INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

AERONAUTICAL ENGINEERING

ASSIGNMENT QUESTIONS

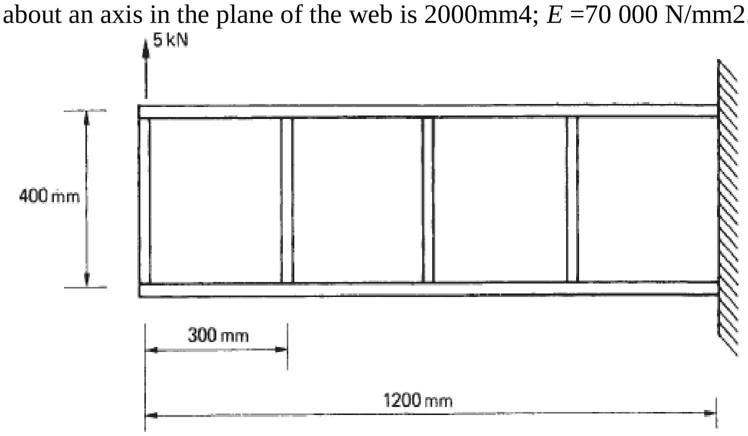
Course Name	:	**AIRCRAFT VEHICLE STRUCTURES II**
Course Code	:	**A52109**
Class	:	III B. Tech I Semester
Branch	:	AERO
Year	:	2017 – 2018
Course Coordinator	:	Dr. Y B Sudhir Shastry, Professor
Course Faculty	:	Dr. Y B Sudhir Shastry, Professor

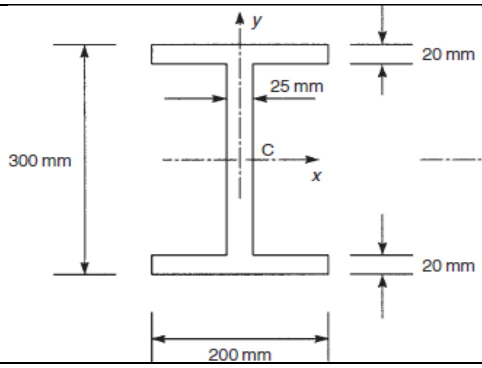
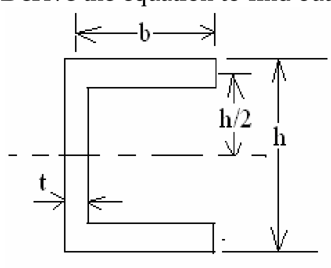
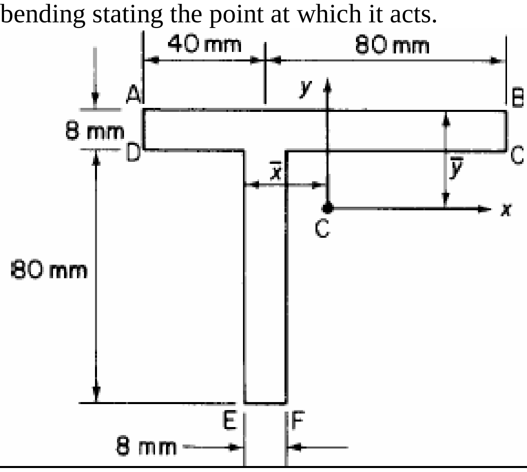
OBJECTIVES

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

S. No	Question	Blooms Taxonomy Level	Course Outcome
ASSIGNMENT-I UNIT-I THIN PLATE THEORY, STRUCTURAL INSTABILITY			
1	**Derive** the equation $(1/\rho) = M / [D(1+\upsilon)]$ of thin plate subjected to pure bending.	Understand	1
2	**Derive** the equation $M_{xy} = D(1-\upsilon)\,\partial^2 w/\partial x\partial y$ for a thin plate subjected to bending and twisting	Apply	3
3	A plate 10mmthick is subjected to bending moments Mx equal to 10 Nm/mm and My equal to 5 Nm/mm. **find** the maximum twisting moment per unit length in the plate and the direction of the planes on which this occurs.	Apply	2
4	A thin rectangular plate a×b is simply supported along its edges and carries a uniformly distributed load of intensity q0. **Determine** the deflected form of the plate and the distribution of bending moment.	Understand	1
5	A rectangular plate *a*×*b*, is simply supported along each edge and carries a uniformly distributed load of intensity q0. Assuming a deflected shape given by. $w = A_{11}\sin\frac{\pi x}{a}\sin\frac{\pi y}{b}$ **Determine** using the energy method, the value of the coefficient *A*11 and hence find the maximum value of deflection.	Analyze	1

