UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016

COURSE NAME	:	ENGINEERING MATERIALS SELECTION
COURSE CODE	:	BDA 20402
PROGRAMME	:	2 BDD
EXAMINATION DATE	:	JUNE/JULY 2016
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) Discuss imitative selection method. Support your discussion with at least TWO (2) appropriate examples.

(5 marks)

(b) "Product as technical system". Apply this statement on an automobile.

(10 marks)

(c) Compare between ceramic and metal and sketch their tensile test profile.

(7 marks)

(d) List all the stages involve in design process.

(3 marks)

Q2 (a) Explain in details the important criteria in selection of tool steel and stainless steel.

(8 marks)

(b) Copper and Magnesium are non-ferrous metals. List the properties of each material.

(3 marks)

(c) Aluminium is designated as 1XXX or 1XX.Y. Describe all digits in 1XXX and 1XX.Y.

(4 marks)

(d) Select ONE (1) suitable material for each of the following purpose and write your justifications:

(i) Bicycle frame
(ii) Coins

(10 marks)

Q3 (a) Discuss in detail TWO (2) factors that give interrelated constraint to materials selection process.

(4 marks)

(b) Describe briefly TWO (2) types of design. Support your description with an appropriate example.

(6 marks)

(c) A group of student needs to determine the optimum steel to be used for their design of a mini bridge. The design requires a 75 mm round with a minimum hardness of 1500 MPa tensile strength at about a ½ -radius position in the cross section. The steel will be heat treated in non-scaling atmosphere and will be quenched in an agitated water bath at velocity of 200ft/min. Determine

the potential steel that can be used (using **Figure Q3(c) (i) – (v)** and **Table Q3 (c)**).

(15 marks)

Q4 (a) A part of a consumer electronics device as shown in **Figure Q4 (a)** requires an axially loaded spring to return a mechanical piece to its starting location. This axial spring will be loaded in tension and must have the largest stored energy possible. In addition, the total mass of the spring must be equal to m_o. Assume the diameter, 2r, is free, but the length, L, is fixed. Use the following information to answer the design questions below. Energy stored in the axial spring under the maximum stress, σ_f: $Energy = \frac{1}{2}\frac{\sigma_f^2}{E}\pi r^2 L$ (In this equation, the maximum stress σ_f is the material property of the yield strength). The mass of the spring is $m = \pi r^2 L\rho$

(i) What is the measure of performance, P, for this design?

(1 mark)

(ii) Derive the materials selection criterion, M, using the mass constraint

(2 marks)

(b) A particular design asks us to choose a material using $M = \frac{\lambda^2}{\rho^{\frac{1}{3}}}$. For a plot of; *log (ρ) [X axis] versus log (λ) [Y axis],* determine the slope of the selection line.

(2 marks)

(c) Use the selection chart in **Figure Q4(c)** to determine the subset of materials with a Young'smodulus *(E)* less than 1 GPa and a selection index $M = \frac{\eta^2}{E}$ greater than $M = 1\times10^{-4}\left[\frac{1}{GPa}\right]$. Show your materials with a sketch on the selection chart clearly in **Figure Q4(c)** to indicate the selection region. You **HAVE TO ATTACH Figure Q4(c)** with your answer sheet.

(5 marks)

(d) Discuss details of compounding polymer. Please include FOUR (4) general terms in your answer.

(10 marks)

(e) List FIVE (5) common aspects to be considered in the selection of materials for refractory.

(5 marks)

Q5 (a) Justify the importance usage of composites in aircraft and airframe.

(5 marks)

(b) PQR Ceramic was sintered and weight 335 grams when dry, 235 grams when suspended in water, and 335 grams when wet. The true density of a ceramic is 4 g/cm^3.

(i) Determine the percentage of closed porosity of this ceramic product.

(6 marks)

(ii) In your opinion, what is the process that may have been through by PQR ceramic? Discuss.

(4 marks)

(c) Determine the composite modulus of elasticity for polyester reinforced with 60 % volume of E-glass if under condition:

(i) isostrain

(3 marks)

(ii) isostress

(3 marks)

Given : $E_{polyester}$ = 6.9 GPa and $E_{E\text{-}glass}$=72.4 GPa

(d) Explain the classification of polymer.

