Benha University **Electronic circuits (B)** **Electrical Eng. Dept.**
Faculty of Engineering **3rd year communication**
Shoubra **2012-2013**

Sheet (6)-solution

Oscillators – part 3

1. What is a VCO, and basically, what does it do?

A voltage-controlled oscillator exhibits a frequency that can be varied with a dc control voltage.

2. Upon what principle does a relaxation oscillator operate?

The basis of a relaxation oscillator is the charging and discharging of a capacitor.

3. What type of signal does the circuit in figure 1 produce? Determine the frequency of the output.

Triangular waveform.

$$f = \frac{1}{4R_1C}\left(\frac{R_2}{R_3}\right) = \frac{1}{4(22\,\text{k}\Omega)(0.022\,\mu\text{F})}\left(\frac{56\,\text{k}\Omega}{18\,\text{k}\Omega}\right) = \mathbf{1.61\ kHz}$$

4. Show how to change the frequency of oscillation in figure 1 to 10 KHz.

Change f to 10 kHz by changing R_1:

$$f = \frac{1}{4R_1C}\left(\frac{R_2}{R_3}\right)$$

$$R = \frac{1}{4fC}\left(\frac{R_2}{R_3}\right) = \frac{1}{4(10\,\text{kHz})(0.022\,\mu\text{F})}\left(\frac{56\,\text{k}\Omega}{18\,\text{k}\Omega}\right) = \mathbf{3.54\ k\Omega}$$

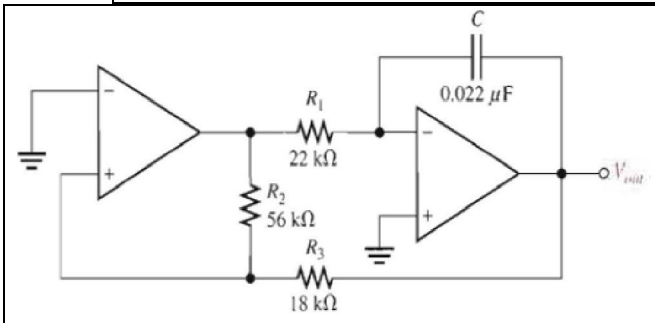


Figure 1

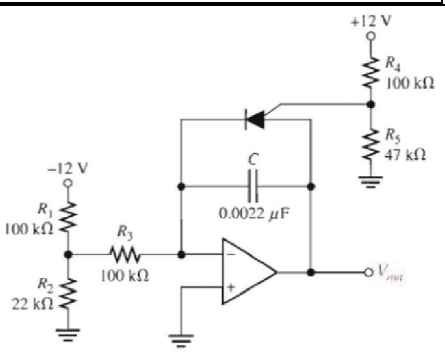


Figure 2

Dr.Rokaia Mounir

5. Determine the amplitude and frequency of the output voltage in figure 2. Use 1V as the forward PUT voltage.

$$T = \frac{V_p - V_F}{\left(\frac{|V_{IN}|}{RC}\right)}$$

$$V_p = \left(\frac{R_5}{R_4 + R_5}\right)12\text{ V} = \left(\frac{47\text{ k}\Omega}{147\text{ k}\Omega}\right)12\text{ V} = 3.84\text{ V}$$

PUT triggers at about +3.84 V + 0.7 V = 4.54 V

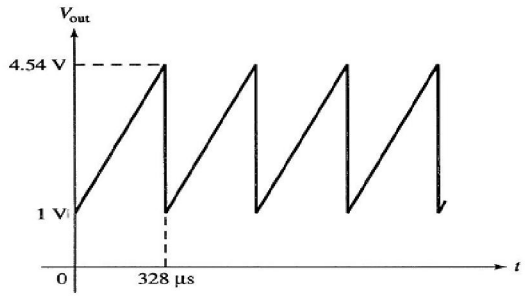
Amplitude = +4.54 V − 1 V = **3.54 V**

$$V_{IN} = \left(\frac{R_2}{R_1 + R_2}\right)(-12\text{ V}) = \left(\frac{22\text{ k}\Omega}{122\text{ k}\Omega}\right)(-12\text{ V}) = -2.16\text{ V}$$

$$T = \frac{4.54\text{ V} - 1\text{ V}}{\left(\frac{2.16\text{ V}}{(100\text{ k}\Omega)(0.002\ \mu\text{F})}\right)} = 328\ \mu\text{s}$$

$$f = \frac{1}{T} = \frac{1}{328\ \mu\text{s}} = \mathbf{3.05\ kHz}$$

See Figure 16-1.



6. Modify the sawtooth generator in figure 2 so that its peak-to-peak is 4V.

$V_G = 5$ V. Assume $V_{AK} = 1$ V.

$$V_G = \left(\frac{R_5}{R_4 + R_5}\right)12\text{ V}$$

Change R_4 to get $V_G = 5$ V.

$5\text{ V}(R_4 + 47\text{ k}\Omega) = (47\text{ k}\Omega)12\text{ V}$

$R_4(5\text{ V}) = (47\text{ k}\Omega)12\text{ V} - (47\text{ k}\Omega)5\text{ V}$

$$R_4 = \frac{(12\text{ V} - 5\text{ V})47\text{ k}\Omega}{5\text{ V}} = \mathbf{65.8\ k\Omega}$$

7. A certain Sawtooth generator has the following parameters values: V_{IN}=3V, R=4.7KΩ, C=0.001µF.determine its peak-to-peak output voltage if the period is 10µs.

$$T = \frac{V_p - V_F}{\left(\frac{V_{IN}}{RC}\right)}$$

$$V_p = \left(\frac{V_{IN}}{RC}\right)T + V_F = \left(\frac{3\text{ V}}{(4.7\text{ k}\Omega)(0.001\ \mu\text{F})}\right)10\ \mu\text{s} + 1\text{ V} = 7.38\text{ V}$$

$$V_{pp(out)} = V_p - V_F = 7.38\text{ V} - 1\text{ V} = \mathbf{6.38\ V}$$