UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2023/2024

COURSE NAME	:	AIRCRAFT STRUCTURE
COURSE CODE	:	BDX 30303
PROGRAMME CODE	:	BDX
EXAMINATION DATE	:	JANUARY/FEBRUARY 2024
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER FOUR QUESTIONS ONLY 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ 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

Q1 (a) Describe about divergence phenomenon. Explain how it could occur.

(5 marks)

(b) **Figure Q1.1** shows the cross section of a wing's stringer is subjected to a bending moment of -2000 Nm, acting in the vertical plane.

(i) Determine the location of centroid.

(4 marks)

(ii) Calculate the maximum direct stress due to bending moment and state the point where the maximum direct stress acts.

(12 marks)

(iii) Sketch a stress distribution along edge AF.

(4 marks)

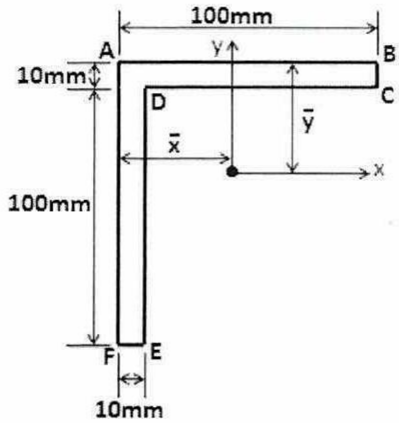

Figure Q1.1

Q2 (a) (i) Describe the components of laminated composite structure and give the example of the components.

(3 marks)

(ii) State the advantage of composite structure over the metallic structure.

(2 marks)

(b) **Figure Q2.1** shows the front view of a wing spar for an aircraft which carries a uniformly distributed load of 10 kN/m along its length. Each flange has a cross section of 500 mm^2 with top flange being horizontal.

(i) If the flanges are assumed to resist all direct loads while the spar web is effective only in shear, determine the flange loads and the shear flows in the web at sections 1.

(9 marks)

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(ii) If the web in the wing spar has a thickness of 2 mm and is fully effective in resisting direct stresses, calculate the maximum value of shear flow in the web at a section 1.

(11 marks)

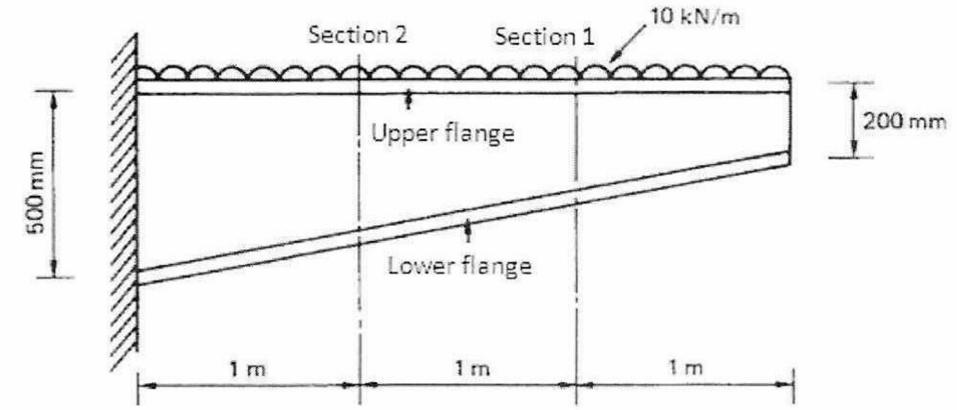

Figure Q2.1

Q3 (a) A thin-walled circular section beam has a diameter of 200 mm and is 2 m long as shown in **Figure Q3.1**. It is firmly restrained against rotation at each end. A concentrated torque of 20 kNm is then applied to the beam at its mid-span point. If the maximum shear stress in the beam is limited to 200 N/mm^2 and the maximum angle of twist to 2°, calculate the minimum thickness of the beam walls. Take G = 25 000 N/mm^2.

