K. J. SOMAIYA COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS ENGINEERING
ELECTRONIC CIRCUITS
OSCILLATOR CIRCUITS

13^{th} **July, 2020** **Numerical**

1. In Collpits oscillator, amplifier components are:
   $R_1 = 100\text{k}\Omega$, $R_2 = 18\ \text{k}\Omega$, $R_E = 1\ \text{k}\Omega$, $C_{C1} = 1\ \mu\text{F}$, $C_E = 150\ \mu\text{F}$, $C_{C2} = 1\ \mu\text{F}$, $V_{CC} = 10$ V
   Select LC tank circuit elements such that the frequency of oscillation is close to 80 kHz

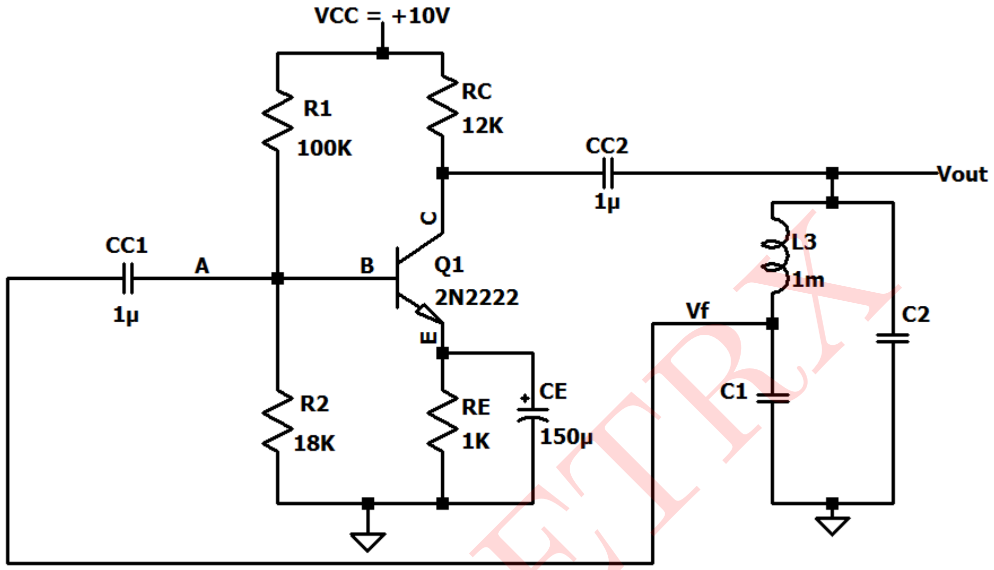

Figure 1: Circuit 1

Solution:

$$f_o = \frac{1}{2\pi\sqrt{C_{eq} \times L_3}}$$

$$C_{eq} = \frac{C_1 \times C_2}{C_1 + C_2}$$

$L_3 = 1$ mH, $f_o \approx 80$ kHz

$$80 \times 10^3 = \frac{1}{2\pi\sqrt{10^{-3} \times C_{eq}}}$$

$\therefore C_{eq} = 3.957$ nF

Let $C_1 = C_2 = 2 \times 3.957 \times 10^{-9} = 7.914$ nF

Feedback fraction (k) $= \dfrac{C_1}{C_2} = 1$

Time period of oscillations $= \dfrac{1}{f_o} = 12.5\ \mu$s

Phase shift offered by LC tank circuit $= 180°$

SIMULATED RESULTS:
Above circuit is simulated using LTspice and the results are presented below:

