**RF SYSTEMS – 1th End term test**
**24 January 2019**

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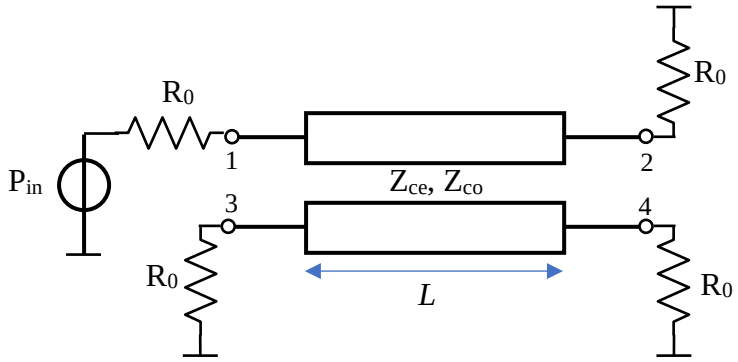
| **Surname & Name** |
| **Identification Number** |
| **Signature** |

Exercise 1

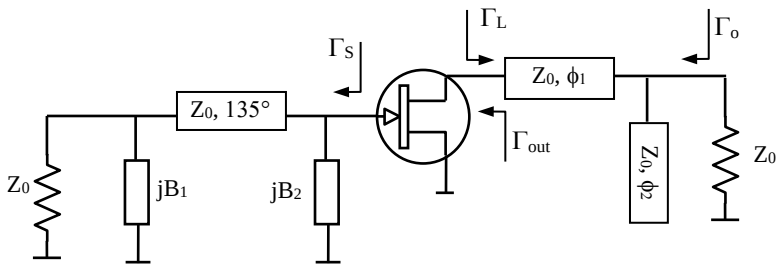
Consider two coupled lines characterized by the even and odd mode characteristic impedances Zce=62.5 Ω and Zco=40 Ω. The length of the lines is *L*=4.5 cm and the relative dielectric constant of the medium is $\varepsilon_r$=2.2 (assume the lines homogeneous). The four ports of the coupled structure are connected to terminations of equal value ($R_0$). A source with available power Pin=1 W is connected at port 1.




1) Determine the value of $R_0$ for which all the ports are matched ($S_{11}=S_{22}=S_{33}=S_{44}=0$)
2) Evaluate the frequency $f_0$ at which the power delivered to port 3 is maximum
3) Evaluate the output power at ports 2, 3, 4 at the frequency $f_0$
4) If the length L is halved, what is the delivered power to port 4 at $f_0$?

Exercise 2

We want realize the LNA with the scheme in the figure (the scattering and noise parameters of the transistor are also reported). The output network (lossless) has been designed, giving the following result: $\phi_1$=57.4795°, $\phi_2$=50.1474° (the shunt-connected element is an open circuited stub)




$Z_0$=50 Ohm
$S_{11}$=0.519∠ -133.27°
$S_{12}$=0.095∠17.7°
$S_{21}$=4.071∠ 41.2°
$S_{22}$=0.392∠ -90.39°
$NF_{min}$=0.35 dB
$\Gamma_{min}$=0.52∠94.6°
$r_n$=0.081

1) Using the Smith Chart, find the value of $\Gamma_s$ determining NF=0.5 dB with the largest value of the available power gain $G_{AV}$.
2) Compute $\Gamma_L$ produced by the output network.
3) Compute $\Gamma_{out}$ and specify what condition is verified at the transistor output.
4) What is the transducer gain $G_T$ of the amplifier? Justify the answer
5) Design the input network (i.e. evaluate the susceptances $B_1$ and $B_2$) producing the required $\Gamma_s$.
6) What is the value of $\Gamma_o$? Justify the answer