Enrolment No:

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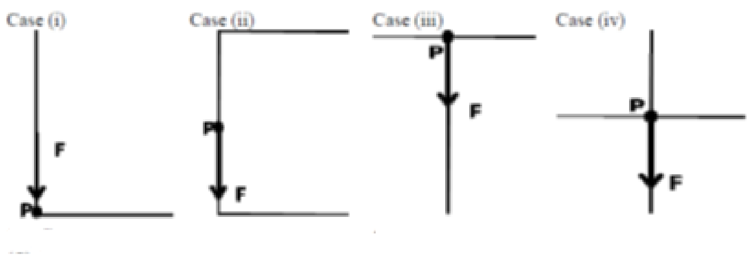
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2021

Course: Aircraft Structure-II **Semester: VI**
Program: B.Tech ASE , ASE+AVE **Time 03 hrs.**
Course Code: ASEG 3013 **Max. Marks: 100**

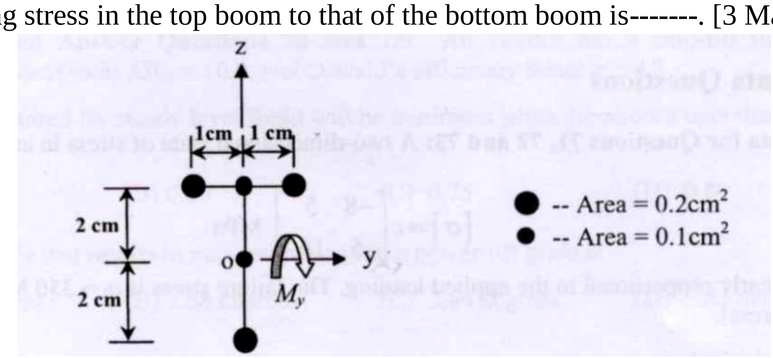
Note: Section A and B is compulsory. Attempt any **ONE** Questions from Section-C. Assume any **MISSING** data accordingly. Brief and to the point, answers are expected.

SECTION A (30 Marks)

S. No.		**Marks**	**CO**
Q 1	1A: Which of the following statements about the compatibility equations are true: P. Strain compatibility equations must be satisfied in the solution of three-dimensional problem of elasticity. Q. Six Strain are defined in terms of three displacement functions and can have arbitrary values. R. Compatibility equations are an expression of the continuity and displacements. (A) P and Q (B) Q and R (C) P and R (D) P, Q and R 1B: Which of the following is not a part of the aircraft Structural components? P) Fuselage Q) Wing R) Stabilizing tail S) Landing gear T) Engines. (A) P and Q (B) Q and R (C) S and T (D) R, S and T 1C: The benefit of a semimonocoque fuselage compared to a monocoque fuselage is that the semimonocoque fuselage does not require the skin to carry any load thereby reducing the stress on the skin. (TRUE/FALSE). 1D: Longerons are the longitudinal members in a monocoque fuselage. (TRUE/FALSE). 1E: Ribs can be lightened by stamping holes in the assembly. (TRUE/FALSE).	**5**	**CO1**
Q 2	2A: "Generally, a thin plate is the structural member having" (A) small dimensional structural member (B) thickness is small as compared to other dimensions (C) youngs modulus is small (D) shear modulus is small 2B: The assumptions made in the bending theory of thin plate (A) The displacement of the plate in a direction parallel z-axis is small as compared to thickness of plate (B) plane section of plate before bending remain plane after bending (C) applied bending moments are postive when they induce tension on the Lower surface of the plate (D) All of the above 2C: "Flexural rigidity of the plate, depends on " (A) Youngs Modulus (B) poissons ratio (C) thickness of the plate (D) All of the above	**5**	**CO3**

<table>
<tr><td></td><td>2D: In the case of simple beam theory, the middle plane of the plate does not deform during the bending (True/False).
2E: Navier Solution for the thin simply supported plate provides approximate solution. (True/False)</td><td></td><td></td></tr>
<tr><td>Q 3</td><td>3A: Consider four thin-walled beams of different open cross-sections, as shown in the cases (i-iv). A shear force of magnitude ‘F’ acts vertically downward at the location ‘P’ in all the beams. In which of the following case, does the shear force induce bending and twisting?


