Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2018

Subject Code:2150107 **Date:04/12/2018**

Subject Name:Aerodynamics I

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Usage of Isentropic properties table and Normal Shock properties table are permitted**
5. **Usage of $\theta - \beta - M$ chart is permitted**

			MARKS
Q.1	**(a)**	Explain different types of elementary flows.	**03**
	(b)	What is Aerodynamics? Write an application of Aerodynamics in the various fields.	**04**
	(c)	Explain with neat sketches the forces and moments acting on an aircraft.	**07**
Q.2	**(a)**	Write short note on airfoil stalling.	**03**
	(b)	Classify the NACA series standard for airfoils with a neat sketch.	**04**
	(c)	For a particular aerofoil section the pitching moment coefficient about an axis 1/3 chord behind the leading edge varies with the lift coefficient in the following manner:	**07**

C_L	0.2	0.4	0.6	0.8
C_M	-0.02	0.00	+0.02	+0.04

Find the aerodynamic centre and the value of C_{M0}

OR

	(c)	Consider the lifting over a circular cylinder. The list coefficient is 5. Calculate the peak (negative) pressure coefficient.	**07**
Q.3	**(a)**	Enlist various types of drags on an airfoil.	**03**
	(b)	Draw and explain coefficient of lift V/s angle of attack for cambered airfoil.	**04**
	(c)	What is airfoil? Explain characteristics of airfoil with a neat sketch.	**07**

OR

Q.3	**(a)**	Define: Source flow, Doublet , Principle of Superposition	**03**
	(b)	Explain detached shock wave in front of a blunt body.	**04**
	(c)	Consider an NACA 2412 airfoil with a chord of 0.64 m in an airstream at standard sea level conditions (ρ = 1.23 kg/m^3). The free stream velocity is 70 m/s. the lift per unit span is 1254 N/m. Calculate a. The angle of attack b. Drag per unit span. c. The moment per unit span about the aerodynamic center.	**07**
Q.4	**(a)**	Write a note on vorticity and circulation.	**03**
	(b)	Show that free vortex is an example of irrotational motion.	**04**
	(c)	Write a note on Rankine Oval Body.	**07**

OR

Q.4	**(a)**	Write a short note on Normal Shock wave.	**03**
	(b)	Derive an equation of speed of sound.	**04**
	(c)	Consider a point in an air flow where the local Mach number, static pressure and static temperature are 3.5, 0.3 atm and 180 K respectively. Calculate the local values of p_0, T_0, T^*, a^* and M^*.	**07**
Q.5	**(a)**	What is the function of Pitot Tube? How is it work?	**03**
	(b)	Derive an equation for Stream function and Velocity potential for a uniform flow.	**04**
	(c)	Consider a normal shock wave in air where the upstream flow properties are u_1 = 680 m/s, T_1 = 288 K, and p_1 = 1 atm. Calculate the velocity, temperature, and pressure downstream of the shock.	**07**

OR

Q.5	**(a)**	What is Shock? What happens to the flow properties during the shock? Explain in brief.	**03**
	(b)	With a neat sketch explain lifting flow over circular cylinder.	**04**
	(c)	Consider a supersonic flow with M = 2, p = 1 atm and T = 288 K. This flow is detected at a compression corner through 20 °. Calculate M, p, T, p_0 and T_0 behind the resulting oblique shock wave.	**07**

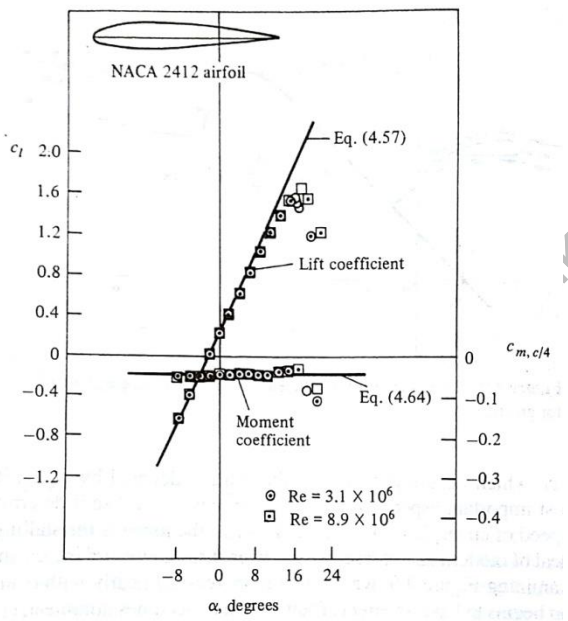

Figure 4.10 Experimental data for lift coefficient and moment coefficient about the quarter-chord point for an NACA 2412 airfoil. *(Source: Data obtained from Abbott and von Doenhoff, Reference 11.)*

