

# Unit VII: Sinusoidal Oscillator

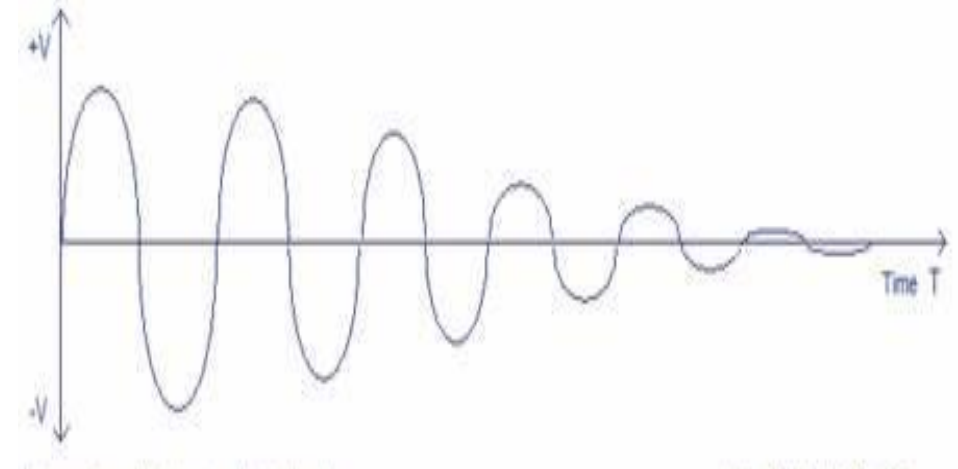
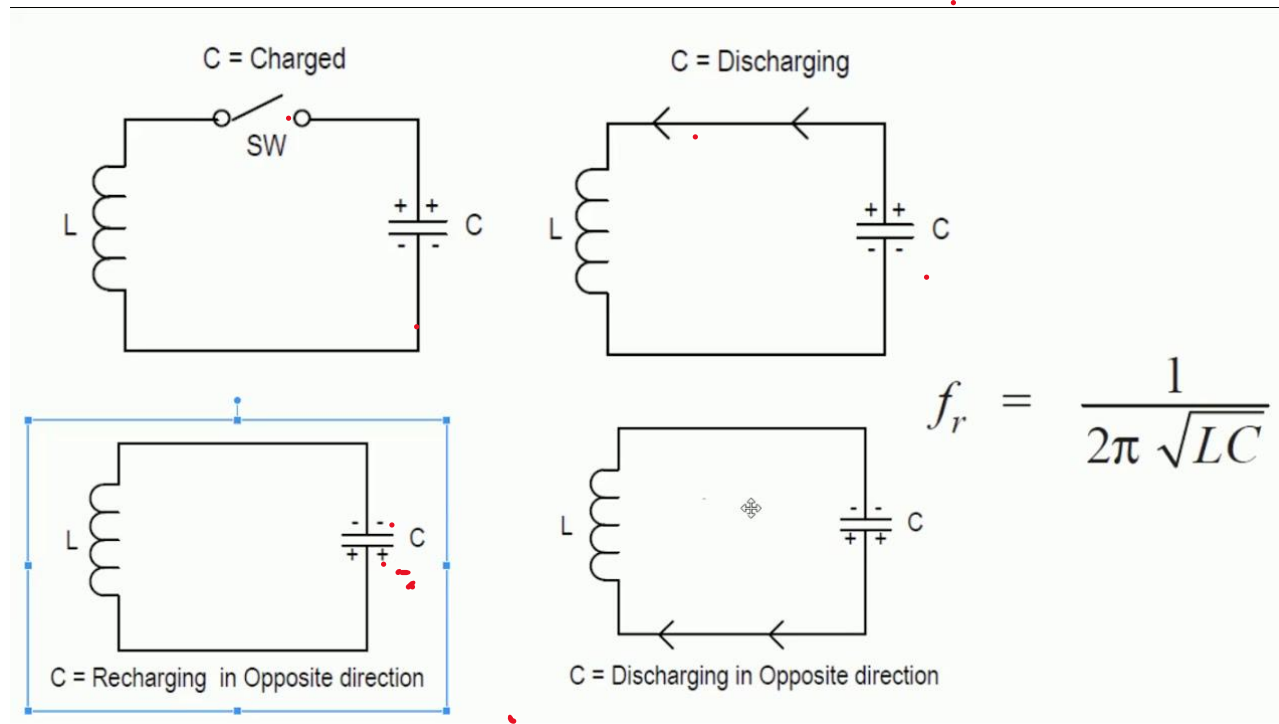
