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# Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

**IV SEMESTER B.TECH (AERONAUTICAL ENGINEERING)**

**END SEMESTER EXAMINATIONS, JUNE 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.** Derive the fundamental equation of thin airfoil theory and what are this theory limitations? **(05)**

**1B.** Explain the function of Pitot static probe and also write down the calculation of velocity with the help of this Pitot static probe **(03)**

**1C.** What are Irrotational & Rotational flows in aerodynamics? Also mention one application of these flows when we consider a flow over an airfoil. **(02)**

**2A.** Derive the Continuity equation which physically explains "mass neither can be created nor destroyed" both in integral and differential forms. **(05)**

**2B.** Explain what doublet flow is and derive the equation for stream function and velocity potential of doublet flow. **(05)**

**3A.** Describe the followings **(03)**

a) Bound vortex
b) Aerodynamic center
c) Karman vortex sheet

**3B.** Explain the Biot-Savart law for infinite span and also mention Helmholtz's theorem. **(04)**

**3C.** Consider a jet transport and its cruising at a velocity of 220m/s at an altitude of 11km (density at this altitude is o.4415kg/$m^3$) The weight and wing planform area of the airplane are 72000N and 35$m^2$ respectively. Zero lift angle for this airplane is -3deg and the lift slope of the airfoil section is 0.12$deg^{-1}$. Aspect ratio is equal to 8 and lift efficiency factor ($\tau$) is 0.05. Calculate the angle of attack of the airplane at cruising condition. **(03)**

**4A.** Describe in detail about leading edge stall and trailing edge stall. How its application varies in civil aviation? **(03)**

**4B.** What are Kelvin circulation theorem and Starting vortex? **(04)**

**4C.** Consider an aircraft cruising at a standard altitude of 4km (density=0.81935kg/$m^3$). The pressure sensed by the pitot tube on the wing is 6.7 x $10^4$ N/$m^2$. **(03)**

a) If then at what velocity airplane is flying?
b) This aircraft experiences a certain dynamic pressure at its cruising speed of 114.2m/s at 4km altitude. Now assume this aircraft is flying at sea level, if then at what velocity must if fly at sea level to experience the same dynamic pressure?

**5A.** Consider the lifting flow over a circular cylinder. The lift coefficient is 5. Calculate the peak pressure coefficient, location of stagnation points and points on the cylinder where pressure equals freestream static pressure. **(05)**

**5B.** Derive and prove that according to aerodynamics elliptical wing shape is ideal when we compare it to any other shape. **(05)**