Aircraft Performance VTU CBCS Question Paper Set 2018

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

10AE62

Sixth Semester B.E. Degree Examination, June / July 2014
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 drag polar and sketch the plot. **(04 Marks)**

b. Sketch the following plots:

i) $\left(\frac{L}{D}\right)$ Vs angle of attack.

ii) T_R Vs V_∞ .

iii) P_R Vs V_∞. **(12 Marks)**

c. Define hodograph and sketch a typical hodograph for climb performance at a given altitude. **(04 Marks)**

2 a. Write down the equations of motions for steady, level flight. **(02 Marks)**

b. Consider an airplane at steady, level flight and it's a function of altitude, velocity and weight. For the above said condition show that,

$$\left(\frac{L}{D}\right)_{max} = \frac{1}{\sqrt{4C_{D_0}K}}$$ **(10 Marks)**

c. By analytical approach show that the minimum power required occurs when the airplane is flying such that $\left(\frac{C_L^{\frac{3}{2}}}{C_D}\right)$. **(08 Marks)**

3 a. For a propeller-driven airplane show that,

$$\left(\frac{R}{C}\right)_{max} = \frac{n_{pr}P}{W} - \frac{2}{P_\infty}\sqrt{\frac{K}{SC_{D_0}}}\left(\frac{W}{S}\right)^{\frac{1}{2}}\frac{1.155}{\left(\frac{L}{D}\right)_{max}}.$$ **(10 Marks)**

b. Explain service and absolute ceilings in detail. **(10 Marks)**

4 a. What are high lift devices, how they increases the performance of airplane? **(10 Marks)**

b. Write short notes on:

i) $\left(\frac{T}{W}\right)$ ratio.

ii) $\left(\frac{L}{D}\right)$ ratio. **(10 Marks)**

PART – B

5 a. For a jet-propelled airplanes, derive the Brequet range equation. **(10 Marks)**

b. State the conditions for maximum endurance for a jet propelled airplane. **(05 Marks)**

c. Derive the general equation for endurance of airplane. **(05 Marks)**

6 a. Explain the various phases of 'Take-off' of an airplane with neat sketch. **(10 Marks)**

b. Explain in detail about the 'Calculation of distance while airborne to clear an obstacle'. **(10 Marks)**

7 a. Sketch the typical variation of forces acting on an airplane during landing. **(05 Marks)**

b. Estimate the landing ground roll distance at sea level for airplane at the given conditions. No thrust reversal is used, however spoilers are employed such that $L = 0$. The spoilers increases the zero-lift, drag co-efficient by 10%. The fuel tanks are essentially empty, so neglect the weight of any fuel used by the airplane. The maximum lift co-efficient, when flaps fully employed at touch down is 2.5. **(15 Marks)**

8 a. Explain V-n diagram for a typical jet trainer aircraft. **(10 Marks)**

b. Explain the pull-up and push-down maneuvers with necessary equations. **(10 Marks)**

* * * * *

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

10AE62

Sixth Semester B.E. Degree Examination, June/July 2015
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. What is drag polar? Derive the drag polar equation for an airplane. Show graphical representation. **(10 Marks)**

b. Define the terms aerodynamic center and center of pressure and derive an expression to locate the aerodynamic center. **(10 Marks)**

2 a. Consider an airplane at steady, level flight and it's a function of altitude, velocity and weight. For the above said condition show that:

$$\left(\frac{L}{D}\right)_{max} = \frac{1}{\sqrt{4C_{DO}k}}.$$ **(10 Marks)**

b. A single engine propeller driven airplane have following characteristics:
$b = 10.91m$, $s = 16.16m^2$, $w = 1340kg$, $e = 0.8$, $C_{D,O} = 0.022$.
Calculate the thrust required at sea level of flight velocity of 100m/s. **(10 Marks)**

3 a. For a propeller-driven airplane show that

$$\left(\frac{R}{C}\right)_{max} = \frac{\eta_{pr}P}{W} - \frac{z}{\rho_\infty}\sqrt{\frac{k}{sc_{D,O}}}\left(\frac{w}{s}\right)^{1/2}\frac{1.155}{(L/D)_{max}}$$ **(12 Marks)**

b. Explain service and absolute ceilings. **(08 Marks)**

4 a. By analytical approach show that aerodynamic relations associated with different lift to drag ratio that is $\left(\frac{C_L^{3/2}}{C_D}\right)_{max}$. **(10 Marks)**

b. An aircraft is flying at an altitude of 9km where $\rho = 0.467\ kg/m^3$ has the following characteristics: $W = 33000kg$, $S = 90m^2$, $C_{D,O} = 0.015$, $K = 0.08$. Find the maximum values of $\frac{C_L^{3/2}}{C_D}$, $\frac{C_L}{C_D}$ and $\frac{C_L^{1/2}}{C_D}$. **(10 Marks)**

PART – B

5 a. For a propeller driven airplane, derive the Breguet range equation. **(10 Marks)**

b. A light single engine, propeller driven airplane have the following characteristics:
Wing span = 10.912m, wing area = 16.165m^2
Normal gross weight = 13127.5N
Fuel capacity of 65 gallons of aviation gasoline
Power plant = one piston engine of 230hp at sea level
Specific fuel consumption of 7.456×10^{-7}/m
Parasite drag coefficient $c_{D,0} = 0.025$
Oswald efficiency factor = 0.8
Propeller efficiency is 0.8
Estimate the maximum range for the above aircraft. **(10 Marks)**

