UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 2 Examination in Engineering: November 2016

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

[Three Hours]

[Answer **all questions,** All Questions carries TEN marks]

Part A

Q1. a) I. What is a sine bar?

II. Explain the procedure to use it using a sketch.

III. Discuss the limitations of the use of a sine bar.

[4.0 Marks]

b) I. Why should a pattern, as applied during sand casting, be tapered?

II. What is a shrinkage allowance?

III. What properties determine the quality of a sand mold for sand casting?

[4.0 Marks]

c) Identify the labeled items shown in the sectional view of the sand casting shown in the Figure Q1 (A to H)

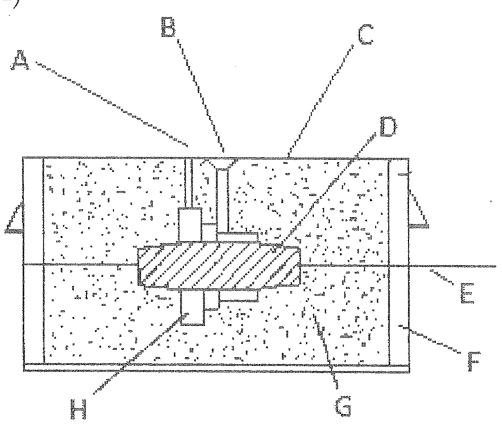
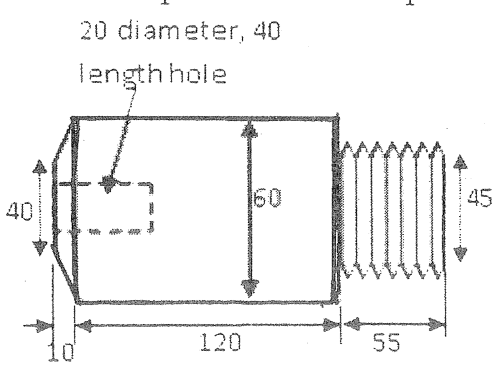


Figure Q1 [2.0 Marks]

Q2. a) The part shown in Figure Q2 is to be machined from 65mm diameter, 200mm long steel bar. Both end faces of the part should be very smooth. Suggest the machine/machines required and the sequence of operations to be performed.

