UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015

COURSE NAME	:	MATERIAL SCIENCE
COURSE CODE	:	DAM 20802
PROGRAMME	:	2 DAM
EXAMINATION DATE	:	DECEMBER 2014/ JANUARY 2015
DURATION	:	2 ½ HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q 1 (a) Materials can be divided into 5 categories, which are metals, ceramics, composites, polymers and electronic materials. Each material has their advantages and disadvantages. From the given statement, answer the following question:

(i) Give **one (1)** an example of material for each category.

(5 marks)

(ii) List **one (1)** advantage and disadvantage for 4 categories of material.

(6 marks)

(b) Mechanical property testing or destructive testing is used to determine the materials mechanical properties. There are several types of mechanical properties testing. List and describe **four (4)** types of mechanical testing.

(9 marks)

Q2 (a) Give definition of any **two (2)** of the following terms:

(i) Schottky imperfection
(ii) Frenkel imperfection
(iii) mixed dislocation
(iv) edge dislocation
(v) screw dislocation

(2 marks)

(b) State **four (4)** essence, which are involved in material science and engineering.

(4 marks)

(c) Explain **three (3)** essences of material and science.

(9 marks)

(d) The support cable rod for a new crane system for a lightweight use required to be designed to withstand a maximum load of 440 kN. With four supports cable to bear the load equilibrium. Plain carbon steels from 1045 series was selected. The minimum yield strength and tensile strength of this alloy are 620 MPa and 1130 MPa respectively. Assume safety factor, N = 5. Calculate the suitable size of cable rod diameter.

(5 marks)

Q3 (a) Heat treatment is used to adjust the microstructure and mechanical properties of a material for a specific purpose. There are several types of heat treatment for example annealing, normalizing, quenching, and tempering. Describe the purposes of each type of the above heat treatment.

(8 marks)

(b) Sketch the design flow chart in designing process.

(4 marks)

CORRECTION (DAM 20802)

Q3 (c) By plotting phase diagram of Pb-Sn (Refer **Figure Q3(c)**), plot the graph and make a phase analysis for composition of 30 % Sn at 183 °C + ΔT and 30 % Sn at 183 °C - ΔT by calculate:

(i) Each phase composition for 30 % Sn at 183 °C + ΔT and 35 % Sn at 183 °C - ΔT.

(4 marks)

(ii) Amount of weight proportion for each fraction for 30 % Sn at 183 °C + ΔT and 35 % Sn at 183 °C - ΔT.

(4 marks)

....

Q3 (c) By plotting phase diagram of Pb-Sn (Refer **Figure Q3(c)**), plot the graph and make a phase analysis for composition of **30 % Sn at 250 °C and 35 % Pb at 150 °C** by calculate:

(i) Each phase composition for **30 % Sn at 250 °C and 35 % Pb at 150 °C**.

(4 marks)

(ii) Amount of weight proportion for each fraction for **30 % Sn at 250 °C and 35 % Pb at 150 °C**.

(4 marks)

(c) By plotting phase diagram of Pb-Sn (Refer **Figure Q3(c)**), plot the graph and make a phase analysis for composition of 30 % Sn at 183 °C + ΔT and 30 % Sn at 183 °C - ΔT by calculate:

    250   35 % Pb   150 °C

    (i) Each phase composition for 30 % Sn at 183 °C + ΔT and 35 % Sn at 183 °C - ΔT.

                250   35 % Pb

                                    (4 marks)

    (ii) Amount of weight proportion for each fraction for 30 % Sn at 183 °C + ΔT and 35 % Sn at 183 °C - ΔT.

                                    (4 marks)

Q4 (a) By using stress-strain graph several properties could be determined by interpreting the graph. List **five (5)** properties that could be determined from the graph.

                                    (5 marks)

(b) **Figure Q4(b)** shows the stress strain graph of Polypropylene. By plotting the stress-strain graph, determine the Polypropylene yield strength and tensile strength. (Assume offset line = 0.002)

                                    (2 marks)

(c) Sketch a stress-strain graph and label its elastic region, plastic region, necking region and fracture, then sketch the sample figure at each region. (Assume offset line = 0.002)

                                    (5 marks)

(d) One rod of aluminium Al 2024-T4 sample will be tested under ASTM B211 to determine tensile properties. The sample have 20 mm diameter with 1500 mm length and 1480 mm gage length. During testing, sample is fractured at 150 kN and the sample diameter is reduced to 10 mm and gage length is elongated to 1500 mm. From the given situation, calculate following value:

    (i)   engineering stress
    (ii)   engineering strain
    (iii) true stress
    (iii) true strain

                                      (8 marks)

Q5 (a) (i) Explain briefly the difference between ferrous and non-ferrous metals.

