INf = 8.68 dB

The LNM Institute of Information Technology, Jaipur

Department of Electronics and Communication Engineering

Engineering Electromagnetics (ECE 335)

Exam Type: Quiz | Academic Year: 2017-18 | Semester: ODD

Degree*: B.Tech | Programme*: B.Tech in ECE | Year: 2nd and 3rd

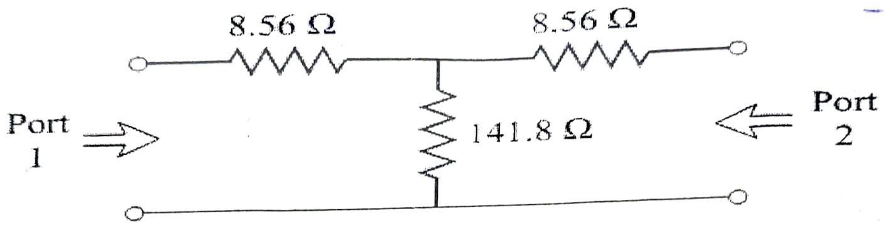
Time : 60 minutes | Date: 19/09/2017 | Maximum Marks: 30

	CO1	CO2	CO3	CO4	CO5
Questions	1,2a	3,4	-	-	-
Marks	6+2	22	-	-	-
Marks/Max Marks(%)	27	73	-	-	-

$S_{11} = 1$

Instruction: *Write answer to all parts of question in same place. Write Roll no on top right corner of the smith chart.*

[Q1]. Find the scattering parameters of the 3 dB attenuator with characteristic impedence 50 Ω circuit shown in figure below. Also find Z_{11}



$A = 1 + \frac{Z_1}{Z_2}$

$B = Z_3$

[2+2+2=6]

Q2]. A telephone line opearted at 1 kHz has $R = 30\ \Omega/km, L = 100\ mH/km, G = 0, and\ C = 20\ \mu F/km$. obtain

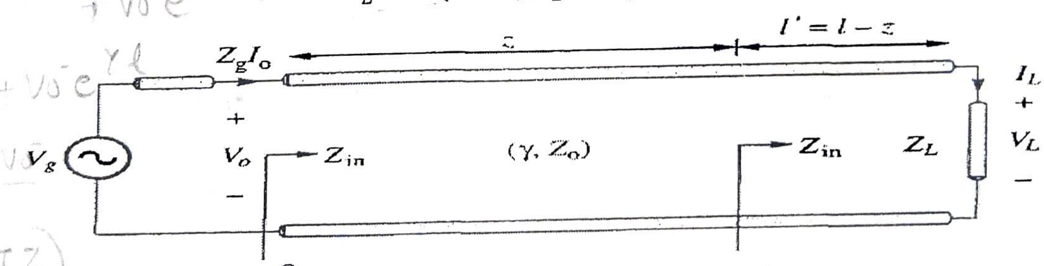
(a) The value of α in *dB/km.*

(b) The characteristic impedance of the line.

[2+2=4]

Q3]. (a) In the following figure derive equations for V_0^+ and V_0^-. Given the conditions at the load

$$V_L = V(z = l), I_L = I(z = l)$$



$V(l) = V_0^+ e^{-\gamma l} + V_0^- e^{\gamma l}$

$= V_0^+ e^{-\gamma l} + V_0^- e^{\gamma l}$

$\frac{V_0^+ e^{-\gamma l} - V_0^- e^{\gamma l}}{Z_0}$

$V_0^+ = \frac{1}{2}(V + IZ)$

(b) Show that the voltage reflection coefficient at any point on the line is given by $\Gamma(z) = \Gamma_L e^{-2\gamma l'}$

[4+4=8]

Q4]. A 30-m- long transmission line with $Z_0 = 50\ \Omega$ operating at 2 MHz is terminated with a load $Z_L = 60 + j40\ \Omega$. The velocity of propagation on the line is u = 0.6C, find **with and without using Smith Chart**

(a) The reflection coefficient Γ

(b) The standing Wave Ratio S

(c) The input impedence.

Use different color to indicate clearly the impedence and admittence. Label points.

[(2+2+2)+(2+2+2)=12]

$v = \frac{c}{\lambda}$

$\lambda f = u$

$\Gamma(z) = \frac{V_0^-(z)}{V_0^+(z)} = \frac{V_0^- e^{\gamma z}}{V_0^+ e^{-\gamma z}} = \frac{V_0^-}{V_0^+} e^{2\gamma(l-l')}$

$\lambda = \frac{u}{f} = 0.6 \times 3 \times 10^8$

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Department of Electronics and Communication Engineering

Engineering Electromagnetics (ECE0332)

End Term Examination

Academic Year: 2017-18 End Term-2017

Degree: *B. Tech.* **Program:** ECE/CCE

Time: 180 minutes **Date:**04/12/2017 **Maximum Marks:** 50

Instructions: THIS QUESTION PAPER CONTAINS TWO PAGES. EACH OF THE TEN (10) QUESTIONS CARRIES 5 MARKS. ALL QUESTIONS ARE COMPULSORY.
You can bring in FOUR A4 size formula-sheets with you to the Examination Hall. These sheets should be used to write (in your own hand-writing) difficult-to-memorize equations, formulas, vector relationships, values of natural constants, etc.

