THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
BACHELOR OF TECHNOLOGY - LEVEL 5
FINAL EXAMINATION - 2011/12

MEX 5272 - MATERIALS & MANUFACTURING TECHNOLOGY
DATE : 22nd MARCH 2012
TIME : 1400-1700 HRS
DURATION : 3 HOURS

ANSWER (05) QUESTIONS ONLY. ALL QUESTIONS CARRY EQUAL MARKS.

1. (a) Explain the terms "Phase" and "Equilibrium Phase Diagram" of materials.

(b) Two pure metals A and B are partially soluble in one another in solid state. Metal A has melting point of 1200^0 C. Metal A will dissolve 15% of B at 500^0 C and 2% at 0^0 C. Metal B has melting point of 1000^{0}C. Metal B will dissolve 10% of A at 500^0 C and 5% at 0^{0}C. The eutectic reaction occurs at 500^{0}C with composition 50%B.

(i) Construct the thermal equilibrium diagram for the above system and label the axes and all phase fields. Assume all phase boundaries are straight lines (Use a graph paper).
(ii) Briefly describe the solidification of an alloy containing 15% of metal B when cooled from 1000^{0}C under equilibrium conditions. Use your graph in section (i) to answer this question.
(iii) Calculate the percentage of liquid present at 800^{0}C when the alloy containing 15% of metal B.

2. Using the isothermal transformation diagram in Figure 2 , for a 1.13 wt% C steel alloy determine the final microstructure of a small specimen that has been subjected to the following time-temperature treatments. In each case assume that the specimen begins at 920^{0}C and that it has been held at this temperature long enough to have achieved a complete and homogeneous austenitic structure.

(a) Rapidly cool to 400^{0}C, hold for 500s, then quench to room temperature.

(b) Rapidly cool to 650^{0}C , hold at this temperature for 10s, rapidly cool to 450^0 C hold for 10 s and then quenched to room temperature.

(c) Determine the requirements for heat treatment (time temperature paths) to produce the following microstructures.

(i) 100% coarse pearlite
(ii) 50% martensite and 50% austenite
(iii) 50% coarse pearlite, 25% bainite and 25% martensite

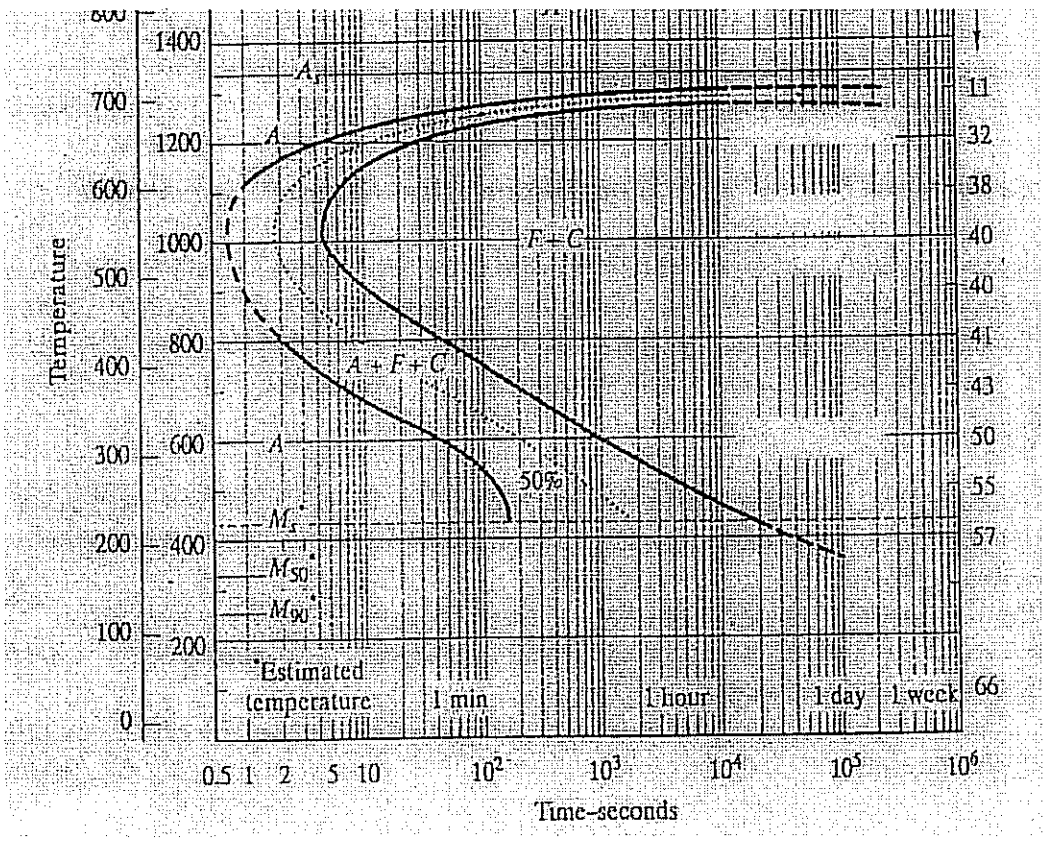


Figure 2

3. Discuss and analyze any **three** of the following topics.

(a) Plain carbon steel
(b) Types of mechanisms available to increase the strength of metals
(c) Invariant reactions occur in Iron-Carbon Phase diagram
(d) Types of Cast Iron
(e) Three types of polymers

4. (a) Discuss the advantages and disadvantages of casting over other manufacturing processes.

   (b) Recommend the most suitable casting method to produce the following. Justify your answer.

      (i) Casting with complex design having several cores.

      (ii) Casting with thin walls.

      (iii) Casting made out of an alloy with high melting point.

   (c) What are the design aspects that have to be taken into consideration to avoid defects in castings?

5. (a) Distinguish orthogonal cutting from oblique cutting with regard to metal cutting operations. Elaborate on your answer with neatly drawn sketches.

   (b) Since various types of chips are formed during metal cutting processes, having an understanding about chip formation plays a significant role in analysing metal cutting and designing of machine tools. Explain.

   (c) What are advantages and disadvantages of machining over other manufacturing processes? Explain by taking suitable examples.

6. (a) Explain the difference between a fusion welding process and a solid-state welding process. Give examples for the above two types of welding processes.

   (b) Distinguish incomplete fusion from incomplete penetration. Briefly discuss the remedial action need to be taken in order to prevent incomplete fusion and incomplete penetration, during a welding process.

   (c) Describe the MIG welding process and identify its major application areas.

7. (a) Briefly discuss **five** (05) important characteristics that a measuring instrument should possess.

   (b) Giving suitable examples, explain the types of Working Standards used in measuring length.

   (c) Explain with the aid of neat sketches the Centre Line Average (CLA) and Ten point height of irregularities, numerical assessment methods in the context of surface texture measurement.

8. (a) How are the various types of manufacturing processes classified? Explain.

   (b) How do you select a manufacturing process for a particular job? Explain by using a suitable example.

   (c) Discuss impact of mechatronics in modern manufacturing industry.

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