S. No	Question	Blooms Taxonomy Level	Course Outcome
6	A thin rectangular plate *a*×*b* is simply supported along its edges and carries a uniformly distributed load of intensity *q*0 and supports an in-plane tensile force *Nx* per unit length..**Determine** the deflected form of the plate.	Apply	2
7	A rectangular plate *a*×*b*, simply supported along each edge, possesses a small initial curvature in its unloaded state given by $w = A_{11} \sin \frac{\pi x}{a} \sin \frac{\pi y}{b}$ **Determine**, using the energy method, its final deflected shape when it is subjected to a compressive load *Nx* per unit length along the edges *x* =0, *x* =*a*.	Understand	1
8	**Explain** Instability of Stiffened panels.	Apply	2
9	The beam shown in is assumed to have a complete tension field web. If the cross-sectional areas of the flanges and stiffeners are, respectively, 350mm2 and 300mm2 and the elastic section modulus of each flange is 750mm3, **determine** the maximum stress in a flange and also whether or not the stiffeners will buckle. The thickness of the web is 2mm and the second moment of area of a stiffener about an axis in the plane of the web is 2000mm4; *E* =70 000 N/mm2. 	Apply	2
10	**Derive** the equation for critical stress (σCR) = [kπ2E /12(1 – υ2)] (t/b)2 for plate subjected to the compressive load.	Apply	2
	UNIT- II **BENDING AND SHEAR AND TORSION OF THIN WALLED BEAMS**		
1	**Derive** $(\sigma_z) = [(M_y I_{xx} - M_x I_{xy}) / (I_{xx} I_{yy} - I_{xy}^2)]\, x + [(M_x I_{yy} - M_y I_{xy}) / (I_{xx} I_{yy} - I_{xy}^2)]\, y$	Understand	1
2	Figure in pg 495 problem P.16.1of Megson shows the section of an angle purlin. A bending moment of 3000 Nm is applied to the purlin in a plane at an angle of 30^o to the vertical *y* axis. If the sense of the bending moment is such that its components *Mx*and *My* both produce tension in the positive *xy* quadrant, **calculate** the maximum direct stress in the purlin, stating clearly the point at which it acts.	Understand	1
3	**Explain** the i) shear flow, ii) shear centre, iii) centre of twist.	Understand	1
4	**Write** short notes on the following: Symmetrical bending Unsymmetrical bending Anticlastic bending	Understand	1
5	The cross-section of a beam has the dimensions shown in figure. If the beam is subjected to a negative bending moment of 100 kNm applied in a vertical plane,	Understand	1

S. No	Question	Blooms Taxonomy Level	Course Outcome
	determine the distribution of direct stress through the depth of the section.		
6		Analyze	3
7	**Derive** the equation to find out the shear center of figure shown. 	Understand	1
8	The beam section of problem 1 above, is subjected to a bending moment of 100 kNm applied in a plane parallel to the longitudinal axis of the beam but inclined at 30◦ to the left of vertical. The sense of the bending moment is clockwise when viewed from the left-hand edge of the beam section. **Determine** the distribution of direct stress.	Understand	1
9	A beam having the cross section shown in Figure is subjected to a bending moment of 1500 Nm in a vertical plane. **Calculate** the maximum direct stress due to bending stating the point at which it acts. 	Understand	1
10	A thin-walled circular section beam has a diameter of 200 mm and is 2 m long; it is firmly restrained against rotation at each end. A concentrated torque of 30 kN m is 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 2^0, **calculate** the minimum thickness of the beam walls. Take G=25000N/mm^2.	Apply	3

