U.S.N.										

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

Autonomous Institute Affiliated to VTU

August 2024 Supplementary Examinations

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

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

			UNIT - I	*CO*	*PO*	Marks
1	a)		Describe the order of rotation of Euler angles to get the actual orientation of the body frame relative to the fixed frame.	*CO1*	*PO1*	**6**
	b)		Graphically represent a system which is statistically stable but dynamically unstable.	*CO1*	*PO1*	**2**
	c)		Formulate the basic equations of motion for six-degrees of freedom of an aircraft.	*CO1*	*PO2*	**12**
			UNIT - II			
2	a)		Infer about small perturbation theory.	*CO2*	*PO2*	**4**
	b)		Starting with the X force equation, use the small-disturbance theory to determine the linearized force equation. Assume a steady-level flight for the reference flight conditions.	*CO2*	*PO2*	**16**
			OR			
3			Derive the expression for stability derivatives due to the pitching rate.	*CO2*	*PO2*	**20**
			UNIT - III			
4	a)		Derive the expression for stability derivatives due to rolling rate.	*CO3*	*PO2*	**16**
	b)		Infer about the effect of wing span on roll damping coefficient.	*CO3*	*PO2*	**4**
			UNIT - IV			
5	a)		Differentiate short period oscillations and Phugoid oscillations.	*CO4*	*PO1*	**4**
	b)		Find the natural frequency and the damping ratio based on two degree of freedom long period approximation is given by the standard equation given below.	*CO4*	*PO1*	**16**

			$\begin{bmatrix} s - X_u - X_{T_u} & -X_\alpha & g\cos\Theta_1 \\ -Z_u & [s(U_1 - Z_{\dot{\alpha}}) - Z_\alpha] & [-(Z_q + U_1)s + g\sin\Theta \\ -(M_u - M_{T_u}) & -(M_{\dot{\alpha}}s + M_\alpha + M_{T_\alpha}) & (s^2 - M_q s) \end{bmatrix} = \begin{bmatrix} X_{\delta_e} \\ Z_{\delta_e} \\ M_{\delta_e} \end{bmatrix} \delta_e s$			
			UNIT - V			
	6	a)	Calculate the velocity of an artificial satellite having a circular orbit around the Earth at an altitude of 200 km above the Earth's surface. (Radius of the earth R = 6378.14 km and μ = 398600.5 km^3/s^2).	*CO5*	*PO1*	**4**
		b)	Write short notes on Newton's Law of Universal Gravitation with suitable diagram.	*CO5*	*PO1*	**4**
		c)	State and prove Kepler's first law of planetary motion	*CO5*	*PO2*	**12**
			OR			
	7	a)	State and Prove Kepler's third law of planetary motion.	*CO5*	*PO1*	**14**
		b)	Find the gravitational force of attraction between the moon and the earth if the mass of the moon is 1/81 times the mass of earth. G = 6.67 x 10^{-11} N m^2/kg^2, radius of moon's orbit is 3.58 x 10^5 km. Mass of the earth = 6 x 10^{24} Kg.	*CO5*	*PO2*	**6**

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