Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	ENGINEERING MATERIALS SELECTION
COURSE CODE	:	BDA 20402
PROGRAMME CODE	:	BDD
EXAMINATION DATE	:	JUNE / JULY 2019
DURATION	:	2 HOURS
INSTRUCTION	:	PART A – COMPULSORY PART B – ANSWER **THREE (3)** QUESTIONS **ONLY**

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

PART A (COMPULSORY)

Q1 (a) Faculty of Mechanical and Manufacturing (FKMP) students are planning for bungee-jumping off the Tunku Tun Aminah library of UTHM (**Figure Q1(a)**). They want to make sure they got the right material for the elastic bungee cord. One of the design goals is to make sure the cord stretches elastically as far as possible under the end load, F. The elastic stress-strain relation gives the following:

$$\frac{F}{\pi r^2} = \frac{\Delta L}{L_0} E$$

where E is the Young's modulus of the cord. Also, because of airline luggage charges, the total mass of the cord must be equal to m_0. Assume the diameter is free, but the initial length, L_0, is fixed. The mass of the spring is

$$m = \pi r^2 L_0 \rho$$

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

(3 marks)

(ii) Derive the materials selection criterion using mass constraint.

(5 marks)

(b) A particular design asks us to choose a material using $M = \frac{\sigma^{\frac{3}{2}}}{v^5}$. For a plot of *log(v)[Y axis] versus log (σ)[X axis]*, determine the slope of the selection line.

(7 marks)

(c) Use the selection chart in **Figure Q1(c)** to determine the subset of materials with a thermal conductivity, λ less than 0.3 [W/mK] and a selection index of $M = \alpha^2 \lambda$ greater than $M = 1 \times 10^3 \left[\frac{microstrain^2.W}{m.K^3}\right]$. Show your materials with a sketch in **Figure Q1(c)** clearly indicating the selection region. Attach **Figure Q1(c)** in your answer script.

(10 marks)

PART B (ANSWER THREE QUESTIONS ONLY)

Q2 (a) List THREE (3) main characteristics in imitative selection methods.

(3 marks)

(b) Sketch and label a diagram that related to conventional design framework.

(5 marks)

(c) How would you use **Figure Q2(c)** to show the evolution of body armor?

(7 marks)

(d) A device is required to allow access to water in a corked bottle with convenience, at modest cost, and without contaminating the water. Analyse the concept, embodiment, and detail design of the device.

(10 marks)

Q3 (a) List THREE (3) properties of ceramics that need to be considered in materials selection for tile industry.

(3 marks)

(b) Explain what you understand about Modulus of Rupture (MOR) and its application?

(5 marks)

(c) Write THREE (3) mechanical properties of composite (polymer reinforced fiber).

(7 marks)

(d) Differentiate between toughness, ductility and strength of the engineering materials by referring to graph stress versus strain.

(10 marks)

Q4 (a) List THREE (3) methods of selecting carbon and low alloy structural steel.

(3 marks)

(b) Explain the selection criteria for copper alloys.

(5 marks)

(c) A non-ferrous metal needs to be used in high temperature (>1300 ^{o}C), with suitable strength and toughness. The metal needs to be combined using welding technique. Choose the correct metals with justification.

(7 marks)

(d) Based on your knowledge in materials, examine the future trends of metal and alloys in aerospace industry.

(10 marks)

Q5 (a) What is "additive"?

(3 marks)

(b) Describe the process to add an additive into polymer.

(5 marks)

(c) Sketch the schematic showing the additive effects during compounding

(3 marks)

(d) Compare between heat stabilizer, antioxidant and UV light absorber.

(6 marks)

(e) Illustrate all phases in composite.

(4 marks)

(f) Compare the interface properties between synthetic fiber and natural fiber in polymer matrix composite.

