SPC 407
Sheet 3
Compressible Flow – Normal Shock wave

1. Consider supersonic flow impinging on the rounded nose of an aircraft. Is the oblique shock that forms in front of the nose an attached or a detached shock? Explain.
2. Can a shock wave develop in the converging section of a converging–diverging nozzle? Explain.
3. Air enters a normal shock at 26 kPa, 230 K, and 815 m/s. Calculate the stagnation pressure and Mach number upstream of the shock, as well as pressure, temperature, velocity, Mach number, and stagnation pressure downstream of the shock. Calculate the entropy change of air across the normal shock wave.
4. For an ideal gas flowing through a normal shock, develop a relation for V2/V1 in terms of k, Ma1, and Ma2.
5. Air enters a converging–diverging nozzle with low velocity at 2.0 MPa and 100°C. If the exit area of the nozzle is 3.5 times the throat area, what must the back pressure be to produce a normal shock at the exit plane of the nozzle?
6. What must the back pressure be in Prob. 5 for a normal shock to occur at a location where the cross-sectional area is twice the throat area?
7. Air enters a converging–diverging nozzle of a supersonic wind tunnel at 1 MPa and 300 K with a low velocity. If a normal shock wave occurs at the exit plane of the nozzle at Ma = 2.4, determine the pressure, temperature, Mach number, velocity, and stagnation pressure after the shock wave.