UNIVERSITY OF GHANA

BSc. (Eng) MATERIALS SCIENCE AND ENGINEERING

FIRST SEMESTER EXAMINATIONS 2015/2016

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

MTEN 303: INTRODUCTION TO MATERIALS PROCESSING (2 CREDITS)

TIME- 2HRS

ATTEMPT ALL QUESTIONS

1.

(a) What are the two necessary ingredients needed for the extraction of iron from its ore? With appropriate equations, explain the role of limestone in iron extraction. **(5 marks)**

(b) What is pig iron? List the five **principal** impurity elements found in pig iron. **(5 marks)**

(c) What is the difference between ingot and billet? **(4 marks)**

(d) What is cross-linking in a polymer, and what is its significance? **(4 marks)**

(e) Identify four advantages of shape-casting processes. **(4 marks)**

(f) What are the differences between bulk deformation processes and sheet metal processes? **(4 marks)**

(g) What is the mechanism by which carbon strengthens steel during heat treatment? **(4 marks)**

2.

(a) There are several ways of shaping plate or sheet glass. Name and briefly describe one of them. **(5 marks)**

(b) Describe the type of material that is commonly used to make windshields for automobiles. **(4 marks)**

(c) Briefly describe the three **principal** methods used to produce metallic powders. **(6 marks)**

(d) What are the three basic steps in the conventional powder metallurgy shaping process? **(3 marks)**

(e) Describe liquid phase sintering. **(4 marks)**

(f) Describe the slip casting process in traditional ceramics processing. **(4 marks)**

(g) What is the difference between dry pressing and semi-dry pressing of traditional ceramic parts? **(4 marks)**

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3.

(a) Differentiate between superheat and heat of fusion as applied in metal casting technology. **(4 marks)**

(b) List two sources of contraction in a metal casting after pouring. **(4 marks)**

(c) A large steel sand casting shows the characteristic signs of penetration defect: a surface consisting of a mixture of sand and metal. Outline three steps can be taken to correct the defect? What other possible defects might result from taking each of these steps? **(6 marks)**

(d) The housing for a certain machinery product is made of two components, both aluminum castings. The larger component has the shape of a dish sink, and the second component is a flat cover that is attached to the first component to create an enclosed space for the machinery parts. Sand casting is used to produce the two castings, both of which are plagued by defects in the form of misruns and cold shuts. The foreman complains that the parts are too thin, and that is the reason for the defects. However, it is known that the same components are cast successfully in other foundries. Outline two other explanations that can be given for the defects? **(4 marks)**

(e) The total solidification times of three casting shapes are to be compared: (1) a sphere, (2) a cylinder, in which the length-to-diameter ratio = 1.0, and (3) a cube. For all three geometries, the volume = 1000 cm^3. The same casting alloy is used in the three cases.

i. Determine the relative solidification times for each geometry. **(12 marks)**

ii. Based on the results of part (i), which geometric element would make the best riser? Explain your answer. **(4 marks)**

iii. If the mould constant = 3.5 min/cm^2 in Chvorinov's rule, compute the total solidification time for each casting. **(6 marks)**

[**Hint:** Volume of sphere = $4/3\,\pi R^3$; Volume of cylinder = $\pi R^2 h$; Volume of cube = L^3].

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