Printed Pages: 03 **Subject Code:RAE601**

Paper Id: 148237 **Roll No:** | | | | | | | | | | |

BTECH
(SEM VI) THEORY EXAMINATION 2018-19
AIRCRAFT STRUCTURES

Time-3:00 Hours **Total Marks - 70**

Note- Attempt all sections. If required any missing data, then choose suitably.

SECTION - A

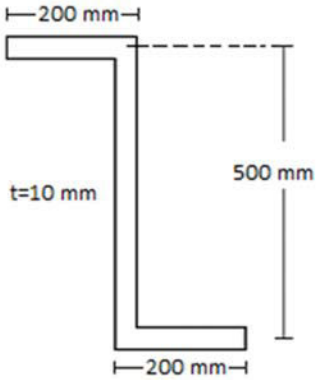
1. Attempt all questions in brief. **2 x 7 = 14**

a. What is meant by structural idealization?
b. What are composite materials? Mention its constituents.
c. Differentiate between flexural and torsional shear flow?
d. What is meant by shear center? State its significance.
e. When does unsymmetrical bending of a rectangular-section cantilever beam take place?
f. What are the underlying asumptions of St. Venant torsion theory?
g. What is the degree of static indeterminacy for a fixed-fixed beam subjected to point load at the mid-span?

SECTION –B

2. Attempt any three of the following. **7 x 3 = 21**

a. With the help of neat sketches, explain the different configurations of fuselage and wing with their merits and demerits.
b. What is the difference between plane stress and plane strain condition ? Derive the stress-strain relations for a plane strain problem.
c. For bars with narrow rectangular cross-section under torsion, prove that torsion constant $J = \frac{bt^3}{3}$ and thereby determine the torsional rigidity of the following cross-section.



d. Derive the Euler-Bernoulli beam equation for unidirectional bending of a symmetric cross-section.

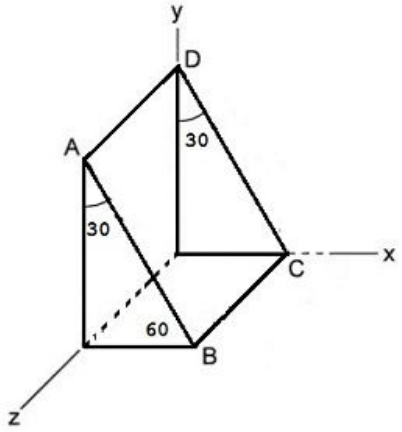
e. For a narrow rectangular cross-section, derive the expression for transvere shear stress.

SECTION –C

3. Attempt any one part of the following **7 x 1 = 7**

a. What is the importance of theories of failure ? Explain von-Mises yield criteria for bi-axial loading. Also draw the corresponding region of safety.

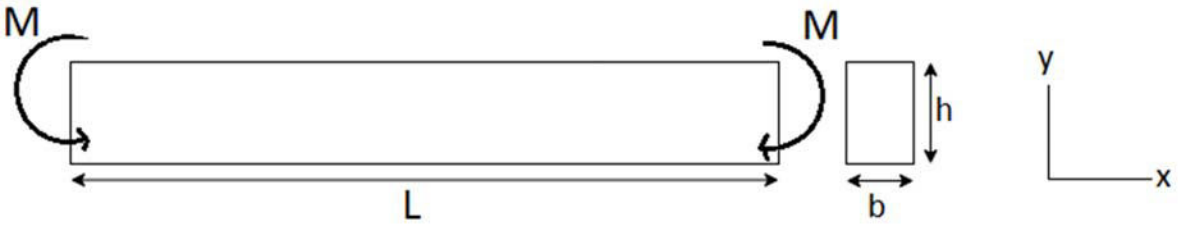
b. The state of stress in a body is uniform and is given by: σ_{xx}=4 Mpa, σ_{yy} =2 MPa, σ_{zz} =1 Pa, τ_{xy}=2 MPa, τ_{yz} =3 MPa and τ_{xz} =1 MPa. Calculate the normal, shear and resultant stresses on the surface ABCD a shown in figure.



