

Instructions to candidates

Duration: 02 hours

Number of questions: 05

Mark allocation: 100

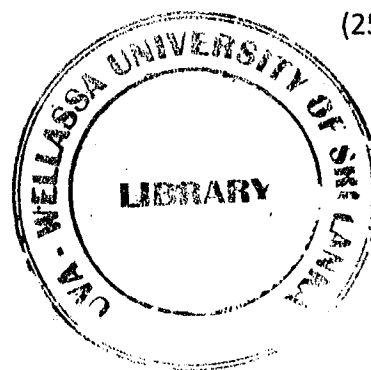
Answer four (04) questions only

- 1.
- What is the carbon content in 86100 steel?
 - Write down the main steps of processing an iron ore.
 - What are the carbon contents in *wrought iron*, *steel* and *cast iron*.
 - List the main ingredients needed for steel manufacturing.
 - State two advantages of **electrical induction furnace** over the **cupola furnace**, used for cast iron manufacturing.

(25 marks)

- 2.
- What is the type of *solid solution* existing in carbon steel?
 - Name the crystal structure types of α – iron, γ -iron and δ -ferrite. Out of these three forms of steel, name the room-temperature form and high-temperature form.
 - On a rough sketch of iron-carbon diagram drawn between 0-2% carbon and up to 1100 °C, mark the followings;
 - upper transformation temperature line*
 - lower transformation temperature line*
 - isothermal line at 727 °C
 - eutectoid invariant point
 - ferrite and austenite transformation region*
 - cementite and austenite transformation region*
 - State the carbon percentages found in *pearlite* and *pure cementite*.
 - Write down two important mechanical properties of cementite.

(25 marks)



3.

- a) List the three structural types of steel expected to form by slow-cooling of austenite to room temperature. What will be formed if the cooling is rapid?
- b) Name the two main mechanical properties that can be changed with the rapid cooling (*quenching*) of steel.
- c) With the help of a rough plot, explain the expected changes in temperature during the four stage quenching process.
- d) Define the term *annealing*.
- e) Highlight the differences between annealing and normalizing heat treatment techniques.

(25 marks)

4.

- a) Briefly explain why it is important to *case harden* cutting tools before use. What is really happening in the cutting tool under case hardening?
- b) What are the three basic methods used in *surface hardening*?
- c) Name the two chemical elements used to impregnate the steel surface under the *cyaniding* hardening technique.
- d) Briefly explain the *tempering* procedure by highlighting its effect on properties of steel.
- e) Name two types of special tempering processes.

(25 marks)

5.

- a) Name three strengthening mechanisms that are commonly used with nonferrous metals.
- b) Give two reasons for the extensive use of aluminium in power transmission lines.
- c) What are the main *alloying elements* added to copper for preparing brass and bronze?. Name the strengthening mechanism involved with brass formation.
- d) Explain the mechanism behind *galvanizing* of steel sheets.
- e) Briefly explain the steps of the *wave soldering* process, which uses a low temperature molten solder bath to connect electronic components in printed circuit boards.

(25 marks)