

KIBABII UNIVERSITY

MAIN UNIVERSITY EXAMINATIONS

ACADEMIC YEAR 2021/2022

THIRD YEAR SECOND SEMESTER EXAMINATIONS

BACHELOR OF SCIENCE

COURSE CODE: SPM 323

COURSE TITLE: THE STEELS

DATE: 30/08/2022

TIME: 2:00PM-4:00PM

INSTRUCTIONS TO CANDIDATES

Answer question ONE and any TWO of the remaining.

Time: 2 hours

KIBU observes ZERO tolerance to examination cheating

QUESTION ONE (30 MARKS)

- a) State any three areas where steel is used. (3 marks)
- b) Name three types of carbon steel (3 marks)
- c) Inter-granular corrosion occurs when austenitic stainless steels are subjected to prolonged heating between 450 – 850° C. Highlight any three ways to avoid inter-granular corrosion (3 marks)
- d) What is a time, temperature, transformation (TTT) diagram (2 marks)
- e) Define plastic working (2 marks)
- f) State any three reasons why heat treatment processes are carried out (3 marks)
- g) Name two major steel numbering systems that are widely used in steel industries (2 marks)
- h) State and explain any two types of steel based on steel smelting (de-oxidation) process (4 marks)
- i) What are austenitic steels? (2 mark)
- j) State and explain any two main welding processes used to join steel. (4 marks)
- k) What is meant by hardenability of steel? (2 marks)

QUESTION TWO (20 MARKS)

- a) What is an alloy steel (2 marks)
- b) Alloying in steel is done using several alloying elements including nickel, chromium, tungsten, vanadium, manganese, silicon, cobalt and molybdenum. Discuss the effect of each alloying element on steel. (18 marks)

QUESTION THREE (20 MARKS)

- a) What is heat treatment of steel? (2marks)
- b) Discuss the different types of heat treatment processes of steel. (18 marks)

QUESTION FOUR (20 MARKS)

a) Figure 1. below shows a time temperature transformation (TTT) diagram for a 1080 steel.

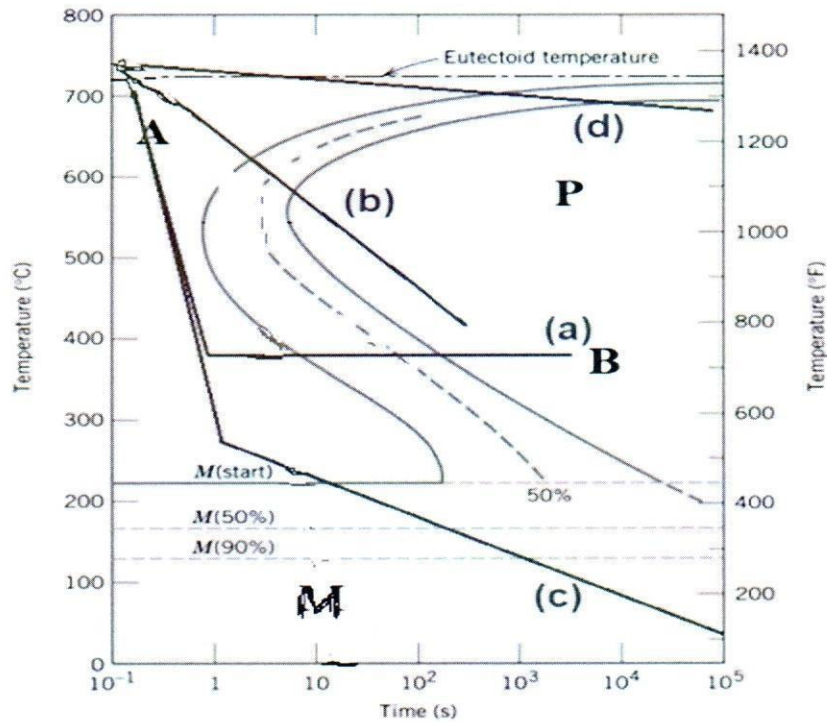


Figure 1.

- (i) What is the name of heat treatment (a)? (2 marks)
- (ii) What is the resulting structure for heat treatment (b)? (2 marks)
- (iii) Why does heat treatment (c) change cooling rates at approximately 275°C? What is the main advantage of processing in this way? What is the name of this treatment? (3 marks)
- (iv) On the TTT diagram, draw a new cooling curve that would produce a microstructure of 50% fine pearlite and 50% martensite (start at approximately 750°C) (3 marks)
- b) What is quenching? (2 marks)
- c) Discuss four methods used for quenching steel. (8 marks)

QUESTION FIVE (20 MARKS)

- a) Discuss four circumstances under which cracking in structural steel may occur (8 marks)
- b) Figure 2 below shows three compositions of plain carbon steel cooled very slowly in a turned-off furnace from approximately 830°C. For each composition, the FCC grains of γ -austenite (prior to transformation) are shown in an optical monograph of the material surface.

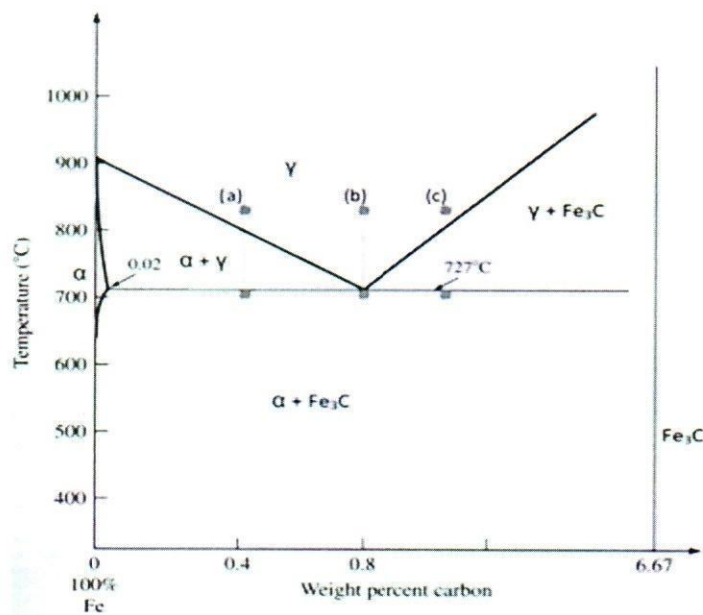


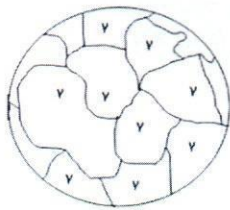
Figure 2

- (i) Sketch and label the phases making up the microstructures present in the right hand micrograph just after the austenite has completed transformation (note: the outlines of the prior γ -grains may prove helpful).

Part (a)

(3 marks)

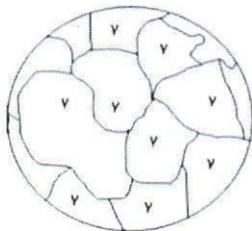
$C_0 = 0.42\% C$ (by wt).
830°C



Part (b)

(3 marks)

$C_0 = 0.80\% C$ (by wt).
830°C

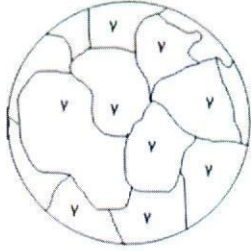


Part (c)

(3 marks)

$C_0 = 1.05\% C$ (by wt)

$830^\circ C$



- (ii) For the composition of part (c), $C_0=1.05\%C$ (by wt), calculate the fraction of the solid that is pearlite at $726^\circ C$. (3 marks)