Indian Institute of Space Science and Technology

AE 111 - Introduction to Aerospace Engineering (I Semester)

Test 2

Duration: 60 minutes **Total Marks:30**

Name:
SC No: SC
Batch

1. $C_{l_{max}}$ of an airfoil [1]

   A. first increases with t/c, then decreases

   B. first decreases with t/c, then increases

   C. increases with t/c

   D. decreases with t/c

2. In a NACA 4-digit airfoil, NACA-WXYZ

   (a) W indicates Max Camber. [1]

   (b) X indicates position of max. Camber from LE in tenths of chord [1]

   (c) YZ indicates max thickness as % of chord. [1]

3. List 4 parameters which affect $C_{L_{max}}$ [4]

   1. thickness
   2. Camber.
   3. Reynolds number.
   4. Nose radius.

4. In cruise flight, while flying at low speeds the aircraft flies at a high. [1]
   α.

5. Induced drag coefficient depends on C_L as $C_{D_i} \propto C_L^2$. [1]

6. Induced drag coefficient depends on aspect ratio as $C_{D_i} \propto \frac{1}{AR}$. [1]

7. Induced angle of attack depends on aspect ratio as $\alpha_i \propto \frac{1}{AR}$. [1]

8. Induced angle of attack depends on C_L as $\alpha_i \propto C_L$ [1]

9. The mass flow in a choked nozzle is $\dot{m} \propto p_0$ to total pressure p_0. [1]

10. What are the major sections of a turbojet engine? [2]

    1. Diffuser
    2. Compressor
    3. Burner
    4. Turbine
    5. Nozzle

11. In the reciprocating engine propeller combination, 2 rotations of the shaft, we get one power stroke. [1]

12. Define aerodynamic center [1]

    point at which the ~~aerodynamic~~ pitching moment does not change with C_L.

13. You are provided the normal force N, and axial force A on an airfoil at angle of attack α kept in a freestream with velocity of V_∞. Give the expressions for lift L and drag D [2]

    $L = N\cos\alpha - A\sin\alpha$

    $D = N\sin\alpha + A\cos\alpha$

14. How does flap deflection effect the C_L vs α graph? [1]

    Changes the $\alpha_{L=0}$ without any change in $\frac{\partial C_L}{\partial \alpha}$ (as camber changes)

15. How does a leading edge flap change the C_L vs α graph? [1]

    Increases the $C_{L_{max}}$ + a small change in $\alpha_{L=0}$

16. Define aspect ratio of a wing. Provide an expression for the same. [1]

$AR = \frac{b}{c} \rightarrow \frac{b^2}{S}$ S - area, b - span.

17. Define taper ratio of a wing. Provide an expression for the same. [1]

$\lambda = \frac{c_t}{c_r}$ c_t - tip chord, c_r - root chord.

18. What is the difference between geometric twist and aerodynamic twist for a wing? [1]

→ geometric twist: The wing is geometrically twisted along the span, with same airfoil section spanwise. i.e. geometric α is different at different sections.

→ aero twist: Spanwise sections have different airfoils, i.e. different $\alpha_{L=0}$

19. Define mean aerodynamic chord of a wing. Provide an expression for the same. [1]

$$mac = \frac{1}{S} \int_{0.5b}^{0.5b} [c(y)]^2 dy$$

20. How does the sectional lift curve change due to downwash? [1]

Slope reduces → $\frac{\partial c_l}{\partial \alpha}$ reduces.

21. How does the thrust available and power available vary with velocity in an turbojet engine? [2]

T_A is constant with velocity

$P_A = T_A \cdot V$ $P_A \propto V$

22. Define specific impulse. [1]

Thrust produced per unit rate of consumption of propellant. $I_{sp} = \frac{T}{\dot{W}}$