Kaferelsheikh University		**Faculty of Engineering**
Department of Electrical Engineering		**Year: 3rd** Electronics and
Subject: Electromagnetic waves		**Electrical Communication**
Academic Number: EPM 3130		
Full Mark: 90 degree Final Exam: 2 pages	**Date: 13 /1/2019**	**Time allowed: 3 h**

This exam measures the ILOs (a.4, a.20, a.21, b2, b3, c1 and c2)

Answer the following questions:

[1] Question One: (20 Mark)

A- Define the following properties for a dielectric medium:

- Linearity   - Homogeneity   -Isotropy   [a.20.1 *(5 marks)*]

B- Starting with the general form of wave equation, **drive** an expression for the time and distance evolution for the magnetic field in lossless dielectric unguided medium [c.1.1*(5 marks)*]

C- Identify the different polarization types of plane waves

[a.21.1*(5 marks)*]

D- In a certain medium non-magnetic lossless medium with a relative permittivity 6.25, the magnetic field of an EM wave is given by: $H = 0.6\cos(10^8 t + \beta x)a_z \, A/m$

Find β, the direction of wave propagation and the electric field component using Maxwell equations.   [c.1.1*(5 marks)*]

[2] Question Two: (25 Mark)

A- A plane wave traveling in the +y direction in a lossy medium $(\varepsilon_r = 4, \mu_r = 1, \sigma = 10^{-2} \, moh/m)$ has $E = 30\cos(10^9 \pi t + \pi/4)a_z$ V/m, at y=0. **Find E at y=1m and t=2ns** and **Determine** the skin depth and wave polarization [a.21.1, b.3.1*(7 marks)*]

B- A uniform plane wave in air with $E_{is} = 10\cos(\omega t - 4x - 3y)a_z$ V/m is incident on lossless dielectric slab (y>0), having $\varepsilon_r = 2.5$ and $\mu_r = 1$. **Find** the polarization of the wave, angle of incidence and the electric field component of the reflected wave.   [a.21.1, b.3.1*(6 marks)*]

C- Discuss the phenomena of skin effect in electromagnetic wave propagation. [a.21.1 *(6 marks)*]

D- Brass waveguides are often silver plated to reduce losses. If at least the thickness of silver $(\varepsilon_r = 1, \mu_r = 1, \sigma = 6.1x10^7 S/m)$ must be five times of the skin depth, **find** the minimum thickness required for a waveguide operating at 12 GHz. [c.2.1*(6 marks)*]

[3] Question three: (20 Mark)

A- **prove** that an open or short section of transmission line can be used as an inductor or capacitor in microwave applications. [b.3.1*(6 marks)*]

B- It is desired to match a 50- ohm line to a load impedance of 60 - j50 ohm. **Design** a 50-ohm stub that will achieve the match. Find the length of the line and how far it is from the load (**Use smith chart**) [a.4.1, b.3.1*(8 marks)*]

C- The following measurements were taken using the slotted line technique: with load, s =1.8, V_{max} occurred at 23 cm, 33.5 cm,. . . ; with short, V_{max} occurred at 25 cm, 37.5 cm,. . . . If Zo = 50 ohm, determine the load impedance [c.1.1*(6 marks)*]

[4] Question four: (25 Mark)

A- **Define** the dominant mode for the propagation through wave guides, then **prove** that the dominant mode for rectangular wave guide is TE_{10}. [a.21.2, c.1.2*(6 marks)*]

B- An air-filled rectangular waveguide of dimensions a = 4 cm, b = 2 cm transports energy in the dominant mode at a rate of 2 mW. If the frequency of operation is 10 GHz, **determine** the **impedance** of the waveguide and the **peak value of the electric field** in the waveguide. [b.2.1, c.1.2*(7 marks)*]

C- A 2-cm by 3-cm waveguide is filled with a dielectric material with ε_r = 4. If the waveguide operates at 20 GHz with TM_{11} mode, **find**: (a) cutoff frequency, (b) the phase constant, (c) the phase velocity. [b.2.1, c.2.1*(6 marks)*]

D- An air-filled cubical cavity operates at a resonant frequency of 2 GHz when excited at the TE_{101} mode. **Determine** the dimensions of the cavity. [b.2.2, c.2.1*(6 marks)*]

Best Wishes **Committee of Correctors and Testers**

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