This exam includes five problems. Note that there can be text at both sides of the papers. Each problem gives 6 points at maximum.

1.

Answer in short with few words to the following questions.
a) The general form of system function of the second order circuit

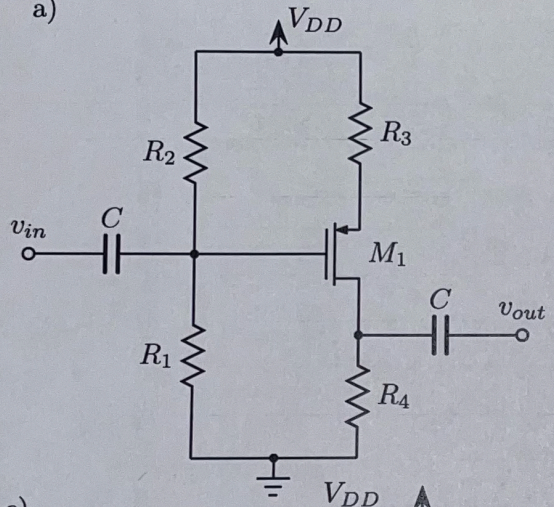
$$H(s) = \frac{p(s)}{s^2 + s\frac{\omega_0}{Q} + \omega_0^2}.$$

How does polynomial $p(s)$ affect the operation of the circuit?
b) How can you recognize an active circuit from its scattering parameters?
c) In the feedback system, you have to adjust negative feedback value β to achieve the required closed loop gain. How does this affect bandwidth?

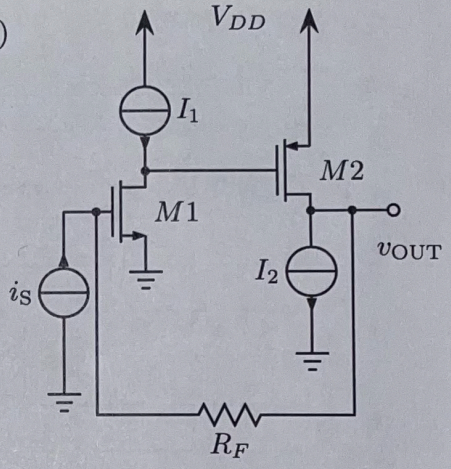
2.

These circuits are from exercise problems 3.3 and 7.4. Draw the small signal model for these circuits.

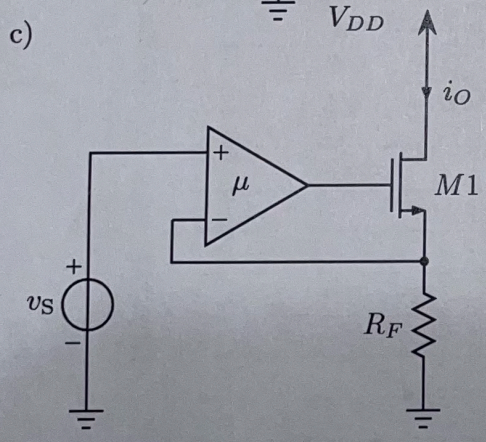
a)



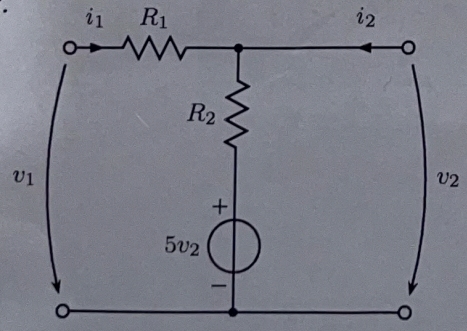
b)



c)



3.



Determine the hybrid parameters of the circuit.

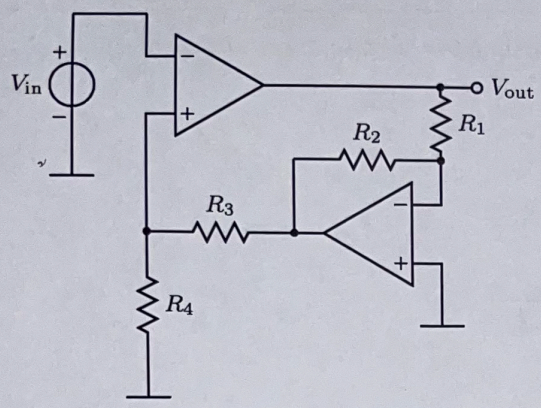
$$h_{11} = \left.\frac{V_1}{I_1}\right|_{V_2=0} \qquad h_{12} = \left.\frac{V_1}{V_2}\right|_{I_1=0}$$

$$h_{21} = \left.\frac{I_2}{I_1}\right|_{V_2=0} \qquad h_{22} = \left.\frac{I_2}{V_2}\right|_{I_1=0}$$

$$R_1 = 4\ \Omega \quad R_2 = 3\ \Omega.$$

4.

