Lab #3: Operational Amplifier Electronic Circuits

1) Each group will get an oscilloscope, a function generator, a solderless breadboard, a 741 operational amplifier chip, resistors and a capacitor as needed.

2) Build the RC circuit shown in Figure 1 and enter the code as provided in Figure 2 to cause the Boe-Bot to generate a continuously changing analog voltage signal in the shape of a triangle wave.

3) Using the pin-out of the 741 op amp as shown in Figure 3 and non-inverting configuration shown in Figure 4., design the circuit such that the closed loop gain is ***vo/vi*** = 2, as per the gain equation **(1)**.

4) Construct the operational amplifier circuit of Figure 4 for the gain that you designed from part 3) of this lab. Use the DC power supplies to power your op amp with ±16 V.

5) Using the output signal of the Boe-Bot as the input signal to the op amp, display both traces on the oscilloscope simultaneously to show the gain of the op amp circuit and to verify your design.

6) Sketch the input and output waveforms seen with the oscilloscope.

7) Using the inverting operational amplifier circuit of Figure 5, design the circuit such that the closed loop gain is ***vo/vi*** = -2, as per the gain equation **(2)**.

8) Construct the operational amplifier circuit of Figure 5 for the gain that you designed from part 6) of this lab. Again use the DC power supplies to power your op amp with ±16 V.

9) Using the output signal of the Boe-Bot as the input signal to the op amp, display both traces on the oscilloscope simultaneously to show the gain of the op amp circuit and to verify your design.

10) Sketch the input and output waveforms seen with the oscilloscope.

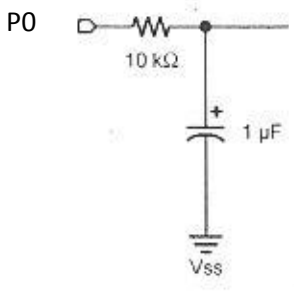

Figure 1. RC circuit

```
' {$STAMP BS2}
' {$PBASIC 2.5}

DUTY              VAR      Byte

DO
   FOR DUTY = 100 to 0 STEP 1
      PWM 0, DUTY * 255/100, 5
   NEXT
   FOR DUTY = 0 to 100 STEP 1
      PWM 0, DUTY * 255/100, 5
   NEXT
LOOP
```

Figure 2. Boe-Bot code listing

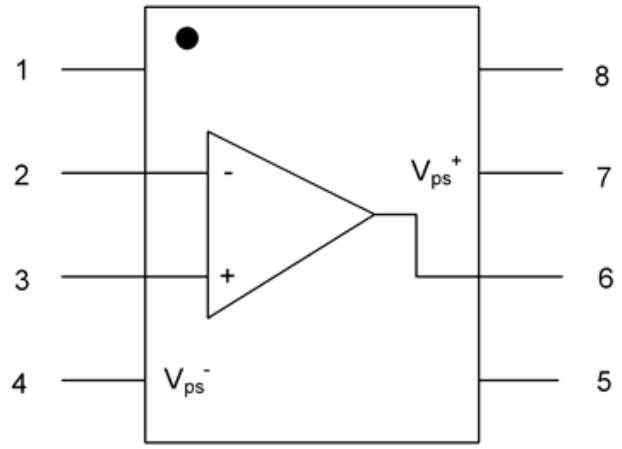

Figure 3. Pin out of the 741 operational amplifier

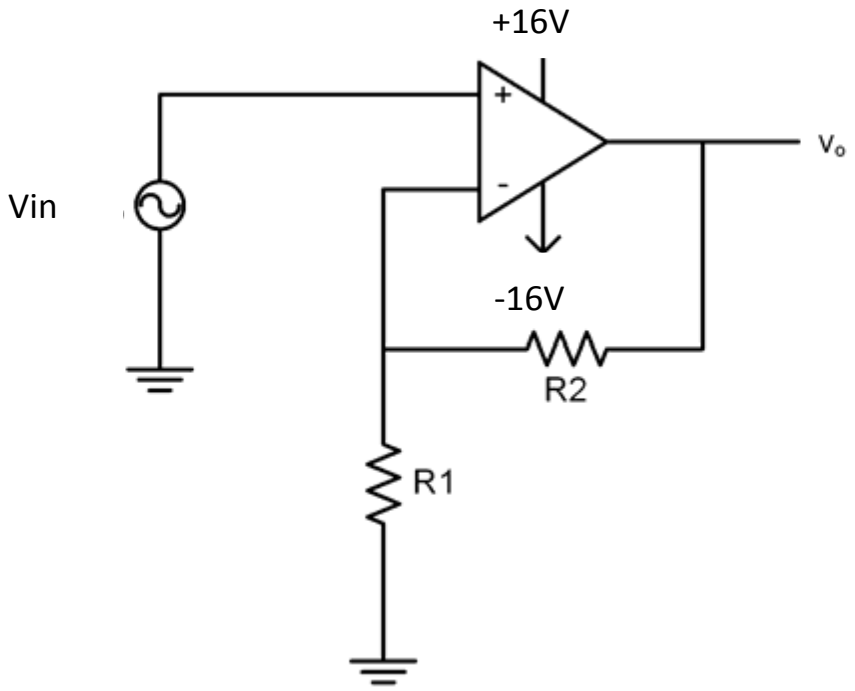

Figure 4. Non-inverting op amp configuration

Gain equation (1):

$$\frac{v_{out}}{v_{in}} = 1 + \frac{R_2}{R_1}$$

Vin

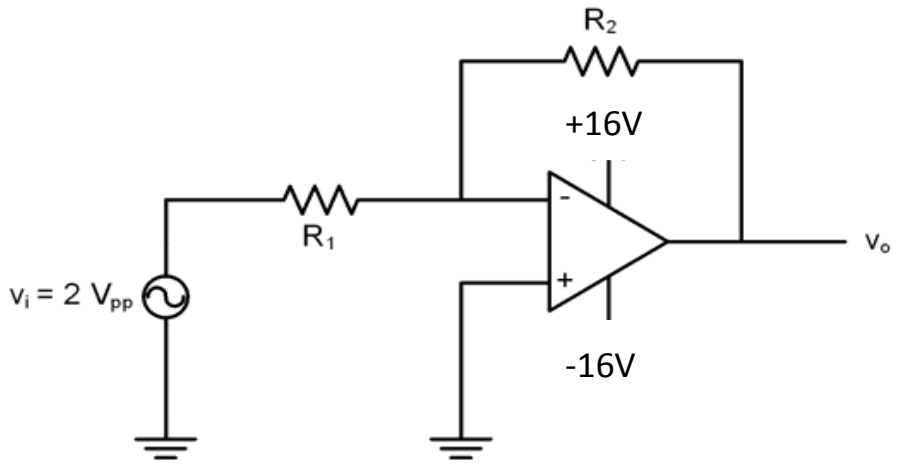

Figure 5. Inverting op amp configuration

Gain equation (2):

$$\frac{v_{out}}{v_{in}} = -\frac{R_2}{R_1}$$