ROBOTICS AND COMMUNICATIONS SYSTEMS ENGINEERING TECHNOLGY
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)**

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; include frequencies and dBs for each of the following: Fc, First-Octave, Second-Octave, First-Decade, and Second-Decade.
   - 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**

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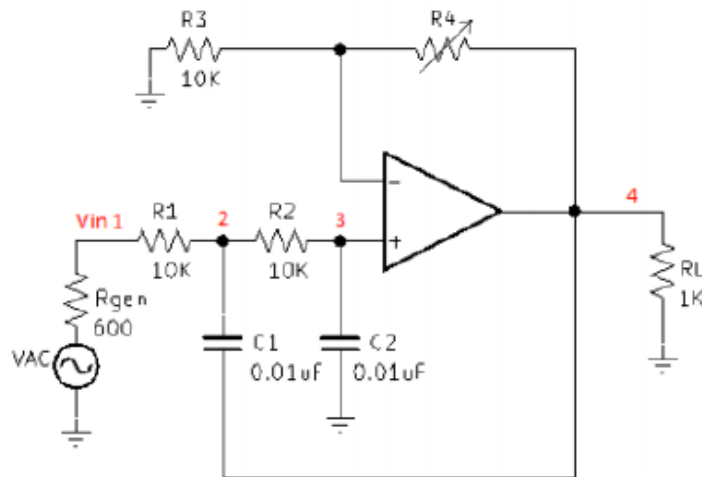
	Vin 1	2	3	d	R4	AV	4
Bessel	2 vpp	1.414 vpp	1 vpp	2	0.0Ω	1	1 vpp
	1.73 vpp	1.414 vpp	1 vpp	1.73	2.68 KΩ	1.268	1.268 vpp
Butterworth	1.414 vpp	1.414 vpp	1 vpp	1.414	5.86 KΩ	1.586	1.586 vpp
Chebyshev	1 vpp	1.414 vpp	1 vpp	1	10 KΩ	2	2 vpp
	0.5 vpp	1.414 vpp	1 vpp	0.5	15 KΩ	2.5	2.5 vpp
Oscillator	0.0 vpp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

Check.

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