UNIVERSITY OF ESWATINI

FACULTY OF SCIENCE & ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

RESIT / SUPPLEMENTARY EXAMINATION JANUARY 2019

TITLE OF PAPER:	**ELECTROMAGNETIC FIELDS II**
COURSE CODE:	**EEE441/EE441**
TIME ALLOWED:	**THREE** HOURS

INSTRUCTIONS:

1. Answer all **(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.

DO NOT OPEN THE PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR.

QUESTION 1

A 2.1 GHz generator with series impedance Z_g = 10 Ω and voltage source given by

$$v_g(t) = 10\sin(\omega t + 30^0) \qquad (V)$$

Is connected to a load ZL = (50 + j50) through a 50 Ω , 67cm long lossless transmission line. The phase velocity of the line is 0,7C where c is the velocity of light in a vacuum. Find

a) The phase constant β (5 marks)
b) The reflection coefficient Γ (4 marks)
c) The input impedance Z_{in} (7 marks)
d) The incident voltage V_0^+ (Note: This parameter is complex) (9 marks)

QUESTION 2

a) A rectangular loop shown in Figure 3 is situated in the x-y plane and moves from the origin with velocity $\mathbf{u} = \hat{\mathbf{y}}10$ (m/s) in a magnetic field given by $\mathbf{B} = \hat{\mathbf{z}}0.4e^{-0.2y}$ (T).
At the instant that the loop sides are at y_1 = 4 m and y_2 = 4.5 m, and if the resistor R = 4 , find the following

i. The voltage V_{12} (7 marks)
ii. The voltage V_{43}, and (7 marks)
iii. The current I. (4 marks)

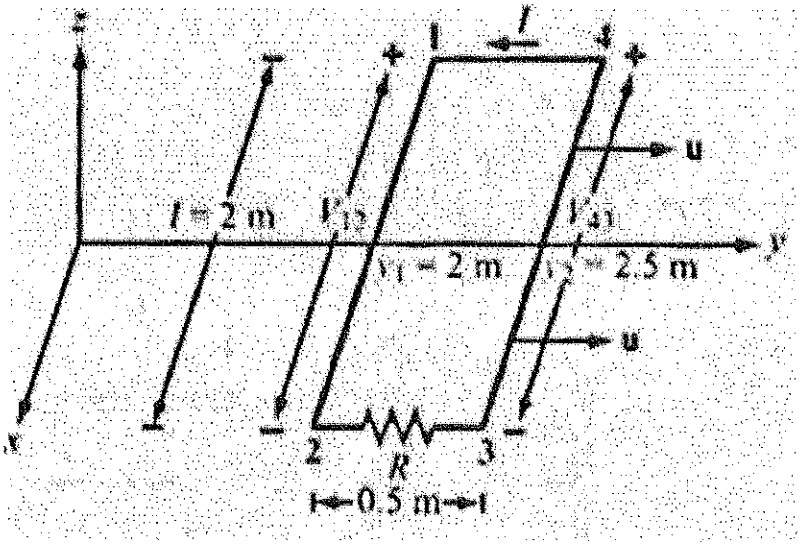

Figure 3

b) Explain how microwave energy is converted into thermal energy. (7 marks)

QUESTION 3

A 50 Ω transmission line connected to 116.67 Ω load is excited by a pulse from a generator with 21.429 Ω internal impedance. The pulse is rectangular, has a duration of 5 ns, an amplitude equal to 5 V, and starts at t = 2 ns. If the pulse takes 10 ns to propagate from the generator to the load, then generate a bounce diagram and draw the voltage waveform at the load for 80 ns. (25 marks)

QUESTION 4

a) A TM propagating in a dielectric-field waveguide of unknown permittivity has a magnetic field with a y-component given by $H_y = 6\cos(50\pi x)\sin(100\pi y)\sin(1.8\pi \times 10^9 t - 90\pi z)$ (mA/m). If the waveguide dimensions are a=2b=4cm, determine the mode numbers and the phase velocity (9 marks)

b) A submarine of 100 m below the sea surface uses a wire antenna to receive signal transmission at 1kHz. Determine the power density incident upon the submarine antenna due to the EM wave has $\alpha = 0.12$ (np/m), $|E_{x0}| = 4.5$ (mV/m) and $\eta_c = 0.06e^{j45}$. (10 marks)

c) Define linear polarization, polarization handedness, and skin depth. (6 marks)