Problem Set No. 3

Reading assignment: Section 3.3, 3.4 ; J. A. Kong, "*Electromagnetic Wave Theory*," EMW Publishing, 2005.

Problem P3.1

Use the *kDB* system to determine the dispersion relations for a biisotropic medium (Tellegen medium) with the constitutive relation

$$\overline{D} = \epsilon \overline{E} + \xi \overline{H}$$
$$\overline{B} = \xi \overline{E} + \mu \overline{H}$$

Problem P3.2

A Nicol prism made of calcite is cut diagonally and then joined together with a film of Canada balsam (refractive index n=1.53). Calcite is a negative uniaxial crystal with $\sqrt{\epsilon_z/\epsilon} = 1.49/1.66$. An incident light from the left will become a linearly polarized light when it leaves the crystal from the right. Show that with the arrangement shown in Fig. 1 an incident light from the left becomes a linearly polarized light when it leaves the crystal from the right. ($\alpha \approx 30.5^\circ$)

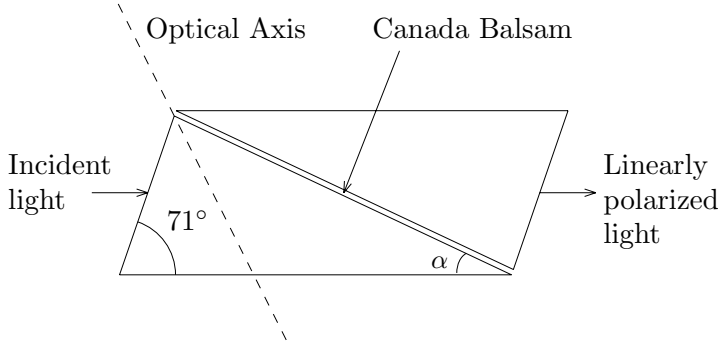

Fig. 1.

Problem P3.3

In a ferrite, the magnetic moment $\overline{M}$ roughly obeys the relationship $d\overline{M}/dt = g\mu_0 \overline{M} \times \overline{H}$, where g is the gyromagnetic ratio. When a $\hat{z}$-directed dc magnetic field $\overline{H}_0$ (zeroth order) is present, the total fields take the form $\overline{H} = \hat{z}H_0 + \overline{H}_1$, $\overline{M} = \hat{z}M_0 + \overline{M}_1$, and $\overline{B} = \mu_0(\overline{H} + \overline{M})$. Find dispersion relations for the first-order fields. Show that Faraday rotation exists in the ferrite.