TECHNICAL UNIVERSITY OF MOMBASA

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN APPLIED PHYSICS AND BACHELOR OF TECHNOLOGY IN ENVIRONMENTAL PHYSICS & RENEWABLE ENERGY

APS 4206: STRUCTURE &PROPERTIES OF MATTER

END OF SEMESTER EXAMINATION

SERIES: MAY 2016

TIME: 2 HOURS

DATE: MAY 2016

Instructions to Candidates
You should have the following for this examination
-*Answer Booklet, examination pass and student ID*
This paper consists of 4 questions.
Do not write on the question paper. Answer question ONE (compulsory) and any other two questions.

Question ONE

(a)   (i)What is the capacity of any sub shell having an orbital quantum number l ?

(1 mark)

(ii) Determine the maximum number of electro for the orbital quantum number $l = 3$

(3 marks)

(b)   List various types of bonds in materials giving an example of a material for each bond.

(6 marks)

(c)   (i)   Draw the fcc unit cell and   (1 mark)

(ii)   Calculate the packing factor   (4 marks)

(d)   (i)   Distinguish between long range order and short range order in solids.

(2 marks)

(ii)   Give two examples of short range order materials   (2 marks)

(e) (i)   What is a dislocation?   (1 mark)
     (ii) Briefly describe two basic types of dislocations   (4 marks)

(f) Describe two methods of hardening materials   (4 marks)

(g) How significant are phase diagrams for alloys?   (2 marks)

Question TWO

(i) What is coordination number of an atom?   (1 mark)
     (ii) Calculate the basis of a unit all for:
           Simple cubic (sc)   (2 marks)
           Face centred cubic (fcc) and   (2 marks)
           Body centred cubic (bcc)   (2 marks)

(b) Determine the critical ratio of ionic radii $\left(\dfrac{r^+}{r^-}\right)$ for which the bcc structure is just stable,

     showing clearly your working.   (5 marks)
(c) List all the $<101>$ members.   (5 marks)

Question THREE

(a) Explain the difference between soft loading and hard loading   (2 marks)

(b) Distinguish between plastic and elastic behavior of materials   (2 marks)

(c) Describe how the Charpy test is used to determine toughness of a metal (4 marks)

(d) Explain what you understand by the following terms
     (i)   Ductility   (2 marks)
     (ii) Hardness   (2 marks)
     (iii) Annealing of materials   (2 marks)
     (iv) Flexure   (2 marks)

(e) Describe two ways of strengthening glasses   (4 marks)

Question FOUR

(a) In connection with alloys define the following
       (i)   Interstitial solid solution   (1 mark)
       (ii)   Substitutional solid solution   (1 mark)

(b)   State the conditions necessary for the formation of each of the solid solutions in (a).
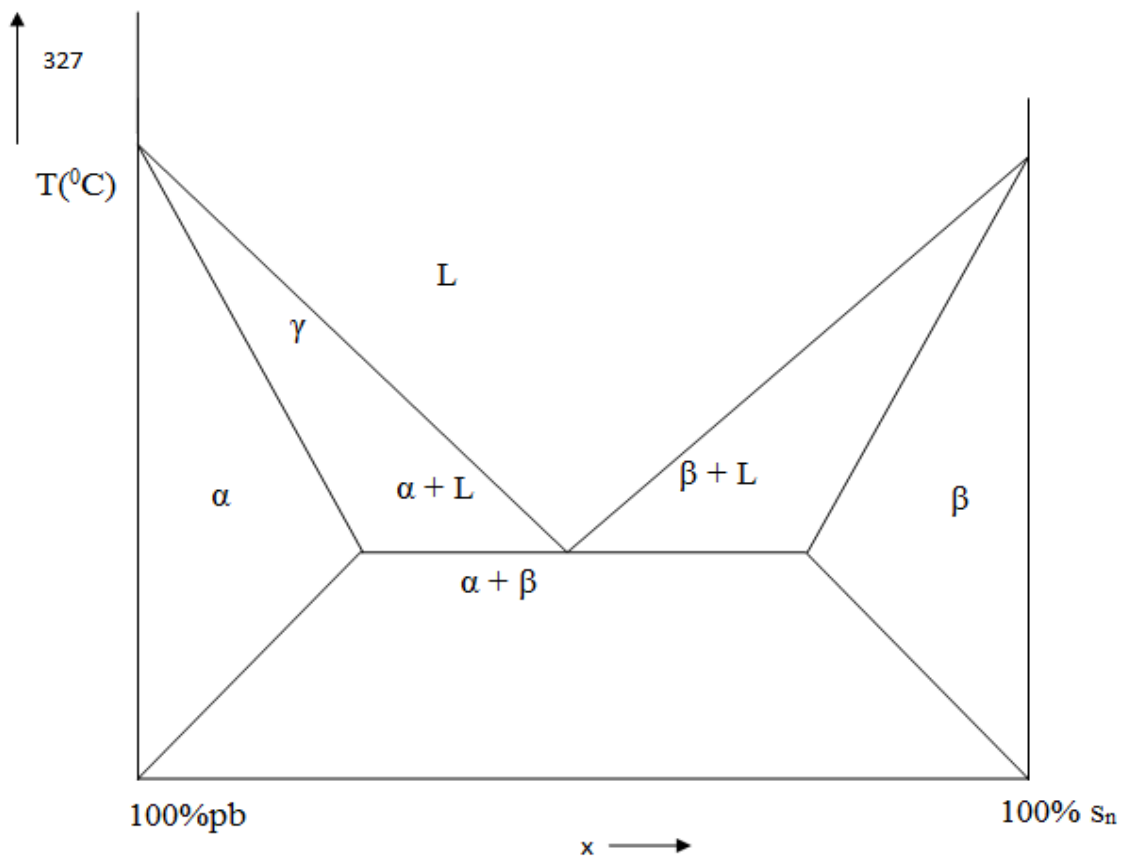   (4 marks)

(c)   With regard to eutectic mixtures,
       (i)   Explain eutectic composition and   (2 marks)
       (ii)   Describe the eutectic structure   (2 marks)

(d)   Refer to the tin-lead T-X diagram below

(i) Define the x-phase and the β phase (2 marks)

(ii) What is the composition of:
  I.   Liquid phase and (1 mark)
  II. Solid phase at the temperature and compress marked γ ?(1 mark)

(iii)   Describe all the phase transformations which is cooled from above 327^0C down to room temperature (about 20°C) (4 marks)

(iv)   State the lever's rule and rise it to calculate the ratio of the amount of solid to liquid at γ
(2 marks)

(v) Determine the maximum amount (in percentage) of tin which may be dissolved in lead at 180^0C and say what happens to the rest of tin. (1 mark)