Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	MATERIALS TECHNOLOGY AND SELECTION
COURSE CODE	:	BPC 21903
PROGRAMME CODE	:	BPB
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) The traditional ceramic process generally involves seven steps; namely milling, batching, mixing, forming, drying, sintering, and finishing.

(i) Explain **TWO (2)** importance of milling.
(4 marks)

(ii) List **THREE (3)** types of drying techniques.
(3 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) Identify the cause of problem.
(2 marks)

(ii) Propose a solution to overcome his problem.
(4 marks)

(c) Explain the forming process of glass-ceramics from traditional glass.
(3 marks)

(d) Differentiate between atom arrangement of traditional glass and glass-ceramics.
(4 marks)

Q2 (a) Explain the function of primary phase and secondary phase in a composite.
(4 marks)

(b) Describe the laminar composite with appropriate illustration.
(5 marks)

(c) List **TWO (2)** examples of reinforcement for composite.
(2 marks)

(d) A polymer matrix composite consisting of 20 vol % alumina whiskers within an epoxy matrix is prepared. Given that modulus of elasticity for alumina whiskers and aluminium are 430 GPa and 7 GPa, respectively.

Calculate the composite modulus under:

(i) Isostrain condition
(ii) Isostress condition

(6 marks)

(e) Plot a graph of modulus elasticity, E versus volume fraction of filaments, Vp for the case of epoxy reinforced alumina whisker based on **Q2(d**

(8 marks)

Q3 (a) Explain the **THREE (3)** differences between thermoplastic and thermoset polymers.

(6 marks)

(b) Explain the addition polymerisation with the aid of diagrams.

(5 marks)

(c) List **THREE (3)** examples of polymer processing techniques.

(3 marks)

(d) Describe briefly the function of materials characterisation techniques listed below:

(i) Atomic Absorption Spectroscopy (AAS)
(ii) Fourier-transform Infrared Spectroscopy (FTIR)
(iii) Energy-dispersive X-ray Spectroscopy (EDS)

(6 marks)

(e) Discuss the surface morphology of the TiO_2 nanotubes as shown in **Figure Q3**.

(5 marks)

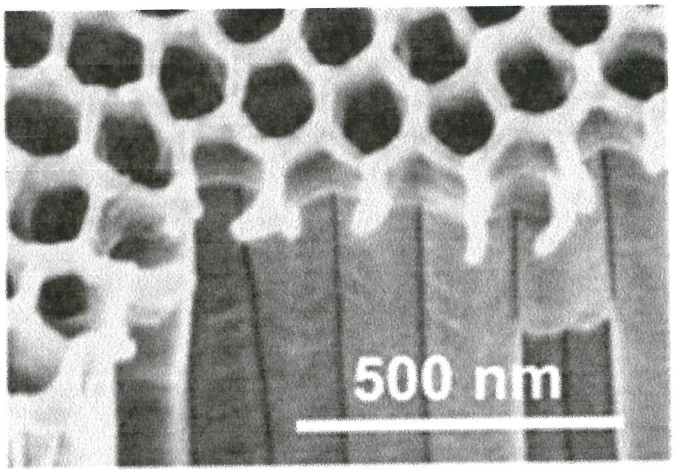

Figure Q3: TiO_2 nanotubes.

Q4 (a) Identify the materials with both a modulus E > 50 GPa and a density $\rho < 2$ Mg/m^3 by using Young's modulus-density (E-ρ) chart in **Appendix I**. Attach **Appendix I** together with your answer booklet.

(10 marks)

(b) Identify the materials that have a fracture toughness K_{Ic} greater than 100 MPa.m$^{1/2}$ and a toughness $G_{Ic} = K_{Ic}^2/E$ greater than 10 kJ/m^3 by using the fracture toughness-modulus chart in **Appendix II**. Attach **Appendix II** together you're your answer booklet.