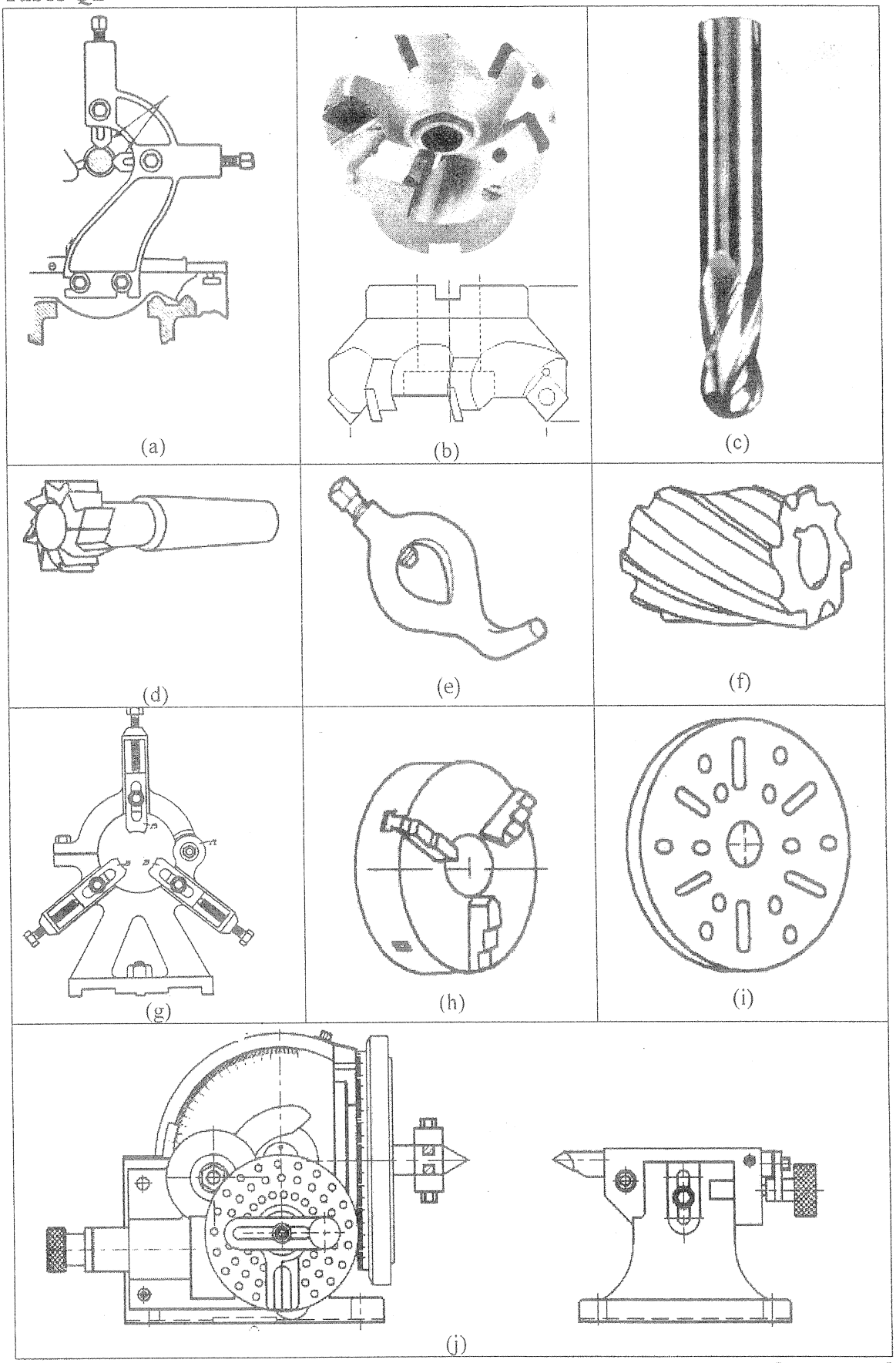


All Dimensions in mm

Figure Q2 [5.0 Marks]

b) Name the Figures [(a) to (j)] shown in Table Q2.

Table Q2



[5.0 Marks]

Part B

Q3. Composites and alloys are extensively used in various engineering designs.

a) Explain the differences between composite and metal alloy.

[2.5 Marks]

b) Why are polymeric fibers generally a better choice for low temperature (room temperature) applications but not for high temperature applications?

[2.5 Marks]

c) What are the functions of "Matrix" of a composite material?

[3.0 Marks]

d) Explain why sandwich composites with aluminum face sheets and high performance polymeric honeycombs are used in aircraft wings.

[2.0 Marks]

Q4. Study of the constitution and structure of all steels and irons must first start with the Iron- Iron carbide equilibrium diagram as shown in Figure Q4.

a) Briefly describe the following phases present in Iron- Iron carbide equilibrium diagram.

I. α- Ferrite

II. γ -Austenite

III. Fe_3C (Iron carbide or Cementite)

[4.5 Marks]

b) Name the phase regions marked as A, B, C, D, F and G in Figure Q4.

[1.5 Marks]

c) List four different heat treatment methods use in steel industries and describe one of them.

[4.0 Marks]

