Grading: Pick part a or b in Units 1, 2, 3 (Problems 3-6), You must answer both Problem 1 and Problem 2 This Homework will replace lowest homework score

Problem 1) Filter Design 1

Design a filter that meets the specifications below. You need to pick values for any resistors, capacitors or inductors in your circuit. <u>Simulate the circuit in PSpice to verify</u> that your design meets specifications. Use the ideal amplifier component called OPAMP in your simulations. Note, small deviations from the design specifications are allowed and in a real circuit always exist, but they need to be small. Show calculations to justify your design (guessing in PSpice is not a design solution). (note: this problem has units Hz)

- a. Highpass filter with a cutoff frequency of 159MHz
- b. In the specified frequency range, the gain must be >-3dB
- c. The rolloff in the stopband should be 80dB
- d. The circuit should contain a single unity gain (voltage follower) amplifier stage (no other amplifiers should be in your circuit).

Problem 2) Filter Design 2

Design a filter that meets the specifications below. You need to pick values for any resistors, capacitors or inductors in your circuit. <u>Simulate the circuit in PSpice to verify</u> that your design meets specifications. Note, small deviations from the design specifications are allowed and in a real circuit always exist, but they need to be small. Show calculations to justify your design (guessing in PSpice is not a design solution).

ω [rad/s]	H(s) in dB
10	6
100	6
1000	6
1E4	3
1E5	-14
1E6	-34

Problem 3) Thevenin/Norton

a. Find the Thevenin equivalent circuit.



b. Find the current through the 4k resistor



Problem 4) Differential Equations and Laplace

a. Differential equations



- 1. Determine the differential relationship for the voltage across C1.
- 2. Determine values for R1 and R2 so that the circuit is underdamped.

b. Laplace



The source voltage is 5 V for t < 0 and becomes 10 V for t > 0.

1. Draw the s-equivalent circuit.

2. Use circuit analysis and partial fraction expansion to find the voltage across the inductor for t>0.

Problem 5) AC Steady State Circuit Analysis



- 1. Determine a value for C1 so that the current through the source is 5mA and has zero phase.
- b. Frequency response



1. Sketch the Bode plots for the magnitude and phase, H(s)=Vout/Vin

Problem 6) Transformers and Power Circuits

a. Transformers



- 1. Determine the phasor form of the current through the source.
- 2. Determine the total power in the left branch, (R3 and C1)

b. Power



- 1. Determine Zunknown such that the power produced is purely real.
- 2. Determine the power produced in each load and the source

out