(4 marks)

~ END OF QUESTIONS ~

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 2018/2019 PROGRAMME CODE : BDD
COURSE NAME: ENGINEERING MATERIALS SELECTION COURSE CODE : BDA 20402

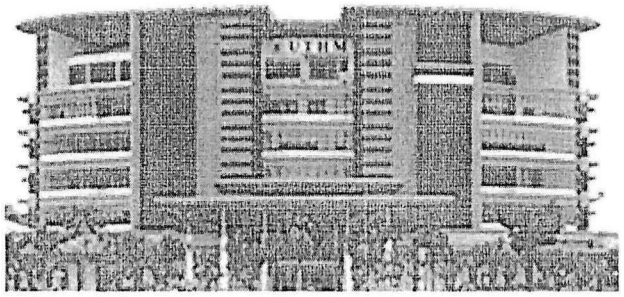

FIGURE Q1(a)

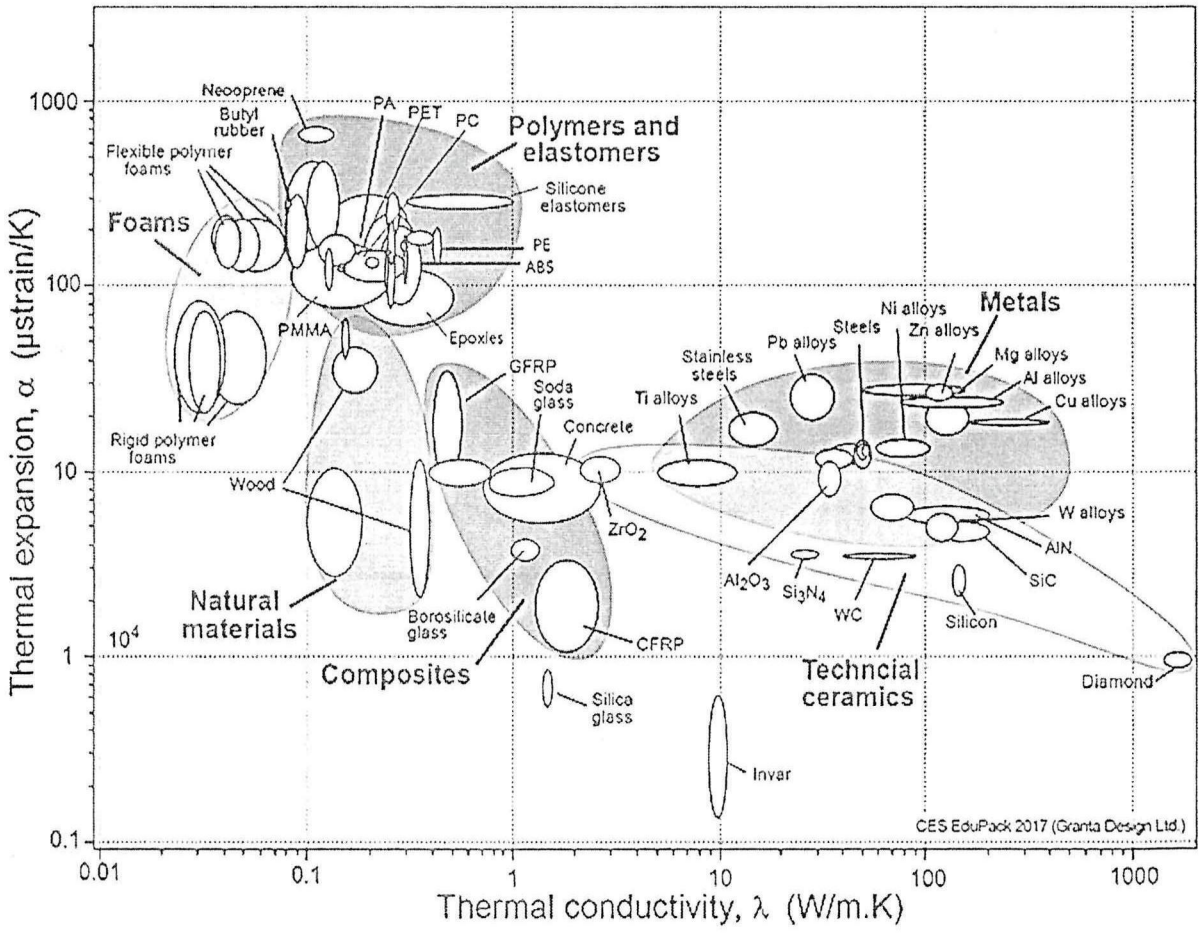

FIGURE Q1(c)

