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**UTHM**

Universiti Tun Hussein Onn Malaysia

**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2022/2023**

COURSE NAME : MATERIAL ENGINEERING  
TECHNOLOGY

COURSE CODE : BDX 10703

PROGRAMME CODE : BDX

EXAMINATION DATE : JULY/AUGUST 2023

DURATION : 3 HOURS

INSTRUCTION :

1. ANSWERS **FIVE (5)** QUESTIONS  
**ONLY FROM SIX (6)** QUESTIONS GIVEN
2. THIS FINAL EXAMINATION IS  
CONDUCTED VIA **CLOSED BOOK.**
3. STUDENTS ARE **PROHIBITED** TO  
CONSULT THEIR OWN MATERIAL OR  
ANY EXTERNAL RESOURCES DURING  
THE EXAMINATION CONDUCTED VIA  
CLOSED BOOK.

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

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- Q1** (a) (i) Mechanical properties is one of an important property in aircraft. Define tensile strength and shear strength. (3 marks)
- (i) How tensile strength and shear strength are measured? (4 marks)
- (ii) Describe the causes that result in tensile and shear strength. (4 marks)
- (b) Carbon steel is one of the most commonly used materials in aerospace industry due to its fantastic properties, which include a high degree of strength. Differentiate **THREE (3)** types of carbon steel in terms of;
- (i) the carbon composition,
- (ii) their properties and
- (iii) application (9 marks)
- Q2** (a) The era of aerospace materials started with the first powered flight by Wright brothers.
- (i) Identify **TWO (2)** type of material that are used to build the flight in (a) and which part of the flight that the material applies to. (4 marks)
- (ii) State **THREE (3)** reason why wood was chosen as part of the material used in the first powered flight. (3 marks)
- (b) By referring to **Figure Q2 (b)**;
- (i) Label (a), (b) and (c) (3 marks)
- (ii) Identify the function of every part in (i) (6 marks)
- (iii) Define **FOUR (4)** important material properties of the empennage. (4 marks)
- Q3** (a) One of the methods that could strengthen the metal is by dispersion hardening. Explain how this method strengthen the metal using the appropriate hardening mechanism. (10 marks)

- (b) Nearly all the aluminium used in aircraft structures is in the form of wrought heat-treatable alloys. Show the reasoning of the statement mentioned. (10 marks)
- Q4**
- (a) What are the main advantages of using titanium alloys in aircraft structures? Give examples of commonly used titanium alloys in the aerospace industry. (6 marks)
- (b) Describe the different types of titanium alloy heat treatments used in the aerospace industry. How do these treatments affect the properties of the titanium alloy? (4 marks)
- (c) Between the properties of AZ31B and AZ61A magnesium alloys, which one would you choose for a specific structural component in an aircraft, and why? (6 marks)
- (d) State the key characteristics and properties of magnesium alloys that make them suitable for use in aircraft structures. Provide examples of commonly used magnesium alloys in the aerospace industry and the applications they are used for. (4 marks)
- Q5**
- (a) Identify the factors that can affect the selection of steel for aircraft applications and evaluate their relative importance. (6 marks)
- (b) Determine the effects of different heat treatment processes on the properties of steel and determine which process would be most appropriate for a particular aircraft component. (6 marks)
- (c) Compare the composition and microstructure of nickel-based superalloys and cobalt based superalloys used in gas turbine engines, and explain the factors that influence their selection for different engine components. (8 marks)

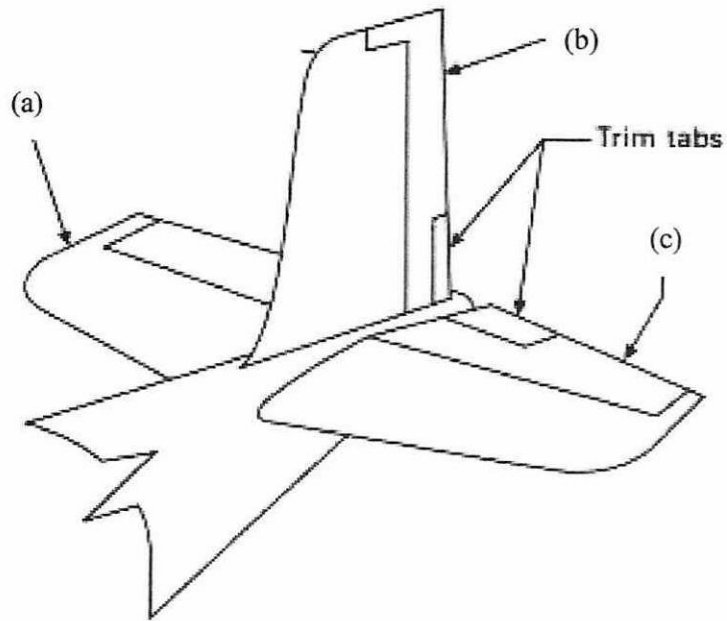
- Q6** (a) Compare the properties and applications of different types of polymers used in aircraft, such as thermoplastics, thermosetting polymers, and elastomers, and identify their advantages and disadvantages in specific aircraft components. (8 marks)
- (b) Identify the differences between CFRP and aluminum as materials used in aircraft structures and assess the strengths and weaknesses of each material in terms of weight, strength, stiffness, durability, and cost. (6 marks)
- (c) Describe the basic properties and uses of CFRP in aircraft, and analyze how it differs from other materials utilized in aircraft structures in terms of its characteristics and performance. (6 marks)

**- END OF QUESTIONS -**

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**Figure Q2(b) Typical empennage lay-out**

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