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

Course Code: ECE 323

Midterm Examination 2017-2018
Time : 1 Hour
Date : Saturday, March 17, 2018
Total Marks: 20 Marks
Instructor : Dr. Ahmed Farghal

Name: Dr. Ahmed Farghal **Sec:** [Instructor]

Total: _____

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

$$L' = \frac{\mu d}{W}, \quad C' = \frac{\epsilon_o \epsilon_r W}{d}, \quad L' = \frac{\mu_c}{2\pi}\ln\left(\frac{b}{a}\right), \quad C' = \frac{2\pi\epsilon_o\epsilon_r}{\ln(b/a)}, \quad 1\ \text{Np} = 8.686\ \text{dB}$$

ANSWER ALL QUESTIONS

[Q1] [6 Marks] An engineer started bounce diagram shown below, but being interrupted by a Facebook posting, never finished his work. As ECE 323 student, find:

(a) Γ_L=_____

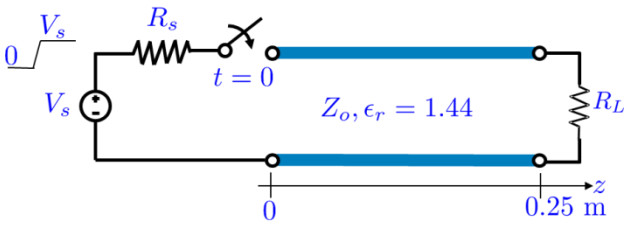
(b) R_L=_____

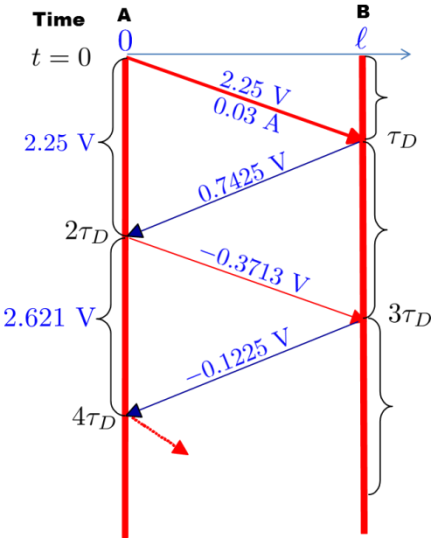
(c) Z_0=_____

(d) τ_D=_____

(e) R_s=_____

(f) V_s=_____





[Q2] [7 Marks] An electrician and plumber decide to start a new side project making **96 Ω lossless coaxial lines**. In their first product, they use an outer conductor made from copper water pipe with an **inside diameter of 1.27 cm**. The inner conductor is made from solid copper wire with an **outside diameter of 0.254 cm**. They use air as a dielectric.

(a) Unfortunately, there are not enough 1.27 cm diameter water pipes. Having not taken ECE 323 course, the plumber thought it would be fine to replace copper water pipe with an inside diameter 1.5875 cm. How will the voltage and current of an incident wave traveling down this T-line change? Why?

(b) The electrician thought they could save money and weight by using an inner conductor of hollow tubing with the same outside diameter of the solid copper wire. If they continue to use an outer conductor of 1.5875 cm diameter copper pipe, how will the characteristic impedance of this new cable be different from the cable with the solid center conductor? Why?

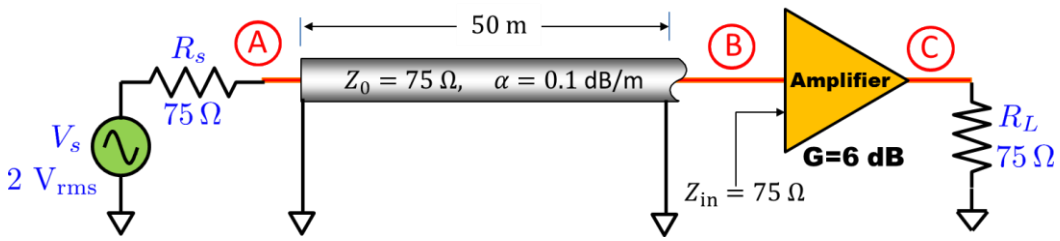
(c) The plumber and electrician decide to replace the air dielectric with the peanuts. This changes the per unit length capacitance to 50 pF/m, and Z_0 to 92 Ω. Determine:

i) Phase velocity

ii) Inductance per meter

iii) Dielectric constant ϵ_r

[Q3] [5 Marks] Consider the T-line circuit below.



