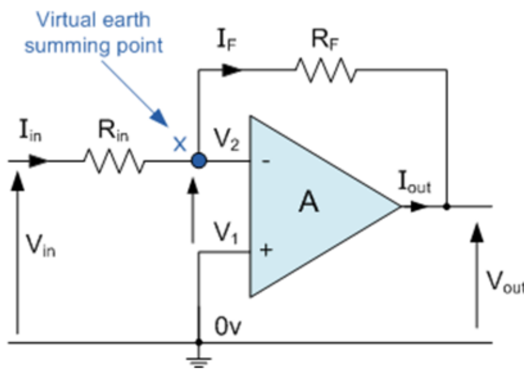
Imp questions 4 , 5 , 6 , 12 , 13 , 17 , 18 , 22 , 23 , 26

4 MARKS

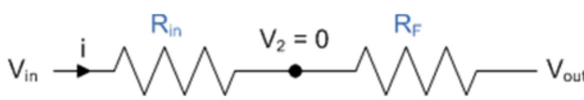
1.Describe in details about the inverting Amplifier ?

Inverting Amplifier Circuit



In inverting amplifier circuit the operational amplifier is connected with feedback to produce a closed loop operation. There are two very important rules to remember about inverting amplifiers: "no current flows into the input terminal" and that "V_1 equals V_2". This is because the junction of the input and feedback signal (X) is at the same potential as the positive (+) input which is at zero volts or ground then, the junction is a **"Virtual Earth"**. Because of this virtual earth node the input resistance of the amplifier is equal to the value of the input resistor, R_{in}. Then by using these two rules one can find the equation for calculating the gain of an inverting amplifier, using first principles.
Current (i) flows through the resistor network as shown.

$$i = \frac{V_{in}}{R_{in}} = -\frac{V_o}{R_f}$$



The negative sign in the equation indicates an inversion of the output signal with respect to the input as it is 180° out of phase. This is due to the feedback being negative in value.
Then, the **Closed-Loop Voltage Gain** of an Inverting Amplifier is given as.

$$Gain = \frac{V_o}{V_{in}} = -\frac{R_f}{R_{in}}$$

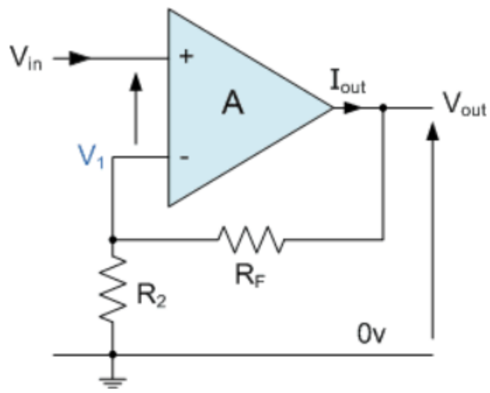
Example No1

2.Describe in details about the non inverting Amplifier ?

Non-inverting Amplifier

The second basic configuration of an operational amplifier circuit is that of a **Non-inverting Amplifier**. In this configuration, the input voltage signal, (V_{in}) is applied directly to the Non-inverting (+) input terminal which means that the output gain of the amplifier becomes "Positive" in value in contrast to the "Inverting Amplifier" circuit whose output gain is negative in value. Feedback control of the non-inverting amplifier is achieved by applying a small part of the output voltage signal back to the inverting (-) input terminal via a R_f - R_2 voltage divider network, again producing negative feedback. This produces a Non-inverting Amplifier circuit with very good stability, a very high input impedance, R_{in} approaching infinity (as no current flows into the positive input terminal) and a low output impedance, r_{out} as shown below.

Non-inverting Amplifier Circuit

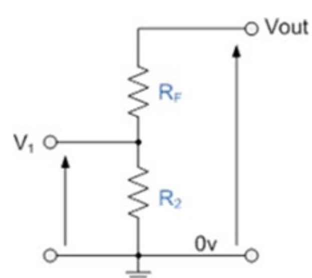


Since no current flows into the input of the amplifier, $V_1 = V_{in}$. In other words the junction is a **"Virtual Earth"** summing point. Because of this virtual earth node, the resistors R_f

and R_2 form a simple voltage divider network across the amplifier and the voltage gain of the circuit is determined by the ratios of R_2 and R_f as shown below.

Equivalent Voltage Divider Network

Then using the formula to calculate the output voltage of a potential divider network, we can calculate the output Voltage Gain of the **Non-inverting Amplifier** as:



$$V_0 = V_{in}\left(1 + \frac{R_f}{R_2}\right)$$

$$Gain = \frac{V_o}{V_{in}} = 1 + \frac{R_f}{R_2}$$

We can see that the overall gain of a Non-Inverting Amplifier is greater but never less than 1, is positive and is determined by the ratio of the values of R_f and R_2. If the feedback resistor R_f is zero the gain will be equal to 1, and if resistor R_2 is zero the gain will approach infinity, but in practice it will be limited to the operational amplifiers open-loop differential gain, (A_o).

3.Draw the diagram of crystal oscillator .

which will be in parallel with the capacitance of its electrodes C_p.

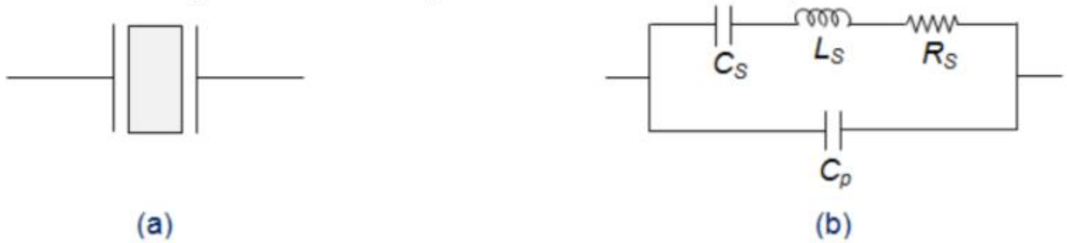


Figure 1 (a) Quartz Crystal (b) Equivalent Electric Circuit

impedance when operated in anti-resonant or parallel resonant mode (Figure 2b).

