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10AE62

Sixth Semester B.E. Degree Examination, June/July 2019
Aircraft Performance

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO full questions from each part.***

PART – A

1 a. At what point on the body do the L and D or R act? **(05 Marks)**

b. Why don't we use CP as reference point in aircraft dynamics? Explain with neat diagram. **(08 Marks)**

c. How do the co-efficient vary with α, Re and M? **(07 Marks)**

2 a. Derive the equation which describe the translational motion of an airplane through 3-dimensional space over a flat earth, from Newton's second law. **(12 Marks)**

b. Explain and Plot the thrust required curve at an altitude of 20,000ft and with weight of 10,000*lb*. **(08 Marks)**

3 a. Using analytical approach, calculate the minimum time to climb to 30,000 ft for the aircraft with the following data: a = 179.9 ft/s, $b = -2.52 \times 10^{-3}$. **(06 Marks)**

b. Using the appropriate analytical expressions, calculate directly the values of θ_{max}, $V_{\theta_{max}}$, $(R/C)_{max}$, $V_{(R/C)_{max}}$ and plot hodograph with the following data: T = 27,700, W = 73000 *lb*, S = 950 ft^2, K = 0.08, C_{DO} = 0.015, $(L/D)_{max}$ = 14.43, $\rho_\infty = 0.002377$ slug/ft^3. **(14 Marks)**

4 a. Calculate the value of L/D for a velocity of 400 ft/sec, with the following characteristics W = 73000 *lb*, S = 950 ft^2, $C_{D,0}$ = 0.015, $\rho_\infty = 8.9068 \times 10^{-4}$ slug/ft^3. **(05 Marks)**

b. Calculate the maximum value of $C_L^{3/2}/C_D$, C_L/C_D as well as the flight velocities at which they occur, where $C_{D,0}$ = 0.015, K = 0.08, W/S = 76.84 lb/ft^2, $\rho_\infty = 8.9068 \times 10^{-4}$ slug/ft^3. **(06 Marks)**

c. List and explain with a neat diagram, various types of high left devices. **(09 Marks)**

PART – B

5 a. Estimate the maximum endurance for jet propelled airplane with following data: $C_t = 1.917 \times 10^{-4}\ s^{-1}$, L/D = 14.42, W_0 = 73000*lb*, W_1 = 43,500*lb*. **(05 Marks)**

b. Derive Breguet Range and endurance equation for propeller driven airplane. **(10 Marks)**

c. How to maximize endurance in jet powered airplane. **(05 Marks)**

6 a. Describe various phases of take-off flight with neat diagram. **(08 Marks)**

b. Represent the forces acting on an aeroplane during take-off. Derive the expression for estimating take-off ground roll distance considering ground effect and margin of safety. Plot the typical variation of forces during take off and discuss the various parameters that influences in reducing the take off distance. **(12 Marks)**

7 a. Describe the various phases of landing flight and derive the expressions for estimating approach distance and flare distance. **(12 Marks)**

b. Estimate the landing ground roll of an airplane, with no thrust reversal. However, spoilers are used such that L = 0. The spoilers increase the zero left drag coefficient by 10%. The fuel tanks are empty, so neglect the weight of any fuel carried by the airplane. The maximum lift coefficient is 2.5. The other characteristics are
$W = 54966.4N$, $S = 29.54$, $C_{D0} = 0.02$, $\mu_r = 0.4$ $\rho_\infty = 1.225$, $g = 32.2$ **(08 Marks)**

8 a. Derive the expression for the following maneuvers: i) Level turn ii) Pull up and iii) Pull down and also obtain the expression for h_{max} in level turn. **(12 Marks)**

b. Calculate the minimum turning radius, load factor and velocity, with following characteristics $W/S = 76.84$ lb/ft^2, $T/W = 0.3795$, $n = 1.4$, $C_{D0} = 0.015$ $\rho_\infty = 0.00237$ slug/ft^3, $g = 32.2$, $K = 0.08$. **(08 Marks)**

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