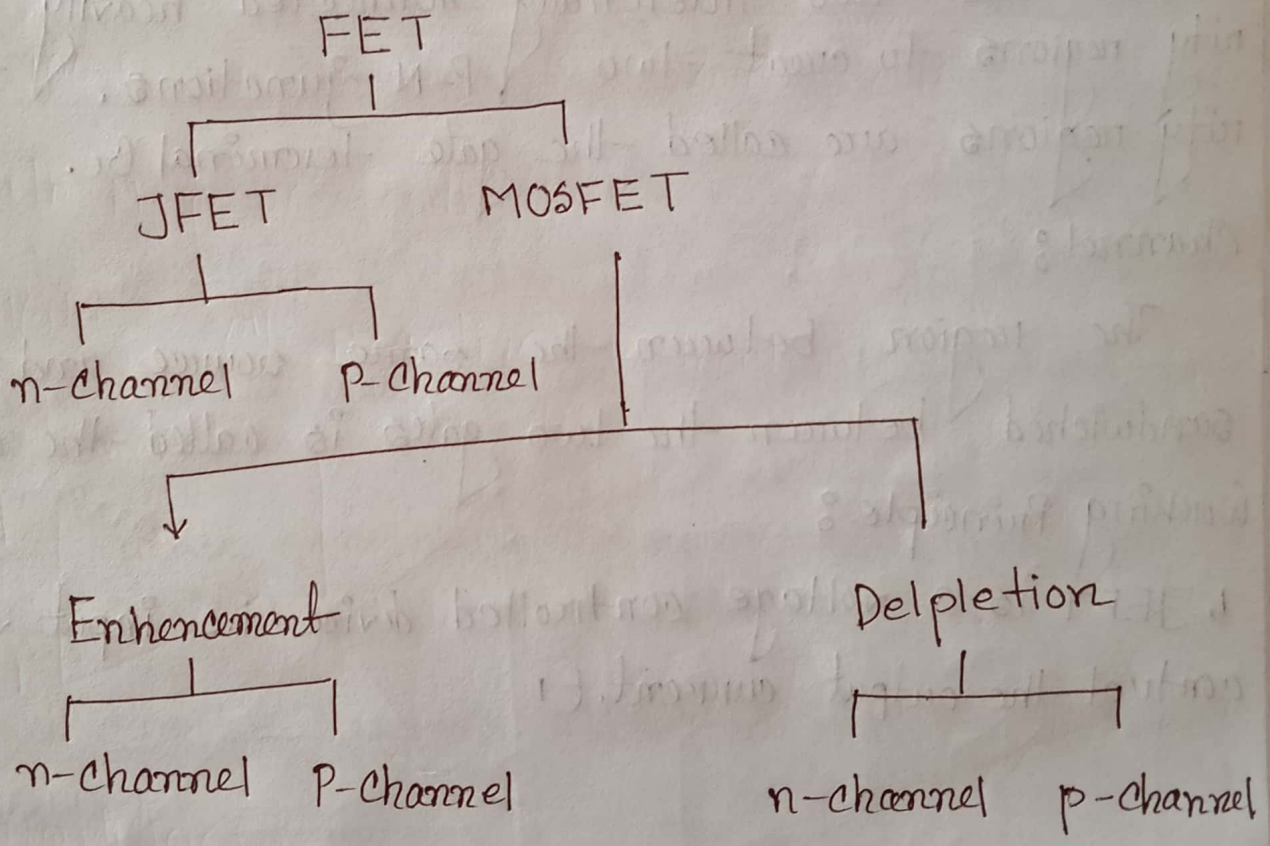
Autumn - 18

1.(a) What is FET? Write down the classification of FET?

⇒ FET:

The field effect transistor is a three terminal unipolar ~~device~~ semiconductor device. It is a device in which the number of current carier avaible in conducting region is control by the application of a electric field at the surface of semi-conductor.

Types of FET:



b) What is JFET? Describe its construction and working principle (N-channel JFET)

⇒ JFET:

Junction Field effect transistor is one of the simplest types of field-effect transistor. Contrary to the Bipolor Junction

Transistor, JFET is voltage control device.

Construction and working principle of JFET:

Source:

The terminal through which the majority carries enter into the channel is called the source terminal S.

Drain:

The terminal, through which the majority carries leave from the channel is called the drain terminal D.

Gate:

There are two internally connected heavily doped impurity regions to creat two P-N junctions. These impurity regions are called the gate terminal Gr.

Channel:

The region between the ~~same~~ source and drain, sandwiched between the two gates is called the channel.