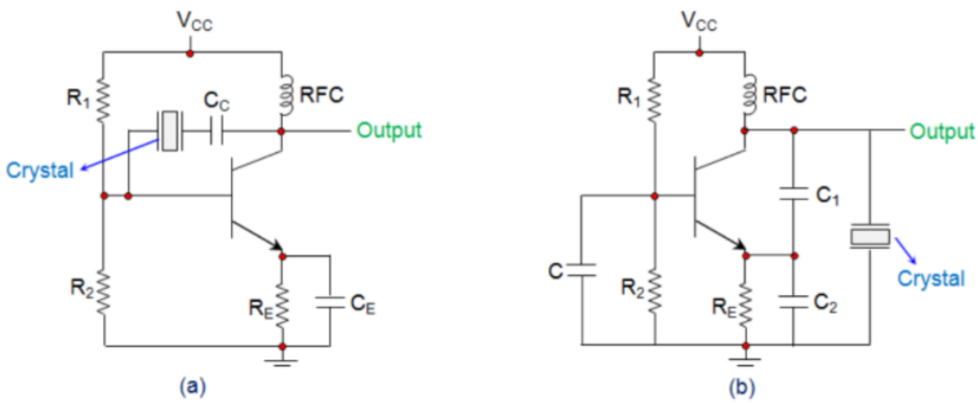


Figure 2 Crystal Oscillator Operating in (a) Series Resonance (b) Parallel Resonance

(any one of the above circuit)

4.Difference between the FET and BJT

BJT	JFET
Bipolar device (current condition, by both types of carriers, i.e. majority and minority-electrons and hole).	Unipolar device (current conduction is only due to one type of majority carrier either electron or hole).
The operation depends on the injection of minority carries across a forward biased .junction.	The operation depends on the control of a junction depletion width under reverse bias.
Current controlled device. The base current controls the output current.	Voltage controlled device. The gate voltage controls output current.
High noise level. (current conduction through junctions)	Low noise level. (current conduction is through n-channel or p-channel and no junction crossing)
Low input impedance (due to forward bias at input side).	High input impedance (due to reverse bias).
Gain is characterized by voltage gain.	Gain is characterised by transconductance.
Low thermal stability. (positive temperature coefficient at high current levels lead to thermal breakdown)	Better thermal stability.(NTC at high current levels prevent thermal breakdown)
Cheaper	Relatively costly

5.Derive the relationship between alpha beta and gamma

RELATIONSHIP OF α,β, γ

$$\alpha_{dc} = \frac{I_C}{I_E}$$

$$\gamma = \frac{I_E}{I_B}$$

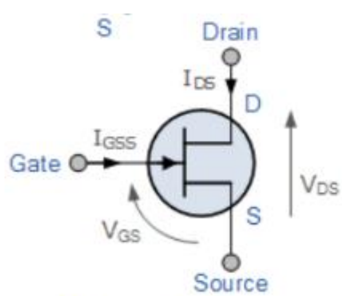
$$\beta_{dc} = \frac{I_C}{I_B}$$

$$\gamma = \beta + 1$$

$$\alpha = \frac{\beta}{\beta + 1}$$

$$\beta = \frac{\alpha}{1-\alpha}$$

6.Draw the diagram and Explain the construction of the N channel JFET



N-channel JFET

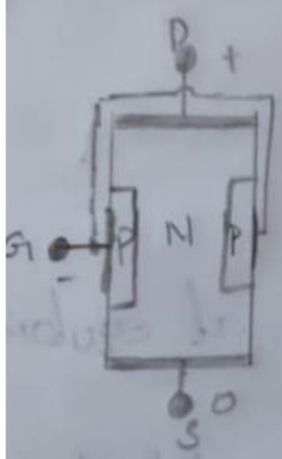
The n channel JFET :-

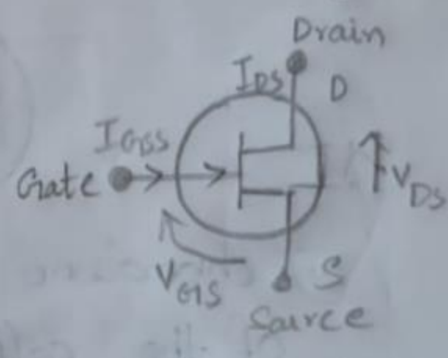
It consists N type semi-conductor that silicon bar with two p type heavily doped regions distributed on opposite sidy of its middle part.

~~It~~ There are three terminals:

→ Drain (D) and Source (S) are conneated to n channel.

→ The n-channel is widely used.

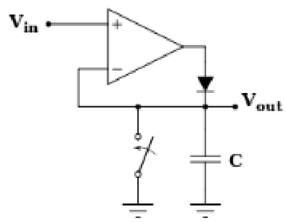


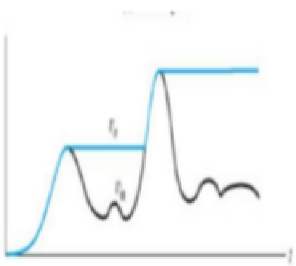


N-channel JFET.

7.Explain in details about the peak detector with diagram

Peak detector:



