Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

IV SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, JUNE 2017

SUBJECT: FLIGHT MECHANICS [AAE 2203]

REVISED CREDIT SYSTEM
(19/06/2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. Describe in detail, the temperature distribution in the standard atmosphere. **(3)**

1B. Define the following: Range, endurance & TSFC. **(3)**

1C. Consider a wing with an aspect ratio of 10 and a NACA 23012 airfoil section. Assume $R_e=5\times10^6$. The span efficiency factor is 0.95. If the wing is at 4^o angle of attack, calculate lift coefficient and drag coefficient of the wing. Given profile drag coefficient is 0.006. **(4)**
For NACA 23012, $C_l=1.2$ at $\alpha_{effective}=10^o$
$C_l = 0.14$ at $\alpha_{effective} =0^o$
$\alpha_L= 0 = -1.5^o$

2A. 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. **(3)**

2B. Derive the expression for the speed of an aircraft at which the power required to fly the aircraft is minimum. **(3)**

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, **(4)**
(b) $(C_D / C_L)_{min}$, $(C_D / C_L^{3/2})_{min}$, T_{rmin}, P_{rmin}, V_{md} and V_{mp} under sea level conditions.

3A. Explain the various techniques for increasing the lift with the help of suitable diagrams. **(3)**

3B. An airplane weighing 180,000N has a wing area of 45 m^2 and drag polar given by $C_D = 0.017 + 0.05\ C_L^2$. 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. **(3)**

3C. A jet airplane has a weight of 922,140 N and wing area of 158 m^2. The weight of the fuel and oil together is 294,300 N. The drag polar is given by: $C_D = 0.017 + 0.0663\ C_L^2$ Obtain the maximum range in constant C_L flight at an altitude of 10 km assuming the TSFC to be 0.95/hr. **(4)**

4A. Explain about service ceiling and absolute ceiling altitude with neat graphs. **(3)**

4B. 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. **(3)**

4C. An airplane has a jet engine which produces a thrust of 24,525 N at sea level. The weight of the airplane is 58,860 N. The wing has an area of 28 m^2, zero-lift angle of -2.2^o and a slope of lift curve of 4.6 per radian. Find **(4)**
(a) the radius of a correctly banked 4g level turn at the altitude where density ratio = 0.8 and the wing incidence is 8^o
(b) time required to turn through 180^o and
(c) thrust required in the maneuver if the drag coefficient at this angle of attack be 0.055.

5A. Explain the phases of landing with the help of a diagram. **(3)**

5B. Write a short note on boundary layer control devices. **(3)**

5C. Consider a Propeller driven aircraft of weight 249100.41N, wing area 92.9 m^2 with a shaft horse power of 2400/engine. Given that, C_{Lmax}(stall)=2.4, $V_{TO}=1.2V_{stall}$,Drag polar $C_D=0.024+0.04C^2_L$, $\mu_{Ground}=0.25$, Propeller efficiency=75%, Static thrust=28913.39 N/engine. Calculate the ground run during takeoff and time taken at sea level in a standard atmosphere. **(4)**