Bhartiya Vidya Bhavan's Shri Ishvarlal L. P. Arts-Science and J. Shah Commerce College, Dakor
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B.Sc. (semester -3)

Subject : Physics

Course : USO3CPHY22

BASIC SOLID STATE ELECTRONICS

UNIT 3: OSCILLATORS

Lecture 2

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❖ <u>In today's lecture we try to cover following topics</u>

- The starting voltage
- Basic principles of LC oscillators
- Hartley oscillator
- Colpitts oscillator
- Basic principles of RC oscillators
- Phase shift oscillator
- Wien bridge oscillator

❖ The starting voltage:-

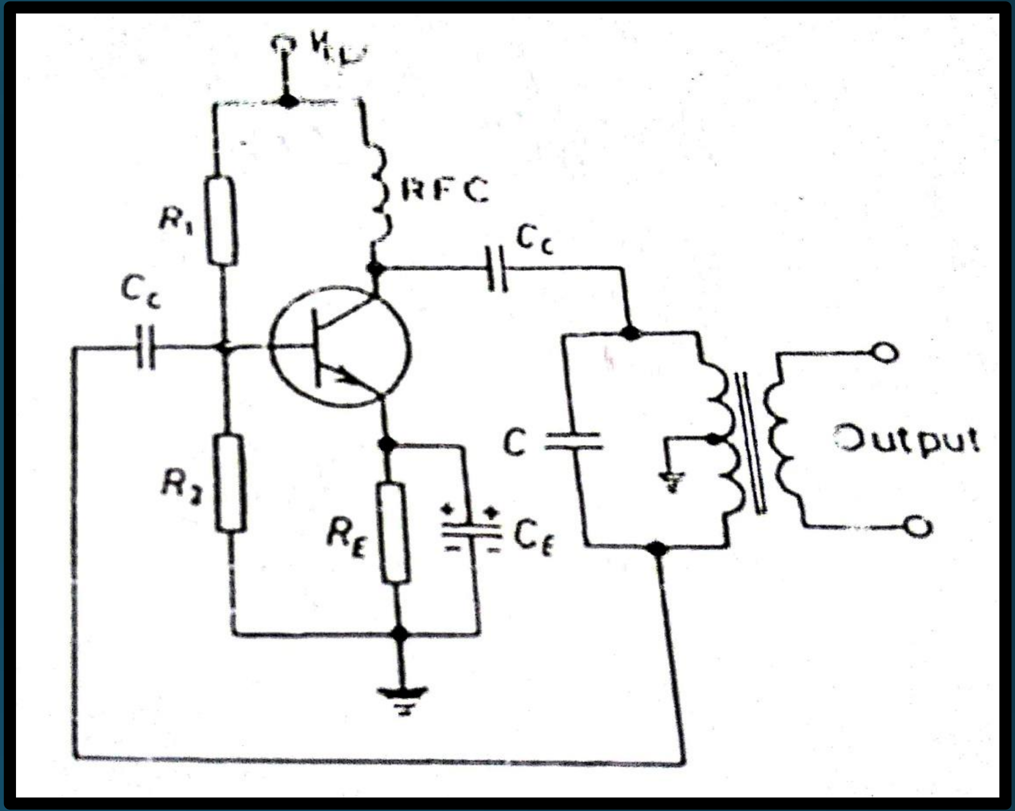
- No external input is required in case of oscillators.
- The oscillator output supplies its own input under proper conditions.
- If no input is required, how oscillator starts?
- From where does the starting voltage come?
- We know that..... Every resistance has some free electrons. With normal room temperature, they start moving randomly in various directions.
- Such movement of free electron generate a voltage called noise voltage across the resistance & these voltages gets amplified.
- To do so, $A\beta$ is kept >I at start. Such amplified voltage appears at the output terminals.
- The part of output is sufficient to drive the input of the amplifier circuit.
- The circuit then adjusts itself to get $A\beta = 1$ & with 360° phase shift, and we get sustained oscillations..

