# MALLA REDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF AERONAUTICAL ENGINEERING

III B.TECH I SEMESTER

***R15 SUPPLEMENTARY***

***PREVIOUS QUESTION PAPERS***

## *LIST OF SUBJECTS*

| *CODE* | *NAME OF THE SUBJECT* |
|---|---|
| R15A2110 | Aircraft Stability and Control |
| R15A2109 | Aerospace Vehicle Structures - II |
| R15A2108 | High Speed Aerodynamics |

**R15**

**Code No: R15A2110**

# MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

**(Autonomous Institution – UGC, Govt. of India)**

## III B.Tech I Semester Supplementary Examinations, February 2021

**Aircraft Stability and Control**

**(AE)**

| Roll No | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

**Time: 2 hours 30 min** **Max. Marks: 75**

Answer Any **Five** Questions

All Questions carries equal marks.

| | | |
|---|---|---|
| 1 | Define static stability. Write Short notes on absolute angle of attack. | **[15M]** |
| 2 | Explain the criteria for longitudinal static stability of an airplane | **[15M]** |
| 3 | How does the vertical tail contribute towards the lateral static stability of an airplane? Explain | **[15M]** |
| 4 | Explain the effect of high-wing, mid-wing and low-wing configurations on lateral static stability with suitable diagrams. | **[15M]** |
| 5 | What is meant by dihedral wing? How does the wing dihedral angle affect the airplane's lateral static stability? | **[15M]** |
| 6 | How does the wing sweep contribute towards the directional static stability of an airplane | **[15M]** |
| 7 | Define dynamics stability of an aircraft and explain the possible types of motions following a disturbance. | **[15M]** |
| 8 | Write short notes on: (i) Spin recovery (ii) Autorotation (iii) Spiral divergence | **[15M]** |

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**R15**

**Code No: R15A2109**

# MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

**(Autonomous Institution – UGC, Govt. of India)**

## III B.Tech I Semester Supplementary Examinations, February 2021

**Aerospace Vehicle Structures - II**

**(AE)**

| Roll No | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

**Time: 2 hours 30 min** **Max. Marks: 75**

Answer Any **Five** Questions

All Questions carries equal marks.

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**1.a** Identify the differences in between bending of thin plate with and without initial curvature. **[7M]**

**.b** A plate 8 mm thick is subjected to bending moments $M_x$equal to 15 Nm/mm and $M_y$ 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. **[8M]**

**2.** Derive the relations for a thin plate subjected to bending. **[15M]**

**3** Derive direct stress distribution for an unsymmetrical cross section. **[15M]**

**4** Calculate the position of the shear center of the thin-walled section shown in Figure.5; the thickness of the section is 2 mm and is constant throughout. **[15M]**

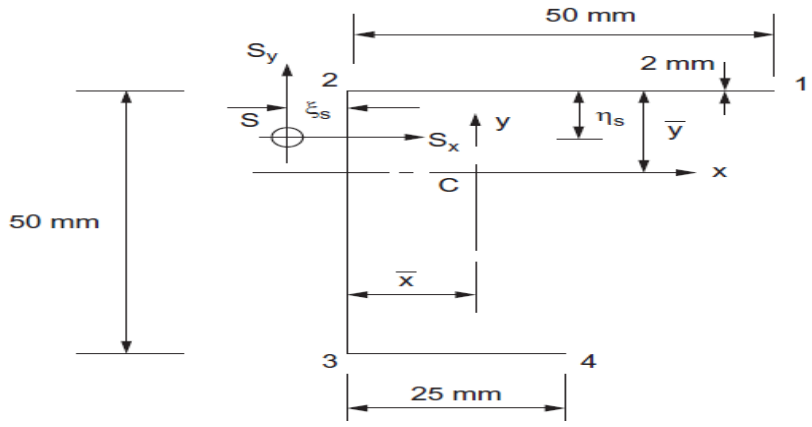


Figure.5

**5** The fuselage section shown in Figure. 6 is subjected to a bending moment of 200 kN-m 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 booms 6 to 9 only. Take $I_{xx}$= 1854 × $10^6$ $mm^4$. **[15M]**

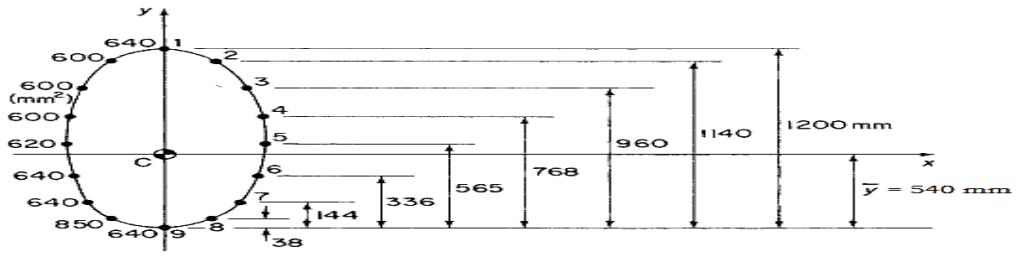


Figure. 6

**6** Figure.7 shows the cross-section of a single cell, thin-walled beam with a horizontal axis of symmetry. The direct stresses are carried by the booms $B_1$ to $B_4$, while the walls are effective only in carrying shear stresses. Assuming that the basic theory of bending is applicable, calculate the position of the shear centre S. The shear modulus $G$=25,000 N/$mm^2$,is the same for all walls.Cell area=135 000 $mm^2$. Boom areas: $B_1$ =$B_4$ =450 $mm^2$, $B_2$ =$B_3$ =550 $mm^2$. **[15M]**

