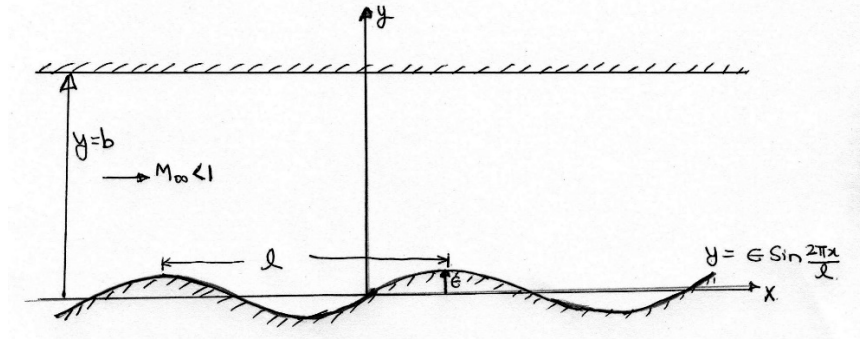


Compressible Aerodynamics (AE-311) (2019-20 – I Semester)

Assignment 6

Problem 1: (Subsonic flow over a wavy wall of finite lateral extent)



Assume the flow is bounded at $y = b$ by a solid wall, i.e., impose the boundary condition $v = 0$ at $y = b$. Show that the perturbation potential is given by:

$$\phi = \frac{-\varepsilon U}{\sqrt{1-M_\infty^2}} \frac{\cosh[\alpha \sqrt{1-M_\infty^2}(b-y)]}{\sinh[\alpha \sqrt{1-M_\infty^2}b]} \cos(\alpha x)$$

Problem 2: Consider a flat plate (planform area, S) with chord length c at an angle of attack α to a supersonic free stream of Mach number M_∞ . The quarter chord point is located, by definition, at a distance equal to $c/4$ from the leading edge. Using linearized theory, derive the following expression for the moment coefficient about the quarter chord point for supersonic flow

$$C_{M_{c/4}} = \frac{-\alpha}{\sqrt{M_\infty^2 - 1}}$$

where $C_{M_{c/4}} = \frac{M_{c/4}}{\frac{1}{2} \rho_\infty V_\infty^2 S c}$. The positive moment is in the direction of increasing angle of attack.