



10AE63

Sixth Semester B.E. Degree Examination, June/July 2019
Aerodynamics - II

Time: 3 hrs.

Max. Marks: 100

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

PART - A

- 1 a. Explain the Non-Lifting flow over arbitrary bodies? The source panel method. (14 Marks)
b. Consider the NACA 2412 airfoil, data for which the data are given for two values of Reynolds's number based on chord length for the case where $R_{cc} = 3.1 \times 10^6$ estimate :
 - i) The laminar boundary layer thickness at the trailing edge for chord length of 1.5 m
 - ii) the net laminar skin friction drag coefficient for the airfoil. (06 Marks)
- 2 a. Define and Explain
 - i) Down wash ii) Induced drag iii) Vortex filament iv) Biot-savart law (08 Marks)
b. Derive and explain Prandtl's classical lifting line theory and its limitations. (12 Marks)
- 3 a. Describe and explain the linearised velocity potential equation. (14 Marks)
b. Explain Prandtl - Glauert compressibility correction. (06 Marks)
- 4 a. Deduce the relation between oblique shock wave angle and the mach angle. (04 Marks)
b. Define and explain critical mach number, Drag-divergence mach number, sound Barrier and transonic area rule with neat sketches. (12 Marks)
c. Consider an oblique shock wave with a wave angle of 30° . The upstream flow mach number is 2.4. Calculate the deflection angle of the flow, the pressure and temperature ratios across the shock wave, and the mach number behind the wave. (04 Marks)

PART - B

- 5 a. Derive an expression for simplified horseshoe vortex model. (06 Marks)
b. Explain the equations the influence of down wash on tail plane. (08 Marks)
c. Prove that for monoplane, a rational formula for down wash in degrees, at the tail plane is constant X_{Cl}/AR . Determine the numerical value of constant for a point on the center line of the $2^S/3$ behind the gates of pressure, S being the semi-span. (06 Marks)
- 6 a. Describe the subsonic flow past over as thin flat plates at zero incidence. (14 Marks)
b. What are the different types of small perturbation flows? Explain with neat sketches. (06 Marks)
- 7 a. What are high lift devices list them and explain this effects an aerodynamics characteristics? (12 Marks)
b. Discuss the advantages of swept wing in modern airplane. (08 Marks)
- 8 a. Derive and explain Navier - Stokes equation for two dimensional flows. (12 Marks)
b. Consider a float plate at zero angle of attack in an airflow at St. sea level conditions ($P_\infty = 1.01 \times 10^5 \text{ N/m}^2$ and $T_\infty = 288\text{K}$). The chord length of plate is 2m. The planform area of the plate is 40m^2 . @ Standard sea level conditions, $\mu_\infty = 1.7894 \times 10^{-5} \text{ kg/ms}$. Assume the wall temperature is the adiabatic wall temperature T_w . Calculate the friction drag on the plate when the free stream velocity is 100m/s. (08 Marks)

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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.