نموذج اجابة "موجات كهرومغناطيسية"

Kaferelsheikh University — **Faculty of Engineering**

Department of Electrical Engineering — **Year: 3rd Electronics and Electrical Communication**

Subject: Electromagnetic waves

Academic Number: EPM 3130

Full Mark: 90 degree **Final Exam: 2 pages** **Date: 10 /1/2018** **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- Write down the conditions for the following mediums:

- Perfect dielectric - lossy dielectric -good conductor [a.20.1 *(5 marks)*]

B- Starting with Maxwell equations, , **drive** the wave equation which describes the time and distance evolution for the electric field [c.1.1*(5 marks)*]

C- Discuss the effect of the dispersive medium on the electromagnetic wave velocity [a.21.1*(5 marks)*]

D- The electric field in free space is given by: $E = 50\cos(10^8 t + \beta x)a_y V/m$

i- **Find** the direction of wave propagation

ii- **Calculate** β and the time it takes to travel a distance of λ/2 [c.1.1*(5 marks)*]

[2] Question Two: (25 Mark)

A- A lossy dielectric has an intrinsic impedance of $200e^{j\pi/6}$ at a particular frequency. If, at that frequency, the plane wave propagating through the dielectric has the magnetic field component $H = 10\,e^{-\alpha x}\cos(\omega t - 0.5x)a_y$ A/m. **find E** and **Determine** the skin depth and wave polarization [a.21.1, b.3.1*(7 marks)*]

B- A 5-GHz uniform plane wave $E_{is} = 10e^{-j\beta z}a_x$ V/m in free space is incident normally on a large plane, lossless dielectric slab (z>0), having $\varepsilon_r = 4$ and $\mu_r = 1$. **Find** the electric field components of both the reflected and transmitted waves [a.21.1, b.3.1*(6 marks)*]

C- Derive an expression for the reflection coefficient in case of oblique incidence with parallel polarization. [a.21.1, c.1.1*(6 marks)*]

D- A polarized wave is incident from air to polystyrene with $\varepsilon_r = 3$ and $\mu_r = 1$ at Brewster angle. **Determine** the transmission angle [c.2.1*(6 marks)*]

[3] Question three: (20 Mark)

A- Given a distortion less T.L having distributed parameters of R, L, G and C. **Deduce** the relation used to determine the attenuation constant [b.3.1*(6 marks)*]

B- A 75 ohm lossless line is to be matched to a 100 - j80 (ohm) load with a shorted parallel stub. **Use smith chart to calculate** the stub length, its distance from the load, and the necessary stub admittance. [a.4.1, b.3.1*(8 marks)*]

C) Explain the slotted line technique used for impedance measurement. [a.4.1*(6 marks)*]

[4] Question four: (25 Mark)

A- with the aid of equations, prove that the wave propagation through rectangular wave guides takes zigzag paths. [a.21.2, c.1.2*(6 marks)*]

B- A standard air-filled rectangular waveguide with dimensions a = 8.636 cm, b = 4.318 cm is fed by a 4-GHz carrier from a coaxial cable. **Determine** the phase velocity and the group velocity if a TE_{10} mode will be propagated. [b.2.1, c.1.2*(7 marks)*]

C- Design a rectangular waveguide with an aspect ratio of 3 to 1 for use in the k band (18-26.5 GHz). Assume that the guide is air filled. [b.2.1, c.2.1*(6 marks)*]

D- Design an air-filled cubical cavity to have its dominant resonant frequency at 3 GHz [b.2.2, c.2.1*(6 marks)*]

Best Wishes **Committee of Correctors and Testers**

Dr. Shamia Ghamry