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The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Mechanical Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: DMX5572 / MEX5272**
	Materials and Manufacturing Technology
Academic Year	: 2017/18
Date	: 25th January 2019
Time	: 1400-1700hrs

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Eight (8)** questions.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. This is an Closed Book Test (CBT).
6. Answers should be in clear hand writing.
7. Do not use Red colour pen.

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1. (a) State the **four** factors that affect the solubility in formation of substitutional solid solutions.

   (b) The Fig. (1) shows the Hafnium-Vanadium phase diagram. Using the phase diagram answer the following.

   (i) Label the phase/s in areas marked 1-8 in the phase diagram.

   (ii) For an alloy containing 10wt% Vanadium and 90 wt% Hafnium, describe the process of solidification from 2000^{0}C.

   (iii) Calculate the amount of liquid and βHf present at 1600^{0}C and at 10 wt% Vanadium.

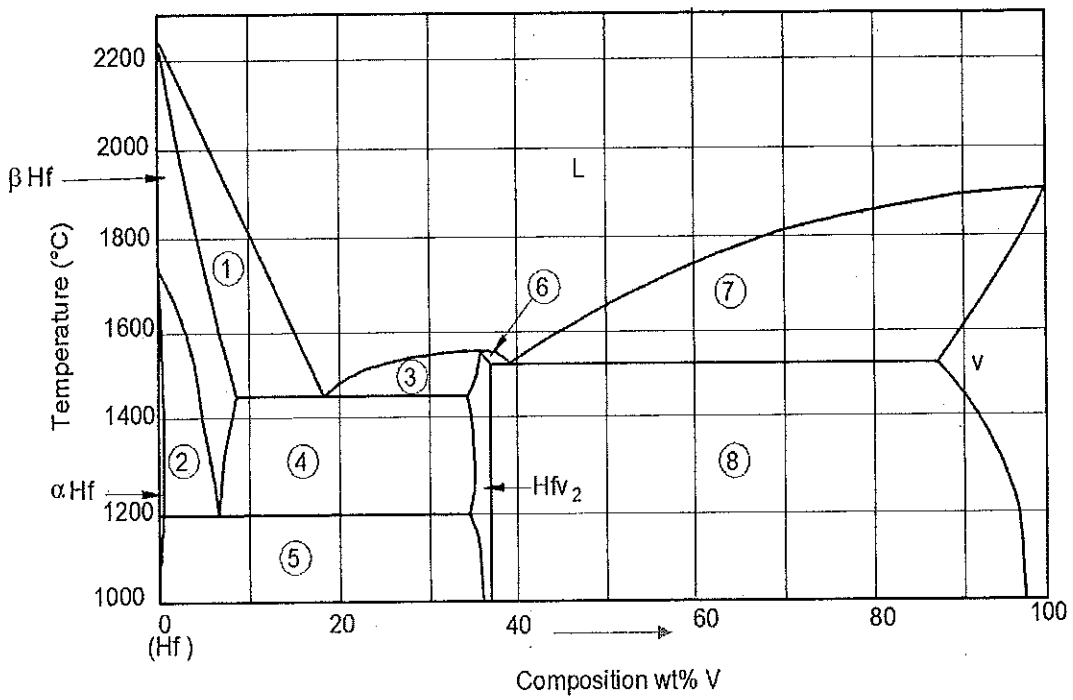

Fig. (1)

2. (a) What is the use of Time-Temperature Transformation (TTT) curves?

(b) Using the isothermal transformation diagram given in Fig. 2, for an iron-carbon alloy of eutectoid composition, specify the nature of the final microstructure (in terms of microconstituents present and approximate percentages) of a small specimen that has been subjected to the following time-temperature treatments. In each case assume that the specimen begins at 760^0C and that it has been held at this temperature long enough to have achieved a complete and homogeneous austenitic structure.

(a) Rapidly cool to 350^0C, hold for 10^4 s, and quench to room temperature.

(b) Rapidly cool to 250^0C, hold for 100s, and quench to room temperature.

