Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, Dec 2023

Course: Aerodynamics – II **Semester: V**
Program: B.Tech, ASE **Time 03 hrs.**
Course Code: ASEG 3011 **Max. Marks: 100**

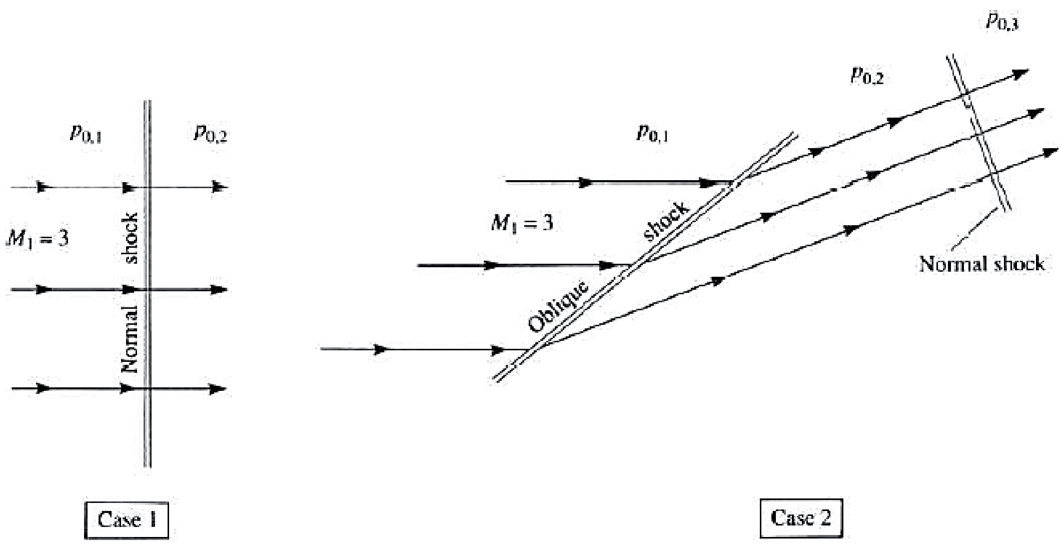
Note: Students are allowed to have printout of gas table. No notes or formula should be written on the printout.

