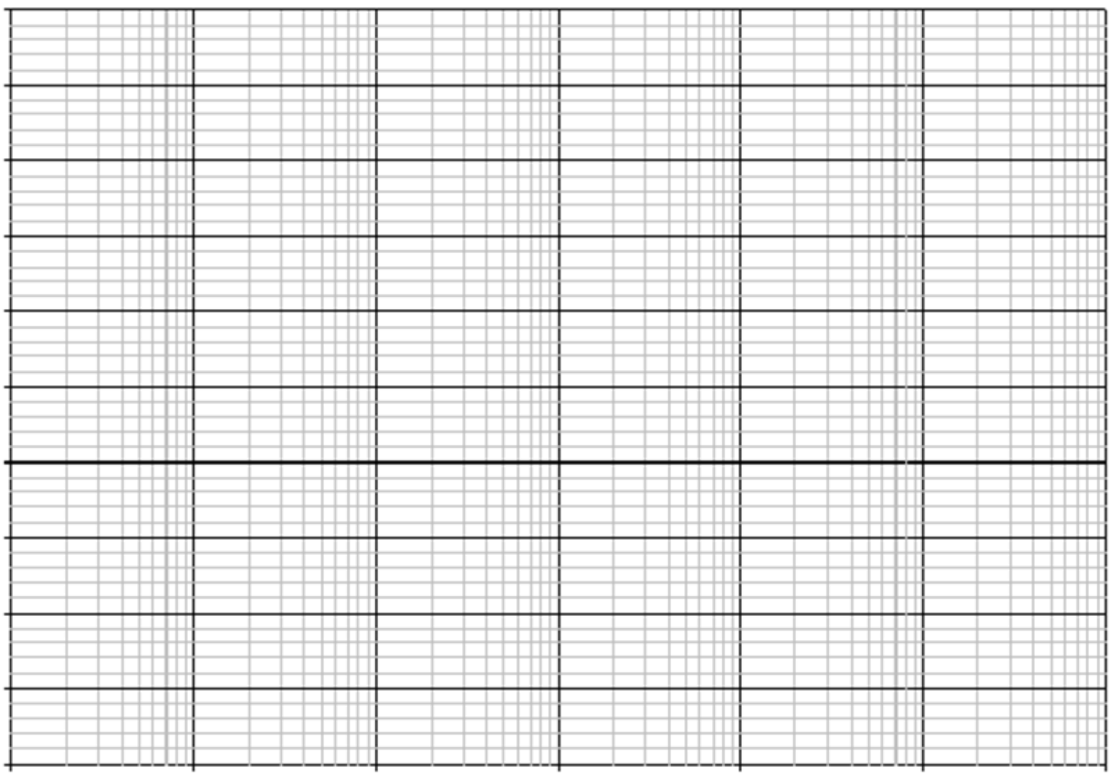
Problem 1) Sketching Bode Plots

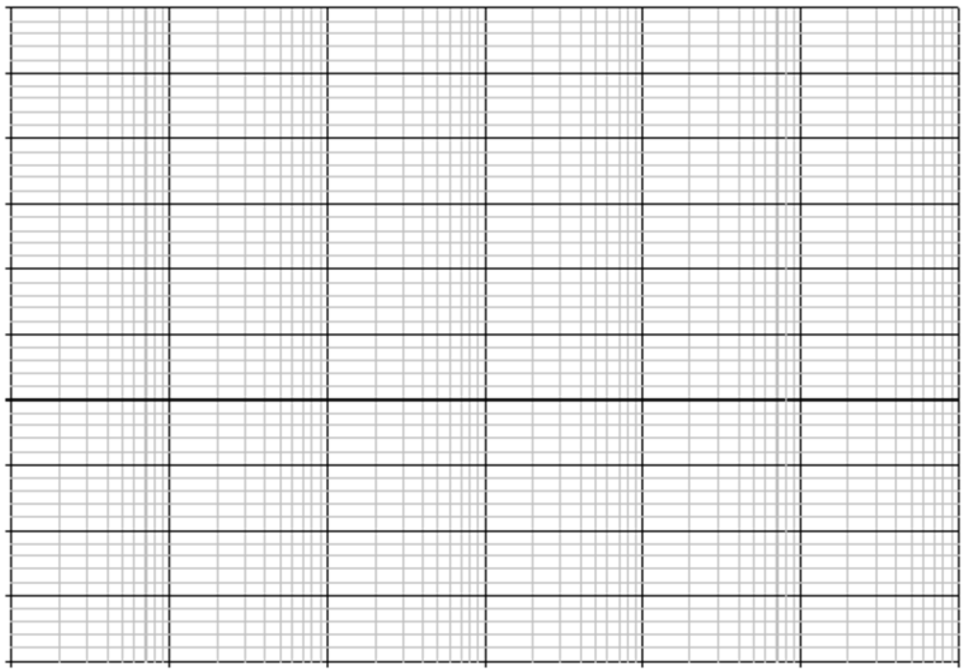
Sketch the 'ideal' Bode plots of the magnitude (dB) and phase for the following transfer functions.

