$E = E(S, V)$

$W = W(S, P)$

$F = F(T, V)$

$\Phi = \Phi(T, P)$

$$dE = \left(\frac{\partial E}{\partial S}\right) dS + \left(\frac{\partial E}{\partial V}\right) dV$$

$$dW = \left(\frac{\partial W}{\partial S}\right)_P dS + \left(\frac{\partial W}{\partial P}\right) dP$$

$$dF = \left(\frac{\partial F}{\partial T}\right)_V dT + \left(\frac{\partial F}{\partial V}\right)_T dV$$

$$d\Phi = \left(\frac{\partial \Phi}{\partial T}\right)_P dT + \left(\frac{\partial \Phi}{\partial P}\right)_T dP$$

$$dE = T\,dS - P\,dV$$

$$\boxed{T = \left(\frac{\partial E}{\partial S}\right) \;;\; P = -\left(\frac{\partial E}{\partial V}\right)_S}$$

$$dW = T\,dS + V\,dP$$

$$\boxed{T = \left(\frac{\partial W}{\partial S}\right) = T \;;\; \left(\frac{\partial W}{\partial P}\right)_S = V}$$

dF ; $d\Phi$

$$\boxed{\left(\frac{\partial F}{\partial T}\right)_V = -S \;;\; \left(\frac{\partial F}{\partial V}\right)_T = -P}$$

$$\boxed{\left(\frac{\partial \Phi}{\partial T}\right)_P = -S \;;\; \left(\frac{\partial \Phi}{\partial P}\right)_T = V}$$

Maxwell Relations

$$f(x,y) = \left(\frac{\partial f}{\partial x}\right) dx + \left(\frac{\partial f}{\partial y}\right)_x dy$$

$$\frac{\partial^2 f}{\partial x \partial y} = \frac{\partial^2 f}{\partial y \partial x}$$

$$\frac{\partial^2 E}{\partial S \partial V} = \frac{\partial^2 E}{\partial V \partial S}$$

$$\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V \quad \text{Energy}$$

$$\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P \quad \text{Enth}$$

$$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V \quad \text{Helm}$$

$$\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P \quad \text{Gibbs}$$