UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE & ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

SUPPLEMENTARY EXAMINATION JULY 2014

TITLE OF PAPER:	**ELECTROMAGNETIC FIELDS II**
COURSE CODE:	**EE441**
TIME ALLOWED:	**THREE** HOURS

INSTRUCTIONS:

1. Answer any **four (4) questions**
2. Each question carries 25 marks.
3. Marks for different sections are shown in the right-hand margin.

This paper has 3 pages including this page.

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Question 1

A I-GHz x-polarized plane wave traveling in the +z-direction is incident from air upon a copper surface. The air-to-copper interface is at $z = 0$ and copper has $e_r = I$, $m_r = I$, and s = 5.8 X 10^7 S/m. If the amplitude of the electric field of the incident wave is 20 (mV*1*m*)*, and assume the metal surface to be several skin depths deep, obtain

a) the wavenumber and intrinsic impedance for the air. (5 marks)
b) the reflection transmission coefficient, and (6 marks)
c) expressions for the instantaneous electric and magnetic fields in the air medium. (14marks)

Question 2

In the response to a step voltage, the voltage waveform shown in Figure 2 was observed at the midpoint of a lossless transmission line with $Z_0 = 50\ \Omega$ and $u_p = 2.5 \times 10^8$ m/s. Determine:

a) Determine the length of the line, (3 marks)
b) Draw the voltage bounce diagram, (13 marks)
c) Determine load impedance, (3 marks)
d) Determine generator impedance, and (3 marks)
e) Determine generator voltage. (3 marks)

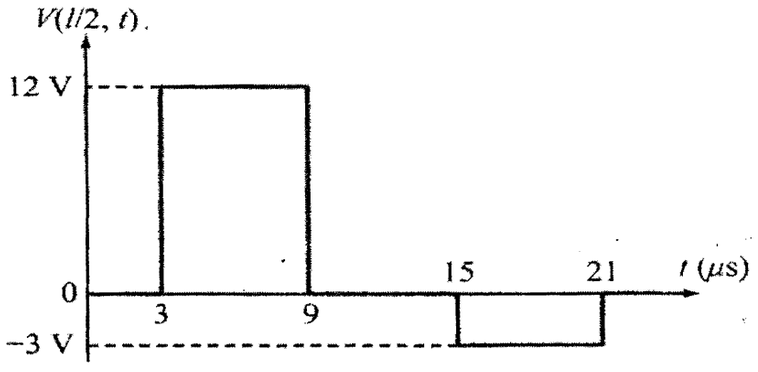

Figure 2

Question 3

Use the Smith chart to determine the input impedance Z_{in} of the feed line shown in Figure 3. All lines are lossless with $Z_0 = 50\ \Omega$. (25 marks)

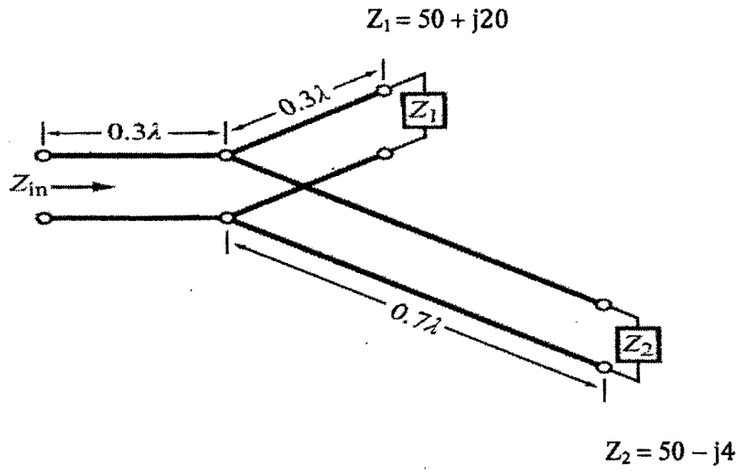

Figure 3

Question 4

The electric-field phasor of a uniform plane wave traveling downward in water is given by

$$\widetilde{E} = \hat{x}8e^{-0.2z}e^{-j0.2z}$$

where $\hat{z}$ is the downward direction and z = 0 is the water surface. If $\sigma = 4$ S/m.

Determine:

a) the expression for intrinsic impedance η_C, (6 marks)

b) the expression for the average power density S_{av}, (8marks)

c) the attenuation rate, (3marks)

d) the depth at which the power density has been reduced by 40 dB., and (3 marks)

e) the expression for E(z,t). (5 marks)

Question 5

Explain in detail the principles of operation of an electromagnetic motor and an electromagnetic generator. (25 marks)