

INTERNATIONAL INSTITUTE OF  
INFORMATION TECHNOLOGY

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H Y D E R A B A D

*Department*  
*of*  
*Electronics & Communication Engineering*

Analog Electronic Circuits

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Project Initial Report

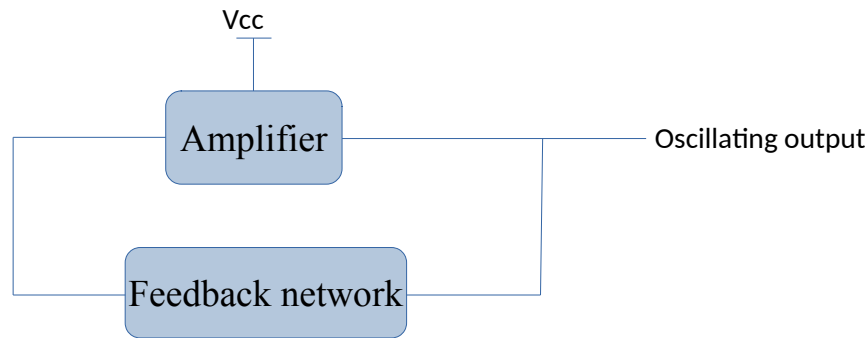
Gokulraj R – 2020102042

Sreya Garapati - 2020102055

# COLPITTS OSCILLATOR

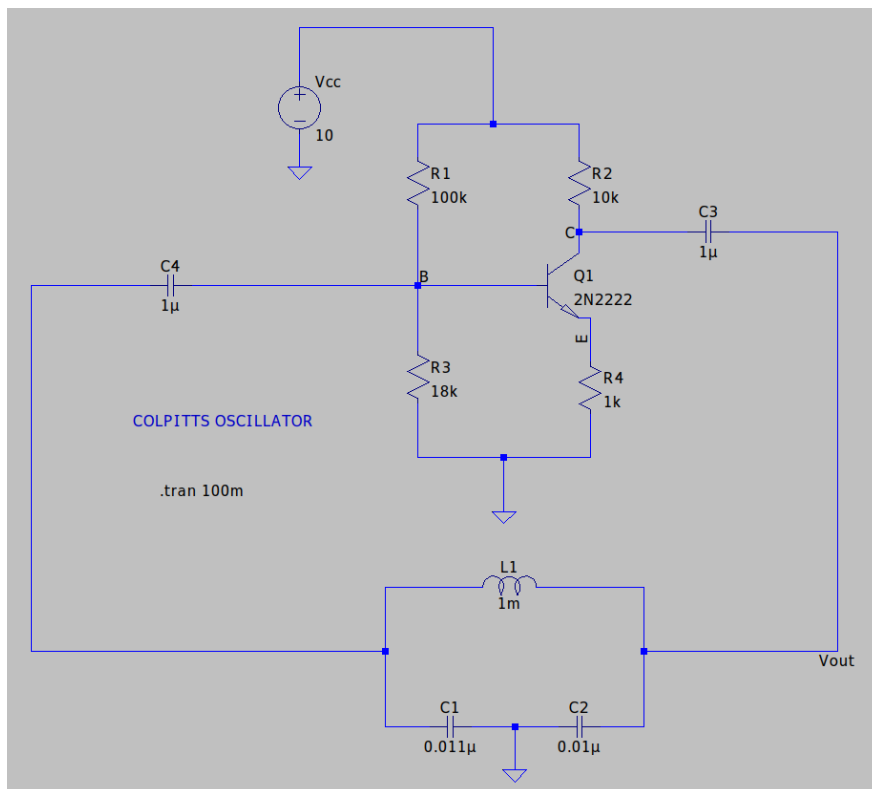
## Introduction:

An oscillator is a circuit that generates sinusoidal output without any AC inputs. The circuit uses the DC power supply and generates oscillating output. The general structure of an oscillator consists of an amplifier and a feedback network.



In Colpitts oscillator, a Common Emitter amplifier is used and an LC network is used as the feedback network. The LC tank circuit used in Colpitts oscillator has two series capacitors connected in parallel to an inductor. The frequency of the oscillation is given by the frequency of the LC circuit. Colpitts oscillator generates high frequency sinusoidal oscillations (10kHz to 300 Mhz).