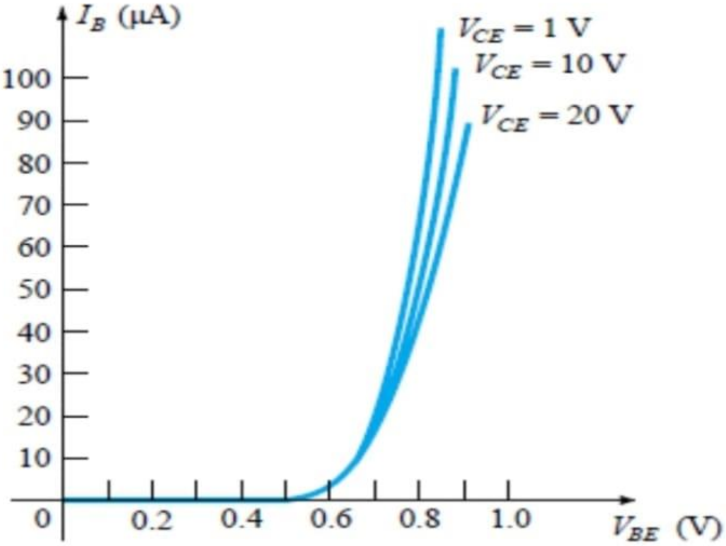


(b) Typical waveforms

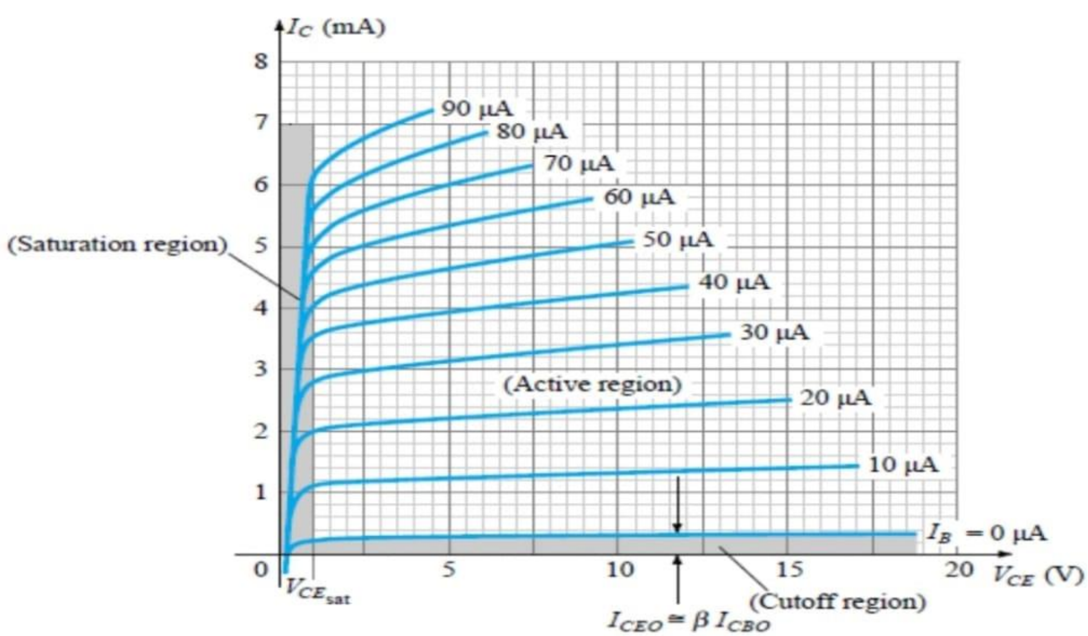
- The function of a peak detector is to compute the peak value of the input.
- The circuit follows the voltage peaks of a signal and stores the highest value on a capacitor. The highest peak value is stored until the capacitor is discharged.
- $V_{out} < V_{in}$; D ON and C charges to peak value of input, (i.e) voltage follower.
- $V_{out} > V_{in}$; D OFF and C holds the peak value of input.
- The circuit can be reset, capacitor voltage can be made zero by connecting low leakage MOSFET switch across the capacitor.
- Applications: Measurement and instrumentation, Amplitude modulation.

8.Draw the input and output Characteristics of CE amplifier ?

COMMON EMITTER INPUT CHARACTERISTICS

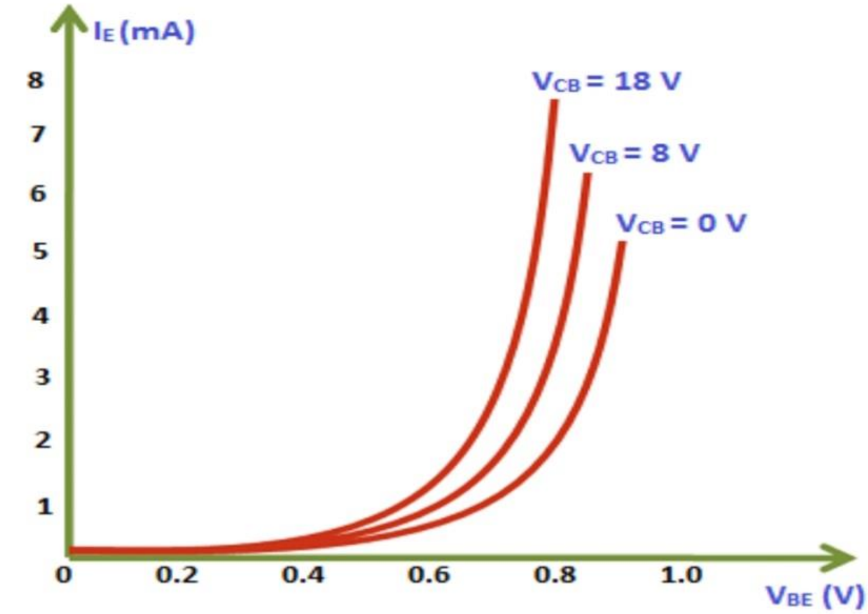


COMMON EMITTER OUTPUT CHARACTERISTICS

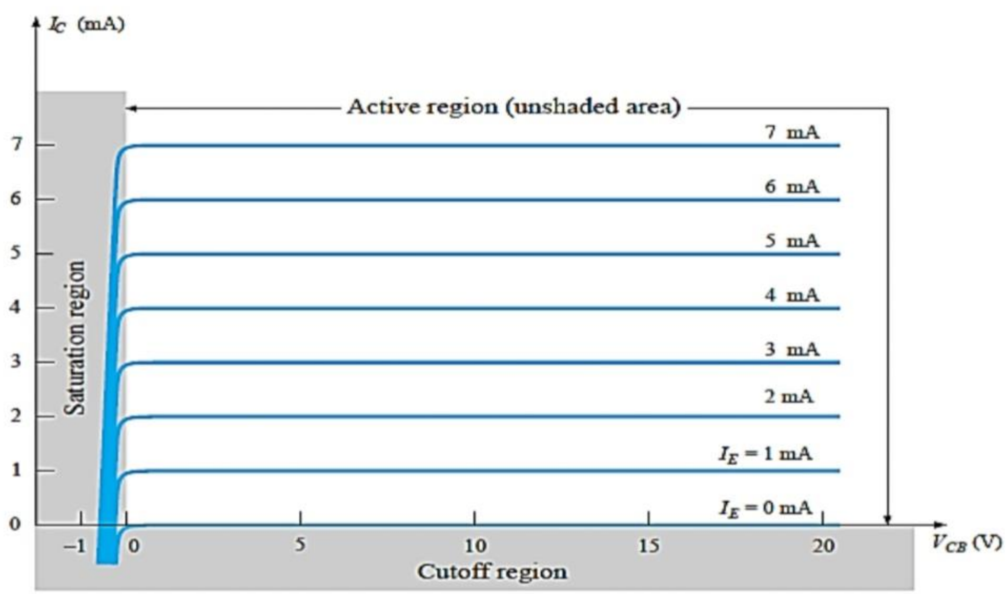


9.Draw the input and output Characteristics of CB amplifier ?