Working Principle:

1. JEFT is a voltage controlled device i.e input voltage (V_{GS}) control the output current. E1

c) A JFET has the following parameter: $I_{DSS} = 32mA$; $V_{GS(off)} = -8V$; $V_{GS} = -4.5V$. Find out the value of drain current.

$$\Rightarrow I_D = I_{DSS}\left[1 - \frac{V_{GS}}{V_{GS(off)}}\right]^2 = 32\left[1 - \frac{(-4.5)^2}{-8}\right]^2 mA$$

$$= 6.125mA$$

2. (a) What is switching circuit? Write down the classification of it?

⇒ Switching circuit:

A circuit which can turn ON or OFF current in an electrical circuit is known as a switching circuit.

The switches can be broadly classified into the following three types:

i) Mechanical switch
ii) Electro-mechanical switch or Relay
iii) Electronic switch

b) Explain the switching action of transistor with proper diagram in

i) OFF region

ii) ON region

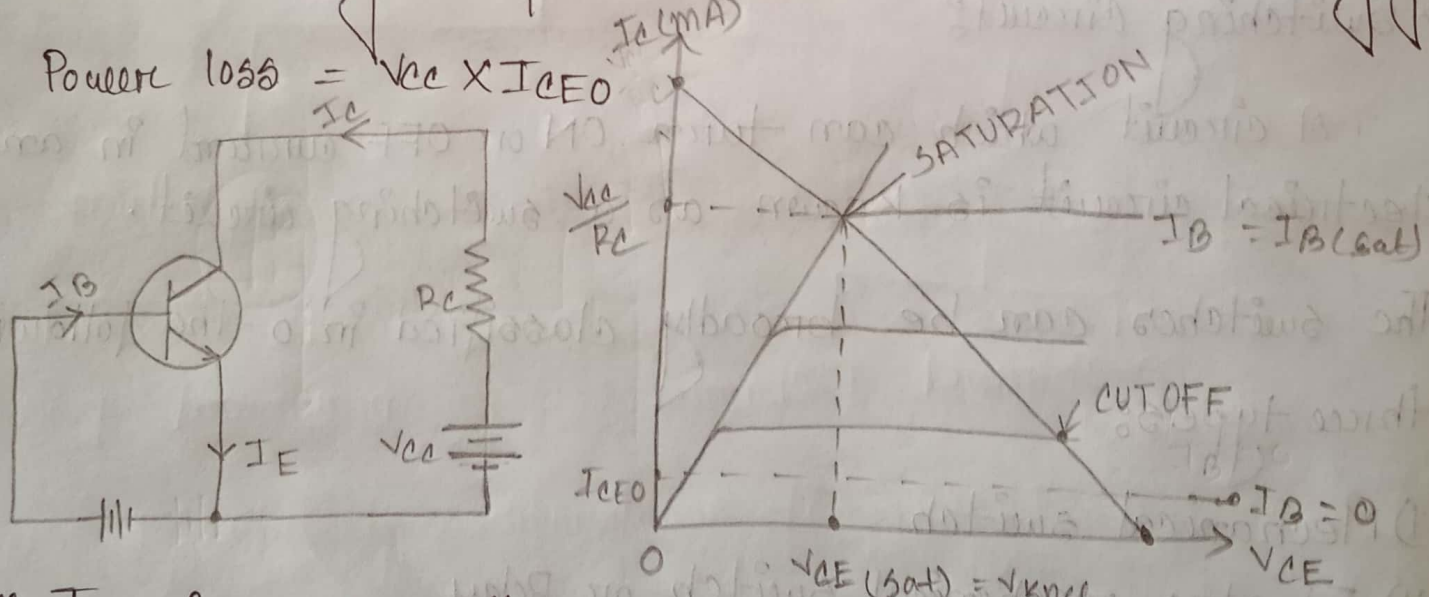
⇒ i) OFF region:

When the input base voltage is zero or negative the transistor is said to be in the OFF condition. In this condition $I_B = 0$ and the collector current is equal to the collector leakage current I_{CEO}. The value of I_{CEO} can be obtained from the characteristics if we know V_{CE}.

Power loss = Output voltage × Output current

As already noted, in the OFF condition the output voltage $= V_{cc}$ since voltage drop in the load due to I_{CEO} is negligible

Power loss = $V_{cc} \times I_{CEO}$



Since I_{CEO} is very small as compared to full-load current that flows in the ON condition, power loss in the transistor is quite small in the off condition. It means that the transistor has a high efficiency as a switch in the OFF condition.

ii) ON region:

When the input voltage is made so much positive that saturation collector current flows, the transistor is said to be in the ON condition. In this condition the saturation collector current is given by;

$$I_c = \frac{V_{cc} - V_{knee}}{R_c}$$

Power loss = Output voltage × Output current

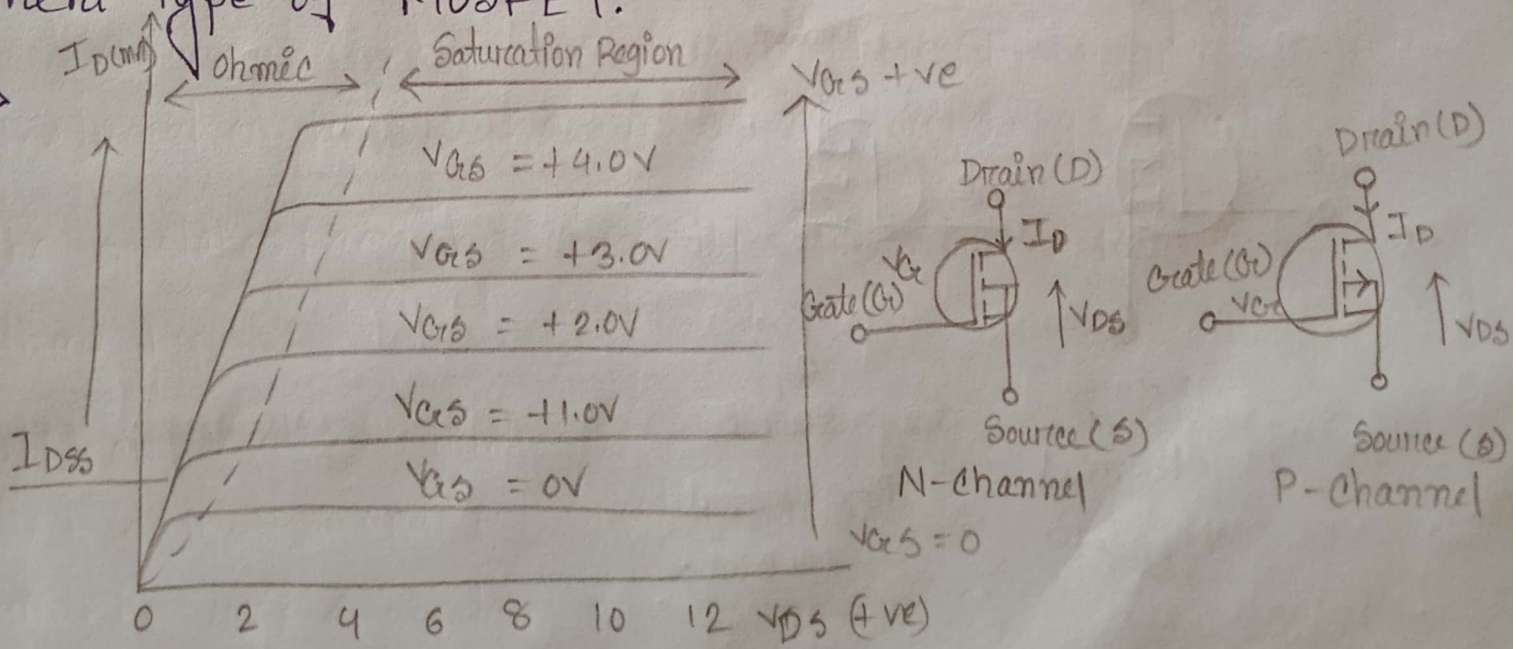
The output voltage in the ON condition is equal to V_{knee} and output current is $I_{c(sat)}$

$$\text{Power loss} = V_{knee} \times I_{c(sat)}$$

Again the efficiency of transistor as a switch in the ON condition is high. It is because the power loss in this condition is quite low due to small value of V_{knee}.

c) Draw the drain or output characteristics curves of Enhancement type of MOSFET.

⇒



d) A transistor is used as switch if $V_{cc} = 10V$; $R_c = 1K\Omega$ and $I_{CBO} = 10\mu A$ determine the value of V_{CE} when the transistor is

i) cut off

ii) Saturation.

⇒ Given,

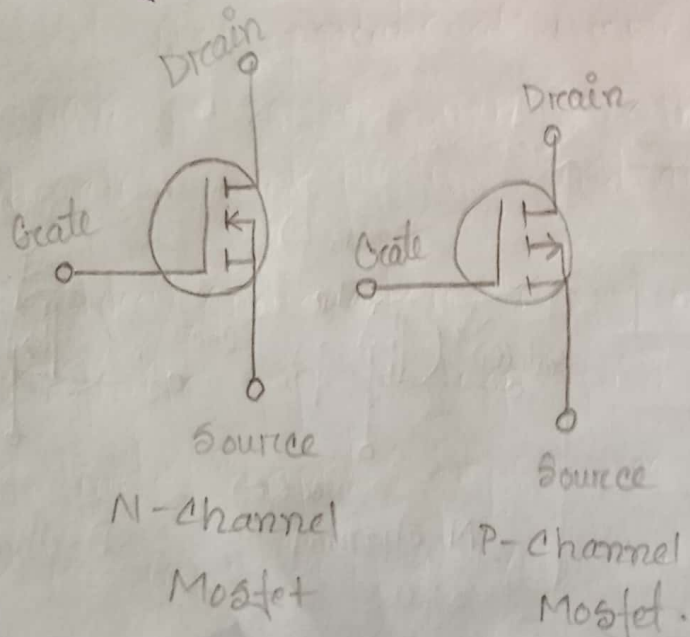
$V_{cc} = 10V$

$R_c = 1K\Omega$

$I_{CBO} = 10\mu A$

3. a) Draw the symbol of n-channel and p-channel enhancement type of MOSFET.

