USN | | | | | | | | | | |

10AE62

Sixth Semester B.E. Degree Examination, Feb./Mar. 2022
Aircraft Performance

Time: 3 hrs. Max. Marks:100

Note: ***Answer any 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 4605ft^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 gulfstream 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. Calculate L/D for an aircraft with weight 75,000 lb, S = 950 ft^2, $C_{Do} = 0.015$ and k = 0.08 flying level at 3000 ft high where $\rho_\infty = 8.9 \times 10^{-4}$ slugs/ft^3 and the speed of the aircraft is 400 ft/sec. **(10 Marks)**

b. Draw and explain the trailing edge high lift devices used in modern passenger plane and select the best out of it. **(10 Marks)**

PART – B

5 a. Derive the range equation for a jet airplane and wrote the condition for maximum range. **(10 Marks)**

b. Derive the endurance equation for a propeller aircraft and give the condition for maximum endurance. **(10 Marks)**

6 a. Derive an equation for the Ground Rum distance to reach V_{To}. **(10 Marks)**

b. Calculate the ground run distance for an aircraft at V_{To} = 20 ft/sec to clear an obstacle of 50 ft high. **(10 Marks)**

7 a. What is energy height of an a/c? Explain with a proper expression and examples. **(10 Marks)**

b. Derive an expression for specific excess power which required for accelerate along its flight path. **(10 Marks)**

8 a. Derive an expression for load factor corresponding to the minimum turning radius in case of level turn flight. **(10 Marks)**

b. A light a/c weighing 9000 N and with a wing area 12.5 m^2 has a maximum lift coefficient of 1.5 and its drag equation is $C_D = 0.02 + 0.05 C_L^2$. It is powered by a single turbo jet engine giving a thrust of 1350 N at all speeds at sea level. Estimate the minimum time required to turn through 180m at sea level and corresponding load factor and wing lift. **(10 Marks)**

* * * * *