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

Aircraft Flight Mechanics Paper - I

P. Pages : 2 **KNT/KW/16/7371**

Time : Three Hours * 0 6 8 2 * 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 ISA Tables is permitted.

1. a) Derive the hydrostatic equation for pressure variation, thereby define the following terms: **8**
i) Absolute altitude
ii) Geometric - altitude
iii) Geo-potential altitude.

b) Define SFC and explain its variation with velocity and altitude. **5**

OR

2. a) Derive an expression for variation of pressure and density ratios in stratosphere region. **7**

b) The efficiency 'η' of a fan depends on density 'ρ', dynamic viscosity 'μ' of the fluid angular velocity 'ω', diameter of the rotor 'D', and the discharge 'Q'. Express efficiency in terms of dimension less - parameters. **6**

3. a) Explain drag polar of Flight vehicle from low speed to high speed. **6**

b) Find out the pressure, density and dynamic viscosity at an altitude of 23 km w.r.t. ISA. **8**

OR

4. a) Derive the condition for minimum thrust required in steady level flight. Explain velocity stability in thrust required curve. **8**

b) With the help of Hodograph, explain absolute and service ceiling. **6**

5. a) An airplane having an engine - propeller combination weighs 88,290 N and has a wing area of 50 m^2. Its drag polar is given by: $C_D = 0.022+0.059\ G^2$. **7**

Obtain the maximum range and endurance at sea level in a steady level flight at a constant angle of attack from the following additional data:

Weight of fuel and oil = 15 450N

BSFC = 2.67 N / kw – hr .

Propeller efficiency (n_P) = 85%.

b) Obtain the expression for turn radius and turn rate for pull up and pull-down maneuvering with neat sketches. **6**

OR

6. a) An airplane weights 100215N has a wing plan - form area of 70 m^2. Its drag polar is of the form $C_D = 0.023 + 0.07\ G^2$. During cruise at an altitude of 3 km ($p=0.179\ kg/m^3$) its engine suddenly fails and it is forced to descend down in a powerless glide. Calculate: **6**

i) The minimum glide path angle.
ii) The maximum range covered over the ground.
iii) The equilibrium glide velocity of that altitude corresponding to minimum glide angle.

b) Explain V-n diagram with its significance. **7**

7. a) An airplane with a weight of 160,000 N and a wing area of 50 m^2 has a drug polar given by $c_d = 0.017+0.06\ G^2$. It accelerates under standard sea - level conditions from a velocity of 100 m/s to 220 m/s. Obtain the distance covered and the time taken during the acceleration, assuming the thrust output to remain roughly constant at 53 950 N. **7**

b) Derive the Breguet range and endurance formula for a jet propelled airplane and discuss its implications. **7**

OR

8. Derive an expression to determine the take - off distance of an airplane clearly mentioning assumptions involved. **14**

9. a) What is meant by stability of an airplane and what way it is different from controllability. **3**

b) What is the criterion for longitudinal static stability? Derive the expression for horizontal tail contribution to static longitudinal stability and offer comments on this expression. **10**

OR

10. a) Discuss the effect of wing position on fuselage to wards longitudinal static stability. **5**

b) Explain Aerodynamic balancing of control surfaces. **8**

11. a) Show that elevator angle for trim is given by **8**

$$\delta_{trim} = -\left\{\frac{C_{m,o}\ C_{L_\alpha} + C_{m_\alpha}\ C_{L_{trim}}}{C_{m_\delta}\ C_{L_\alpha} - C_{m_\alpha}\ C_{L_\delta}}\right\}.$$

b) Explain contribution of fuselage in longitudinal static stability. **5**

OR

12. a) Write short note on Power effects on longitudinal stability of a jet aircraft. **5**

b) Write the procedure to obtain Neutral point in actual practice. **8**

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