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Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)



## III SEMESTER B.TECH (AERONAUTICAL ENGINEERING) END SEMESTER EXAMINATIONS, DEC 2015/JAN 2016

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. When you get higher in the atmosphere, the air density becomes lower. The balloon will expand because the pressure is also lower. What will happen when the balloon reaches its maximum altitude? What do you need to know to calculate that maximum altitude?
- **1B.** What are the other factors besides geometry influence the aerodynamic **(03)** characteristics of an airfoil? Explain each factor briefly.
- **1C.** Common aerodynamic practice is to work with non-dimensional forms of the **(05)** lift and drag, how do you non-dimensionalize these parameters and what is the significance of non-dimensionalization?
- 2A. Consider an airfoil in a flow of air, where far ahead of the airfoil the pressure, velocity and density are 1.013 bar, 160 kmph and 1.23 kg/m<sup>3</sup> respectively. At a given point A on the airfoil, the pressure is 0.99 bar. What is the velocity at point A?
- **2B.** At what value of the geometric altitude is the difference  $h-h_g$  equal to 2 percent (03) of the geopotential altitude? Take Radius of the Earth = 6357 km.
- **2C.** Calculate the standard atmosphere value of Temperature (T), Pressure (P) and **(05)** Density( $\rho$ ) at a geopotential altitude of 14 km.
- **3A.** What is meant by boundary layer? Why the Bernoulli's principle is invalid inside **(02)** the boundary layer?
- **3B.** How true airspeed is different from indicated, calibrated, equivalent and ground **(03)** airspeed?

- 3C. For the flat plate calculate and compare the local shear stress at the locations (05) 1 and 5 cm from the front edge (the leading edge) of the plate, measured in the flow direction.
- **4A.** Why the golf balls have dimples over their surface? How does it change the **(02)** aerodynamics of the ball?
- 4B. The altimeter on a low speed aircraft reads 2438.4 meter (P = 7.5262\*10^4 (03) N/m^2 and density = 0.9437 kg/m^3). By an independent measurement, the outside air temperature 277.78 K. If a pitot tube mounted on the wing tip measures a pressure of 7.9002\*10^4 N/m^2, what is the true velocity of the airplane? What is the equivalent airspeed? Take R = 287 J/kg-K.
- **4C.** Consider a Boeing 747 airliner cruising at a velocity of 246 m/s at a standard (05) altitude of 11.6 km, where the freestream pressure and temperature are 20713 N/m^2 and 216.67 K respectively. A one-fiftieth scale model of the 747 is tested in a wind tunnel where the temperature is 238.89 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  $\mu$  and speed of sound are proportional to T<sup>0.5</sup>.
- **5A.** Why the turbofan engines are more efficient at high speed than the turboprop **(02)** engines?
- **5B.** Derive the equation of motion for steady level horizontal flight, and steady level **(03)** climbing flight with neat diagram.
- **5C.** Explain briefly the following terms: (a) Propulsive Efficiency (b) Thermal **(05)** Efficiency and (c) Overall Efficiency (d) By-pass ratio (e) Specific Impulse