Problems Ch 9

9.1. Solve for the magnetization vs. field for a) a thin film of amorphous iron boron silicon (assume $\mu_o M_s = 1.6$T and $K = 0$) with the field applied normal to the film surface. b) a single crystal sphere of Ni with the field applied along the [111] direction.

9.2 Does the energy required for complete saturation in the Stoner-Wohlfarth model as described by Eq. 9.13 diverge for $0 < \theta_o < \pi/2$ or take on a finite value?

9.3 Consider the magnetization process in a single-domain particle having cubic anisotropy using a field applied along an easy axis orthogonal to the initial magnetization. (Because of the uniqueness of this initial condition, i.e. the special way the sample is prepared before application of the measuring field, the result you derive will not be typical for cyclic magnetization.) Write and plot the energy density vs. θ then find the shape of the *m-h* curve. Locate the critical parameters by combining the equilibrium condition with the condition that the solution to $f'(\theta) = 0$ also be an inflection point.

9.4 Consider the two dimensional magnetization of a thin film with four-fold in-plane anisotropy $f_a = K_1 \cos^2 2\theta$ with an external field and stress σ_{xx} applied collinearly as shown below:
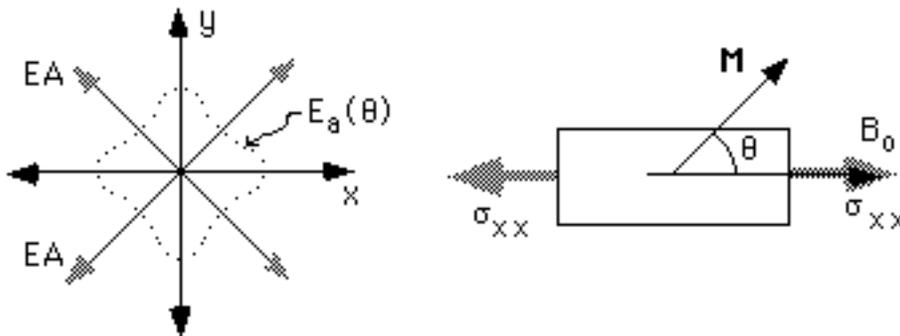
Solve for the equation of magnetization and sketch the results for $B_1e_{xx} > 0$ and < 0. Compare with the results in Prob. 9.4.

9.5 Consider a thin film with in-plane cubic anisotropy K_1 and a superimposed uniaxial anisotropy with easy axis along one of the four-fold easy axes. A field is applied in-plane, perpendicular to the uniaxial easy axis. a) Write the expression for the free energy. b) Sketch the energy surfaces for the various terms. c) Write the equation of motion and sketch m vs. H. d) How does m-H differ for $K_u > 5\,K_1$ or $K_u < 5\,K_1$?

9.6 Work out the steps to derive the field dependence of magnetization $M(H)$ for a material with uniaxial magnetic anisotropy and H applied perpendicular to the easy direction of magnetization.

9.7 Explain why the coercivity of amorphous alloys goes through a minimum as the magnetostriction constant λ_s goes through zero. Give formula(s) to support your explanation.

9.8 Derive an expression for rotational permeability in cubic anisotropy, and compare with Eq. 9.8 for uniaxial anisotropy.

9.9. Determine the g-factor of the YIG sphere in Fig. 9.46 using Eq. 9.15.