❖ ***Basic principles of LC oscillators***

- LC oscillators are generally used to generate High frequency oscillations
- There are mainly two types of LC Oscillator
  - Hartley oscillator
  - Colpitts oscillator
- Every LC oscillator circuit contains RFC (Radio Frequency Choke)

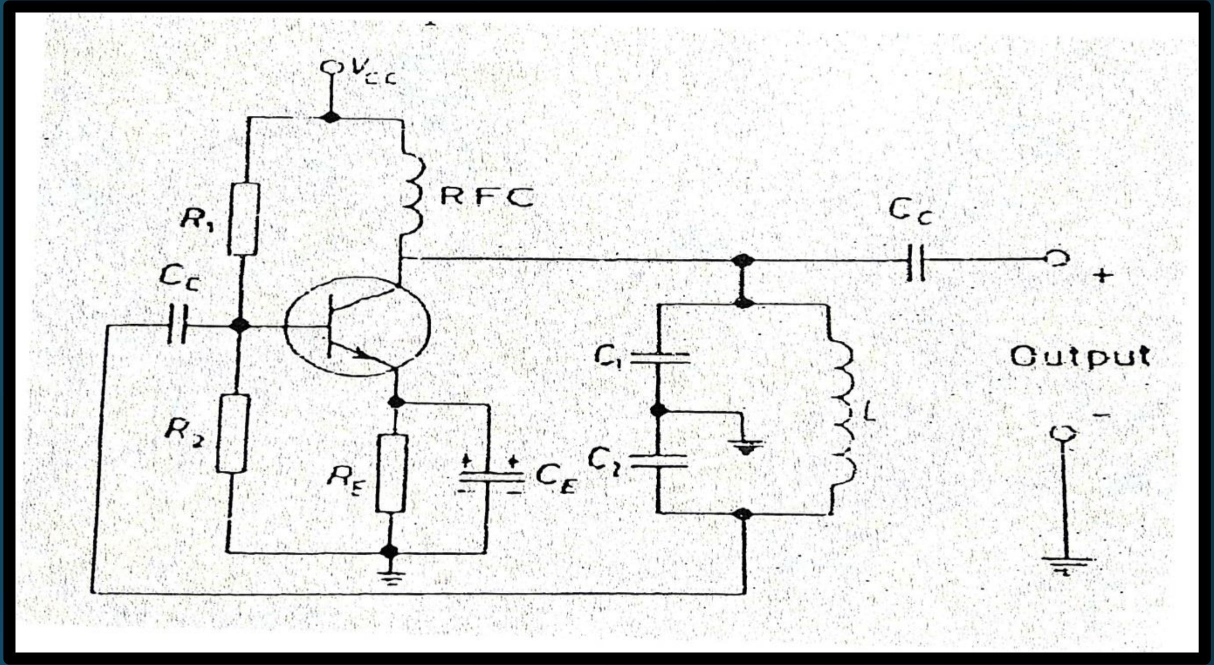
- A RFC (Radio Frequency Choke) is a basic inductor used to choke radio frequencies..
- This kind of inductor will allow DC current to pass through but block AC current in the radio frequency range..

❖ Hartley Oscillator



- The Hartley oscillator circuit is shown in the fig .
- In this circuit the coil becomes an integral part of the tank circuit
- It uses a split tank inductor.
- The Radio Frequency Choke (RFC) permits an easy flow of dc current
- It offers high impedance to high frequency currents.
- The coupling capacitor Cc does not permit the dc current to go to the tank circuit
- The radio-frequency energy developed across the RFC capacitively coupled to the tank circuit through the capacitor Cc.

❖ *Colpits Oscillator*



- The Colpitts oscillator circuit is shown in the figure .
- It is widely used in commercial signal generators above 1 MHz
- It uses a spirit tank capacitor C as shown in the figure.
- The Radio Frequency Choke (RFC) permits an easy flow of dc current.
- It offers high impedance to high frequency currents.
- The voltage developed across the capacitor C2 provides the regenerative feedback required for the sustained oscillations

- The values of L, C_1, and C_2 determine the frequency of oscillation The frequency of oscillations is given by the equation