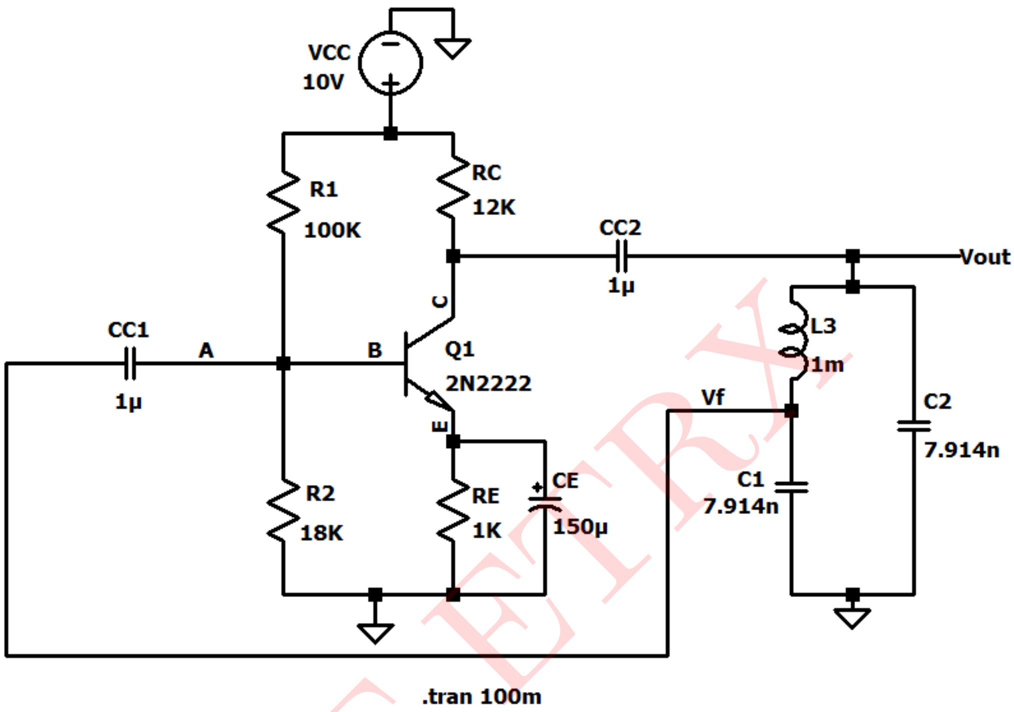

Figure 2: Circuit schematic

The waveform for output voltage V_{out} is shown in Figure 3

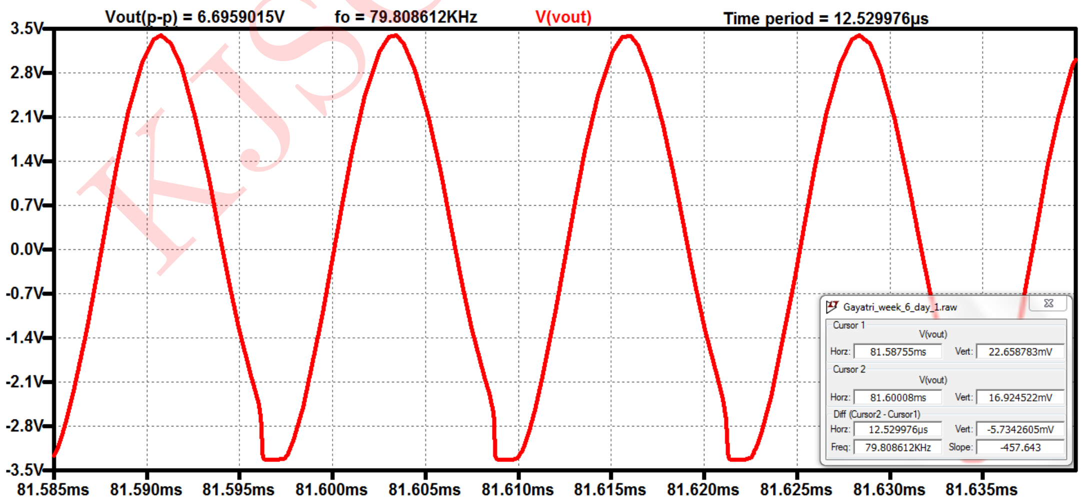

Figure 3: Waveform for V_{out}

The waveforms for feedback signal V_f and output signal V_{out} are shown in Figure 4