COMMON BASE INPUT CHARACTERISTICS



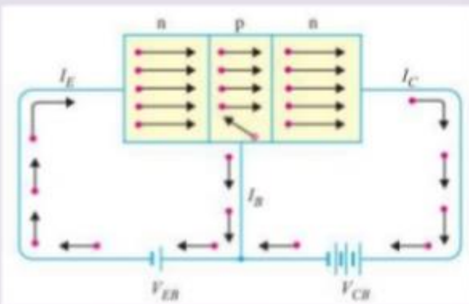
COMMON BASE OUTPUT CHARACTERISTICS



10.Explain working operation of NPN transistor

Transistor Operation

1) Working of npn transistor:



✓ Forward bias Is applied to emitter-base junction and reverse bias is applied to collector-base junction.

✓The forward bias in the emitter-base junction causes electrons to move toward base. This constitute emitter current, I_E

1) Working of npn transistor:

✓ As this electrons flow toward p-type base, they try to recombine with holes. As base is lightly doped only few electrons recombine with holes within the base.

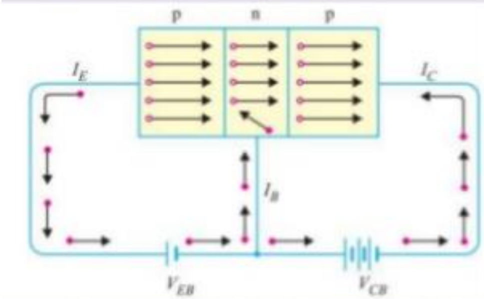
✓These recombined electrons constitute small base current.

✓The remainder electrons crosses base and constitute collector current.

$$I_E = I_B + I_C$$

11.Explain working operation of PNP transistor

2) Working of pnp transistor:



✓ Forward bias is applied to emitter-base junction and reverse bias is applied to collector-base junction.

✓The forward bias in the emitter-base junction causes holes to move toward base. This constitute emitter current, I_E

Transistor Operation

2) Working of pnp transistor:

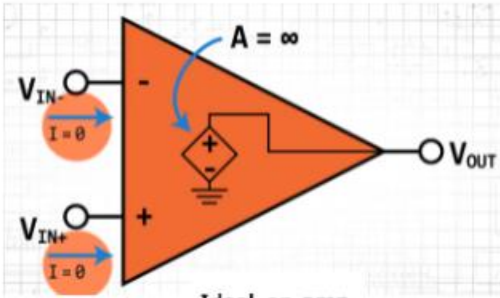
✓ As this holes flow toward n-type base, they try to recombine with electrons. As base is lightly doped only few holes recombine with electrons within the base.

✓These recombined holes constitute small base current.

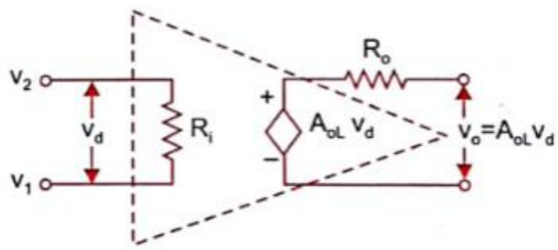
✓The remainder holes crosses base and constitute collector current.

12.Mention the ideal characteristics of OP AMP

THE IDEAL OPERATIONAL AMPLIFIER



Ideal op-amp,



Equivalent circuit of an op-amp

- The **input resistance of an op amp must be very high** where as the **output resistance should be quite low**.
- An op amp should also **have very high open loop gain**.
- In **Ideal Cases,** the input resistance and open loop gain of an op amp should be infinity whereas the output resistance would be zero.

Characteristic	Value
Open Loop Gain (A)	∝
Input Resistance (Impedance)	∝
Output Resistance (Impedance)	0
Bandwidth of Operation	∝
Offset Voltage	0

$$V_o = A(V_1 - V_2)$$

It can be observed that

(i)An ideal op-amp allows zero current to enter into its input terminals, i.e. $i_1 = i_2 = 0$.

Due to infinite input impedance, any signal with source impedance can drive the op-amp without getting inflicted with any loading effect.

(ii) The gain of the ideal op-amp is infinite.

Hence, the voltage between the inverting and non-inverting terminals is essentially zero for a finite output voltage.

(iii) The output voltage V_o is independent of the output current drawn from the op-amp, since $R_o = 0$.

This means that the output can drive an infinite number of output devices of any impedance value.

13.what is necessary to go with class AB power amplifier.

Advantages of Class AB power amplifier.

No cross over distortion.
No need for the bulky coupling transformers.
No hum in the output.

Disadvantages of Class AB power amplifier

14.what are the advantages and disadvantages of class c power amplifier

CLASS C POWER AMPLIFIER.

Advantages

- High efficiency.
- Excellent in RF applications.
- Lowest physical size for a given power output.

Disadvantages

- Lowest linearity.
- Not suitable in audio applications.
- Creates a lot of RF interference.
- It is difficult to obtain ideal inductors and coupling transfor
- Reduced dynamic range.

