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The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Bachelor of Technology Honours in Engineering
Name of the Examination	:	Final Examination
Course Code and Title	:	**MEX5272 –Materials and Manufacturing Technology**
Academic Year	:	2016/17
Date	:	**17th November 2017**
Time	:	**1400-1700 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.

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1. (a) With the aid of sketches, briefly explain complete solid solubility and partial solid solubility in alloys. **4 marks**

(b) Construct the phase diagram for two pure metals A and B which are partially soluble in one another in the solid state. Following information are given.

(i) The melting temperature of A is 600°C.
(ii) The maximum solubility of B in A is 4 wt% B, which occurs at 400°C.
(iii) The solubility of B in A at room temperature is 0 wt% B.
(iv) Eutectic reaction occurs at 400°C and 40 wt% A-60 wt% B.
(v) The melting temperature of B is 650°C.
(viii)The maximum solubility of A in B is 5wt%A, which occurs at 400°C.
(ix) The solubility of A in B at room temperature is 0 wt% A.

(Draw all boundaries using straight lines.) **6 marks**

(c) Using the above phase diagram answer the following.

(i) Mark all phase fields. **3 marks**

(ii) For an alloy containing 30wt% A, describe the process of solidification from 700°C 3 marks

(iii) Calculate the amount of liquid and solid present at 450°C and at 30 wt% A. 4 marks

2. (a) Differentiate between Hardness and Hardenability. **5 marks**

(b) A cylindrical piece of component of diameter 50 mm will be made with alloy steel. The candidate materials are 1040, 5140, 8640, 4140 and 4340 alloy steels. The component will be austenized and quenched in moderately agitated oil and the surface and center hardnesses must be at least 50 HRC and 46 HRC respectively.

(i) What is the carbon content of these alloy steels? **5 marks**

(ii) Determine the hardnesses of these alloys at the surface and the centre, if it was quenched in moderately agitated oil. Comment on which of the alloys will satisfy the hardness requirements.

Cooling rate as a function of diameter and the Hardenability curves for different alloy steels are given in Fig.2(a) & Fig.2 (b) respectively. **10 marks**

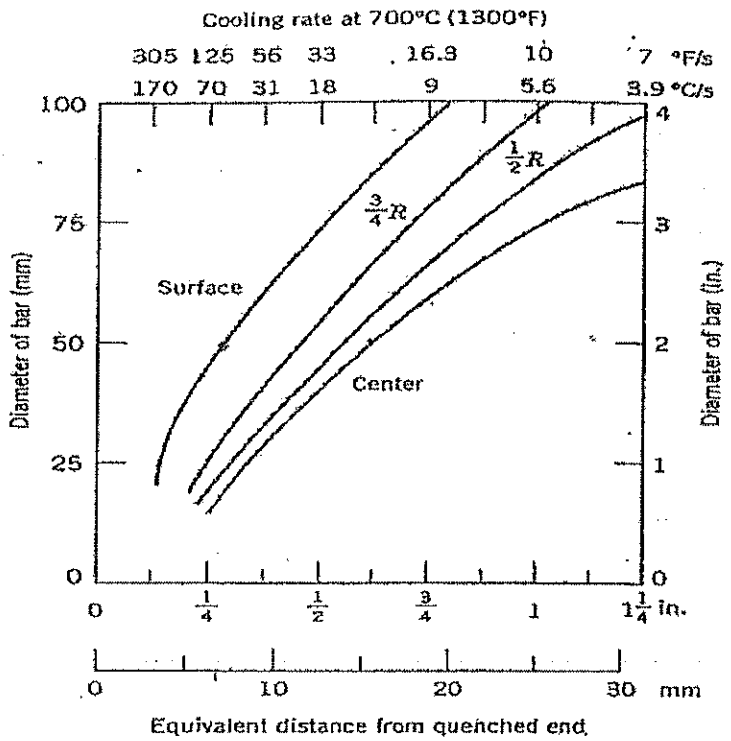


Fig. 2 (a) Cooling rate as a function of diameter at surface, three-quarter radius(3R/4), mid radius (1/2 R) and center positions for cylindrical bars quenched in moderately agitated oil.

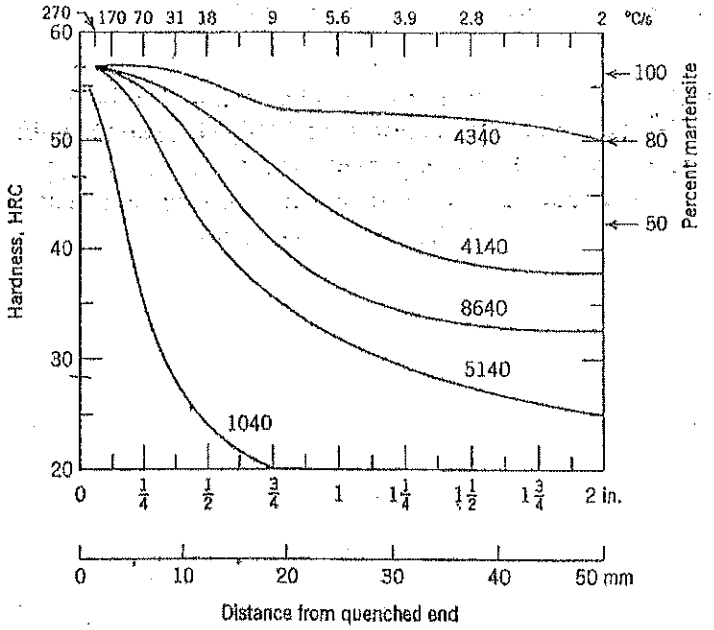


Fig. 2 (b) Hardenability curves for five different alloy steels.

3. Discuss and analyze any **three** of the following topics. **20 marks**

(a) Strengthening mechanisms which are used to strengthen a material.

(b) Three types of polymers and their applications.

(c) Types of stainless steels and their applications.

(d) Invariant reactions that occur in Iron-Carbon phase diagram.

(e) Types of cast iron and their applications.

4. (a) Why is manufacturing considered to be an important contributory aspect of a country's economic growth? Explain. **6 marks**

(b) What are the types of manufacturing processes/technologies involved in the primary sector of an industry? Elaborate by taking a suitable example. **7 marks**

(c) What are the key factors involved in manufacturing of products? Discuss how these factors would affect the final products and manufacturing as a whole. **7 marks**

5. (a) Distinguish between primary and secondary manufacturing processes. Give examples for each process. **6 marks**

(b) Explain with a suitable example how you would select an appropriate manufacturing process/s for the production of a particular product. **7 marks**

(c) Explain the importance of materials in manufacturing engineering? Select a suitable example to elaborate. **7 marks**

6. (a) Metrology is the science of measurement. Discuss the significance of metrology in manufacturing. **5 marks**

(b) Briefly discuss at least four (04) important characteristics that a measuring instrument should possess. **8 marks**

(c) What are the common types of errors encountered in Metrology? Briefly discuss the ways in which you would rectify these errors. **7 marks**

7. (a) Compare and contrast between non-consumable and consumable electrode type arc welding processes. **6 marks**

(b) What are the main three types of friction welding processes employed in the industry? Explain them briefly **6 marks**

(c) Briefly discuss four (04) welding defects commonly encountered during and after a welding operation. Propose ways in which these defects could be minimized or eliminated. **8 marks**

8. (a) Distinguish between casting and moulding processes. Give examples for each of the processes. **6 marks**

(b) Explain the design considerations that have to be taken in order to avoid defects in castings. **7 marks**

(c) Discuss the requirements that need to be satisfied, in selecting sand for a moulding. **7 marks**

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