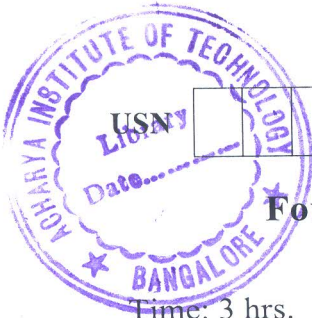


CBCS SCHEME

15AE42



Fourth Semester B.E. Degree Examination, Aug./Sept. 2020 Aerodynamics – I

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Define the following : i) Path lines ii) Stream lines iii) Streak lines. (06 Marks)
b. Derive an expression for energy equation. (10 Marks)

OR

- 2 a. Define Mach number. Explain the classification of flow regimes based on Mach number with a neat sketch. (10 Marks)
b. Obtain the relationship between the stream function and velocity potential. (06 Marks)

Module-2

- 3 a. Derive an expression for axial forces and normal force acting on an airfoil. (10 Marks)
b. Briefly discuss different types of drag. (06 Marks)

OR

- 4 a. With a neat sketch, explain in detail airfoil nomenclature. (06 Marks)
b. Consider an NACA 2412 airfoil with a chord of 0.64m. The free stream velocity is 70m/s, lift per unit span is 1254 N/m. Calculate angle of attack, drag per unit span, and moment per unit span about aerodynamic centre. Given :
 $\alpha = 4^\circ$ for $C_L = 0.65$, $\alpha = 12^\circ$ for $C_L = 1.4$, $C_D = 0.0068$, $C_{m, ac} = -0.05$,
 $\mu = 1.789 \times 10^{-5} \text{kg/m.s}$, $\rho = 1.23 \text{kg/m}^3$. (06 Marks)
c. Define pressure coefficient and aerodynamic center. (04 Marks)

Module-3

- 5 a. Obtain an expression for velocity potential and stream function for a source flow. (06 Marks)
b. What is Kutta-Joukowski theorem? Obtain an expression for the same. (10 Marks)

OR

- 6 a. Briefly explain Kutta condition. (06 Marks)
b. Explain Kelvin's circulation theorem and the starting vortex. (10 Marks)

Module-4

- 7 a. What is Biot-Savart Law? Obtain the same for vortex and semi vortex filament. (10 Marks)
b. Explain how finite wing is simplified to horseshoe vortex. (06 Marks)

OR

- 8 a. Derive an expression for induced angle of attack and induced drag for elliptical lift distribution. (10 Marks)
b. With a neat diagram explain downwash. (06 Marks)

Module-5

- 9 Briefly explain :
i) Formation flying effects (06 Marks)
ii) Ground effects (06 Marks)
iii) Swept back wing (04 Marks)

OR

- 10 a. Briefly explain Transonic Area rule. (08 Marks)
b. List different high lift devices with a neat sketch. How do multi element airfoil augment lift. (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.