# EE 105 Lab 03

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### 1 DC Simulation Values

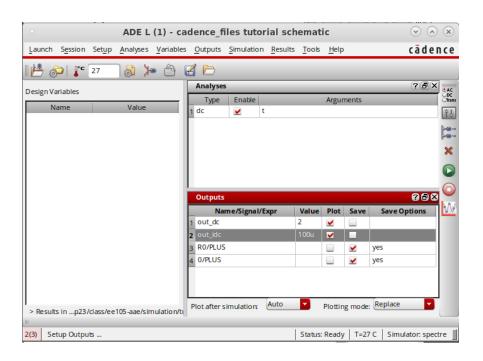


Figure 1: DC simulation parameters.

# 2 Formatted Plot for AC Magnitude Response

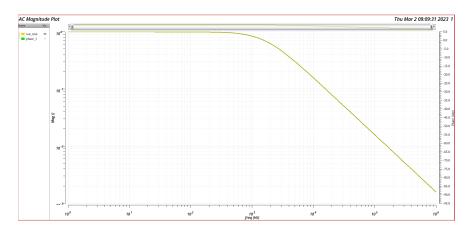


Figure 2: AC magnitude plot.

# 3 Parametric Analysis varying the RC Capacitance

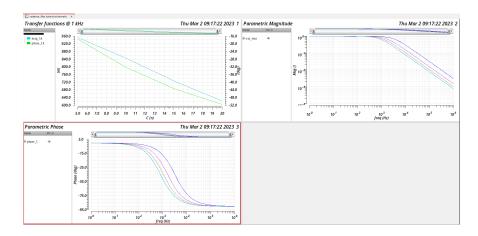


Figure 3: All three plots.

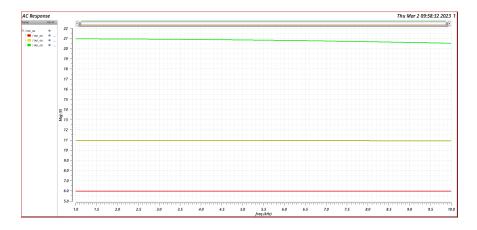


Figure 4: Parametric sweep AC response.

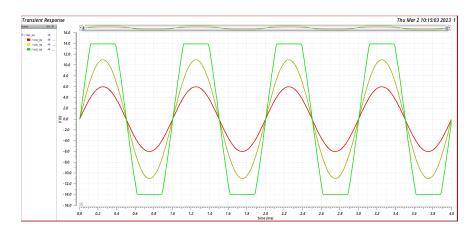


Figure 5: Parametric sweep at 1 kHz.

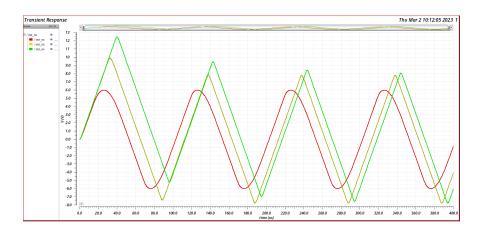


Figure 6: Parametric sweep at  $10\,\mathrm{kHz}$ .

$R [k\Omega]$	Input Frequency [kHz]	Hand-Calculated Output Amplitude [V]	AC Simulation Output Amplitude [V]	Transient Simulation Output Amplitude [V]	Circuit Output Amplitude [V]
5	1	6	5.999	6	6.55
10	1	11	10.999	11	11.55
20	1	21	20.994	14	14.3
5	10	6	5.990	6	6.55
10	10	11	10.937	8.6	11.5
20	10	21	20.560	8.8	14.3

$$|H(f)| = \frac{1}{\sqrt{1 + (2\pi fRC)^2}}\tag{1}$$

$$\angle H(f) = \tan^{-1}(-2\pi fRC) \tag{2}$$

$$|H(f)||_{C=10\,\mathrm{nF}} = 0.85\tag{3}$$

$$|H(f)||_{C=20\,\mathrm{nF}} = 0.62\tag{4}$$

$$\angle H(f)|_{C=10 \,\mathrm{nF}} = 32.1^{\circ}$$
 (5)

$$\angle H(f)|_{C=20 \,\mathrm{nF}} = 51.5^{\circ}$$
 (6)

### 4 Transient Simulation

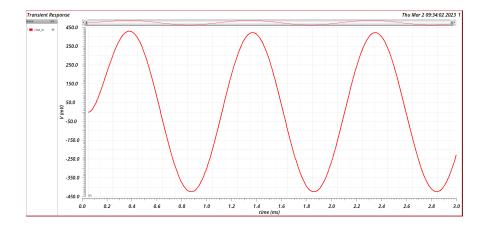


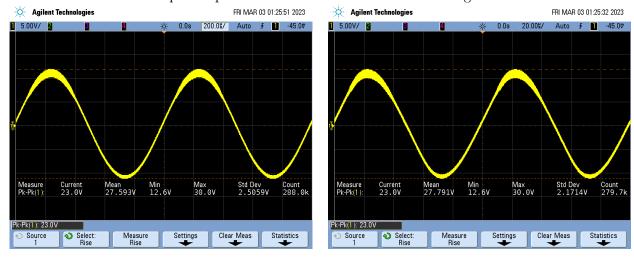
Figure 7: Transient RC simulation.

#### 5 LM741 Simulation

FRI MAR 03 01:26:34 2023 Agilent Technologies Agilent Technologies FRI MAR 03 01:26:18 2023 1 5.00V/ 2 **1** 5.00V/ **2** 0.0s 200.0≝/ Auto ៛ 🚺 -45.0♥ 0.0s 20.00 Auto £ 1 -45.0♥ Mean 26.995V Std Dev 3.8143V Count 305.4k Mean Min 27.306V 12.0V Std Dev 3.1892V Count 299.0 Pk-Pk(1): 13.6V Pk-Pk(1): 13.6V Select: Rise Statistics Select: Measure Rise Measure Rise Clear Meas Settings Clear Meas Statistics

Table 1: Output amplitudes for  $R = 5 \,\mathrm{k}\Omega$ . Left: 1 kHz. Right: 10 kHz.

Table 2: Output amplitudes for  $R = 10 \,\mathrm{k}\Omega$ . Left: 1 kHz. Right: 10 kHz.



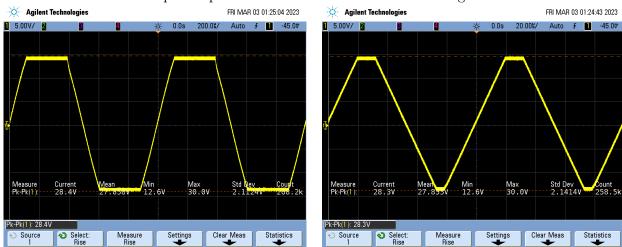


Table 3: Output amplitudes for  $R = 20 \,\mathrm{k}\Omega$ . Left: 1 kHz. Right: 10 kHz.

At 1 kHz, the AC simulation had the greatest error. It does not take into account the finite supply voltage.

At 10 kHz, the AC simulation had the greatest error. It does not take into account the slewing of the input signal.

In hand calculation, we assume an ideal op-amp, such as infinite gain and supply voltage, as well as a non-dependence on frequency. In AC simulation, we still maintain infinite supply voltage, but now we have a finite gain and frequency dependence. In transient simulation, we take into account slewing as well as finite supply voltage. This suggests that transient simulation is the closest to reality.