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

- Where C_1, and C_2 are in series and hence

$$C = \frac{C_1 C_2}{C_1 + C_2}$$

❖ ***Basic principles of RC oscillators:-***

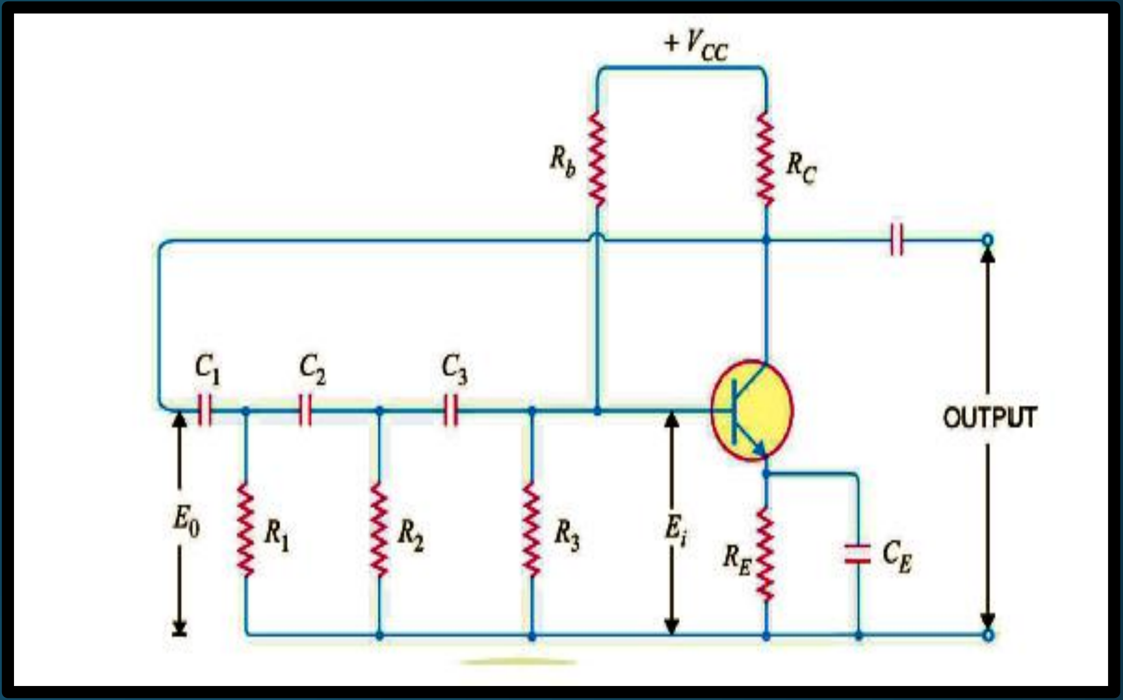
- RC oscillators are generally used to generate low frequency oscillations
- There are mainly two types of RC Oscillator: Phase Shift Oscillator and Wein Bridge Oscillator
- A single stage amplifier shifts the phase of the input signal by 180^0
- So if the output is directly fed back to the input then a negative feedback occurs which decreases the net output voltage
- However for producing oscillations a positive feedback is required. This occurs only if the feedback signal is in phase with input signal

- This can be achieved in two different ways.

- One way is to give the input signal a phase shift of 180° prior to feeding it back to the input. This makes the total phase shift 360°. This technique is used in the phase shift oscillator.

- Another way is to use two stages of amplifiers. Each stage produces a phase shift of 180° and hence the total phase shift will be 360° The technique is used in Wein Bridge oscillator.

