B.E. (Aeronautical Engineering) Fifth Semester (C.B.S.)

Aircraft Flight Mechanics

Paper – II

P. Pages : 2 **TKN/KS/16/7459**

Time : Three Hours * 0 8 6 8 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.
12. Use of the standard altitude tables is allowed.

1. a) The pressure difference ΔP in a pipe of diameter D and Length ℓ due to turbulent flow depends on the Velocity V. Viscosity μ, Density ρ, and roughness K. Using Buckingham's Pi theorem, obtain an expression for ΔP. **8**

b) Calculate pressure and temperature at an altitude of 18 km in ISA. **5**

OR

2. a) State Buckingham's Pi theorem. **3**

b) Derive an expression for variation of pressure and density ratios in troposphere region. **7**

c) Why SFC varies with velocity and altitude? **3**

3. a) Derive the expression for drag polar and explain with a neat plot. **6**

b) Explain the variation of thrust required w.r.t. velocity. Hence explain concept of "velocity stability". **7**

OR

4. a) Derive an expression for the forces and moments acting on flight vehicle with suitable diagram. **6**

b) Draw and explain power available and power required curves for both propeller driven and jet driven airplane. **7**

5. a) Derive the condition for minimum thrust required and power required in steady state level flight. **10**

b) Define absolute and service ceiling. **3**

OR

6. a) Explain the effect of Headwind on Range and Endurance. **5**

b) An airplane has a weight of 180,000 N at the beginning of the flight and 20% of this is the weight of the fuel. In a flight at a speed of 800 kmph the lift to drag ratio is 12 and TSFC of the engine is 0.8. Obtain rough estimate of the range and endurance. **8**

7. a) Obtain the expression for turn radius and turn rate for pull up and pull down maneuvering with neat sketches. **8**

b) Explain the significance of V – n diagram. **6**

OR

8. a) Derive an expression for ground run during "landing performance". **10**

b) Explain "Balanced Field Length" during take off performance. **4**

9. a) Explain static and dynamic stability with the help of neat sketch. **4**

b) What is the criterion for static longitudinal stability? **4**

c) Discuss the advantages and disadvantages of 'CANARD' configuration. **6**

OR

10. a) Derive an expression for H – tail contribution to static longitudinal stability. **8**

b) Describe briefly : **6**
i) Trim ii) Static Margin iii) Elevator.

11. A sailplane has the following characteristics : $C_{\infty} = 0.02 + 0.025 C_L^2, .$ **13**

$C_{L\alpha\omega} = 0.093; \alpha_{OL\omega} = -4; i_{\omega} = 0;$

a.c. Location $= 0.24\,\bar{c}$; $s_t = S/7;$

$\ell_t = 4\,\bar{c}$; $\varepsilon = 0.4\alpha; C_{L\alpha t} = 0.05$

and $\eta = 0.9$. All the angles are in degrees. Neglect the contribution of fuselage. Find the c.g. Location for which the equilibrium is reached with zero lift on the tail at the lift coefficient corresponding to the best guiding angle. Calculate the tail setting. Is the sailplane stable?

OR

12. a) Obtain an expression for the elevator angle to trim the aircraft. **7**

b) Explain how to obtain stick – free neutral point using flight test data. **6**

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