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10AE62

Sixth Semester B.E. Degree Examination, June/July 2017
Aircraft Performance

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define standard atmosphere. Explain the variation of thrust, power and SFC with velocity and altitude for air-breathing engines. **(04 Marks)**

b. Define the term 'Aerodynamic center' and centre of pressure and derive an expression to locate the aerodynamic center. **(06 Marks)**

c. Draw and explain the variation of lift, drag and moments with respect to angle of attack with a neat sketch. **(04 Marks)**

d. The Boeing 777 has the wing planform area of 4605 ft^2 (i) Assume a take off 506000 lb and a take off velocity 160 mi/hr. Calculate the lift coefficient at take off for standard sea level conditions. (ii) Compare the above result with the lift coefficient for cruise at Mach no. 0.833 at 30,000 ft, assuming the same wt. **(06 Marks)**

2 a. Define four forces of flight. Derive the equations of motion of an airplane through three – dimensional space over a flat earth. **(08 Marks)**

b. Derive and explain thrust available and the max velocity of the airplane. **(08 Marks)**

c. For the Gulf stream IV at the conditions given below, calculate the min. thrust required and the velocity at which it occurs. Given $W = 73{,}000$ lb, $S = 950\ ft^2$, $\rho_{ca} = 8.9068 \times 10^{-4}$ slug/ft^3, $C_{0,0} = 0.015$ and $K = 0.08$? **(04 Marks)**

3 a. Derive an expression for rate of climb and explain by graphical approach. **(08 Marks)**

b. For the unpowered gulf stream IV at 30,000 ft. Calculate
(i) The sink rate for the case of min. glide cycle and
(ii) The minimum sink rate. **(06 Marks)**

c. Explain with neat sketches the service and absolute ceilings. **(06 Marks)**

4 a. Define and derive the equation for fundamental parameters of airplane. **(04 Marks)**

b. For the gulf stream IV at the conditions given in Fig. Q4 (b), calculate the maximum value of $\left(\frac{C_L^{3/2}}{C_D}, \frac{C_L}{C_D}\right)$ and $\frac{C_L^{1/2}}{C_D}$, as well as the flight velocities at which they occur. **(08 Marks)**

c. What is stall? Calculate the stalling velocity (roll of C_{L_m}) and with neat sketches, explain the various types of high lift devices. **(08 Marks)**

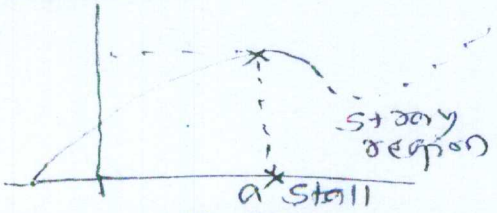

Fig. Q4 (b)

PART – B

5 a. State and discuss the Brequet equation for range and endurance for propeller – driven airplane and jet propelled airplane. **(10 Marks)**

b. Explain with figure the effect of head wind tail on the airplane range and endurance. **(06 Marks)**

c. Estimate the maximum endurances for the gulfstream IV, using the pertinent data. Fuel weight is 29,500 lb and the specific consumption is 0.69 lb of fuel covered per/hr/pond of thrust, which in constant units gives $C_t = 1.917 \times 10^{-4} S^{-1}$ the maximum value of L/D is 14.43. **(04 Marks)**

6 a. Explain the take off performance and calculation of ground roll of an aircraft in accelerated flight. **(10 Marks)**

b. Describe the calculation of distance while airborne to clear an obstacle. **(10 Marks)**

7 a. Explain with neat sketches the analysis of landing path and landing distance. **(08 Marks)**

b. Calculate the total landing distance for the Gulf stream-like airplane at standard sea level, assuming that (for conservation) the landing wt is the same as the take off gross weight of 73,000 lb. Assume that no thrust reversal is used and that the runway is dry concrete with a brakes – on value of $\mu_r = 0.4$. The approach angle is 3°. **(12 Marks)**

8 a. Explain under maneuvering performance minimum turn radius and maximum turn of accelerated flight. **(12 Marks)**

b. With neat sketch, explain the V-n diagram for a typical jet trainer aircraft. **(08 Marks)**

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