Seat No: ______________ Enrollment No: ______________

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

B.Tech. Summer 2018 - 19 Examination

Semester: 6 **Date: 11/05/2019**
Subject Code: 03101354 **Time: 10.30 am to 1.00 pm**
Subject Name: Aircraft Performance **Total Marks: 60**

Instructions:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 Objective Type Questions - (All are compulsory) (Each of one mark) **(15)**

1. Drag Polar Equation=______________.
2. SFC for propeller-reciprocating engine is ________________.
3. TSFC for turbojet engine is _________________.
4. For propeller driven aircraft, intersection of power available and power required defines ____________________ for straight and level flight.
5. Equation of $\left(\frac{L}{D}\right)_{max}$ is given by ________________.
6. Under same atmospheric conditions when landing gears are taken in from out position. Among C_{D_0} and k which will change significantly?
7. Using slots in flaps how stall angle is affected?
8. What happens to V_{stall} when altitude increases?
9. Which drag do the vortices cause?
10. Suppose an aircraft is flying in such atmosphere that there is no wind. As altitude increases, how mach no. changes for same speed.
11. Pressure is dependent on
    a) altitude
    b) time of day
    c) location on globe
    d) All the above
12. Which of the following is true
    a) Thrust required at lower velocities decreases due to drag increase due to lift.
    b) Thrust required at lower velocities decrease due to zero-lift drag increase.
    c) Thrust required at lower velocities increase due to zero-lift drag increase.
    d) Thrust required at lower velocities increase due to drag increase due to lift.
13. For maximum range for a jet propelled airplane
    a) Fly at maximum $\frac{C_L^{\frac{3}{2}}}{C_D}$
    b) Fly at maximum $\frac{C_L^{\frac{1}{2}}}{C_D}$
    c) Fly at maximum $\frac{C_L}{C_D}$
    d) Does not depend on these ratios

14. For maximum endurance for a propeller driven airplane
    a) Fly at maximum $\frac{C_L^{\frac{3}{2}}}{C_D}$
    b) Fly at maximum $\frac{C_L^{\frac{1}{2}}}{C_D}$
    c) Fly at maximum $\frac{C_L}{C_D}$
    d) Does not depend on these ratios

15. Rate of climb increases with
    a) Increase in aircraft weight
    b) Increase in wing loading at higher velocities
    c) Increase in wing loading at lower velocities
    d) Increase in wing loading at all velocities

Q.2 Answer the following questions. (Attempt any three) **(15)**

A) Discuss about Thrust and SFC of Turbofan engine.
B) Derive Drag Polar Equation.
C) Derive equation of motion for all 3 axis.
D) Explain about split flap and leading edge slat.

Q.3 A) Draw graph of Thrust required vs Velocity graph and state the 5 steps to find T_R. **(07)**

B) Jet propelled aircraft at 30,000ft. **(08)**
@30,000ft, $\rho_\infty = 8.9068 * 10^{-4} slug/ft^3$
@sea level, $\rho_\infty = 0.002377 slug/ft^3$
W=73,000lb, S=950ft^2, $C_{D,o}$=0.015, K=0.08
Calculate minimum power required and velocity at which it occurs and minimum thrust required and velocity at which it occurs.

OR

B) Jet propelled aircraft at 30,000ft. **(08)**
@30,000ft, $\rho_\infty = 8.9068 * 10^{-4} slug/ft^3$
@sea level, $\rho_\infty = 0.002377 slug/ft^3$
W=73,000lb, S=950ft^2, $C_{D,o}$=0.015, K=0.08
At 30,000ft altitude, Calculate $\left(\frac{C_L^{\frac{3}{2}}}{C_D}\right)_{max}$, $\left(\frac{C_L^{1}}{C_D}\right)_{max}$ and $\left(\frac{C_L^{\frac{1}{2}}}{C_D}\right)_{max}$
and Velocity @ $\left(\frac{C_L^{\frac{3}{2}}}{C_D}\right)_{max}$, $\left(\frac{C_L^{1}}{C_D}\right)_{max}$ and $\left(\frac{C_L^{\frac{1}{2}}}{C_D}\right)_{max}$

Q.4 A) Derive the calculation of ground roll during take-off performance also derive the calculation of distance while airborne to clear an obstacle. **(07)**

OR

A) Calculate the total landing distance for an airplane at standard sea level, assuming landing weight and take-off weight are same and is 73,000lb, S=950ft^2, b=75ft. Assume no thrust reversal and μ_r=0.4. Height of the wing above the ground roll is 5.6ft The approach angle is 3°.$C_{L_{max}}$=2.39. It's a commercial airplane, so $V_f = 1.23 V_{stall}$, $V_{TD} = 1.15 V_{stall}$, k_1=0.02, and C_L=0.1 for ground roll. G=$\frac{\left(16\frac{h}{b}\right)^2}{1+\left(16\frac{h}{b}\right)^2}$, e=0.9, ΔC_{D_0}=0.0124,C_{D_0}=0.015. Assume N=3s.@sea level, $\rho_\infty = 0.002377 slug/ft^3$ **(07)**

Hints:

$R = \frac{V_f^2}{0.2g}$, $h_f = R(1-\cos\theta_a)$, $s_a = \frac{50-h_f}{\tan\theta_a}$, $s_f = R\sin\theta_a$

$J_T = \frac{T_{rev}}{W} + \mu_r$ & $J_A = \frac{\rho_\infty}{2\frac{W}{S}}\left[C_{D0} + \Delta C_{D_0} + \left(k_1 + \frac{G}{\pi e AR}\right)C_L^2 - \mu_r C_L\right]$

$$s_g = NV_{LO} + \frac{1}{2gK_A} ln\left(1 + \frac{K_A}{K_T}V_{LO}^2\right)$$

B) Derive the Endurance equation for propeller driven and turbojet aircrafts. **(08)**