(A) Case (i) (B) Case (ii) (C) Case (iii) (D) Case (iv)

3B: Which of the following statements about the neutral axis of a beam with unsymmetrical cross-section is true:
(A) The product of second moment of area about the neutral axis is always zero.
(B) The normal stress along the along the neutral axis is always zero.
(C) The shear stress along the neutral axis is always zero.
(D) The product of second moment of area about the neutral axis and the normal stress about neutral axis are always zero.
3C: The location of the shear center depends upon the loads applied. (True/False).
3D: The maximum bending shear stress in unsymmetrical bending of beams is at a point furthest from the neutral axis. (True/False)
3E: Shear center in case of a T- section beam will lie
(A) Within the cross section (B) Outside the cross section
(C) On the outer edge of the section (D) cant say.</td><td>5</td><td>CO2</td></tr>
<tr><td>Q 4</td><td>4A: An idealized thin-walled cross-section of a beam and the respective areas of the booms are as shown. A bending moment M_y is acting on the cross-section. The ratio of the magnitude of the bending stress in the top boom to that of the bottom boom is-------. [3 Marks]


(A) 5/11 (B) 2/5 (C) 1 (D) 5/2</td><td>5</td><td>CO4</td></tr>
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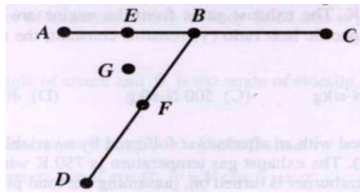
<td>4B: For the Thin walled beam cross section as shown in the figure, the shear center lies at: [2 marks]


(A) Mid-Point of AB i.e. at point E   (B) Mid-point of BD i.e. at point F
(C) Junction Point B   (D) at Point G</td>
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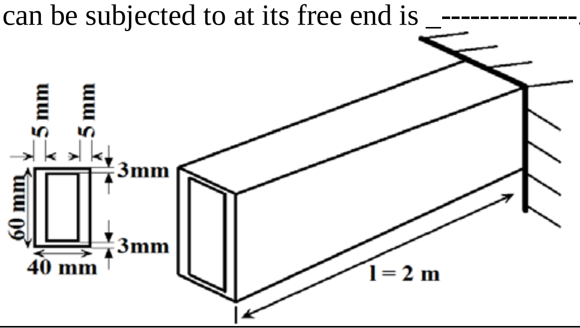
<td>Q 5</td>
<td>5A: A cantilever with thin-walled channel cross section is subjected to a lateral force at its shear center. The cantilever undergoes [1 Marks]
(A) bending without twisting
(B) bending and twisting
(C) neither bending nor twisting
(D) twisting without bending.
5B: When a closed section beam is subjected a pure torque, the shear flow in the section is depends on: [1 Marks]
(A) Thickness of the section.
(B) Area of closed section.
(C) Material of the beam section.
(D) boundary condition of the beam.
5C: The thin rectangular tube shown below is made of a material with shear modulus, G = 80 GPa . If the free end is allowed to twist no more than 0.0727 radians, then the maximum torque (in N) which the tube can be subjected to at its free end is _--------------. [3 Marks]

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<td>5</td>
<td>CO2</td>
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<tr>
<td>Q 6</td>
<td>A plate 12 mm thick is subjected to bending moments M_x equal to 15 Nm/mm and M_y equal to 10 Nm/mm. The maximum bending stresses on the plate are ---------------- and ------------.</td>
<td>5</td>
<td>CO3</td>
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<tr>
<td colspan="4" align="center">SECTION B (5 x 10 = 50 Marks)</td>
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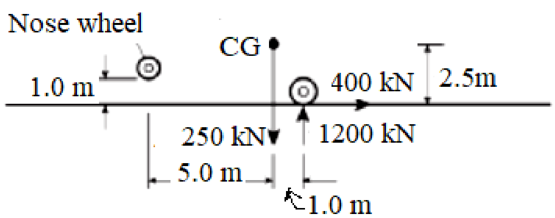
<tr>
<td>Q 7</td>
<td>An aircraft having a weight of 250 kN and a tricycle undercarriage, lands in such a way that the vertical and horizontal reactions on the main wheels are 1200 kN and 400 kN respectively; at this instant the nose wheel is 1.0m off from the ground, as shown in Figure below. If the mass moment of inertia of the aircraft about its CG is 5.65×10^{8} Ns^2 mm. Determine the accelerations and inertia forces on the aircraft.

