CBCS SCHEME

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18AE61

Sixth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Aircraft Performance

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Derive the equations of motion of the aircraft considering translational motion of airplane through 3D space over flat earth. **(10 Marks)**

b. Describe the conditions for the un-accelerated static performance of an aircraft. Obtain the equations of motion for the same. **(10 Marks)**

OR

2 a. Consider an airplane at steady level, unaccelerated flight, show that $\left(\frac{L}{D}\right)_{max} = \frac{1}{\sqrt{4C_{DO}K}}$. Mention its significance on the airplane performance. **(10 Marks)**

b. A twin turbofan aircraft has following details weight = 73000 lb, AR = 5.92, K = 0.08, $C_{DO} = 0.015$, S = 950 ft^2. Calculate and plot the thrust required curve at 30,000 ft altitude for the velocities from 300 ft to 1300 ft. Take velocity increment as 100 ft/s. Density at 30000 ft is 8.9068×10^{-4} slug/ft^3. **(10 Marks)**

Module-2

3 a. Derive the expression for the rate of climb and explain its significance using graphical approach and hodograph diagram with respect to climb performance. **(14 Marks)**

b. Explain absolute and service ceiling with relevant graph. **(06 Marks)**

OR

4 a. Derive the expression for time to climb. Explain how it is calculated graphically and analytically. **(10 Marks)**

b. Bring out the importance and significance of sink rate. State the condition for minimum sink rate and relate with excess power. Explain briefly. **(10 Marks)**

Module-3

5 a. Explain the fundamental parameters that impact the aircraft performance. Mention the importance of each parameter with necessary equations. **(10 Marks)**

b. Show the aerodynamic relations associated with different lift to drag ratio. **(10 Marks)**

OR

6 a. Define Range. Derive the Breguet range equation for a jet airplane. **(10 Marks)**

b. Considering the data given in Q.2(b), and assuming density = $8.9068 * 10^{-4}$ slug/ft^2. Estimate the maximum endurance of 30000 ft. The maximum usuable fuel weight is 29500 lb. The thrust specific fuel consumption at 30000 ft is 0.69 lb of fuel consumed per hour per pound of thrust. Also calculate the flight velocity to obtain the maximum endurance. **(10 Marks)**

Module-4

7 a. Illustrate the intermediate segments of Ground Roll with respect to take off scenario of aircraft with a neat sketch. Explain each segment in detail. **(08 Marks)**

b. Derive an expression for ground roll with respect to take off performance. **(12 Marks)**

OR

8 a. Explain the landing scenario of an aircraft in detail with a neat schematic. **(08 Marks)**

b. Calculate the total landing distance for the aircraft data given in Q.2(b) at the sea level, assuming that the landing weight is the same as the take off gross weight of 73000 lb. Assume that no thrust reversal is used and that the runway is dry concrete with brakes on value of $\mu_r = 0.4$. The approach angle is 3 degrees. **(12 Marks)**

Module-5

9 a. Derive the expression for the minimum turn radius of the airplane in level turn condition. **(10 Marks)**

b. Explain different constraints act on the load factor with respect to maneuver performance. **(10 Marks)**

OR

10 a. Draw the v-n diagram of an aircraft and explain each condition of it. **(10 Marks)**

b. Explain pull up and pull-down maneuvers in detail. **(10 Marks)**

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