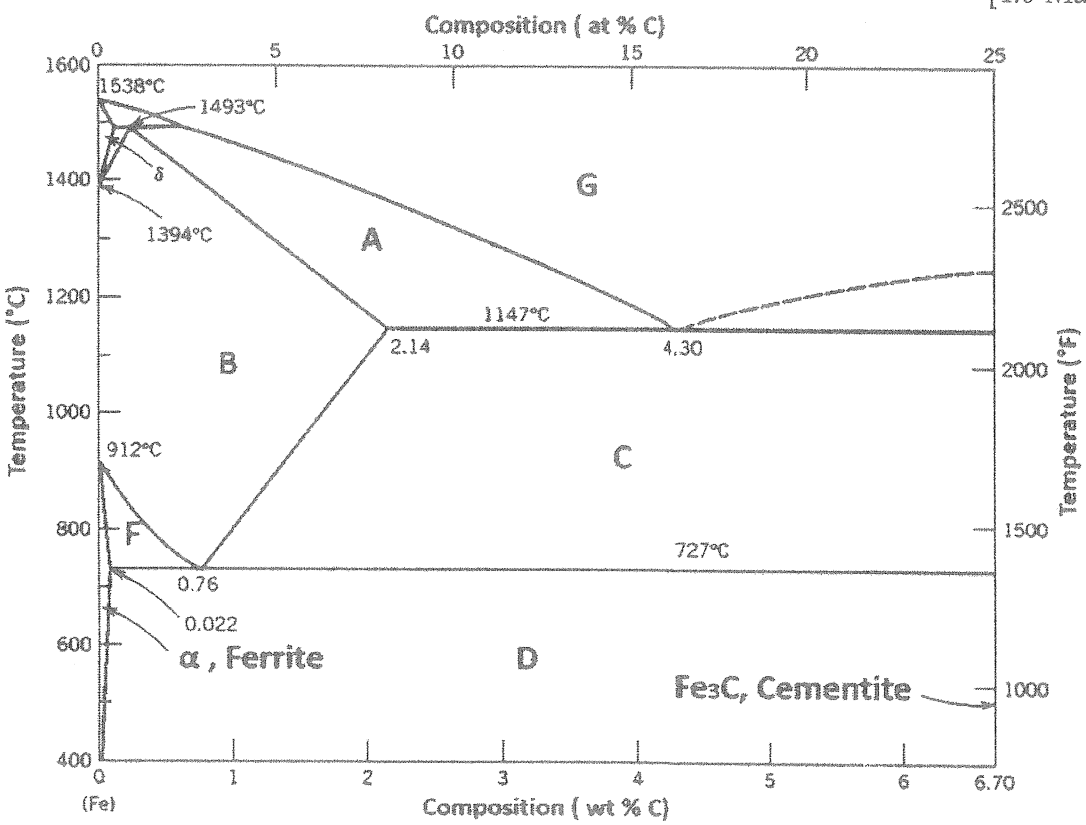


Figure Q4

Q5. a) What are the three primary bonds in materials? Which is the strongest? Why?

[2.0 Marks]

b) What are the differences between crystalline and non-crystalline materials?

[1.0 Mark]

c) Sketch a unit cell and show the following planes.

(i) (112)
(ii) (101)
(iii) (111)
(iv) (123)

[2.0 Marks]

d) What is known as the number of atoms per unit cell?

[0.5 Marks]

e) Estimate the density of **platinum** and **lead** from their lattice parameters at room temperature. Both are FCC (face centered cubic) structured.

A= Atomic weight N=Avogadro number (6.02×10^{23}). a= Lattice parameter	For platinum A=192.09 a=3.9239 Angstrom	For lead A=207.2 a=4.9502 Angstrom

[2.0 Marks]

f) Classify polymeric materials into three categories, and describe their important properties giving two examples of each.

[1.5 Marks]

g) Discuss important properties and uses of,

(i) Glass and glass products,
(ii) Cement.

[1.0 Mark]

Q6. a) Elastic moduli, elastic limits and strengths of material all are quoted with the same unit, Pascal. Explain the differences between these three physical quantities.

[2.0 Marks]

b) You are asked to plot and interpret the engineering stress vs. engineering strain curve for aluminum.
Diameter of test specimen, d_0= 12.8 mm
Length of test specimen, l_0= 50.8 mm
Load vs. elongation data for the test specimen given in the **Table Q6** (shown in page 5).

(i) Plot the engineering stress (σ) vs. engineering strain (ε) curve.

[3.0 Marks]

(ii) Calculate the,

- Modulus of elasticity,
- Proof strength,
- Yield strength,
- Ultimate Tensile Strength (UTS),
- The ductility of the material.

[5.0 Marks]

Table Q6

Load (N)	Length (mm)
0	50.8
7330	50.851
15100	50.902
23100	50.952
30400	51.003
34400	51.054
38400	51.308
41300	51.816
44800	52.832
46200	53.848
47300	54.864
47500	55.88
46100	56.896
44800	57.658
42600	58.42
36400	59.182