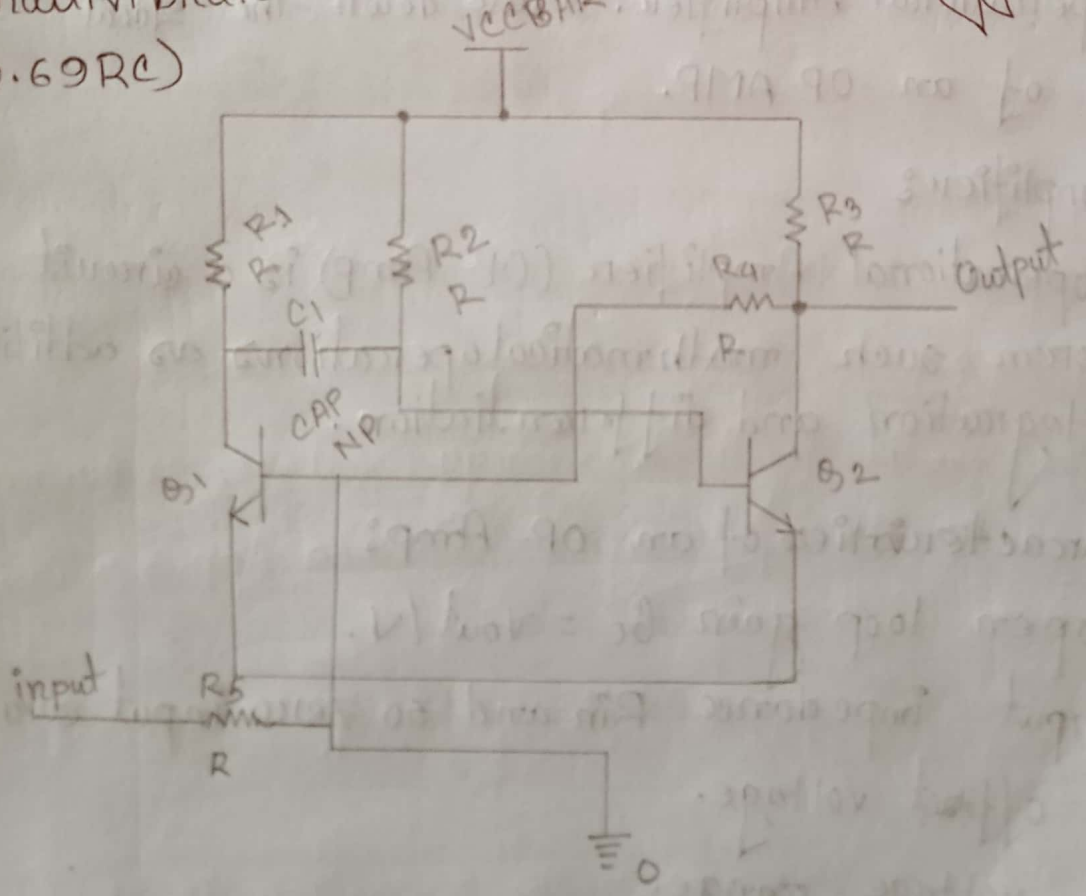
⇒



b) Explain the operation principle of Monostable Multivibrator with proper diagram.

⇒ Operation of Monostable Multibrator is the stable state. As Q_1 is OFF, the collector voltage will be V_{cc} at point A and hence C_1 gets charged. A positive triggle pulse applied at the base of the transistor Q_1 turns the transistor ON. This decreases the collector voltage, wich turns OFF the transistor Q_2.

When capacitor charges to V_{CC} the Q_2 will turn on again and automatically Q_1 is turn off. So, the time period for charging capacitor through the resistor is directly proportional to the quasi or astable state of multivibrator when a external trigger occurred ($t = 0.69RC$)



Monostable Multivibrator Circuit Diagram

c) An E-Mosfet gives $I_{D(on)} = 500mA$ at $V_{GS} = 10V$ and $V_{GS(th)} = 1V$ Determine the drain current for $V_{GS} = 5V$

⇒

Group-B

4. (a) Define Operational Amplifier. Write down the Ideal characteristics of an OP AMP.

