Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

III SEMESTER B.TECH (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: INTRODUCTION TO AEROSPACE ENGG. [AAE 2103]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. One of the main "laws" in aerospace engineering is to design and build lightweight vehicles. Why lightweight? Justify your answer. **(02)**

1B. Typical volume for a 3-4 person hot air balloon is said to be 2500 m^3. What is the total weight of the balloon, basket and payload for such a balloon, assuming the mentioned maximum temperature of 120°C. (assume ρ_{atm} = 1.225 kg/m^3 Temperature, T = 15°C, g = 9.81 m/s^2) **(03)**

1C. What are the advantages of a balloon compared to a winged aircraft in terms of lift and drag? So for what types of flight the balloon is more efficient than the winged aircraft? **(05)**

2A. As the altitude increases, temperature decreases and its get cold at higher altitude why? **(02)**

2B. At 12 km in the standard atmosphere the pressure, density, and temperature are 1.9399×10^4 N/m^2;3.1194×10^{-1} kg/m^3;216.66 K respectively. Using these values, calculate the standard atmospheric values of pressure, density and temperature at an altitude of 18 km. **(03)**

2C. An aircraft flying at 6096 m pressure altitude (T = 249.20 K; P = 4.7217×10^4 N/m^2; Density = 6.6011×10^{-1} kg/m^3) has an indicated airspeed of 106 m/s. If the outside air temperature is 244 K, position error is -2.6 m/s, and there is a 21 m/s headwind, then what is the aircraft's groundspeed? (Compressibility correction factor, f = 0.987). **(05)**

3A. What makes the difference in lift performance of an infinite wing and finite wing? **(02)**

3B. State in words the definition of an inertial reference system. Newton formulated his laws with respect to a reference system fixed relative to the stars, is the system used by Newton a truly inertial reference system? Is the Earth an inertial or a non-inertial reference system? **(03)**

3C. Describe the following definitions briefly in a clear way: **(05)**

(a) Critical Mach Number (b) Boundary Layer Transition (c) Mean Camber line (d) Aerodynamic Center (e) Induced drag

4A. Using Area-Velocity relationship, design subsonic inlet and supersonic nozzle. Justify your answer. **(02)**

4B. Consider the flow over two cylinders, one having four times the diameter of the other. The flow over the smallest cylinder has a freestream density, velocity and temperature given by $\rho_1, V_1 \text{ and } T_1$ respectively. The flow over the larger cylinder has a freestream density, velocity and temperature given by $\rho_2, V_2 \text{ and } T_2$ respectively, where $\rho_2 = \rho_1/4\,;\ V_2 = 2V_1; \text{and } T_2 = 4T_1$. Assume that both viscosity and speed of sound are proportional to $T^{0.5}$. Show that the two flows are dynamically similar. **(03)**

4C. In a low speed subsonic wind tunnel, one side of mercury manometer is connected to the settling chamber (reservoir) and the other side is connected to the test section. The contraction ratio of the nozzle A_2/A_1 equals 1:15. The reservoir pressure and temperature are P_1 = 1.1 atm and T_1 = 300 K, respectively. When the tunnel is running, the height difference between the two columns of mercury is 10 cm. The density of liquid mercury is 1.36×10^4 kg/m^3 Calculate the airflow velocity in the test section V_2. (**1 atm =** 1.01×10^5 N/m^2) **(05)**

5A. Draw the Free Body Diagram (FBD) and the Kinetic Diagram (KD) visualizing all forces and accelerations that act on the aircraft for symmetric flight. Draw the aircraft with a certain pitch angle, flight path angle and angle of attack. Also indicate the direction of the velocity vector. The thrust can be assumed in the direction of the velocity vector. **(02)**

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

5C. Explain briefly about various subsystems of the spacecraft and their contributions in association with other subsystems. **(05)**