CBCS SCHEME

USN | | | | | | | | | | |

BAE402/BAS402

Fourth Semester B.E./B.Tech. Degree Supplementary Examination, June/July 2024

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 tables is permitted.

		Module – 1	M	L	C
Q.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, $C_P = 1 - 4\sin^2\theta$	10	L3	CO1
		OR			
Q.2	a.	Derive an equation for C_L over symmetric airfoil using classical their aerofoil theory.	10	L4	CO1
	b.	Explain Kutta's condition by Cusped and finite trailing edge and also state Kelvin's circulation theorem.	10	L2	CO1
		Module – 2			
Q.3	a.	Derive an expression for co-efficient of lift using Prandtl's classical lifting line theory.	10	L4	CO2
	b.	What is vortex filament? Explain Biot-Savart law.	10	L2	CO1
		OR			
Q.4	a.	Prove that co-efficient of drag increases with increase in drag and inversely proportional to aspect ratio using elliptical lift distribution.	10	L4	CO2
	b.	Write short notes on Vortex sheet, downwards and induced drag for an complete aircraft.	10	L2	CO2
		Module – 3			
Q.5	a.	What are high lift devices? Explain in detail about Fowler flaps and Kruger flaps with neat diagram.	10	L5	CO2
	b.	Define critical Mach number and explain the concept of swept wing.	10	L2	CO2
		OR			
Q.6	a.	Explain about Ground effect and flying formation effects in a simplified horseshoe vortex.	10	L2	CO2
	b.	Define drag divergence mach number and explain about transonic area rule.	10	L2	CO2
		Module – 4			
Q.7	a.	Derive Bernoulli's equation for compressible flow.	10	L3	CO3
	b.	An aircraft flies at 800 km/hr at an altitude of 10,000 meters (T = 223.15 K, 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	L5	CO3

		OR			
Q.8	**a.**	Derive an expression for Area ratio as a function of Mach number.	**10**	**L4**	**CO3**
	b.	Derive an expression for impulse function in a duct.	**10**	**L4**	**CO3**
		Module – 5			
Q.9	**a.**	Derive Prandtl-Meyer relation for Normal shock wave in perfect gas and prove $M_x^* \cdot M_y^* = 1$	**10**	**L3**	**CO3**
	b.	Derive the Mach number down stream of Normal shock wave as, $M_y^2 = \dfrac{\dfrac{2}{\gamma-1} + M_x^2}{\dfrac{2\gamma}{\gamma-1} M_x^2 - 1}$	**10**	**L4**	**CO3**
		OR			
Q.10	**a.**	Derive the rankine-hugoniot equation for oblique shock wave as, $a^{*2} - \dfrac{\gamma-1}{\gamma+1} C_1^2 = \dfrac{P_2 - P_1}{\rho_2 - \rho_1}$	**10**	**L4**	**CO3**
	b.	With a neat sketch, explain shock polar diagram and also define weak shocks, strong shocks	**10**	**L2**	**CO3**

* * * * *