Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV 2016

SUBJECT: AIRCRAFT STRUCTURES [AAE 2101]

REVISED CREDIT SYSTEM
(25/11/2016)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. Define the terms: Neutral layer and Flexural rigidity. **(2)**

1B. Prove that relation,

$$\frac{M}{I}=\frac{\sigma}{y}=\frac{E}{R}$$

(4)

Where, M =Bending moment I = M.O.I
σ = Bending stress y = Distance from N.A
E = Young's modulus and R = Radius of curvature

1C. A beam is of square section of the side 'a'. If the permissible bending stress is 'σ', find the moment of resistance when the beam section is placed such that (i) two sides are horizontal, (ii) one diagonal is vertical. Find also the ratio of the moments of the resistance of the section in the two positions. **(4)**

2A. Write a note on Mohr's circle of stresses. **(2)**

2B. Derive an expression for the stresses on an oblique plane of a rectangular body, when the body is subjected to a simple shear stress. **(4)**

2C. A point in a strained material is subjected to stresses as shown in fig.1. Using Mohr's circle method, determine the normal and tangential stresses across the oblique plane. Check the answers analytically. **(4)**

3A. Define slenderness ratio. State the limitations of Euler's formula. **(2)**

3B. Find the maximum deflection and maximum slope for the beam loaded as shown in fig.2. Using Macaulay's method. Take EI=15000 kN-m^2 **(4)**

3C. Derive an expression for the Euler's crippling load for a long column with both ends are fixed. **(4)**

4A. Define polar modulus of section. Find the expression for polar modulus for a hollow shaft and for a solid shaft. **(2)**

4B. Prove that a hollow shaft is stronger and stiffer than the solid shaft of the same material, length and weight. **(4)**

4C. A stepped shaft is subjected to torque as shown in fig.3. Determine the angle of twist at the free end. Take G= 80 GPa. Also find the maximum shear stress at any step. **(4)**

5A. How will you determine the shear centre for channel section and I-section? **(2)**

5B. Determine the position of shear centre for the channel section shown in fig.4. **(4)**

5C. The cross section shown in fig.5. is subjected to a torque of T=1000in-lb. Take G=4×10^8 psi. Find, **(4)**

(i) Stresses at all points in the cross section.

(ii) Angle of rotation per unit length of the cross section.

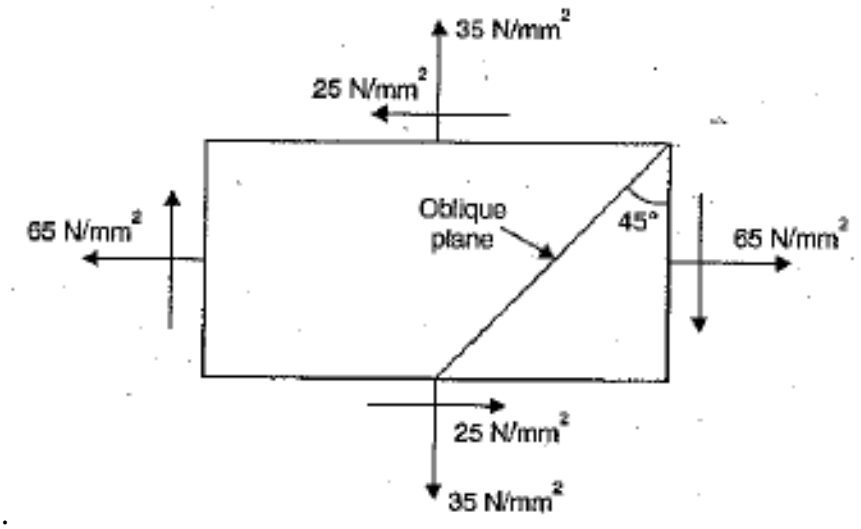

Fig.1

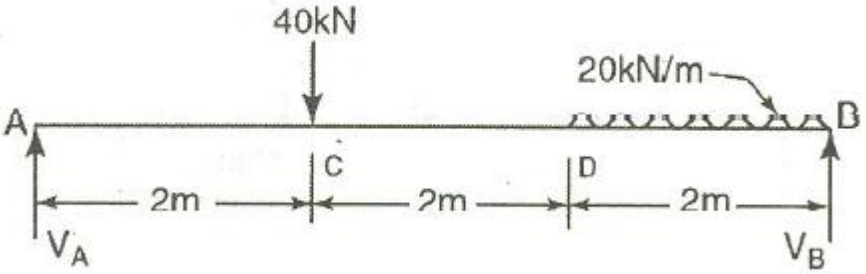
40kN
20kN/m
A
B
C
D
2m
2m
2m
V_A
V_B

Fig.2.