1.1 $$H(s) = -10\cdot\frac{s}{s + 1\cdot 10^4}$$

Magnitude Bode Plot

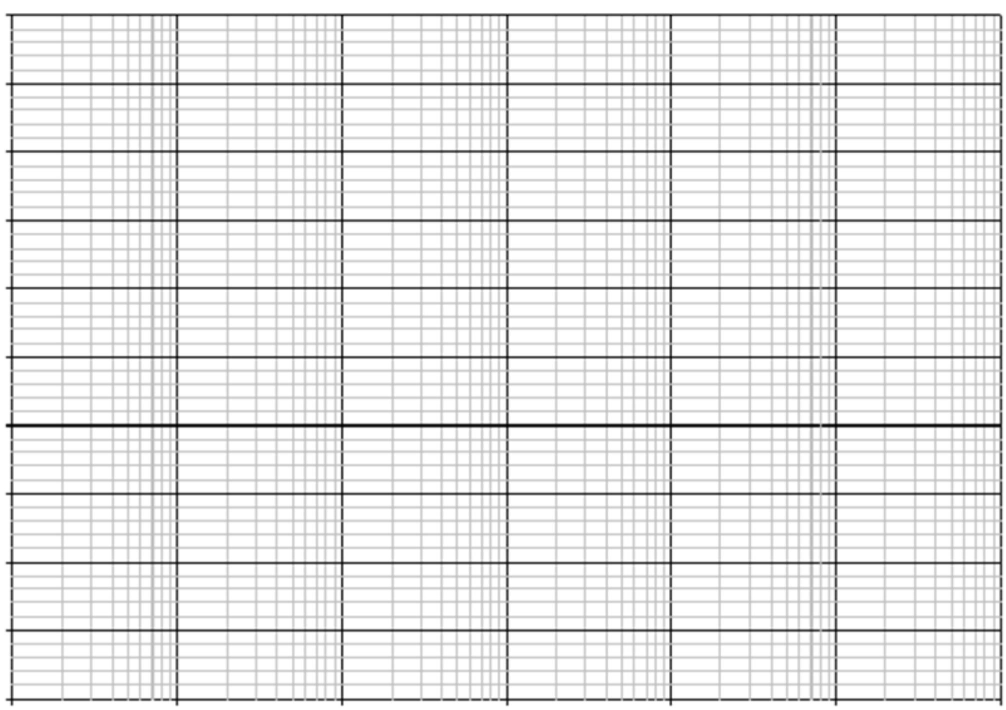


Phase Bode Plot

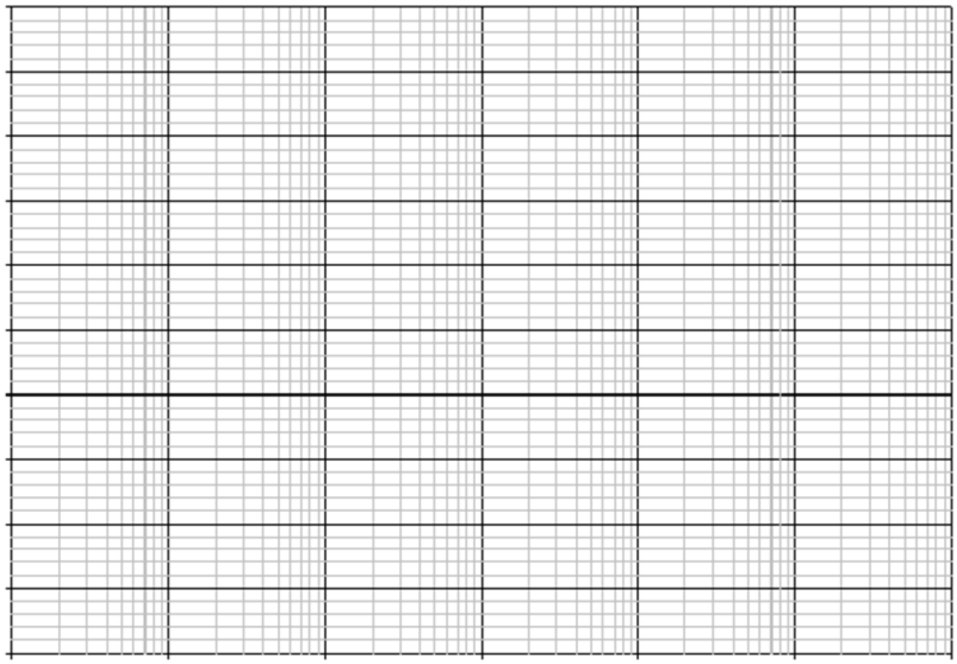


1.2. $$H(s) = \frac{(s+5000)}{(s+10)(s+1E6)}$$

Magnitude Bode Plot

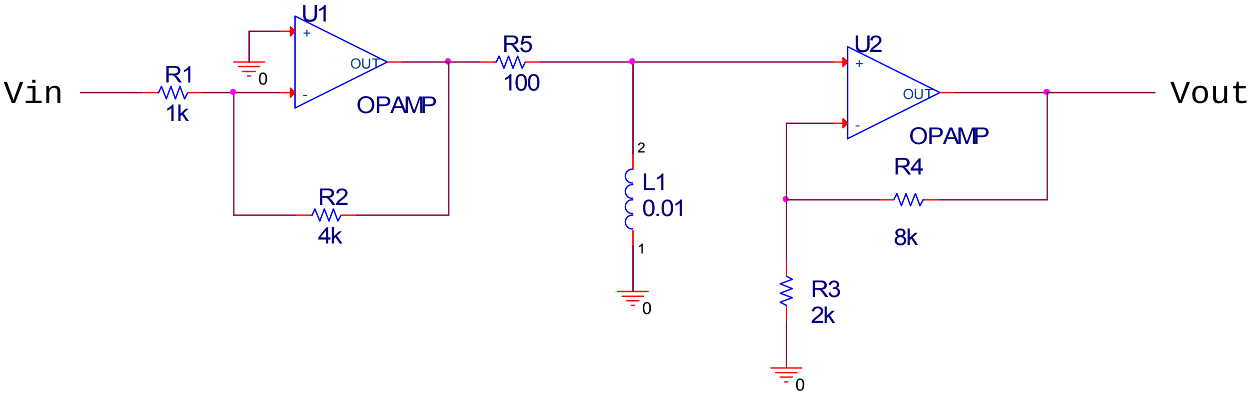


Phase Bode Plot



