Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, DEC 2016

SUBJECT: INTRODUCTION TO AEROSPACE ENGINEERING [AAE 2103]

REVISED CREDIT SYSTEM
(02/01/2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. The constant gravity concept in the calculation of standard atmospheric properties fails when the aircraft is flying above 65 km. justify the statement. **(02)**

1B. Calculate the standard atmosphere values of temperature, pressure and density at a geopotential altitude of 12 km. **(03)**

1C. A hot-air balloon with an inflated diameter of 30 feet is carrying a weight of 800 lbs, which includes the weight of the hot air inside the balloon. Calculate (a) its upward acceleration at sea level the instant the restraining ropes are released (Hint: Use Newton's second law) (b) the maximum altitude it can achieve, assuming the balloon volume does not change. Assume that the variation of density in the standard atmosphere is given by $\rho = 0.002377\left(1 - (7 \times 10^{-6}\mathrm{h})\right)^{4.21}$, where h is the altitude in feet and ρ is the density in slug/feet^3. **(05)**

2A. A Pitot tube is mounted in the test section of a low-speed subsonic wind tunnel. The flow in the test section has a velocity, static pressure, and temperature of 67 m/s, 1 atm, 294.3 K respectively. Calculate the pressure measured by the Pitot tube. **(02)**

2B. If a sphere is mounted in a low-subsonic wind tunnel and the freestream velocity is varied such that Reynolds number increases from 10^5 to 10^6, then a drop in drag coefficient is observed at about a particular Reynolds number as shown in the figure 1 below. What causes this decrease in drag? **(03)**

2C. Consider a low-speed subsonic wind tunnel designed with a reservoir cross section area $\mathrm{A_1} = 2\mathrm{m}^2$ and a test section cross section area $\mathrm{A_2} = 0.5\mathrm{m}^2$. The pressure in the reservoir $(\mathrm{P_1})$ and the test section $(\mathrm{P_2})$ is 1.019×10^5 and $1\ \mathrm{atm}$ respectively. Assume constant density equal to standard sea level value. If the pressure difference $(\mathrm{P_1} - \mathrm{P_2})$ is doubled, calculate the flow velocity in the test section. **(05)**

3A. Why does a flow separate from the surface? How to delay the flow separation time over a blunt body and a streamlined body? **(02)**

3B. Explain briefly how jet engine works? What is the difference between a turbojet and a turbofan engine? Which one of these engines is more efficient? **(03)**

3C. Using the method of dimensional analysis, derive the expression $L = 1/2 \times \rho \times V^2 \times S \times C_L$ for the aerodynamic lift on an airfoil, where S is the wing planform area and C_L is the lift coefficient. How do you relate the lift of a wind tunnel model with full scale model of an aircraft? **(05)**

4A. Why all the modern high-speed aircraft have swept back wings? **(02)**

4B. The wing is being tested in the MIT wind tunnel. It has a wing area of 0.14 m^2. The span of the wing is 0.91 m. The test speed is 40 m/s. The air is at standard sea level conditions. At $\alpha = -1°$ the lift measured is zero. At $\alpha = 2°$ the lift is measured as 2.268 kg. Assume a span efficiency of 0.9. what is the airfoil lift curve slope? **(03)**

4C. Explain the following terms briefly: **(05)**

a) Taper ratio
b) Induced drag
c) Profile drag
d) Parasite drag
e) Critical Mach number

5A. What is the difference between monocoque and semi-monocoque fuselage structure? **(02)**

5B. State three laws of planetary motion proposed by Kepler. **(03)**

5C. Name any five subsystems that are used in the spacecraft. **(05)**

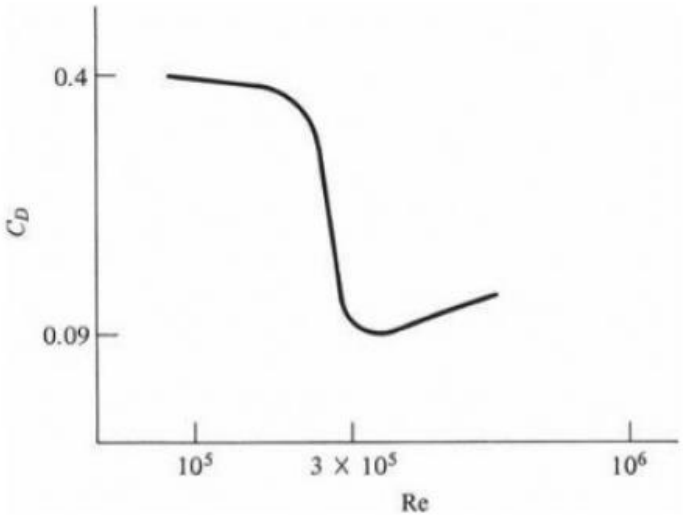

Figure 1