U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

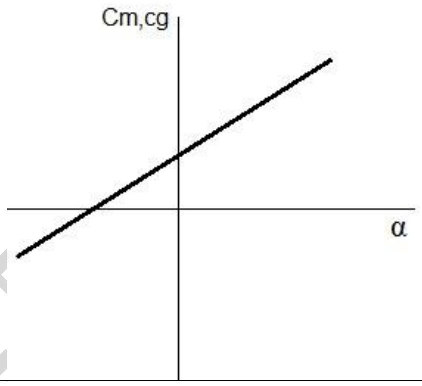
Autonomous Institute Affiliated to VTU

July 2023 Semester End Main Examinations

Programme: B.E. **Semester: VI**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 20AE6DCDSM **Max Marks: 100**
Course: Flight Dynamics and Space Mechanics **Date: 05.07.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Is the airplane having $C_{m,cg}$ vs α graph, as shown in Fig. 1, controllable and flyable? Justify.  **Fig. 1**	*CO1*	*PO2*	**4**
	b)	Explain the following axes system used in dynamic stability analysis with neat sketch. i) Body axes system ii) Earth axes system	*CO1*	*PO1*	**4**
	c)	Derive the equations of motion of a rigid body subjected to inertial forces and moments.	*CO1*	*PO2*	**12**
		UNIT - II			
2		Derive the expression for stability derivatives due to change in forward speed.	*CO2*	*PO2*	**20**
		OR			
3		Derive the expression for stability derivatives due to time rate of change of angle of attack.	*CO2*	*PO2*	**20**
		UNIT - III			
4	a)	Illustrate the influence of yaw rate on relative velocity distribution on wing and tail with a neat sketch.	*CO3*	*PO2*	**4**
	b)	Derive the expression for stability derivatives due to yawing rate.	*CO3*	*PO2*	**16**

			UNIT – IV			
	5	a)	Find the natural frequency and the damping ratio based on two degree of freedom short period approximation is given by the standard equation given below. $\begin{bmatrix} s - X_u - X_{T_u} & -X_\alpha & g\cos\Theta_1 \\ -Z_u & [s(U_1 - Z_{\dot\alpha}) - Z_\alpha] & [-(Z_q + U_1)s + g\sin\Theta \\ -(M_u - M_{T_u}) & -(M_{\dot\alpha}s + M_\alpha + M_{T_\alpha}) & (s^2 - M_q s) \end{bmatrix} = \begin{bmatrix} X_{\delta_e} \\ Z_{\delta_e} \\ M_{\delta_e} \end{bmatrix} \delta_e s$	*CO4*	*PO1*	**16**
		b)	Define the term longitudinal dynamic stability of the airplane. Explain if an airplane when possessing static longitudinal stability will as well be dynamically stable.	*CO4*	*PO2*	**4**
			UNIT - V			
	6	a)	Write the equation for calculating the velocity in an elliptical orbit and hence deduce an expression for calculating the velocity in a circular orbit.	*CO5*	*PO1*	**2**
		b)	State the Kepler's three empirical laws of planetary motion.	*CO5*	*PO1*	**6**
		c)	Prove the Kepler's first law of planetary motion.	*CO5*	*PO1*	**12**
			OR			
	7	a)	The distance of a planet from the earth is 2.5 x 10^7 km and the gravitational force between them is 3.82 x 10^{18} N. Mass of the planet and earth are equal, each being 5.98 x 10^{24} kg. Calculate the universal gravitation constant.	*CO5*	*PO2*	**6**
		b)	An earth satellite is in an orbit with perigee altitude Zp = 400 km and an eccentricity e = 0.6. Find (i) the perigee velocity (ii) the apogee radius (iii) the semi-major axis (iv) the apogee velocity (v) the period of the orbit. (μ = 3,98,600 km3/s2 and the radius of the earth R = 6378 km)	*CO5*	*PO2*	**14**

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