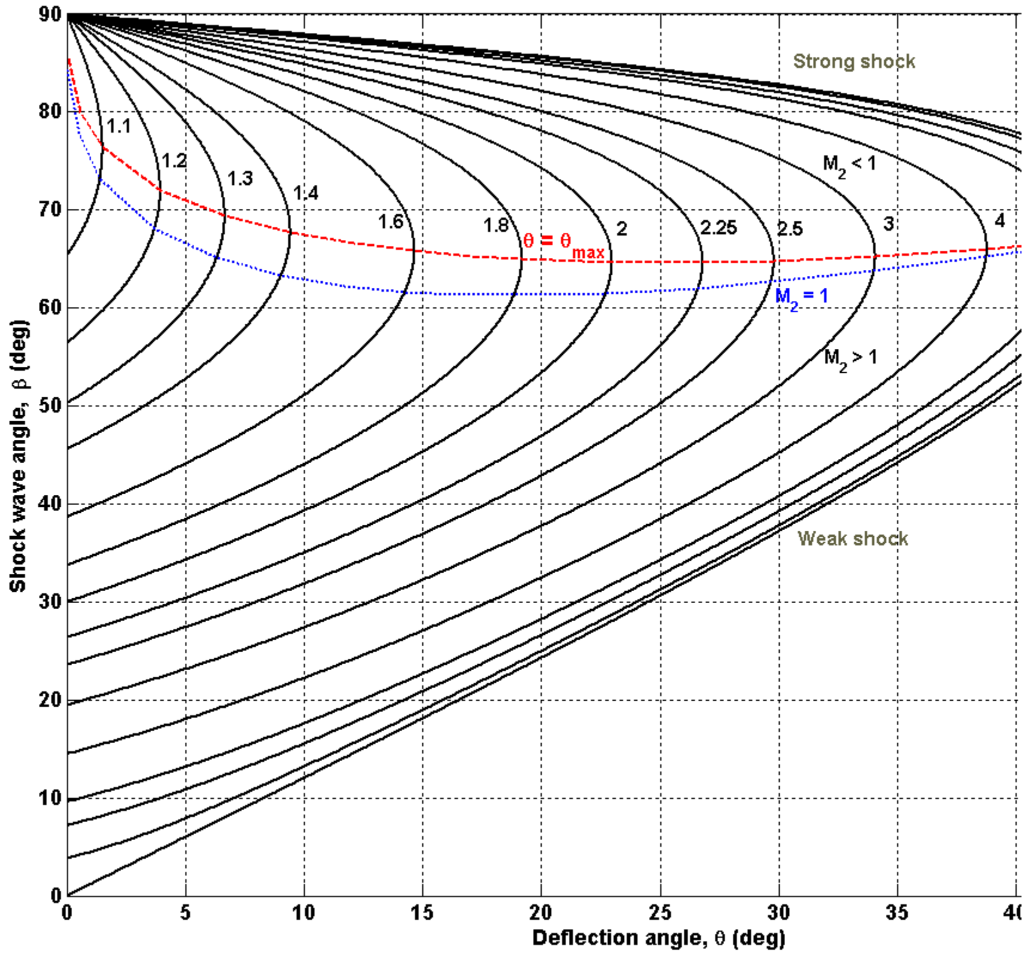
SECTION A

S. No.		Marks	CO
Q1.	How does the flow properties change for the supersonic flow over a concave and a convex corner.	**4**	**CO1**
Q2.	With the help of sketch, briefly discuss the isentropic compression and isentropic expansion of a supersonic flow.	**4**	**CO2**
Q3.	Write the basic governing equations for a steady, one-dimensional, and inviscid flow across an oblique shock wave.	**4**	**CO3**
Q4.	Consider a long tube with a length of 300 m. The tube is filled with air at a temperature of 320 K. A sound wave is generated at one end of the tube. How long will it take for the wave to reach the other end?	**4**	**CO2**
Q5.	Drag divergence Mach number comes just before the critical Mach number. Is the above statement true or false? Explain with reason.	**4**	**CO5**

SECTION B

Q6.	Applying the energy equation, derive the relation between static and stagnation properties (pressure, temperature, and density) in an adiabatic flow. **OR** Derive the basic governing equations for a steady, one-dimensional, and inviscid flow across a normal shock wave.	**10**	**CO2**
Q7	A Pitot tube is inserted into an airflow where the static pressure is 1 atm. Calculate the flow Mach number when the Pitot tube measures *(i)* 1.276 atm, *(ii)* 2.714 atm, *(iii)* 12.06 atm.	**10**	**CO1**
Q8	Consider the flow over a 22.2° half-angle wedge. If $M_1 = 2.5$, $p_1 = 1$ atm, and $T_1 = 300$ K, calculate the wave angle and p_2, T_2, and M_2.	**10**	**CO3**

Q9	Derive perturbation velocity potential equation by linearizing the velocity potential equation.	**10**	**CO5**
	SECTION-C		
Q 10	Consider a Mach 3 flow. It is desired to slow this flow to a subsonic speed. Consider two separate ways of achieving this: Case 1: The Mach 3 flow is slowed by passing directly through a normal shock wave; Case 2: The Mach 3 flow first passes through an oblique shock with a 40◦ wave angle, and then subsequently through a normal shock. These two cases are sketched in Figure. Calculate the ratio of the final total pressure values for the two cases, that is, the total pressure behind the normal shock for case 2 divided by the total pressure behind the normal shock for case 1. Comment on the significance of the result.  	**20**	**CO3**
Q 11	A supersonic flow at $M_1 = 3$, $T_1 = 285$ K, and $p_1 = 1$ atm is deflected upward through a compression corner with $\theta = 30.6^\circ$ and then is subsequently expanded around a corner of the same angle such that the flow direction is the same as its original direction. Calculate the Mach number, pressure, and temperature downstream of the expansion corner. **OR** Consider an infinitely thin flat plate at an angle of attack α in a Mach 2.6 flow. Calculate the lift and wave-drag coefficients for: (a) $\alpha = 5^\circ$ (b) $\alpha = 15^\circ$ (c) $\alpha = 30^\circ$	**20**	**CO4**



The relation between flow deflection angle, wave angle, and the Mach number