The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Diploma in Technology/Bachelor of Technology (Engineering)
Name of the Examination	:	Final Examination
Course Code and Title	:	**MEX5272 –Materials and Manufacturing Technology**
Academic Year	:	2013/14
Date	:	**4th September 2014**
Time	:	**0930-1230 HRS**
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of 8 questions. All questions carry equal marks.
3. Answer **any 5** questions only.

Q.1 Using the isothermal transformation diagram given in Fig. (1) for an iron-carbon alloy of eutectoid composition, answer the following questions. In each case assume that the temperature of the specimen begins at 760° C and that it has been held at this temperature long enough to achieve a complete and homogeneous austenite structure.

(a) If the specimen was rapidly cooled down, at what temperature will martensite start to form and at what temperature can we expect to have 50% martensite?

(b) What is the minimum cooling rate required to form 100% martensite?

Specify the nature of the final microstructure (in terms of micro constituents present and approximate percentages of each) of a small specimen that has been subjected to time temperature treatments as given in the question (c) to (e).

(c) Cool rapidly to 650°C, hold for 10 sec, and then quench to room temperature.

(d) Rapidly cool to 425°C, hold for 10 sec, and then quench to room temperature.

(e) Rapidly cool to 650°C, hold for 10 sec, rapidly cool to 450°C, hold for 5 sec and then quench to room temperature in water.

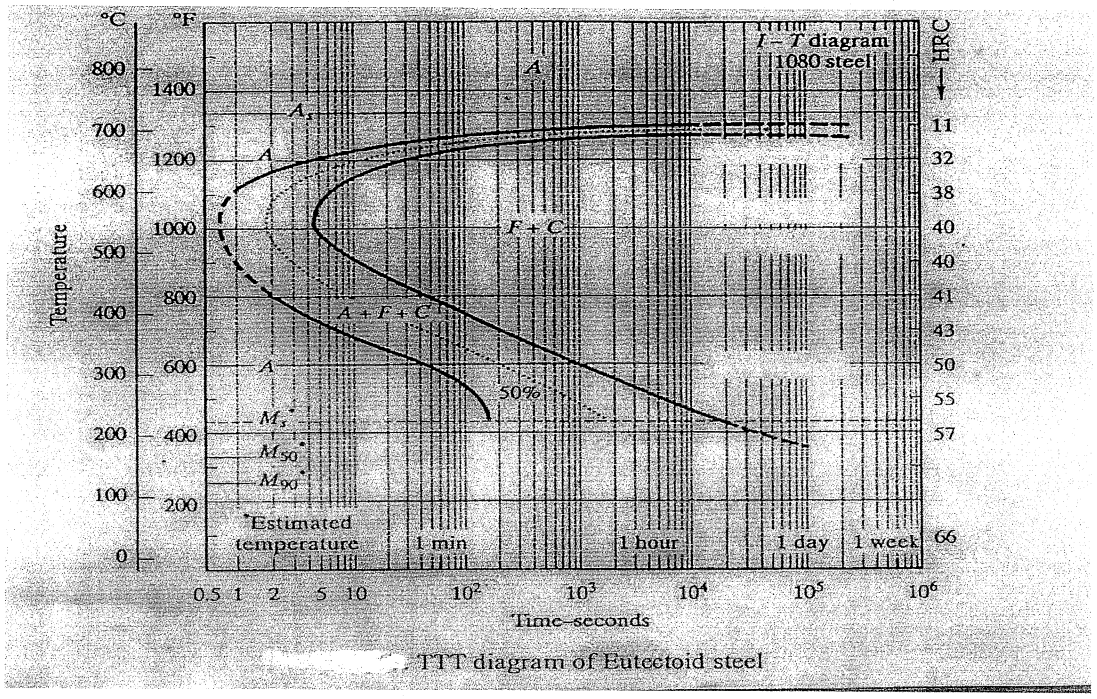

Fig. 1

Q.2 A phase diagram of a binary alloy system A-B is shown in Fig.(2) given at the end of this paper.

(a) Label the phase(s) in areas 1-6.
Name the reaction which occurs at point E and explain the reaction.

(Remember to attach the phase diagram with the answer script)

(b) Considering an alloy containing A-72wt% and B-28wt%, state the phase change when cooling from T_{ma} to T_0.

(c) Calculate the amounts of liquid and solid present at temperature T_x for the above alloy.

Q.3 Discuss and analyze any **three** of the following topics from an engineering view point.

(a) Types of cast iron and their applications.
(b) Types of polymers and their applications.
(c) Types of stainless steels and their applications.
(d) Types of strengthening mechanisms.
(e) Invariant reactions occur in Iron-Carbon phase diagram.

