



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019**

COURSE NAME : MATERIAL ENGINEERING
SELECTION

COURSE CODE : DAM 21102

PROGRAM : DAM

EXAMINATION DATE : DECEMBER 2018 / JANUARY 2019

DURATION : 2 HOURS 30 MINUTES

INSTRUCTION : ANSWER **FOUR (4)** QUESTIONS
ONLY

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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 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)** factor 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. Give examples for each classes. (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)

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Q4 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.

- (a) Identify design requirements (function, objective and constraints) from the case study above. (6 marks)
- (b) Given best material for the diaphragm is the largest value of M:

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

Using the Ashby Method of materials selection, recommend a suitable material for diaphragm, using the following information and the Strength 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)** classification 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.

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- (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)** characteristics 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)

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- END OF QUESTION -

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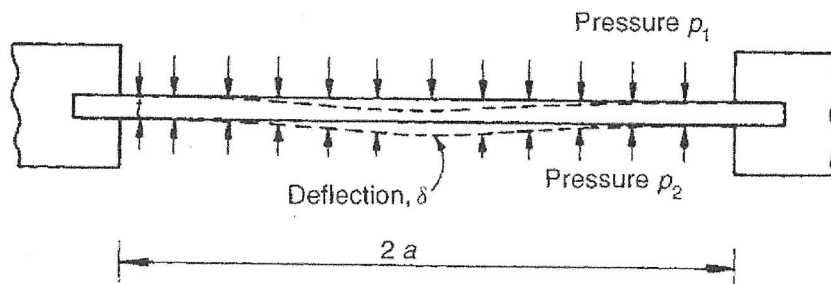


FIGURE Q4(a)

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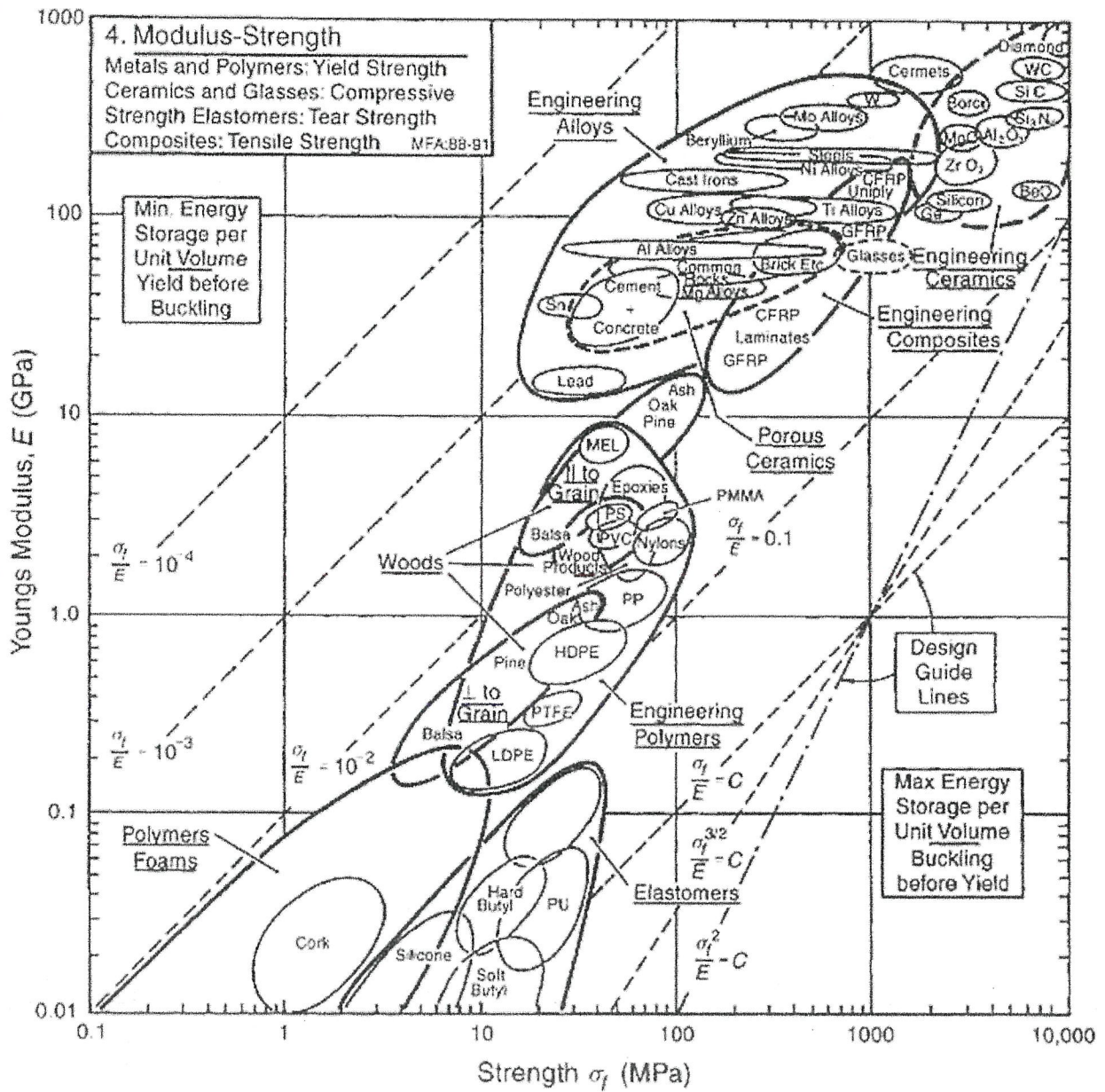


FIGURE Q4(b)

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