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Universiti Tun Hussein Onn Malaysia

**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2019/2020**

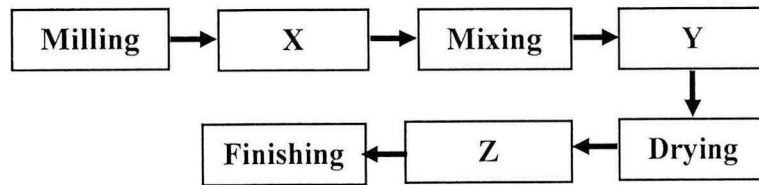
COURSE NAME : MATERIALS TECHNOLOGY AND SELECTION  
COURSE CODE : BPC 21903  
PROGRAMME CODE : BPB  
EXAMINATION DATE : DECEMBER 2019 / JANUARY 2020  
DURATION : 3 HOURS  
INSTRUCTION : ANSWER ALL QUESTIONS

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THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

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**Q1** (a) **Figure Q1** demonstrates the common processing of ceramic.



**Figure Q1: Ceramics processing**

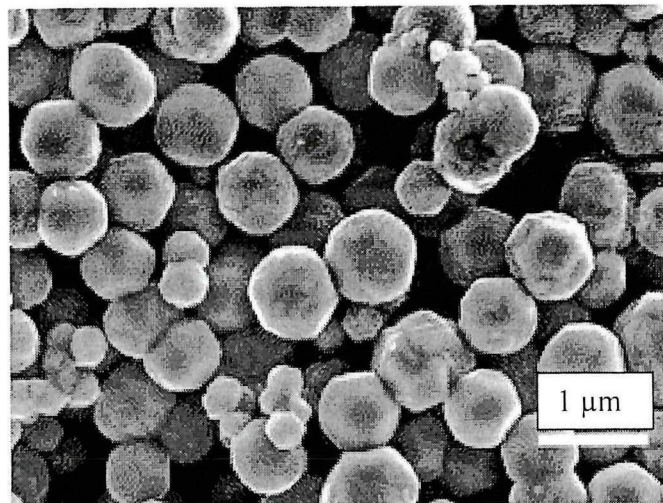
- (i) Name the process of X, Y and Z. (3 marks)
  - (ii) Explain **TWO (2)** importance of process Z. (4 marks)
  - (iii) Explain the microstructure changes of ceramic from milling process to finishing process with appropriate sketch. (5 marks)
- (b) Dr. Aizat could not obtained the required density for his compacted tungsten carbide block even though it has been sintered at 1700 °C for 4 hours. Given that the melting temperature for tungsten carbide is 2850 °C.
- (i) Explain the cause of problem. (2 marks)
  - (ii) Propose a solution to overcome problem in **Q1(b)(i)**. (6 marks)
- (c) Explain the forming process of glass-ceramics from traditional glass. (5 marks)

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- Q2** (a) Explain the function of matrix and reinforcement phase in a composite. (4 marks)
- (b) Explain the properties of particle reinforced composite. (6 marks)
- (c) A polymer matrix composite consisting of 35 vol % tungsten whiskers within an epoxy matrix is prepared. Given that modulus of elasticity for alumina whiskers and aluminium are 407 GPa and 7 GPa, respectively.
- Calculate the composite modulus under:
- (i) Isostrain condition  
(ii) Isostress condition (6 marks)
- (d) Plot a graph of modulus elasticity,  $E$  versus volume fraction of filaments,  $V_p$  for the case of epoxy reinforced alumina whisker based on **Q2(c)(i)** and **Q2(c)(ii)**. (9 marks)

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- Q3**
- (a) Explain the forming process of natural chitosan. (4 marks)
  - (b) Explain **THREE (3)** properties of elastomer. (6 marks)
  - (c) List **FOUR (4)** examples of thermoset. (4 marks)
  - (d) Explain the function of materials characterisation techniques listed below:
    - (i) Atomic Absorption Spectroscopy (AAS)
    - (ii) Field Emission Scanning Electron Microscopy (FESEM)
    - (iii) X-ray Diffractometer (XRD)(6 marks)
  - (e) Discuss the surface morphology of the magnetite particles as shown in **Figure Q3**. (5 marks)