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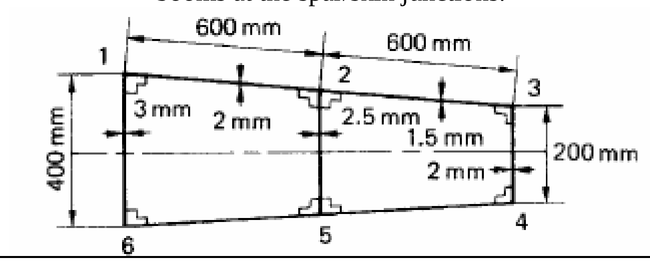
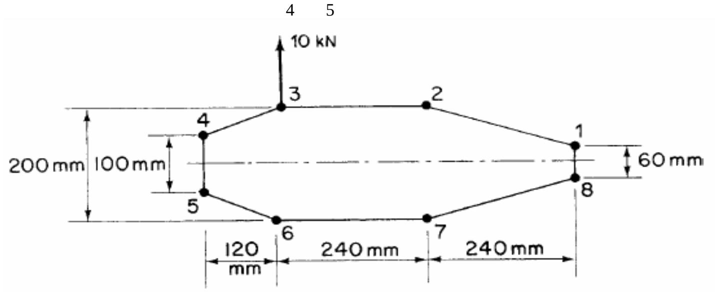
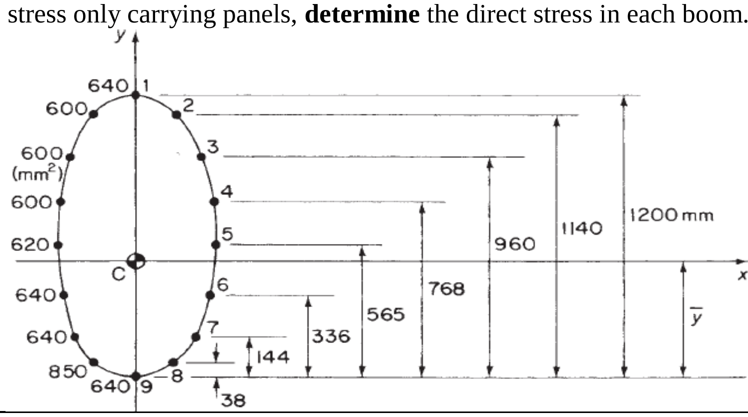
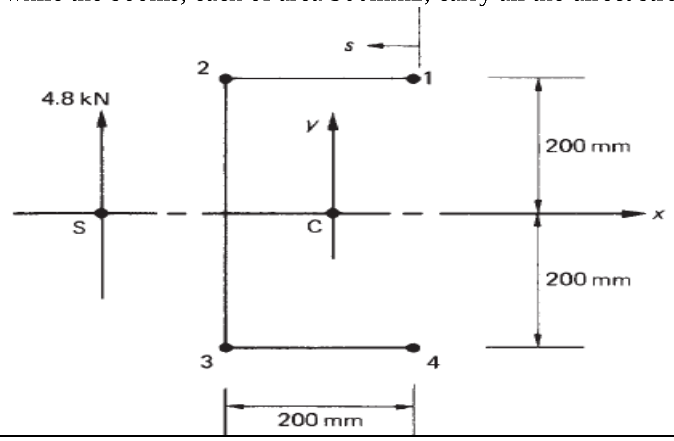
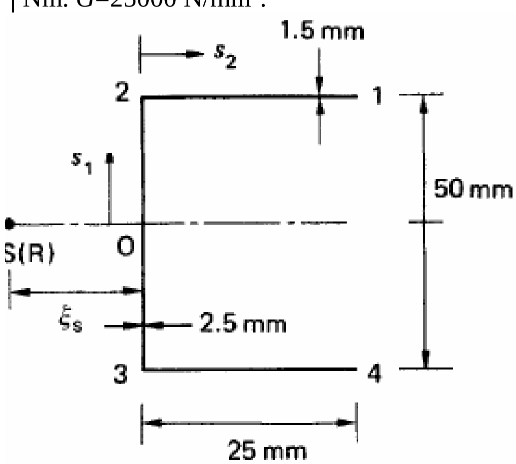
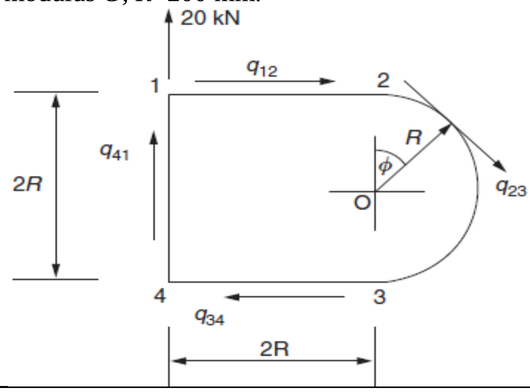
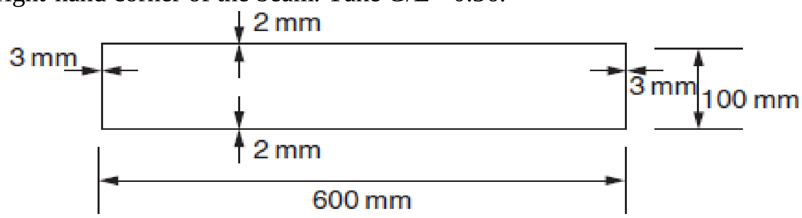
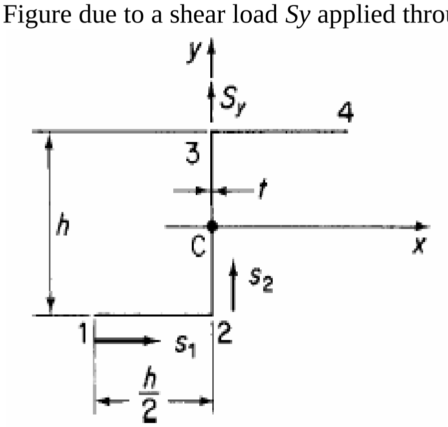
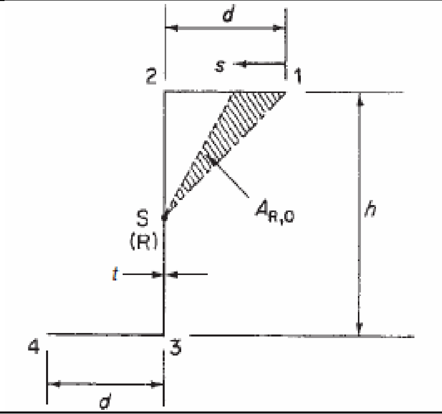
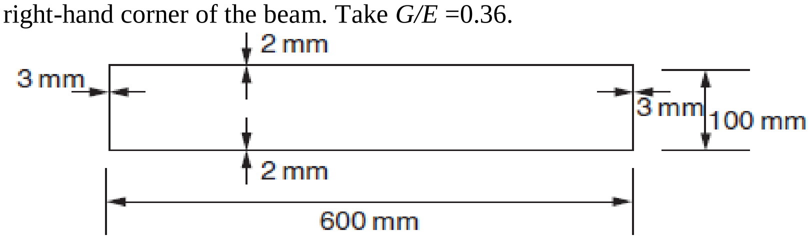
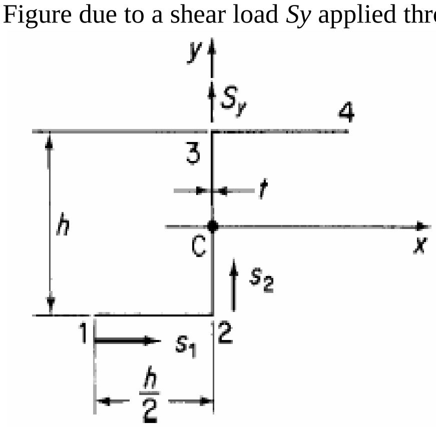
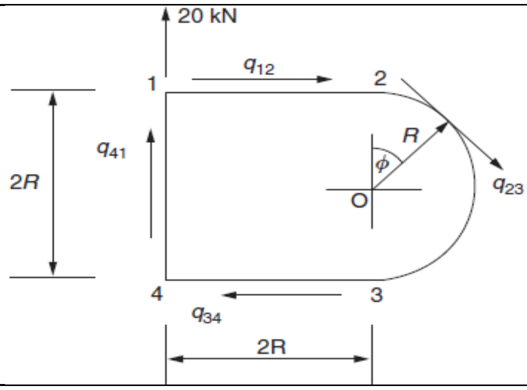
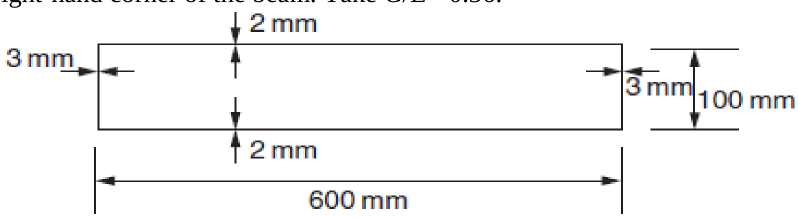
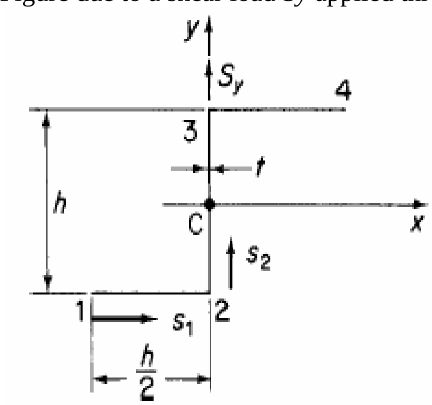
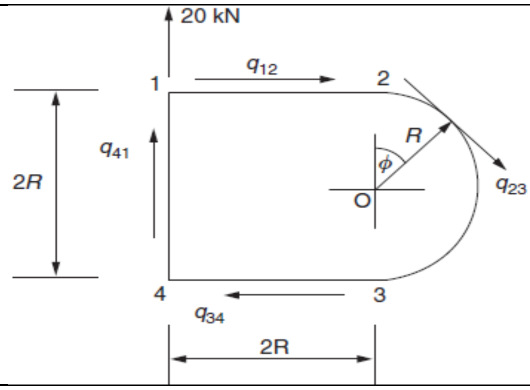
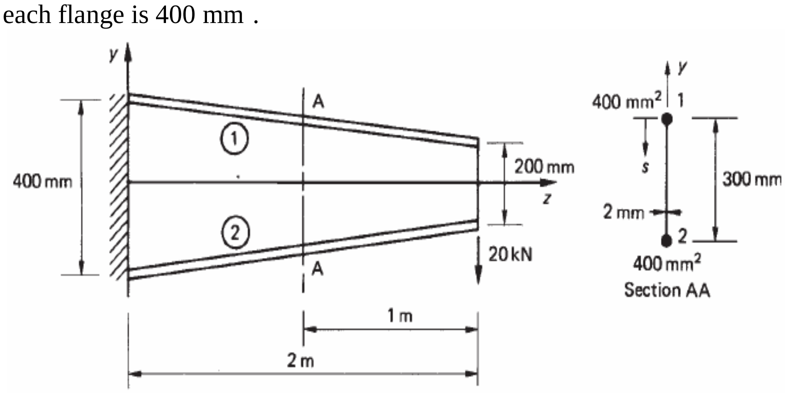
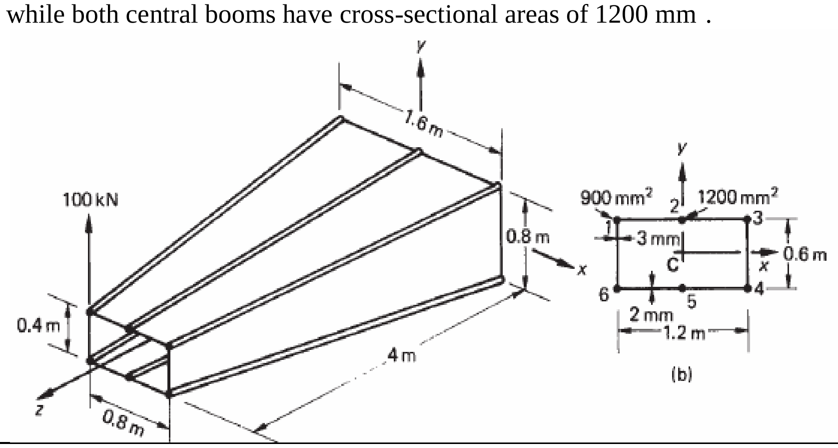
