

CRASH COURSE

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10AE54

Fifth Semester B.E. Degree Examination, May 2017 Aerodynamics – I

Time: 3 hrs.

Max. Marks: 100

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

PART – A

- 1 a. Develop continuity and momentum equations for any finite control volume fixed in space. (10 Marks)
b. Differentiate between inviscid and viscous flows. (04 Marks)
c. Explain Mach number regimes. (06 Marks)
- 2 a. What are pathlines, streakline and streamlines of a flow. (04 Marks)
b. Derive the formulae for i) Vorticity; ii) Circulation and iii) Stream function. (06 Marks)
c. Develop the relationship between stream function and velocity potential. (10 Marks)
- 3 a. With a neat diagram, describe airfoil section geometry. (08 Marks)
b. Derive aerodynamic forces and moments with explanation of their direction, sign conventions and significance. (06 Marks)
c. What do you understand by i) Centre of pressure and its significance and ii) Pressure coefficient for an airfoil. (06 Marks)
- 4 a. Develop both Bernoulli's and Euler's equations of motion for an inviscid incompressible fluid flow. (10 Marks)
b. How is airspeed measured in a pitot-tube? Draw a clear diagram and indicate all variables of flow. (06 Marks)
c. What is the condition of irrotationality and governing equation for irrotational, incompressible flow? (04 Marks)

PART – B

- 5 a. Consider the nonlifting flow over a circular cylinder and derive the formula for surface pressure coefficient over the above cylinder as $C_p = 1 - 4 \sin^2 \theta$. (10 Marks)



R is the radius and C represents centre for the circular cylinder.

- b. Derive Kutta-Joukowski theorem. (10 Marks)

- 6 a. What is Kelvin's circulation theorem? (04 Marks)
b. Derive the fundamental equation of thin airfoil theory and demonstrate that centre of pressure is at the quarter chord point for a symmetric airfoil. (12 Marks)
c. What is aerodynamic centre and draw clearly all necessary aerodynamic force with respect to an aerodynamic centre. (04 Marks)
- 7 a. Derive Navier-Stokes equations for an unsteady, compressible, three-dimensional viscous flow. (14 Marks)
b. Draw a neat diagram showing boundary-layer properties and write what is boundary layer separation. (06 Marks)
- 8 a. Compare different features of low speed, transonic and supersonic wind tunnel. (08 Marks)
b. 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)

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