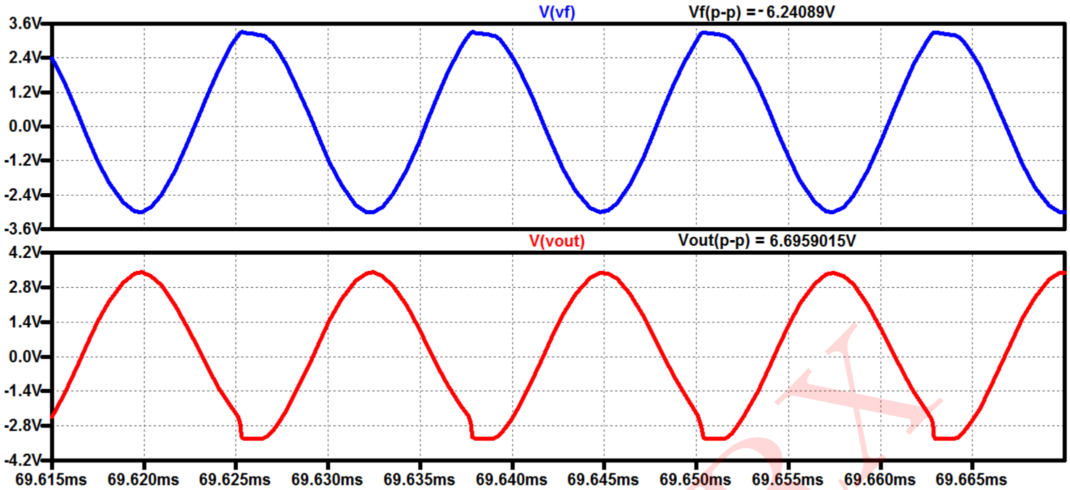

Figure 4: Waveforms for V_f and V_{out}

Comparison of theoretical and simulated values:

Parameters	Theoretical	Simulated
Frequency of oscillation(f_o)	80 kHz	79.808612 kHz
Time period of oscillations	12.5 μs	12.529976 μs
Amplitude of oscillations	–	6.6959015 V
Feedback signal (V_f) amplitude and phase w.r.t. V_{out}	–	6.24089 V, 180°
Feedback fraction and phase shift offered by LC tank circuit	1, 180°	0.932046, 180°

2. In Collpits oscillator, amplifier components are
$R_1 = 100\text{k } \Omega$, $R_2 = 1 \text{ k}\Omega$, $R_E = 1 \text{ k}\Omega$, $C_{C1} = 1 \text{ }\mu\text{F}$, $C_{C2} = 1 \text{ }\mu\text{F}$, $V_{CC} = 10 \text{ V}$
Select LC tank circuit elements such that the frequency of oscillation is close to 650 kHz

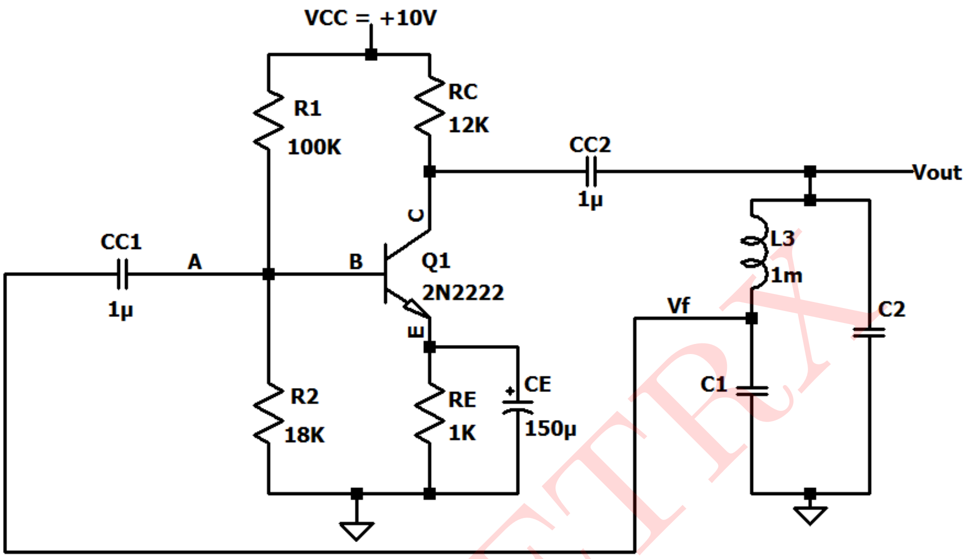

Figure 5: Circuit 1

Solution:

$$f_o = \frac{1}{2\pi\sqrt{C_{eq} \times L_3}}$$

$C_{eq} = C_3$

$L_3 = 0.1 \text{ mH}, \ f_o \approx 650 \text{ kHz}$

$$650 \times 10^3 = \frac{1}{2\pi\sqrt{10^{-4} \times C_3}}$$

$\therefore C_3 = 0.5995 \text{ nF}$

$C_1 = C_2 = 0.01 \text{ }\mu\text{F}$

$$\text{Feedback fraction (k)} = \frac{C_1}{C_2} = 1$$

$$\text{Time period of oscillations} = \frac{1}{f_o} = 12.5 \text{ }\mu\text{s}$$

Phase shift offered by LC tank circuit $= 180°$

SIMULATED RESULTS:

Above circuit is simulated using LTspice and the results are presented below: The

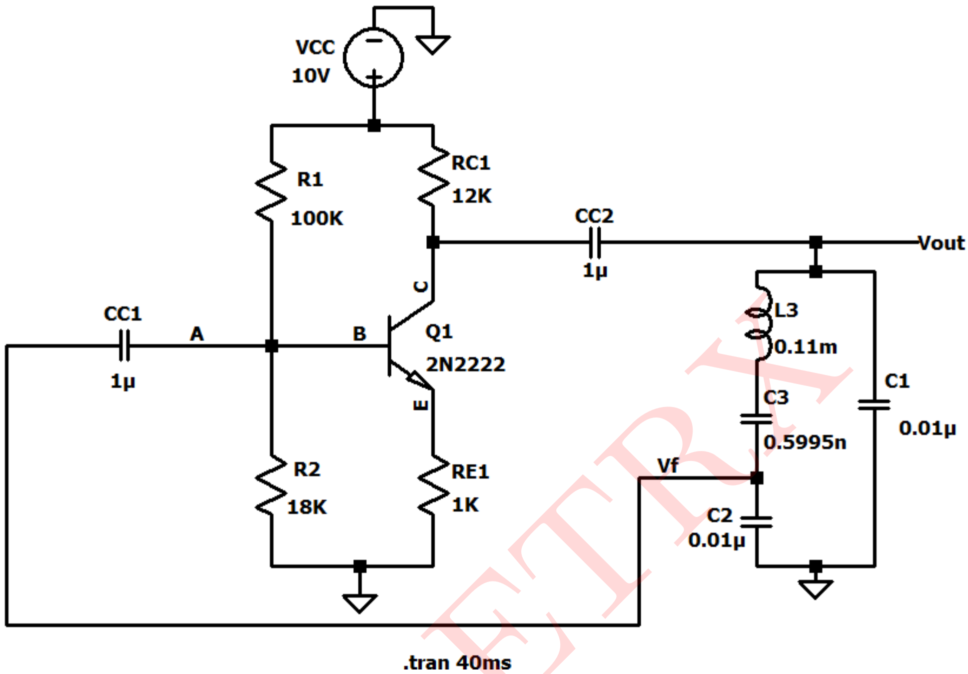

Figure 6: Circuit schematic

waveform for output voltage V_{out} is shown in Figure 7