Problem 2) Transfer functions, Bode plots, first order circuits

Determine the transfer functions in the following circuits



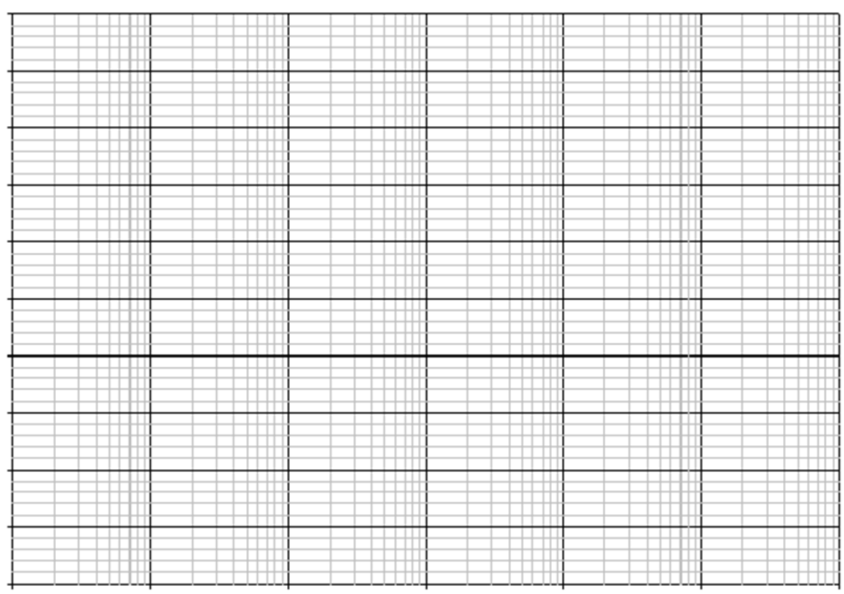
2.1 Draw the above circuit as a three stage network (put boxes around the stages for example and label Hn(2) n=1,2.3....etc). Indicate the tranfer function for each stage.