	ASSIGNMENT – II **UNIT-III** **Structural Idealization of Thin Walled Beams**		
1	Part of a wing section is in the form of the two-cell box shown in Figure in which the vertical spars are connected to the wing skin through angle sections, all having a cross-sectional area of 300 mm^2. **Idealize** the section into an arrangement of direct stress-carrying booms and shear-stress-only-carrying panels suitable for resisting bending moments in a vertical plane. Position the booms at the spar/skin junctions.  	Apply	2
2	The thin-walled single cell beam shown in Figure has been idealized into a combination of direct stress-carrying booms and shear-stress-only-carrying walls. If the section supports a vertical shear load of 10 kN acting in a vertical plane through booms 3 and 6, **calculate** the distribution of shear flow around the section. Boom areas: $B_1=B_8=200$ mm^2, $B_2=B_7=250$ mm^2 $B_3=B_6=400$ mm^2, $B_4=B_5=100$ mm^2.  	Understand	1
3	The fuselage section shown in Fig. 20.5 is subjected to a bending moment of 100 kNm applied in the vertical plane of symmetry. If the section has been completely idealized into a combination of direct stress carrying booms and shear stress only carrying panels, **determine** the direct stress in each boom.  	Understand	1
4	**Calculate** the shear flow distribution in the channel section shown in Fig. 20.7 produced by a vertical shear load of 4.8 kN acting through its shear centre.	Apply	2