1. A 50-Ω, 12-cm long lossless transmission line is operating at a frequency of 10 MHz. The line inductance is known to be L= 2.5 mH/m. If the line is terminated with load impedance Z_L= 20 – j30 Ω, how much VSWR will be observed on the line? Also calculate the input impedance of the line.
2. Consider a two-port network with the following ABD parameters: A = 3, B = -j3 ohm, D = 1/3. The network is known to be reciprocal. What is the numerical value of the parameter C of the network? If two such networks are connected in cascade, calculate the scattering matrix of the overall combination. Assume port impedance (for all ports) to be 50 Ω.
3. A 100*MHz* generator with $V_g=10\angle 0°$ (*V*) and internal resistance 50Ω is connected to a lossless 50Ω air line that is 3.6*m* long and terminated in a 25+*j*25(Ω) load. Find (a) $V(z)$ at a location z from the generator, (b) V_i at the input terminals and V_L at the load, (c) the voltage standing-wave radio on the line, and (d) the average power delivered to the load.
4. A). A plane-wave propagating in a lossless dielectric medium has electric field strength given as $E_x=10\cos(1.51\times10^{10}t - 61.6z)$ mV/m, $E_y=0$, $E_z=0$, where t is the time measured in seconds. In which direction is the wave traveling? Also calculate the dielectric constant of the medium, the wavelength, the phase-velocity, and the wave-impedance for this wave.
   B). Consider a discharging capacitor for which the charge is varying with time t according to the following relationship: q (t) = 10 exp (-t) milli-coulombs where t is measured in seconds from the instant the discharge started. What will be value of the displacement current density produced between the plates 1 second after the discharge began? Assume that the medium between plates is air and that the plates are circular in shape with diameter equal to 10 cm.
5. Starting with the four Maxwell's equations, rigorously demonstrate that the intrinsic impedance of a good conductor has phase angle approximately equal to 45 degrees.
6. For a rectangular waveguide operating in its dominant TE_{10} mode, rigorously derive the mathematical expressions for the various field components. Assume that the material inside the waveguide is a lossless dielectric. Make appropriate assumptions if necessary, and clearly state the assumptions made. Hx, Hy Hz.
7. An X-band air-filled rectangular waveguide (a=22.86mm,b=10.16mm) is operating in its dominant TE_{10} mode at a frequency of 10 GHz. The energy is flowing along the length of the

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waveguide (i.e., in z-direction). The z-component of the magnetic field-strength vector is given by H_z=94.00cos $(\pi x/a)\exp[j(0.5\pi - k_z z)]$ mA/m. Calculate the power being transmitted in the waveguide. Neglect the effects of waveguide losses and the effects of higher-order modes

8. For an air-filled circular waveguide with diameter equal to 10 cm, calculate the cutoff frequencies of the first three TE modes and the first three TM modes. Neatly tabulate your results. Identify 'degenerate' modes if any present. Use Table 8.1 (for zeroes of the derivatives of Bessel functions) and Table 8.2 (for zeroes of Bessel functions).

n	p'_{n1}	p'_{n2}	p'_{n3}	p'_{n4}
0	3.8317	7.0156	10.1735	13.3237
1	1.8412	5.3314	8.5363	11.7060
2	3.0542	6.7061	9.9695	
3	4.2012	8.0152	11.3459	

Table 8.1 Zeroes p'_{nm} of $J'_n(x)$

n		p_{n1}	p_{n2}	p_{n3}	p_{n4}
0		2.4048	5.5200	8.6537	11.7951
1		3.8317	7.0155	10.1743	
2		5.1356	8.4172	11.6198	
3		6.3801	9.7610		

Table 8.2 Zeroes p_{nm} of $J_n(x)$

9. A). For the circular waveguide in Q 8, calculate the phase velocity, the group velocity, the wave impedance, and the guided wavelength at an operating frequency 1.25 times the cutoff frequency of the dominant TE mode. Assume that no other modes are propagating.

   B). A microstrip line is to be deposited on a 10-mil thick dielectric substrate material whose dielectric constant is equal to 2.22. If the strip width is chosen to be 2 mil, what would be expected value of the characteristic impedance of the line?

10. A). Design an air-filled coaxial line with characteristic impedance of 50 Ω and operating bandwidth of DC to 5.8 GHz. Ignore safety-margin-related concerns regarding the bandwidth of the line. (NOTE: To design means calculating the diameters of the two conductors.)

    B). An air-filled coaxial line has the outer conductor diameter = 2.30 cm and the inner conductor diameter = 1.00 cm. The line is L cm long where L is to be determined without using mechanical means. One end of the line (called 'load end') is terminated with a load whose impedance is 50 + j~~50~~ 25 Ω at 10 MHz frequency. The other end (called 'input end') is connected to a Vector Network Analyzer (VNA) so that the complex value of the input voltage reflection coefficient can be measured. The port impedances for VNA ports are all equal to 50 Ω. VNA measurements, carried out at 10 MHz frequency, show that the magnitude of the input voltage reflection coefficient is approximately equal to ~~0.4472~~ 0.2425 whereas the phase-angle of the same is approximately equal to 26.57 degrees. Determine the numerical value of L.

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