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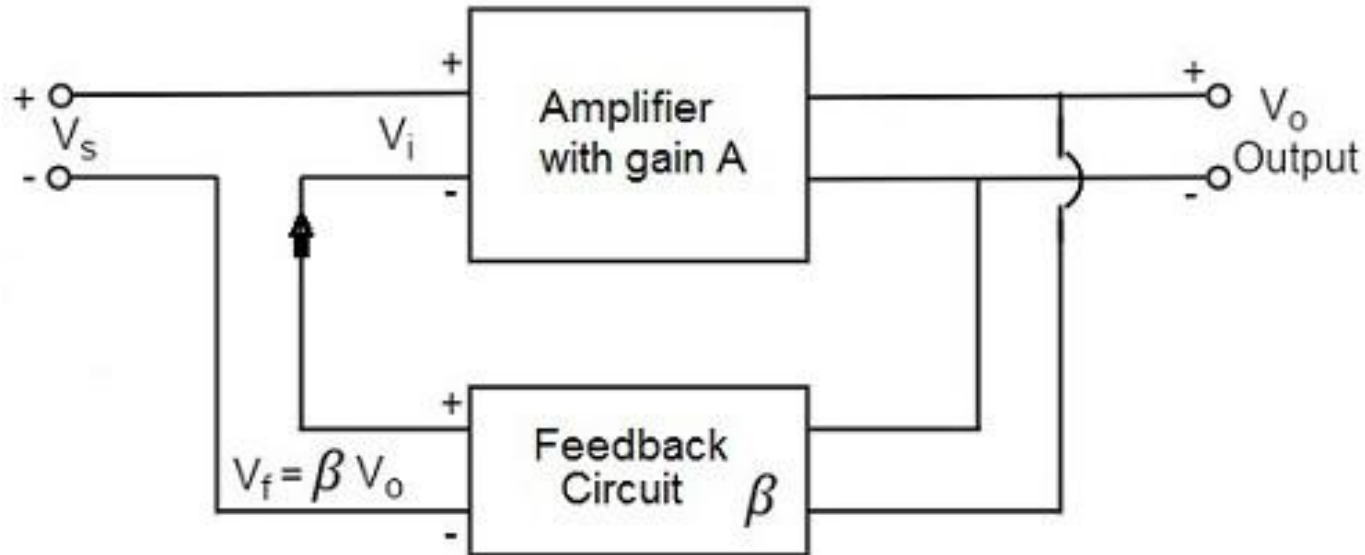
# Introduction

