

Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
400 level 1st Semester Examination - June/July 2017
SCT442-2 Metallurgy



Instructions to candidates

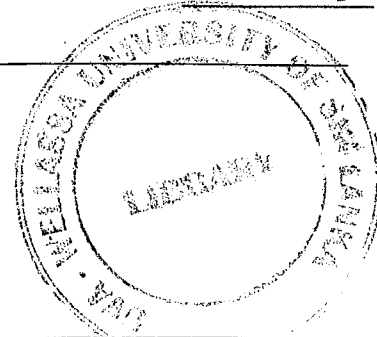
Duration: Two (02) hours

Number of questions: Six (06)

Mark allocation: 100

Answer only five questions

Attach annex 01 to the answer sheet

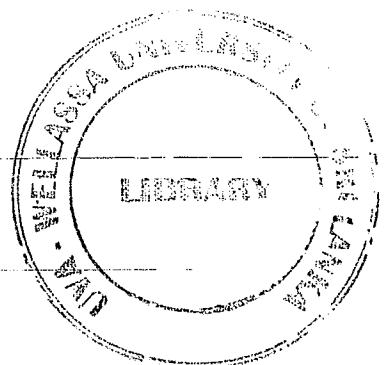


1.
 - a. Briefly explain grains structure of metals. (03 marks)
 - b. List out factors effect for the metal grain size and briefly explain one factor. (04 marks)
 - c. Describe allotropy of iron and their various phases. (03 marks)
 - d. Mark below all points in the given iron carbon diagram (see Figure 1)
 - I. Eutectoid point and Eutectic point with temperature and carbon content. (02 marks)
 - II. Transformation temperatures - A_1 , A_2 , A_3 and A_{CM} (04 marks)
 - III. Phase of each region. (04 marks)
2. One of the manufacturing companies produces steel wire by using hot Extrusion process. Their main raw material is AISI 1039 steel. In the manufacturing process, steel billet is put into the extruder and inside temperature of the extruder is kept at 800°C . After the extrusion process, the wires are cooled. The cooling rate of the product can be controlled. Normally, they are used slow cooling rate.
 - a. Determine carbon content of their raw material. (02 marks)
 - b. Calculate ferrite content of the final product or steel wire. (04 marks)
 - c. Draw phase changes variation of the steel wire from 800°C to room temperature. (05 marks)
 - d. During quality assurance process, they have recognized; strength of one batch of steel wire is lower than their standard level. Give your suggestions to improve their strength up to standard level. (04 marks)

- e. Discuss advantages and limitations of plain carbon steel with compare to the alloy steel. (05 marks)
3. Tool steel is a variety of carbon and alloy steels that are particularly well-suited to be made into tools.
- Name four types of tool steel. (04 marks)
 - Select one type from part (a) and discuss including their properties and applications. (04 marks)
 - Explain briefly, aluminum is recognized in highest ranking material in use next to steel. (02 marks)
 - Name two types of heavy metals and refractory metals. (04 marks)
 - Discuss their properties and applications Selecting one heavy metal and one refractory metal. (06 marks)
4. AISI 1045 steel samples are taken and First sample is full annealing, second sample is normalizing and third sample is quenching using water. Then final mechanical properties are checked.
- Briefly explain important of heat treatment for the steel industry. (04 marks)
 - What are the factors to be considering before do heat thaetment process and discuss one factor? (05 marks)
 - Compare and discuss above three heat treatment processess. (05 marks)
 - What are the expected mechanical properties of final product? Compare and discuss. (06 marks)
5. a. What is the difference between steel and cast iron? (03 marks)
- Name three types of cast iron and explain one of them. (05 marks)
 - Ni, Cr and Mn are the most important alloy elements for steel industry. Discuss the addition of Ni, Cr and Mn for steel industry and applications. (06 marks)
 - What are the main types of stainless steels and discuss one of them including their properties and applications. (06 marks)

6. Materials testing laboratory of the Industrial Institute was received three different steel samples (M_1 , M_2 , and M_3) to do the tensile test. Tensile testing were done for all three samples having circular cross section with length 10 cm and diameter 1cm and their stress strain curves are drawn as Figure 2. Initial and final area and yield stress of each sample are included Table 1.