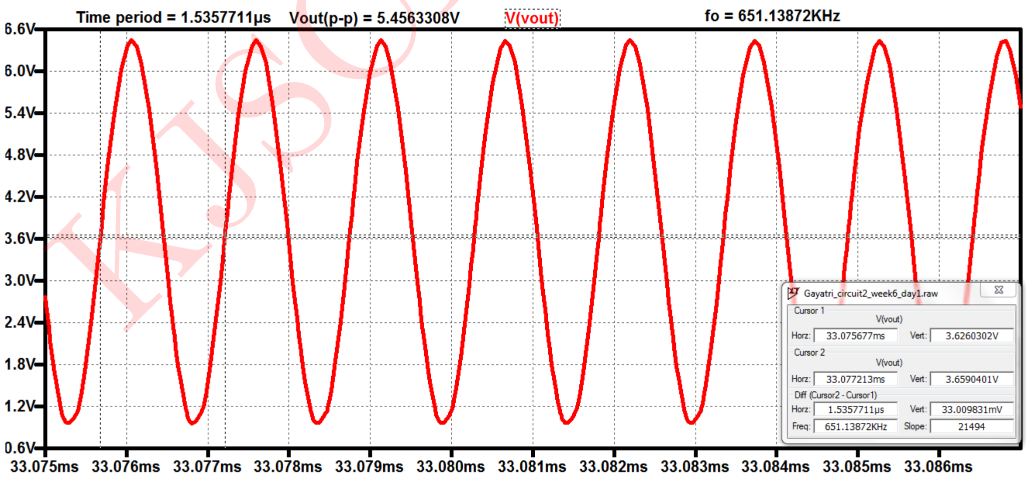

Figure 7: Waveform for V_{out}

The waveforms for feedback signal V_f and output voltage V_{out} are shown in Figure 8

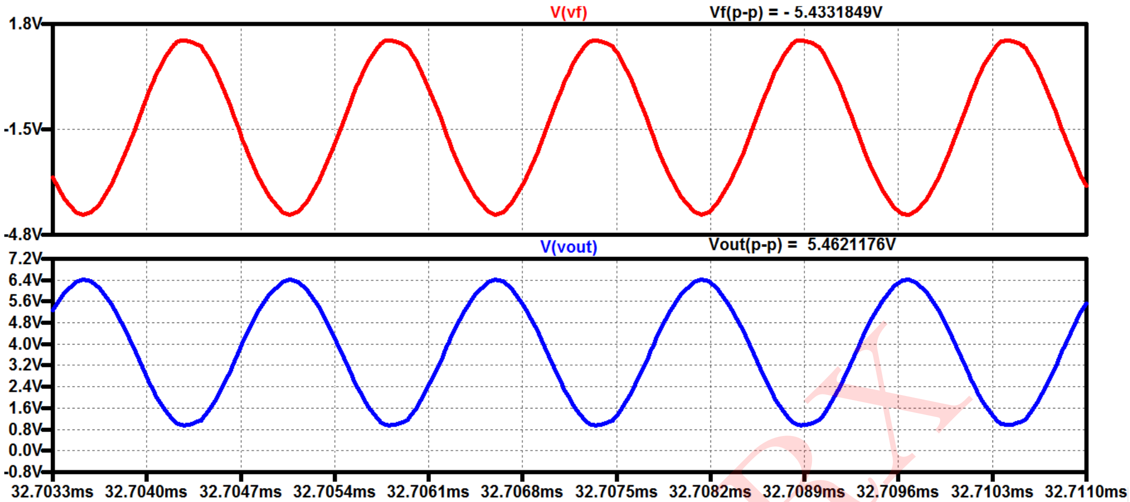

Figure 8: Waveforms for V_f and V_{out}

Comparison of theoretical and simulated values:

Parameters	**Theoretical**	**Simulated**
Frequency of oscillation(f_o)	650 kHz	65.1387 kHz
Time period of oscillations	1.538 μs	1.53711 μs
Amplitude of oscillations	–	5.4621176 V
Feedback signal (V_f) amplitude and phase w.r.t. V_{out}	–	5.433 V, 180°
Feedback fraction and phase shift offered by LC tank circuit	1, 180°	0.99466, 180°

Table 1: Numerical 1