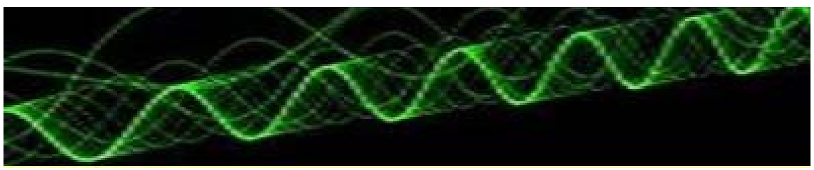
OSCILLATORS



Oscillators

- Electronic circuits that produces output signal of any specific frequency.
- An oscillator consists of an amplifier and a feedback network
- 'Active device' either Transistor or Op Amp is used as an amplifier.

Types of Oscillators

- 1. **RC oscillators**: They use a resistance-Capacitance network to determine the oscillator frequency.
  - They are suitable for low (audio range) and moderate frequency applications (5Hz to 1MHz). They are further divided as,

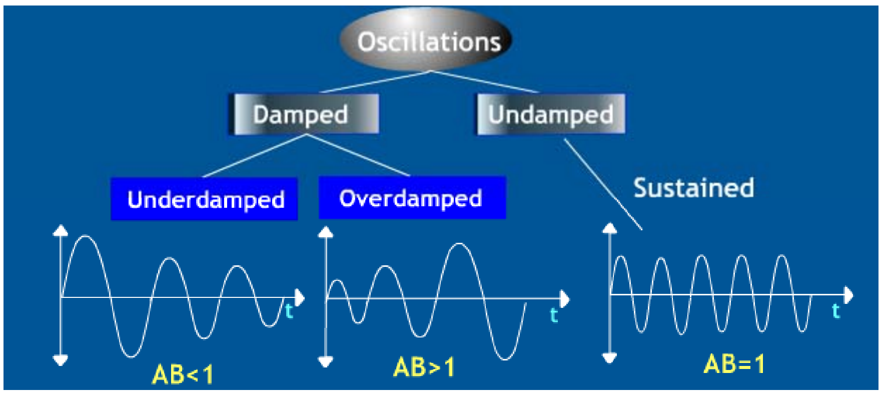
    RC phase shift oscillator
    Wien bridge oscillator
    Twin-T oscillator
- 2. **LC oscillators**: Here, inductors and capacitors are used either in series or parallel to determine the frequency.
  - They are more suitable for radio frequency(1 to 500 MHz) and further classified as,

Cont'd

- Hartley Oscillators
- Colpitts Oscillators
- Clapp Oscillators
- Armstrong oscillators

- 3. **Crystal oscillator**: Like LC oscillators it is suitable for radio frequency applications. But it has very high degree of stability and accuracy as compared to other oscillators.

Types of Oscillations



Barkhausen Criterion

- **Barkhausen Criterion**
  - **Condition 1**
    - The magnitude of the loop gain (Aβ) must be unity.
    - Beta = feed back Ratio : The fraction of the output given at the input

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

Cont'd

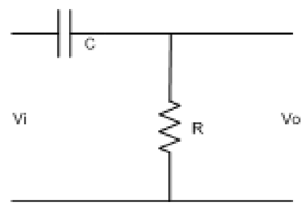
- When $A\beta = 1$ $A_f = \infty = Vo/Vi$
  - $Vo/Vi = \infty$, implies that Vi =0
  - Means without giving any input voltage we are getting output Vo
  - **Condition 2**
    - The second condition is that the phase shift around the loop must be 360° or 0°. This means, the phase shift through the amplifier and feedback network has to be 360° or 0°

Cont'd

- An amplifier if given the positive feed back results in Oscillations
- Positive Feed Back : Output voltage and input voltage should be in phase .
- For making positive feedback, introduce a phase shift network, that network produces another 180^0 phase shift
- total $180^0 + 180^0 = 360^0 = 0^0$