                                    (2 marks)

    (ii) Give **two (2)** examples for each type.

                                    (2 marks)

(b) Steels are basically categorized into three types, namely, low carbon, medium carbon and high carbon steels.

    (i)   Indicate the percentage of carbon content for each type of steel.

(3 marks)

    (ii)   Give **two (2)** examples (products) for each one of them.

(3 marks)

(c) List **four (4)** properties of any three of the following non-ferrous metal:

    (i)   aluminium
    (ii)   titanium
    (iv)   magnesium
    (v)   nickel
    (vi)   copper

(10 marks)

Q6 (a) Briefly explain electrochemical corrosion

(2 marks)

(b) The following are the types of corrosion. Briefly explain any **five (5)** of them.

    (i)   Uniform Attack – General Corrosion
    (ii)   Galvanic Corrosion
    (iii)   Crevice Corrosion
    (iv)   Pitting
    (v)   Intergranular Corrosion
    (vi)   Selective Leaching
    (vii)   Erosion Corrosion

(18 marks)

- END OF QUESTIONS -

FINAL EXAMINATION
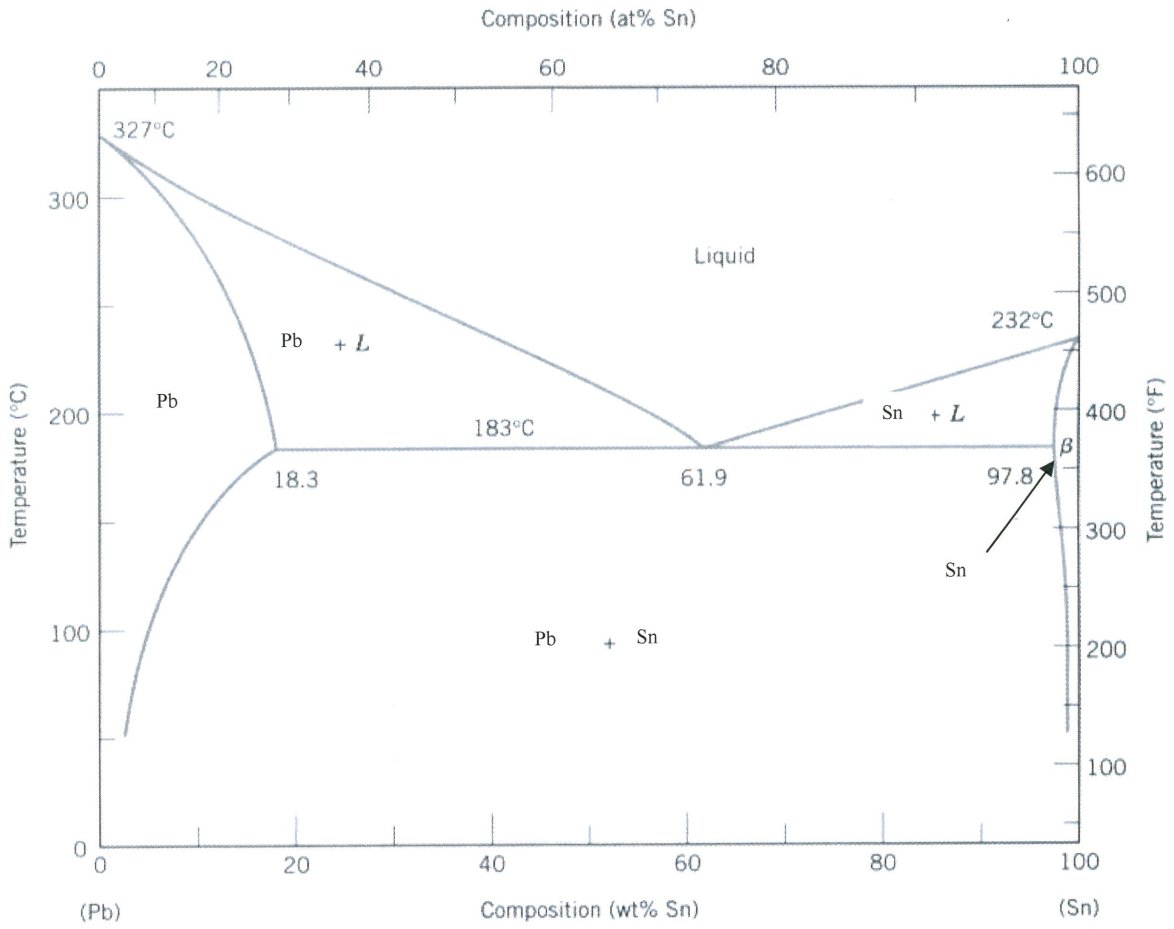
Figure Q3 (c)