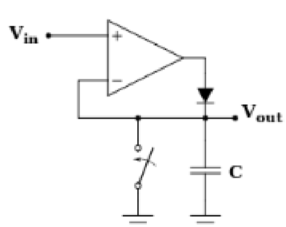
15.Write short notes on peak detector

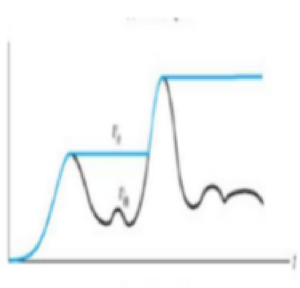
7. Write a short note on peak dectector

Peak detector circuits are used to determine the **peak** (maximum) value of an input signal. It stores the peak value of input voltages for infinite time duration until it comes to reset condition. The peak detector circuit utilizes its property of following the highest value of an input signal and storing it

[redacted]

Peak detectors **capture the extreme of the voltage signal at its input.** A positive peak detector captures the most positive point of the input signal and a negative peak detector captures the most negative point of the input signal.





Peak detector:

- The function of a peak detector is to compute the peak value of the input.
- The circuit follows the voltage peaks of a signal and stores the highest value on a capacitor. The highest peak value is stored until the capacitor is discharged.
- $V_{out} < V_{in}$; D ON and C charges to peak value of input, (i.e) voltage follower.
- $V_{out} > V_{in}$; D OFF and C holds the peak value of input.
- The circuit can be reset, capacitor voltage can be made zero by connecting low leakage MOSFET switch across the capacitor.
- Applications: Measurement and instrumentation, Amplitude modulation.

16.What is cross over distortion?

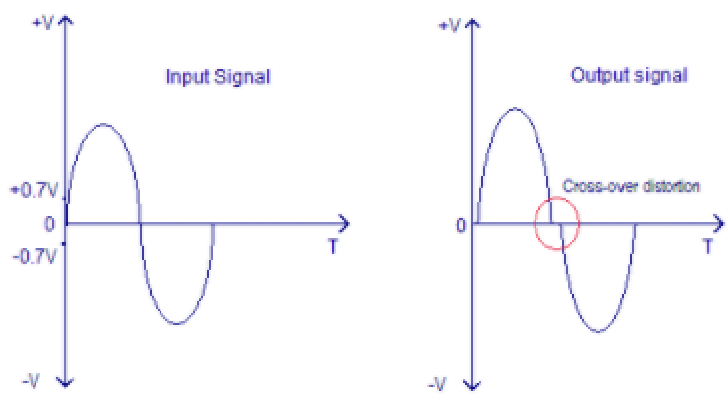
2.What is cross over distortion

Crossover Distortion is a common feature of Class-B amplifiers where the non-linearities of the two switching transistors do not vary linearly with the input signal

Crossover Distortion produces a zero voltage “flat spot” or “deadband” on the output wave shape as it crosses over from one half of the waveform to the other

CROSS OVER DISTORTION

- The regions of the input signal where the amplitude is less than 0.7V will be missing in the output signal and it is called cross over distortion.

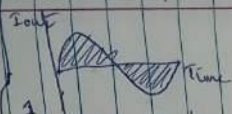
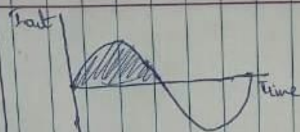
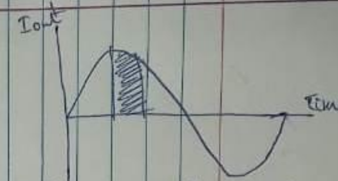


17. Compare CE,CB and CC configurations

1. Compare CE,CB and CC configurations

Characteristic	Common base (CB)	Common emitter, (CE)	Common collector,(CC)
Input Dynamic Resistance	Very Low(less than 100 ohm)	Low(less than 1K)	Very High(750K)
Output Dynamic Resistance	Very High	High	Low
Current Gain	Less than 1	High	Very High
Voltage gain	Greater than CC but less than CE	Highest	Lowest(less than 1)
Power gain	Medium	Highest	Medium
Leakage current	Very small	Very large	Very large
Relationship between I/p and o/p	In phase	Out of phase(180°)	In phase
Application	For High freq. applications	For Audio freq. Applications	For impedance Matching Applications

18.Compare class A,B,C power amplifiers

	CLASS A	CLASS B	CLASS C
Operating mode	 1 device conducts for the whole A-C cycle. conduction angle = 360°	 2 device, each conducting for half of A-C cycle. Conduction angle = 180°	 1 device conducts small portion of A-C cycle. conduction angle << 180°.
Maximum peak to peak voltage	MPP < Vcc	MPP = Vcc	Mpp = 2 (Vcc)
Uses	Low power amplifiers where efficiency is not important.	Output power amplifiers.	Tuned RF amplifiers but cannot be used as audio amplifiers due to high distortion.
Linearity & Distortion	Highest linearity & lowest distortion among all.	Lower linearity than Class A amplifiers & has small to moderate distortion.	Poorest linearity highest distortion among all.
Efficiency	Maximum possible overall efficiency = 25% with resistive load. Maximum possible collector efficiency with resistive load = 50%. If an output transformer is used, both of these efficiencies are 50%.	Average current is less, power dissipation is also less when compared to class A. Overall efficiency is increased. The theoretical efficiency in class B = 78.5% while in class A its only 50%	Most of DC power is converted into AC load because transistor and coil losses are small. When conduction angle = 180°, efficiency = ~~78~~ 78% - the theoretical max. efficiency of class B amp. conduction angle ↓, efficiency ↑ Max. efficiency = 100%.

19. What is positive and negative feedback? Explain the types of negative feedback

POSITIVE FEEDBACK

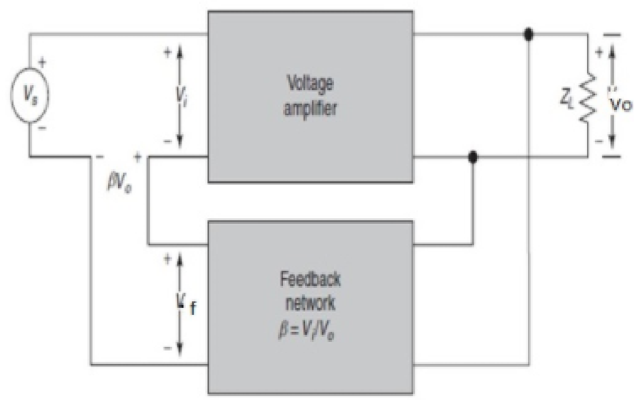
Positive feedback or regenerative feedback is the one that takes the output signal which is in phase with the applied input and fed it back to the reference input. This facilitates adding the feedback signal with the reference input and the added signal further acts as the controlling signal for the system in which the feedback loop is incorporated