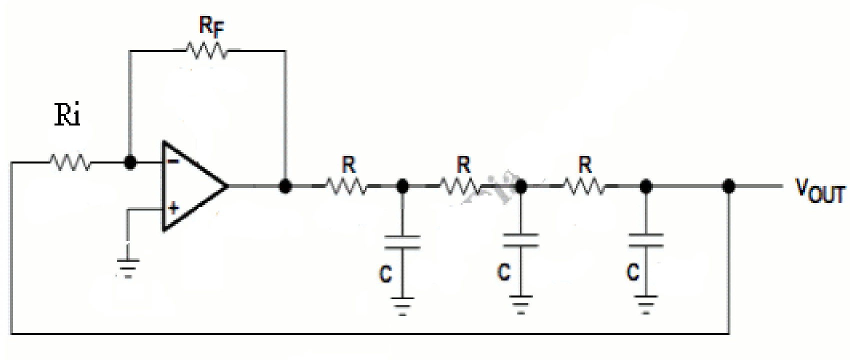
How to produce Phase Shift

- Introduce RC Network to produce the phase shift.



- $\Phi = \tan^{-1} (Xc / R)$
  - When Xc = 0, tan Φ =0 , Φ = 0°
  - When R = 0 tan Φ = ∞, Φ =90°
    - By having 1-RC circuit, we can have a phase difference of 0 – 90°
    - So phase shift using 1RC is max 90, but mostly less than 90°
    - A min of 3-RC circuits is required to produce phase shift of 180°

RC Phase Shift Oscillators

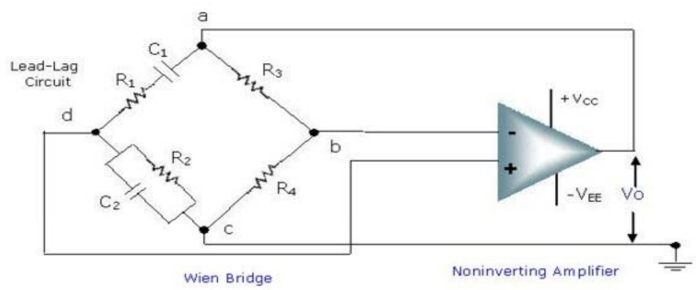


$f = 1/ (2\pi * \sqrt{6} * C. R)$
Av = Rf/Ri

Problem

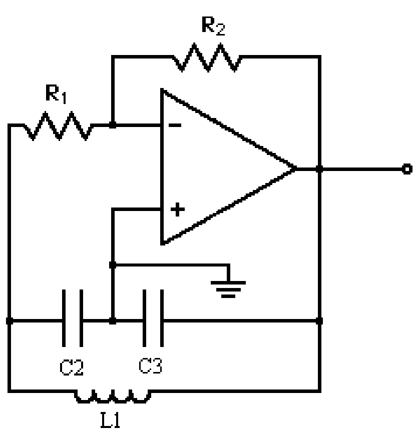
- Determine the value of R_f necessary for the circuit to operate as an oscillator, Determine the frequency of oscillation.
  - Given : C= 0.01µF, R= 10kΩ, Av= 29
  - **Solution**
    - $f = 1/ (2\pi * \sqrt{6} * C. R) = 1/ (2\pi * \sqrt{6} * 0.01\mu . 10k)$
      f = 650 Hz
      Av= Rf/Ri
      Rf = Av* Ri = 29 * 10k = 290kΩ

Wein – Bridge Oscillators



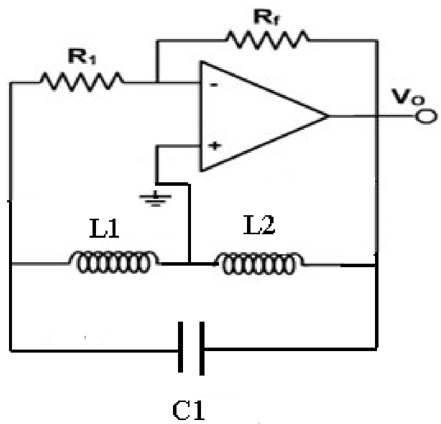
f = 1/ (2π* √(C1 .C2 .R1. R2)

Colpit Oscillator



- f = 1/ (2π*√(L1 . Cs))
- Cs = C2.C3/(C2 + C3)
- Av = C2/C3

Hartley Oscillator



- f = 1/ (2π*√(C1(L1+L2))
- Gain = L2/L1