2.2. Determine the transfer functions, H(s) Vout(s)/Vin(s), for the circuit.

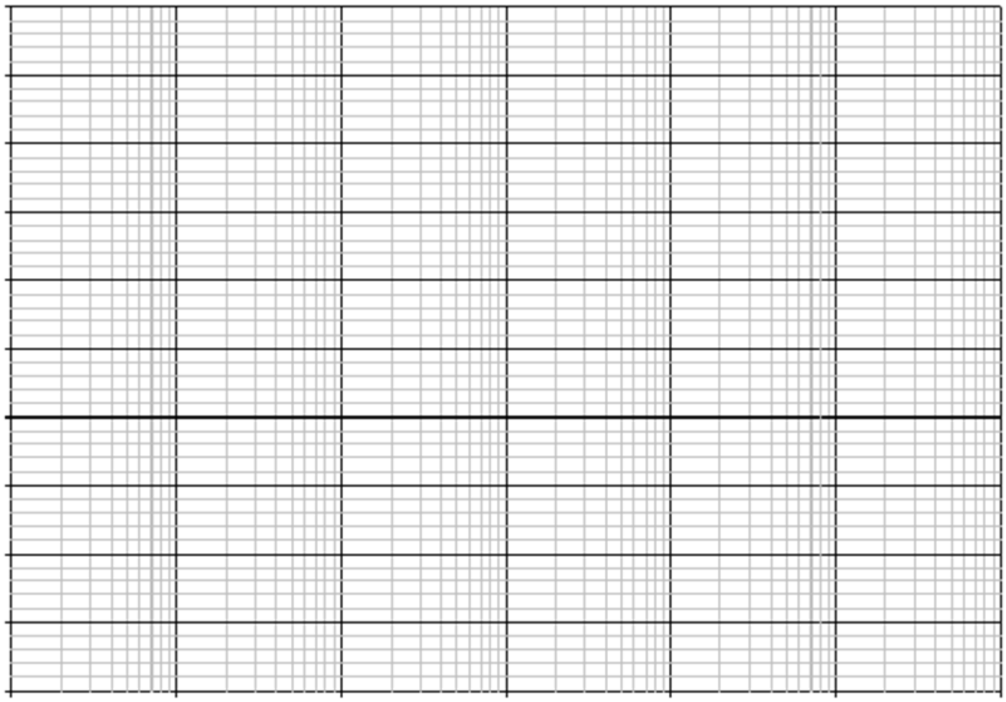
2.3. What is the gain of the circuit?

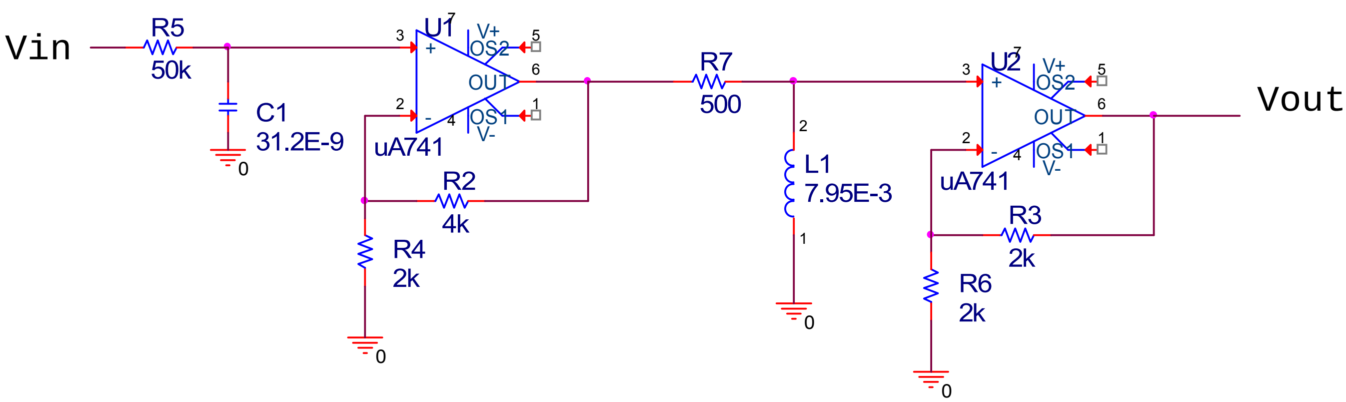
2.4. What is the cutoff frequency?