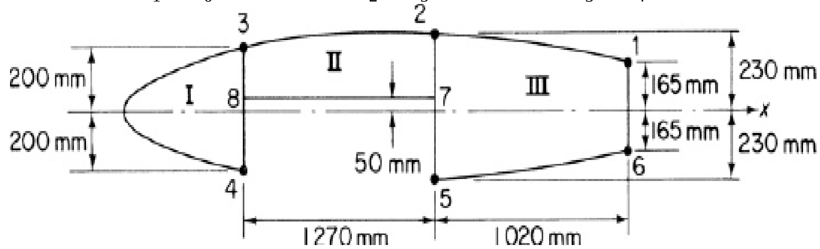
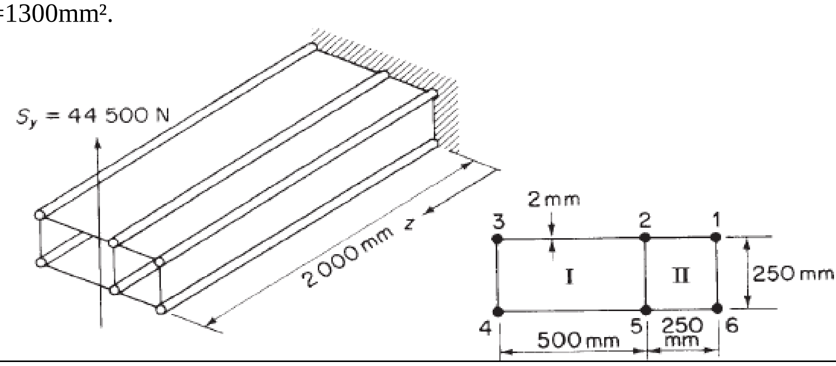
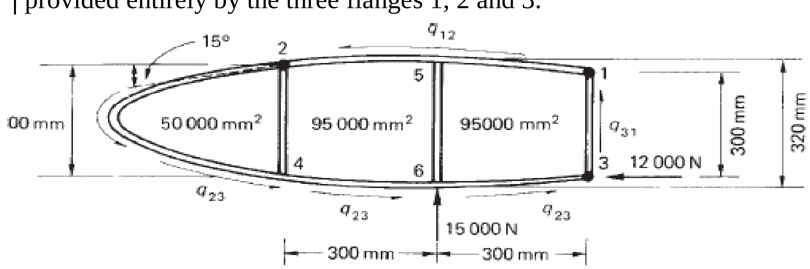
S. No	Question	Blooms Taxonomy Level	Course Outcome
	Assume that the walls of the section are only effective in resisting shear stresses while the booms, each of area 300mm2, carry all the direct stresses. 		
5	**Determine** the maximum shear stress and the warping distribution in the channel section shown in Figure when it is subjected to an anticlockwise torque of 10 Nm. G=25000 N/mm^2. 	Understand	1
6	**Write** short notes on the following: Symmetrical bending Unsymmetrical bending	Understand	1
7	**Explain** the following terms. Shear center Shear flow Centre of twist	Apply	2
8	**Derive** the equations to find out the primary and secondary warping of an open cross section subjected to torsion.	Apply	2
9	**Derive** the Bredt-Batho formula for thin walled closed section beams with the help of neat sketch.	Analyze	3
10	**Explain** the condition for Zero warping at a section, and derive the warping of cross section.	Analyze	3
UNIT-IV **STRUCTURAL AND LOADING DISCONTINUITIES IN THIN WALLED BEAMS**			
1	**Determine** the shear flow distribution at the built-in end of a beam whose cross-section is shown in Fig. below. All walls have the same thickness t and shear	Apply	2

