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**UNIVERSITI TUN HUSSEIN ONN
MALAYSIA**

**FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021**

COURSE NAME : COMPOSITES
COURSE CODE : BDB 40703
PROGRAMME : BDD
EXAMINATION DATE : JANUARY/FEBRUARY 2021
DURATION : 3 HOURS
INSTRUCTION : ANSWER FIVE (5) QUESTIONS
ONLY

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THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

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- Q1**
- (a) Give the main reason why people/industry prefers to make a composite structure instead of using the one type material only. The explanation can be associated to any materials as the targeted example to ease your explanation. (4 marks)
 - (b) An engineer of one company has been assigned to investigate the failure of boiler body that operating at very high temperature that made from high spec of stainless steel. This boiler component also working under vibration and corrosive condition that also consider factors that may assist the crack/failure propagation in this boiler at high temperature. Give **ONE (1)** suggestion of composite materials that suit to be used and replace the existing boiler component with considering the working environment as stated above. Give strong justifications of your selection of this composite material. (6 marks)
 - (c) Even composite materials offer better improvement of characteristic and properties compared to other materials type, but for some reason some industries and peoples still do not prefer to use these composite materials due to some limitation. Give strong reason and explanation with good examples of composite materials to support the above statement. (4 marks)
 - (d) Composite classification can be grouped into three types which are Polymer matrix composite(PMC), Metal matrix composite(MMC) and Ceramic Matrix composite(CMC). Discuss the advantages and disadvantages of these **THREE (3)** types composite based on the criteria below;
 - i. Cost: processing cost, cost of materials, etc
 - ii. High temperature ability and corrosive protection
 - iii. Processing and production Time
 (6 marks)

- Q2**
- (a) Justify the important of fiber surface area that associate to fiber interaction within matrix structure by showing the correlation between the fiber diameter, fiber length and interfacial diameter using an appropriate equation. (4 marks)
 - (b) Give justification why the fiber with higher surface area (longer fiber) is more preferred compared to fiber with lower surface area (shorter, thicker fiber). (4 marks)
 - (c) Explain the function of interface in composite structure component. (2 marks)

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- (d) i. Consider one fiber that made from different materials has integrate into matrix composite that made from different materials from the fiber.

Fiber A = contact angles 35°

Fiber B = contact angles 140°

Which of the composite will show good wetting condition? Justify your answer by using an appropriate equation.

(5 marks)

- ii. Suggest **ONE (1)** composite material that highly exposed to the problem the surface wettability between fiber and matrix. Suggest **ONE (1)** technique that can be used to improve this composite interface wettability problem.

(5 marks)

- Q3** (a) Describe **TWO (2)** function of matrix

(4 marks)

- (b) Give strong justification for the statements below;

- i. The application of matrix composite from thermoplastic is widely used compared to the application of thermoset matrix.

(3 marks)

- ii. For high temperature application, thermoset matrix are favored to be used.

(3 marks)

- (c) MMC with ceramic contained in metallic matrix phase can be in the form of carbides and oxides. Which compound of ceramic are widely used?. Support your answer with strong reason.

(4 marks)

- (d) There are **TWO (2)** possible mechanism of fiber in composite structure either strengthening or Toughening.

- i. Which mechanism is applied for most reinforcement concept in ceramic composite material

(2 marks)

- ii. Give justification for your answer.

(4 marks)

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- Q4** (a) Suggest **ONE (1)** possible conventional method that can be used to fabricate body component of the boat from polymer composite materials. Explain in detail the steps of the fabrication process and state what are the limitation of this process. (6 marks)
- (b) Give **ONE (1)** reason why in processing of CMC component using the wet processing method sometimes is more preferred even the conventional powder processing route offer easier step and lower sintering temperature. (3 marks)
- (c) Justify why most of Hot Isostatic pressing component has more higher density compared to sintering component with conventional route. Support your answer with relate to process variables and finished body properties. (4 marks)
- (d) i. Explain briefly **THREE (3)** types of MMC fabrication methods. (3 marks)
- iii. In liquid metal ceramic particulate mixing process, there are some problem that associates to the inhomogeneous mixture and failure in getting good dispersion of MMC. Give **TWO (2)** possible reason with brief explanation that will occur in this problem (4 marks)
- Q5** (a) Suggest the possible plot of stress vs strain diagram of the composite for PMC and CMC. Justify your answer with an appropriate reason to support the above plots. (4 marks)
- (b) The mechanical properties of aluminum may be improved by incorporating fine particles of Silicon Carbides (SiC). Given that the moduli of elasticity of these materials are, respectively, 69 GPa(Al) and 451 GPa(SiC). Propose plot modulus of elasticity versus the volume percent of Al_2O_3 in aluminium from to 1 volume fraction using both upper-and lower-bound expressions. (5 marks)
- (c) MMC composite has a critical, σ_c of 1550MPa and K_{IC} of 98 MPa.(m^{1/2}). Calculate the size of a surface, (a) that will lead to catastrophic failure at an applied stress equal to σ_c . (5 marks)
- (d) To avoid catastrophic failure of one component ceramic brittle materials, other phase that has good toughness is dispersed into this component. Suggest **TWO (2)** possible toughening mechanism that will take place in this brittle materials (4 marks)

- Q6** (a) i. Justify why most of airplane body are made from PMC and MMC, but not form CMC. Support your justification based on materials properties and behavior. (5 marks)
- iii. Which part in the airplane body possibly need a component that made from cemented MMC, give justification for your answer. (5 marks)
- (b) Explain briefly the important of composite development in car technology starting from previous technology to the current technology. Give strong justification on how the composite improvement and development significantly influence the car technology improvement. (6 marks)
- (c) Give several reasons why the research and development Polymer matrix composite(PMC) is intensively being conducted until now. (4 marks)

-END OF QUESTIONS -