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Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Aerodynamics – I

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions, selecting at least TWO questions from each part.

PART – A

- 1
 - a. Derive continuity and momentum equations for any finite control volume fixed in space. (10 Marks)
 - b. Define and explain the compressibility. (04 Marks)
 - c. Explain the following aerodynamics flows:
 - i) Inviscid Vs Viscous flow
 - ii) Laminar Vs Turbulent flow
 - iii) Incompressible Vs Compressible flow. (06 Marks)

- 2
 - a. The stream function for a two – dimensional flow is given by $\psi = 2 \times y$, calculate the velocity at point P(2,3). Find the velocity potential function, ϕ . (06 Marks)
 - b. Derive the formulae for
 - i) Vorticity
 - ii) Circulation
 - iii) Stream Function. (06 Marks)
 - c. Derive the integral form fo continuity equation and hence deduce the differential form. (08 Marks)

- 3
 - a. With a neat sketch, explain in detail about the airfoil nomenclature. (06 Marks)
 - b. Name and classifications of NACA airfoils and write down the explanation of the digits in each if the following :
 - i) NACA 2414
 - ii) NACA 23014
 - iii) NACA 65, -214. (10 Marks)
 - c. Consider an airfoil at 12° angle of attack. The normal and axial force coefficients are 1.2 and 0.03 respectively. Calculate the lift and drag co-efficient. (04 Marks)

- 4
 - a. Derive both Bernoulli's and Euler's equation of motion for an inviscid incompressible fluid flow. (10 Marks)
 - b. Tabulate the velocity, ϕ and ψ expression for
 - i) Uniform flow in X-direction
 - ii) Source
 - iii) Vortex
 - iv) Doublet. (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – B

- 5 a. Consider a Lifting flow over a circular cylinder and derive the expression following :
- Stream function
 - Location of stagnation points
 - Pressure co-efficient. (10 Marks)
- b. Consider the lifting flow over a circular cylinder. The lift co-efficient is 5. Calculate the location of the stagnation points and the points on the cylinder where the pressure equals force stream static pressure. (10 Marks)
- 6 a. Briefly explain the following, wit neat sketches and relevant expression :
- Kelvin's circulation theorem
 - The starting vortex
 - Vortex sheet. (10 Marks)
- b. Derive an expression for left co-efficient for symmetric airfoil, using classical thin airfoil theory. (10 Marks)
- 7 a. Explain the boundary layer, with relevant sketch: Derive the expression for
- Displacement thickness
 - Momentum thickness. (10 Marks)
- b. Derive Navier – Stokes equation for an unisteady, compressible, three – dimensional viscous flow. (10 Marks)
- 8 a. Draw a neat diagram of wind tunnel and Give a brief description how aerodynamic loads and moments are measured in a wind tunnel. (12 Marks)
- b. Derive the Area – velocity relation and discuss the physical significance of subsonic supersonic and sonic flow with relevant sketches. (08 Marks)