Calculate voltage gain $V_{\text{out}}/V_{\text{in}}$.



5.

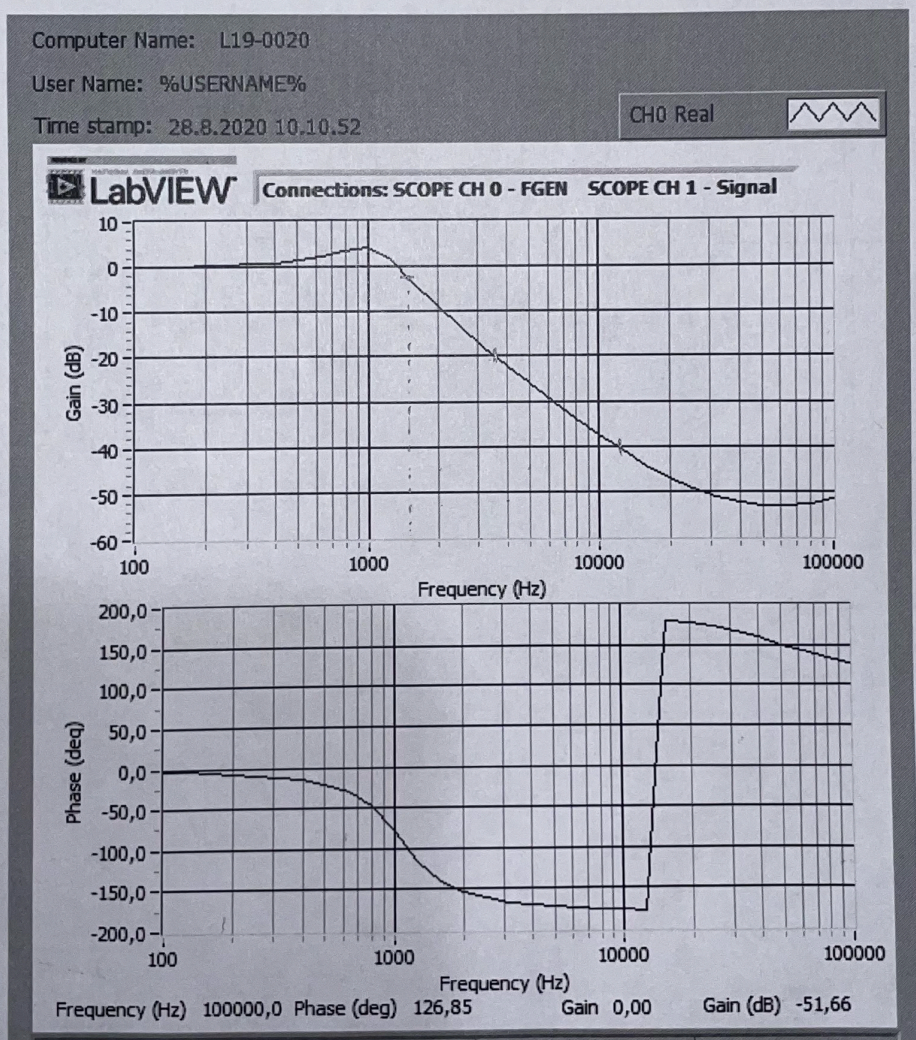
In the lab, you measured the Sallen Key filter. Explore the bode plot measurement results.

a) What is the cutoff frequency f_0?

b) At which frequency $|H(s)| = 0.1$?

c) At which frequency $|H(s)| = 0.01$?

d) Why has the phase response a rapid change after 10 kHz?



Parameter	Value	Parameter	Value
Device	Dev6 (NI ELVIS II+)	Op-Amp Polarity	Normal
Stimulus Channel	SCOPE CH 0	Graph Mapping	Logarithmic
Response Channel	SCOPE CH 1		
Start Frequency	100,00 Hz		
Stop Frequency	100,00k Hz		
Steps / decade	10		
Peak Amplitude	1,00		