Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2022

Subject Code:3150101 Date:06-01-2023

Subject Name:Flight Mechanics

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define stability and its types.	**03**
	(b)	What is International standard atmosphere? Explain the variation of temperature with altitude in standard model of atmosphere.	**04**
	(c)	With a neat sketch explain the details of V-N Diagram.	**07**
Q.2	**(a)**	Discuss in brief the effect of tail moment arm on fight stability.	**03**
	(b)	Obtain the values of pressure, density and temperature at 5 km in ISA.	**04**
	(c)	Obtain the maximum speed and minimum speed in steady level flight at sea level for the following airplane: W = 36,000 N; S = 26.0 m^2; $C_D = 0.032 + 0.043C_L^2$ BHP = 503 kW; Propeller efficiency = 82%; $C_{Lmax} = 1.5$	**07**
		OR	
	(c)	Consider a flying wing with a wing area of 206 m^2, an aspect ratio of 10, a span effectiveness factor of 0.95, and an NACA 4412 airfoil. The weight of the airplane is 7.5 x $l0^5$ N. If the density altitude is 3 km (free stream density 0.909 kg/m^3) and the flight velocity is 100 m/s, calculate the total drag on the aircraft. Assume profile drag coefficient as 0.006.	**07**
Q.3	**(a)**	Define Pressure, Temperature and Density Altitudes.	**03**
	(b)	What is the effect of acceleration on rate of climb?	**04**
	(c)	Derive the equations of motion for an airplane in translational flight.	**07**
		OR	
Q.3	**(a)**	Shortly explain the Roll Control.	**03**
	(b)	How the Thrust required TR for a given airplane is to be measured from the thrust-required curve.	**04**
	(c)	A wing-body model is tested in a subsonic wind tunnel. The lift is found to be zero at a geometric angle of attack α = - 1.5°. At α = 5° the lift coefficient is measured as 0.52. Also, at α = 1.0° and 7.88°, the moment coefficients about the center of gravity are measured as -0.01 and 0.05, respectively. The center of gravity is located at 0.35c. Calculate the location of the aerodynamic center and the value of $C_{M,ac,wb}$.	**07**

Q.4	**(a)**	Explain the effect of elevator deflection on moment coefficient.	**03**
	(b)	What are the altitude effects on power required for a Jet-propelled airplane?	**04**
	(c)	Derive the expression of power required for level, unaccelerated flight.	**07**

OR

Q.4	**(a)**	What are the limitations on forward and rearward movements of c.g.	**03**
	(b)	Differentiate between stick fixed and stick free stability.	**04**
	(c)	Derive the contributions of wing to the pitching moment coefficient.	**07**

Q.5	**(a)**	Define Neutral point and Static Margin. Also explain stability criteria based on their location.	**03**
	(b)	Write a short note on Directional static stability.	**04**
	(c)	An aircraft having mass 5000 kg is in steady level flight under minimum power requirement condition at altitude of 800 m. Wing span is 9.2 m. Wing area is 16.55 m^2. e=0.81 & C_{D0}=0.02. Find velocity and thrust required. Take density = 1.1337 kg/m^3.	**07**

OR

Q.5	**(a)**	Derive the relation between geopotential altitude and geometric altitudes.	**03**
	(b)	What is Longitudinal static stability? Discuss necessary criteria for longitudinal balance and static stability.	**04**
	(c)	An aircraft having mass 7000 kg is flying at sea level with constant velocity. Wing span is 9.2 m. Wing area is 42 m^2, Aspect Ratio is 6.5, e=0.81 & C_{D0}=0.025. Thrust available is 9000 N. (i) If velocity is 75 m/s. Calculate Rate of climb and climb angle. (ii) If same aircraft is flying at altitude of 7km with velocity of 105 m/s, Calculate Rate of climb and climb angle. Take density= 0.59 kg/m^3.	**07**

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