FINAL EXAMINATION
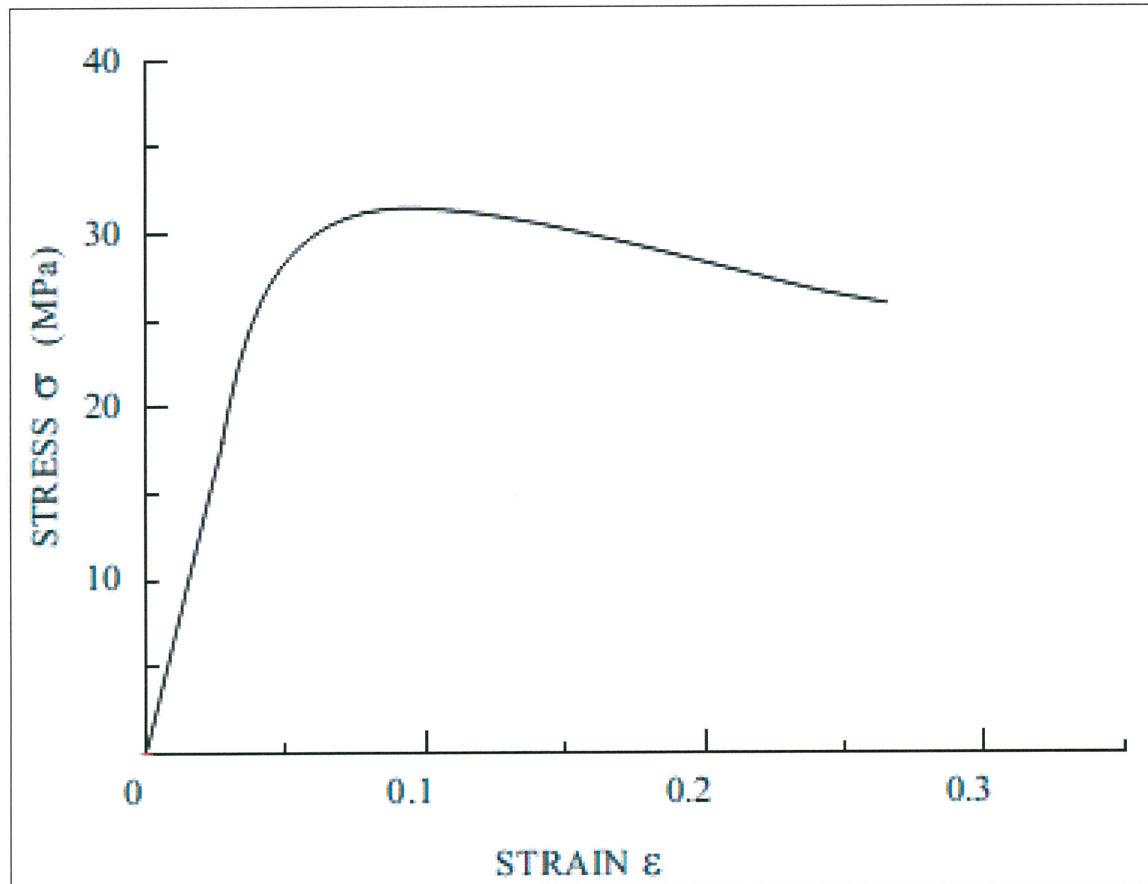
Figure Q4 (b)

Include this chart together with your answer book