KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
DEPARTMENT OF ELECTRICAL ENGINEERING
Electronic Circuits II – EE303

Experiment # 8
Sinusoidal Oscillators

OBJECTIVE

To investigate the operation of sinusoidal oscillators using operational amplifiers, specifically, the phase shift oscillator, the Wein-Bridge oscillator and the quadrature oscillator.

PRELAB WORK

Students must perform the following calculations and PSPICE before coming to the lab.

1. For the different oscillator circuits shown in Figure 1, perform an approximate hand calculation assuming ideal operational amplifiers. In each case obtain an expression for the frequency of oscillation and the condition of oscillation.

2. Using SPICE simulate the different configurations and from SPICE output file obtain the oscillation frequency. For simulating the op-amp you can use the first model presented in Experiment # 3 or the second model presented in Experiment # 7. Try the second model to see the effect of the gain frequency characteristic of the op-amp on the frequency and condition of oscillation. For the SPICE simulation it is essential to calculate the closed loop gain of your circuit. As you know the closed loop gain is the overall gain of the amplifier and the feedback network. Of course in oscillator circuits, we do not have an input ac signal. However, we can open the loop at an appropriate point and assume that an input voltage of say, 1V ac is applied at this input. Then we calculate the output voltage and phase angle as functions of the input frequency. If we find that at certain frequency the overall gain is unity and the overall phase angle is zero, then this is the possible frequency of oscillation. Notice that for oscillation to start the condition of oscillation must be satisfied. Thus, do not be disappointed if you notice that for certain value of R_1 the overall gain cannot be unity and phase shift is not zero. Try again using a larger value of R_1.

3. Tabulate the results obtained from your hand calculations and from SPICE simulation in Table I.

You must have your SPICE output file with your hand calculations ready before you come to the lab.

EXPERIMENTAL WORK

1. Construct the circuit shown in Figure 1. In each case change the variable resistance until you get an output on the oscilloscope. This means that your circuit is oscillating. In each case record the value of the resistance R_1 at which oscillation just starts to appear on the oscilloscope. Check whether it satisfies the condition of oscillation obtained from your theoretical work.

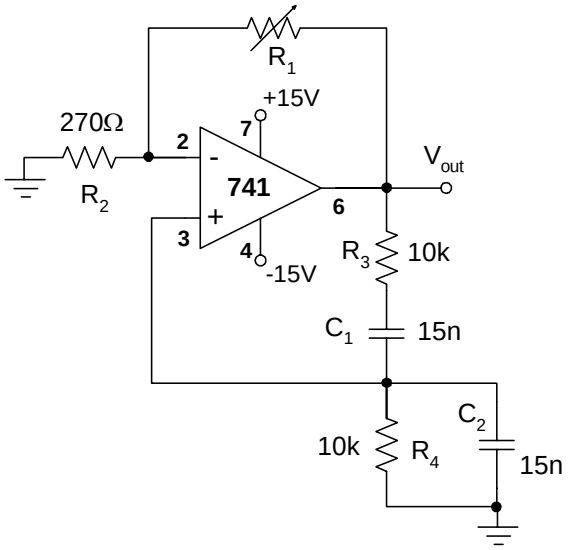
2. In each case observe the output waveform. Is it pure sinusoidal signal? If not, what are the sources of distortion in your opinion?

3. Also observe the amplitude of the output waveforms. Can we control it? If the answer is yes, how?

4. Tabulate your results in Table I.

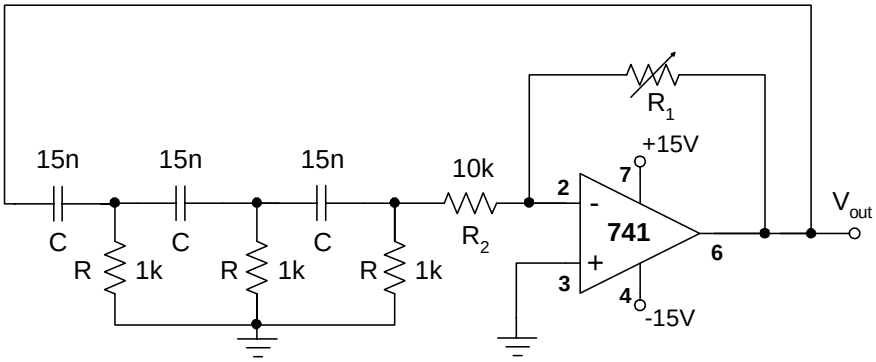
Table I: Summary of hand calculations, SPICE simulation and experiment

Circuit		Hand Calculation	SPICE Simulation	Experimental Result
Figure 1	Frequency			
	Condition of Oscillation			
Figure 2	Frequency			
	Condition of Oscillation			
Figure 3	Frequency			
	Condition of Oscillation			



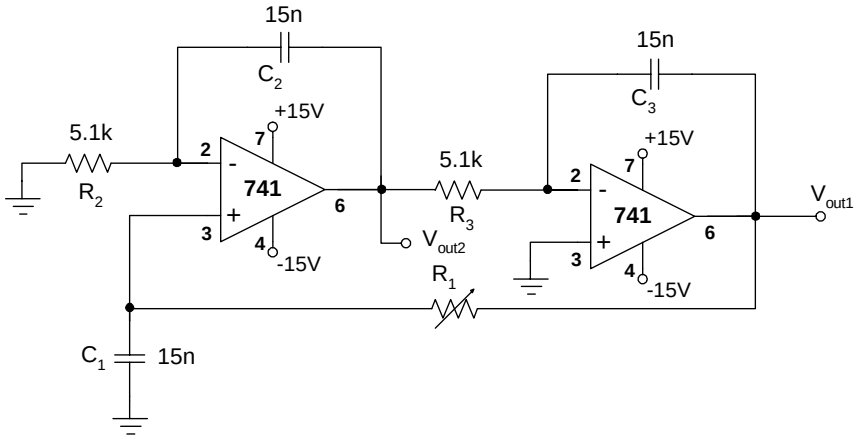
(a) Wein Bridge Oscillator

$f_o = 1/2\pi CR$
$C = 15nF$, $R = 10k\Omega$
$R_2 = 270\Omega$, $R_1 > 2R_2$



(b) Phase shift Oscillator

$f_o = 1/2\pi\sqrt{6}\,CR$
$C = 15nF$, $R = 1k\Omega$
$R_2 = 10k\Omega$, $R_1 > 29R_2$



(c) Quadrature Oscillator

$f_o = 1/2\pi\sqrt{C_2C_3R_2R_3}$
$C_1=C_2=C_3=15nF$, $R = 1k\Omega$
$R_2=R_3=5.1k\Omega$, $R_1 > R_2$

Figure 1