Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: INTRODUCTION TO AEROSPACE ENGINEERING [AAE 2103]

REVISED CREDIT SYSTEM
(30/11/2016)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. At what value of the geometric altitude is the difference $h - h_G$ equal to 2 percent of the geopotential altitude, h? Take radius of Earth as 6357 km. **(02)**

1B. Compare the advantages and disadvantages between Lighter-Than-Air vehicle (LTA) and Heavier-Than-Air vehicle (HTA). **(03)**

1C. Consider a hot air balloon, which has a mass of 700kg uninflated, the balloon, when inflated, has a volume of 2900m^3. The air inside the balloon has T_{in}=120°C, and outside, it's T_{out}=20°C. the pressure inside and outside the balloon is atmospheric pressure (1.01 x 10^5 N/m^2). Assume the molar mass of the air is 28g/mol. Calculate the outside temperature at which the balloon would be neutrally buoyant. **(05)**

2A. What is isentropic flow? Give three examples of aerodynamic flows that can be treated as isentropic flow. **(02)**

2B. With the help of area-velocity relationship, draw the longitudinal cross section of diffuser and nozzle for subsonic and supersonic flow conditions. **(03)**

2C. You are given the job of designing a supersonic wind tunnel that has a Mach 3 flow at standard sea-level conditions in the test section. **(05)**

a) what reservoir pressure (P_0) is required?
b) What reservoir temperature (T_0) is required?
c) What is the flow speed (V_{ts}) in the test section?
d) What is the flow speed (V^*) in the throat?
e) What is the expansion ratio (A_{ts}/A^*)?

3A. What are the other factors besides geometry influence the aerodynamic characteristics of an aircraft? **(02)**

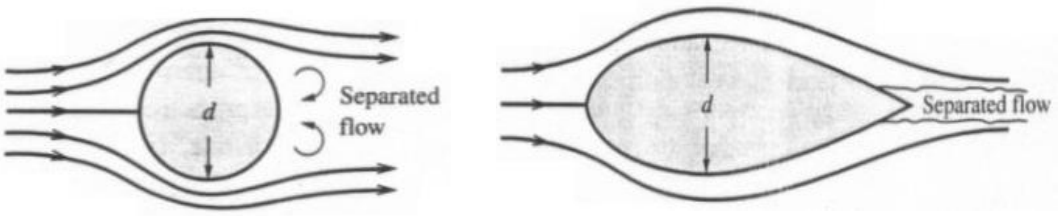
3B. The altimeter on a low speed aircraft reads 2438.4 m. A Pitot tube mounted on the wing tip measures a pressure of 7.9*10^4 N/m^2. If the outside air temperature is 272.3 K, what is the true velocity of the airplane? What is the equivalent airspeed? **(03)**

3C. Consider a Boeing 747 airliner cruising at a velocity of 245.9 m/s at a standard altitude of 11,200 m, where the freestream pressure and temperature are 2.1997*10^4 N/m^2 and 216.66 K respectively. A one-fiftieth scale model of the 747 is tested in a wind tunnel where the temperature is 238.9 K. Calculate the required velocity and pressure of the test airstream in the wind tunnel such that the lift and drag coefficients measured for the wind tunnel model are the same as for free flight. Assume that both viscosity and speed of sound are proportional to $\sqrt{T}$. **(05)**

4A. List out the structural elements that frame the skeleton of an aircraft. **(02)**

4B. Consider a circular cylinder (blunt body) and an airfoil (streamlined body): **(03)**

a. Which one of the following body has more total drag?
b. Among (a) and (b), which one of the following has more pressure drag?
c. In which case, the skin friction drag is the most dominant form of drag among (a) and (b)?



(a) Blunt Body **(b) Airfoil**

4C. Draw the Free Body Diagram (FBD) and Kinetic Diagram (KD) visualizing all the forces and accelerations that act on the aircraft for symmetric flight. Also, derive the equation of motion for general symmetric flight. **(05)**

5A. Why the modern aircraft engines are so huge in size? **(02)**

5B. State in words the six fundamental orbital parameters and the geometrical meaning for each of them. **(03)**

5C. Explain briefly the following terms: **(05)**

a) Propulsive efficiency
b) Thermal efficiency
c) Overall efficiency
d) Specific Impulse
e) Thrust Specific Fuel Consumption (TSFC)