

ELEG 667-016; MSEG-667-016 - Solid State Nanoelectronics – Fall 2005
Homework #3 (revised) - due Thursday, 22 September 2005, in class

1. **Ferroelectric criterion for atoms:** Consider a system of two neutral atoms separated by a fixed distance a , each atom having a polarizability α . Find the relation between a and α for such a system to be ferroelectric. *Hint:* The dipolar field is strongest along the axis of the dipole.

2. **Saturation polarization at Curie point:** In a first-order transition, the equilibrium condition:

$$(T-\Theta)/C - |g_4|P_s^2 + g_6P_s^4 = 0$$

(note: the previous version incorrectly had the term $g_6P_s^6$ in the above equation)

with T set equal T_c gives one equation for the polarization $P_s(T_c)$ at the transition temperature. A further condition at the Curie point is that $F(P_s, T_c) = F(0, T_c)$.

(a) Combining these two conditions, show that $P_s^2(T_c) = 3|g_4| / 4g_6$.

(b) Using this result, show that $T_c = \Theta + 3 C g_4^2 / 16g_6$.