THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
BACHELOR OF TECHNOLOGY – LEVEL 5
FINAL EXAMINATION – 2009/10

MEX 5272 – MATERIALS & MANUFACTURING TECHNOLOGY

DATE : 1ST APRIL 2010
TIME : 1400-1700 HRS
DURATION : 3 HOURS

019

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

1. The solidus and liquidus temperatures for two pure metals A & B in a Binary system are given below.

Composition wt% (A)	Solidus temperature (C^0)	Liquidus temperature C^0
0	938	938
10	1005	1147
20	1065	1226
30	1123	1278
40	1178	1315
50	1232	1346
60	1282	1367
70	1326	1385
80	1359	1397
90	1390	1408
100	1414	1414

(a) Construct the thermal equilibrium phase diagram for this system. (Use a graph paper)

(b) Label all phase fields in the diagram.

(c) Briefly describe the solidification of an alloy containing 15 % of A when cooled from 1250^0 C under equilibrium conditions. Use your diagram in section (a) above to answer this question.

(d) Determine the composition of the liquid and the solid present in equilibrium at 1100^0C in an alloy containing 20% of A.

2. Using the isothermal transformation diagram given in Figure 2, for an iron carbon alloy of eutectoid composition, 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 the time-temperature treatments as given in (a) to (e). In each case assume that the specimen begins at 760^{0}C and that it has been held at this temperature long enough to have achieved a complete and homogeneous austenitic structure.

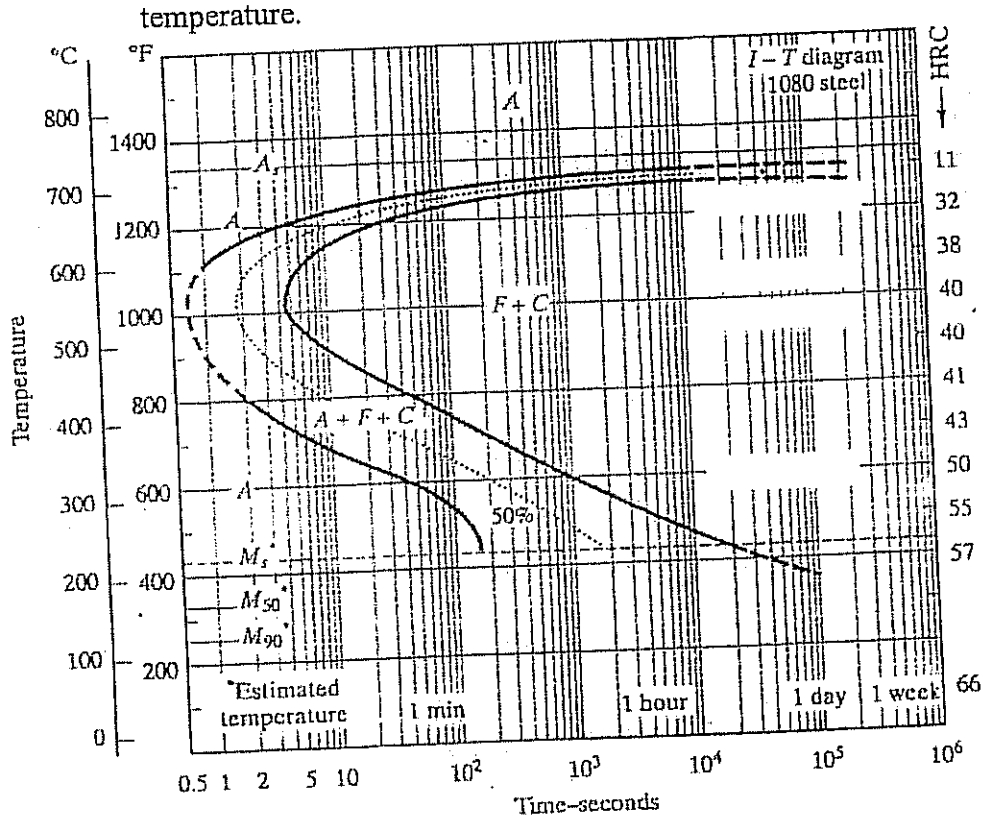
(a) Cool rapidly to 649^{0}C , hold for 10 secs and then quench to room temperature.

