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10AE62

Sixth Semester B.E. Degree Examination, June/July 2018
Aircraft Performance

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain about the technical evolution during pre-wright era. **(10 Marks)**

b. What is the drag polar? Explain. Also draw the drag polar for low mach number to high mach number and explain it. **(08 Marks)**

c. What is standard atmosphere? Define and write the sea level value of P , T and ρ in S.I. unit. **(02 Marks)**

2 a. Derive an expression for maximum velocity, in terms of thrust to weight ratio and wing loading. Show the V_{max} on a curve T vs V_∞ for a jet propelled aircraft. **(10 Marks)**

b. An aeroplane has a wing loading of 2400 N/m^2 and its drag equation is $C_D = 0.016 + 0.055\ C_L^2$. Calculate its (L/D)max, the minimum drag speed and (L/D) ratio at a speed of 100 m/s EAS. **(10 Marks)**

3 a. Draw a Hodograph for climb performance at a given altitude and explain each parameter of the hodograph. **(05 Marks)**

b. Explain time taken in climb (Graphically and analytically). **(03 Marks)**

c. A sailplane weighs 4500 N and has a wing loading of 600 N/m^2. Its drag equation is $C_D = 0.01 + 0.022 C_L^2$. After completing a launch at 350 m in still air, what is the greatest distance the sailplane can cover, and what is the greatest duration of flight possible, assuming in both cases flight over level ground. Find also the corresponding speeds of flight. Assume density is constant. **(12 Marks)**

4 a. Derive an expression of (L/D) ratio, when airplane is flying at m multiple of the minimum drag speed. **(10 Marks)**

b. Calculate the value of $\left(\frac{C_L^{3/2}}{C_D}\right)_{max}$, $\left(\frac{C_L^{1/2}}{C_D}\right)_{max}$ and the corresponding velocities. Use the a/p data as W = 88176.75 N, S = 29.54 m^2, AR = 8.93, C_{Do} = 0.02, K = 0.08 , ρ_∞ = 1.225 kg/m^3. **(10 Marks)**

PART – B

5 a. Define range and endurance of an aircraft. **(02 Marks)**

b. Derive an expression of Breguet range for propeller driven a/c and jet propelled a/c. Discuss the parameters for minimizing the range. **(10 Marks)**

c. Estimate the maximum range for an a/p flying at sea level with following data: Gross weight = 13127.5 N, Propeller efficiency = 0.8 , S.F.C = $7.456\times10^{-7}\ s^{-1}$, weight of the fuel is 1632.5 N, S = 16.165 m^2, C_{Do} = 0.025, e = 0.8, AR = 7.37. **(08 Marks)**

6 a. Explain 'The balanced field length'. **(04 Marks)**

b. Derive an expression for take-off distance of air-borne phase (Sa) **(06 Marks)**

c. Estimate the lift-off distance for the a/c having W = 88176.75 N, b = 16.25 m, S = 29.54 m, T = 32485 N. C_{Do} = 0.02, e = 0.81, μ_r = 0.02, Assume the C_{Lmax} is 1.0 during the ground roll. The wings are 1.83m above the ground. **(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)**

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