⇒ Operational Amplifier:

An operational Amplifier (OP-Amp) is a circuit that can perform such mathmatical operations as additions, subtraction, integration and differentiation.

The Ideal characteristics of an OP-Amp:

1. Infinite open loop gain $G = V_{out}/V_{..}$
2. Infinite input impedance Rin and so zero input current
3. Zero input offset voltage.
4. Infinite out voltage range.
5. Infinite bandwidth with zero phase shift and infinite slew rate.

b) Draw the circuit diagram of inverting and non-inverting OP-AMP and find the gain for both.

⇒ Inverting OP-Amp:

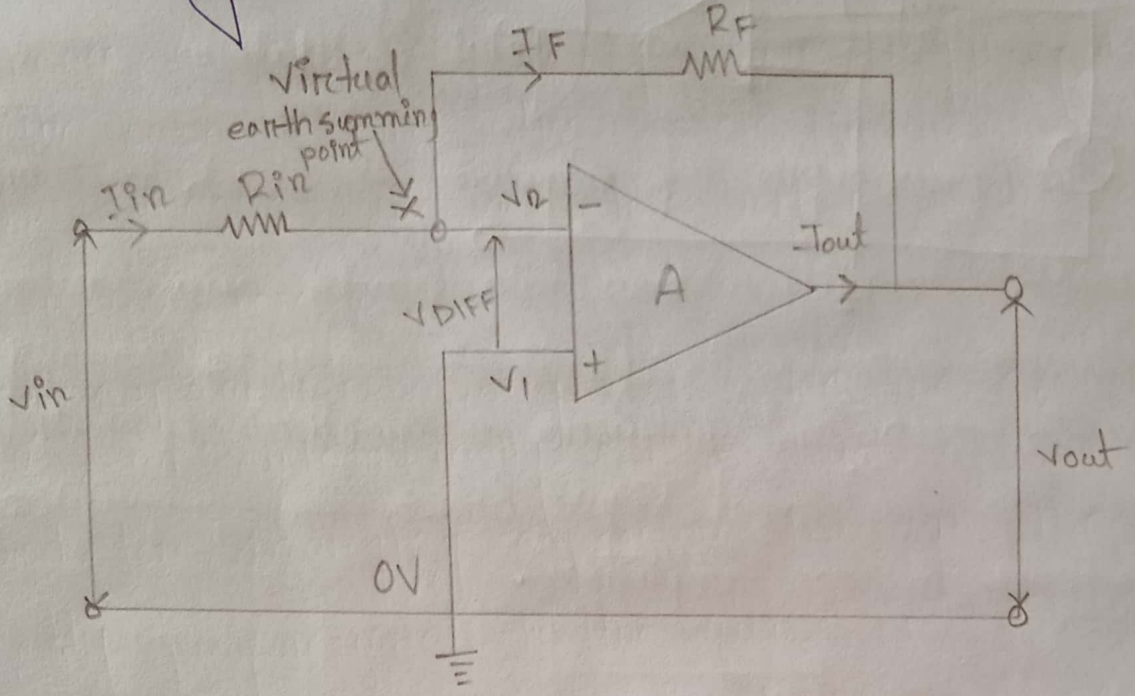


Fig: Inverting OP-Amp

Non-inverting OP-AMP:

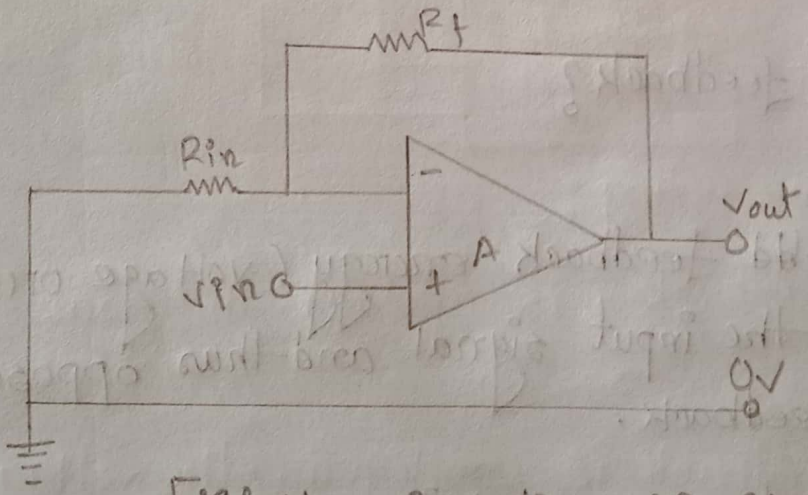
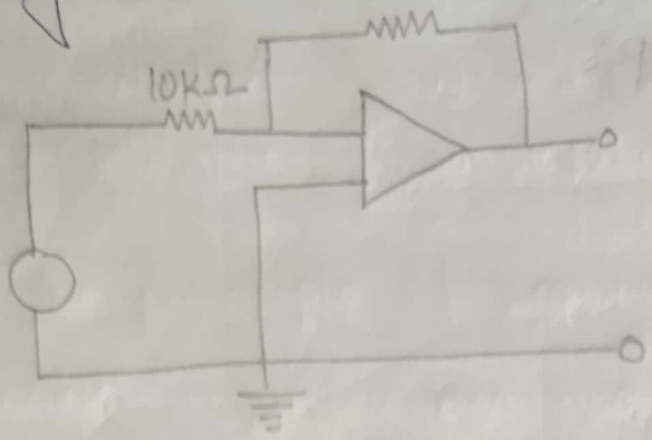