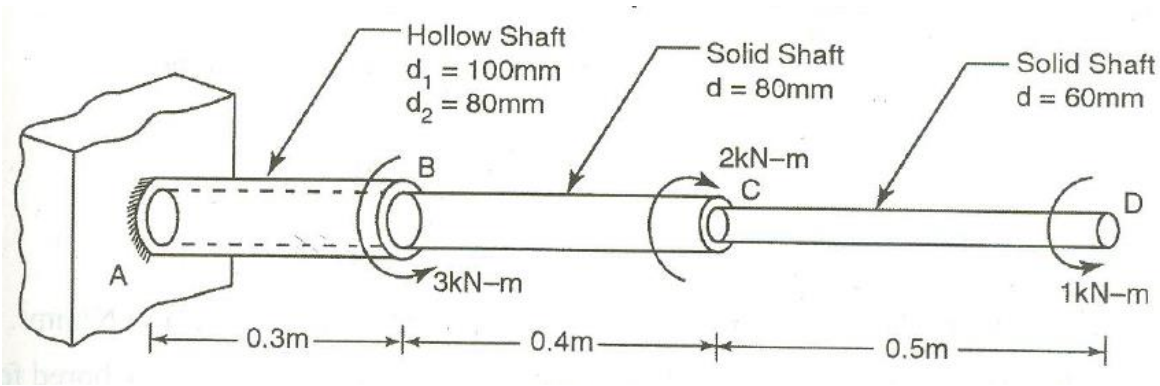
Hollow Shaft
d_1 = 100mm
d_2 = 80mm
Solid Shaft
d = 80mm
Solid Shaft
d = 60mm
2kN–m
A
B
C
D
3kN–m
1kN–m
0.3m
0.4m
0.5m

Fig.3.

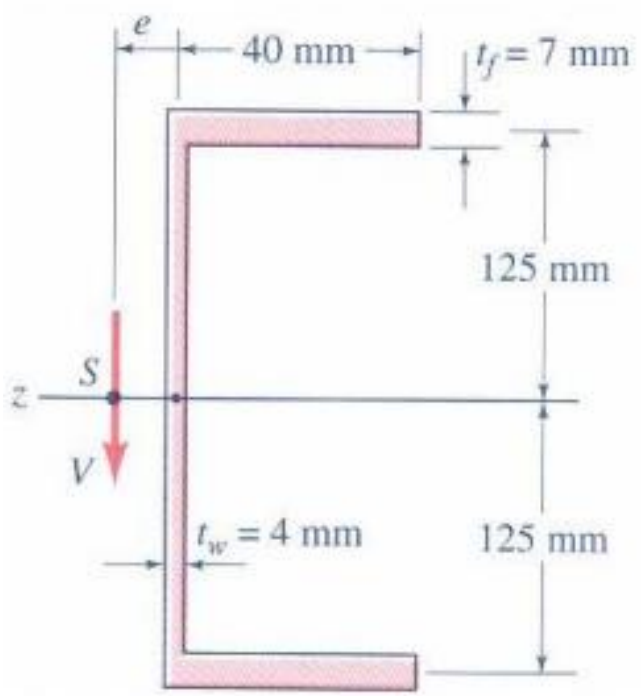
e
40 mm
$t_f = 7$ mm
125 mm
S
z
V
$t_w = 4$ mm
125 mm

Fig.4.

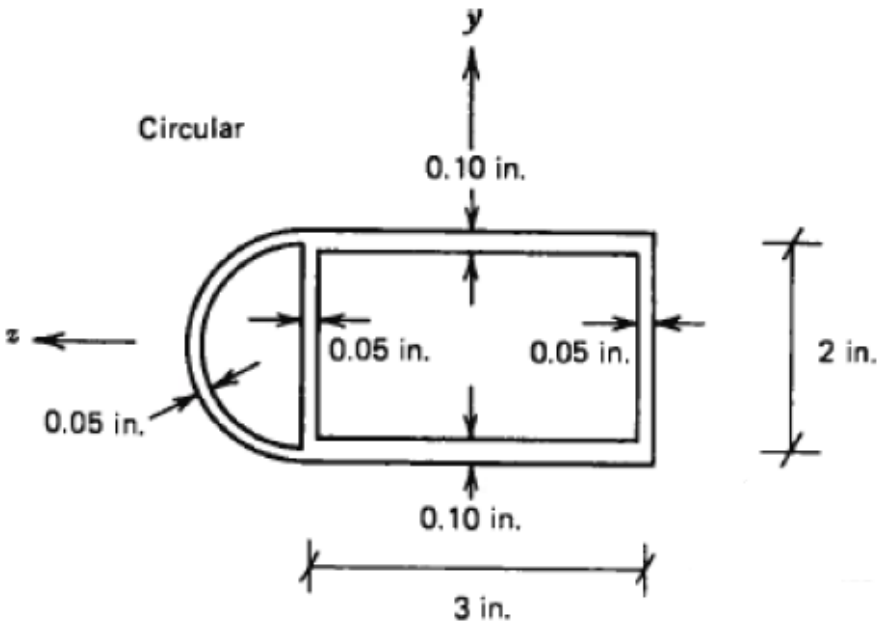
y
Circular
0.10 in.
z
0.05 in.
0.05 in.
0.05 in.
2 in.
0.10 in.
3 in.

Fig. 5.