(4 marks)

- END OF QUESTIONS -

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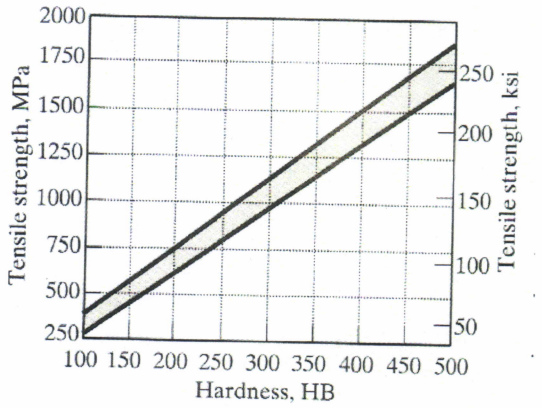

(a)

Figure Q3(c) (i)

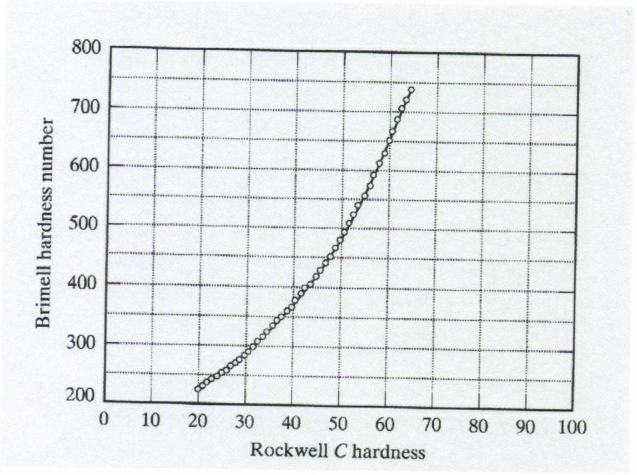

Figure Q3(c) (ii)

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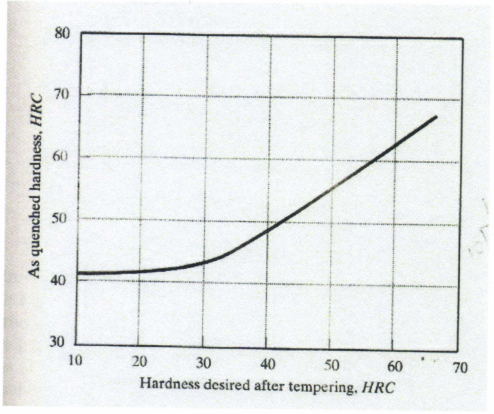

Figure Q3(c) (iii)

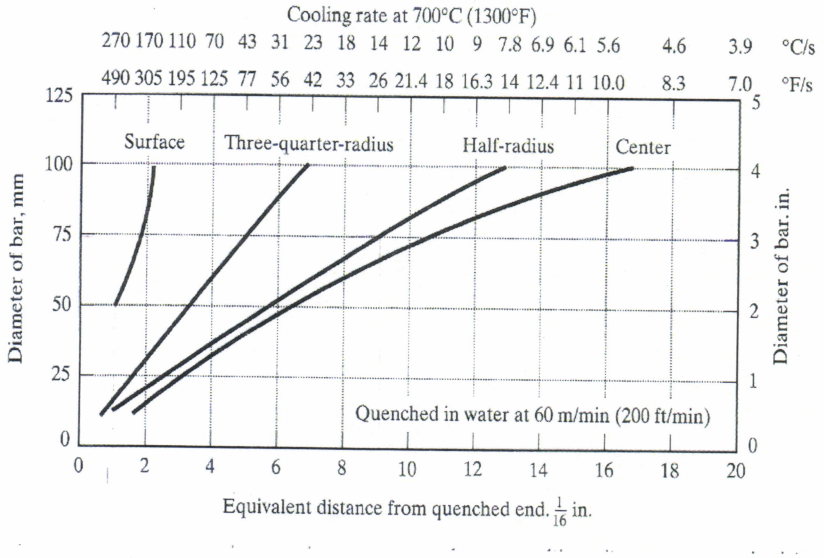

Figure Q3(c) (iv)

