



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 2 Examination in Engineering: December 2015

Module Number: ME2302

Module Name: Introduction to Materials Science and
Manufacturing Engineering

[Three Hours]

[Answer all questions, each question carries 10 marks]

- Q1. a) Explain with a neat sketch, the working principle of radial drilling machine. [3.0 Marks]
- b) With simple sketches explain the following machining operations. [2.0 Marks]
- I. Boring
 - II. Reaming
- c) Discuss the main differences between “shaper” and “planer” [2.0 Marks]
- d) I. Draw and name four different types of chisels classified according to their shape and the width of their cutting edge. [3.0 Marks]
- II. Briefly explain their usages.
- Q2. a) What is the difference between “porosity” and “hot tear”? [2.0 Marks]
- b) Explain, [3.0 Marks]
- I. Shrinkage allowance
 - II. Machining allowance
- c) Why are chills used during casting? [2.0 Marks]
- d) The water pipe joint shown in Figure Q2 has to be produced using material grey cast iron. Briefly explain the steps you follow when producing this component. [3.0 Marks]

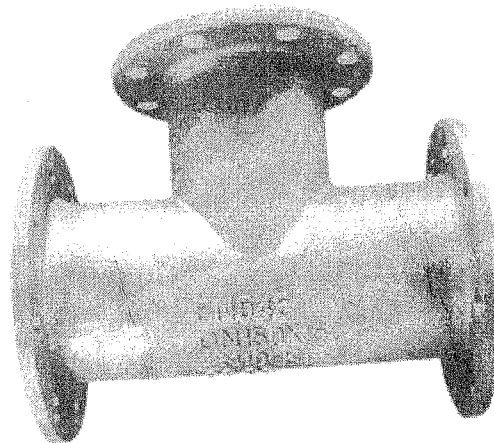


Figure Q2

- Q3. a) Explain four safety precautions to observe when milling. [2.0 Marks]
- b) I. List different types of milling machines. [4.0 Marks]
 II. Compare their construction. [2.0 Marks]
- c) What is indexing in milling operation? [2.0 Marks]
- d) What are the cutting operations shown in Figure Q3?

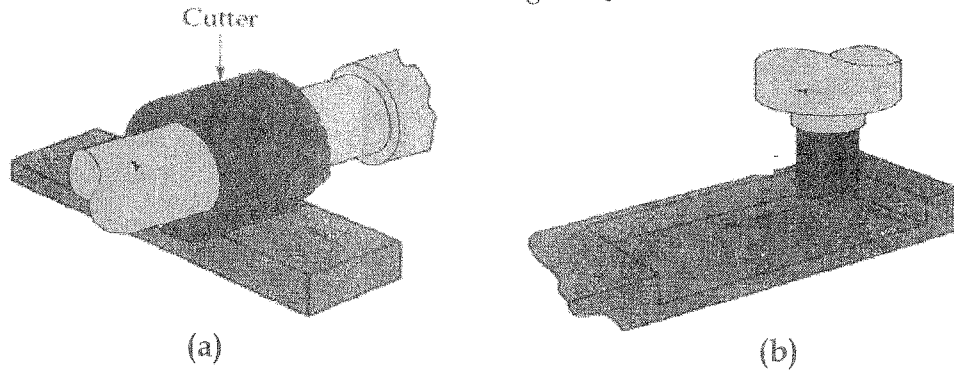


Figure Q3

[2.0 Marks]

- Q4 a) Cu has FCC crystal structure. Determine areal density of Cu atoms per square meter along the plane (111) and linear density along [101] and [110] directions. Lattice parameter of Cu, $a=0.405$ nm [4.0 Marks]
- b) What are the uses of calculating Planer density and Linear density of Metallic Materials? [1.5 Marks]
- c) Suppose you collect 5×10^{26} atoms of Nickel (Ni). Calculate mass in grams and the volume in cubic centimeters represented by this number of atoms.
 Density of Nickel $\rho_{Ni} = 8.902$ g/cm³
 Atomic Weight $AW_{Ni} = 58.71$ g/mole
 Avogadro's Number $A_o = 6.023 \times 10^{23}$ atoms/mole [2.5 Marks]
- d) Draw the graph "Variation of potential energy with interatomic distance" with respect to the Ionic Bond and write a comment regarding interatomic distance at higher temperatures. [2.0 Marks]
- Q5 a) Write a short note on the atomic structure of Diamond. [1.5 Marks]
- b) What do you mean by the "Hardness" of a material? [1.5 Marks]
- c) How do you design a Hardness tester and what is the principle you use? [3.0 Marks]
- d) Although energy need to break a unit volume of a material is obtained by the stress-strain curve, what is the use of Impact testing (Impact tester)? Explain the principle of impact tester. [4.0 Marks]

