Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH(AERONAUTICAL & AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, JUNE/JULY 2016

SUBJECT: FLIGHT MECHANICS [AAE 2203]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. Define geometric and geopotential altitudes **(02)**

1B. Obtain the values of pressure, density and temperature at 5 km in ISA **(04)**

1C. Consider a low speed subsonic wind tunnel designed with a reservoir cross sectional area $A_1=2m^2$ and test section cross section area $A_2=0.5m^2$. The pressure in the test section is p_2= 1atm. Assume sea level constant density. **(04)**

(a) Calculate the pressure required in the reservoir p_1, necessary to achieve a flow velocity V_2=40m/s in the test section

(b) Calculate the mass flow through the wind tunnel.

2A. What is drag? Explain the types of drag and write drag equation. **(03)**

2B. Derive an equation for the range of a jet aircraft in a (shallow) steady climb with constant airspeed and constant lift coefficient. **(03)**

2C. .An airplane weighing 100,000 N is powered by an engine producing 20,000 N of thrust under sea level standard conditions. If the wing area be 25 m^2 , calculate (a) stalling speeds at sea level and at 10 km altitude, **(04)**
(b) $(C_D / C_L)_{min}$, $(C_D / C^{3/2}_L)_{min}$, T_{rmin}, P_{rmin}, V_{md} and V_{mp} under sea level conditions.
Assume C_{Lmax} = 1.5, C_D = 0.016 + 0.064 C^2_L.

3A. Define Range and Endurance. **(02)**

3B. A 600,000 lb aircraft has a drag polar C_D=0.017+ 0.042 C^2_L, and a wing area of 5128 ft^2. The Thrust Specific Fuel Consumption (TSFC) = 0.85 (lbs/hr)/lb. The total fuel on board is W_f = 180,000 lbs. Find the endurance for a constant angle-of-attack flight schedule and for a constant speed, constant altitude flight schedule. Assume the initial conditions to be at 30,000 ft. **(04)**

3C. Derive the equations of motion for a climbing flight with the help of neat sketches. **(04)**

4A. Define load factor. What are its values in (a) level flight (b) free fall (c) in a turn of radius 200 m at a speed of 100 m/s and (d) at the bottom of a loop of radius 200 m at a speed of 100 m/s? **(02)**

4B. A glider weighing 4905 N has a wing area of 25 m^2, C_{DO} = 0.012, A = 16 and e = 0.87. Determine (a) the minimum angle of glide, minimum rate of sink and corresponding speeds under sea level standard conditions (b) the greatest duration of flight and the greatest distance that can be covered when glided from a height of 300 m. Neglect the changes in density during glide. **(04)**

4C. Define steady level co-ordinated-turn. An airplane having a weight of 11,000 N has a wing area of 15 m^2 and drag polar of $C_D = 0.032 + 0.06C^2_L$. Obtain the radius of turn in a steady level coordinated turn at a speed of 160 kmph at sea level from the following data. C_{Lmax} = 1.4, $(THP)_{available}$ = 90 kW, maximum load factor = 3.5. What is the time taken to turn through 180^o? **(04)**

5A. Define the terms airspeed indicator reading, indicated airspeed, calibrated airspeed, equivalent airspeed and true airspeed as used in the calibration of airspeed indicator. **(04)**

5B. A business jet has the following characteristics: Gross weight =10000lbs; b=40ft; $S=200ft^2$; C_{Lmax}=1.8 (normal flight); C_{Lmax}=2.4 (with flaps); $C_D=0.02+0.05C^2_L$; 2 engines with 1000lbs/engine; coefficient of friction on the runway = 0.02. Calculate the distance covered during ground run. **(06)**
Given that, thrust equation **$T = 132{,}500 - 0.0889\ V^2$**