4. Attempt any one part of the following **7 x 1 = 7**

a. For a plane elasticity problem, derive the compatibility equation in terms of Airy stress function in the absence of body forces.

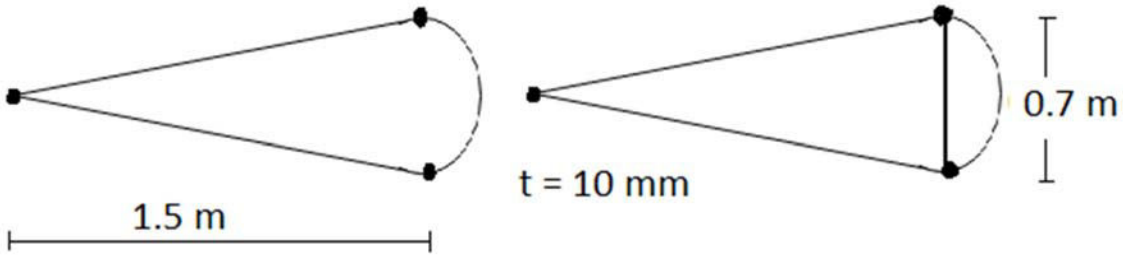
b. A beam of length (L) with a thin rectangular cross-section (bxh) is subjected to pure bending moment (M) at both the ends. Given that the Airy's stress function $\varphi = A\frac{x^3}{6} + B\frac{x^2y}{2} + C\frac{xy^2}{2} + D\frac{y^3}{6}$ solves the problem, determine the coefficients A, B, C and D.



5. Attempt any one part of the following **7 x 1 = 7**

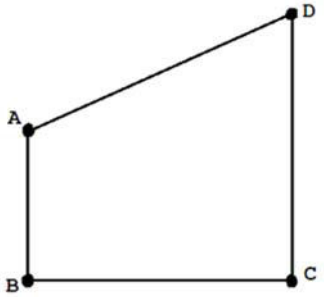
a. Derive the torque (T) in terms of Prandtl stress function (ϕ) for solid shaft under torsion.

b. The two-cell section shown on right is obtained from the single-cell 3-stringer section by adding a vertical web of the same thickness and material as the skin. Compare the torsional rigidities of both the structures. The cross-section is made up of an isosceles triangle and a semicircle.

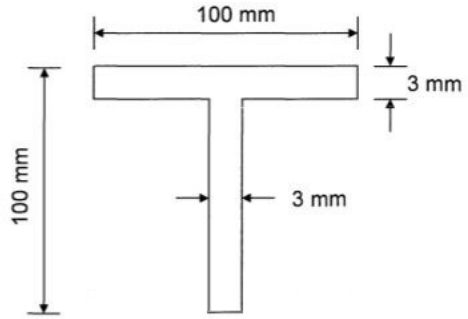


6. Attempt any one part of the following **7 x 1 = 7**

a. The webs of the section as shown in figure are ineffective in bending. Determine the bending stresses in the stringers A, B, C and D if the given section is subjected to positive bending moments of 24 kN-m and 30 kN-m in the horizontal and vertical planes respectively. Areas A, B, C and D are all 2 cm^2 while AD=32 cm, AB=12 cm and BC=24 cm. Also determine the location of neutral axis on the cross-section.



b. A uniform thin-walled T-section is subjected to a vertical shear force V=1000 N. Find (a) the flexural shear flow distribution in each segment and (b) the location of shear center.



7. Attempt any one part of the following **7 x 1 = 7**

a. Determine the Euler's buckling load for a column fixed at one end and free at the other end. Also write the assumptions made for deriving the buckling load.

b. A 800 mm long straight bar of alloy steel and of 10 mm x 4 mm section is mounted on a strut testing machine and loaded axially. The load is increased till the bar buckles. Determine the maximum central deflection such that the yield stress is not to exceed 300 MPa. Take Young's modulus=75 GPa and assume the Euler's formula for pinned-pinned ends.