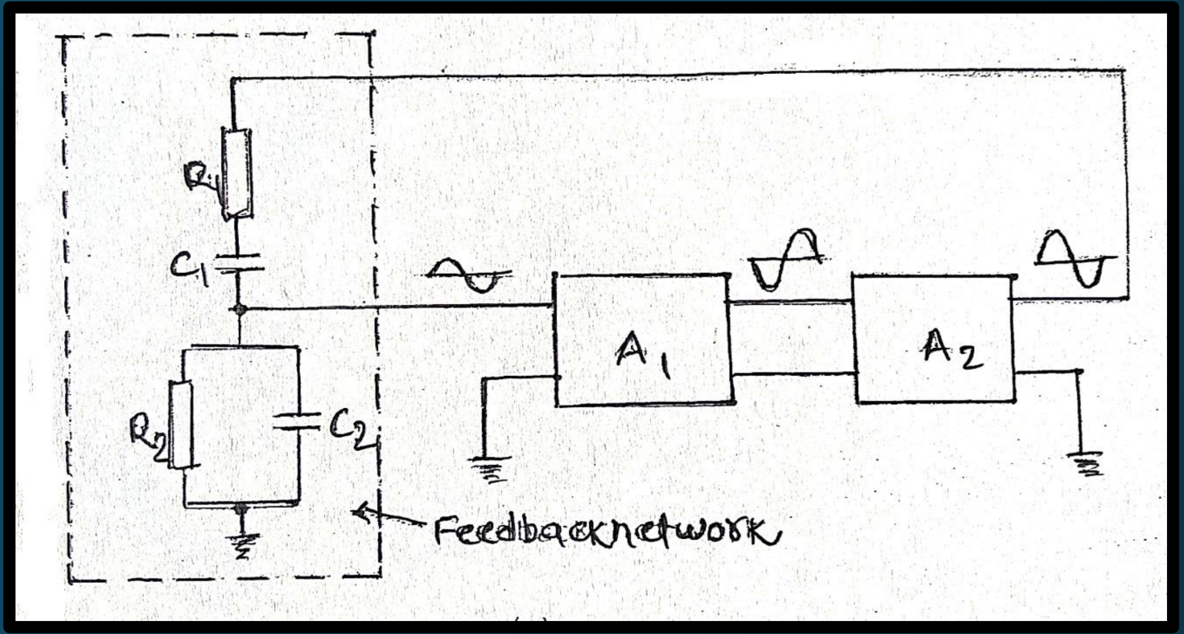
❖ ***Phase Shift Oscillator***



- ❖ The circuit diagram of a phase shift oscillator is shown in the figure
- ➢ Here the combination R_EC_E provides a self-bias for the amplifier
- ➢ The phase of the signal at input gets reversed (180^0 out of phase) when it is amplified by the amplifier
- ➢ The output of amplifier passes through a feedback network consisting of three identical RC networks
- ➢ Each RC network provides a phase shift of 60°, thus making the total phase shift to be 180^0
- ➢ This output will now be in phase with the input signal.

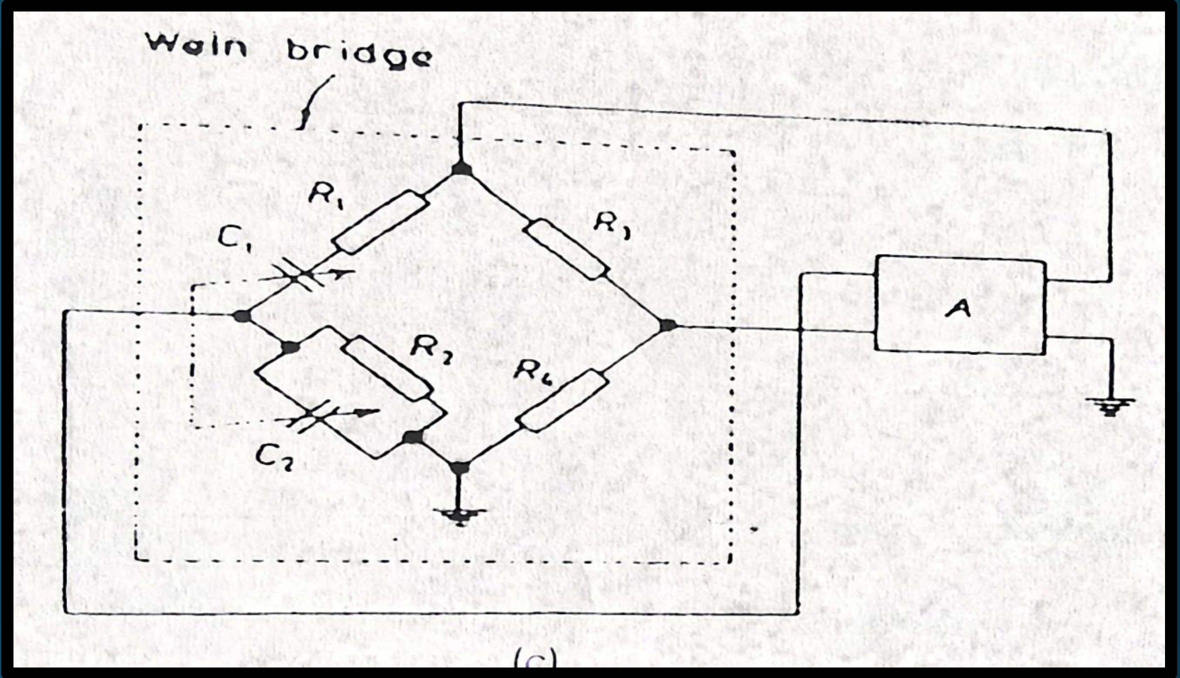
- If the Barkhausen Condition $A\beta = 1$ is satisfied, the oscillations will be sustained
- The frequency at which the RC network provides a phase shift of exactly 180° is given by $f_o = \frac{1}{2\pi RC\sqrt{6}}$
- At this frequency the feedback factor of the RC network is $\beta = \frac{1}{29}$
- Then in order to satisfy the Barkhausen condition to produce the sustained oscillations, the gain A of the amplifier must be greater than 29,
- only then the oscillations will start