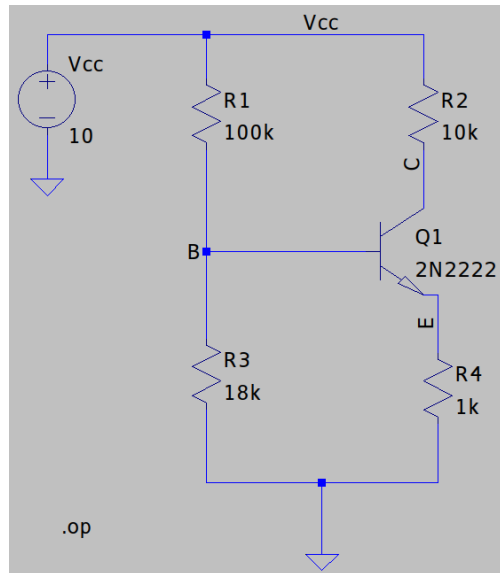
## Circuit:



Theoretically, frequency of oscillations =  $1 / (2\pi\sqrt{LC})$ , where C is the equivalent capacitance of C1 and C2, which is  $C1.C2 / (C1 + C2)$ . So, the theoretically calculated value of the frequency for this circuit is 69.54 kHz.

## Working of the circuit:

- Amplifier part:
  - Biasing the transistor:



--- Operating Point ---

V(vcc):	10	voltage
V(b):	1.46376	voltage
V(c):	1.90112	voltage
V(e):	0.813931	voltage
Ic(Q1):	0.000809888	device_current
Ib(Q1):	4.04265e-006	device_current
Ie(Q1):	-0.000813931	device_current
I(R4):	0.000813931	device_current
I(R3):	8.13198e-005	device_current
I(R2):	0.000809888	device_current
I(R1):	8.53624e-005	device_current
I(Vcc):	-0.000895251	device_current

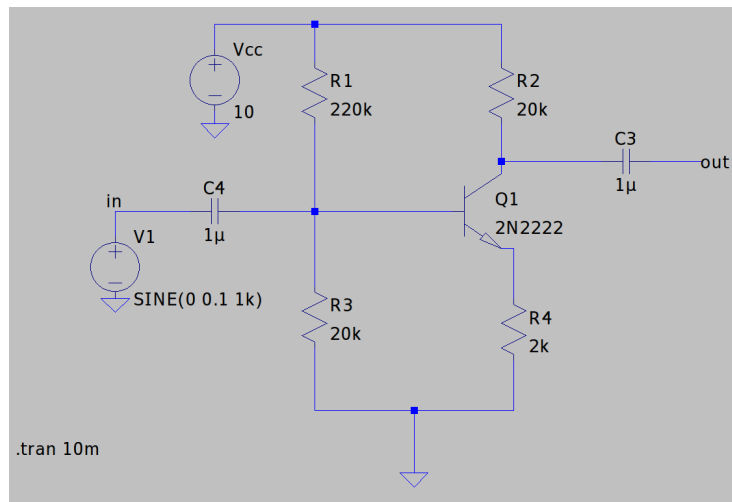
From this, the collector current is  $I_C = 8.1 \text{ mA}$ .

We know that the transconductance  $g_m = I_C / V_T = 8.1 \text{ mA} / 26 \text{ mV} = 0.312 \text{ A/V}$ .

Using the value of  $g_m$ , the theoretically calculated value of small signal gain is,

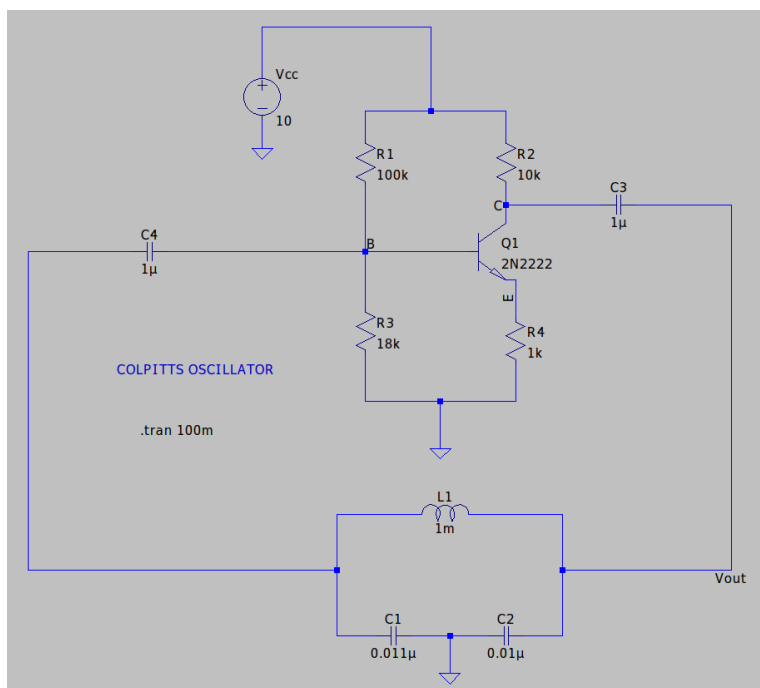
$$A_v = -g_m R_C / (1 + g_m R_E) = -g_m R_2 / (1 + g_m R_4) = 9.9 \text{ (approx.)}$$

