UNIVERSITI SAINS MALAYSIA

KSCP Examination
Academic Session 2009/2010

June 2010

EBB 524/3 - Composite Materials

Duration : 3 hours

Please ensure that this examination paper contains FIVE printed pages before you begin the examination.

This paper contains SEVEN questions. ONE question in PART A, TWO questions in PART B, TWO questions in PART C and TWO questions in PART D.

Instruction: Answer **FIVE** questions. Answer **ALL** questions from PART A, **ONE** question from PART B, **ONE** question from PART C, **ONE** question from PART D and **ONE** question from any sections. If candidate answers more than five questions only the first five questions answered in the answer script would be examined.

The answers to all questions must start on a new page.

All questions must be answered in English.

PART A

1. [a] Using a suitable diagram explain 3 main types of nano composites which can be obtained when a layered silicate is dispersed in a polymer matrix. What are the advantages of using nanosize fillers in polymer composites?

(30 marks)

[b] Discuss the application of metal matrix composites in ground transportation area.

(30 marks)

[c] Discuss two types of bonding at an interface for MMC/CMC.

(40 marks)

PART B

2. [a] Using a suitable diagram, discuss about the following topics:

(i) Influence of fibre length on the mechanical properties of a fibre-reinforced polymer composites.

(ii) Influence of fibre orientation and concentration on the mechanical properties of a fibre-reinforced polymer composites.

(iii) Hybrid composites versus structural composites

(60 marks)

[b] A reinforced plastic sheet is to be made from a matrix with a tensile strength of 60 MN/m^2 and continuous glass fibres with a modulus of 76 GN/m^2. If the resin ratio by volume is 70% and the modulus ratio of the composite is 25, estimate the tensile strength and modulus of the composites.

(40 marks)

3. [a] Discuss the various type of thermoplastic materials which can be used in the polymer composites.

(40 marks)

[b] Discuss briefly the various fibre arrangements in thermosets and any three (3) forming processes to reinforced plastics.

(30 marks)

[c] What do you understand about 'Biodegradable Polymer Composites'? Discuss the 4 types of biodegradable polymers.

(30 marks)

PART C

4. [a] Describe the fabrication of dispersion strengthened Cu-TiB_2 composite via powder metallurgy method using ex-situ and in-situ processing approaches. Explain the main differences in both approaches, including their advantages and disadvantages.

(60 marks)

[b] A metal matrix composite is made from a boron (B) fiber reinforced aluminum alloy (Figure 1). To form the boron fiber, a tungsten (W) wire (r = 20 μm) is coated with boron, giving a final radius of 100 μm. The aluminum alloy is then bonded a round the boron fiber, giving a volume fraction of 0.80 for the aluminum alloy. Assuming that rule of mixture is applied also to ternary mixture; calculate the effective tensile elastic modulus of the composite material under isostrain conditions. Data E_w = 410 GPa; E_B = 379 GPa; E_{Al} = 68.9 GPa.

Figure 1

(40 marks)

5. [a] Write down the 'law of mixtures' equation in terms of the properties and quantities of reinforcement and matrix. Define all the terms involved. What are the importances of this law? Comment on its experimental validity.

(50 marks)

[b] With a schematic diagram, outline the fabrication of Al-SiC composite by liquid melt infiltration under gas pressure.

(50 marks)

PART D

6. [a] CMC's development has lagged behind MMC and PMC for reasons, discuss it.

(40 marks)

[b] Ceramic Matrix Composite is an approach to improve the toughness of ceramic materials. Differentiate toughening mechanisms for fibre and particulate reinforcement.

(60 marks)

7. Design a Fibre Reinforced Ceramic Matrix Composite System using Slurry Infiltration Technique. List any advantages, disadvantages of the materials and technique used in your system and also describe on the problems appear due to chosen materials and technique and gives their solution.

(100 marks)

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