



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

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

COURSE NAME : AIRCRAFT STRUCTURE
COURSE CODE : BDU 20103
PROGRAMME CODE : BDC/BDM
EXAMINATION DATE : FEBRUARY 2023
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER **FOUR** QUESTIONS **ONLY**.
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 **FOUR (4)** PAGES

- Q1** (a) State two purposes of performing stress analysis. (2 marks)
- (b) A steel cylinder of 320 mm external diameter is to be shrunk to a steel cylinder of 160 mm internal diameter. After shrinking the diameter at the junction is 260 mm and radial pressure at the junction is 28 N/mm². Determine the original difference in radii at the junction. Take $E = 2 \times 10^5$ N/mm². (9 marks)
- (c) The state of plane stress shown in **Figure Q1(c)** occurs at a critical point of a high-strength steel A380 landing gear. The tensile yield strength of the steel used is obtained as 280 MPa. Determine the factor of safety with respect to yield, using the maximum shearing stress theory and the maximum distortion energy theory. (9 marks)
- Q2** (a) State two assumptions made in Lamé's theory. (4 marks)
- (b) **Figure Q2(b)** shows a cross section of flap/slat compound tube used in Boeing 777 actuator system. It is formed by shrinking a tube of 100 mm internal diameter and 25mm wall thickness on to another tube of 100 mm external diameter and 25mm wall thickness. The shrinkage allowance based on radius is 0.01mm. If both tubes are of steel ($E = 208$ GPa), calculate the radial pressure set up at the junction due to shrinkage. (16 marks)
- Q3** (a) Explain the following failure modes; yielding, fracture, and buckling. (6 marks)
- (b) A horizontal shaft of 75 mm diameter and 350 mm length is shown in **Figure Q3(b)**. The vertical load of 10 kN, horizontal compression load of 12 kN and torque, T Nm are applied at the free end of the shaft. If the safe stress for the material is 145 MPa and assuming the Poisson's ratio is 0.3, determine torque, T to which the shaft may be subjected using Tresca theory and Von Mises theory. (14 marks)
- Q4** (a) A compound cylinder is formed by shrinking a tube of 250 mm internal diameter and 25 mm wall thickness, onto another similar wall thickness tube of 250 mm external diameter which is made of the same material. The stress set-up between two mating surfaces having shrinkage of 10 MPa. The compound tube is then subjected to an internal pressure of 80 MPa. Determine the hoop stress at each cylinder wall due to:
- (i) Internal pressure only assuming the compound cylinder as a single cylinder.

- (ii) Shrinkage pressure acting on the two separate cylinder.

Determine also the resultant hoop stresses occur across the cylinder wall.

(20 marks)

- Q5** (a) State three criteria of the thick cylinder.

(6 marks)

- (b) The solid shaft shown in **Figure 5(b)** has a radius of 1 cm and is made of steel having a yield stress of 360 MPa. Determine if the loadings cause the shaft to fail according to Tresca and Von Mises theories.

(14 marks)

– END OF QUESTIONS –

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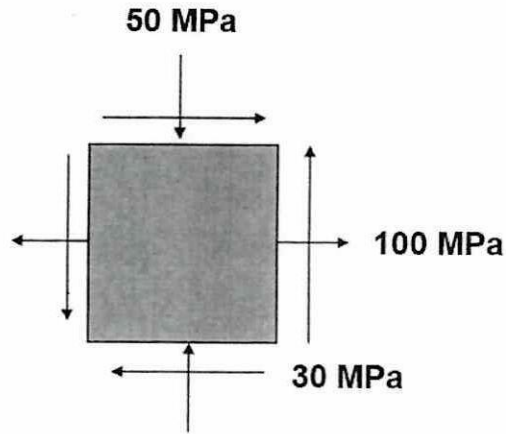
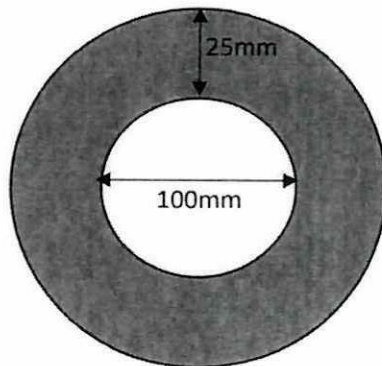
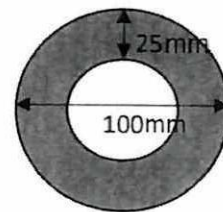


Figure Q1(c)



Outer cylinder



Inner cylinder

Figure Q2(b)

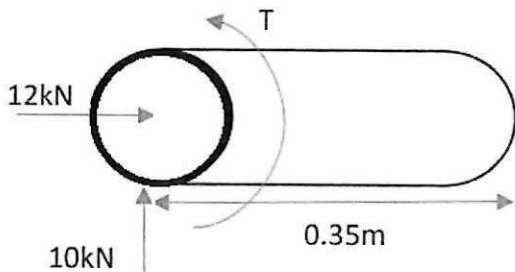


Figure Q3(b)

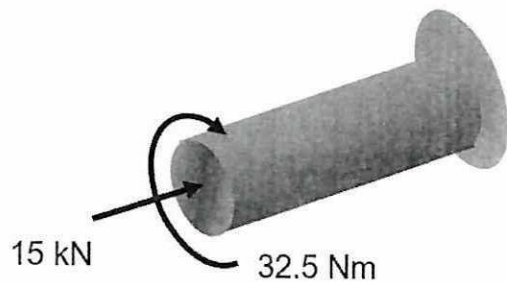


Figure Q5(b)

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