UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session of 2007/2008

October/November 2007

EBB 524/3 – Composite Materials

Duration: 3 hours

Please ensure that this examination paper contains FOUR printed pages before you proceed with the examination.

This paper contains SEVEN questions.

Instruction: Answer **FIVE** (5) questions. If a candidate answers more than five questions, only the first five questions answered will be examined and awarded marks.

Answers to any question must start on a new page.

All questions must be answered in English.

1. [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)

2. [a] Discuss briefly the various fibre arrangements in polymer composites and any 3 forming processes to reinforced polymer composites.

(60 marks)

[b] PEEK is to reinforced with 40% by volume of unidirectional carbon fibres and the properties of the individual materials are given below.

Material	Density (kg/m^3)	Tensile strength (GN/m^2)	Modulus (GN/m^2)
PEEK	1300	0.058	3.8
Carbon fibre	1800	2.1	400

Calculate the fraction of the applied force which will be taken by the fibres in the composites.

(40 marks)

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

(30 marks)

[b] List down the advantages and disadvantages of ceramic matrix composite processing via chemical vapor infiltration techniques.

(30 marks)

[c] Tensile tests were carried out on alumina and SiC fibres of density 3.3 Mg/m^3 and 2.6 Mg/m^3 respectively. The deformation in all tests was elastic up to failure of the fibres and the mean tensile strengths and strains to failure were: alumina, 1000 MPa and 0.2%, and SiC, 1800 MPa and 0.5%. Calculate the specific modulus and the specific strength of the two types of fibre.

(40 marks)

4. [a] Describe the toughening mechanism, which involves a phase transformation of the second phase particles at the crack tip. The discussion should refer to a specific ceramic matrix composite system using a suitable schematic diagram.

(60 marks)

[b] Describe the principle of ceramic matrix composite machining by using water jet technique. Draw a schematic diagram of the equipment.

(40 marks)

5. [a] What are the main drawbacks for ceramic that hinder its application in industry? Briefly described how these problems can be overcome by using ceramic matrix composite approach?

(50 marks)

[b] Describe sol gel processing for ceramic matrix composite manufacturing. The discussion should include flow charts of the method, advantages and disadvantages of the process.

(50 marks)

6. [a] Explain the production of (i) aluminum reinforced with boron fiber and (ii) aluminum reinforced with silicon carbide particulate through solid state processing.

(70 marks)

[b] Write a short note on the application of metal matrix composites in such areas:

(i) Ground transportation, and

(ii) Commercial and military aerospace

(30 marks)

7. [a] With the aid of appropriated diagrams, discuss the effect of reinforcement on properties of metal matrix composite from different aspects such as:

(i) Young's modulus, and

(ii) Properties at elevated temperature

(70 marks)

[b] Discuss the advantages and disadvantages of metal matrix composite production using in-situ techniques.

(30 marks)

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