(b) Cool rapidly to 620^{0}C, hold for 4 secs , rapidly cool to 450^{0}C, hold for 5 secs and then quench to room temperature.

(c) Cool rapidly to 400^{0}C, hold for 2 secs and then quench to room temperature.

(d) Cool rapidly to 400^{0}C, hold for 20 secs and then quench to room temperature.

(e) Cool rapidly to 250^{0}C, hold for 100 secs and then quench to room temperature in water. Reheat to 315^{0}C for 1 hr and slowly cool to room temperature.



TTT diagram of Eutectoid steel

Figure 2

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

(a) Three categories of polymer
(b) Types of Heat treatment used to increase the strength of metals
(c) Effect of various alloying elements on steel
(d) Types of stainless steel
(e) Invariant reactions occurring in Iron-Carbon Phase diagram

4. (a) Discuss why Metrology is important in manufacturing engineering.

(b) Distinguish between 'Measurement' and 'Inspection' in the context of Metrology.

(c) The thickness of a plate was measured using three different length measuring instruments and the readings are represented graphically as shown in Figures (i), (ii) and (iii).

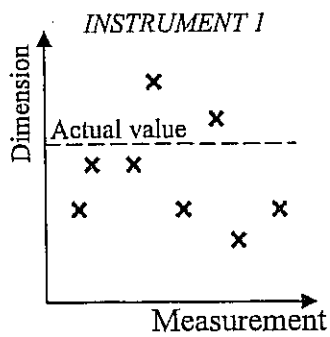


Figure (i)

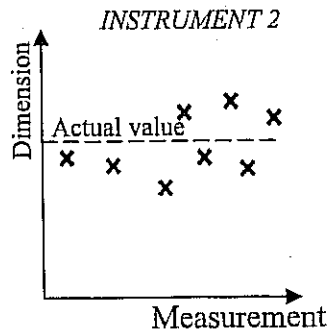


Figure (ii)

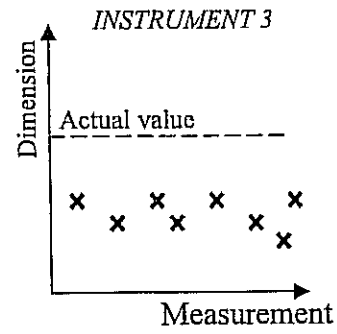


Figure (iii)

(i) Comment on the Accuracy and Precision of the three measuring instruments used in taking the measurements. Justify your answer by using the above figures

(ii) What are the conditions that need to be satisfied when arriving at the above conclusions?

5. (a) "In metal deformation processes, engineering stress and strain are of secondary importance"
In view of the above, describe the important stresses and strains involved in metal deformation processes.

(b) Describe the phenomenon of cold working and hot working and discuss their effect on strength and ductility of metals. With suitable illustrations give examples for hot and cold deformation processes.

(c) List out the advantages and disadvantages of forming processes over other material removal by metal cutting processes.

6. (a) What are the advantages and disadvantages of welding compared to other types of joining processes?

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

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

7. (a) Illustrate positive and negative top rake angle for a single point cutting tool. Use neat sketches to explain your answer. Under what conditions are, positive and negative rake angles recommended?

(b) What is understood by the term 'tool life' in relation to a cutting tool? Enumerate the factors on which tool wear and tool life depend.

(c) Draw a typical curve which represents tool wear against tool life and answer the following questions.

(i) Name the different regions of the curve
(ii) What information can you infer from the different regions of the curve with respect to the cutting edge of the tool?

8. (a) Explain the importance of surface finish measurement in the context of metal cutting. Quote suitable examples to clarify your answer.

(b) Within the scope of surface texture, distinguish between roughness and waviness. What causes these types of surfaces? (Give at least two (02) examples each)

(c) What are the different methods available for measuring surface texture? Explain at least one of these methods giving suitable examples.

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