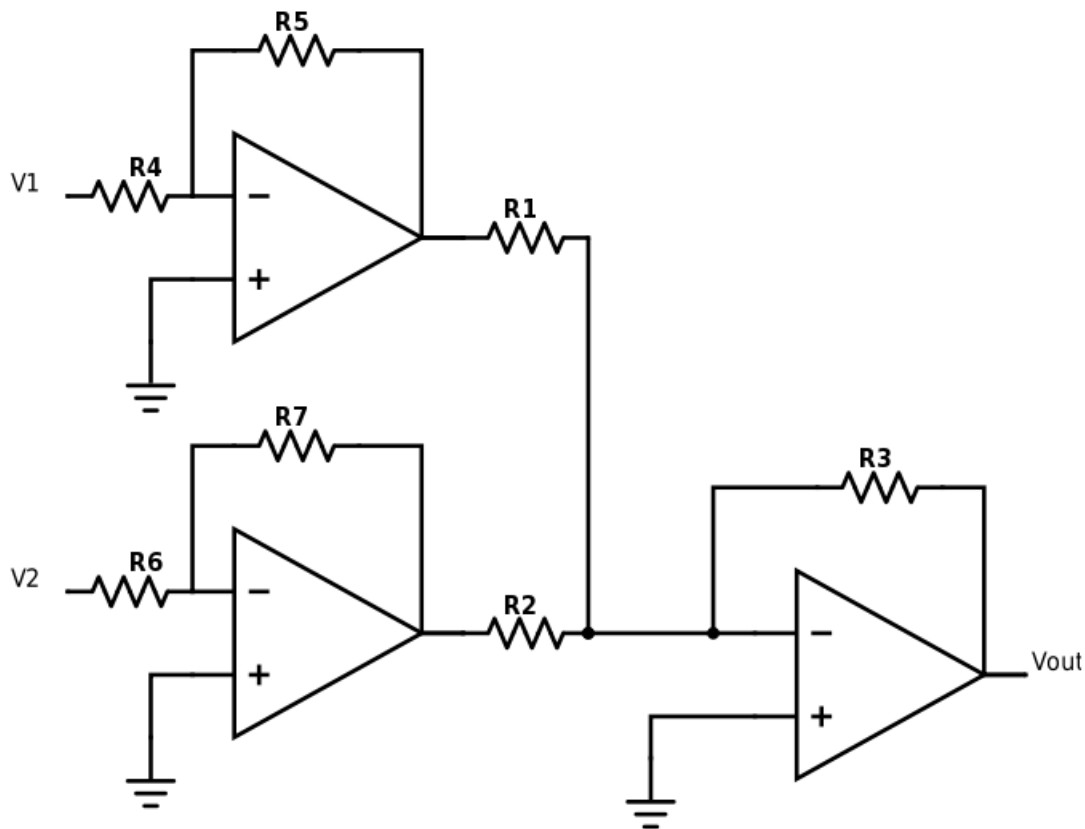# EN-3212 Electronics

Operational Amplifiers: Signal Conditioning 2

For the next section, it's best to think of operational amplifiers as mathematical operators. By doing so, you can combine different inputs in order to get a desired output. For example: I have two input voltages, V_1 and V_2, I wish to multiple each by a fraction and add the resulting voltages together.

$V_{out} = (3/4)V_1 + (7/5)V_2$

There's a number of ways to do this. The circuit below is one of many that will do the trick provided we select the right resistors.

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Operational Amplifiers: Signal Conditioning 2

In addition to having to make up the circuit, we usually have to deal with another constraint in electronics. For example, you don't get to choose any resistor value you like. A list of common resistor values is provided below.

Standard Resistor Values (±5%)						
1.0	10	100	1.0K	10K	100K	1.0M
1.1	11	110	1.1K	11K	110K	1.1M
1.2	12	120	1.2K	12K	120K	1.2M
1.3	13	130	1.3K	13K	130K	1.3M
1.5	15	150	1.5K	15K	150K	1.5M
1.6	16	160	1.6K	16K	160K	1.6M
1.8	18	180	1.8K	18K	180K	1.8M
2.0	20	200	2.0K	20K	200K	2.0M
2.2	22	220	2.2K	22K	220K	2.2M
2.4	24	240	2.4K	24K	240K	2.4M
2.7	27	270	2.7K	27K	270K	2.7M
3.0	30	300	3.0K	30K	300K	3.0M
3.3	33	330	3.3K	33K	330K	3.3M
3.6	36	360	3.6K	36K	360K	3.6M
3.9	39	390	3.9K	39K	390K	3.9M
4.3	43	430	4.3K	43K	430K	4.3M
4.7	47	470	4.7K	47K	470K	4.7M
5.1	51	510	5.1K	51K	510K	5.1M
5.6	56	560	5.6K	56K	560K	5.6M
6.2	62	620	6.2K	62K	620K	6.2M
6.8	68	680	6.8K	68K	680K	6.8M
7.5	75	750	7.5K	75K	750K	7.5M
8.2	82	820	8.2K	82K	820K	8.2M
9.1	91	910	9.1K	91K	910K	9.1M

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Operational Amplifiers: Signal Conditioning 2

Let's try making an op amp circuit that does the following, using as many op amps as you need, an 18V battery, and resistor values from the chart on the previous page. Hopefully building the circuit that takes the derivative of V1 will be easy. Look in your class notes and focus on how we get the 6volt offset.

$$0.0043\,\frac{dV1}{dt} - 6V$$

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Operational Amplifiers: Signal Conditioning 2

Build a circuit that takes the difference of two inputs, multiplies that result by a constant, and adds an offset. You can use as many op amps as you like, the resistors from the table in this worksheet, and an 18 volt battery. *Hint: you can make a new resistance by combining stock resistors in series or in parallel*

$$\frac{44}{47}(V_a - V_b) + 12V$$