Fig: Non-inverting OP-AMP

(c) From the OP-AMP circuit if $V_1 = 0.5V$ calculator i) the output voltage V_o and (ii) the current in the 10 KΩ resistor.

⇒



5 a) What is negative feedback?

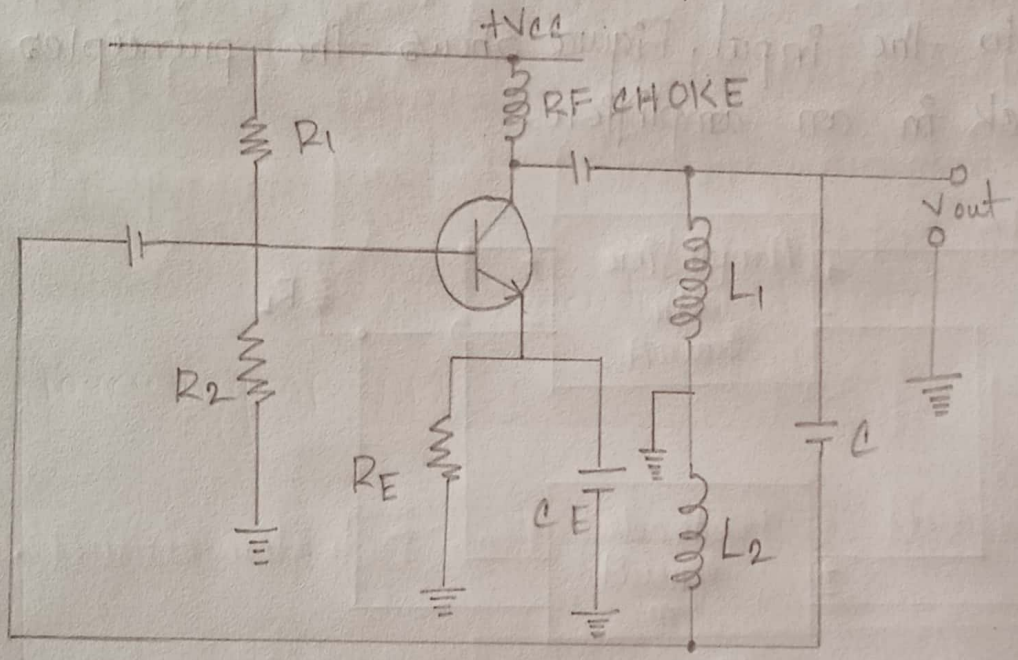
⇒ Negative Feedback:

When the ~~feebd~~ feedback energy (voltage or current) is out of phase with the input signal and thus opposes it, it is called negative feedback.

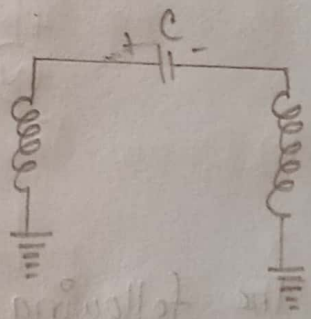
(b) With proper circuit diagram explain the operation of Hartley Oscillator.

⇒ When the circuit is turned on, the capacitor is charge when this capacitor is fully charged, it discharges through coils L_1 and L_2 setting up oscillations of frequency determin

by exp. (1) The output voltage of the amplifier appears across L_1 and feedback voltage across L_2. The voltage across L_2 is 180° out of phase with the voltage development across L_1 (V_{out}) as shown in Fig. It is easy to see that feedback to the transistor provides positive feedback. A phase shift of 180° is produced by the transistor and a further phase shift of 180° is produced by L_1-L_2 voltage divider. In this way feedback is properly phased to produced continuous undamped oscillations.



Hardly Oscillator



Feedback circuit

6.(a) What is an electronic oscillator? Write down the name of different types of transistor oscillator.

