hourly rate of $9.50. Ninety-one kilograms of electrode will be required costing $0.57 per kilogram.
   i) Which method of fabrication will be more economical if only one part is required? (4 Marks)
   ii) What number of parts will be required for welding and casting to break even? (4 Marks)

Question FOUR (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 FIVE (20 Marks)

a) Why do most welding failures in steel components originate in the heat-affected zones? (4 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) How are the properties of carbon and low alloy steels affected by inclusion of:

i) Silicon as an alloying element. (2 Marks)

ii) Manganese as an alloying element. (2 Marks)

iii) Phosphorus as an alloying element. (2 Marks)

iv) Chromium as an alloying element. (2 Marks)