ECE202A Final Exam.

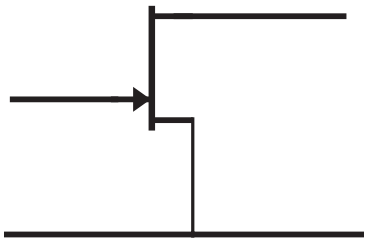
This is a 3-hour exam. There are 3 questions. Please don't turn the cover page until the exam is distributed to everyone.

Use any and all reasonable approximations in circuit analysis, *after stating them.*

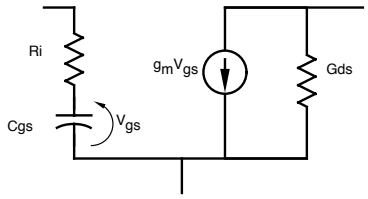
Name: _____

Problem 1, 50 points:
Reactive-matched amplifiers, Stability, etc

Part A. 10 points
Properties of S-parameters

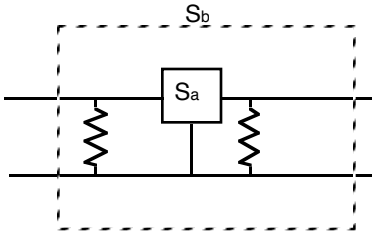


. Find the 4 S-parameters for a the transistor at Left in a 50Ω system at 10 GHz. The transistor model is shown below. The transistor has a 100 mS transconductance, Ri is zero, Rds is 500Ω, and Cgs is 0.318 pF.



B. 15 points

Mason's gain rules

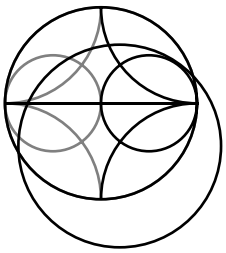


An amplifier (S^a)has S^a_{11}=0.2, S^a_{22}=0.3 S^a_{21}=5 S^a_{12}=0.1. 50Ω resistors are connected to ground on the input and output, thus. Find S^b_{21} of the overall network.

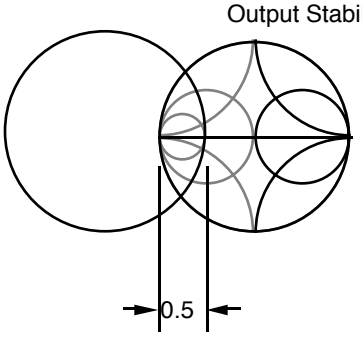
C. 5 points

Stability again

Input Stability circle



Output Stability circle

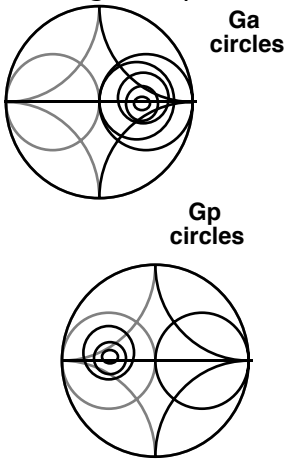


The stability circles for a bipolar transistor is shown to the left. |S11|=2, |S22|=0.5. The system impedance is 50Ω.

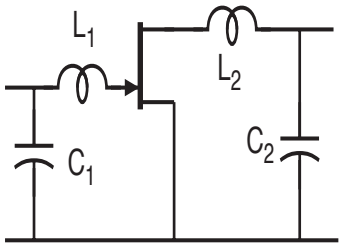
Show circuit diagrams for two methods of ensuring that the transistor is stable, together with the values of the components involved.

Part D, 10 points

Power gain definitions, impedance matching



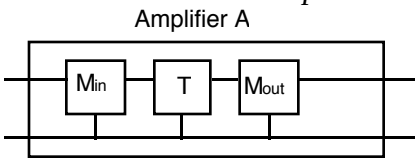
Ga and Gp circles for the transistor are shown at left (10 GHz). The center of the Ga circles is Γ=+0.5, and the center of the Gp circles is Γ=-0.25.



Using the Smith chart, find the values of the components required to Match the amplifier to a 50Ω system at 5 GHz.

E. 10 points

Power Gain Relationships



An transistor (S^t)has S^t_{11}=0.5, S^t_{22}=0.25 S^t_{21}=10 S^t_{12}=0, given a 50 ohm impedance definition

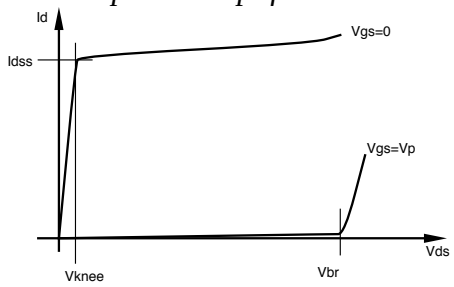
The generator is 25 ohms, the load is 75 ohms.

Impedance-matching networks are connected to the amplifier input and output, creating an amplifier A.

1) Find the MAGNITUDES of the 4 S-parameters of the amplifier A
2) Find the transducer power gain of the amplifier given that the generator is 25 ohms and the load is 75 ohms.
3) Find the transducer power gain of the amplifier if connected to a 50Ω generator and load.

Problem 2, 20 points:

Class-A power amplifiers



On the right are a SiC MESFET's output characteristics. Vknee=5V, Vbr=105V, Idss= 200 mA *per millimeter of Gate Width.* .

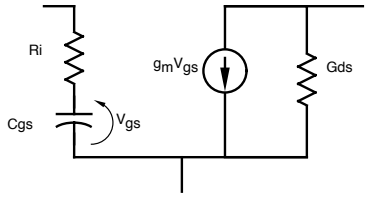
A: 5 points: We want to design a 1 kW class-a power amplifier. What Gate Width is required?

B: 5 points: What is the load impedance required for this?

C: 5 points: What would be the DC-to-RF efficiency?

D: 5 points:If the load impedance was increased 30% from this value, what would be the maximum output power?

Problem 3, 30 points:
Design Problem



The transistor at left has 1000 mS/mm transconductance, Ri=1/gm, a 160 GHz current gain cutoff frequency and a 250 GHz power gain cutoff frequency

The parameters above are obtained with Vds=2 V and Vgs=-0.2 Volts.

It is desired to have an amplifier with 15 dB gain and 100 GHz bandwidth at the 3-dB-point. You will use resistive feedback amplifiers, probably several cascaded stages. Design such a amplifier, showing your calculations for all relevant parameters, and give a full circuit diagram.