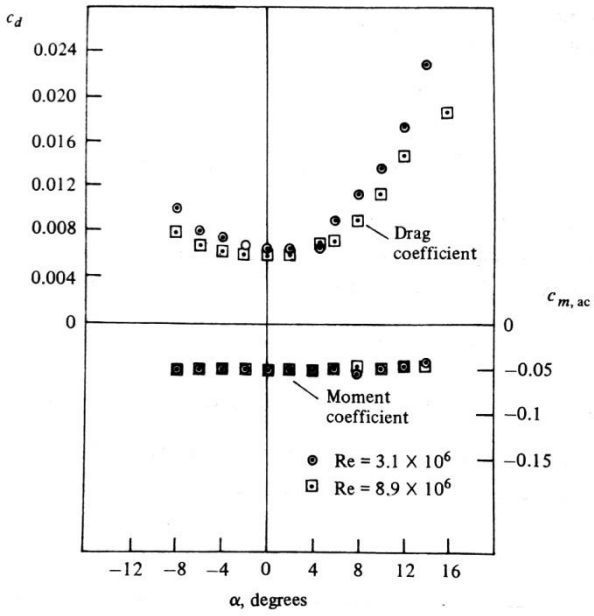

Figure 4.11 Experimental data for profile drag coefficient and moment coefficient about the aerodynamic center for the NACA 2412 airfoil. *(Source: Abbott and von Doenhoff, Reference 11.)*