2.5. Sketch an approximate Bode (dB-log) plot of the magnitude.



2.7. Sketch an approximate Bode (phase-log) plot of the phase.

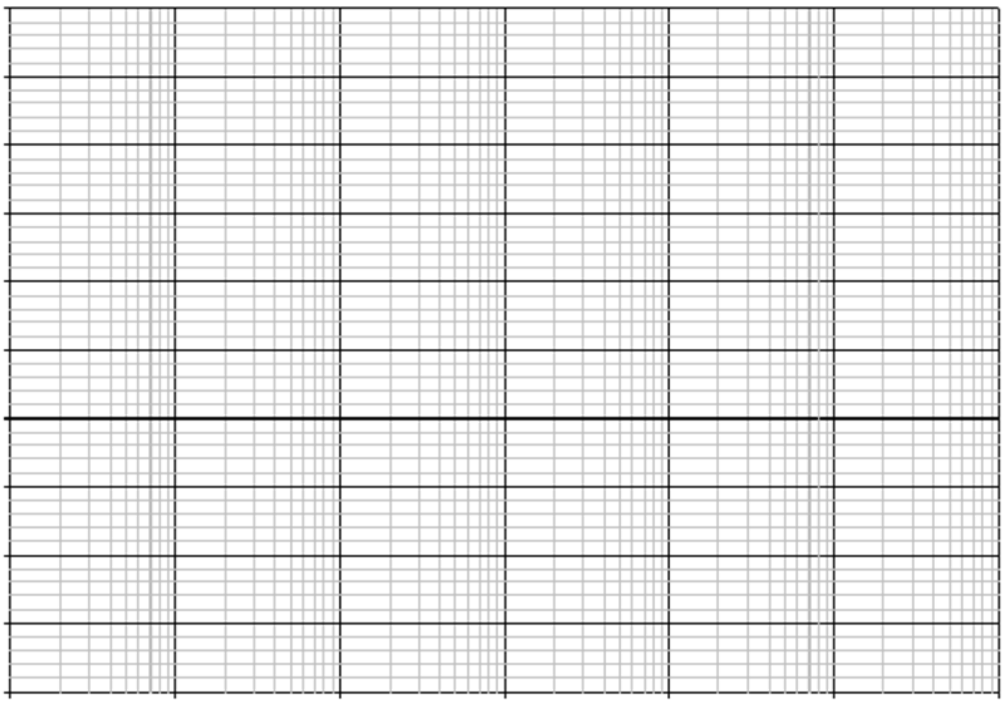




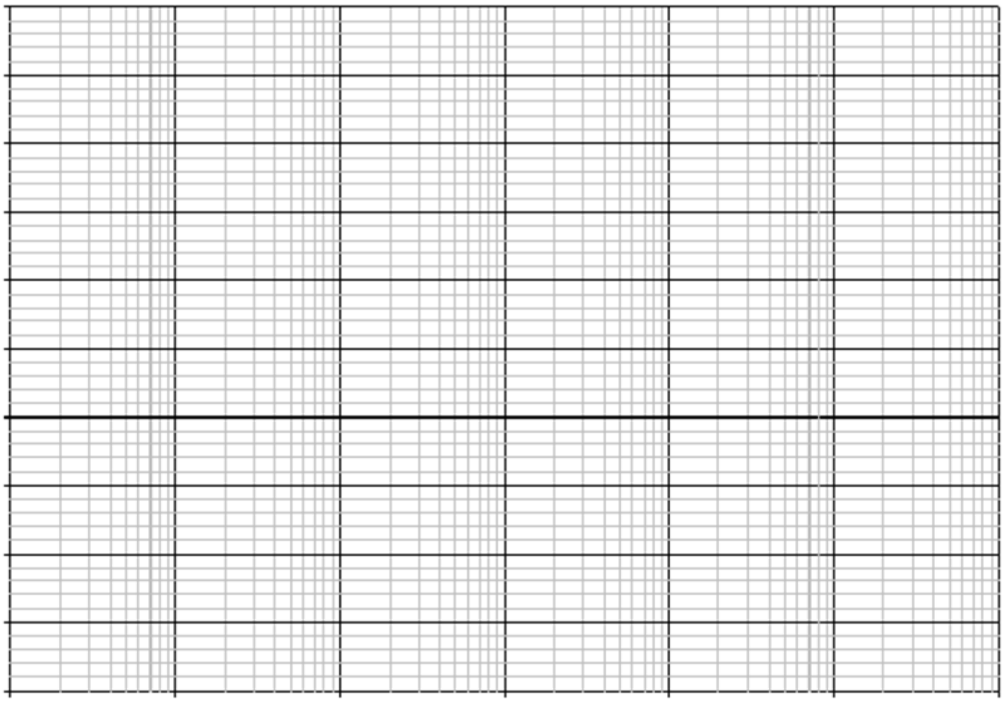
2.8. Draw the above circuit as a three stage network (put boxes around the stages for example and label Hn(2) n=1,2.3....etc). Indicate the tranfer function for each stage.