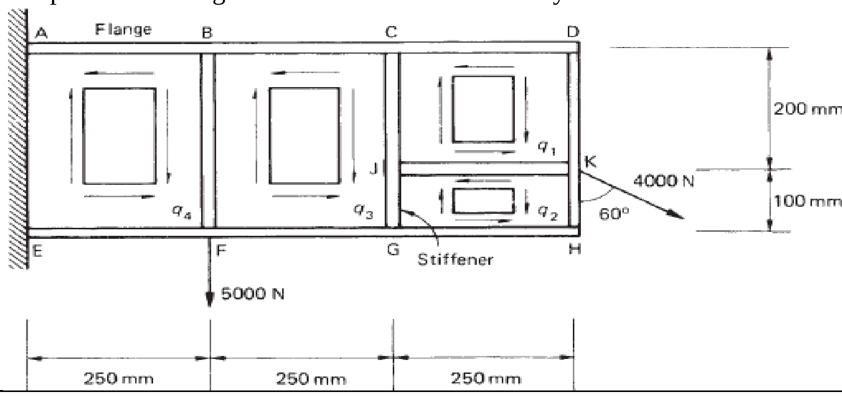
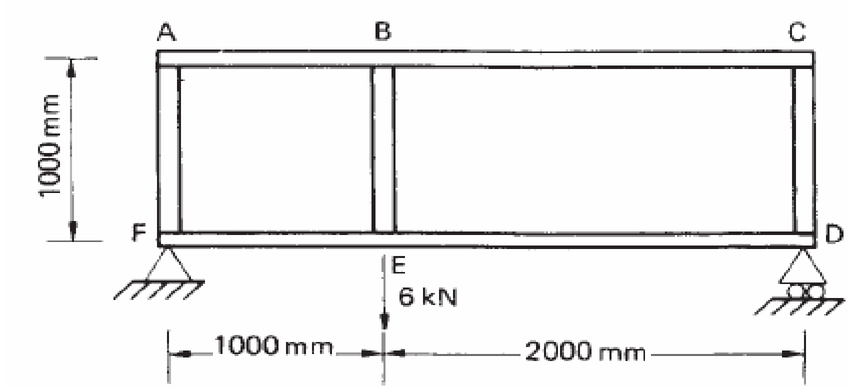
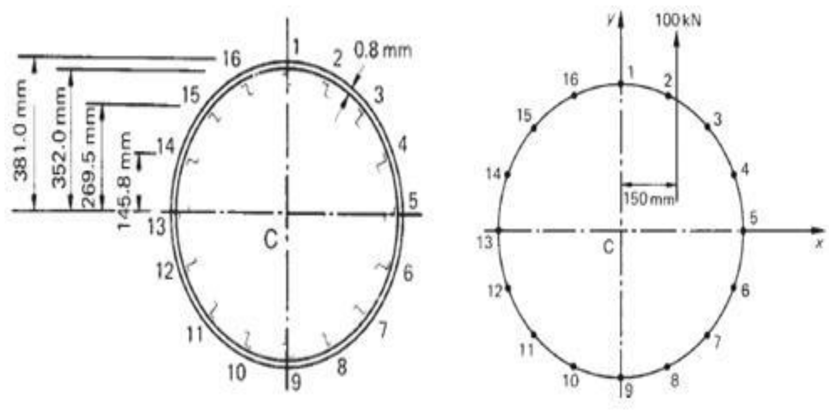
S. No	Question	Blooms Taxonomy Level	Course Outcome
	modulus *G*; *R*=200 mm. 		
2	A shallow box section beam whose cross-section is shown in Fig. 26.20 is simply supported over a span of 2m and carries a vertically downward load of 20 kN at mid span. Idealize the section into one suitable for shear lag analysis, comprising eight booms, and hence **determine** the distribution of direct stress along the top right-hand corner of the beam. Take *G/E* =0.36. 	Apply	2
3	**Determine** the shear flow distribution in the thin-walled Z-section shown in Figure due to a shear load *Sy* applied through the shear center of the section. 	Apply	2
4	An open section beam of length L has the section shown in Figure. The beam is firmly built-in at one end and carries a pure torque T. **Derive** expressions for the direct stress and shear flow distributions produced by the axial constraint (the σ_Γ and q_Γ systems) and the rate of twist of the beam.	Analyze	1

