Electrical Eng. Dept., Jordan Univ. of Science & Technology

Electromagnetics II, EE 307, First Exam, 29/10/2014

- Start each question in a new page. You HAVE to write the expressions used for calculations. Write CLEARLY. Put the final answer in a BOX. Show your work to get partial credit. Good luck!

1. **(8 points)** A microwave oven operating at 2.5 GHz is used to heat a piece of *chicken burger* having a complex permittivity of $\epsilon_c=(100-j)\epsilon_0$ (F/m). Assume that a uniform plane wave penetrates through the *burger* with an amplitude of E_0=1000 (V/m) at its upper surface; i.e., E(z=0)=1000 (V/m) where z=0 is the upper surface of the *burger*. The thickness of this *burger* is 1 cm. (Assume μ_r=1)

   (a) (4 points) Find the magnitude of the electric field at the bottom surface of the *burger*.

   (b) (4 points) Given that the total average power dissipated inside this *burger* is 5.3 W, find its radius.

2. **(7 points)** A uniform plane wave traveling in a very good conductor has:
   $\bar{E} = \hat{x}\,10\,e^{-\alpha z}\cos(\omega t-\beta z)$ (V/m).
   The wave goes through a phase change of 1 radian through a distance of 1.35 mm. (at a fixed time)
   Also, the time-average power density at z=1 cm is 0.8221 W/m^2. Assume $\epsilon=\epsilon_0$ and $\mu=\mu_0$.
   Find the conductivity σ, the frequency, the phase velocity and the wavelength.

3. **(10 points)** A uniform plane wave ($\bar{E}_i = \hat{x}\,E_{i0}\cos(\omega t-\beta_1 z)$ (V/m)) propagating in a non-magnetic lossless dielectric is normally incident on another lossless medium with $\epsilon_{r2}=\mu_{r2}=4$. The figure below shows the standing wave in medium (1).

   (a) (2 points) Find the reflection coefficient Γ.

   (b) (2 points) Find the values of E_{r0} and E_{i0}.

   (c) (3 points) Find the wavelength in medium (2).

   (d) (3 points) Find the distances d_1 and d_2 from the interface (where $d_1 < d_2 < \lambda_1/2$) at which $|\bar{E}_1|$=8 V/m.