CBCS SCHEME

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BAE/BAS402

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Aerodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define the following with stream functions: i) Uniform flow ii) Source iii) Sink iv) Doublet v) Vortex	10	L1	CO1 CO4
	b.	Prove combination of uniform flow and a doublet produces a non-lifting flow over a circular cylinder.	10	L3	CO1
		OR			
Q.2	a.	State and explain i) Kutta Joukowski Theorem ii) Kelvins circulation Theorem	10	L2	CO1
	b.	What is Kutta Condition? Explain it in the form of strength of the vortex sheet.	5	L3	CO2
	c.	Describe thin airfoil theory for symmetric aerofoil.	5	L3	CO1
		Module – 2			
Q.3	a.	State and explain Biot-Savart law and Hermholtz's Theory.	10	L1	CO2
	b.	What is Prandtl's lifting Theory. State the limitation of this theory.	10	L3	CO2
		OR			
Q.4	a.	Derive an equation for induced angle of attack in terms of circulation distribution along the wing.	10	L2	CO2
	b.	What is extended lifting line Theory explain	10	L3	CO3
		Module – 3			
Q.5	a.	Explain swept wing and critical mach numbers.	10	L2	CO3
	b.	Sketch and explain various high lift systems.	10	L3	CO3

		OR			
Q.6	**a.**	What is source panel method? Explain source panel distribution over the surface of a body of arbitrary shape.	10	L3	CO3
	b.	Apply source panel method obtain potential function at any point P.	10	L3	CO3
		Module – 4			
Q.7	**a.**	Derive the expression for energy equation for a flow process $h_1 + \frac{1}{2}c_1^2 + q = h_2 + \frac{1}{2}c_2^2 + w_s$	10	L3	CO2
	b.	An air jet (γ = 1.4, R = 2.87 kJ/kg K) at 400 K has sonic velocity. Determine the velocity of sound at 400 K, velocity of sound at the stagnation conditions, maximum velocity of the jet, stagnation enthalpy.	10	L4	CO2
		OR			
Q.8	**a.**	With suitable plot explain different regions of flow. Further show that the ratio of maximum velocity to stagnation velocity of sound is 2.24 for an isentropic process.	10	L2	CO2
	b.	Air (c_p = 1.05 kJ/kg K, γ = 1.38) at $p_1 = 3 \times 10^5$ N/m^2 and T_1 = 500K flows with a velocity of 200 m/s in a 30 cm diameter duct. Calculate: mass flow rate, stagnation temperature, mach number and stagnation pressure values assuming flow as compressible.	10	L4	CO3
		Module – 5			
Q.9	**a.**	Derive Rankine – Hugonoit relation for a normal shock.	10	L3	CO5
	b.	Consider the flow through a rocket nozzle. Assume the gas flow through the nozzle is an isentropic expansion of calorically perfect gas in the combustion chamber, the gas which results from the combustion of rocket fuel and oxidizer is at a pressure and temperature of 15 atm and 2500 K, respectively the molecular weight and specific heat at a constant pressure of combustion gas are 12 and 4157 J/kg K, respectively. The gas expands to supersonic speed through the nozzle, with a temperature of 1350 K at the nozzle exit. Calculate the pressure, Mach number and velocity at the exit of the nozzle.	10	L4	CO5
		OR			
Q.10	**a.**	How an oblique shock develops? What are its sources?	10	L2	CO5
	b.	Consider an oblique shock wave 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.	10	L4	CO5

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