HACETTEPE UNIVERSITY DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING ELE-313 ELECTRONICS LABORATORY II

EXPERIMENT – 8 OSCILLATORS

REFERENCES

Study the analysis of Oscillators given in the book **Electronic devices and circuit theory, Louis Nashelsky sixth edition pp.789-794, lecture notes and theoritical information given below.**

1.OBJECTIVE

To demonstrate the Wien-bridge and RC phase-shift oscillators.

2.THEORY

Oscillators are circuits that spontaneously generate a periodically changing output voltage due to positive feedback. Two important types of them are wien-bridge and RC phase-shift oscillators. An operational amplifier is ideal for use in oscillator circuits because of its large input impedance, large gain, and the ease with which a positive feedback can be introduced around it. The positive feedback required for oscillation is specified by the *Barkhausen criterion*. According to this criterion, the total gain from input to output and back through the feedback circuitry must equal at least one, and the total phase-shift from input to output and back through the the feedback circuitry must equal 0°, or a multiple of 360°.

A wien-bridge oscillator is shown in Figure 1. It may be regarded as a bridge whose two branches are the resistive voltage divider at the inverting terminal and the reactive voltage divider at the non-inverting terminal of the operational amplifier. The circuit oscillates at a frequency at which the ac voltages at the two terminals are equal. If R1 and R2 (see Figure 1) are made equal-valued resistors, and C1 and C2 equal-valued capacitors, then the ratio of Rf to Rin must be 2:1 to satisfy the Barkhausen criterion. The oscillation frequency for the wien-bridge oscillator, given these assumptions, can be calculated from the following equation:

$$f = \frac{1}{2\pi RC}$$

where R = R1 = R2 , and C = C1 = C2 .

An example of an RC phase-shift oscillator is shown in Figure 2. The RC phase-shift oscillator uses three cascaded stages of RC high-pass filters, with the output of the last stage fed back to the inverting input of the operational amplifier. The purpose of constructing RC filters is to provide a phase shift of 180°. Since the output of these filters is feedback to the inverting terminal, the amplifier itself provides another phase shift of 180°. The total phase-shift of the circuit is therefore 360° or 0°. Given the stipulation that R1, R2 and R3 are all equal-valued resistors, and that C1, C2 and C3 are all equal-valued capacitors, the oscillation frequency of the RC phase-shift oscillator can be calculated using the following equation:

$$f = \frac{1}{2\pi RC\sqrt{6}}$$

where R = R1 = R2 = R3 and C = C1 = C2 = C3.

This equation is exact only if the input resistor on the inverting terminal (10 KΩ in Figure 2) is large enough to prevent any loading of the cascaded RC stages.

3.PRELIMINARY WORK

1. Design a wien-bridge oscillator which oscillates at 25 kHz.

2. Design an RC phase-shift oscillator which oscillates at 100 Hz.

4. EXPERIMENTAL WORK:

In this section, the given steps below will be applied in the experiment. In order to validate your measurements during the experiment, do the pspice simulations beforehand. **Write down the simulation results** near circuits designed and graphs drawn.

1). Set up Wien-bridge oscillator given in :Figure-1.
RIN=1KΩ, RF=1.5KΩ series with 1KΩ pot.
R1=R2=10KΩ and C1=C2=0.1µF

2). Take C1=C2=0.22µF repeat step (1).

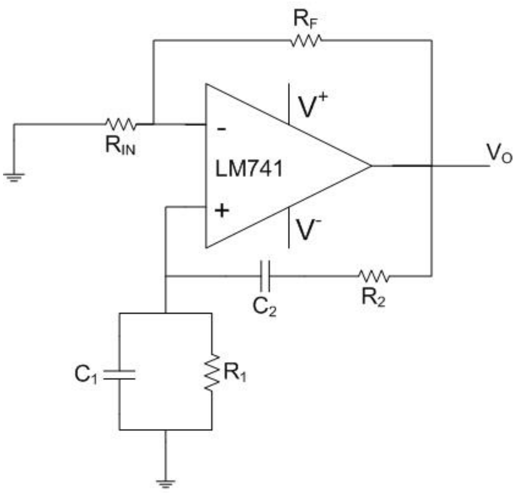
3). Take R1=R2=1KΩ repeat step (1).

4). Set up RC phase shift oscillator given in :Figure-2.
RIN=10KΩ, RF=500KΩ pot.
R1=R2= R3=1KΩ and C1=C2= C3=0.22µF

5). Take C1=C2= C3=0.47µF repeat step(4).

6). Take R1=R2= R3=560Ω repeat step(4).

Carefully adjust the potentiometers in each step in order to obtain output sinusoid signal with least distortion. Measure and record the output frequencies. Supply voltage V±=±15V!



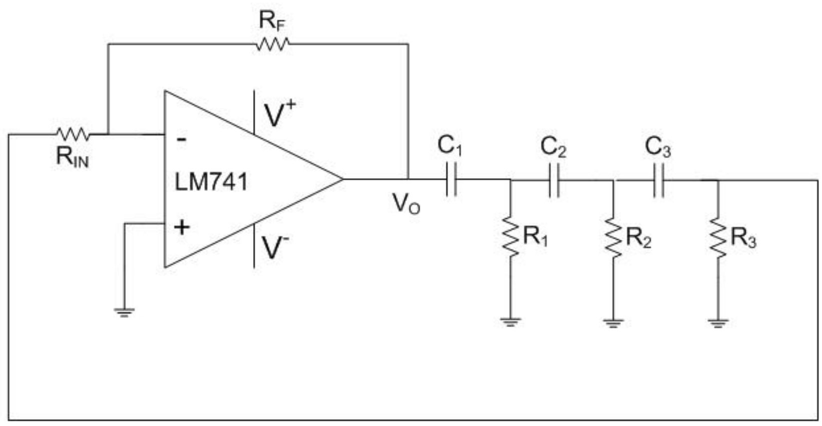


Figure-1 Wien-Bridge Oscillator	**Figure-2** RC Phase Shift Oscillator

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