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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016**

COURSE NAME : MATERIAL ENGINEERING
SELECTION

COURSE CODE : DAM 21102

PROGRAMME : 2 DAM

EXAMINATION DATE : JUNE / JULY 2016

DURATION : 2 HOURS 30 MINUTES

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

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

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- Q1**
- (a) Imitative method is made by equality or similarity of function for material selection. Discuss **two (2)** advantages and disadvantages of imitative method. (4Marks)
 - (b) Explain **three (3)** factors that need to consider in materials selection (6 Marks)
 - (c) The material is subjected to processes to get into the shape. List **four (4)** types of processes. (4 Marks)
 - (d) There are three types of design which are Original, Adaptive and Variant. Explain and give an example for the Adaptive type of design. (4 Marks)
 - (e) Generate design flow chart for designing a brand new piston for a motorcycle engine. (7 Marks)

Q2 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 Q2(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 Q2(b)**. Suggest materials meet the requirements for diaphragms.

(19 Marks)

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- Q3**
- (a) List **three (3)** classifications of engineering materials. (3 Marks)
- (b) Discuss **three (3)** characteristics of successful product. (6 Marks)
- (c) Material behaviour can be measured quantitatively using lab scale apparatus. Name the mechanical test to determine the behaviour of material as follows:
- (i) to determine fracture characteristics of materials.
 - (ii) to measure resistance of a metal to permanent (plastic) deformation.
 - (iii) to determine the behavior of materials under fluctuating loads
 - (iv) to evaluate strength of material
- (4 Marks)
- (d) Pure aluminium 0.5 cm width, 0.040 cm thick and 8 cm length which has gagemarkings 2 cm apart in the middle of the sample is strained so that the gage markings are 2.65 cm apart. Calculate engineering strain elongation which the sample undergoes. (3 Marks)
- (e) A tensile apparatus is to be constructed which must stand withstand a maximum load 220kN. The design calls for two cylindrical support posts, each of which is to support half of the maximum load. Furthermore, plain carbon (1045) steel ground and polished shafting rounds are to be used; the minimum yield and tensile strengths of this alloy are 310 MPa and 565 MPa, respectively. If the safety factor is 1.5, Calculate the working stress and suitable diameter for these support posts. (9 Marks)

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Q4 (a) Explain **two (2)** characteristics of ferrous alloys that limit the utilization. (4 Marks)

(b) Name suitable non-ferrous material for following application

- (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

(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. List the name of material for each UNS designates above.

- (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

(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

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

1. Structural (bridges and building) and low temperature vessel.
2. High-strength gears and machine components
3. Food processing equipment
4. The base for a milling machine (expose to vibration)
5. Drill bit.

(10 Marks)

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Q5 (a) List **three (3)** major factors affecting the selection for aluminium casting product. (3 marks)

(b) Briefly explain **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)

- END OF QUESTION -

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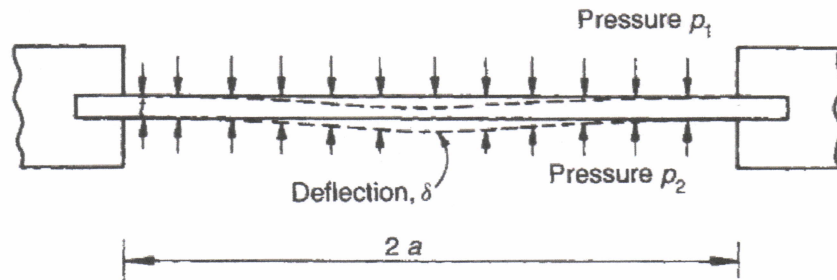


FIGURE Q2 (a)

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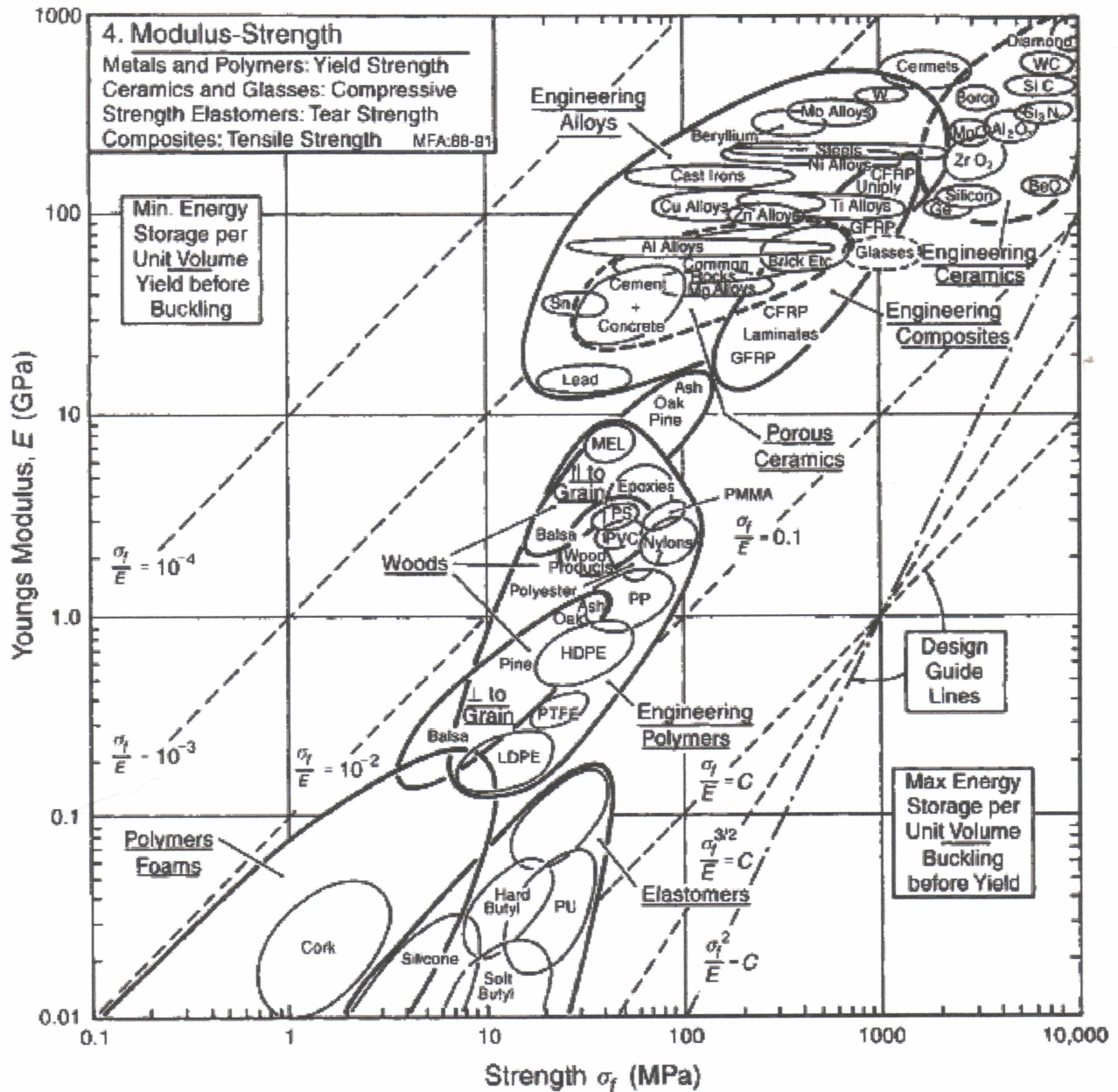


FIGURE Q2 (b)