- Q6 a) Use the phase diagram for the copper (Cu) and silver (Ag) system as shown in the Figure Q6 to answer the following questions.
- I. What do you mean by the “Eutectic point” and “Eutectic Reaction”? [1.0 Mark]
 - II. Consider a point of 60 wt% of Cu – 40 wt% of Ag alloy at 600°C and estimate the weight fractions of each phase. [2.5 Marks]
 - III. Draw microstructures of the Cu-Ag alloy (15 wt% of Cu – 85 wt% of Ag) at 1000°C, 800°C and 300°C under equilibrium cooling. [1.5 Marks]
- b)
- I. Write a short note on “Fiber-reinforced composite materials”. [2.5 Marks]
 - II. Briefly describe “The impact of the fiber amount and orientation of fibers on performance of composite”. [2.5 Marks]

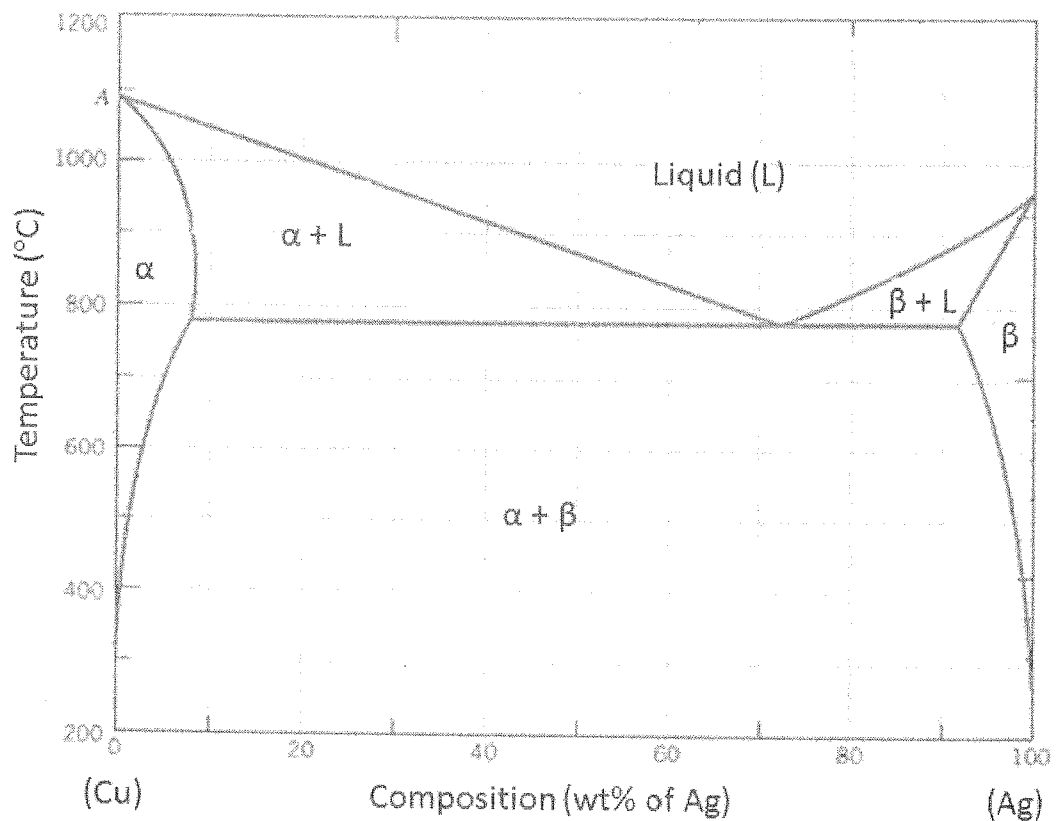


Figure Q6