Texas A&M University
Department of Electrical and Computer Engineering

ECEN 325 – Electronics

Fall 2025

Exam #1

Instructor: Sam Palermo

- Please write your name in the space provided below
- Please verify that there are **6** pages in your exam
- Good Luck!

Problem	Score	Max Score
1		30
2		25
3		25
4		20
Total		**100**

Name: SAM PALERMO

UIN: ______________________

Problem 1 (30 points)
Plot the magnitude and phase response of the following transfer function. Label key points and slopes.

$$H(s) = \frac{10^6(s + 10^4)}{(s + 10^5)(s + 10^6)}$$

DC gain $= \frac{10^6(10^4)}{10^5(10^6)} = 10^{-1} = -20dB$

HF gain $= \phi = -\infty$ dB

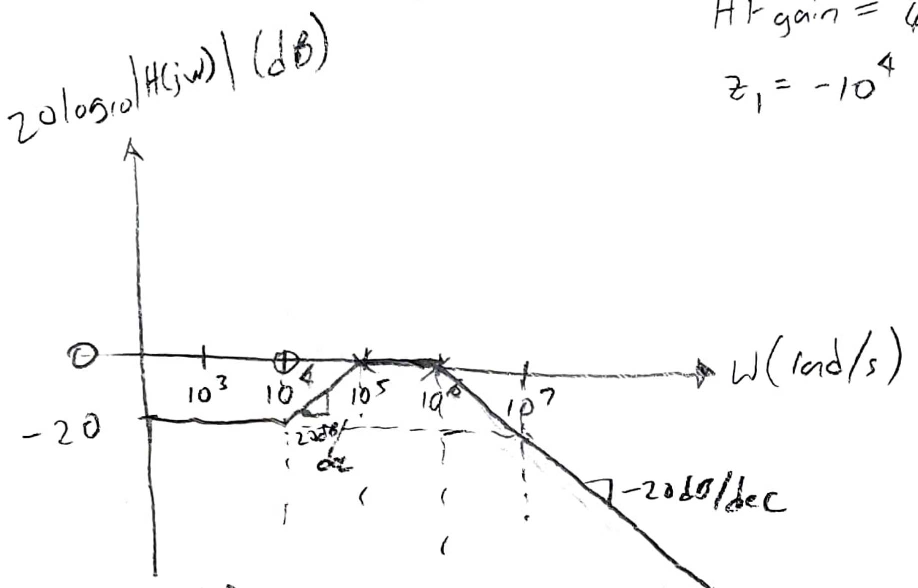
$z_1 = -10^4$ $p_1 = -10^5$ $p_2 = -10^6$

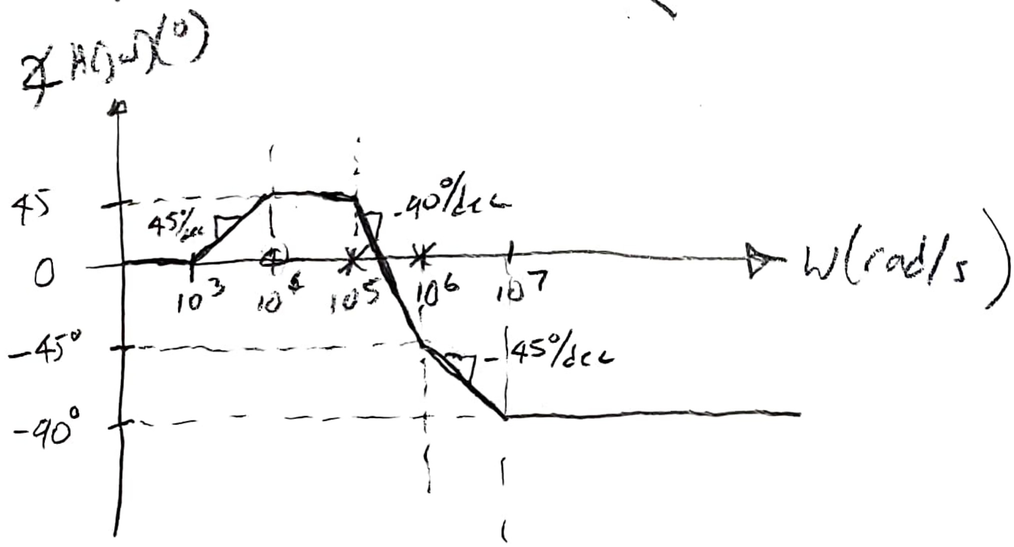
LF Phase $= 0°$

HF Phase $=$

$0° + 90° + 2(-90°)$

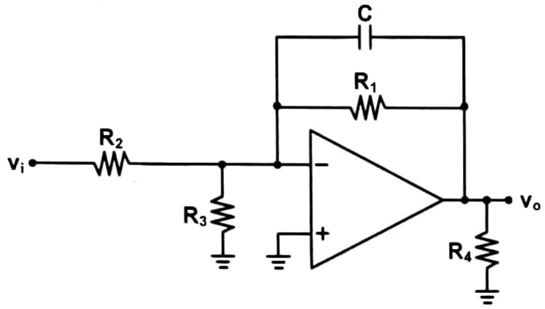
$= -90°$





Problem 2 (25 points)
Assume for the Problem 2 circuit that all operational amplifiers are ideal.
For the following circuit:

i. Obtain the transfer function, $v_o(s)/v_i(s)$
ii. Set the component values to achieve a 1kΩ input resistance, 34dB low-frequency gain (magnitude), and a pole frequency of $|\omega_p| = 1$krad/s.



