1. (a) Derive the Maxwell Relations from the basic thermodynamic relations.

(b). Prove that $du = C_v dT + [T(\frac{\partial P}{\partial T})_v - P]dv$

$dh = C_p dT + [v - T(\frac{\partial v}{\partial T})_p]dp$

(c). Prove that for ideal gas

$du = C_v dT$

$dh = C_p dT$

2. The centrifugal air compressor of a gas turbine receives air from the ambient atmosphere where the Pressure is 1 bar and temperature is 300°K. At the discharge of Compressor the Pressure is 4 bar. the temperature is 480°K, and the velocity is 100 m/sec. The mass rate of flow into the Compressor is 15 kg/sec. Determine the power require to drive the Compressor. ($C_p = 1.0035$ kJ/kg.K)

3. An air-standard Diesel cycle has a Compression ratio of 18, and the heat transferred to the working fluid per cycle is 1800 kJ/kg. At the beginning of the Compression Process the Pressure is 0.1 MPa and the temperature is 15°C. Determine:

(1) The Pressure and tenperature at each point in the cycle.

(2) The thermal efficiency

(3) The mean effective pressure ($C_v = 0.7165$ kJ/kg K)

4. Explain the following terms

(a). Relative humidity and humidity ratio

(b) Throttling Process and Joule-Thomson Coefficient

(c) Availability

(d) Fugacity

(e) Carnot cycle