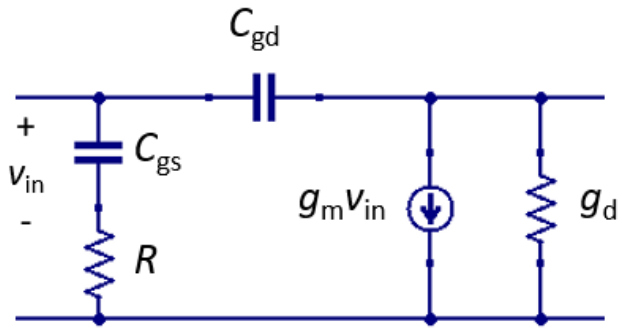
High-speed electronics HT2019 – Exercise 5

"Microwave amplifiers"

1) Using the expressions: $S_{11} = \Gamma_{in}, S_{12} = \frac{2v_1}{v_s}, S_{21} = \frac{2v_2}{v_s}, S_{22} = \Gamma_{out}$ calculate the S-parameters for the resistor circuits.

2) Calculate the S-parameters for the following transistor.



3) If g_m = 20 mS, g_d = 5 mS, C_{gs} = 10 fF, C_{gd} = 5 fF, Ri = 1/(1.4g_m) Ω for the transistor above:
   a) calculate the absolute values of the S-parameters at $\omega = 50$ GHz.
   b) Draw the output stability circle in the Smith chart. Is the transistor unconditionally stable?
   c) If $\Gamma_L = -0.2 + 0.5j$, will the device be stable?
   d) If not stable, add a reactance to the load to stabilize it.

4) Consider a two-port with Z_{out} = 100 + j200 Ohm
   a) Find a suitable set of passive components to add at the output to match it to a 50 Ω load at $\omega = 1$ GHz. Tip: Use a Smith chart.
   b) If ω = 10 GHz instead, how large fraction of the power will be reflected at this interface?