- Working of amplifier (Common Emitter Amplifier):

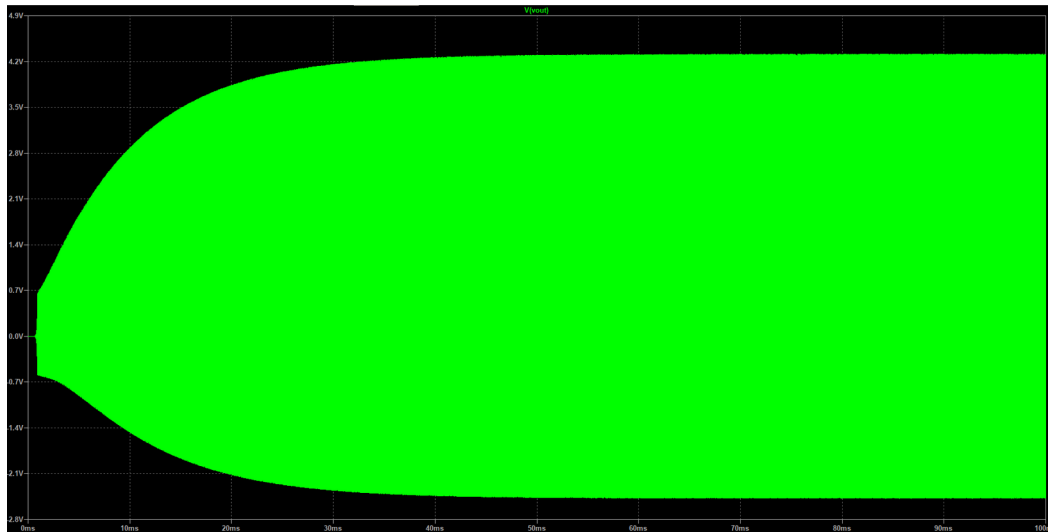


We can see that the gain of the amplifier is -8.73. The value of gain approximately matches with the theoretically calculated gain.

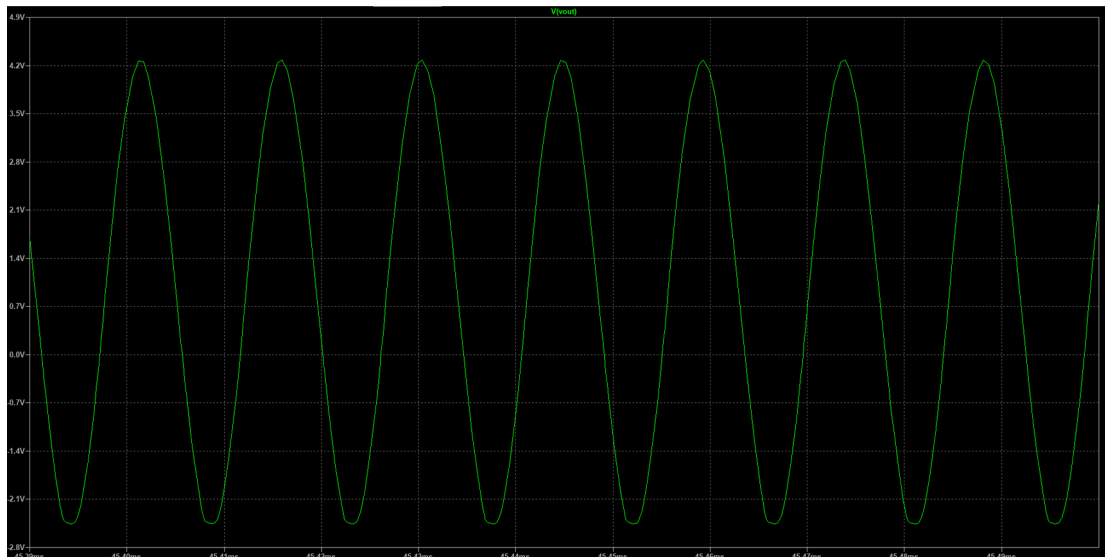
- Amplifier network + LC Feedback network (Colpitts Oscillator) :



Plot of  $V_{out}$ :



The output oscillates with very high frequency. If we zoom in to the scale of 0.01 ms, we see that the output is a sinusoid.



We observe that the time period of oscillations is 0.01447 ms, meaning that the frequency of oscillations is 69.11 kHz, which matches with the theoretically calculated frequency.

## Applications of Colpitts oscillator:

- Colpitts oscillator can be used as High frequency sinewave generator.
- Mostly used as a local oscillator in radio receivers.
- It is also used as R.F. Oscillator.
- Colpitts oscillator using SAW device can be used as the different type of sensors such as temperature sensor.
- Used for applications in which undamped and continuous oscillations are desired for functioning.