$$\frac{V_o}{V_i} = \frac{-Z_C \| Z_{R1}}{Z_{R2}} = -\frac{1}{\left(sC_1 + \frac{1}{R_1}\right)R_2} = \frac{-R_1/R_2}{1 + sR_1C}$$

$$\boxed{\frac{V_o}{V_i} = \frac{-\frac{R_1}{R_2}}{1 + sR_1C}}$$

$$R_{in} = R_2 = 1k\Omega$$

$$|LF_{gain}| = 34dB = 50 V/V \Rightarrow R_1 = 50R_2 = 50k\Omega$$

$$|\omega_p| = 1krad/s$$

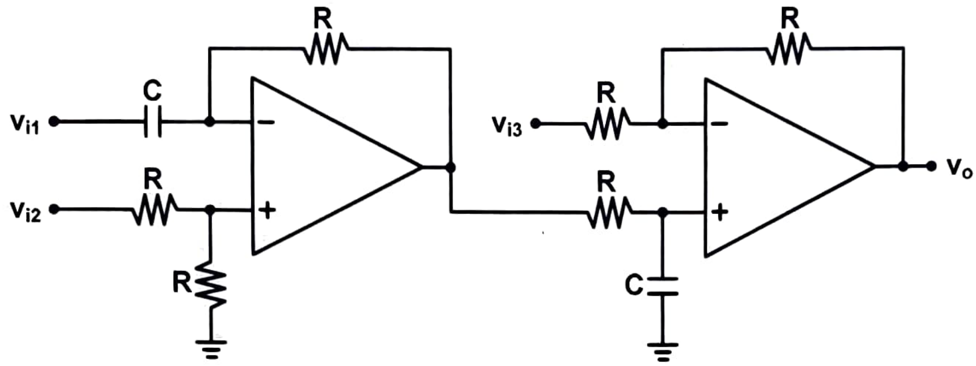
$$C = \frac{1}{R_1|\omega_p|} = \frac{1}{(50k\Omega)(1krad/s)} = 20nF$$

$$\boxed{\begin{aligned} R_1 &= 50k\Omega \\ R_2 &= 1k\Omega \\ C &= 20nF \end{aligned}}$$

Problem 3 (25 points)

Assume for the Problem 3 circuit that all operational amplifiers are ideal.

For the following circuit obtain the expression for v_o as a function of v_{i1}, v_{i2}, and v_{i3}. Assume ideal opamps. Hint: apply superposition.



$$V_o = -\left(\frac{Z_R}{Z_C}\right)\left(\frac{Z_C}{Z_R+Z_C}\right)\left(1+\frac{Z_R}{Z_R}\right)V_{i1} + \left(\frac{Z_R}{Z_R+Z_R}\right)\left(1+\frac{Z_R}{Z_C}\right)\left(\frac{Z_C}{Z_R+Z_C}\right)\left(1+\frac{Z_R}{Z_R}\right)V_{i2} - \left(\frac{Z_R}{Z_R}\right)V_{i3}$$

$$V_o = -\left(\frac{Z_R}{Z_R+Z_C}\right)(2)V_{i1} + V_{i2} - V_{i3} = -\frac{2R}{R+\frac{1}{sC}}V_{i1} + V_{i2} - V_{i3}$$

$$\boxed{V_o = -\frac{s2RC}{1+sRC}V_{i1} + V_{i2} - V_{i3}}$$

Problem 4 (20 points)

The operational amplifier used in the remainder of the problem has the following **open-loop** transfer function

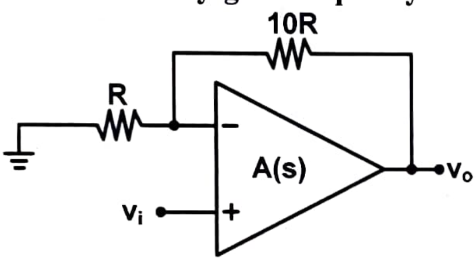
$$A(s) = \frac{10^5}{1 + \frac{s}{10}}$$

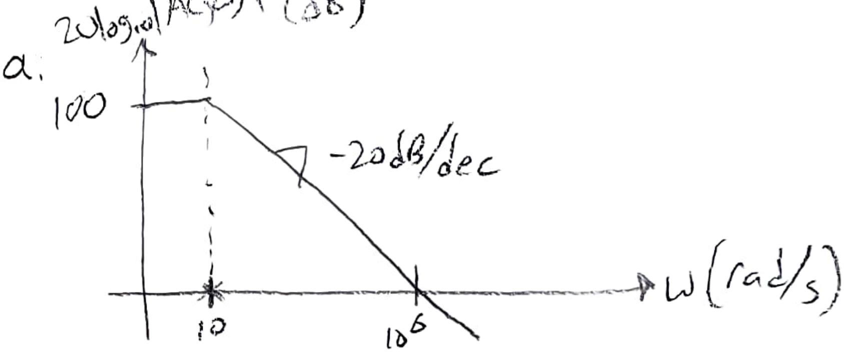
a) Sketch the **open-loop** magnitude response of the operational amplifier. **Make sure to label the unity-gain frequency.**

b) The finite gain-bandwidth operational amplifier from part (a) is used in the following amplifier circuit. Find the expression for the **closed-loop** transfer function (v_o/v_i).

c) What is the **closed-loop** -3dB frequency (bandwidth) of the total amplifier circuit?

d) Sketch the **closed-loop** magnitude response of the amplifier circuit. **Make sure to label the unity-gain frequency.**





b. $\frac{V_o(s)}{V_i(s)} \approx \frac{11}{1 + \frac{s}{10^6/11}}$

c. $\omega_{CL} = \frac{10^6}{11}$ rad/s

d.