- An electronic device that generates oscillation of a desired frequency is known as oscillator. If the oscillation is a sinewave, then it is called sinusoidal oscillator. It does not create energy but it acts as an energy convertor. It receives DC energy and changes it into AC energy.



# Barkhausen's Criterion

- To get the continuous undamped oscillation, the following conditions must be met
  - (a) The feedback should be positive
  - (b)  $\beta A = 1$where,  $\beta$  = feedback fraction  
 $A$  = open loop gain



As we know

$$A_f = \frac{A}{1 - \beta A}$$

If  $\beta A = 1$ , then

$$A_f = \infty$$

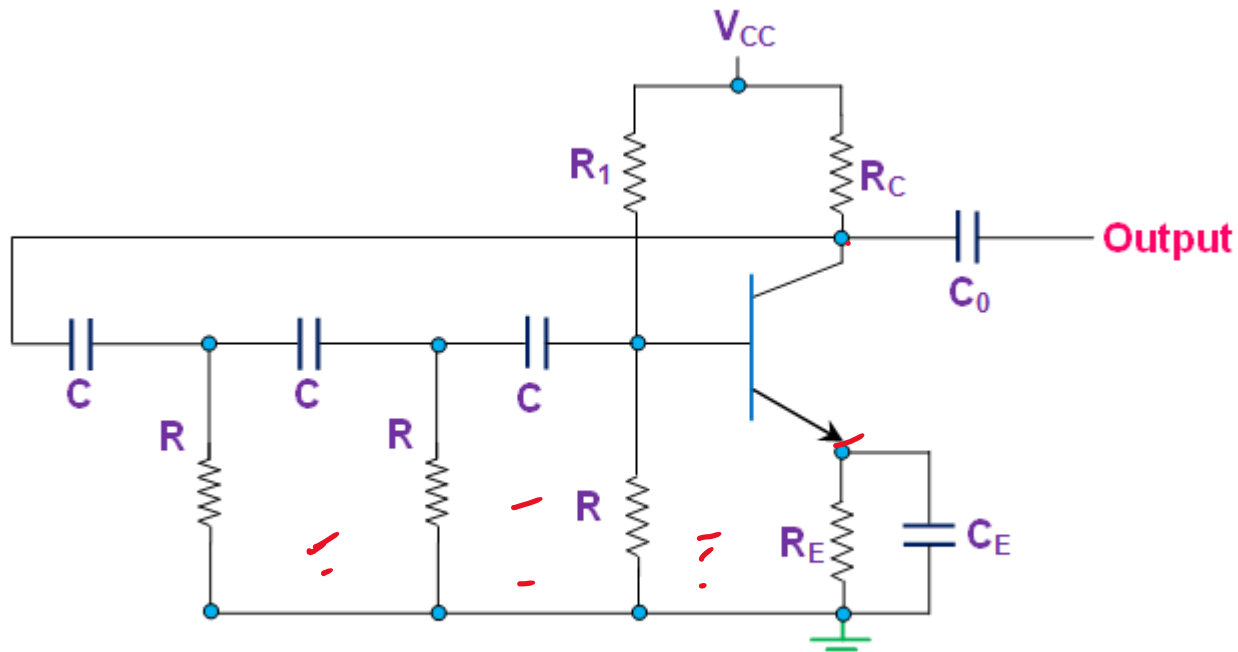
Therefore,  $\frac{V_o}{V_s} = \infty$

$V_s = 0$ ,

Therefore, without any input, there will be output. Such conditions are called the Barkhausen's criterion for self sustained oscillation.

# RC-Phase Shift Oscillator

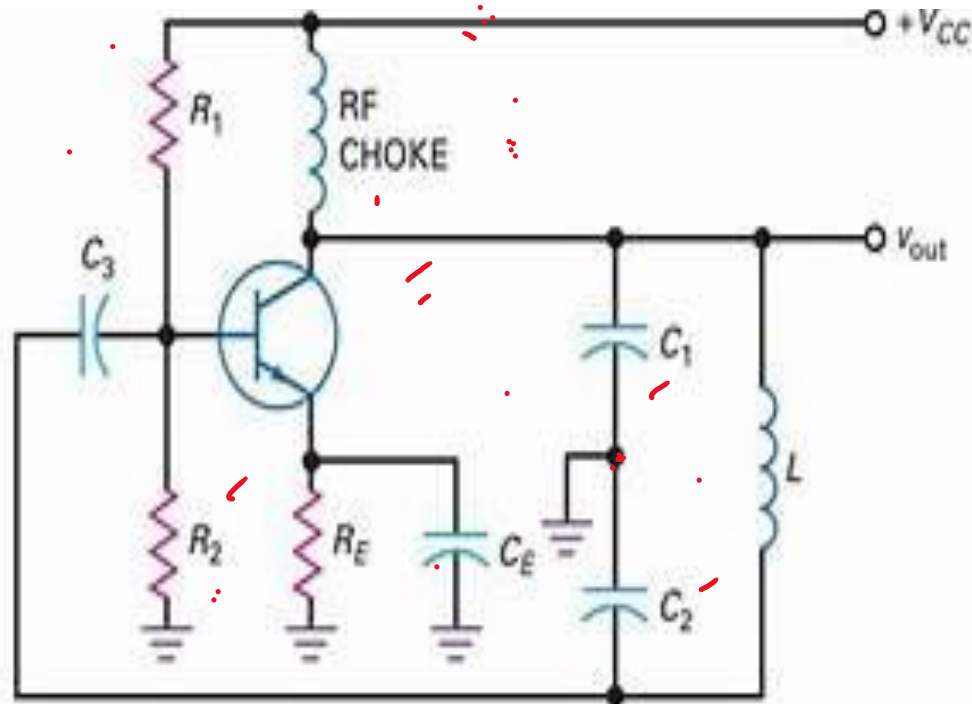
The circuit diagram for an RC phase-shift oscillator is shown in the figure. It consists of a conventional transistor amplifier in CE mode, which produces 180° phase shift and RC phase shift network. The phase shift network consists of three RC networks having equal resistances and capacitance R and C. Each RC network produces 60° phase shifts; the total phase shift is 180°. Therefore, the total phase shift is 360 degrees, which creates positive feedback. Thus, the circuit works as an oscillator.