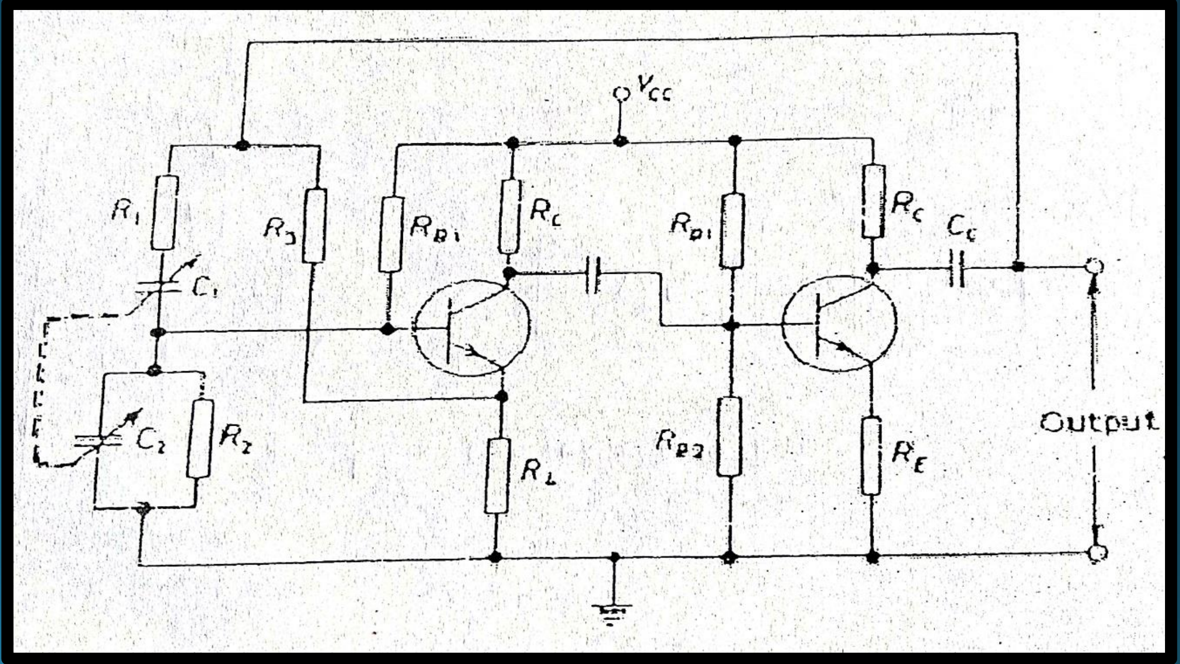
❖ ***Wein Bridge Oscillator***



- A Wein bridge oscillator is used to generate low frequencies in the range of 10 Hz to 1 MHz
- It consists of two stages of RC coupled amplifier and a feedback network The circuit diagram of such an oscillator in shown in fig.
- As shown in fig, A_1 and A_2 are two amplifier stages. The output of second stage goes to the feedback network
- Voltage across C_2 R_2 is fed to the input of the first stage The net phase shift of the two amplifiers is zero
- The sustained oscillations are produced at the frequency $f_o = \frac{1}{2\pi\sqrt{R_1C_1R_2C_2}}$

- This is possible if we have β= 1/3 So the amplifier must have a gain A of at least 3 as per the Barkhausen condition
- In order to achieve this some negative feedback is added The modified circuit in form of Bridge is shown in figure >>>>>>>>>>
- The circuit of figure is called Wein Bridge circuit. Hereby varying the two capacitors C_1 and C_2, we can vary the frequency
- The practical circuit of Wein bridge oscillator using transistor is shown in figure >>>>>>>>>>





- IN THIS WAY OUR UNIT(III) OF PAPER USO3CPHY22 COMPLIT ...
- NEXT LECTURE WE START NEW UNIT
- MAKE PROPER NOTES....

THANK YOU.....