NEGATIVE FEEDBACK

Negative feedback also referred as degenerative feedback is a widely used type of feedback in the control system. Here the signal at the output which is out of phase with respect to the input is fed back to the input. Thus, the two signals at the input of the system get subtracted and the difference of these two signals further drives the system

1) Voltage-series feedback:

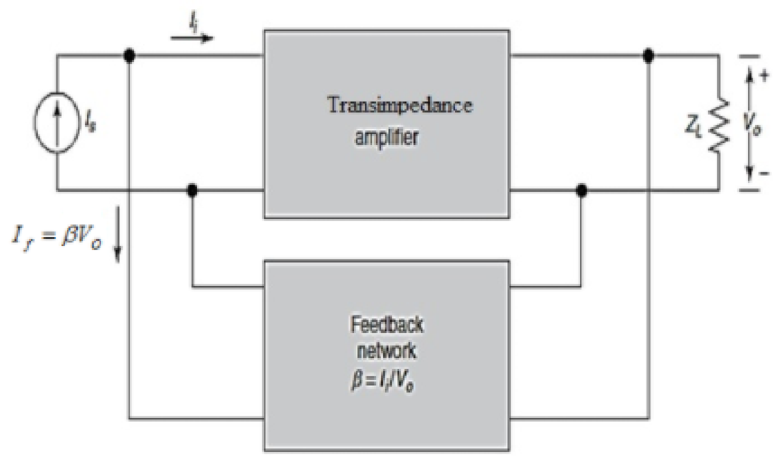
- The input signal is voltage and the output signal is voltage. Voltage is sampled at the output and *feedback in the form of voltage at the input. Forward amplifier converts voltage to voltage. So the gain of the amplifier is voltage gain Av. The feedback path converts voltage to voltage and its gain is β.* $A_{vf} = \dfrac{A_v}{1+\beta A_v}$
- *The voltage gain with feedback is* $A_{vf} \approx \dfrac{1}{\beta}$
- *The voltage gain with feedback reduces the gain Av by the factor (1+β Av). When β Av>>1,*
- *The voltage gain is stabilized to* $A_{vf} \approx \dfrac{1}{\beta}$



Voltage amplifiers with voltage-series feedback

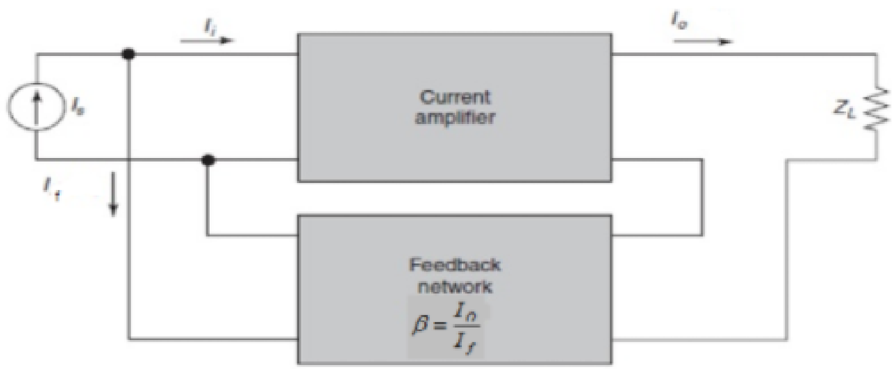
2) Voltage-Shunt Feedback

- The input signal is current and the output signal is voltage. Voltage is sampled at the output and *feedback in the form of current at the input. Forward amplifier converts current to voltage. So the gain of the amplifier is trans impedance* Z_m *. The feedback path converts voltage to current and its gain is β.*
- *The trans impedance with feedback is* $Z_{mf} = \frac{Z_m}{1+\beta Z_m}$
- *The gain with feedback reduces the gain* Z_m *by the factor* $(1+\beta Z_m)$. *When* $\beta Z_m >> 1$, $Z_{mf} \approx \frac{1}{\beta}$
- *The trans impedance with feedback is stabilized to* $Z_{mf} \approx \frac{1}{\beta}$



3)Current-shunt feedback

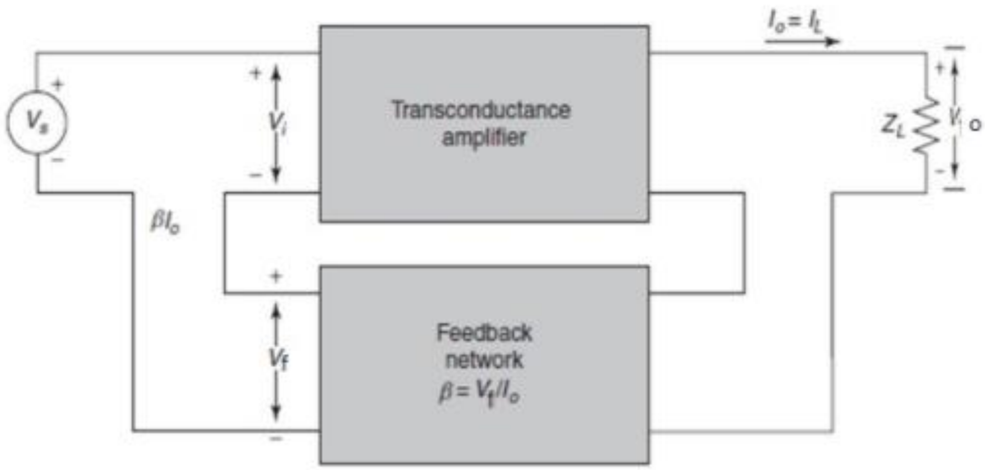
- The input signal is current and the output signal iscurrent. Current is sampled at the output and f*eedback in the form of current at the input. Forward amplifier converts current to current. So the gain of the amplifier is current gain* **A**$_i$*. The feedback path converts current to current and its gain is β.*
- The current gain with feedback $A_{if} = \frac{A_i}{1+\beta A_i}$
- *The current gain with feedback reduces the gain Av by the factor (1+β Av). When* βA_i*>>1,*
- *The current gain with feedback is stabilized to* $A_{if} \approx \frac{1}{\beta}$