⇒ Electronic Oscillator:

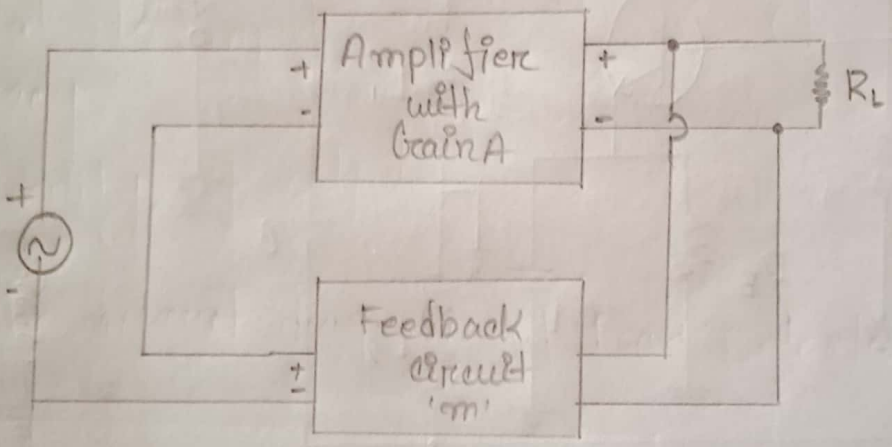
An electronic oscillator is an electronic circuit that produces a periodic, oscillating electronic signal, often a sine wave or a square wave or a triangle wave

Different types of Transistore Oscillatore:

i) Truned collectore oscillatore
ii) Colpit's oscillatore
iii) Hartly oscillatore
iv) phase shift oscillatore
v) Wien Bridge oscillatore
vi) Crystal oscillatore

5.
b) Explain the principle of negative feedback in amplifier

⇒ A feedback amplifier has two parts vin an amplifier and a feedback circuit. The feedback circuits usually consists of resistances and returns a fraction of output energy back to the input. Figure shows the principles of negative feedback in an amplifier.



The following points are noting:

1. when negative feedback is applied, the gain of the amplifier is reduced.
2. when negative feedback is employed, the voltage actually applied to the amplifier is extremely small.
3. In a negative feedback circuit, the feedback fraction m is always between 0 and 1.
4. The gain with feedback is sometimes called closed-loop

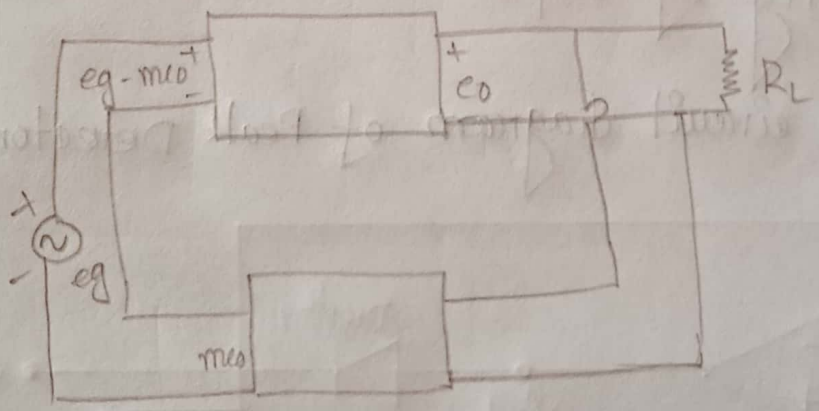
gain while the gain without feedback is called open-loop gain.

5.(c) Derive the gain of negative feedback amplifier.

⇒ Let us consider the negative feedback amplifier is shown in figure. The gain of the amplifier without feedback is A. Negative feedback is then applied by feeding a fraction m of the output voltage e back to amplifier input. Therefore the actual input to the amplifier is the signal voltage eg minus feedback voltage me₀. ie.

Actual input to amplifier = eg − me₀

The output e₀ much be equal to the input voltage eg − me₀ multiplied by gain A of the amplifiers i.e.



$$(eg - me_0)A = e_0 \Rightarrow Aeg - Ame_0 = e_0 \Rightarrow e_0(1+Am) = Aeg$$

$$\Rightarrow e_0/eg = \frac{A}{1+Am}$$

But e_0/eg is the voltage gain of the amplifier with feedback

Voltage gain with negative feedback, $A_{fb} = \frac{A}{1+Am}$

So, when negative feedback is applied the gain is reduced by a factor $1+Am$

7. a) Write short note on comparator circuit and characteristics of it.

⇒ A comparator is an electronic circuit, which compares the two inputs that are applied to it and produces an output. The output value of the comparator indicates which of the inputs is greater or lesser.

The characteristics of comparator:

1. The important characteristic of comparator are. speed of operation. The output of comparator must switch rapidly between the saturation level (+vsat or -vsat) and also respond instantly to any change of condition ~~and~~ at its input
2. Accuracy
3. Compatibility of output

b) Draw the circuit diagram of Peak Detector circuit.

