TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION 2013/2014

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

EMG 2201 : ENGINEERING MATERIALS

TIME: 2 HOURS **SERIES:** DECEMBER, 2013

INSTRUCTIONS TO CANDIDATES

1. You are required to have the following for these examinations:
   - Answer Booklet
   - Scientific Calculator

2. This paper has **FIVE** Questions.
3. Answer **ANY THREE** Questions.
4. All Question carry **EQUAL** marks.
5. This paper consists of **FOUR** ***Printed pages.***

QUESTION 1

(a) Estimate the tensile strength of a steel containing 0.5%C, 0.75%Si, 1.0% V, 0.1%v and 1.5%Ni. **(4 marks)**

(b) A steel piece containing 0.25%C, 0.06%N, 0.6% Si, 5% Ni, 18%Cr and 0.8Ti is heated to and held at 1100ºC for sometime. It is then cooled in still air. Determine the phases present in the structure after the heat treatment. **(4 marks)**

(c) Discuss the composition, properties and application of alloy steels containing:

(i) Manganese
(ii) Tungsten
(iii) Vanadium

(12 marks)

QUESTION 2

(a) State **SIX** properties of cast irons. **(3 marks)**

(b) Explain how the rate of cooling affect the microstructure of a cast iron. **(4 marks)**

(c) Describe the following cast irons:

(i) Nodular cast iron
(ii) Blackheart malleable iron
(iii) White heart malleable iron

(13 marks)

QUESTION 3

(a) Why does a 0.5%C steel rust more quickly in the normalized condition than in the water quenched state? **(3½ marks)**

(b) Describe the dry corrosion method. **(3½ marks)**

(c) Describe the following corrosion protection methods:

(i) Electroplating
(ii) Sherardising

(8 marks)

(d) (i) Describe the surface hardening method of liquid carburizing.

(ii) Calculate the depth of case produced when a low carbon steel is carburized for 22 hours at 900^{o}C (k = 0.533).

(5 marks)

QUESTION 4

(a) Discuss the effect of impurities on the conductivity of copper. **(3 marks)**

(b) Describe the following brasses:

(i) Admiralty brass
(ii) Cartridge brass

(5 marks)

(c) Describe the following bronzes:

(i) Phosphor bronze
(ii) Leaded Gunmetal

(5 marks)

(d) Describe:

(i) Nickel Silvers
(ii) Beryllium Bronze
(iii) Chromium Copper

(7 marks)

QUESTION 5

(a) Describe, with the aid of appropriate sketches, how the mechanical properties of tensile strength, % elongation and hardness for normalized plain carbon steels vary with carbon content upto 1.2%C. **(6 marks)**

(b) Explain, with the aid of appropriate sketches, the production process for obtaining steel from iron ore. **(7 marks)**

(c) By quoting the iron-carbon equilibrium diagram, explain the phase changes as a 1.0% Carbon steel cools slowly from 1000^{o}C to room temperature. **(7 marks)**