2.9. What is the transfer function of the circuit?

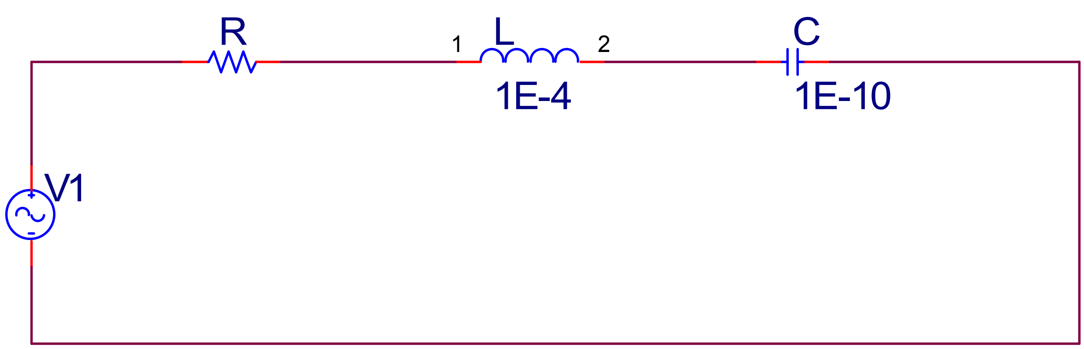
2.10. Sketch an approximate Bode (db-log) of the magnitude.



