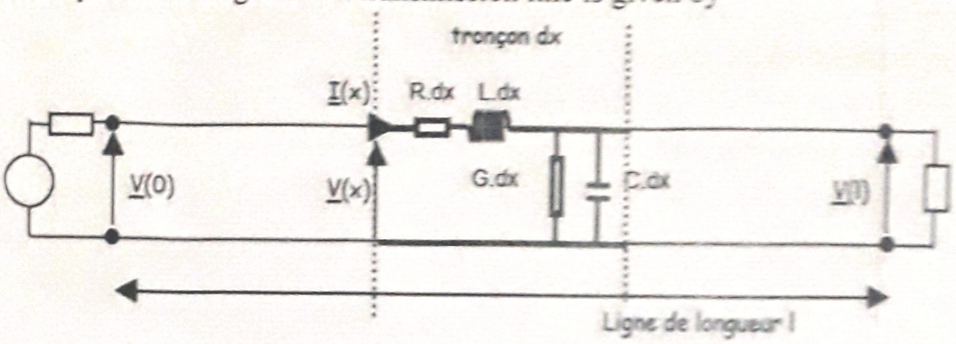
First & Last Name:..

First Exam

Course question: (08 points)

1. The equivalent diagram of a transmission line is given by



What represent Ldx, Rdx, Cdx, and Gdx

- R. linear Resistors to take in account Joule Effect losses in conductors. 0,25
- L. linear inductance in series represents the magnetic effect [illegible] 0,25
- G. " admittance in // represents the losses in insulation S/m. 0,25
- C. " capacitance in // to represent the capacitive effect between conductors F/m 0,25

2. Give the formulas of V(x,t) and I(x,t)) for a transmission line

- $V(x,t) = V_i e^{-\gamma x} + V_r e^{+\gamma x}$ 0,5 $= V_i e^{-\gamma x} + V_r e^{+\gamma x}$
- $I(x,t) = I_i e^{-\gamma x} + I_r e^{+\gamma x}$ 0,5 $= I_i e^{-\gamma x} + I_r e^{+\gamma x}$

3. Give a definition of an antenna and the formula of the Electric Field radiated by the antenna E

An antenna is a device used to radiate or capture radio waves in space. 0,5

$\vec{E} = j \frac{Z_0}{2\lambda R} \vec{I} dl \sin\theta \, e^{-j\beta r} e^{j\omega t} \vec{e_\theta}$ 0,5

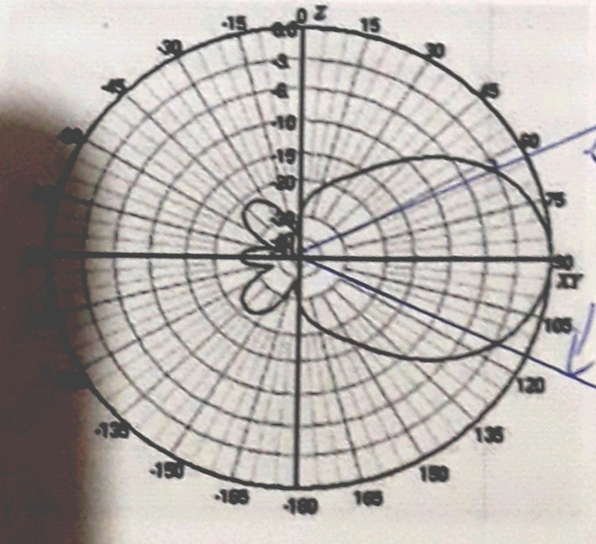
4. Give a definition to the radiation diagram and its formula

represents the variation in the power radiated by the antenna in different directions in space in function of (θ, φ, R) 0,5

$F(\theta,\varphi) = \frac{|\vec{E}|}{|E_{max}|}$ 0,5

5. Calculate approximately the value of the beam's half-power aperture angle (HPBW).

HPBW at (3dB) 0,5



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6. List 4 radiation characteristics of an antenna?

a. caracteristic Function / radiation pattern (0,25)
b. directivity (0,25)
c. Gain (0,25)
d. Width / the opening (HPBW) (0,25)

7. Mention the 4 families of antennas with examples:

a. Wired: Yagi-Uda, Helix, dipole (0,25)
b. with opening: horn, rectangular (0,25)
c. Reflectors: parabolic, horn (0,25)
d. planar: rectangular, circular (0,25)

Exercise 1 (04 points)

The primary parameters of an open-circuit bidirectional transmission line are given by: R = 3 [Ω / km], L = 3 [mH / km], G = 1.5 x 10^7 [S / km], and C = 12 [nF =/km].