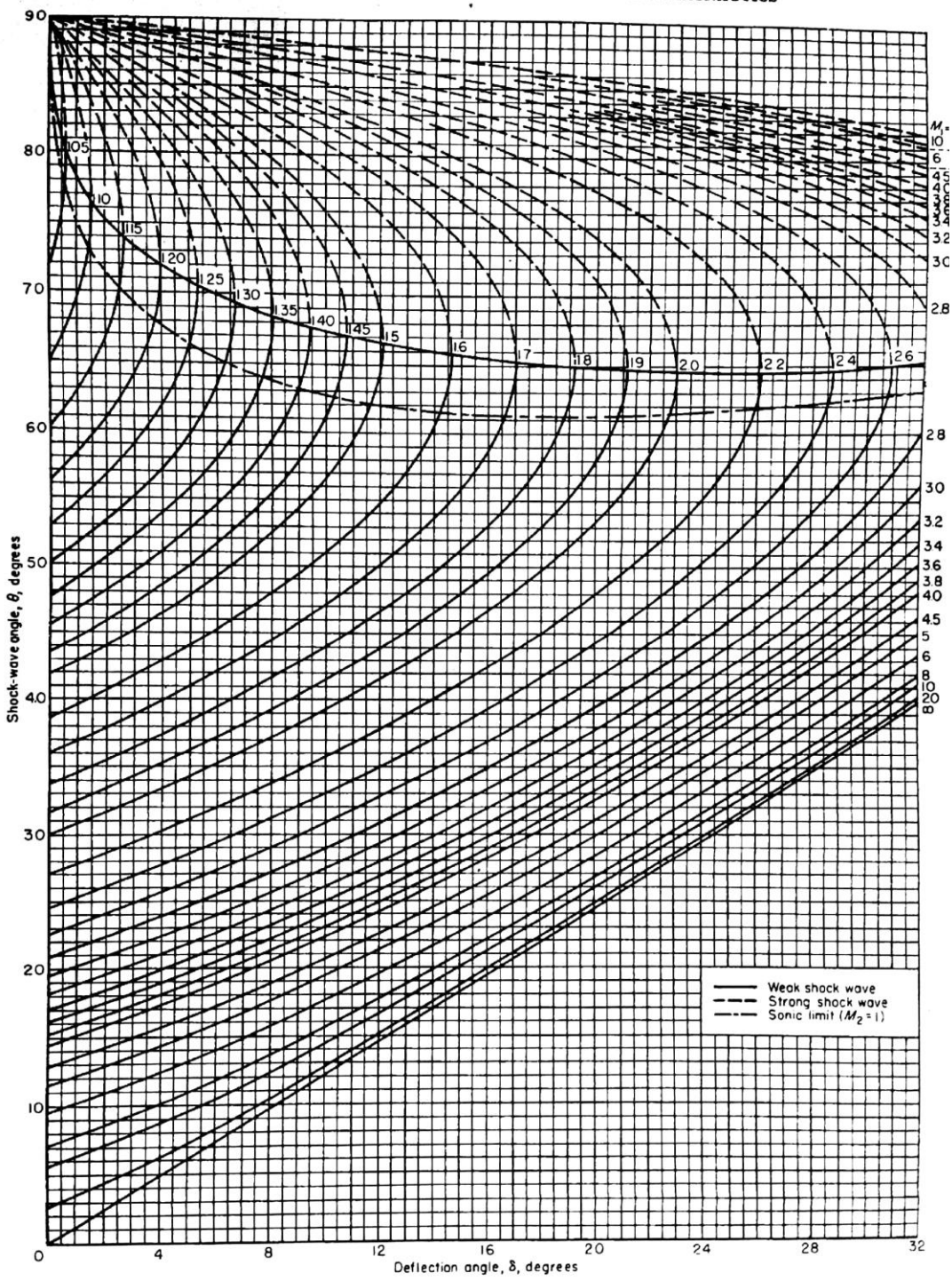

CHART 2.—Variation of shock-wave angle with flow-deflection angle for various upstream Mach numbers Perfect gas, $\gamma = 7/5$.

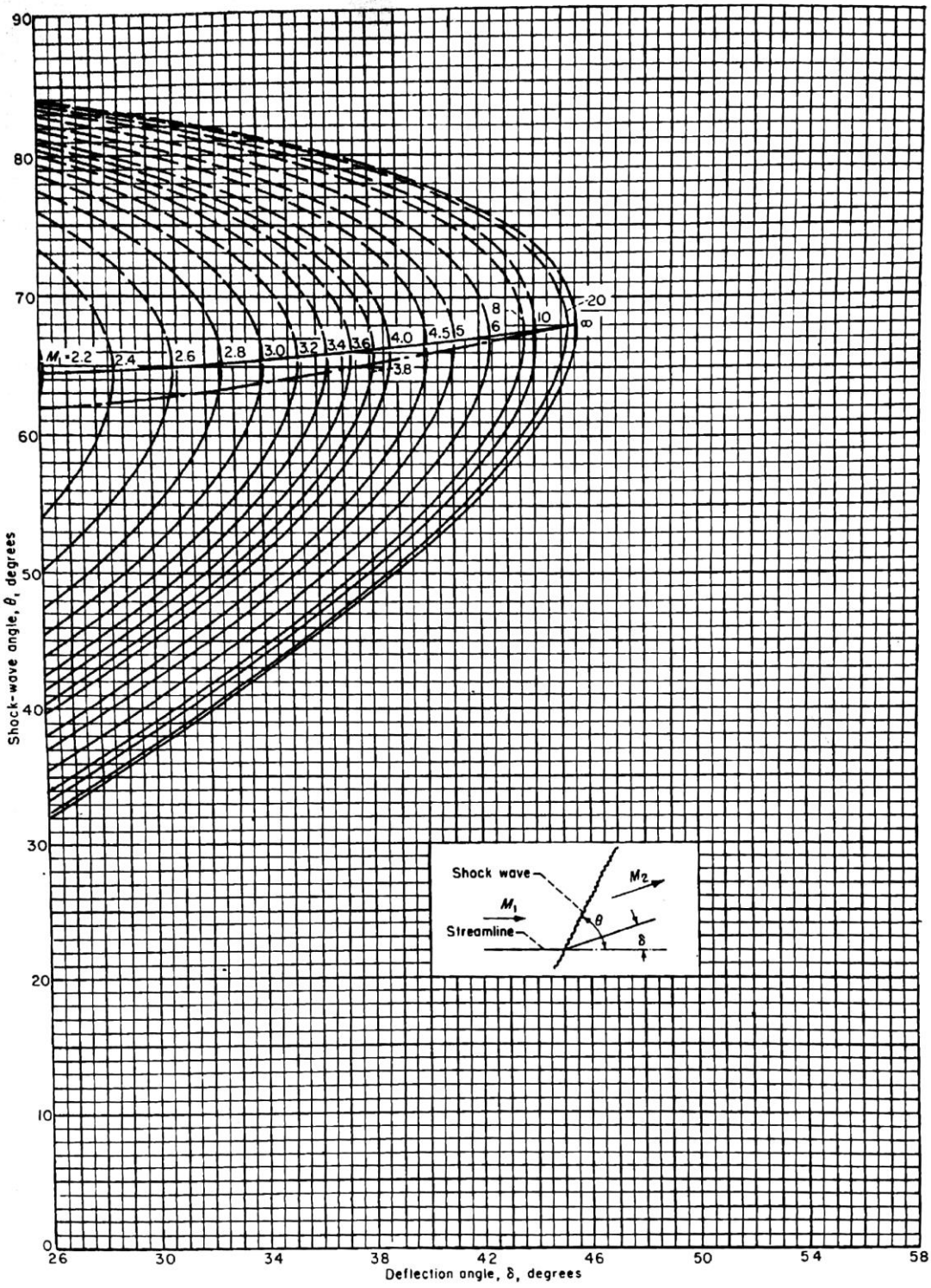

CHART 2.—Concluded