(10 marks)

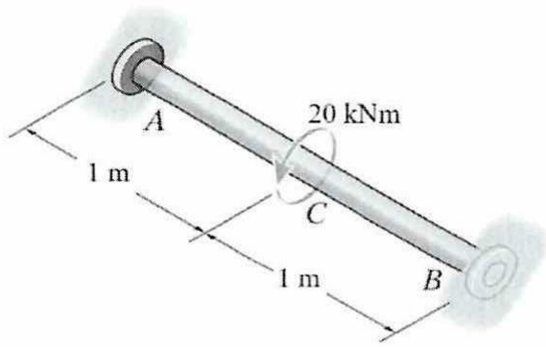

Figure Q3.1

(b) A laminated bar, whose cross-section is shown in **Figure Q3.2**, is 1000 mm long and is composed of an epoxy resin matrix reinforced by a carbon filament having moduli equal to 5,000 N/mm^2 and 200,000 N/mm^2, respectively; the corresponding values of Poisson's ratio are 0.2 and 0.3. If the bar is subjected to an axial tensile load of 200 kN, determine:

(i) The lengthening of the bar and the reduction in its thickness.

(11 marks)

(ii) The stresses in the epoxy resin and the carbon filament.

(4 marks)

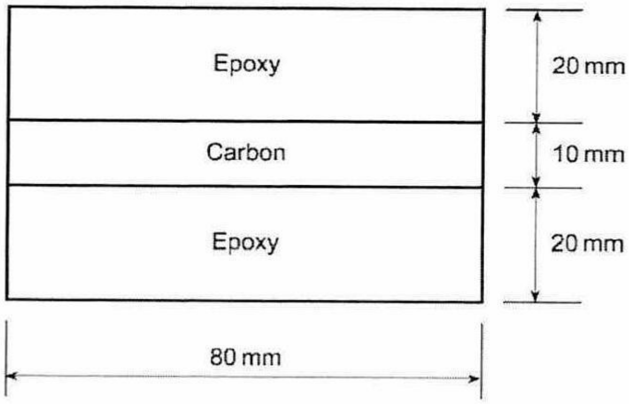

Figure Q3.2

Q4 (a) Explain about static dan dynamic aeroelasticity. Give 2 phenomena occur for each type of aeroelasticity.

(5 marks)

(b) **Figure Q4.1** shows the doubly symmetrical fuselage section has been idealized into an arrangement of direct stress carrying booms and shear stress carrying skin panels. All the boom areas are 150 mm^2. The section is then subjected to a shear load of 50 kN and a bending moment of 100 kNm.

(i) Calculate the direct stresses in the booms.

(7 marks)

(ii) Calculate the shear flows in the panels.

(13 marks)

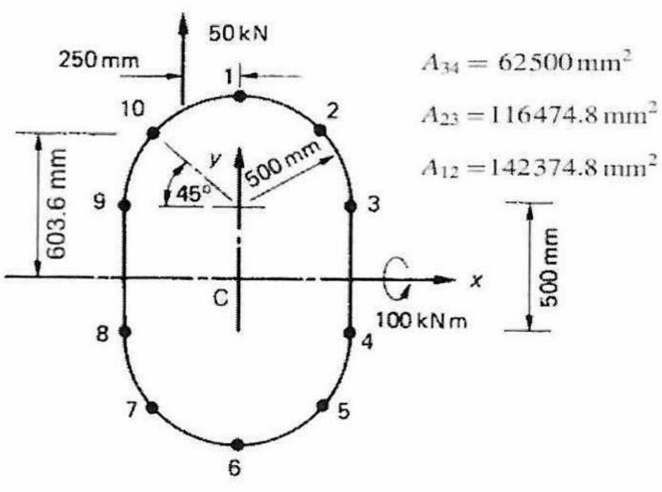

Figure Q4.1

Q5 (a) Describe the flutter and buffeting phenomena.

(6 marks)

(b) Determine the shear flow distribution in the fuselage section in **Figure Q4.1** by replacing the applied load by a shear load through the shear center together with a pure torque. Sketch the fuselage section and show the shear distribution in the section.

(19 marks)

– END OF QUESTIONS –