Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- Vth SEMESTER–EXAMINATION – MAY/JUNE - 2012

Subject code: 150101 Date: 01/06/2012

Subject Name: Flight Mechanics

Time: 02:30 pm – 05:00 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)** Explain in detail critical Mach number and critical pressure coefficient. Maximize the use of appropriate neat sketches and graphs. **07**

(b) Derive the equation to obtain lift off distance for an aircraft with proper schematic of force variation during take off run and mention how lift off distance depends on various parameters. **07**

Q.2 **(a)** What is the importance of "Sweep back angle"? In some aircraft why designers choose variable sweep back in stead of fixed sweep back? **07**

(b) Explain in detail the variation of C_{d} with M_{∞} with the help of a neat sketch and graph. Also explain and define drag divergence Mach number. **07**

OR

(b) For a wing body combination, zero lift angle of attack is - 2.5º. At α = 5º lift coefficient is 0.55. Also at α = 1.5º and 8º the moment coefficient about the C.G are measured as -0.03 and 0.06 respectively. C.G is located 1/3C behind the leading edge of wing. Calculate the location of aerodynamic centre with respect to leading edge. Also calculate moment coefficient about the aerodynamic centre due to flow over wing body combination. **07**

Q.3 **(a)** 1) If an aircraft stalls at 150 knots in straight and level flight and at 250 knots during turn. What will be the load factor on the aircraft during turn at stalling velocity? **04**

2) Derive equation to obtain turn rate during a pull down maneuver. **03**

(b) Define static and dynamic stability. Explain dynamically stable, dynamically unstable and dynamically neutral behavior of an aircraft. **07**

OR

Q.3 **(a)** Explain "Stick free stability" briefly. **07**

(b) With neat sketch explain why wing loading increases while steady descending with some thrust. Explain with vector diagram and concerned equations. **07**

Q.4 **(a)** How trim tabs help a pilot to obtain "Stick free" flying? Explain with neat sketches of all primary and secondary control surfaces. **07**

(b) What is the relationship between Rate Of Climb and density altitude of atmosphere? Explain how performance varies with change in density altitude. **07**

OR

Q.4 **(a)** With necessary vector diagram explain why more thrust is required while steady climb rather than steady cruise. **07**

(b) What is Load factor? With necessary vector diagram explain why load factor increases with bank angle. **07**

Q.5 **(a)** In case of steady gliding how aircraft moves forward without thrust in spite of presence of drag force. Explain with necessary vector diagram and concerned equations. **07**

(b) With neat sketch explain why wing loading decreases while steady climb with "maximum thrust available". **07**

OR

Q.5 **(a)** 1) An aircraft has following characteristic. **05**

Wing area = 47 m^2.
Aspect Ratio = 6.5
Oswald Efficiency factor = 0.87
Weight = 103047 N
Zero lift drag coefficient = 0.032
Aircraft is equipped with two jet engines with 40298 N of static thrust each at sea level.
Calculate maximum velocity at sea level and at 5 km altitude.
Sea level air density = 1.225 kg/m^3, Air density at 5 km = 0.73643 kg/m^3.

2) Write down conditions for obtaining maximum range for a propeller driven airplane. **02**

(b) 1) Define geometric and geo potential altitude and derive relation between them. **04**

2) Derive an equation for obtaining endurance of a jet airplane. **03**

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