Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	: AIRCRAFT STRUCTURE
COURSE CODE	: BDU 20103
PROGRAMME	: 2 BDC&2 BDM
EXAMINATION DATE	: JUNE 2017
DURATION	: 3 HOURS
INSTRUCTION	: ANSWER **FOUR (4)** QUESTIONS **ONLY**

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

Q1 (a) Briefly explain the differences between monocoque and semi-monocoque aircraft structure. Provide a sketch of both types of aircraft structure.

(10 marks)

(b) Briefly explain Finite Element Method (FEM). Give two **(2)** advantages of the FEM over a conventional approach.

(5 marks)

(c) Consider the two element system as shown in Figure **Q1(b)** where Node 1 is attached to a fixed support, yielding the displacement constraint $U_1 = 0$, $k_1 = 9$ kN/m, k_2=13 kN/m. Applied forces, $F_2 = F_3 = 333$ N. For these conditions;

(i) sketch Free Body Diagram for the system.
(ii) determine nodal displacements U2 and U3.

(10 marks)

Q2 (a) Define the terms ground load and air load. Give three (3) examples for each of them.

(10 marks)

(b) Figure **Q2(b)** shows a section of the fuselage skin where two plates of 4 mm thick are connected by a single riveted joint. The rivets have a diameter of 3.5 mm. It is known that the failure strength of the rivet in shear and the ultimate tensile strength of the plate are 355 N/mm^2 and 445 N/mm^2 respectively.

(i) Calculate the rivet spacing if the joint is designed so that failure due to shear in rivet and failure due to tension in plate will occur simultaneously.

(6 marks)

(ii) Determine the maximum load P that the joint could withstand.

(3 marks)

(iii) Calculate the joint efficiency.

(3 marks)

(iv) Suggest the means to reduce the rivet shear and the plate tension.

(3 marks)

Q3 (a) Explain the difference between surfaces force and body force. Give two examples for each of them.

(5 marks)

(b) The cross section of a wing's stringer shown in Figure **Q3(b)** is subjected to a bending moment of -2000 Nm, acting in the vertical plane.

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(i) Calculate the maximum direct stress due to bending moment.

(12 marks)

(ii) State the point where the maximum direct stress acts.

(3 marks)

(iii) Sketch a stress distribution along edge AF.

(5 marks)

Q4 (a) The study of aeroelasticity may be broadly classified into two fields i.e. static aeroelasticity and dynamic aeroelasticity. Describe these two classes of aeroelasticity and explain flutter and buffeting phenomena in aircraft structure.

(8 marks)

(b) The doubly symmetrical fuselage section shown in Figure **Q4(b)** has been idealized into an arrangement of direct stress carrying booms and shear stress carrying skin panels. The boom area is 150 mm^2 each. When the section is subjected to shear loads of 50 kN and a bending moment of 100 kNm, calculate;

(i) the direct stresses in the booms

(ii) the shear flows in the panels.

(17 marks)

Q5 (a) Define the term 'airworthiness'.

(5 marks)

(b) Figure **Q5(b)(i)** shows an aircraft which having a total weight of 60 kN. It lands on the deck of aircraft carrier and is brought to rest by means of a cable engaged by an arrester hook. The deceleration induced by the cable is 3 g.

(i) Determine the tension, T, in the cable.

(4 marks)

(ii) Calculate the load on an undercarriage strut.

(4 marks)

(iii) Calculate the shear load, S, and axial load, N, in the fuselage at the section A-A (see Figure **Q5(b)(ii)**) where the weight of the aircraft aft of A-A is 4.5 kN).

(8 marks)

(iv) Calculate the length of deck covered by the aircraft before it is brought to rest if the touch-down speed is 30 m/s.

