CBCS SCHEME - Make-Up Exam

USN

BAE/BAS402

Fourth Semester B.E/B.Tech. Degree Examination, June/July 2025
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.
3. Use of gas table is permitted.

		Module – 1	M	L	C
1	a.	Derive the velocity potential and stream function equation (ϕ, ψ) for uniform flow.	10	L3	CO1
	b.	Consider non-lifting flow over a circular cylinder and derive the expression.	10	L2	CO1
		OR			
2	a.	Derive an equation for C_L over symmetric airfoil using classical thin airfoil theory.	10	L3	CO1
	b.	Explain Kutta's condition by cusped and finite trailing edge and also state Kelvin's circulation theory.	10	L2	CO1
		Module – 2			
3	a.	Derive an expression for coefficient of lift using Prandtl's classical lifting line theory.	10	L3	CO2
	b.	What is vortex filament? Explain Biot-Savart law.	10	L1 L2	CO2
		OR			
4	a.	Prove that coefficient of drag is increased with increase in drag and inversely proportional to aspect ratio using elliptical lift distribution.	10	L3	CO2
	b.	Write short note on vortex sheet, downwash and induced drag for an complete aircraft.	10	L2	CO2
		Module – 3			
5	a.	What are high lift devices? Explain in detail about fowler flops and Kruger flaps with neat diagram.	10	L1 L2	CO3
	b.	Define critical Mach number and explain the concept of swept wings.	10	L1 L2	CO3

		OR			
6	a.	Explain about ground effect and flying formation effects in a simplified horse shoe vortex.	10	L2	CO3
	b.	Define drag divergence mach number and explain about transonic area rule.	10	L1 L2	CO3
		Module – 4			
7	a.	Derive Bernoulli's equation for compressible flow.	10	L3	CO4
	b.	An aircraft flies of 800 km/hr at an altitude of 10,000 meters (T = 223.15K, P = 0.264 bar) the air is reversibly compressed in an inlet diffuser. If the mach number at the exit of diffuser is 0.36. Determine: i) Entry mach number ii) Velocity, pressure and temperature of air at the diffuser exit.	10	L4	CO4
		OR			
8	a.	Derive an expression for area ratio as a function of mach number.	10	L3	CO4
	b.	Derive an expression for impulse function in a duct.	10	L3	CO4
		Module – 5			
9	a.	Derive Prandtl-Meyer relation for normal shock wave in perfect gas and prove $M_x^* \cdot M_y^* = 1$	10	L3	CO5
	b.	Derive the mach number downstream of normal shock wave as: $M_y^2 = \dfrac{\dfrac{2}{r-1} + Mx^2}{\dfrac{2r}{r-1} M_x^2 - 1}$	10	L3	CO5
		OR			
10	a.	Derive the Rankine Hugoniot equation for oblique shock wave as, $a^{*2} - \dfrac{r-1}{r+1} C_t^2 = \dfrac{P_2 - P_1}{P_2 - P_2}$	10	L3	CO5
	b.	With a neat sketch, explain shock polar diagram and also define weak shocks, strong shocks.	10	L2	CO5

* * * * *