- a. What is the difference between elastic and plastic region of the stress strain curve of a metal? (02 marks)
- b. Determine area reduction, ultimate strength, fracture strength and elastic modulus of each metal type. (08 marks)
- c. Compare and discuss their mechanical properties. (06 marks)
- d. Fatigue test and toughness test are important tests for the metallurgy industry. Discuss fatigue and toughness properties of metals. (04 marks)



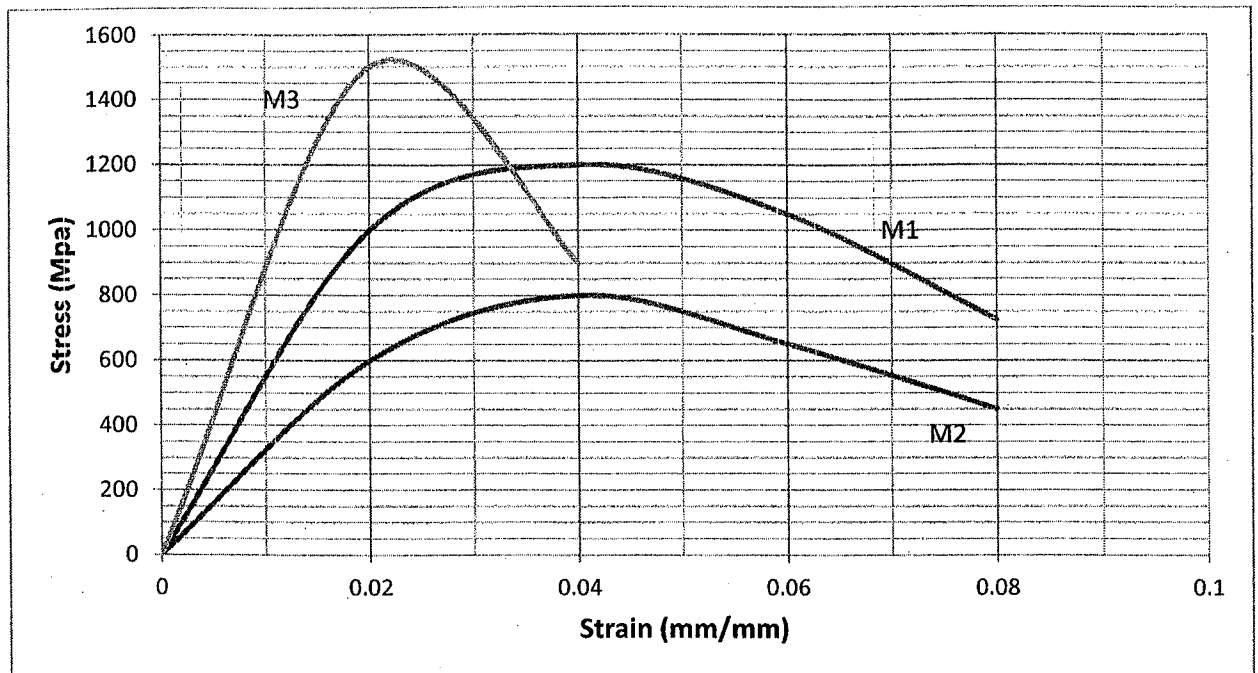
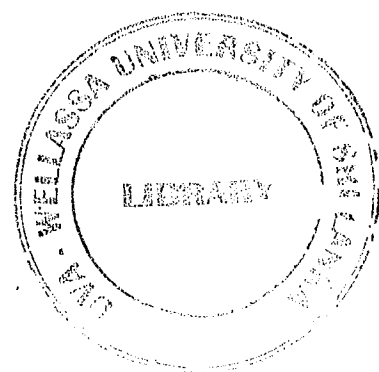


