Menoufia University
Faculty of Electronic Engineering
Electronics and Electrical Commun. Eng. Dept.
Third Year
Microwave Engineering

Course Code: ECE 323

Midterm Examination 2016-2017
Time : 75 Minutes
Date : Thursday, April 27, 2017
Total Marks: 25 Marks
Instructor : Dr. Ahmed Farghal

Name:_____ Sec: [ ] A

ISA, you can ACE this exam!! **Think!!**

Total _____

ANSWER ALL QUESTIONS

Q1] List out the advantages of Microwave **[2 Marks]**

-
-
-
-
-

Q2] Derive an expression for the input impedance of the TL. Hence obtain the input impedance for a lossless line. **[4 Marks]**

-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-

Q3] Drive the expression that relates guided wavelength (λ_g), free space wavelength (λ) and cutoff wavelength (λ_c). **[3 Marks]**

-
-
-
-
-
-
-

Q4] Circle the correct answer(s): (show your justification when needed) [**11 Marks]**

---

1. A lossless TL with return loss 10 dB. The percentage of power that is reflected from the load is
   (a) 90%
   (b) 10%
   (c) 31.622%
   (d) 68.378%

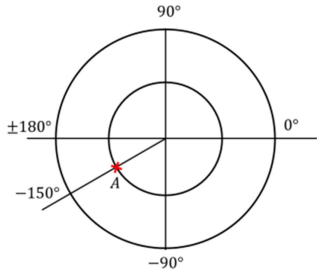
2. A TL at frequency 100 MHz has the following parameters: $R = 1.675$ [Ω/m], $L = 0.592$ [μH/m], $G = 2.12 \times 10^{-4}$ [S/m] and $C = 75$ [pF/m]. The type of this TL is
   (a) Lossless TL
   (b) low-loss TL
   (c) Lossy TL
   (d) Distortionless TL

3. The cutoff wavelengths (in meter) for the first ten modes of a certain air-filled rectangular waveguide are listed below. Circle the modes that can propagate at operating frequency 30 GHz.

TE_{10}	TE_{01}	TE_{11}	TE_{20}	TE_{02}	TE_{21}	TE_{12}	TE_{22}	TE_{30}	TE_{03}
0.03	0.015	0.01342	0.015	0.0075	0.01061	0.00728	0.0067	0.01	0.005

4. In an air TL, adjacent maxima are found at -12.5 cm and -37.5 cm. The source frequency is
   (a) 1.5 GHz
   (b) 600 MHz
   (c) 300 MHz
   (d) 1.2 GHz

5. A 500 m lossless TL is terminated by a load which is located at A on the Smith chart. If λ = 150 m, how many voltage maxima exist on the line?
   (a) 7
   (b) 6
   (c) 5
   (d) 3



6. Which of these is not true of a lossless line?
   (a) $Z_{in} = -jZ_o$ for a shorted line with $\ell = \lambda/8$.
   (b) $Z_{in} = j\infty$ for a shorted line with $\ell = \lambda/4$.
   (c) $Z_{in} = jZ_0$ for an open line with $\ell = \lambda/2$.
   (d) $Z_{in} = Z_o$ for a matched line.
   (e) At $\lambda/2$ from a load, $Z_{in} = Z_L$ and repeats for every half-wavelength thereafter.

7. The dominant mode in waveguides is characterized by
   (a) Having propagation constant equal to zero
   (b) Having phase constant equal to zero
   (c) Cannot be propagated without the other modes
   (d) None of the above

8. The line impedance of a shorted TL can be

(a) Z_0

(b) Zero

(c) Infinite

(d) Negative imaginary

(e) Positive imaginary

9. The mode of operation of a rectangular waveguide with the following magnetic field component $H_z = H_o \cos(\pi x/a) \cos(3\pi y/b)\, e^{-j10z}$ A/m will be

(a) TE_{13}

(b) TM_{13}

(c) TEM_{13}

(d) Both a and b

10. A car enters a 6 m ×4 m tunnel that can be modeled as an air-filled rectangular waveguide. Which radio band the driver can listen to

(a) Long wave radio (148.5 to 283.5 kHz)

(b) AM radio (525 to 1705 kHz)

(c) Shortwave radio (5.9 to 26.1 MHz)

(d) FM radio (87.5 to 108 MHz)

11. A rectangular waveguide is filled with dielectric material with $\varepsilon = 2.25\varepsilon_0$ and operates at 24 GHz. The cutoff frequency of a certain TE mode is 16 GHz, the group velocity and wave impedance of the mode are respectively

(a) 1.49×10^8 m/s and 187.32 Ω

(b) 2.68×10^8 m/s and 337.2 Ω

(c) 1.49×10^8 m/s and 337.2 Ω

(d) None of these

Q5] A load impedance $Z_L = 25 + j30$ Ω is to be matched to a 50 Ω line at a frequency of 500 MHz. Find one solution using an L-section matching network. Plot the resulting circuit with the component values shown. **[5 Marks]**

The Complete Smith Chart

Black Magic Design