# UNIVERSITY OF RUHUNA

**Faculty of Engineering**

End-Semester 2 Examination in Engineering: February 2023

**Module Number: ME2302** **Module Name: Introduction to Materials Science and Manufacturing Engineering**

**[Three Hours]**

[Answer **all questions**]

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Question paper consists of two parts. Part I: Essay and Part II: MCQ

## Part I: Essay Questions

Answer all questions. Each question carries **10 marks**.

Q1. a) Mechanical properties of steel can be altered by heat treatments without changing the composition. State **four** main different heat treatment processes that use to alter the properties of steel.

[1.0 Mark]

b) Figure Q1 shows the Fe-$Fe_3C$ equilibrium phase diagram.

i) Name the missing phase regions marked as A, B, C, and D.

[1.0 Mark]

ii) As shown in the Figure Q1,(in • marks ), draw schematic sketches of the microstructure of a steel sample containing 1.5 wt% of carbon at 1100 °C, 800°C and 600 °C. Label all the phases.

[3.0 Marks]

c) Determine the following for the steel containing 99.85 wt% Fe and 0.15 wt% C at a temperature **just below the eutectoid**. (You may use the data given in Figure Q1)

i) Fractions of total ferrite and cementite phases

[2.0 Marks]

ii) Fractions of the proeutectoid ferrite and pearlite phases

[2.0 Marks]

iii) Fraction of eutectoid ferrite phase

[1.0 Mark]

Q2. a) State **two** functions of a riser in a sand mould.

[2.0 Marks]

b) Briefly explain **three** pattern types used in sand casting.

[3.0 Marks]

c) Explain with the help of neat sketches, the procedure of sand casting process of the solid object shown in Figure Q2.

[5.0 Marks]

Q3. a) What are the advantages and disadvantages of climb milling and conventional milling?

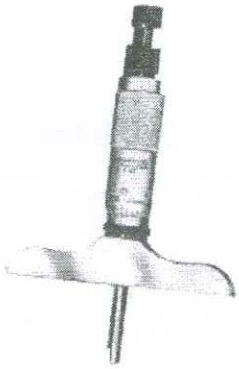
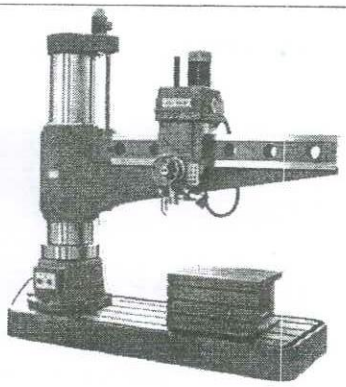
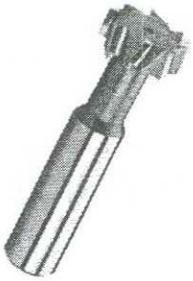
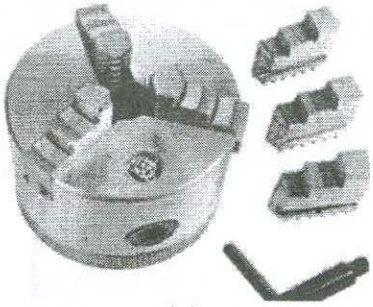
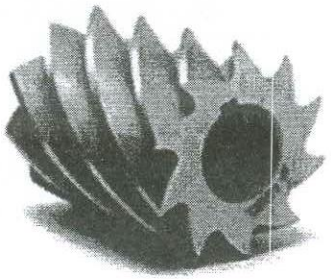
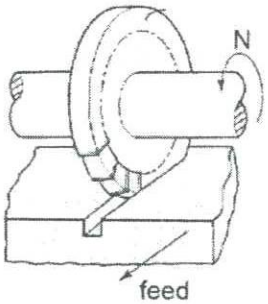
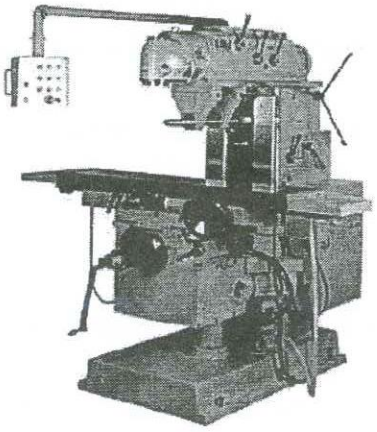
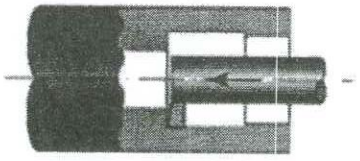
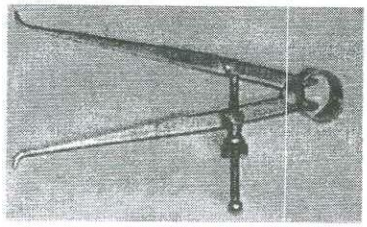
[3.0 Marks]