Figure 2: Stress-Strain Curve

Table 1

Sample No	Initial Area	Final Area	Yield Stress (Mpa)
M ₁	A ₀	0.6 A ₀	1000
M ₂	A ₀	0.6 A ₀	600
M ₃	A ₀	0.8 A ₀	1400



Annex 01

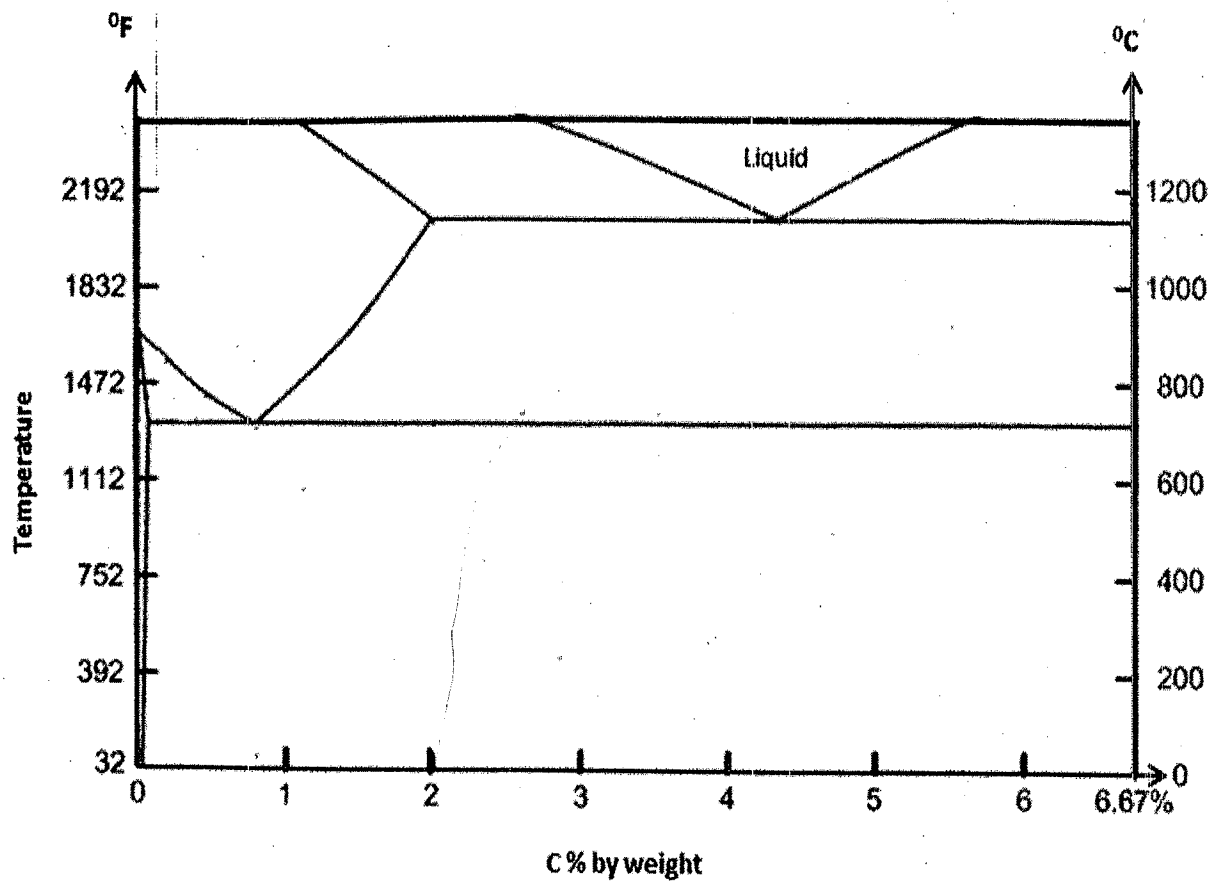


Figure 1: Iron - Carbon Phase Diagram