



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
BSc. Mechanical Engineering
EMG 2201 : ENINEERING MATERIALS
END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2016
TIME: 2 HOURS
DATE: Pick Date Dec 2016

Instruction to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt any **THREE** questions.

Maximum marks for each part of a question are as shown.

Do not write on the question paper.

Question ONE

- Name EIGHT properties of CAST IRON (4 marks)
- Describe growth in cast irons (*4 marks*)
- Describe the following cast irons:
 - Nodular cast iron
 - Pearlitic malleable iron
 - White-heart malleable iron (*12 marks*)

Question TWO

- Why does a 0.5% C steel rust more quickly in the normalized condition than in the water quenched state? (2 marks)
- Describe 'wet corrosion'. (5 marks)
- With the aid of a simplified Pourbaix Fe/ H₂O system, explain how a study of this diagram can solve some corrosion problems. (8 marks).

d)

- (i) Describe the method of carburizing in a liquid bath
- (ii) Calculate the depth of case produced when a low carbon steel is carburized for 10 hours at 875° . ($k=0.44$) (5 marks)

Question THREE

- a) By quoting the iron-carbon equilibrium diagram, explain the phase changes as 1.2% C steel cools slowly from 1000°C to room temperature (7 marks)
- b) Describe, with the aid of appropriate sketches, how the mechanical properties of tensile strength, % elongation and hardness for normalized plain carbon steels vary with carbon content up to 1.2% C (6 marks)
- c) Explain with the aid of appropriate sketches, the production process for obtaining steel from iron ore. (7 marks)

Question FOUR

- a) Estimate the tensile strength of a steel containing 0.25% C, 1.4% Cr, 0.4% Mo, 1.5% Mn, 0.2% V and 2% Ni. (4 marks)
- b) A steel piece containing 0.3% C, 0.06% N, 0.7% Si, 3% Ni, 2% Ti, 2% Nb, 0.4% Mo and 18% Cr is heated to and held at 1100°C for some time. It is then cooled in still air. Determine the phases present in the structure after the heat treatment. (4 marks).
- c) Discuss the composition, properties and applications of alloy steels containing:
 - i) Manganese
 - ii) Boron
 - iii) Tungsten (12 marks)

Question FIVE

- a) Differentiate the terms 'wrought' and 'cast' alloys. (4 marks)
- b) Discuss:
 - i) brasses
 - ii) bronzes (7 marks)
- c) Discuss the following copper alloys:
 - i) Beryllium Bronze
 - ii) Titanium copper
 - iii) K-monel. (9 marks)