2.11. Sketch an approximate Bode (phase-log) plot of the phase.



Problem 3) 2nd Order Filter Circuits

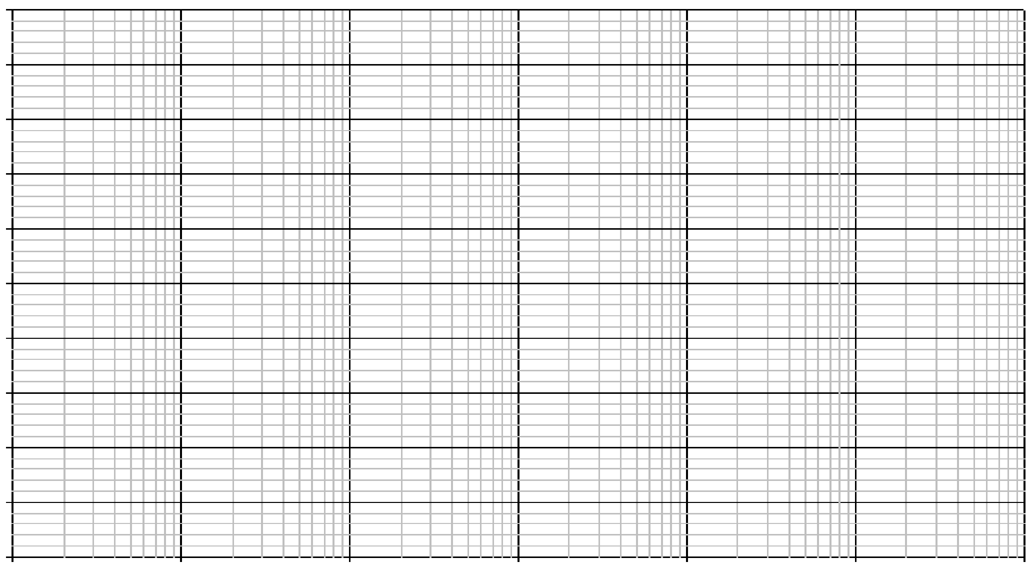


3.1. What is the resonant frequency of the circuit?

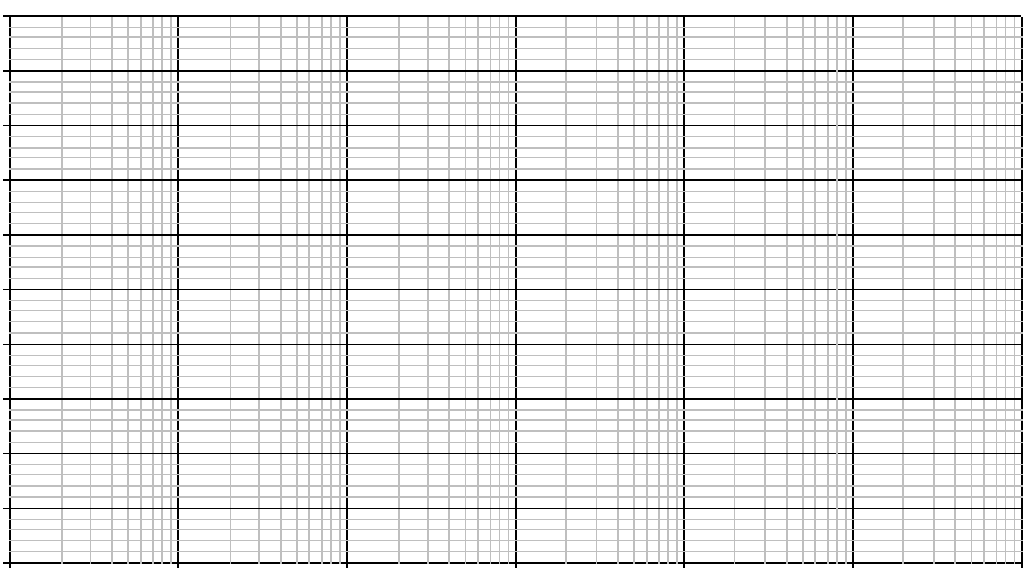
3.2. When R = 100.01 kΩ,

3.2.1. What is the damping ratio, ζ?

3.2.2. Sketch the Bode plot of the magnitude (dB-log) when Vout is the voltage across the inductor, H(s) = VL(s)/V1(s)



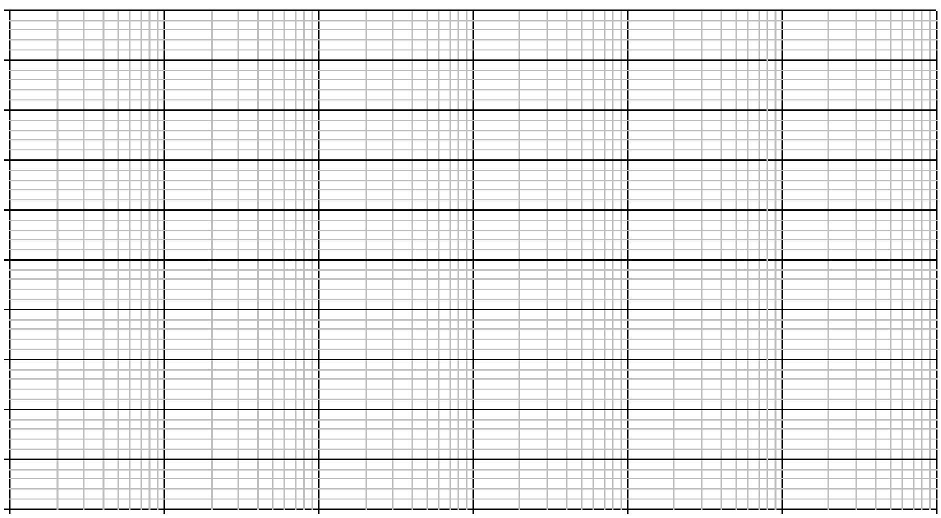
3.2.3. Sketch the Bode plot of the magnitude (dB-log) when Vout is the voltage across the resistor, H(s) = VR(s)/V1(s).