**Figure Q3: Micrograph of magnetite particles.**

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- Q4** (a) Explain the materials selection methods listed below:
- (i) Classical selection
  - (ii) Imitative
  - (iii) Comparison
- (6 marks)
- (b) Explain **TWO (2)** reasons why aluminium and its alloys are widely used in producing the beverage can.
- (4 marks)
- (c) Identify the materials that have a fracture toughness  $K_{Ic}$  greater than  $100 \text{ MPa}\cdot\text{m}^{1/2}$  and a toughness  $G_{Ic} = K_{Ic}^2/E$  greater than  $10 \text{ kJ/m}^3$  by using the fracture toughness-modulus chart in **Appendix I**. Attach **Appendix I** together with your answer booklet.
- (15 marks)

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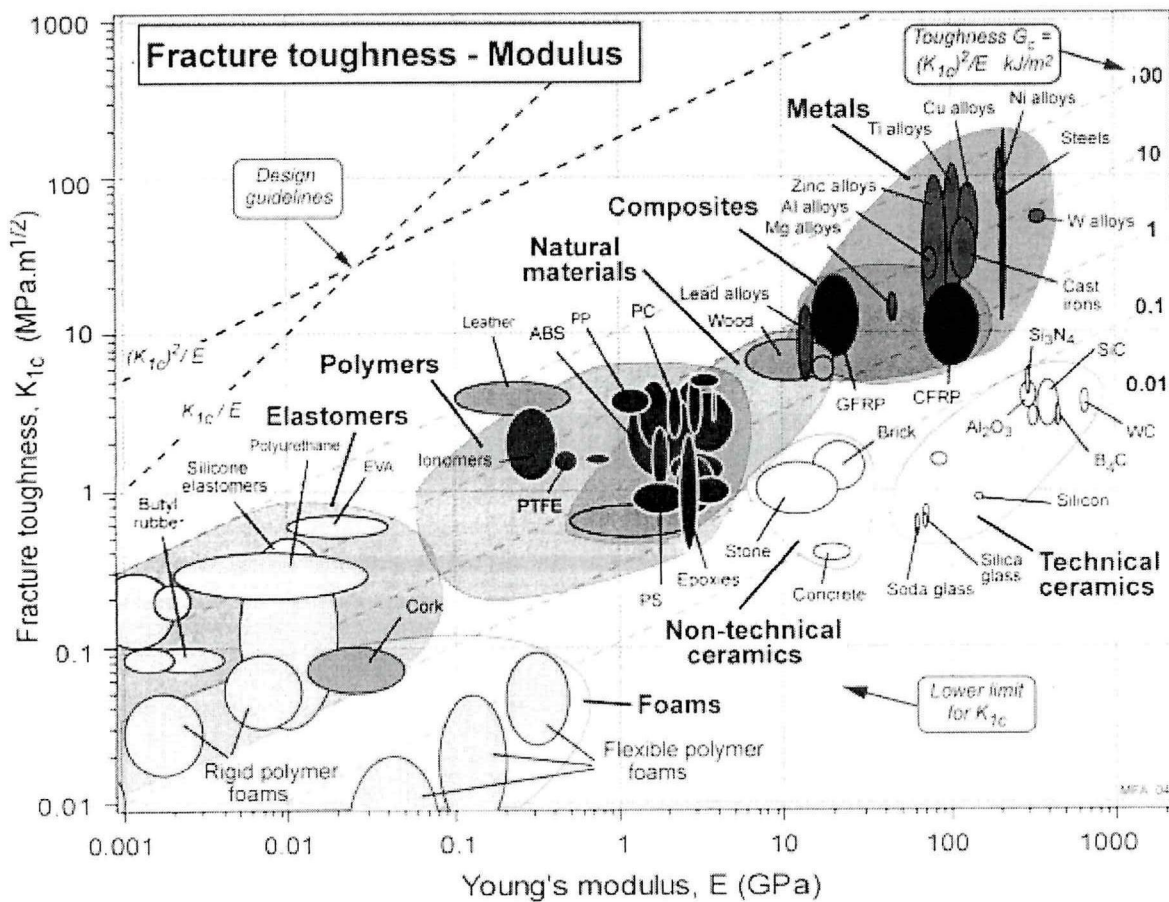
- END OF QUESTIONS -

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Appendix I



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