Q.4 (a) What is a casting process? Discuss the situations in which casting processes would be preferred over other manufacturing processes.

(b) Discuss briefly the six basic steps that are involved in most casting processes.

(c) What functions does the gating system offer in a mold during a casting process? Discuss.

Q.5 (a) What is the fundamental difference between a fusion welding process and a solid-state welding process? Give examples for the above two types of welding processes.

(b) Briefly explain the MIG and TIG welding processes.

(c) What is meant by weld quality? Explain the factors which influence weld quality.

Q.6 (a) Understanding the relationship between dependent and independent variables is of utmost importance in the area of metal forming. What is meant by the dependent and independent variable in relation to metal forming processes?

(b) What are the effects of strain hardening on mechanical properties of a metal? Discuss the ways in which the effects of strain hardening can be minimized.

(c) Distinguish between hot and cold forming of metals.

Q.7 (a) Calibration of measuring instruments plays a vital role in metrology. Briefly explain the importance of calibration with respect to measuring instruments.

(b) Giving suitable examples, explain the types of measurement errors encountered when taking measurements. How would you propose to eliminate or minimize these errors?

(c) Discuss the various branches in metrology.

Q.8 (a) Machining operations are generally carried out on work-pieces after other manufacturing processes such as casting and forming operations, due to their unique characteristics. What are the characteristics of machining operations?

(b) Discuss briefly the classifications of machining operations. Elaborate by giving suitable examples.

(c) With the aid of a neat sketch, indicate the important cutting angles for a single pointed cutting tool.

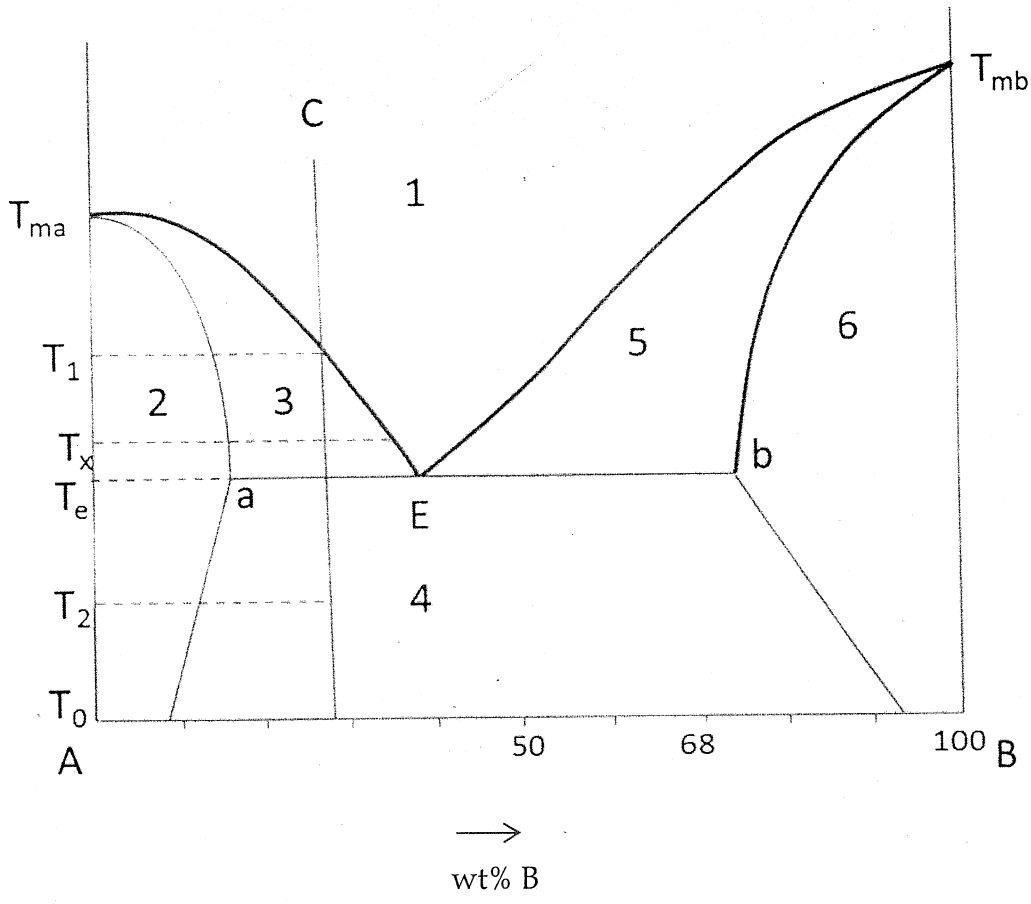

Fig. 2