UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
(ONLINE)
SESSION 2020/2021

COURSE NAME	:	MATERIAL SELECTION
COURSE CODE	:	DAM 11102
PROGRAM CODE	:	DAM
EXAMINATION DATE	:	JANUARY / FEBRUARY 2021
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	1) ANSWER **FOUR (4)** QUESTIONS ONLY 2) THE ANSWER BOOKLET NEED TO BE SUBMITTED 15 MINUTES AFTER THE EXAMINATION END. (SUBMIT ALL THE DOCUMENTS IN PDF)

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

Q1 (a) Imitative method is made by equality or similarity of function for material selection. Describe **two (2)** advantages and disadvantages of imitative method.

(4 marks)

(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 Variant type of design.

(4 marks)

(e) Generate design flow chart for designing a new piston for a motorcycle engine.

(7 marks)

Q2 (a) Several properties could be determined by interpreting the stress-strain graph. List **five (5)** properties that could be determined from the graph.

(5 marks)

(b) **Figure 2(b)** shows a stress-strain graph of a material. Plot the yield strength and tensile strength. Assume that the offset line is 0.002.

(4 marks)

(c) Sketch a stress-strain graph and label its elastic region, plastic region, necking region and fracture.

(8 marks)

(d) A rod of aluminum sample is tested under ASTM B211 to determine the tensile properties. The sample has a diameter of 10 mm and length of 80 mm. During the test, a mass of 170 kg is applied to the sample. Given the diameter of at the neck is 5 mm and the length increase to 100 mm, determine the:

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

(8 marks)

Q3 (a) List and describe **three (3)** main design stages in design process

(6 marks)

(b) List and describe **four (4)** types of mechanical properties testing

(12 marks)

(c) 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 (AISI 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, determine the working stress and suitable diameter for these support posts.

(7 marks)

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 that is 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 Strenght vs Young Modulus chart as in **Figure Q4(b)**. Determine the materials best meet the requirements for diaphragms.

(19 marks)

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Q5   (a)   Define alloy, ferrous and nonferrous. State the relationship between ferrous and nonferrous to alloy.

(5 marks)

(b)   Classification according to Product Shape, Finish Processing and Quality Descriptors is one of the three classification of steels.

(i)   Explain the other two of the three classification of steels.
(ii)   State and explain **three (3)** examples of Finish Processing classification.

(10 marks)

(c)   A material can have a designation of UNS, SAE and AISI number. The table below shows a list material with designation of AISI number with 'X' is any corresponding number describing the material.

AISI Number	Material Component
81XX	Ni 0.30%, Cr 0.40%, Mo 0.12%
86XX	Ni 0.55%, Cr 0.50%, Mo 0.20%
87XX	Ni 0.55%, Cr 0.50%, Mo 0.25%
88XX	Ni 0.55%, Cr 0.50%, Mo 0.35%

(i)   Define UNS, SAE and AISI
(ii)   Explain the relationship among UNS, SAE, AISI
(iii) Referring to the numbers, discuss which metal grade does the material in the table refer to.

(10 marks)

- END OF QUESTIONS -

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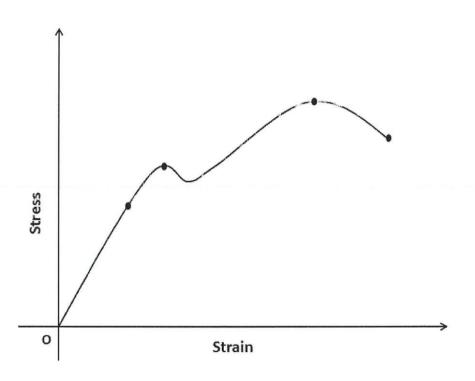COURSE NAME   : MATERIAL SELECTION   COURSE CODE : DAM 11102
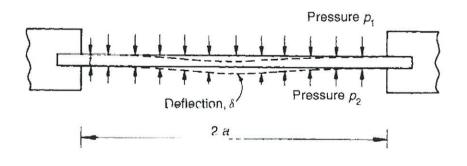

Figure 2(b)

Figure 4(a)

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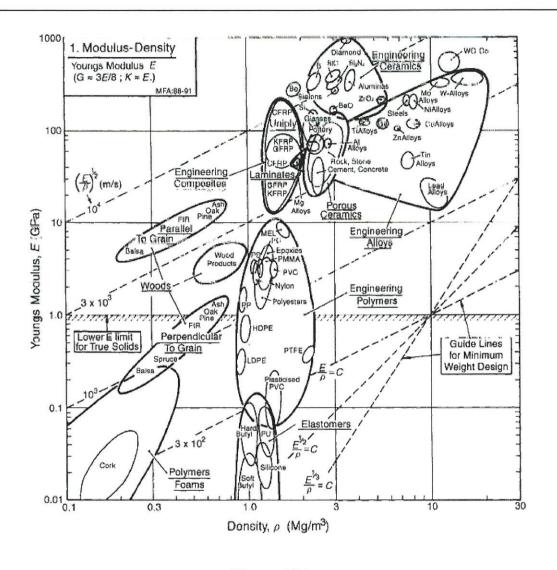COURSE NAME   : MATERIAL SELECTION   COURSE CODE : DAM 11102

Figure 4(b)

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