

## ELEN 3401 Electromagnetics Problem Set #9

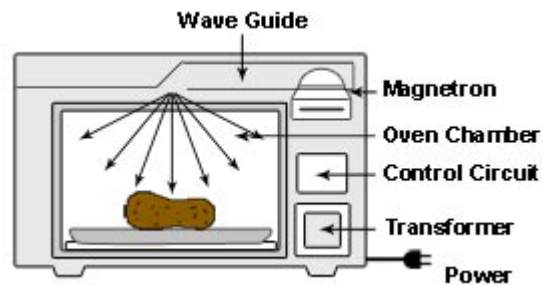
DUE: Friday April 25

Please include your name and UNI on the assignment

### Problem 1: Microwave oven

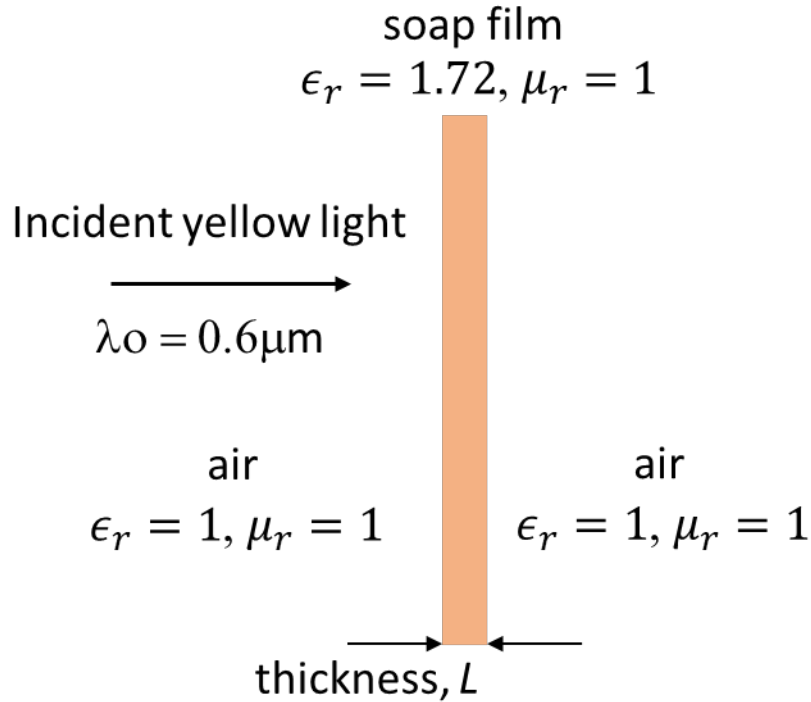
At 2 GHz, the conductivity of meat is on the order of 1 (S/m). When a material is placed inside a microwave oven and the field is activated, the presence of the electromagnetic fields in the conducting material causes energy dissipation in the material in the form of heat.

- Develop an expression for the time-average power per  $\text{mm}^3$  dissipated in a material of conductivity  $\sigma$  if the peak electric field in the material is  $E_0$ .
- Evaluate the result for an electric field  $E_0 = 4 \times 10^4$  (V/m).
- Explain why it is not advisable to use metal in a microwave oven. (Bonus – what might be the advantage of using a metal foil in a microwave oven just below the pizza crust.)



### Problem 2: Plane wave propagation through thin soap film

A thin film of soap is illuminated by yellow light at normal incidence of wavelength,  $\lambda_0 = 0.6 \mu\text{m}$  as shown in the figure below. ( $\lambda_0$  is the wavelength of the yellow light in air or free space)



The film is surrounded on both sides by air (with free space parameters  $\epsilon_r = 1, \mu_r = 1$ ) and can be treated as a planar perfect dielectric slab with parameters  $\epsilon_r = 1.72, \mu_r = 1$ .

Obtain the thinnest film thickness that would produce the strongest reflection of the normally incident yellow light.