DBF Dayanand College of Arts and Science, Solapur

Waveform Generators

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ELECTRONICS	Paper VII: Operational Amplifier
	Module 2: RC Oscillators
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Prerequisites

The student must know

- Types of Waveforms
- Feedback in Amplifier
- Operational Amplifier

Learning Outcome

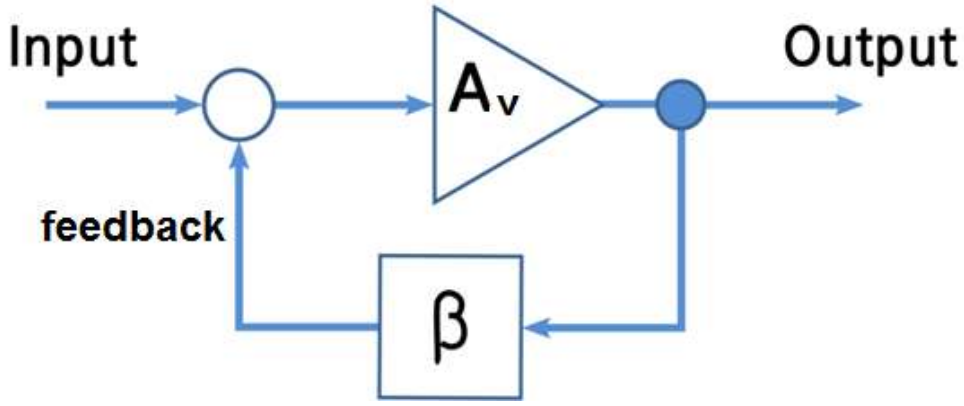
In this module you will learn about

- Meaning of Oscillator
- Types of Oscillators
- Working of Phase Shift Oscillator
- Working of Wien Bridge Oscillator

Oscillator

- Oscillator is a circuit which generates electrical oscillations of definite wave shape, frequency and amplitude
- Here dc power is used to generate electrical oscillations

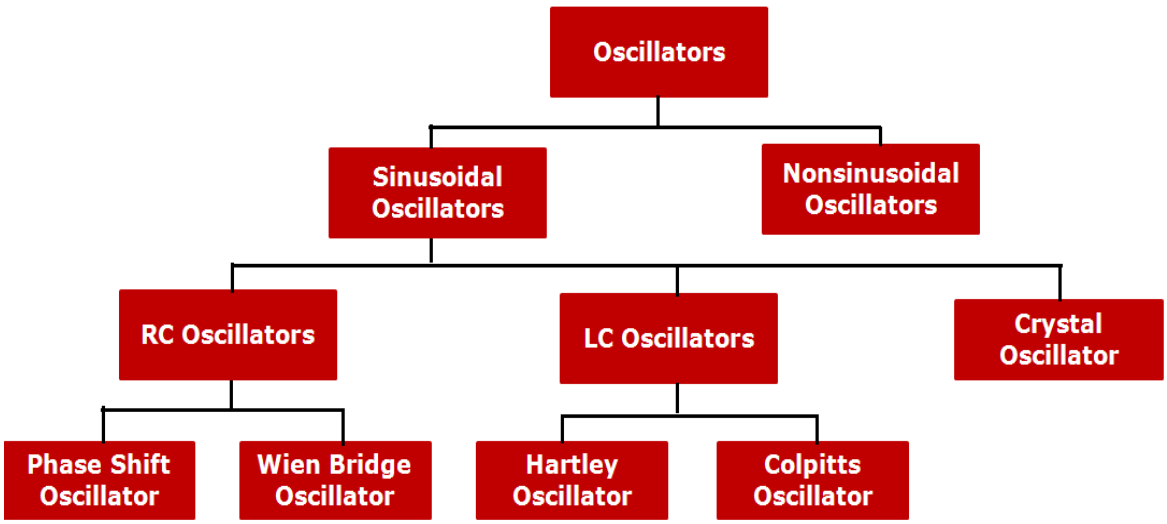
Conditions for Oscillations



- Barkhausen Criteria

1. Feedback must be positive
2. Loop gain (βA_v) must be greater than or equal to one

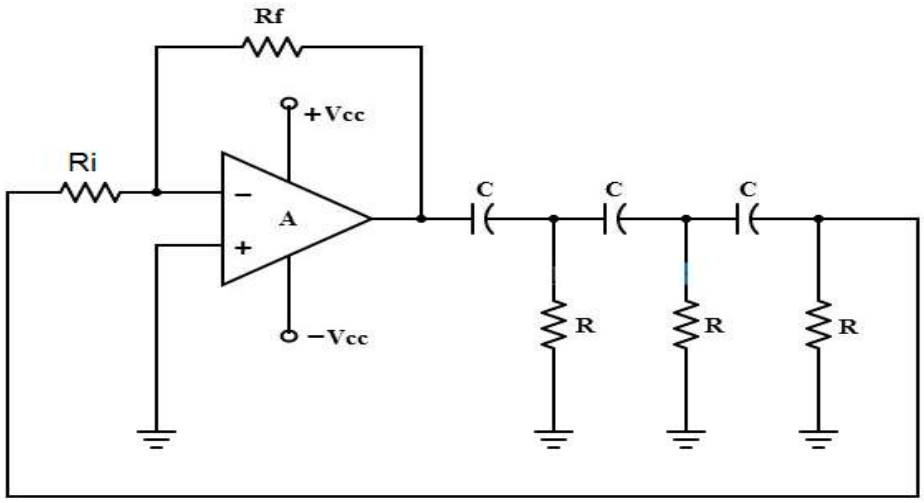
Types of Oscillators



- Depending on the wave shape, oscillators are classified in to two groups
  1. Sinusoudal Oscillator
  2. Nonsinusoidal Oscillator