(4 marks)

- END OF QUESTION –

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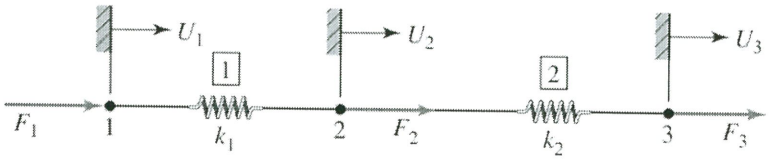

Figure Q1(b)

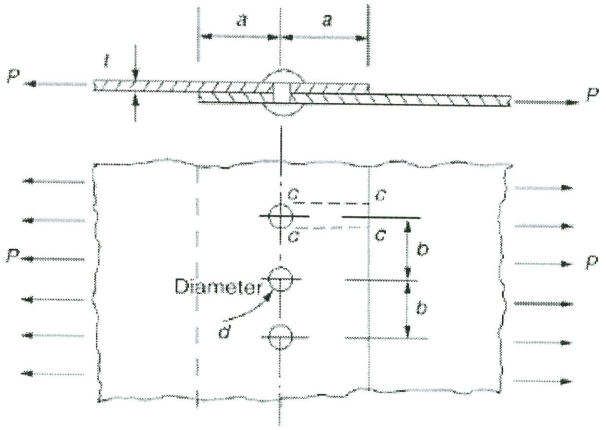

Figure Q2(b)

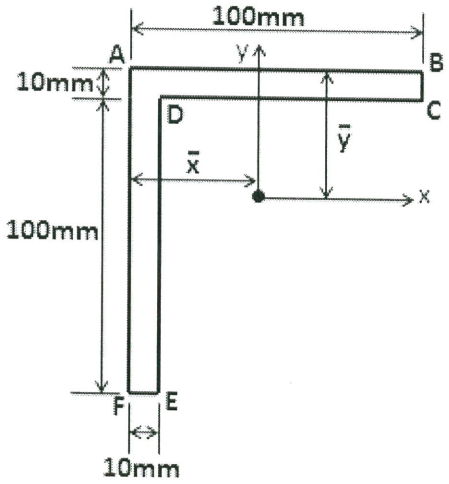

Figure Q3(b)

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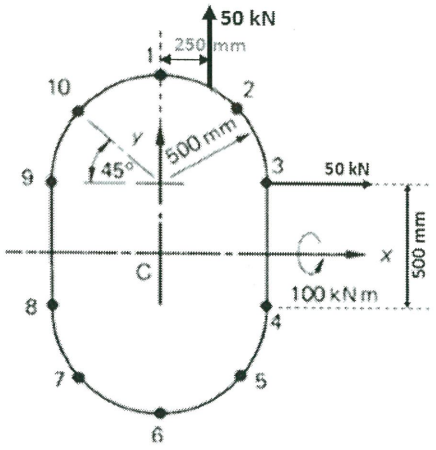

Figure Q4(b)

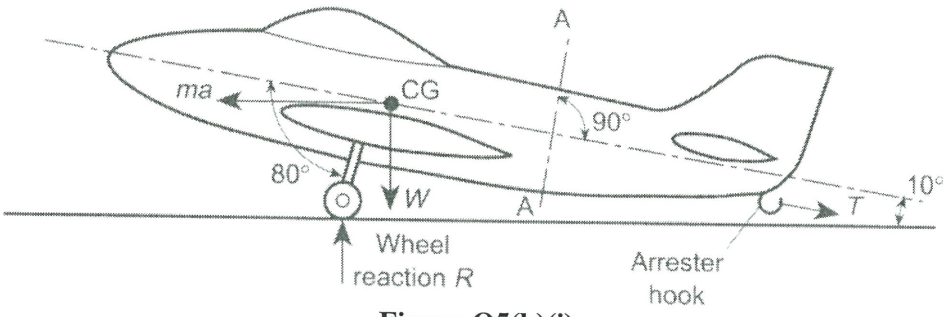

Figure Q5(b)(i)

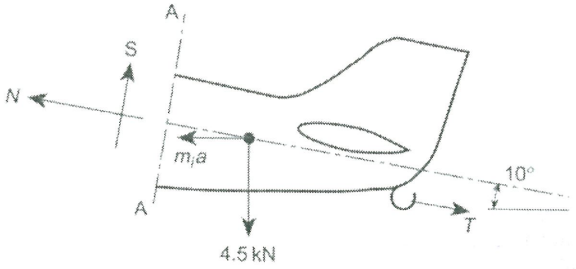

Figure Q5(b)(ii)

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