Roll No. | | | | | | | | | | | | |

Total No. of Pages : 02

Total No. of Questions : 09

B.Tech.(ANE) (Sem.–5)

# AERODYNAMICS – II

Subject Code : ANE-312

Paper ID : [A1036]

Time : 3 Hrs. Max. Marks : 60

**INSTRUCTIONS TO CANDIDATES :**

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**
4. **Make suitable assumptions wherever required.**
5. **All symbols have their usual meaning.**

## SECTION-A

**1. Write briefly :**

a) Write down the Blasius equation and explain its various terms.

b) What are the expressions for lift coefficient both for symmetric and cambered airfoil?

c) Write down the governing equations for panels of constant strength in vortex panel method.

d) State Helmholtz's vortex theorems.

e) Sketch the bound vortex and trailing vortices over a finite wing.

f) State and explain Biot-savrat law.

g) State the assumptions under which the velocity potential equation is valid.

h) Explain the Prandtl-Glauert rule.

i) What is supercritical airfoil?

j) Why is the angle of attack of delta-winged aircraft large during takeoff and landing?

## SECTION-B

2. Obtain incompressible velocity profile for the flow over a flat plate using Blasius equation and sketch the profile.

3. A flat plate is set at zero angle of attack in an airflow at standard sea-level conditions. The chord length of the plate is 1.5 m and the platform area of the plate is 30 $m^2$. Calculate the total frictions drag on the plate when the upstream velocity is 80 m/s.

   Given Data :

   $p_\infty = 1.01 \times 10^5$ N/$m^2$

   $T_\infty = 288$ K

   $M_\infty = 1.7894 \times 10^{-5}$ kg/ms

   R = 287 in SI units.

4. Derive the fundamental equation of thin airfoil theory, and state the physical interpretation of this equation.

5. Sketch the subsonic flow field over the top of a delta wing at an angle of attack and indicate primary vortex core, secondary vortex and primary and secondary attachments on it.

6. Briefly explain the vortex lattice numerical method.



## SECTION-C

7. The NACA 4412 airfoil has a mean camberline given by :

$$\frac{Z}{c} = \begin{cases} 0.25\left[0.8\frac{x}{c} - \left(\frac{x}{c}\right)^2\right] & \text{for } 0 \le \frac{x}{c} \le 0.4 \\ 0.111\left[0.2 + 0.8\frac{x}{c} - \left(\frac{x}{c}\right)^2\right] & \text{for } 0.4 \le \frac{x}{c} \le 1 \end{cases}$$

   Using thin airfoil theory. Calculate $\alpha_L = 0$.

8. Explain the source, doublet and vortex based panel methods for wings of rectangular planform.

9. Write notes on :

   (a) Formation Flying

   (b) Leading Edge Suction Analogy for Delta Wings.