6 a. Explain the various phases of take-off of an airplane with neat sketch. **(10 Marks)**

b. Explain in detail about the calculation of distance while airborne to clear an obstacle. **(10 Marks)**

7 a. Obtain an expression for calculating the approach distance and flare distance. **(15 Marks)**

b. Write a short note on ground effect. **(05 Marks)**

8 a. With the help of neat sketch, explain the v-n diagram. **(10 Marks)**

b. Derive an expression for minimum turning radius. **(10 Marks)**

* * * * *

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

10AE62

Sixth Semester B.E. Degree Examination, June/July 2016
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. Define the term 'standard atmosphere obtain the relation to calculate the pressure, density and temperature in the gradient and constant regions. **(10 Marks)**

b. An airplane is flying at an altitude where the actual pressure and temperature are 4.72×10^4 N/m and 255.7 k respectively what are the pressure, temperature and density altitudes. **(10 Marks)**

2 a. Describe the concept of power available and power required of propeller driven aircraft. **(10 Marks)**

b. Explain with force diagram : i) level flight ii) climb and decending. **(10 Marks)**

3 a. Derive equation of motion for rate of climb and explain graphic of approach. **(10 Marks)**

b. The maximum lift drag ratio for the CP -1 is 13.6, calculate the minimum glide angle and the maximum range measured along the ground covered by the CP – 1 in a power of glide that starts at an altitude of 3048 m and also calculate the equilibrium glide velocity at altitude 3048 and 609.6 m each corresponds to min glide angle (W = 2950 N, S = 174 m^2) and $C_L = 0.634$ $P_\infty = 0.905$ kg/m^3). **(10 Marks)**

4 a. Describe aerodynamic relation for lift–to–drag ratio. **(10 Marks)**

b. Explain briefly high–lift devices. **(10 Marks)**

PART – B

5 a. Derive the Bregnet range expression for a propeller driven airplane. List the condition for obtaining maximum range. **(10 Marks)**

b. Explain with plot the effect of head wind and tail wind on best range airspeed for a propeller driven airplane. **(10 Marks)**

6 a. Explain with neat sketch various phases of airplane undergoes during takeoff. **(10 Marks)**

b. Derive expression for calculation of distance while airborne to clear an obstacle. **(10 Marks)**

7 a. Drive equation for calculating flare distance of airplane. **(10 Marks)**

b. The maximum lift to drag ratio for the CP–1 is 13.6, W = 2950, S = 174 Calculate the minimum glide angle and maximum range measured along the ground, covered by CP–I in a power off glide that starts at altitudes of 3048 m and also calculate the equilibrium glade angle. **(10 Marks)**

8 a. Explain with neat sketch pull-up and pull-down maneuvers. **(10 Marks)**

b. Describe the importance of V-n diagram on aircraft performance and write the limitations of pull-up and push-down. **(10 Marks)**

* * * * *

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

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)**

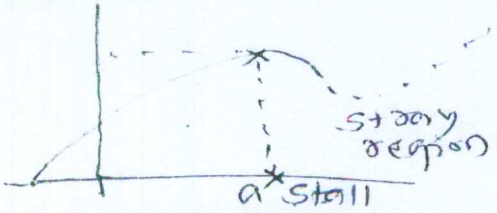

Fig. Q4 (b)

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)**

* * * * *

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

10AE62

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.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. Calculate the temperature at 8500 meters above sea level. The temperature at sea level is 15°C. **(10 Marks)**

b. Prove that an airfoil has an aerodynamic centre within it. **(10 Marks)**

2 a. Calculate thrust required for level unaccelerated flight at 8000 ft high given that the aircraft weight is 75,000 lb, $\rho_\infty = 8.9\times10^{-4}$ slugs/ft^3, S = 950 ft^2, V = 500 ft/sec, $C_{D_0} = 0.015$ and k = 0.08. **(10 Marks)**

b. Calculate the minimum thrust required and the velocity at which it occurs for the data W = 75,000 lb, S = 950 ft^2, $\rho_\infty = 8.9\times10^{-4}$ slugs/ft^3, $C_{D_0} = 0.015$ and k = 0.08. **(10 Marks)**

3 a. Derive an equation for max rate of climb. **(10 Marks)**

b. What is absolute ceiling and service ceiling of a jet aircraft? **(10 Marks)**

4 a. Calculate L/D for an aircraft with weight 75,000 lb, S = 950 ft^2, $C_{D_0} = 0.015$ and k = 0.08 flying level at 3000 ft high where $\rho_\infty = 8.9\times10^{-4}$ 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 are the factors affecting the landing distance required for an airplane to land. **(10 Marks)**

b. Explain the "ground effect" on an airplane while landing. **(10 Marks)**

8 a. Derive the equation connecting radius of turn during an inverted pull down maneuver and "g". **(10 Marks)**

b. Draw a detailed V-n diagram. **(10 Marks)**

* * * * *