Current amplifiers with current-shunt feedback

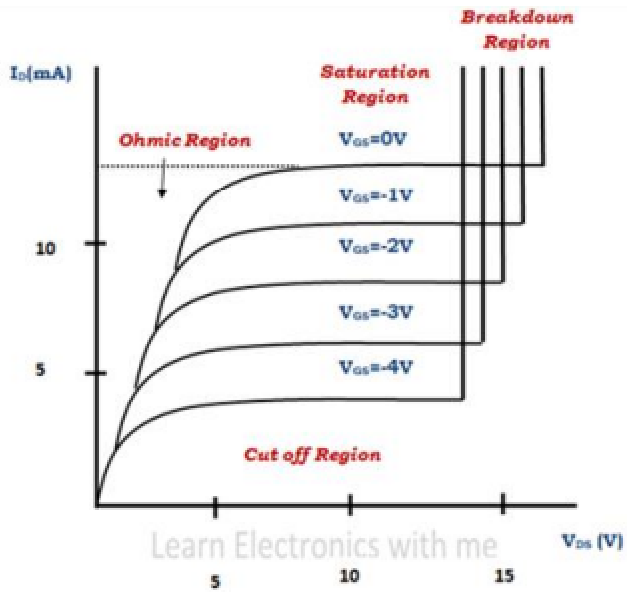
4) Current-Series Feedback:

- The input signal is voltage and the output signal is current. Current is sampled at the output and *feedback in the form of voltage at the input. Forward amplifier converts voltage to current. So the gain of the amplifier is trans conductance. The feedback path converts current to voltage and its gain is β.*
- *The trans conductance with feedback* $G_{mf} = \dfrac{G_m}{1+\beta G_m}$
- *The gain with feedback reduces the gain by the factor* $(1+\beta G_m)$. *When* $\beta G_m >> 1$, $G_{mf} \approx \dfrac{1}{\beta}$
- *The trans conductance with feedback is stabilized to* $G_{mf} \approx \dfrac{1}{\beta}$



Transconductance amplifier with current-series feedback

20.Draw the drain and transfer characteristics of JFET

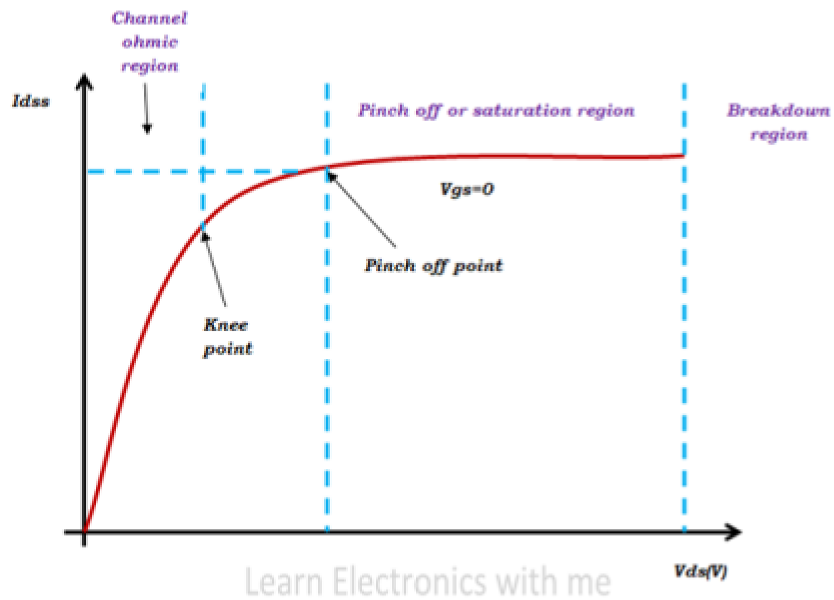


Drain characteristics of JFET with external bias

The input gate source voltage V_{GS} is increased and kept at constant and the output drain source voltage V_{DS} is gradually increased and the output current I_D is observed. Initially the current increases linearly and after it reaches knee voltage it enters the saturation region where the current is almost constant. When the applied voltage is increased further breakdown occurs and

it enters into the breakdown region. In Ohmic region it acts as a resistor.

Very small gate source voltage V_{GS} is applied and the JFET acts as a simple resistor. The drain current I_D increases gradually and reaches the knee point. Then it enters into pinch off region where the drain current I_D is almost constant for the increase in the drain source voltage V_{DS}.

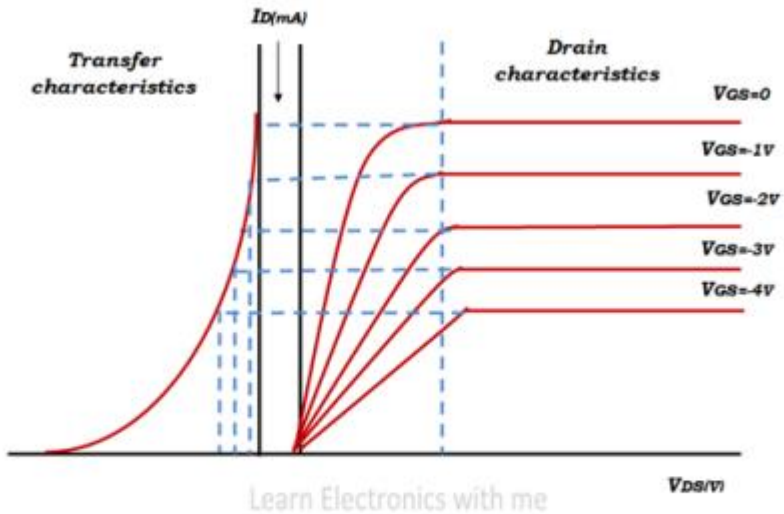


Output characteristics of JFET with shorted gate

Output characteristics of JFET with shorted gate

Knee point: Till this knee point the variation of drain current to the drain source voltage is linear. After this point it looks like a curve.

