CBCS SCHEME

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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.

			M	L	C
		Module – 1			
Q.1	**a.**	Derive the expression for source flow and write its stream function and velocity potential expressions.	10	L2	CO1
	b.	Derive the expressions related to the vortex flow.	10	L2	CO1
		OR			
Q.2	**a.**	Explain the following: i) Kelvin circulation theorem ii) Starting vortex iii) Kutta condition.	8	L1	CO1
	b.	Find the coefficient of lift value for the symmetrical airfoil using thin airfoil theory.	12	L2	CO1
		Module – 2			
Q.3	**a.**	Explain the following: i) Induced drag ii) Downwash iii) Hermholtz's theorems.	10	L1	CO2
	b.	Derive the expressions to find coefficient of lift and coefficient of drag from Prandtl's lifting line theory.	10	L2	CO2
		OR			
Q.4	**a.**	Derive the expression for the velocity induced by the infinite vortex filament and semi-infinite vortex filament from Biot-Savart law.	10	L2	CO2
	b.	Consider a rectangular wing with aspect ratio of 6, an induced drag factor $\delta = 0.055$ and a zero lift angle of attack of -2 deg. At an angle of attack of 3.4 deg, the induced drag coefficient for this wing is 0.01. Calculate the induced drag coefficient for similar wing (a rectangular wing with same airfoil cross section) at same angle of attack. But with an aspect ratio of 10. Assume $\delta = 0.105$ for aspect ratio 10.	10	L3	CO2
		Module – 3			
Q.5	**a.**	Derive the expression for influence of downwash on tail plane.	10	L2	CO2
	b.	Illustrate the concept of high lift devices and explain the trailing edge high lift devices using diagrams.	10	L1	CO3

		OR			
Q.6	**a.**	Explain the following: i) Formation of flight ii) Ground effects.	**10**	**L1**	**CO3**
	b.	Explain about critical mach number and derive the expression for it and explain how to find it for airfoils.	**10**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Derive the expression for reference velocities in terms of i) Critical velocity of sound ii) Mach number (M^*).	**10**	**L2**	**CO3**
	b.	A gas ($\gamma = 1.278$, R = 0.477 kJ/kg ~ K) flowing in a duct has a velocity of 300 m/s, pressure of 1 bar and temperature of 290 K. Determine : i) P_o and T_o ii) Speed of sound in dynamic and stagnation conditions iii) Stagnation pressure assuming constant density.	**10**	**L3**	**CO3**
		OR			
Q.8	**a.**	Derive the expression for area ratio as a function of mach number.	**10**	**L2**	**CO3**
	b.	Derive the expression for mass flow rate in terms of pressure ratio.	**10**	**L2**	**CO3**
		Module – 5			
Q.9	**a.**	Explain the characteristics of normal shock wave and write the governing equation. Also obtain the prandtl relation for normal shock wave.	**10**	**L2**	**CO3**
	b.	An aircraft is moving with mach number 2, pressure of 0.5 atm, and temperature of 300 K through a normal shock wave. Determine the mach number, pressure, temperature and velocity behind the shock wave.	**10**	**L3**	**CO3**
		OR			
Q.10	**a.**	Derive the expression for θ - β - M relation for oblique shock waves.	**10**	**L2**	**CO3**
	b.	Draw and explain about shock polar and hodograph plane.	**10**	**L2**	**CO3**

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