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<td>10</td>
<td>CO1</td>
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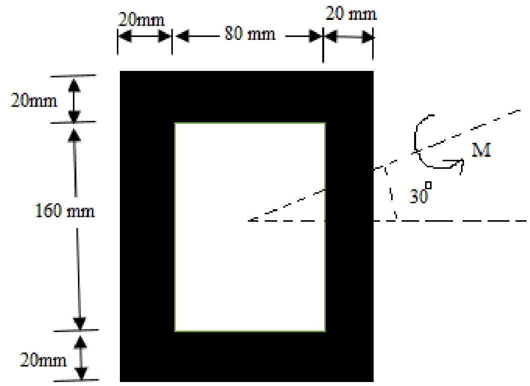
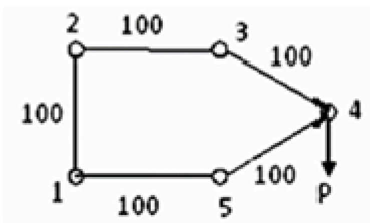
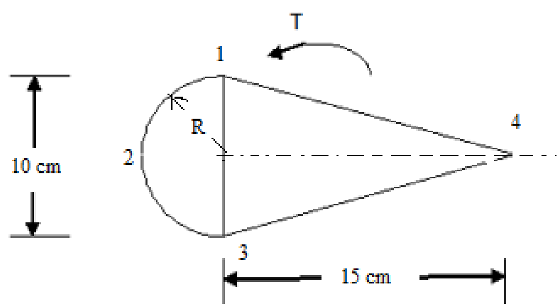
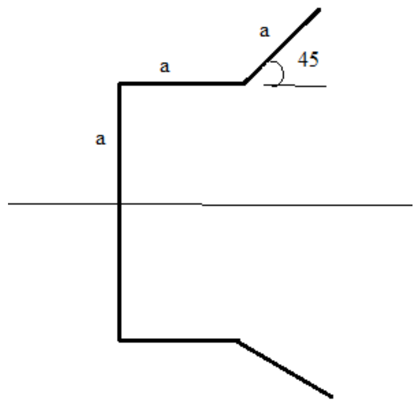
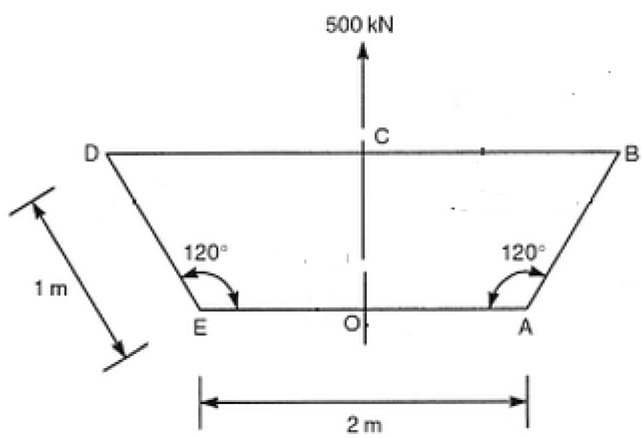
Q 8	If $\sigma_{b,\,max}$ = 160 MPa, calculate the maximum moment M that can be applied on the section on a plane inclined at 30° from horizontal shown below. Also, calculate the orientation of the neutral axis. 	**10**	**CO4**
Q 9	A thin elastic square plate of side 'a' is simply supported on all four sides and supports a uniformly distributed load 'q'. if the origin of axes coincides with the center of the plate, show that the deflection of the plate can represented by the expression, $$w = \frac{q}{96(1-\vartheta)D}[2(x^4+y^4) - 3a^2(1-\vartheta)(x^2+y^2) - 12\vartheta x^2y^2 + A]$$ Where D is the flexural rigidity, ν is Poisson's ratio and A is constant. Calculate the values of A.	**10**	**CO3**
Q 10	With reference to the idealized section as shown in Figure below, all dimensions are in mm. Find the ratio of the shear flow q_{34}:q_{23}. Area of each booms are 150 mm^2. 	**10**	**CO4**
Q 11	The figure below shows a Two cell closed section of an aluminum rubber tab subjected to a torque 5KN-m in anticlockwise direction. Determine the shear flow in the member 13. Also calculate the rate of twist of the section. Take E_{al} = 70 GPa, G_{al} = 26 GPa. Assume t = 5mm same for all members. 	**10**	**CO4**

<table>
<tr><th colspan="4">Section – C (20 Marks)</th></tr>
<tr><td>Q12</td><td>For the uniform thickness open section as shown in the Figure below. (a) Find the value of the Shear flow at each corner point due to a vertical force S_y through the shear center. (b) Locate the shear center.


OR
Determine the Shear flow at each corner point for a thin walled single closed section subjected to a vertical shear force of 500 kN as shown below. Assume t = 5mm, E = 210 GPa and G = 70 GPa.

</td><td>20</td><td>CO2</td></tr>
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