UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 3 Examination in Engineering: July 2017

Module Number: ME 3302 **Module Name: Metallurgy for Engineers**

[Three Hours]

[Answer **all questions**, each question carries **12** marks]

Q1. a) The basic raw materials used for manufacturing of pig iron are iron ores, coke and limestone. State three principle forms of iron ores used in pig iron production and give examples.

[3.0 Marks]

b) *Bessemer process* and *open hearth process* are used for manufacturing of steel. Compare the above two different processes.

[2.5 Marks]

c) Sulfur remained in the steel deteriorates the properties of steel after forming processes such as hot rolling. Describe desulfurification of steel by ladle desulfurization method with a neat sketch. What are the materials use as desulfurizing agent?

[3.0 Marks]

d) Stainless steels can be classified according to the composition and crystal structure. List three different types of stainless steel and discuss briefly the differences among them.

[3.5 Marks]

Q2. a) Most of the metallic structures fail due to the corrosion. Name four types of metallic corrosion.

[2.0 Marks]

b) Define "Anodic reaction" and "Cathodic reaction/s" in electrochemical cell. Give examples.

[3.0 Marks]

c) i) Contact between dissimilar metals is normally avoided in engineering constructions and design of machine components that are likely to be exposed to corrosive media. Identify the type of corrosion occurs in the above situation and explain with a neat sketch.

[3.0 Marks]

ii) Discuss briefly the steps that can be taken to prevent and /or control the corrosion type mentioned in part (i).

[2.0 Marks]

d) Discuss briefly the advantages and disadvantages of electroplating as a prevention method of corrosion.

[2.0 Marks]

Q3. a) i) Why theoretical strength of commercially available metals is much higher than that observed experimentally?

[1.5 Marks]

ii) Explain with neat sketches, why 100 % pure metals are weaker than metal alloys?

[1.5 Marks]

iii) What are the primary functions of alloying elements in steel?

[2.0 Marks]

b) With the aid of suitable sketches briefly describe the two types of dislocations; *Edge dislocation* and *Screw dislocation*.

[4.0 Marks]

c) Hardness is an important property of materials. List three different hardness testing methods and briefly describe one of them.

[3.0 Marks]

Q4. a) Construct the binary phase diagram for metals A and B between room temperature (20°C) and 700°C using following information:
Melting temperature of metal A is 480°C.
Melting temperature of metal B is 600°C.
Eutectic reaction occurs at 400°C and at the composition of 20 wt% B - 80 wt% A.
Maximum solubility of B in A is 10 wt% B, which occurs at 400°C.
Maximum solubility of A in B is 80 wt% B, which occurs at 400°C.
Solubility of B in A at room temperature is 0 wt% B.
Solubility of A in B at room temperature is 95 wt% B.

[4.0 Marks]

b) Name all phase regions of phase diagram constructed in part (a) using following information:
α - Solid solution of B in A
β - Solid solution of A in B
L - Liquid

[1.0 Mark]

c) Properties of steel can be altered by heat treatments. Discus the major factors to be considered before heat treatment of steel.

[4.0 Marks]

d) i) State the four different quenching media used in hardening (quenching) process.

[1.0 Mark]

ii) Discuss briefly the phase transformation during hardening (quenching) process of medium carbon steel.

[2.0 Marks]

Q5. Write short notes on the following:

a) Intergranular corrosion

b) Carburizing of low carbon steel

c) Cast iron

d) Nickel alloys

[12.0 Marks]