b) Figure Q3 shows a component of an oil pump. It has to be machined using a long steel rod of diameter slightly larger than maximum diameter of the component. Selecting a suitable machine/machines describe the procedure of machining the outer shape of the component shown in Figure Q3. You may show/describe the work holding method and the tools used during machining

[7.0 Marks]

Q4. Name the figures [(i) to (x)] shown in Table Q4.

**Table Q4**

| | | |
|---|---|---|
|  (i) |  (ii) |  (iii) |
|  (iv) |  (v) |  (vi) |
|   (vii) |  (viii) |  (ix)  (x) |

[10.0 Marks]

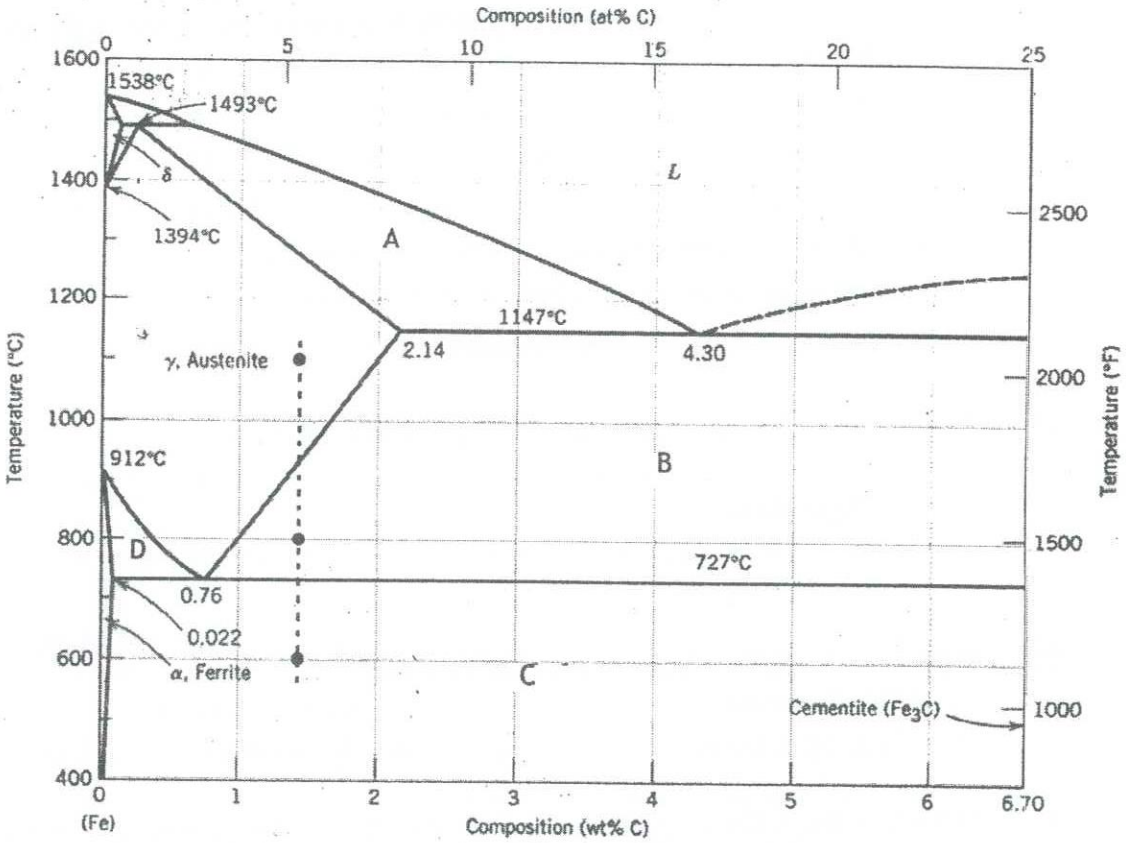



Figure Q1

Figure Q2

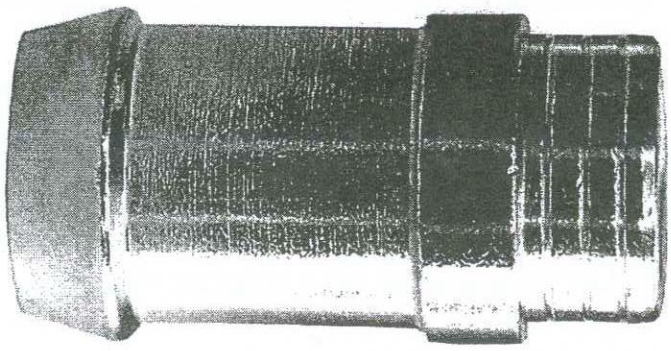


Figure Q3

## • Part II: Multiple Choice Questions (MCQ)

- Part II of this question paper contains 20 MCQ questions
- Answer all questions. Each question has only one answer.
- For each question, put **X** mark on the letter: a), b), c), or d) which corresponds to the correct answer, by using a black or blue ball-point pen.
- **Mark the answers on provided sheet (page 6).**
- Write your index number on answer sheet (page 6).
- Each question carries **1.0 Mark**.

1) Elements in the same column of the periodic table have:
   a) similar valence shell electron configuration
   b) same value of highest principal quantum number
   c) same number of nucleons
   d) all of the mentioned

2) Which of the following is a secondary bond?
   a) Metallic bond
   b) Hydrogen bond
   c) Covalent bond
   d) Ionic bond

3) Which of the following is a basic classification of Engineering Materials?
   a) Metals
   b) Non-Metals
   c) Both Metals & Non-Metals
   d) None of the mentioned

4) Which of the following is not a property of engineering materials?
   a) Mechanical properties
   b) Chemical properties
   c) Polymorphism
   d) Electrical properties

5) Which of the following attributes explain why pure metals are not frequently used in engineering applications?
