ECEN 360 Exam #1
Winter 2010
Feb. 18-23
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Name: ______________________________________

Instructions – Please Read

1. Closed book and closed notes
2. No time limit
3. This exam consists of 8 problems
   a. Questions 1-7 are short answer worth 10 point each. Put your answers on the provided line. Be sure to include your work in case partial credit is awarded.
   b. Question 8 is a longer question worth 30 points. This problem will be awarded partial credit. 10 points will be given for a clear description of your solution. 20 points will be given for providing the correct solution. Be sure to start using equations given in the appendix.

Appendix

Maxwell's Equations

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$\nabla \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$$

$$\nabla \cdot \vec{B} = 0$$

$$\nabla \cdot \vec{D} = \rho_v$$

$$\vec{D} = \varepsilon \vec{E} = \varepsilon_r \varepsilon_o \vec{E}$$

$$\vec{B} = \mu \vec{H} = \mu_r \mu_o \vec{H}$$

$$\vec{J} = \sigma \vec{E}$$

Gauss's Law: $\oint_S \vec{D} \cdot d\vec{s} = \int_v \rho_v \, dv = Q$

Voltage: $V = -\int_l \vec{E} \cdot d\vec{l}$

Resistance: $R = \frac{V}{I} = \frac{-\int_l \vec{E} \cdot d\vec{l}}{\int_s \vec{J} \cdot d\vec{s}} = \frac{-\int_l \vec{E} \cdot d\vec{l}}{\int_s \sigma \vec{E} \cdot d\vec{s}}$

Capacitance: $R = \frac{Q}{V}$

Ampere's Law: $\oint_C \vec{H} \cdot d\vec{l} = \int_s \vec{J} \cdot d\vec{s} = I$

Magnetic flux: $\Phi = \int_s \vec{B} \cdot d\vec{s}$

Inductance: $L = \frac{\Lambda}{I} = \frac{N\Phi}{I}$

Boundary Conditions

Tangential E:	$E_{1t} = E_{2t}$	$\hat{n} \times (\vec{E}_1 - \vec{E}_2) = 0$
Normal D:	$D_{1n} - D_{2n} = \rho_s$	$\hat{n} \cdot (\vec{D}_1 - \vec{D}_2) = \rho_s$
Tangential H:	$H_{1t} = H_{2t} = J_s$	$\hat{n} \times (\vec{H}_1 - \vec{H}_2) = \vec{J}_s$
Normal B:	$B_{1n} - B_{2n} = 0$	$\hat{n} \cdot (\vec{B}_1 - \vec{B}_2) = 0$

Faraday's Law: $V = -N \frac{\partial}{\partial t} \int_S \vec{B} \cdot d\vec{s}$

Calculus Theorems

Divergence Theorem: $\int_V \nabla \cdot \vec{F}\, dv = \oint_S \vec{F} \cdot d\vec{s}$

Stokes's Theorem: $\int_S \left(\nabla \times \vec{F}\right) \cdot d\vec{s} = \oint_C \vec{F} \cdot d\vec{l}$

Material Parameters

Permittivity of free-space: ε_o=8.85 X 10^{-12} F/m

Permeability of free-space: μ_o=4π x 10^{-7} H/m

Plane Wave

General plane wave equation: $\vec{E} = \vec{E}_o\, e^{-j\vec{k}\cdot\vec{r}}$

Propagation constant: $k = \omega\sqrt{\mu\varepsilon} = \frac{2\pi}{\lambda}$

Wavelength: $\lambda = \frac{v}{f}$

Phase velocity: $v = \frac{1}{\sqrt{\mu\varepsilon}} = \frac{c}{\sqrt{\varepsilon_r}}$