Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	MATERIAL ENGINEERING SELECTION
COURSE CODE	:	DAM 21102
PROGRAM	:	2 DAM
EXAMINATION DATE	:	JUNE 2015 / JULY 2015
DURATION	:	2.5 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

Q1 (a) Define **three (3)** methods of material selection.

(6 marks)

(b) Material is one of the scopes in product design. Sketch all scopes of material involved in the design together with their relationship.

(9 marks)

(c) Information path for a design starts with the idea as the source of the design information. Jialaidun Piston Co. Ltd. Plans to manufacture engine piston as their product. Describe **five (5)** elements after the idea in their source of information for the design products.

(10 marks)

Q2 (a) Explain **three (3)** stages of design process product.

(9 Marks)

(b) Design of a product is classified into **three (3)** types. Define each type of design.

(6 Marks)

(c) Describe **five (5)** factors that need to be considered when selecting engineering materials.

(10 Marks)

Q3 (a) Explain the **four (4)** types of material's mechanical tests.

(8 marks)

(b) State **two (2)** classes of material properties with examples.

(7 marks)

(c) A pure stainless steel rods with 0.75 cm in diameter and 10 cm long with a gauge length of 3 cm mark, elongation occurs in the middle of the sample in which gauge shows 3.55 cm mark. Calculate engineering and true strain experienced by this samples.

(10 marks)

Q4 (a) A barometer is a pressure actuator. Changes in atmospheric pressure, acting on one side of a diaphragm, cause it to deflect as shown in Figure **Q4(a)**. The deflection is transmitted through mechanical linkage or electromagnetic sensor to a read-out. Similar diaphragms form the active component of altimeters, pressure gauges, and gas-flow controls for diving equipment.

(i) Identify design requirements (function, objective and constraints) from the case study above.

(6 marks)

(ii) Given best material for the diaphragm is the largest value of M:

$$M = \frac{\sigma_f^{3/2}}{E}$$

(b) Using the Ashby Method of materials selection, recommend a suitable material for diaphragm, using the following information and the Strenght vs Young Modulus chart as in Figure **Q4(b)**. Which materials best meet the requirements for diaphragms.

(19 marks)

Q5 Ferrous material could be divided into two categories which are steel and cast iron.

(a) List **two (2)** classifications of steel and give one example of its application for each type of steel.

(4 marks)

(b) List **three (3)** types of cast iron and give one example of its application for each type of cast iron.

(6 marks)

(c) Below is the list of ferrous metals and its alloy together with its typical application in the UNS (Unified Numbering System) designation form.

(i) F3XXXX – High-strength gears and machine components.
(ii) K1XXXX – Automobile industries.
(iii) S3XXXX – Chemical and food processing equipment.
(iv) T3XXXX – Punches, drill bit
(v) G1XXXX – Paper clip

List the name of material for each UNS designates above.

(5 marks)

(d) Below is a list of ferrous metals and alloys:

(i) Stainless steel
(ii) Plain low carbon steel
(iii) Gray cast iron
(iv) Tool steel
(v) Nodular Iron

Select from this list, choose **one (1)** metal or alloy that is best suited for each of the following applications, and describe at least **one (1)** reason for your choice:

(i) Structural (bridges and building) and low temperature vessel.
(ii) High-strength gears and machine components
(iii) Food processing equipment
(iv) The base for a milling machine (expose to vibration)
(v) Drill bit.

(10 marks)

Q6 (a) List **three (3)** characteristics of ferrous alloys that limit their utilization.

(3 marks)

(b) List **two (2)** characteristcs for each material listed below:
(i) Aluminum
(ii) Titanium
(iii) Magnesium
(iv) Nickel
(v) Copper

(10 marks)

(c) Suggest suitable material for the following application and explain why
(i) Jet aircraft landing gear bearings and bushings
(ii) Aircraft mainframe
(iii) Die casting equipment that provided good creep resistance
(iv) Gas turbine engine casings and rings
(v) Valves/pumps for corrosive industry
(vi) Food processing, kitchen hardware

(12 marks)