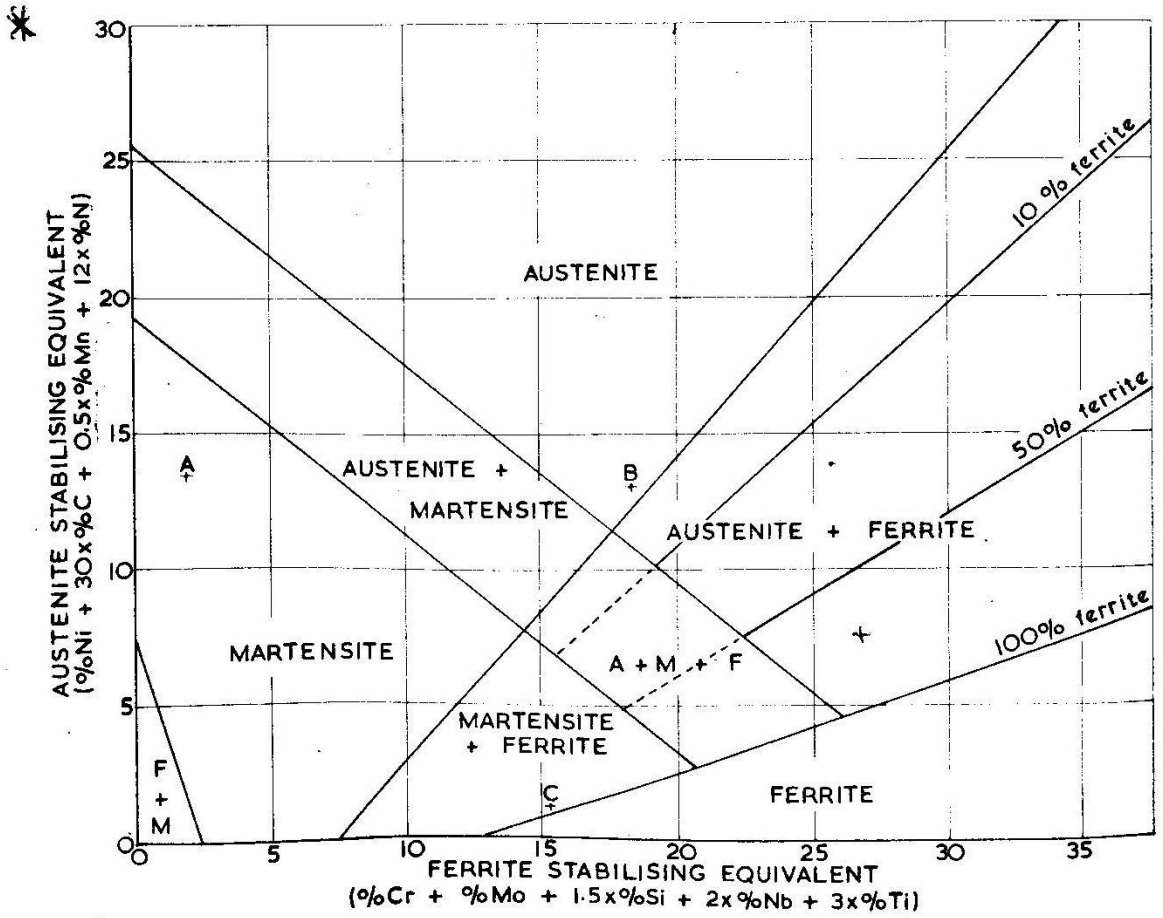


Fig.1 Schaefer Diagram

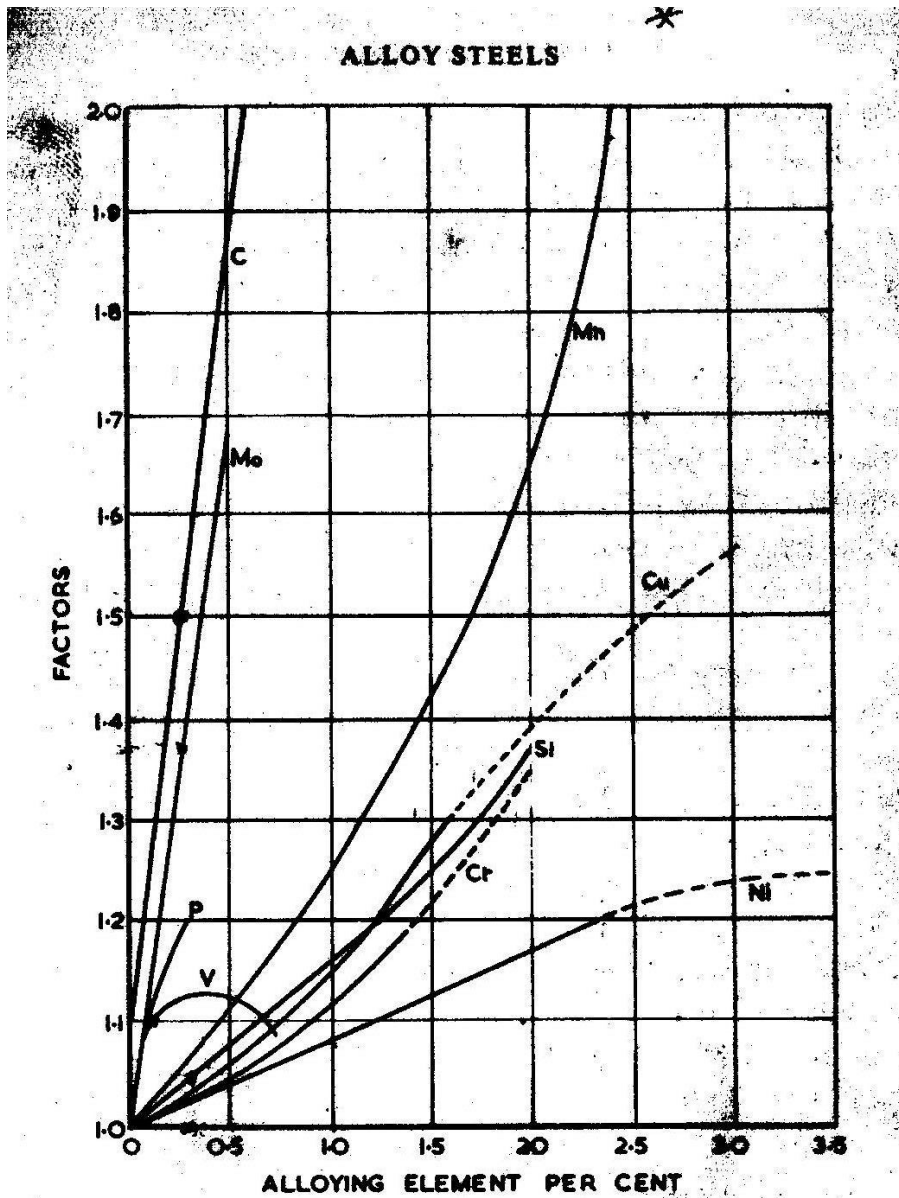


Fig.2 Walters Factors Diagram