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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

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

COURSE NAME : COMPOSITE
COURSE CODE : BDB 40703
PROGRAMME CODE : BDD
EXAMINATION DATE : JULY 2021
DURATION : 3 HOURS
INSTRUCTION : ANSWER FIVE (5) QUESTIONS ONLY.

TERBUKA

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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- Q1**
- (a) Composite is a macroscopic combination of metallic, ceramic, or polymeric materials having an identifiable interface between them. Describe the composite components and explain the concept of composite material. (4 marks)
- (b) Classification of composite materials is based on the arrangement of the reinforcement. Sketch THREE (3) types of arrangement of the reinforcement. (6 marks)
- (c) The good selection of reinforcement material is important in composite properties improvement. However, properties of matrix material also need to be considered in materials selection. Give justification on the important of matrix material selection. (5 marks)
- (d) Fiberglass boats are among the most familiar examples since fiberglass is a composite where a matrix polymer is reinforced by glass fibers which may be arranged randomly, or as a chopped strand mat, or as a woven fabric. Select ONE (1) suitable type of polymer matrix in fiberglass boats. Give the advantages of the selected polymer. (5 marks)
- Q2**
- (a) Mechanical performance of composite materials can be determine under tensile test. Sketch the stress-strain curve of the following components in one graph.
(i) Matrix
(ii) Brittle fiber
(iii) Ductile fiber (4 marks)
- (b) Compare the longitudinal and transverse stiffnesses (E_{11}/E_{22}) of the composite with the same matrix but different fibers. Given $E_m/E_f=25$ and $V_f=0.5$ (6 marks)
- (c) Calculate the composite modulus for aluminium reinforced with 50 vol. % boron filaments under:
(a) isostrain condition
(b) isostress condition
Given: $E_{\text{aluminium}}=69$ GPa, $E_{\text{boron}}=410$ Gpa (4 marks)
- (d) Metal Matrix Composite (MMC) specimen with fracture toughness of 45 MPam^{1/2} is exposed to a stress of 1000 MPa. Will this specimen experience fracture if it is known that the largest surface crack, a is 0.75 mm. (6 marks)
- Q3**
- (a) Matrix holds the fibers together and protect the fibers from environment. Identify the desired properties of a polymer matrix (4 marks)

- (b) The selection of reinforcement is based on the properties desired in the finished product. Determine the form of fibers used in the following polymer composite processing:
- (i) Filament winding
 - (ii) Prepreg
- (4 marks)
- (c) Differentiate between hand lay-up method and spray-up method by using illustration and explanation.
- (6 marks)
- (d) Engineer in company A planning to fabricate ceramic matrix composite (CMC) which is carbon fiber glass ceramic. Suggest one method to fabricate the carbon fiber glass ceramic and explain the process with an appropriate diagram.
- (6 marks)
- Q4** (a) Explain briefly TWO (2) types of MMC fabrication methods
- (4 marks)
- (b) In liquid metal-ceramic particulate mixing process, there are some problems 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.
- (6 marks)
- (c) Polaris Defense, a division part of Polaris Industries Inc. had planned to develop new prototype of combat vehicle. This vehicle door assembled with lightweight armor panel which design to be able withstand ballistic impact and high temperature for bullet proof purpose. To meet these purposes, titanium layer (Ti) with stainless steel wire mesh (SS) were selected as a door panel in stacking condition. The stacking arrangement of the layer is Ti-SS-Ti-SS. By evaluating the case given, brief the involved manufacturing process by using figure and flowchart to produce lightweight armor door panel.
- (10 marks)
- Q5** (a) Compare fibrous and particulate reinforcement in the basis of their aspect ratio. Support your explanation with a suitable diagram.
- (6 marks)
- (b) One property that is common with most composites is low weight-to-strength ratio. This attribute is the reason for their wide applications in biomedical. Suggest one composite material that is suitable in dental application. State your reason for the selected material
- (6 marks)
- (c) The Boeing 787 Dreamliner is the first major commercial airplane to have a composite fuselage, composite wings, and use composites in most other airframe components. From your knowledge, suggest one composite material

that is suitable in aircraft engine exhaust application. Support your answer with the advantages of the material chosen.

(8 marks)

- Q6**
- (a) What are the differences between carbon fiber composites that using pre-impregnation (pre-preg) layup with autoclave curing and hand lay-up with room temperature curing.
(6 marks)
- (b) Recommend THREE (3) types of appropriate mechanical properties testing in order to verify the properties limit for airplane wing. Explain the reason of the selected testing.
(6 marks)
- (c) Natural fiber-based composites hold significant potential for automotive, energy and aircraft industries. Do you agree? Please give a strong reason why natural fibers are more favorable than synthetic fibers.
(8 marks)

-END OF QUESTIONS –