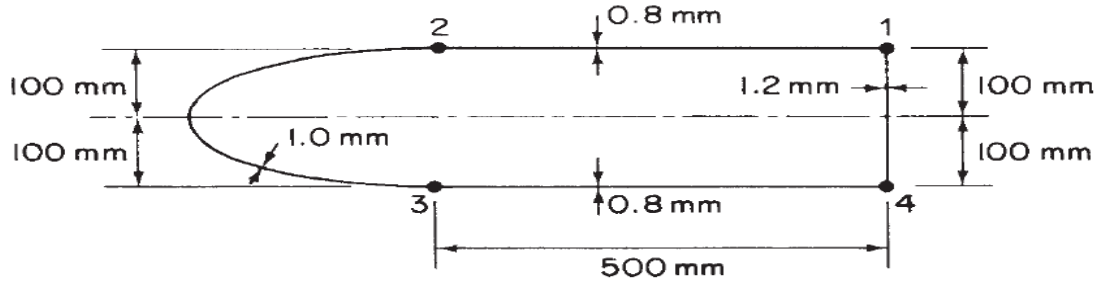


Figure.7

**7** Find the angle of twist per unit length in the wing whose cross-section is shown in Figure.9 when it is subjected to a torque of 15 kN m. Find also the maximum shear stress in the section. G = 25,000 N/mm$^2$. Thickness of the section = 3 mm. **[15M]**

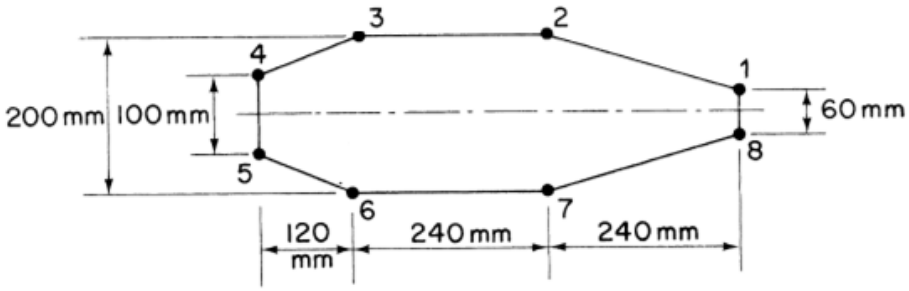


Figure.9

**8** A singly symmetric wing section consists of two closed cells and one open cell (see Figure.10.). The webs 25, 34 and the walls 12, 56 are straight, while all other walls are curved. All walls of the section are assumed to be effective in carrying shear stresses only, direct stresses being carried by booms 1–6. Calculate the distance $x_S$ of the shear centre S aft of the web 34. The shear modulus *G* is the same for all walls. **[15M]**

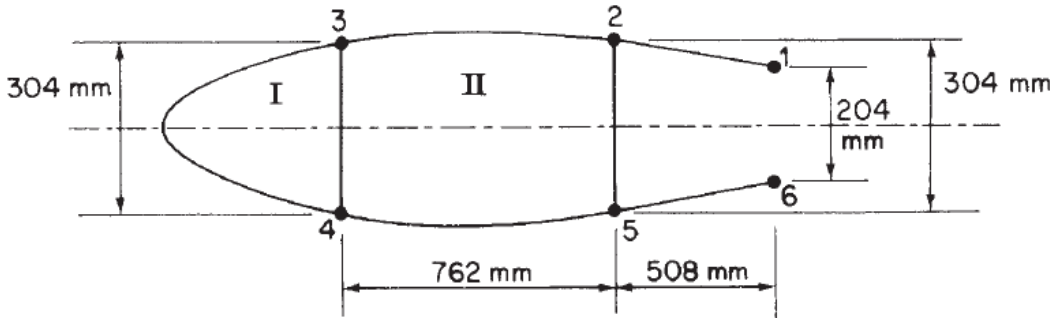


Figure.10

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**R15**

**Code No: R15A2108**

# MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

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## III B.Tech I Semester Supplementary Examinations, February 2021

**High Speed Aerodynamics**

**(AE)**

| Roll No | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

**Time: 2 hours 30 min** **Max. Marks: 75**

Answer Any **Five** Questions

All Questions carries equal marks.

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**Note: Isentropic &Shock tables are allowed**

1 What is speed of sound? Derive the expression for speed of sound for perfect gas under isentropic conditions. **[15M]**

2 Air flows isentropically through a convergent-divergent nozzle of inlet area 12 $cm^2$ at a rate of 0.7 kg/s. The conditions at the inlet and exit of the nozzle are 8 $kg/m^3$ and 400 K and 4 $kg/m^3$ and 300 K, respectively. Find the cross-sectional area, the pressure and the Mach number at the nozzle exit. **[15M]**

3 Show that for a perfect gas, the Mach number behind the oblique shock ($M_2$) is a function of Mach number ahead of the shock ($M_1$), Shock angle ($\beta$) and flow deflection angle ($\theta$). **[15M]**

4 A uniform supersonic stream at Mach 2.2 expands around two convex corners of $10^o$ each. Determine the Mach number downstream of the second corner and the angle of the second fan. **[15M]**

5 Derive the Prandtl-Glauret compressibility correction relations for subsonic flows **[15M]**

6 Express the coefficient pressure in terms of perturbed velocity and freestream velocity. **[15M]**

7 What are the various flow fields possible in a convergent-divergent nozzle when operated at various pressure ratios? Explain. **[15M]**

8 Describe the construction and working of constant current hot wire anemometer for measurement of fluid velocity. **[15M]**

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