UNIVERSITY OF NOTRE DAME
DEPARTMENT OF AEROSPACE AND MECHANICAL ENGINEERING

Professor H.M. Atassi
113 Hessert Center
Tel: 631-5736
Email:atassi@nd.edu

AME-60639
Advanced Aerodynamics

Homework 8

Two fundamental problems of supersonic flows were studied in class:

1. The supersonic flow over a wedge turned into itself was analyzed and shown to produce a compression wave. An exact solution for this problem was developed using the oblique shock theory.

2. The supersonic flow over a wedge turned away from itself was shown to produce an expansion wave known as the Prandtl-Meyer expansion. An exact solution for the Prandtl-Meyer expansion was derived.

The supersonic flow over a thin airfoil was determined by noting that the upper surface of the airfoil produces an expansion wave and that the lower surface of the airfoil produces a compression waves. This has enabled us to calculate the lift and drag of the airfoil in supersonic flow.

A linearized supersonic flow theory over a thin airfoil gives the following simple formula for the lift coefficient

$$C_L' = \frac{4\alpha}{\sqrt{M^2 - 1}}, \tag{1}$$

where α is the angle of attack, and M is the Mach number.

Assess the validity of the linearized theory by calculating lift coefficients for $M = \{1.5, 3, 5\}$ and $\alpha = \{5^o, 10^o, 15^o\}$ and comparing and plotting the results with equation (1).