Last Name:	First name:
Student number	Signature

Faculty of Applied Science and Engineering

ECE357 Electromagnetic Fields

Second Test, March 22, 2005

Examiners – M. Mojahedi

Only Calculators approved by Registrar allowed
Answer the questions in the spaces provided or on the facing page
A complete paper consists of answers to all questions
For numerical answers specify units

DO NOT REMOVE STAPLE

Do not write in these spaces

1	2	3	4	5	TOTAL

$\varepsilon_0 = 8.854\times10^{-12}$ $[F/m]$, $\mu_0 = 4\pi\times10^{-7}$ $[H/m]$, $c = 3\times10^{8}$ $[m/s]$

Problem 1) Consider a lossy but simple medium (linear, isotropic, homogenous) which contains both electric and magnetic impressed (source) current densities ($\vec{J}_i$, and $\vec{M}_i$) and magnetic (fictitious) and electric charge density (ρ_{mv}, ρ_{ev}).

(a) For the above medium find the wave equation governing the dynamical behavior of the instantaneous magnetic field intensity, $\vec{H}(r,t)$. **(26 pts)**

(b) Give the time-harmonic form of the wave equation found in part (a). **(7 pts)**

Problem 2) A $75\,\Omega$ lossless transmission line of length 0.4λ is connected to a $Z_L = 100 + j150\,\Omega$ load. Using the Smith chart (attached) answer the following questions

a) Determine the reflection coefficient, Γ. **(6 Pts)**

b) Determine the standing wave ratio, S. **(6 Pts)**

c) Locate and give value of the load admittance, Y_L. **(6 Pts)**

d) Determine the line input impedance, Z_{in}. **(8 Pts)**

f) Determine the location of the first voltage maximum. **(7 Pts)**

Important Note: To receive full credit, you must mark the appropriate points on the chart and clearly describe the procedure used to obtain the values for the above parameters.

Problem 3) In discussing the solution to the wave equation for scalar potential

$$\nabla^2 V(r,t) - \frac{1}{c^2}\frac{\partial^2 V(r,t)}{\partial t^2} = -\rho_{ev}(r,t)/\varepsilon_0 \,, \qquad (1)$$

we began by considering the electrostatic case; stating that the solution to

$$-\nabla^2 V(r) = \rho_{ev}(r)/\varepsilon_0 = \phi(r) \qquad (2)$$

is given by

$$V(r) = \iiint \frac{\phi(r')}{4\pi\left|\vec{r} - \vec{r}'\right|}\, d^3 r' \,. \qquad (3)$$

Here prove that indeed (3) is a solution of (2). **(34 Pts)**