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**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2015/2016**

**COURSE NAME : COMPOSITES**  
**COURSE CODE : BDB 40703**  
**PROGRAMME : 4 BDD**  
**EXAMINATION DATE : DECEMBER 2015/JANUARY 2016**  
**DURATION : 3 HOURS**  
**INSTRUCTION : ANSWER FIVE (5) QUESTIONS ONLY**

**THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES**

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- Q1** (a) Propose a composite material that can be used to fabricate composite bicycle and give your reasons of choosing it. (4 marks)
- (b) The main failure mechanism is related to interfacial bonding between the matrix and fibers. Describe the mechanism of interfacial bonding that occurs in matrix-reinforcement interface. Justify your answer. (12 marks)
- (c) Figure Q1 shows the stress strain graph of polymer matrix particulate composite. By plotting the stress-strain graph, determine the polymer matrix particulate composite yield strength and tensile strength. (PLEASE ATTACH THE FINAL PAPER TOGETHER) (4 marks)
- Q2** (a) If the surface energy per unit area of Al/SiC composite ( $\gamma_s$ ) is  $0.40 \text{ J/m}^2$ . Calculate the critical stress,  $\sigma_c$  required for the crack propagation (a) of:  
 (i)  $a = 0.07 \text{ mm}$   
 (ii)  $2a = 0.22 \text{ mm}$   
 Given : Young's Modulus,  $E = 79 \text{ GPa}$  (10 marks)
- (b) The most important in reinforcing materials is the fibers, because it will supply the basic strength of the composite. Verify why longer fibers carry stress more efficiently than shorter fiber. (10 marks)
- Q3** (a) Determine the composite modulus of elasticity for polyester reinforced with 60 % volume of E-glass particles if under condition of:  
 (i) isostrain  
 (ii) isostress  
 Given: Young's Modulus of polyester,  $E_{\text{polyester}} = 6.9 \text{ GPa}$  and Young's Modulus of glass,  $E_{\text{E-glass}} = 72.4 \text{ GPa}$  (6 marks)
- (b) Define the concept of composites. (2 marks)

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- (c) Particle or discontinuously reinforced Metal Matrix Composites (MMC) is more common than others type of reinforcement in MMC. Defend the statement with THREE (3) primary reasons.

(6 marks)

- (d) Transformation toughening is one of toughening mechanism to shield the crack tip from applied stress. Illustrate the mechanism involve during transformation toughening.

(6 marks)

- Q4** (a) CTRM AC Sdn. Bhd were awarded with Boeing project to produce Boeing 747 Fuselage. Fuselage is the main structure of an airplane which have long dimension with cylindrical shape. Carbon fiber and epoxy resin are the material for fuselage, as referred to Boeing Manufacturing Standards.

Based on the statements, choose the suitable process to produce fuselage and illustrate the process involved.

(5 marks)

- (b) Differentiate between hand lay-up method and spray-up method by using illustration and explanation.

(6 marks)

- (c) Compression molding is one of composite processing technique. Suggest suitable product to be produced by using this technique. Develop and sketch the mold design and explain the manufacturing stage.

(9 marks)

- Q5** (a) Proton Research and Development (PRD) division is planning to develop new prototype aluminum engine block. This engine is designed to withstand high temperature that cause by high engine revving. To strengthen this engine, PRD decided to use Silicon Carbide (SiC) particles to enhance the material properties.

Construct the suggested manufacturing process figure and flowchart by selecting suitable processing method to cast the engine block.

(8 marks)

- (b) Justify the importance usage of composites in aircraft and airframe.

(4 marks)

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- (c) Compare general properties of carbon fiber composites and glass fiber composites. (8 marks)
- Q6** (a) Choose suitable process to develop ceramic matrix composites (CMC) that consists of ceramic slurry and continuous fiber class. Sketch the figure of the process. (6 marks)
- (b) Differentiate between CMC's hot press method and hot isotactic press. (4 marks)
- (c) Asian Composites Manufacturing (ACM) Sdn. Bhd. is planning to develop aluminium foil-stainless steel laminate composites. As a Production Engineer (PE), develop the production planning documents.
- (i) Select the manufacturing technique of aluminum foil and stainless steel fiber mat to become laminate composites. The matrix and reinforcement fiber have to be stacked prior to fabrication. (3 marks)
- (ii) Describe the manufacturing technique and use a diagram to illustrate the step and brief the procedure. (7 marks)

– END OF QUESTIONS –

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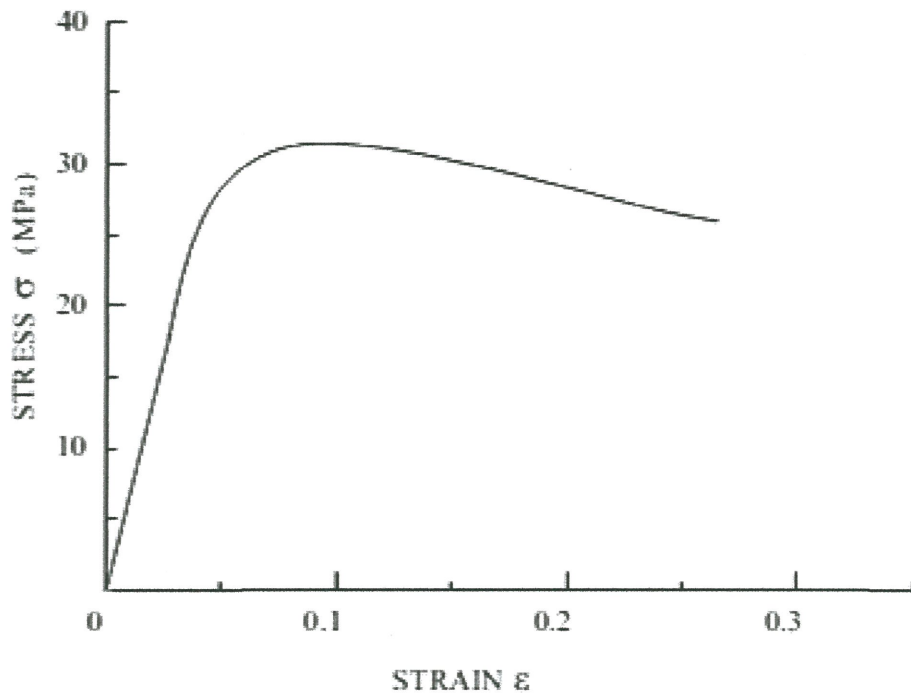


FIGURE Q1

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