⇒

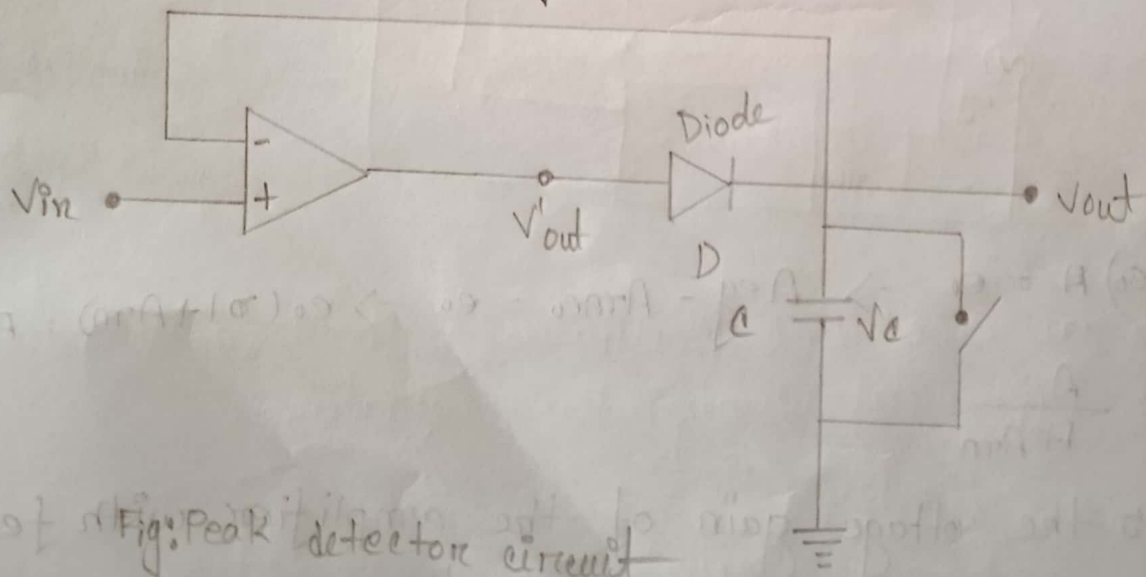


Fig: Peak detector circuit

c) With proper circuit diagram explain the operation of Schmit Tigger.

⇒ A Schmitt trigger is a comparator circuit with hysteresis implemented by applying possitive feedback to the noninverting input of a comparator or differential amplifier. It is an active circuit which converts an analog input signal to a digital output signal.

A Schimitt trigger makes use of positive feedback - it takes a sample of the output and feeds it back into the input so as to 'reinforce' so to speak, the output - which is the exact opposite to negative feedback, which tries to nullify any changes to the output.

Circuit diagram:

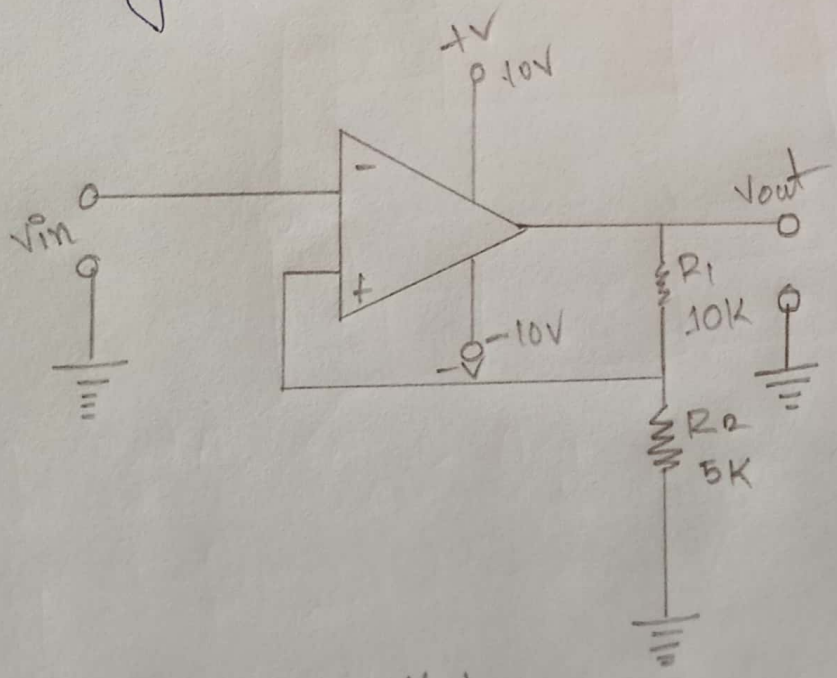


Fig: Schmitt trigger