- END OF QUESTIONS –

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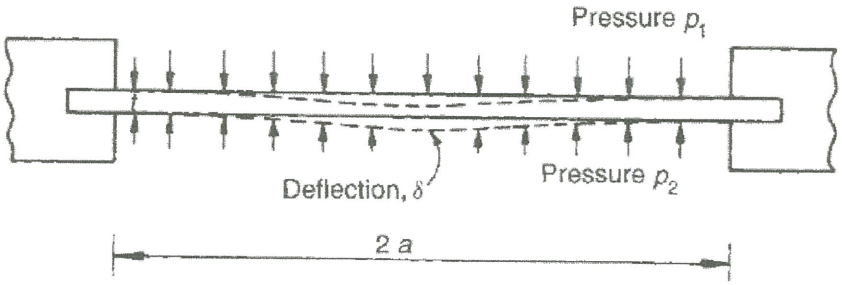

FIGURE Q4 (a)

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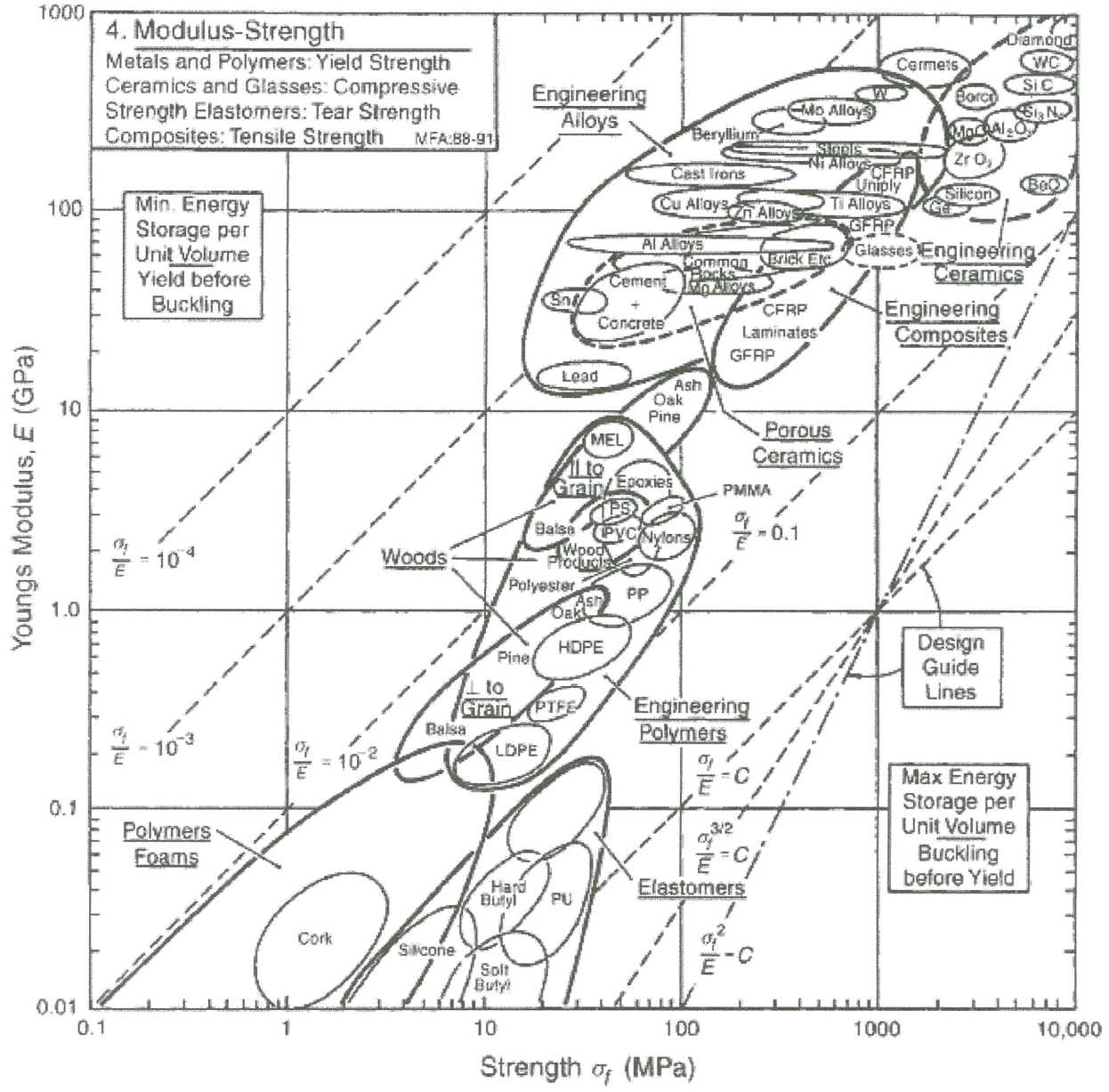

FIGURE Q4 (b)