Menoufiya University Faculty of Engineering Shebin El- Kom Final Term Exam. Academic Year: 2013 – 2014 Date: 16/ 6/ 2014		Dept. : Production Engineering Year : 500 دراسات- دبلوم مستوى Subject: Composite Materials Code : PRE 504 Time Allowed: 3 hours Total Marks: 100 Marks

Allowed Tables and Charts: None

Answer all the following Questions:

Question 1: (4×5   marks)

  a) Indicate in what way manufacturing using advanced composites is different from the manufacturing using metals.

  b) Explain the influence of fiber length on the properties of composites.

  c) Derive the rule of mixtures for the modulus of elasticity of a fiber-reinforced composite when a stress (σ) is applied along the axis of the fibers.

  d) It is desired to produce an aligned carbon fiber-epoxy matrix composite having a longitudinal tensile strength of 690 MPa. Calculate the volume fraction of fibers necessary if the average fiber diameter and the average fiber length are 0.01 mm and 0.5 mm respectively; the fiber fracture strength is 4000 MPa, the fiber-matrix bond strength is 50 MPa and the matrix stress at composite failurevis 7.0 MPa.

Question 2: (15 + 15   marks)

  a) Explain briefly the four common processing steps in thermoset and thermoplastic composites, indicating why is processing of thermoset composites easier than that of thermoplastic composites?

  b) Describe the injection molding process for making thermoset composites, indicating the difference when it is used for making thermoplastic composites?

Question 3: (5+15+5   marks)

  a) List the factors that must be considered for fabricating MMCs to obtain castings with high quality and good properties.

  b) Describe Liquid Metallurgy / Vortex Technique for fabricating Al-Matrix composites indicating why it is essential to control the temperature. Mention some treatments that are required for the reinforcement and melt to promote wetting.

  c) Write down some of the applications of filament winding indicating the limitations of filament winding.

Question 4:   (7+8+10   marks)

a) Ceramic-matrix composites are believed to be toughened by three main mechanisms. Explain these mechanisms.

b) Explain the concept of Hybrid Composites indicating their advantages and their principal applications.

c) A ceramic-matrix composite is made with continuous SiC fibers embedded in a glass-ceramic matrix. The composite consists of 35 vol % SiC fibers.

   i) Calculate the tensile elastic modulus of the composite under isostrain conditions,

   ii) Will the matrix or the fibers crack first? and

   iii) What stress on the composite in the direction of the fibers will cause the first crack to form?

Data are as follows:

Glass-ceramic matrix :   SiC fiber

   $E = 94$ GPa , $E = 350$ GPa

   $K_{Ic} = 2.4$ MPa$\sqrt{m}$, $K_{Ic} = 4.8$ MPa $\sqrt{m}$

largest preexisting flaw is 10 μm   largest surface notches

diameter.   are 5 μm   deep.

assuming $Y = 1$ in both cases.

Good Luck

This exam contributes "by measuring ILOs" in achieving Programme Academic Standards according to NARS													
Question Number	Q1-a	Q2-a	Q3-a	Q4-a	Q1-c	Q2-b	Q3-c	Q4-b		Q1-d	Q2-b	Q3-b	Q4-a,	Q4-c
Skills	a3-1,2	a3-1,2	a19-2	a3-1	b13-1	b2-1, b2-2, b2-3	b2-1, b2-2, b2-3	b1-1		c5-1	c1-1	c1-1	c1-1	c5-1,c16-1
	Knowledge & Understanding Skills				Intellectual Skills					Professional Skills				