PRN:		Course Code :	AER3501

Third Year **B. Tech** End Semester Examination Winter 2023

Aerodynamics II

Day and Date: wednesday, 29/11/2023 Max Marks: **100**

Time : 10.30 am to 1.30 PM Duration: **03** hrs

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Instructions: All questions are compulsory.
Gas table is allowed for the exam

		Marks	Bloom's Level	CO
Q.1	**Attempt the following**			
a)	Derive the expression for the Stagnation condition of an inviscid compressible flow and interpret your findings.	08	3	1
b)	At a point in an airflow the pressure, temperature, and velocity are 1 atm, 320 K, and 1000 m/s. Calculate the total temperature and total pressure at this point.	08	3	1
	OR			
b)	Derive the isentropic relation from Second law of thermodynamics.	08	3	1
Q.2	**Attempt the following**			
a)	Derive the basic normal shock equations.	08	3	2
b)	Consider a normal shock wave in air where the upstream flow properties are u1=680 m/s, T1=288K and P1 = 1 atm. Calculate the velocity temperature and pressure downstream the shock.	08	3	2
	OR			
b)	Derive and show that $T_0/T = 1+\frac{(\gamma-1)}{2} M$. Also calculate the value of T0/T*.	08	3	2
Q.3	**Attempt any two from the following**			
a)	Derive the θ-β-M relation for Oblique shock.	08	3	3
b)	Consider a supersonic flow with M = 2, p = 1 atm, and T = 288 K. This flow is deflected at a compression corner through 20°. Calculate M, p, T, P_0, and T_0 behind the resulting oblique shock wave.	08	3	3
c)	Explain the Physical phenomena associated with oblique shock waves with the help of θ-β-M curve.	08	2	3
Q.4	**Attempt any two from the following**			
a)	Derive the governing equations for quasi-one-dimensional flow	08	3	4
b)	Derive Area Velocity relation and explain how flow Velocity changes for convergent and Divergent duct	08	3	4
c)	Write note on Classification of Supersonic Wind Tunnel and explain the working of Induction type wind tunnel.	08	2	4

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Q.5	**Attempt any Two of the following**				
	a)	Derive the Velocity Potential Equation.	09	3	5
	b)	Derive the perturbation velocity potential equation	09	3	5
	c)	What is critical Mach number and Derive the expression to find critical coefficient of pressure	09	2	5
Q.6	**Attempt any Two of the following**				
	a)	Derive linearized supersonic pressure coefficient formula.	09	3	5
	b)	Derive and show that for supersonic flow over thin flat plate $C_L = 4\alpha / (M_\infty -1)1/2$ and $C_d = 4\alpha^2 / (M_\infty -1)^{1/2}$	09	3	5
	c)	Using linearized theory, calculate the lift and drag coefficients for a flat plate at a 5° angle of attack in a Mach 3 and Mach 5 flow.	09	2	5

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