Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH(AERONAUTICAL & AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 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. What is the need to define ISA and give its values at standard sea level conditions? **(02)**

1B. The altimeter of a low speed Piper Aztec reads 8000 ft. A Pitot tube mounted on the wing tip measures a pressure of 1650 lb/ft^2. If the outside air temperature is 500 deg R, what is the true velocity of the airplane? What is the equivalent airspeed? Density = 0.001831 slug/ft^3
(Hint : Temperature unit remains same, no conversion) **(04)**

1C. Consider an aircraft that has a wing span of 15m, a wing area of 37.5m^2, and a gross weight of 88000N. In level flight the lift equal the weight. The aircraft is flying at 102.88 m/s at an altitude of 10km. Also the Oswald's efficiency factor is 0.9 and the zero lift drag coefficient is 0.022. Determine the following a) Lift coefficient b) induced drag coefficient c) Total Drag coefficient d) Induced Drag e) Zero lift drag f) Total Drag g) Lift to drag ratio **(04)**

2A. Show that minimum power required to overcome induced drag is three times the power required to overcome profile drag. **(02)**

2B. An airplane climbs at constant equivalent air speed in troposphere. Obtain an expression for the correction to be applied to the value of rate of climb calculated with the assumption of the steady climb **(04)**

2C. An airplane with a wing area of 20 m^2 and a weight of 19,620 N dives with engine switched off, along a straight line inclined at 60^o to the horizontal. What is the acceleration of the airplane when the flight speed is 250 kmph? If the airplane has to pull out of this dive at a radius of 200 m, what will be the lift coefficient required and the load factor? Drag polar $C_D = 0.035 + 0.076\ C^2_L$ and the maneuver takes place around an altitude of 2 km. **(04)**

3A. Define Induced drag. **(02)**

3B. Obtain an expression for air range in steady level flight for a jet airplane flying at constant altitude and constant angle of attack. **(04)**

3C. An aircraft having wing area of $75m^2$ starts cruise at 18000kg including fuel of 3500kg. The drag polar of aircraft is $C_D = 0.025+0.065\ C^2_L$, SFC=2.8×10^5Kg/N/sec. Determine the maximum range for flight at constant speed from an altitude where the air density ratio is 0.53. Also find the amount of fuel at half the range distance. **(04)**

4A. Define steady level coordinated turn. Show that radius of turn for turning flight is minimum when load factor is maximum. **(03)**

4B. An airplane weighing 180,000 N has a wing area of 45 m^2 and drag polar Given by $C_D=0.017 + 0.05\ C^2_L$. Obtain the thrust required and power required for a rate of climb of 2,000 m/min at a speed of 540 kmph at 3 km altitude. **(03)**

4C. An aircraft weighing 9000N is going through steady level coordinated turn at sea level at a speed of 144 kmph and goes through 90 degrees in 15 seconds. The wing loading is $1000N/m^2$ and at this speed the (L/D) ratio is 10. Calculate the radius of turn, load factor and the power required. **(04)**

5A. Describe various phases of take off flight. Write down the equations of motion during takeoff run. **(03)**

5B. A jet airplane with a weight of 441, 450 N and wing area of 110 m^2 has a tricycle type landing gear. Its C_{Lmax} with flaps is 2.7. Obtain the take-off distance to 15 m screen height. **(04)**
Given that: (i) $V_1 = 1.16\ V_s$
(ii) $V_2 = 1.086\ V_1$
(iii) C_L during ground run is 1.15
(iv) Drag polar with landing gear and flaps deployed is $C_D = 0.044 +0.05C^2_L$
(v) Thrust variation during take-off can be approximated as :
$T = 128,500 – 0.0929\ V^2$; where V is in kmph and T is in Newton
(vi)Take-off takes place from a level, dry concrete runway ($\mu = 0.02$) at sea level.
Take $C_{Ltransition}$=1.605

5C. Also calculate the time taken for the take off distance. **(03)**