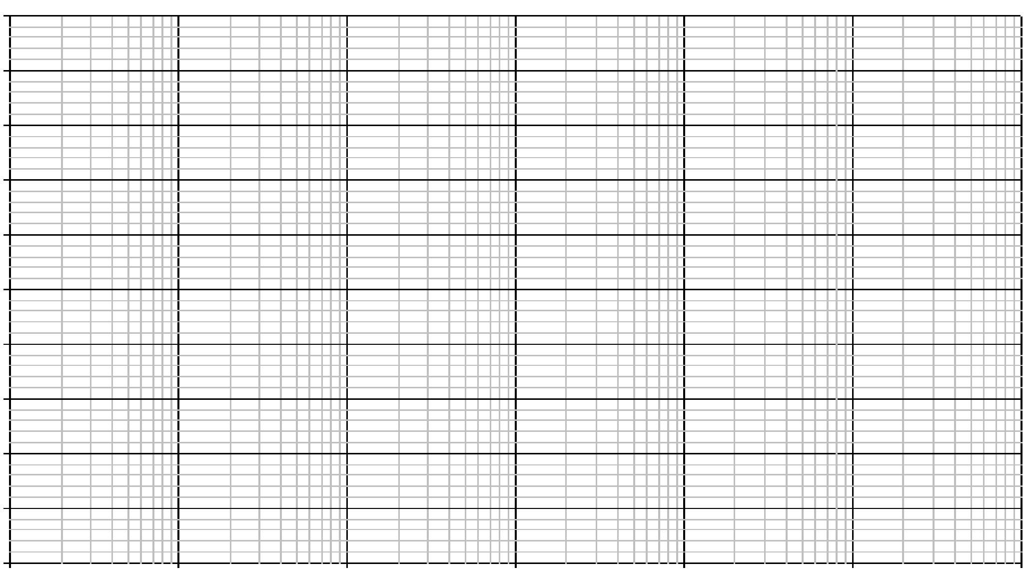
3.3. When R = 2000Ω,

3.3.1. What is the damping ratio, ζ?

3.3.2. Sketch the Bode plot of the magnitude (dB-log) when Vout is the voltage across the inductor, H(s) = VL(s)/V1(s)



3.3.3. Sketch the Bode plot of the magnitude (dB-log) when Vout is the voltage across the resistor, H(s) = VR(s)/V1(s)



Problem 4) Design Problems

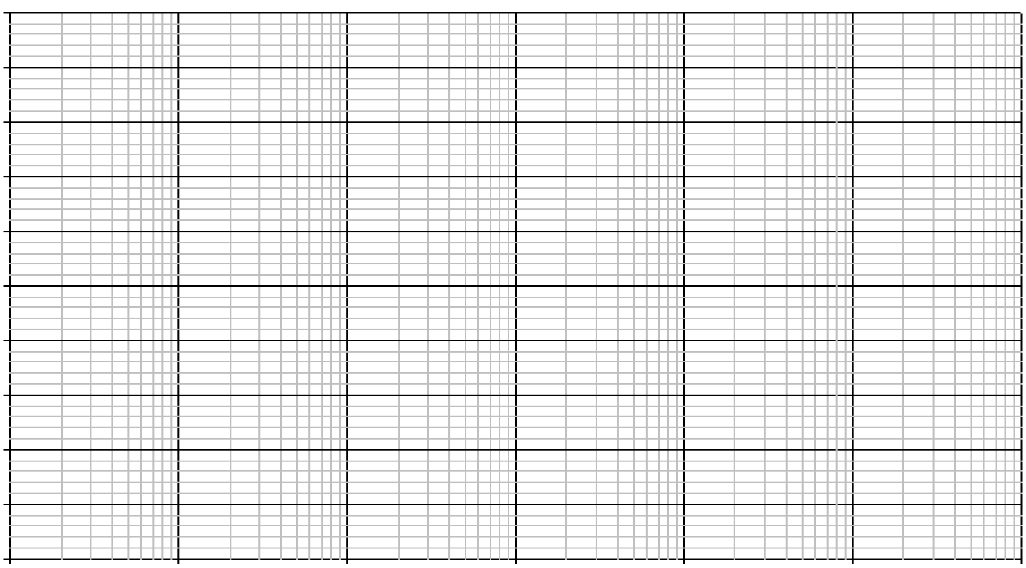
For the problem design specifications, determine a transfer function that meets the requirements. The answers may not be unique. You should provide a plot that verifies that your transfer function meets the specifications.

1. Design 1

a. Bandpass filter with a passband of 100 [rad/s] to 100E3 [rad/s]

b. In the passband, the gain should be 0<gain<10dB

c. The rolloff (slope) in the stopbands should have a magnitude of 40dB/decade



2. Design 2
a. Narrow bandpass filter centered at f = 960MHz
b. The gain at the center of the passband should be 20dB
c. The 17dB points should be ~940MHz at ~980MHz