$2\ V_{rms}$ AC source drives a 75 Ω T-Line with a $\alpha = 0.1$ dB/m. The end of the T-Line is terminated in a 6 dB (**voltage gain**) amplifier that has $Z_{in} = 75\ \Omega$. The output of this amplifier drives a $75\ \Omega$ resistive load. Find:

(a) The RMS voltage at point B

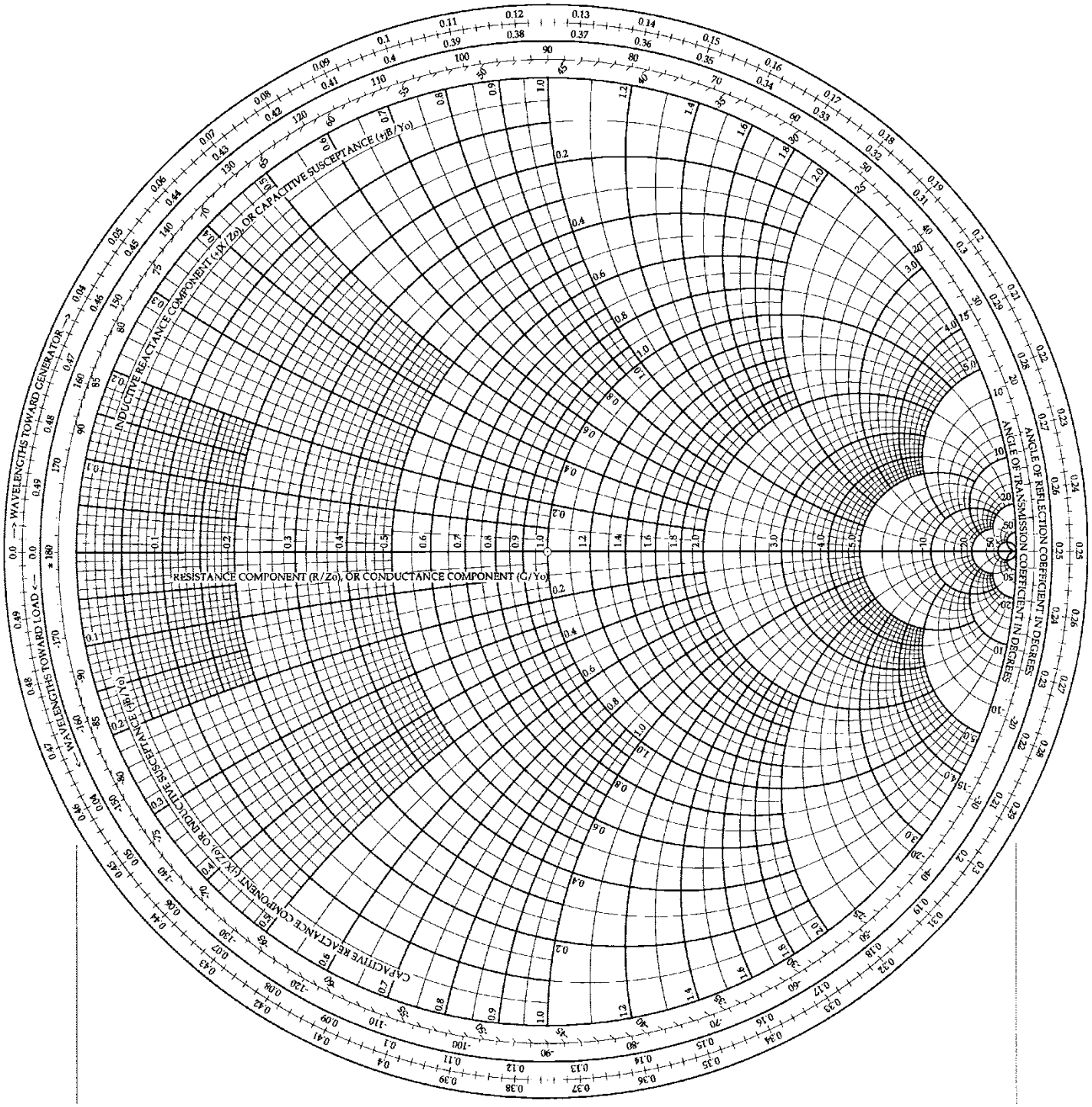
(b) The RMS voltage at point C

(c) The power delivered to the $75\ \Omega$ load in dBm.

[Q4] [7 Marks] Design a quarter-wavelength transformer (QWT) to match a load $Z_L = 45 - j60\ \Omega$ to a line with $Z_0 = 50\ \Omega$.

Is there a problem with your design? If yes, please state it.

With the help of Smith chart (and **without using any lumped elements or stubs**), show how you can tackle this problem. Show all possible solutions and determine the characteristic impedance of QWT for each possible solution.


RESISTANCE COMPONENT (R/Zo), OR CONDUCTANCE COMPONENT (G/Yo)
INDUCTIVE REACTANCE COMPONENT (+jX/Zo), OR CAPACITIVE SUSCEPTANCE (+jB/Yo)
CAPACITIVE REACTANCE COMPONENT (-jX/Zo), OR INDUCTIVE SUSCEPTANCE (-jB/Yo)
ANGLE OF REFLECTION COEFFICIENT IN DEGREES
ANGLE OF TRANSMISSION COEFFICIENT IN DEGREES
WAVELENGTHS TOWARD GENERATOR
WAVELENGTHS TOWARD LOAD