UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2011/2012

January 2012

EBB 524/3 – Composite Materials

Duration : 3 hours

Please ensure that this examination paper contains <u>FIVE</u> printed pages before you begin the examination.

This paper consists of ONE question from PART A and SIX questions from PART B.

Instruction: Answer **ALL** questions from PART A and **FOUR** questions from PART B. 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]   Discuss about self-propagating high temperature synthesis (SHS) in ceramic matrix composite fabrication.   List the advantages and disadvantages of this process.

(30 marks)

[b]   Write a short note on the influence of size of reinforcement on the properties of metal matrix composite.

(30 marks)

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

(40 marks)

PART B:

2.   [a]   By using a suitable examples, explain what do you understand with hybrid composites and structural composites?

(30 marks)

[b]   For fibre reinforced composites, one of the important factor to determine the strength of composites material is critical fibre length, ℓ_c

$$\ell_c = \frac{\sigma_f d}{2\tau_c} \qquad \text{----------------------- (1)}$$

Explain the meaning of equation (1) above. By using suitable figure, draw stress-position profiles for a fibre reinforced composites that is subjected to a tensile stress for fibre length, ℓ (i) is equal to the critical length, ℓ_c (ii) is greater than ℓ_c and (iii) is less than ℓ_c.

(30 marks)

[c]   Discuss various forming processes which can be used to manufacture polymer composite.

(40 marks)

3.   [a]   By considering a polymer composite with uni-directional continuous aligned fibres at longitudinal and transverse direction, show that the resultant modulus is:

$$E_{cL} = E_f V_f + E_m V_m \quad \text{and}$$
$$E_{cT} = E_f E_m / (V_f E_m + V_m E_f)$$

(50 marks)

    [b]   Short carbon fibres with a diameter of 10 μm are to be used to reinforced nylon 66. If the design stress for the composite is 400 MN/m^2 and the following data is available on the fibres and nylon, calculate the load transfer length for the fibres and also the critical length. The volume fraction of the fibres is to be 0.3.

	Modulus (GN/m^2)	Strength (GN/m^2)
Carbon fibres	230	2.9
Nylon 66	2.8	-

The interfacial shear strength for carbon/nylon may be taken as 4 MN/m^2.

(50 marks)

4. [a]   Explain the limitations in production of aluminum composite reinforced with ceramic particles using casting. Propose remedy actions to solve the above limitations.

(60 marks)

    [b]   Describe friction stir processing and its importance in producing ceramic particles reinforced aluminum composite.

(40 marks)

5. Discuss the importance of magnesium matrix composite in transportation industry including the following:
    (i)   Processing technique
    (ii)   Main issue (challenge)
    (iii) Properties
    (iv)   Advantages and disadvantages

(100 marks)

6. [a]   What is toughening in CMC? Describe TWO of the toughening mechanisms.

(50 marks)

    [b]   Discuss on factors you need to consider in choosing the suitable process in fabricating the CMC products?

(50 marks)

7. Explain the mechanical and chemical bonding in CMC interfaces. How these interfaces affect the CMC properties?

(100 marks)

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