



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 $\frac{T}{T_0} = \left(1 + \frac{\gamma-1}{\gamma+1} M^2 \right), \text{ for } \gamma = 1.4 \text{ and } M = 2.0.$	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 wave.	10	L3	CO3
OR					
Q.10	a.	Obtain the expression for $\theta - \beta - M$ relation for oblique shock.	10	L3	CO3
	b.	Explain above shock polar and Hodograph plane.	10	L3	CO3

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