

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. **07**
 2. Write a short note on critical Mach Number and Critical pressure coefficient
 (b) Discuss wave drag at supersonic speeds in detail with all the relevant sketches. **07**
- OR**
- (b) Write a short note on: **07**
 1. Swept back wings
 2. Induced Drag
- 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. **07**
 Given: Temperature at 11 km = 216.66 K
- 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. **07**
- (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 .
- 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**