The frequency of oscillation is

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

# Colpitt's Oscillator



The circuit diagram for Colpitt's oscillator is shown in the figure. Capacitors  $C_1$  and  $C_2$  are placed across a common inductor  $L$ , and the center of the two capacitors is taped, which is a tank circuit.

When the circuit is turned on,  $C_1$  and  $C_2$  are charged. The capacitor discharges through  $L$ , setting up the oscillation frequency. The output voltage is developed across  $C_1$  and the feedback voltage is developed across  $C_2$ . The voltage across  $C_2$  is 180 degrees out of phase with voltage across  $C_1$ . Since the amplifier with CE mode provides 180 degree phase difference. Thus, the total phase difference is 360 degrees, and positive feedback is obtained. Therefore, the oscillation is sustained in such circuit.

The frequency of oscillation is

$$f = \frac{1}{2\pi \sqrt{L \frac{C_1 C_2}{C_1 + C_2}}}$$

**Q1: Which among the following parameters acts as an initiator for the operation of an oscillator in the absence of input signal?**

- 1.Noise figure
- 2.Noise voltage
- 3.Noise power
- 4.Noise temperature

**Q2: Multivibrators belongs to which of the following category?**

- 1.Square wave oscillators
- 2.Sinusoidal oscillators
- 3.Ramp wave oscillators
- 4.Triangular wave oscillators

**Q3: Which among the following oscillators does not adopt any kind of feedback mechanism?**

- 1.Wein bridge oscillator
- 2.UJT relaxation oscillator
- 3.Phase-shift oscillator
- 4.All of the above

junction transistor

~~Q4: An oscillator employs ..... feedback~~

1. Positive
2. Negative
3. Neither positive nor negative
4. Data insufficient

**Q5: Which of the following is not an example for the non-sinusoidal oscillator?**

1. Sawtooth Generators
2. Blocking oscillators
3. Multivibrator
4. Crystal oscillators



**Q6: The sinusoidal oscillator is also called**

1. LC oscillator
2. Harmonic oscillator
3. RC oscillator
4. Crystal oscillators

**Q7: Which of the following oscillators cannot be used in low-frequency oscillations?**

1. Wein bridge oscillators
2. RC phase shift oscillators
- ~~3. Colpitts oscillators~~
4. RC oscillators

**Q8: In an LC oscillator, the frequency of the oscillator is..... L or C.**

1. Proportional to square of
2. Directly proportional to
3. Independent of the values of
4. Inversely proportional to the square root of

✓✓

$$f = \frac{1}{2\pi\sqrt{LC}}$$

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Q9: A phase shift oscillator uses 5 pF capacitor. Find the value of  $R$  to produce a frequency of 800 kHz.

Q10: What are the differences between RC phase shift and Colpitts oscillator?

Q11: What do you understand by damped and undamped electrical oscillations? Illustrate your answer with examples.

Q12: How will you get an undamped oscillation from a tank circuit?

Q13: For a Colpitts oscillator,  $C_1=750\text{pF}$  (Output voltage capacitor) and  $C_2 = 2500\text{ pF}$  (feedback capacitor), and inductance of the coil,  $L= 40\text{ }\mu\text{H}$ . Determine (i) the operating frequency, (ii) feedback fraction.