Register Number:……..

KUMARAGURU
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B.E DEGREE EXAMINATIONS: APRIL / MAY 2023

(Regulation 2018)

Sixth Semester

AERONAUTICAL ENGINEERING

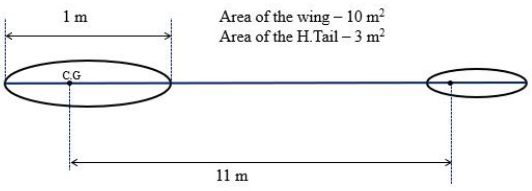
U18AET6001: Flight Dynamics

COURSE OUTCOMES

CO1: Calculate atmospheric properties at various altitudes
CO2: Calculate the performance of an airplane for non-accelerating flight conditions
CO3: Solve accelerated performance equations to get Take-off and landing distances.
CO4: Estimate Longitudinal static stability and trim requirements for an aircraft.
CO5: Assess lateral and directional stability requirements for an aircraft

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

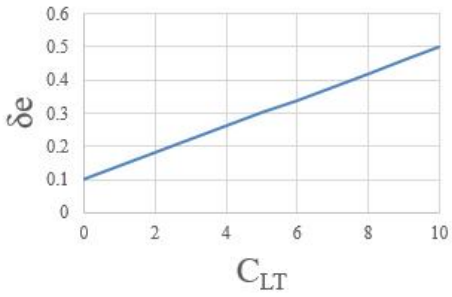
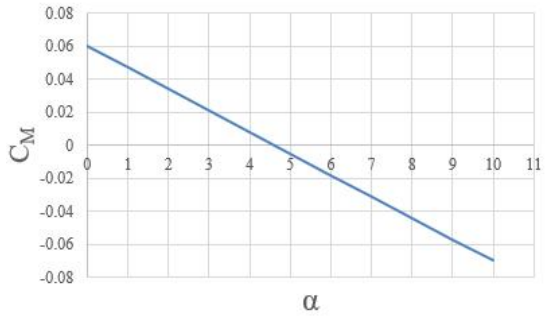
1.	Calculate the temperature at 10 km altitude in the International standard atmosphere.	CO1	[K_3]
2.	Define Equivalent airspeed and give its relation with true airspeed.	CO1	[K_2]
3.	Estimate the $\left(\frac{L}{D}\right)_{max}$ of an aircraft with the drag polar $C_D = 0.015 + 0.08\ C_L^2$.	CO2	[K_3]
4.	Calculate the maximum Range covered over the ground for an aircraft which is at an altitude of 9100m starts gliding and its drag polar of given by $C_D = 0.015 + 0.08\ C_L^2$.	CO2	[K_3]
5.	Explain the significance of Decision speed during Take-off	CO3	[K_1]
6.	State the various ways of decreasing the Landing distance for an aircraft.	CO3	[K_2]
7.	 Calculate the Tail volume ratio for the above configuration.	CO4	[K_3]
8.	State the significance of Neutral point in an aircraft	CO4	[K_2]
9.	Explain the difference between Yaw and Sideslip angle in brief	CO5	[K_1]
10.	State the most stable and an unstable wing configuration in Lateral stability	CO5	[K_2]

Answer any FIVE Questions:-
PART B (5 x 4 = 20 Marks)
(Answer not more than 80 words)

11.	Calculate the Minimum Thrust required and Velocity at minimum drag for an aircraft weighing 39420 kg with a planform area of 88m^2 with a drag polar 0.017 + 0.08 C_L^2 flying at sea level condition ρ = 1.2256 kg/m^3.	CO2	[K_3]
12.	Calculate the aircraft's climb velocity, and climb angle if the Rate of climb is 15 m/s and horizontal velocity of the aircraft is 80 m/s.	CO2	[K_3]
13.	Explain V-n diagram in brief with a neat sketch.	CO3	[K_1]
14.	Calculate the load factor experienced by the aircraft in a level turn, if it is rolled to an angle of 50 degrees. Also calculate the Turn radius taken by the aircraft if the velocity is 100 m/s.	CO3	[K_3]
15.	Calculate the moment coefficient about the center of gravity and also assess the longitudinal stability or a given wing alone configuration with its aerodynamic center lies 0.05 chord length ahead of the center of gravity. The moment coefficient about the aerodynamic center is −0.016 and the lift coefficient is 0.45	CO4	[K_3]
16.	Explain how position of the wing on the fuselage affects the Lateral stability.	CO5	[K_2]

Answer any FIVE Questions:-
PART C (5 x 12 = 60 Marks)
(Answer not more than 300 words)

17.	Derive the equation of motion of a rigid flight vehicle with six degrees of freedom and also simplify it for the steady level flight conditions with proper assumptions stated	12	CO1	[K_4]
18.	Prove that, in straight and level flight show that the velocity corresponding to minimum power condition is 0.76 times the velocity corresponding to minimum thrust required condition	12	CO2	[K_2]
19.	Calculate $\left(\frac{C_L^{\frac{3}{2}}}{C_D}\right)_{max}$, $\left(\frac{C_L^{\frac{1}{2}}}{C_D}\right)_{max}$, Velocity at minimum Power V_{mp}, Velocity at minimum drag for an aircraft with a drag polar 0.015 + 0.08 C_L^2 , Weight = 39500 kg and wing planform area of 60 m^2 flying at sea level conditions.	12	CO2	[K_3]

20.	a)	Calculate the Take-off ground roll distance for an aircraft at sea-level conditions with a wing-loading of 3679 N/m^2 and a constant thrust of 132 kN. Maximum lift coefficient of 2.7 with the aircraft weight of 36,500 kg. (V_{LO} = 1.2 V_s)	6	CO3	[K_3]
	b)	Derive the Turn radius and Angular rate expression for a pull up and pull-down maneuvers	6	CO3	[K_3]
21.	a)	$\delta_{trim} = \frac{C_{M,0} + (\partial C_{M,cg}/\partial \alpha_a)\alpha_n}{V_H(\partial C_{L,t}/\partial \delta_e)}$ Derive the above elevator angle to trim expression from longitudinal control.	6	CO4	[K_3]
	b)	  Calculate the elevator angle to trim to a new trim angle of 6.5^0 for an aircraft with above characteristics with a tail volume ration of 0.34.	6	CO4	[K_3]
22.	a)	Explain Dutch roll, spiral divergence and Auto rotation in brief.	6	CO5	[K_2]
	b)	Explain Adverse yaw and state the three methods to reduce adverse yaw.	6	CO5	[K_2]

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