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Table 12-24 Classification of H steels according to minimum hardnesses at various Jominy equivalent cooling distances from quenched end. (*Continued*)

Distance from quenched end, 1/16th in.	H steels with a minimum hardenability curve that intersects the specified hardness at the indicated distance from the quenched end of the hardenability specimen	Distance from quenched end, 1/16th in.	H steels with a minimum hardenability curve that intersects the specified hardness at the indicated distance from the quenched end of the hardenability specimen
55HRC		*55HRC* (*Continued*)	
1	1141, 1042, 4042, 4142, 1045, 1146, 1050, 8642	$5\frac{1}{2}$	8650, 5152, 4068
$1\frac{1}{2}$	50B46	6	50B50
2	8742, 5046, 4047, 5145	$6\frac{1}{2}$	5160, 9262
$2\frac{1}{2}$	6145	7	4147, 8750, 8655
3	4145, 8645, 1345	$7\frac{1}{2}$	50B60
$3\frac{1}{2}$	86B45, 5147, 4053, 9260	9	8653, 51B60, 8660
4	5150, 40635	$9\frac{1}{2}$	4150
5	81B45, 6150, 9261, 5155	17	9850

Table Q3(c)

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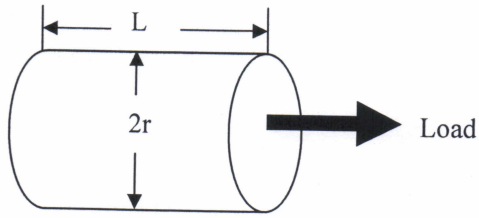

Figure Q4(a)

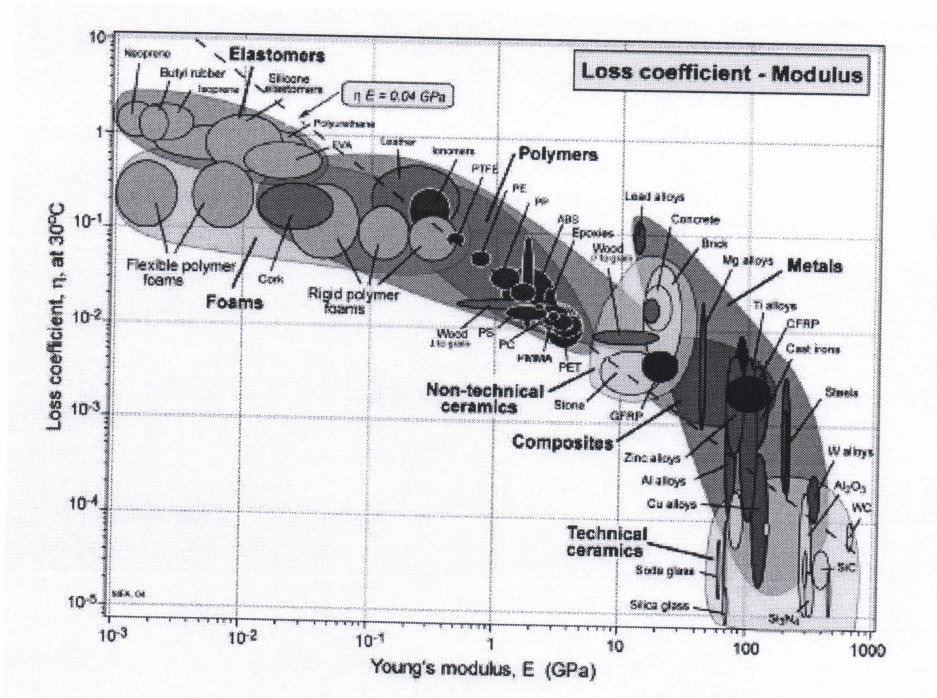

Figure Q4(c)