(c) Rapidly cool to 650^0C, hold for 20 s, rapidly cool to 400^0C, hold for 10^3 s, and quench to room temperature.

(d) Determine the requirements for heat treatment (Time-Temperature paths) to produce the following microstructures.

(i) 50% fine pearlite and 50% martensite

(ii) 50% martensite and 50% austenite

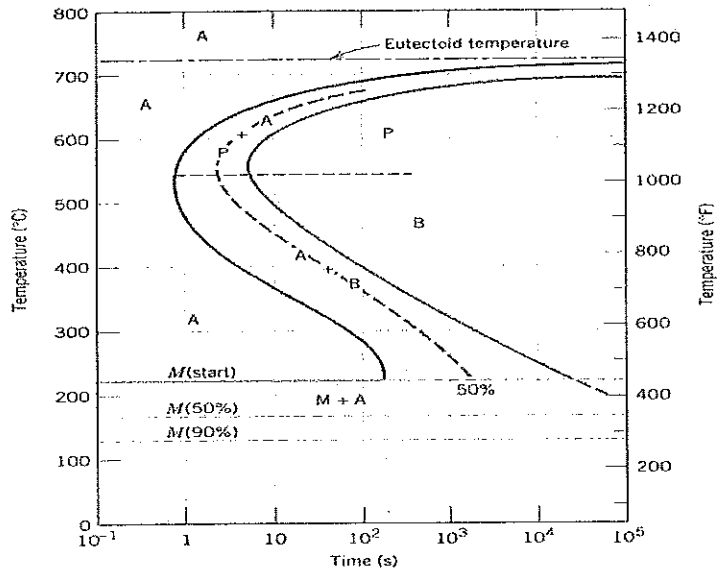

Fig. 2- The complete isothermal transformation diagram for an iron-carbon alloy of eutectoid composition: A-austenite, B—bainite, M-martensite, P-perlite.

3. (a) Briefly explain different types of cast iron and their applications.

(b) List the strengthening mechanisms used to strengthen a material. Explain two of them in detail.

(c) Briefly explain categories of Plain-Carbon steel and compare their properties.

4. (a) Distinguish between Manufacturing and Production. Elaborate on your answer by taking suitable examples.

(b) Manufacturing plays a major contributory factor towards the economic health of a country and is currently facing various challenges, due to the nature of highly competitive global market environment. Explain the importance of studying manufacturing technology, in the context of meeting the challenges faced by the modern manufacturing industry.

5. (a) Mechatronics have revolutionized the modern-day manufacturing systems. Discuss the role played by mechatronics in making the current manufacturing processes and systems more efficient and effective. Take suitable examples to illustrate your answer.

(b) Consider the following products given below. Discuss and justify the selection of materials, manufacturing processes and technologies in the context of form, fit and function.

i) Overhead electrical transmission lines.
ii) A soda can (Eg: Coca-cola or any other similar soft beverage).
iii) CPU air cooler.
iv) An automobile engine block.

6. (a) What is unique about welding when compared with other joining processes? Explain.

(b) In solid state welding, discuss the importance of maintaining a clean faying surface of the parts to be joined.

(c) Distinguish between solid state welding and fusion welding.

(d) What causes porosity in welding? State at least four precautionary measures that could be adopted in order to minimize or prevent porosity

7. (a) Distinguish between traditional and non-traditional material removal processes. Why has there been a vast development in the area of non-traditional material removal processes?

(b) Briefly explain one of the non-traditional material removal processes that are widely used in the manufacturing industry.

(c) Explain the importance of studying the formation of chips during a cutting operation.

(d) Explain the involvement of mechatronics in material removal systems.

8. (a) What is the basic difference between direct-reading and indirect-reading with respect to linear measurements? Name the instruments used in each category.

(b) Describe the operational principle of an optical comparator.

(c) Why do manufacturing processes produce parts with a wide range of tolerances? Explain, giving suitable examples.

(d) Discuss how you would use mechatronics in Metrology. Elaborate by taking a suitable example.