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BAE/BAS402

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.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 tables permitted.***

		Module – 1	M	L	C
Q.1	a.	Explain the concept of source and sink flow. Obtain the expression for velocity, stream and velocity potential for source flow.	8	L2	CO1
	b.	With a neat sketch and notations, illustrate the non-lifting flow over a circular cylinder.	12	L3	CO1
		OR			
Q.2	a.	State Kelvin's circulation theorem.	4	L1	CO1
	b.	What is Kutta condition?	4	L1	CO1
	c.	Derive an expression for symmetrical thin airfoil theory.	12	L3	CO2
		Module – 2			
Q.3	a.	Derive the expression for the velocity induced by infinite vortex filament using the Biot-savart law.	12	L3	CO2
	b.	Derive an expression for lift coefficient and induced drag coefficient in terms of circulation strength $\Gamma(y)$ for a finite wing through Prandtl's classical lifting line theory.	8	L4	CO2
		OR			
Q.4	a.	Obtain the expression for induced drag coefficient and induced angle of attack for an elliptical lift distribution on a wing.	12	L3	CO2
	b.	Consider a finite wing with an aspect ratio of 8 and taper ratio 0.8. The airfoil section is thin and symmetric. Calculate the lift and induced drag coefficient for the wing when it is at an angle of attack of 5°. Assume $\delta = \tau$. Data: $\delta = 0.055$.	8	L4	CO2
		Module – 3			
Q.5	a.	Illustrate the importance of swept wing and its effect in configuration of an airfoil.	10	L1	CO2
	b.	Describe Horseshoe vortex model with a neat sketch.	5	L1	CO2
	c.	Write a note on influence of downwash on tail plane.	5	L1	CO2
		OR			
Q.6	a.	With a neat sketch, explain the different types of High lifting devices.	10	L2	CO2

	b.	Briefly explain the transonic area rule.	**10**	**L2**	**CO2**
		Module – 4			
Q.7	**a.**	Derive the energy equation for flow and non-flow process.	**8**	**L2**	**CO3**
	b.	Derive the Bernoulli's equation for Isentropic compressible flow.	**8**	**L2**	**CO3**
	c.	For adiabatic flow of perfect gas show that $\frac{T}{T_0}=\left(1+\frac{\gamma-1}{\gamma+1}M^{*2}\right)$, for $\gamma = 1.4$ and $M = 2.0$.	**4**	**L1**	**CO3**
		OR			
Q.8	**a.**	Derive the impulse function.	**10**	**L2**	**CO3**
	b.	A nozzle in a wind tunnel gives a test section Mach number of 2.0. Air enters the nozzle from a large reservoir at 0.69 bar and 310K. The cross sectional area of the throat is 1000 cm^2. Determine the following properties for one dimensional isentropic flow. i) Pressure temperature and velocity at throat and test sections ii) Mass flow rate iii) Power required to drive the compressor.	**10**	**L4**	**CO3**
		Module – 5			
Q.9	**a.**	Derive the Prandtl-Meyer relation for normal shock wave in perfect gas.	**10**	**L3**	**CO3**
	b.	Derive an equation for Mach number downstream of normal shock wise.	**10**	**L3**	**CO3**
		OR			
Q.10	**a.**	Obtain the expression for θ - β - M relation for oblique shock.	**10**	**L3**	**CO3**
	b.	Explain above shock polar and Hodograph plane.	**10**	**L3**	**CO3**

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