

**Homework # 1**  
**Introduction to Compressible Flow**  
**Due 1/24/3**

Read chapters 1, 2 and 3. Scan and be able to answer the problems in chapters 1 and 3 (Note some of the topics we will have not yet covered by the due date of the assignment.) In addition, turn in the following problems.

1. For steady isentropic flow of a compressible fluid, show that

$$\frac{p}{p_o} = 1 + \frac{1}{p_o K_s} \ln \left( 1 - \frac{1}{2} M^2 \right)$$

and

$$\frac{\dot{M}}{A} \sqrt{\frac{K_s}{\rho_o}} = M \sqrt{1 - \frac{1}{2} M^2}$$

where  $K_s = (1/\rho)(\partial\rho/\partial p)_s$ , is the isothermal coefficient of compressibility.

2. Air is flowing in a convergent nozzle. At a particular location within the nozzle the pressure is 280 kPa, the stream temperature is 345 K, and the velocity is 150 m/s. If the cross-sectional area at this location is  $9.29 \times 10^{-3} \text{ m}^2$ , find:
- (a) The Mach number at this location.
  - (b) The stagnation temperature and pressure.
  - © The area, pressure and temperature at the exit where  $M = 1.0$ .
  - (d) The mass rate of flow for the nozzle.

Indicate any assumptions you may make and the source of data used in the solution.