   a) Softness
   b) Hardness
   c) Brittleness
   d) Luster

6) Which of the following is true for polymers?
   a) They have very high molecular mass
   b) They do not have a linear stress-strain curve
   c) They have high strength to mass ratio
   d) All of the mentioned

7) Which of the following is an example of a thermoplastic?
   a) Melamine
   b) Epoxide
   c) Urethane
   d) Polyethylene terephthalate

8) Which of the following is not a property of fiberglass?
   a) Nonflammable
   b) Reinforcement for plastics
   c) Thermal insulation
   d) Organic

9) Lead is a metallic crystal having a _____ structure.
   a) FCC
   c) HCP

b) BCC
d) TCP

10) Which of the following has an HCP crystal structure?
a) W
b) Mo
c) Cr
d) Zr

11) Amorphous solids have _____ structure.
a) regular
b) linear
c) irregular
d) dendritic

12) The smallest portion of the lattice is known as _____.
a) lattice structure
b) lattice point
c) bravais crystal
d) unit cell

13) What is the atomic radius of a BCC crystal structure?
a) a/2
b) a/4
c) $a\sqrt{2}/4$
d) $a\sqrt{3}/4$

14) What is the atomic packing factor of BCC structure?
a) 0.54
b) 0.68
c) 0.74
d) 0.96

15) Tensile test can be performed on
a) impact testing machine.
b) universal testing machine.
c) rockwell tester.
d) brinell tester.

16) The ability of the material to resist stress without failure is called?
a) Strength
b) Hardness
c) stiffness
d) toughness

17) The property of a material that resists penetration or indentation by means of abrasion or scratching is known as;
a) strength.
b) hardness.
c) toughness.
d) brittleness.

18) During hardness test the indenter is usually a
a) ball.
b) pyramid.
c) cone.
d) all of the above.

19) The impact test is done to test _____ of a material.
a) strength
b) ductility
c) toughness
d) hardness

20) Which of the following is found out by calculating the area under the stress strain graph?
a) Toughness
b) Endurance
c) Hardness
d) Strength