For a frequency of 500 Hz, calculate:

1. The characteristic impedance.
2. The propagation constant.

Exercise 02: (04 points)

The geostationary satellite Meteosat, located at an altitude of 36,000 km above the Gulf of Guinea, transmits cloud cover images to Europe:

The satellite transmits a power of Po = 6 W

It is equipped with an antenna with a gain of G1 = 12,6 dBi

The receiving dish has a gain of G2 = 25 dBi

The transmission frequency is f = 1691 MHz (channel 1)

Find Po en dBm, G1, G2 and the power Pr received by the receiving dish?

Exercise 3: (04 points)

Represent on the Smith chart the following impedance Z_L=30- j55, Zc = 50Ω.

1. What is the reflection coefficient (voltage, current) $\Gamma_{zL}$and SWR (TOS $_{zL}$) for the impedance
2. If $\lambda = 8cm$, find Zin located at d=11cm from the charge, Γ_{zin} and SWR(TOS $_{zin}$)

GOOD LUCK

Exo 2 : $R = 3.10^{-3}\ \Omega/m$; $L = 3.10^{-6}\ H/m$; $G = 1,5.10^{-4}\ S/m$;

$C = 12.10^{-12}\ F/m$, $f = 500\ Hz \rightarrow \omega = 2\pi f = 3140\ rad/s$

(1)

$$Z_c = \sqrt{\frac{R+jL\omega}{G+jC\omega}} = \sqrt{\frac{(R+jL\omega)(G-jC\omega)}{G^2+C^2\omega^2}} = \sqrt{\frac{RG+\omega^2LC+j\omega(LG-RC)}{G^2+C^2\omega^2}}$$

$$Z_c = \sqrt{\frac{3.10^{-3}\cdot 1,5.10^{-4} + (3140)^2\, 3.10^{-6}\cdot 12.10^{-12} + j\,3140\,(3.1,5\,10^{-10} - 36\,10^{-15})}{(1,5.10^{-4})^2 + (12.10^{-12})^2(3140)^2}}$$

$$Z_c = \sqrt{10^{-7}(2+j6,28)} \Rightarrow Z_c = 10^{3}(0,64+j0,47)\,\Omega$$ (1)

(1)

$$\gamma = \sqrt{(R+jL\omega)(G+jC\omega)} = \sqrt{(3.10^{-3}+j9,42.10^{-3})(1,5\,10^{-4}+j3,768.10^{-8})}$$

$$\gamma = \sqrt{44,9+141,3j} = 9,68 + j7,08$$ (1)

Exo 3

$d = 36.10^{6}\ m$; $P_0 = 6\ W$, $G_1 = 12\ dBi$, $G_2 = 25\ dBi$, $f = 1691.10^{6}\ Hz$.

$\Rightarrow \lambda = \frac{c}{f} = 0,18\ m$ (0,25)

1/ $P_{0\,dBm} = 10\log\left(\frac{6W}{10^{-3}}\right) = 37,78$ (0,5) (0,25)

$G_{1\,dBi} = 12,6 = 10\log\left(\frac{G_1}{G_{anti}}\right) = 10\log\left(\frac{G_1}{1}\right) \Rightarrow G_1 = 10^{1,26} = 18,19$ (0,5) (0,25)

$G_{2\,dBi} = 25 = 10\log\left(\frac{G_2}{G_{anti}}\right) = 10\log\left(\frac{G_2}{1}\right) \Rightarrow G_2 = 10^{2,5} = 316,23$ (0,5)

[illegible] dBi $- A_{dB\ Freespace}$ / $A_{FS\,dB} = 20\log\left(\frac{4\pi d}{\lambda}\right) = 188$ (0,25) (0,25)

[illegible] 188 = −11[illegible] dBm. (0,25)

(2)

Exo 4

$Z_L = (30 - j55)\,\Omega$; $Z_{Lr} = \frac{30 - j55}{50} = 0{,}6 - j1{,}1$ (0,5)

$Z_c = 50\,\Omega$

$\Gamma_{Z_L} = 0{,}63\, e^{-j76°}$ (0,5)

$ROS(SWR_{Z_L}) = 4{,}5 = 13\,dB$ (0,25)

$d = 1{,}375\,\lambda$ (0,5)

$Z_{in} = 3{,}4 + j1{,}9$ (0,5)

$ROS(SW_{Z_{in}}) = 4{,}5 = 13\,dB$ (0,25)

$\Gamma_{Z_{in}} = 0{,}63\, e^{j14}$ (0,5)

(4)

Module: Antennas

3rd Year RT S5