(15 marks)

- END OF QUESTIONS -

APPENDIX I

FINAL EXAMINATION

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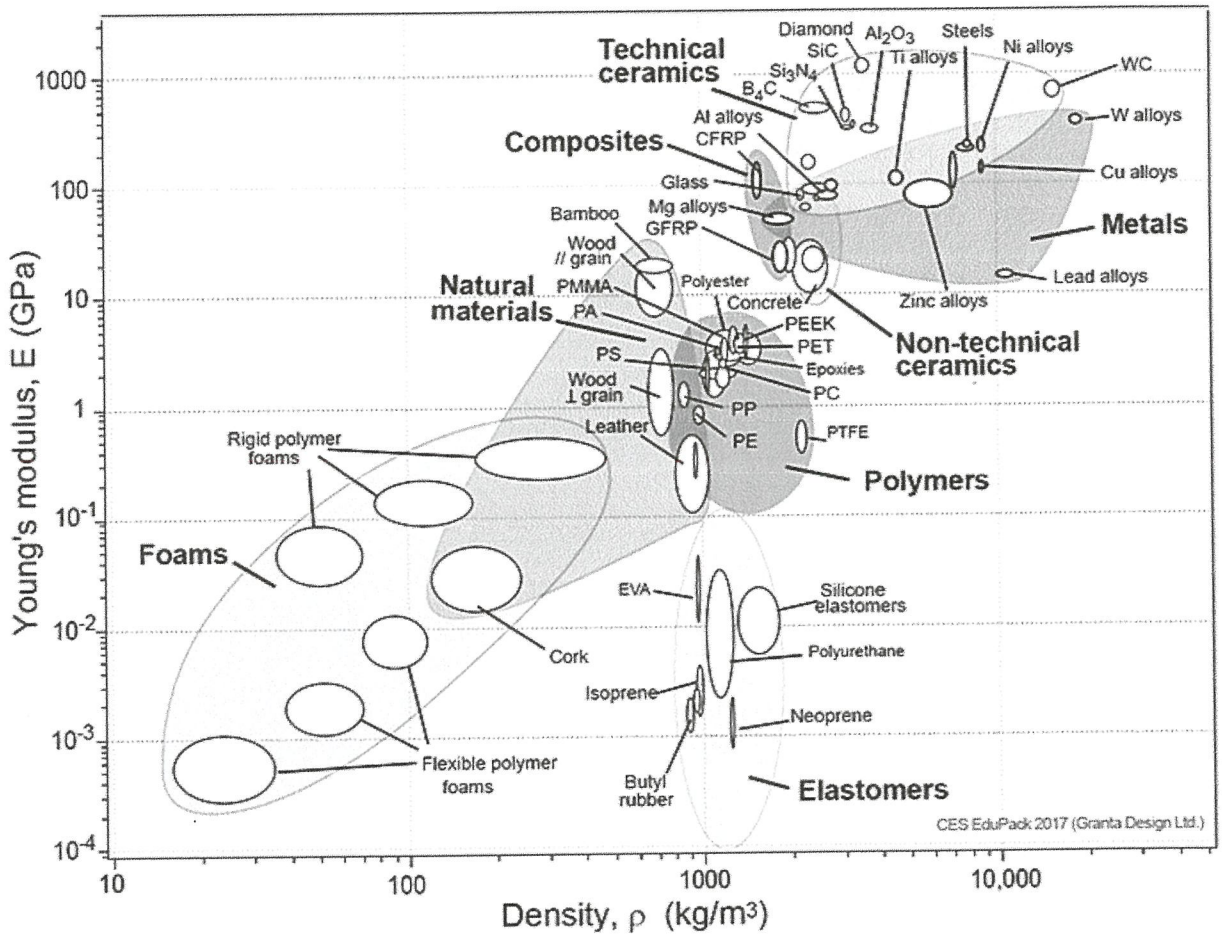
Appendix I



APPENDIX II

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Appendix II