

Magnetic systems

$$E(S, H)$$

$$dE = T dS - p dV$$

↓ Legendre transformation

$$F(T, H) = E - TS$$

$$dF = -S dT - M dH$$

Maxwell relation
 \implies

$$\left(\frac{\partial S}{\partial H}\right)_T = \left(\frac{\partial M}{\partial T}\right)_H$$

↓ Legendre transformation

$$A(T, M) = F + MH$$

$$dA = -S dT + H dM$$

Maxwell relation
 \implies

$$-\left(\frac{\partial S}{\partial M}\right)_T = \left(\frac{\partial H}{\partial T}\right)_M$$