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 2018/2019
COURSE NAME: ENGINEERING MATERIALS SELECTION

PROGRAMME CODE : BDD
COURSE CODE : BDA 20402

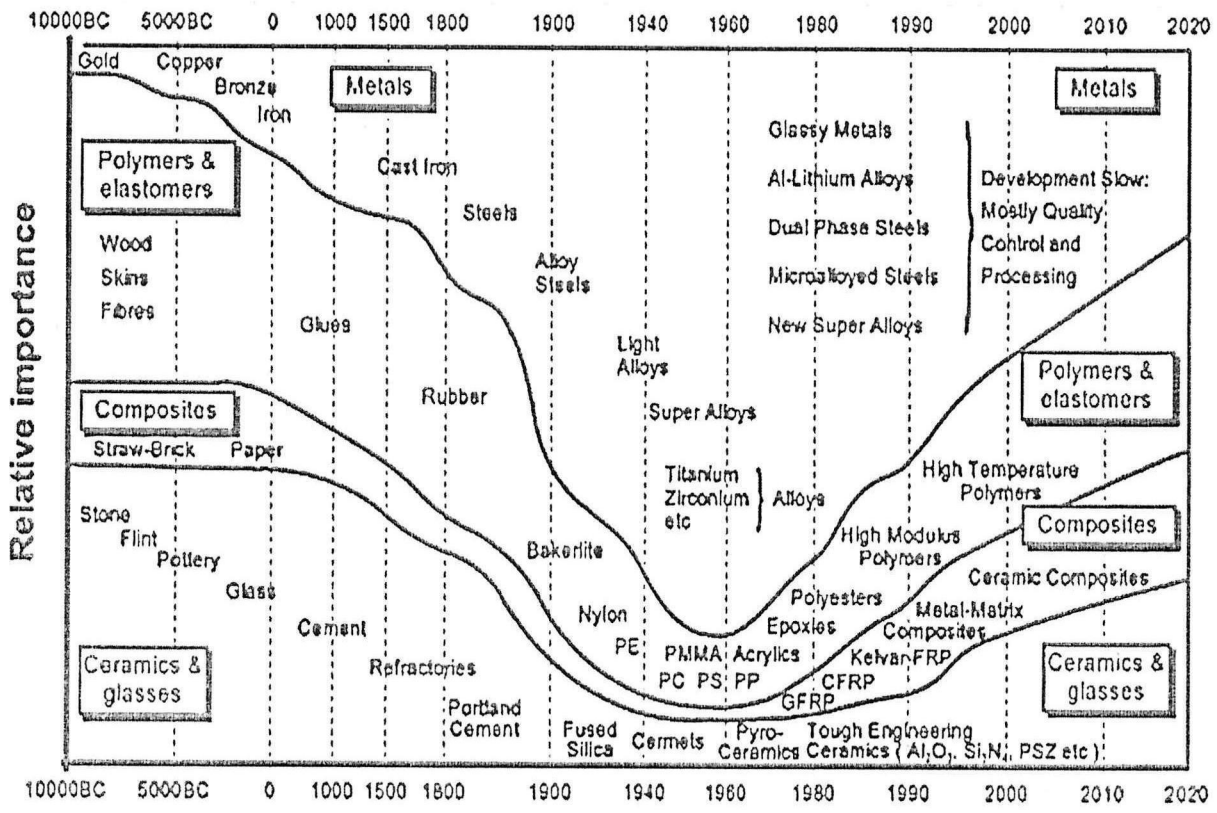

FIGURE Q2(c)