S. No	Question	Blooms Taxonomy Level	Course Outcome
			
5	A shallow box section beam whose cross-section is shown in Fig. 26.20 is simply supported over a span of 2m and carries a vertically downward load of 20 kN at mid span. Idealize the section into one suitable for shear lag analysis, comprising eight booms, and hence **determine** the distribution of direct stress along the top right-hand corner of the beam. Take *G/E* =0.36. 	Apply	2
6	**Determine** the shear flow distribution in the thin-walled Z-section shown in Figure due to a shear load *Sy* applied through the shear center of the section. 	Analyze	1
7	**Determine** the shear flow distribution at the built-in end of a beam whose cross-section is shown in Fig. below. All walls have the same thickness *t* and shear modulus *G*; *R*=200 mm.	Analyze	1

S. No	Question	Blooms Taxonomy Level	Course Outcome
			
8	A shallow box section beam whose cross-section is shown in Fig. 26.20 is simply supported over a span of 2m and carries a vertically downward load of 20 kN at mid span. Idealize the section into one suitable for shear lag analysis, comprising eight booms, and hence **determine** the distribution of direct stress along the top right-hand corner of the beam. Take *G/E* =0.36. 	Analyze	1
9	**Determine** the shear flow distribution in the thin-walled Z-section shown in Figure due to a shear load *Sy* applied through the shear center of the section. 	Analyze	L
10	**Determine** the shear flow distribution at the built-in end of a beam whose cross-section is shown in Fig. below. All walls have the same thickness *t* and shear modulus *G*; *R*=200 mm.	Analyze	l

S. No	Question	Blooms Taxonomy Level	Course Outcome
			
UNIT-V **STRESS ANALYSIS OF AIRCRAFT COMPONENTS- WING, FUSELAGE**			
1	**Determine** the shear flow distribution in the web of the tapered beam shown in Figure at a section midway along its length. The web of the beam has a thickness of 2 mm and is fully effective in resisting direct stress. The beam tapers symmetrically about its horizontal centroidal axis and the cross-sectional area of each flange is 400 mm^2. 	Analyze	2
2	The cantilever beam shown in Figure is uniformly tapered along its length in both *x* and *y* directions and carries a load of 100 kN at its free end. **Calculate** the forces in the booms and the shear flow distribution in the walls at a section 2 m from the built-in end if the booms resist all the direct stresses while the walls are effective only in shear. Each corner boom has a cross-sectional area of 900 mm^2 while both central booms have cross-sectional areas of 1200 mm^2. 	Analyze	2

S. No	Question	Blooms Taxonomy Level	Course Outcome
3	The wing section shown in Figure has been idealized such that the booms carry all the direct stresses. If the wing section is subjected to a bending moment of 300 kN m applied in a vertical plane, **calculate** the direct stresses in the booms. Boom areas: $B_1 = B_6 = 2580\ mm^2$ $B_2 = B_5 = 3880\ mm^2$ $B_3 = B_4 = 3230\ mm^2$ 	Analyze	2
4	**Calculate** the deflection at the free end of the two cell beam shown in figure below. Allowing for both bending and shear effects. The boom carries all constant thickness throughout, are effective only in shear. Take E =69000 N/mm² and G =25900 N/mm². Boom areas: B1 =B3 =B4 =B5 =B6 =650mm²; B2 =B5 =1300mm². 	Analyze	2
5	A wing spar has the dimensions shown in Fig. P.21.1 and carries a uniformly distributed load of 15 kN/m along its complete length. Each flange has a cross-sectional area of 500mm2 with the top flange being horizontal. 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 and 2m from the free end.	Analyze	2
6	**Calculate** the shear flows in the web panels and direct load in the flanges and stiffeners of the beam shown in Figure if the web panels resist shear stresses only.	Apply	3
7	flanges of the wing rib shown in Figure. Assume that the web of the rib is effective only in shear while the resistance of the wing to bending moments is provided entirely by the three flanges 1, 2 and 3. 	Analyze	2
8	A cantilever beam shown in Figure carries concentrated loads as shown. **Calculate** the distribution of stiffener loads and the shear flow distribution in the	Analyze	2

S. No	Question	Blooms Taxonomy Level	Course Outcome
	web panels assuming that the latter are effective only in shear. 		
9	The beam shown in Figure is simply supported at each end and carries a load of 6000 N. If all direct stresses are resisted by the flanges and stiffeners and the web panels are effective only in shear, **calculate** the distribution of axial load in the flange ABC and the stiffener BE and the shear flows in the panels. 	Apply	3
10	The fuselage shown in Fig. a) below is subjected to a vertical shear load of 100 kN applied at a distance of 150mm from the vertical axis of symmetry as shown, for the idealized section, in Fig. b). **Calculate** the distribution of shear flow in the section. 	Analyze	3

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