Transfer Characteristics of JFET:



JFET Transfer characteristics from Drain characteristics

Transfer characteristics of JFET

The transfer characteristics can be determined by keeping the drain source voltage V_{DS} constant, drain current I_D is observed by changing the gate source voltage. So it is observed that when the gate source voltage V_{GS} is increased in the negative region the drain current I_D decreases.

21.Draw the input and output characteristics of the BJT and explain

3. Draw the input and output characteristics of the BJT and explaim

Input Characteristics :

It is the curve between input current I_Band input voltage 〖V〗_BEat constant collector-emitter voltage, V_BE. The base current is taken along Y-axis and V_BE is taken along X-axis. Fig shows the input characteristics of a typical transistor in common-emitter configuration.

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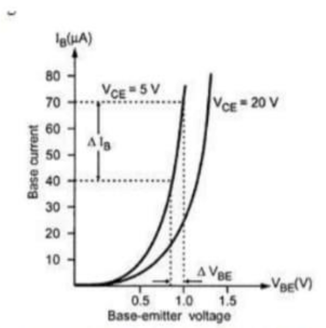


Fig 3.2: Input characteristics of the transistor in CE configuration

B) Output Characteristics:

This characteristic shows the relation between the collector current I_C and collector voltageV_CE, for various fixed values of 〖I〗_B. This characteristic is often called collector characteristics.

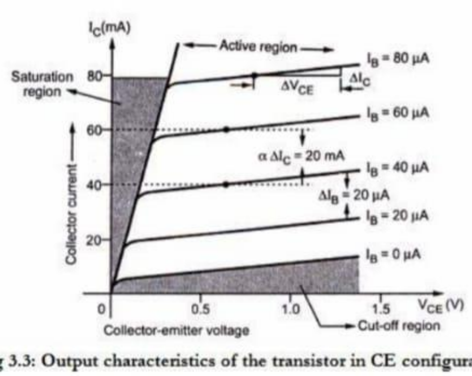


Fig 3.3: Output characteristics of the transistor in CE configuration

22. Derive the efficiency of class A amplifier

is at its minimum. The efficiency of this type of Class A amplifier configuration can be calculated as follows.

R.M.S. Collector voltage is given as

$$V_{CE} = \frac{V_{C(max)} - V_{C(min)}}{2\sqrt{2}} = \frac{2V_{CC} - 0}{2\sqrt{2}}$$

R.M.S. Collector current is given as

$$I_{CE} = \frac{I_{C(max)} - I_{C(min)}}{2\sqrt{2}} = \frac{2I_{C} - 0}{2\sqrt{2}}$$

The r.m.s. Power delivered to the load (Pac) is therefore given as

$$P_{ac} = V_{CE} \times I_{CE} = \frac{2V_{CC}}{2\sqrt{2}} \times \frac{2I_C}{2\sqrt{2}} = \frac{2V_{CC}\,2I_C}{8}$$

The average power drawn from the supply (Pdc) is given by

$$P_{dc} = V_{CC} \times I_C$$

Efficiency of a Transformer-coupled Class A amplifier is given as

$$\eta_{(max)} = \frac{P_{ac}}{P_{dc}} = \frac{2V_{CC}\,2I_C}{8V_{CC}I_C} \times 100\%$$

An output transformer improves the efficiency of the amplifier by matching the impedance of the load with that of the amplifiers output impedance. By using an output or signal transformer with a suitable turns ratio, class-A amplifier efficiencies reaching 40%..

23.Compare inverting and non inverting amplifier

Basis of Comparison	Inverting Amplifier	Non-Inverting Amplifier
Basic	It provides an amplified signal which is out of phase with the applied input.	It is designed to provide an amplified signal which is in phase with the signal present at the input.
Phase difference between input and output	180°	0°
Input	Applied at negative input terminal	Provided at positive input terminal
Achieved output	Inverted in nature	Non-inverted in nature
Expressed as	Negative polarity	Positive polarity
Gain of Amplifier	Ratio of resistances.	Summation of 1 with the ratio of resistances.
Ground connection	The positive input terminal is grounded	The negative input terminal is grounded
Gain Polarity	Negative	Positive

12 Mark

24. With neat sketch explain, Negative feedback amplifiers

25. What is operational amplifier? Explain their ideal characteristics and parameters

26. What is the difference between oscillators and amplifiers? Explain an oscillator and amplifier circuit with their applications

27.Explain briefly the operations and applications of class A and class AB amplifier

28. With neat sketch explain, JFET configurations

JFET Configurations :-

They're are three configuration :- ① Common Source

② Common Drain

③ Common Gate.

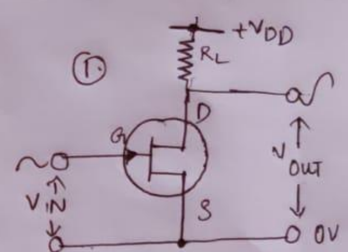
① Common source (CS) configuration :-

→ It is Good voltage amplifier.

→ Mostly used, Similar to CE transistor.

→ Generally used in audio frequency amplifiers and in high input impedance pre-amplifier stages.

→ 180 degree phase shif between input and output.



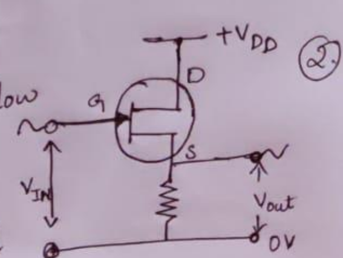
② Common Drain (CD) configuration :-

→ It is Good voltage buffur

→ Source follower.

→ High input impedance and a low output impedance.

→ Approx. unity voltage gain - used in buffer amplifiers.



→ refferred to as "Common Drain" because there is no signal available at the drain connection.

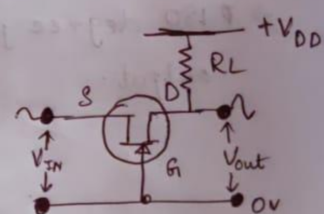
③ Common Gate (CG) configuration :-

→ It is Good current buffer.

→ It Has a low input independence, but a high output impedance.

→ Applied in high frequency circuits (or) in impedance matching circuits. where a low input impedence needs to be matched to the high output impedance.

→ Microphone amplifiers.



29.Explain any two applications of operational amplifiers