Reg.No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 2016

SUBJECT: AERODYNAMICS [AAE 2201]

REVISED CREDIT SYSTEM

Time: 3 Hours. MAX.MARKS: 50

Instructions to Candidates:

- Answer **ALL** questions.
- Missing data may be suitably assumed

1A. Consider the flat plate and estimate the followings **(05)**

Case-1: Where $Re=4.6x10^6$, if then calculate,

a) The laminar boundary layer thickness at the trailing edge for a chord of 1.4m and the net laminar skin friction drag coefficient for the plate. (assume complete laminar flow over the plate)

b) The turbulent boundary layer thickness at the trailing edge for chord length of 1.4m and the net turbulent skin friction drag coefficient for the plate (assume complete turbulent flow over the plate)

Case-2: Consider the following figure and calculate the net skin friction drag coefficient by assuming that the critical Reynolds number is 600000.

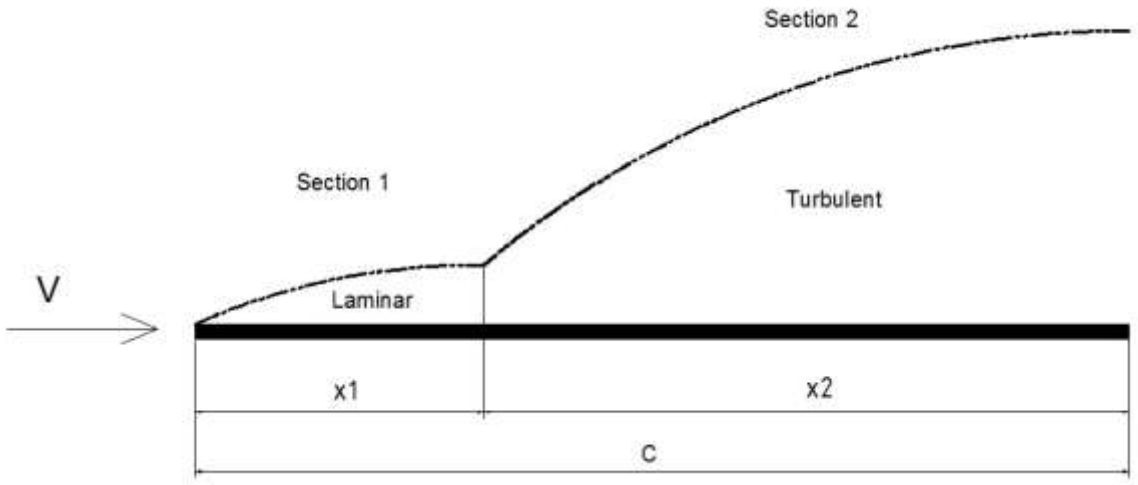

Figure - 1

1B. Draw the schematic diagrams of open circuit and closed circuit wind tunnels with their components and their purposes. Also write down the advantages & disadvantageous between these two wind tunnels and drive the equation of velocity inside the test section in terms of Area, Pressure and Density. **(05)**

2A. Derive the momentum equation in integral form and y-component of momentum equation in differential form. **(05)**

2B. Considering a lifting flow over a circular cylinder and the lift coefficient is 2.85. **(03)**

Calculate the peak pressure coefficient, location of stagnation points and points on the cylinder where pressure equals freestream static pressure.

2C. Prove that Vortex flow is irrotational except at its origin. **(02)**

3A. With the help of fundamental equation of thin airfoil theory derive and prove that for symmetric airfoil, center of pressure is at quarter chord point of the airfoil and lift is directly proportional to angle of attack. **(05)**

3B. Why do we prefer thicker airfoil in civil aviation? Write down the effect of $C_{L.max}$ on thicker and thinner airfoils. **(02)**

3C. Explain the types of flows dealing in aerodynamics and classify the aerodynamics according to altitude and Mach number. **(03)**

4A. Describe the followings: **(03)**

a) Form drag

b) D' Alemberts paradox

c) Streak line and path line

4B. Explain the general procedures and conditions to obtain vortex strength over an airfoil with numerical vortex panel method. **(04)**

4C. Derive and prove that the Aerodynamic center exists as a fixed point on the airfoil **(03)**

5A. Consider a rectangular wing with aspect ratio of 5, the induced drag coefficient factor (δ) is 0.052 and zero lift angle is -2.1 deg. At the angle of attack of 3.6 deg, the induced drag coefficient for this wing is 0.021. Calculate the induced drag coefficient for similar wing (rectangular wing with same airfoil) but with aspect ratios of 6, 8 and 10. (consider $\delta = \tau$) **(03)**

5B. By considering standard atmospheric conditions , the flow velocity in the test section of low speed subsonic wind tunnel is 45m/s. Calculate the reservoir pressure (contraction ratio is 9 to 1) and by how much be the reservoir pressure to increase to achieve 75m/s in the test section of the same wind tunnel. **(03)**

5C. Through elliptical circulation distribution prove that induced angle of attack and induced drag coefficients are proportional to coefficient of lift. **(04)**