Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – WINTER • 2014

Subject Code: 150101 **Date: 26-11-2014**

Subject Name: Flight Mechanics

Time: 10.30 am - 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.**

Q.1	**(a)**	Derive equations of motion for an airplane in translational motion.	**07**
	(b)	Derive formula for Thrust required for level, unaccelerated flight. Also derive condition for minimum thrust required.	**07**
Q.2	**(a)**	1. Derive lift coefficient from pressure coefficient, also sketch the pressure coefficient on the upper and lower surface across the chord . 2. Write a short note on critical Mach Number and Critical pressure coefficient	**07**
	(b)	Discuss wave drag at supersonic speeds in detail with all the relevant sketches.	**07**
		OR	
	(b)	Write a short note on: 1. Swept back wings 2. Induced Drag	**07**
Q.3	**(a)**	Define all the different types of altitudes and derive the relation between geopotential altitude and geometric altitudes.	**07**
	(b)	Calculate the standard atmosphere values of temperature, pressure and density at a geopotential altitude of 14 km. Given: Temperature at 11 km = 216.66 K	**07**
		OR	
Q.3	**(a)**	Discuss in detail High-lift devices	**07**
	(b)	An airplane is flying at 80 m/sec. The pressure coefficient and flow velocity at point 1 are -1.5 and 110 m/sec, respectively. The pressure coefficient and flow velocity at point 2 is point -0.8. Calculate the velocity at point 2 if the flow is incompressible.	**07**
Q.4	**(a)**	Explain V-n diagram in detail.	**07**
	(b)	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 & $C_{d,o}$=0.02. Find velocity and thrust required. Take density = 1.1337 kg/m^3.	**07**
		OR	
Q.4	**(a)**	Explain Landing performance for an airplane.	**07**
	(b)	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 & $C_{d,o}$=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**
Q.5	**(a)**	Write a short note on Longitudinal static stability. Also discuss necessary criteria for longitudinal balance and static stability.	**07**

	(b)	If maximum (L/D) of an aircraft having mass 7000 kg is 16. Calculate minimum angle of glide. Also calculate what velocity will the aircraft have at altitude of 3000 m &1000 m. Wing area is 42 m^2. If the engine fails at altitude of 5000 m and the next available landing site is 39 km far away on the ground, will the a/c be able to land safely? $Density_{1000m}$=1.1117 kg/m^3 & $Density_{3000m}$=0.909 kg/m^3.	**07**

OR

Q.5	**(a)**	Write a short note on Directional static stability.	**07**
	(b)	Derive Breguet range formula for propeller driven airplane.	**07**

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