Reg. No.								

B.Tech. DEGREE EXAMINATION, JULY 2009

Fourth Semester

AS0202 – AERODYNAMICS – I

(For the candidates admitted from the year 2007-2008 onwards)

Time: Three hours Max.Marks:100

PART – A (10 × 2 = 20 Marks)

Answer **ALL** Questions

1. What are the differences between a potential vortex and a real vortex?
2. Write down the properties of a vortex line.
3. Explain the influences of increasing circulation around cylinder in uniform parallel flow.
4. Describe the generation of lift on a wing which starts from rest.
5. A moment is present in a cambered aerofoil at zero lift. Explain how?
6. Explain the mechanism of separation in a real flow with an example.
7. Explain the concept of induced drag in wings of finite span.
8. Explain Kutta's trailing edge condition for airfoil with sharp trailing edge.
9. What is the significance of critical Reynolds number?
10. Why are taper and twist applied to a wing?

PART – B (5 × 16 = 80 Marks)

Answer **ANY FIVE** Questions

11. A circular cylinder of radius 'a' is placed in a uniform flow with velocity U parallel to the x-axis. A clockwise

circulation of strength Υ is super imposed on the flow. Determine the velocity around the cylinder and locate the stagnation points. What is the force acting on the cylinder? What happens to the stagnation points as the circulation strength is increased gradually from zero?

12. Derive an expression for the kinematic flow condition for the flow past a camber line at a small angle of attack.
A camber surface has its leading and trailing edges on the x-axis. A uniform flow of velocity U passes over the camber at zero angle of attack. The camber develops a circulation distribution along the x-axis given by
$\gamma = 2Uf.\sin(\varphi)$ where $x/c = [1+\cos(\varphi)]/2$. Determine the shape of the camber surface.

13. A two-dimensional biplane is modeled by two flat plates of chords C1 and C2 and arranged so that C2 is below C1 by a distance of C1. The bi-plane is at a small angle of attack α in a free stream of velocity V_2. Determine the lift on each wing by placing a vortex at the c/4 points and satisfying the kinematic flow condition at their 3c/4 points.

14. Wind tunnel test on an aerofoil gave the following results:

α	C1	Cd	Cm (c/4)
0.0	0.316	0.0180	– 0.095
4.0	0.684	0.0456	– 0.195
8.0	1.052	0.0755	– 0.295

Determine the aerodynamic centre and the centre of pressure for $\alpha = 4$ and $\alpha = 8$.

15. An airplane has a wing of elliptic planform with no twist. The weight of the aircraft is 75 kN and it has a span of 16 m. The aircraft flies at low altitude with a velocity of 90 m/s and the density at the altitude is 1.0 kg/m. Determine the induced drag.

16. Derive an expression for the thrust of a propeller by the application of linear momentum principle. Also obtain an expression for the efficiency of the propeller. An aircraft flying at a speed of 100 m/s has a propeller, 6 m in diameter and develops a thrust of 29688 N. Calculate the power required to drive the propeller and propulsive efficiency. The density of air at the altitude = 1.0 kg/m.

17. A uniform air flow at takes place over a flat plate with a velocity of 50 m/s. The velocity distribution in the boundary layer can be approximated by the relation
$u/U = (2-y/\delta)\,(y/\delta)$ where u is the velocity in the boundary layer and U – is the free stream velocity. Using Von Karman's momentum integral relation, obtain expression for the shear stress along the plate. The kinematic viscosity of air $\gamma = 1.45\ m^2/s \times 10^{-5}$.

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