- Sinusoudal oscillators are classified as
  1. RC Oscillators
  2. LC Oscillators

Op Amp Phase Shift Oscillator



- Op amp works as inverting amplifier and introduces 180^o phase shift
- Additional 180^o phase shift is introduced by a phase shift network consisting of three RC combinations (each RC network 60^o phase shift)
- Thus total phase shift becomes 360^o i.e. positive feedback
- Resistors R_i and R_f decides the gain
- Here $\beta=1/29$ Hence for sustained oscillations $Av \geq 29$
- The frequency of oscillations is given by

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

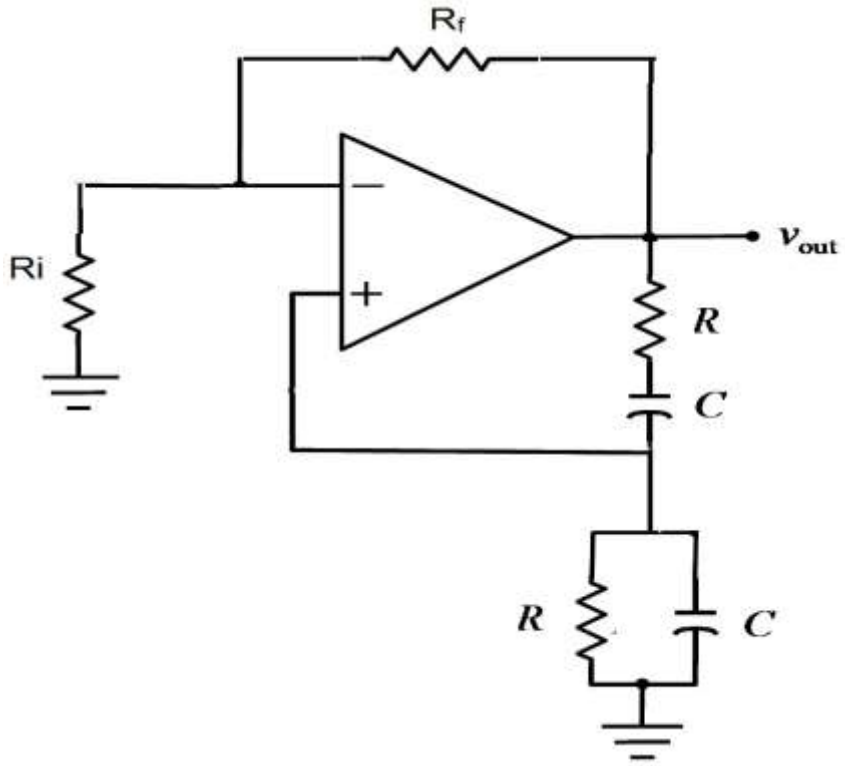
- Advantages

1. It does not require bulky and expensive inductors
2. Since conditions of oscillations are satisfied for only one frequency, the circuit produces pure sine wave
3. Suitable for low frequency oscillations

- Disadvantages

1. The circuit is not suitable for variable frequency
2. The circuit is not suitable for high frequency

Wien Bridge Oscillator



- A Wien Bridge network is used to select the frequency of oscillations.
- It introduces 0^o phase shift at a particular frequency
- The feedback factor β=1/3
- Hence gain of amplifier must be greater than or equal to 3
- The frequency of oscillations is given by

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

- Advantages

1. It does not require bulky and expensive inductors
2. Since conditions of oscillations are satisfied for only one frequency, the circuit produces pure sine wave
3. It gives constant output
4. Suitable for low frequency oscillations
5. The frequency of oscillations can be easily changed

- Disadvantages

1. To start oscillations, initially gain must be large
2. It cannot generate high frequency oscillations

Links for Videos and Assignment

Video 1

https://www.youtube.com/watch?v=Gvb4GIV5ig8

Video 2

https://www.youtube.com/watch?v=gbUXbaxvX94

Source for Videos: All about Electronics from YouTube

Assignment

https://forms.gle/5DZSw28mYrGPnqNB8

Additional Resources

1. Linear Integrated Circuit – D. Roy Choudhari, Shail Jain (Wiley Eastern Ltd.)
2. Op-Amps and Linear circuits – Ramakant A. Gaikwad (PHI)
3. Operational Amplifiers and Linear ICs – Caughlin and Driscoll (PHI)
4. Design with Operational Amplifiers and Analog ICs – Franco (McGraw Hill, 2000)