

ROBOTICS AND COMMUNICATIONS SYSTEMS ENGINEERING TECHNOLOGY
DAC, ADC, & ACTIVE FILTERING USING OPERATIONAL AMPLIFIERS LAB
3RD SEMESTER, SR. INSTRUCTOR TIM LEISHMAN

General Objective:

Upon completion of this lab, the student will be able to:

- A. Calculate analog to digital & digital to analog circuits using operational amplifiers.
- B. Calculate active filtering circuits using operational amplifiers
- C. Construct and measure designed circuits. Demonstrate the proper use of the test equipment.

References:

- Theory notes
- First Year Text & Lab books
- [LM741 Datasheet with offset null](#)
- [MCP6002 Datasheet](#)
- [TL071 Datasheet](#)

Check-Off Sheet:

- [Check-Off Sheet](#)

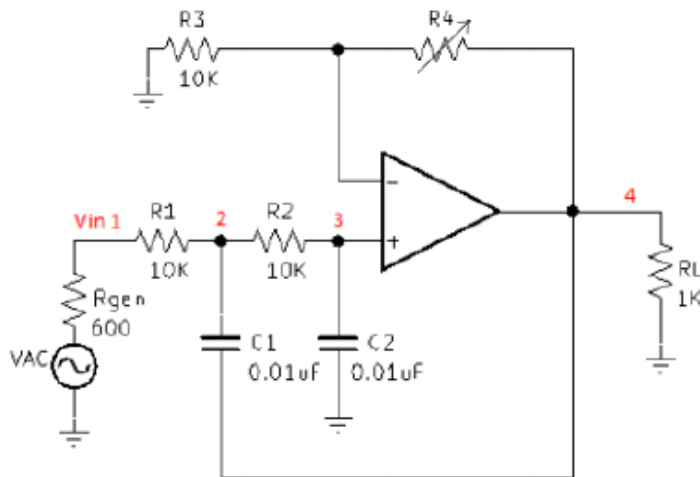
Specific Objectives:

1. Design and show all calculations for a 3-bit D/A converter (DAC) using an op-amp. Use a Mod-8 counter to drive the DAC. Show predicted inputs vs. output waveforms. **(Instructor Check)**
2. Assemble DAC and document the input vs. output waveforms. **(Instructor Check)**
3. Design and show all calculations for a 3-bit A/D converter (ADC) using op-amps. Use a 7 segment to display digital output. Show predicted inputs vs. outputs. **(Instructor Check)**
4. Assemble DAC and document the input vs. output waveforms. **(Instructor Check)**

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5. Calculations, Butterworth Active Filtering -for each of the following circuits, design for a critical frequency between 5Khz & 30Khz. Calculate the frequency, voltage, & phase at the passband, critical frequency and at the one-decade point. Additionally, draw the bode plot with passband, F_c and One-decade points included.
 - First Order Low Pass filter.
 - First Order High Pass filter.
 - First Order Single Stage Op-Amp Notch Filter
 - Second Order Low Pass filter.
 - Second Order High Pass filter.
 - Second Order Single Stage Band Pass filter
 - **Instructor Check**
6. Assemble the previously calculated Butterworth Active Filtering circuits and measure frequency responses for each. **Instructor Check**
7. Construct and measure an active -40db low pass filter circuit that is adjustable to produce a Bessel, Butterworth, and Chebyshev response. with the sweep generator. **Instructor Check.**

Bessel, Butterworth, & Chebyshev:



	Vin 1	2	3	d	R4	AV	4
Bessel	2 vpp	1.414 vpp	1 vpp	2	0.0Ω	1	1 vpp
	1.73 vpp	1.414 vpp	1 vpp	1.73	2.68 KΩ	1.268	1.268 vpp
Butterworth	1.414 vpp	1.414 vpp	1 vpp	1.414	5.86 KΩ	1.586	1.586 vpp
Chebyshev	1 vpp	1.414 vpp	1 vpp	1	10 KΩ	2	2 vpp
	0.5 vpp	1.414 vpp	1 vpp	0.5	15 KΩ	2.5	2.5 vpp
Oscillator	0.0 vpp	Undetermined	*0	* 20 KΩ	*3		OSC.

8. Complete Conclusion and submit completed Check-Off sheet and Lab writeup in Moodle.