GAYATRI VIDYA PARISHAD COLLEGE OF ENGINEERING FOR WOMEN (AUTONOMOUS)

BASIC ELECTRONICS ENGINEERING

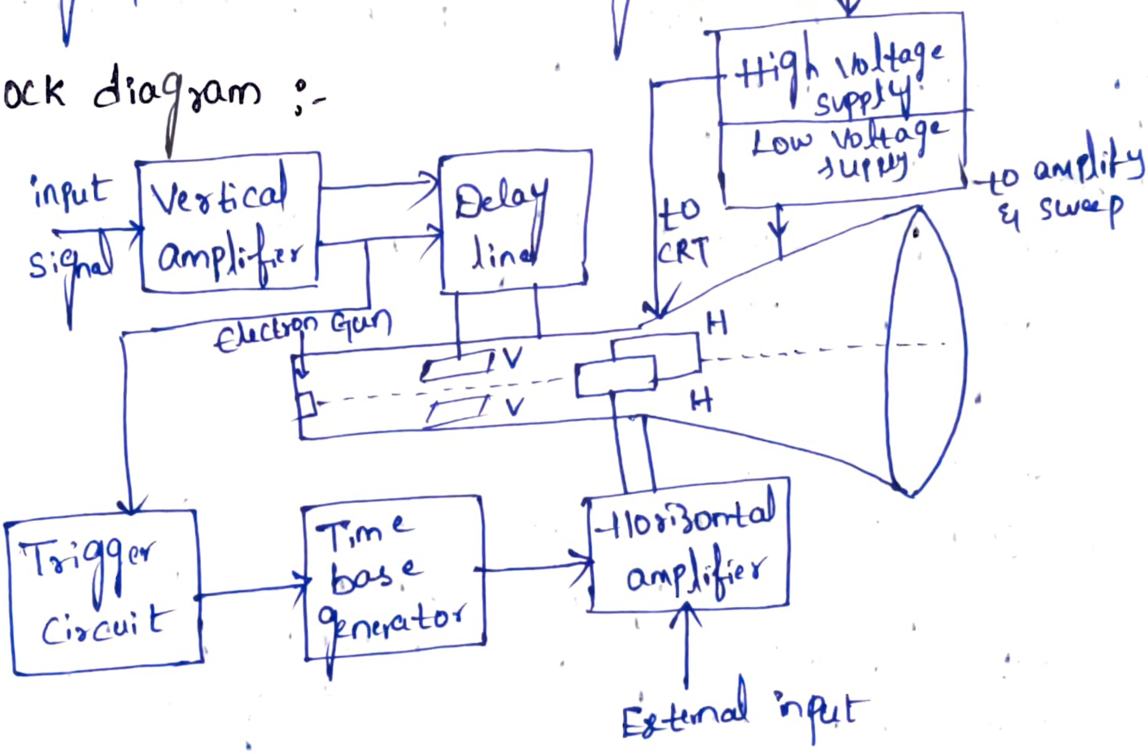
Scheme of Evaluation

1(a) CRO :-

Ans:- Introduction :-

The cathode-ray oscilloscope (CRO) is a multipurpose display instrument used for the observation, Measurement, and analysis of waveforms by plotting amplitude along Y-axis and time along X-axis.

Block diagram :-



Functions of Various blocks in CRO :-

1. Electron Gun :-
   - Produces a focused electron beam
2. Vertical deflection system :-
   - Deflect the beam along Y-axis.

- Vertical Amplifier amplifies the input signal and applies it to the vertical deflection plates.

3. Horizontal deflection system:-
- Deflect the beam along the X-axis.
- Horizontal amplifier processes the time base signal and applies it to the horizontal deflection plates.

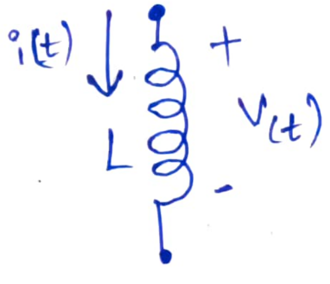
4. Time Base Generator:-
- Produces a ramp signal to control the horizontal deflection, ensuring the beam sweeps uniformly across the screen.

5. Trigger circuit:-
- synchronizes the input signal with the time base signal for a stable display.

6. power supply:-
- provides the required voltage for various components, including the CRT.

1(b) Inductor:-

Ans:- The Inductor is an passive electrical component consisting of a coil of wire which is designed to take advantage of the relationship between magnetism and electricity as a result of an electric current passing through coil.



$$V_L(t) = \frac{d\phi}{dt} = \frac{dLi}{dt} = -L\frac{di}{dt}$$

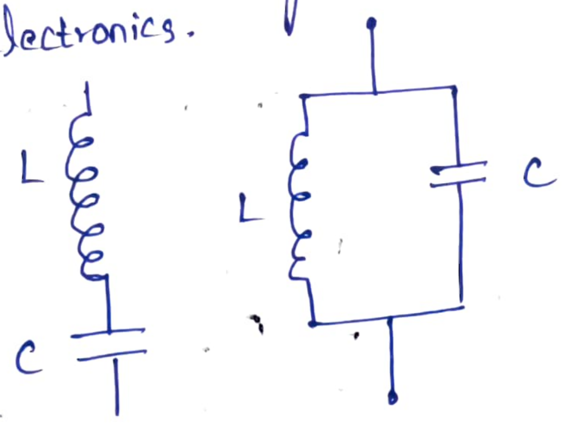
- Inductors are extensively used in filter circuits due to their frequency-dependent impedance characteristics.
- Use of Inductor for filter :-

Inductors allow low-frequency signals to pass (low impedance at low frequencies) and block high frequency signals (high impedance at high frequencies).

- This makes them ideal for designing low-pass filters.

Use of Inductor in tuning circuits :-

- Inductive tuning circuits, or LC circuits are pivotal in electronics for signal processing and power electronics.
- Their function relies on the properties of reactance in AC circuits.
- LC circuits are key in devices like radios, TVs and Power electronics.



2(a) ANS:- 1. Resistor :-

A Resistor is a passive electrical component that opposes or limits the flow of electric current in a circuit.

symbol :- 

unit :- ohm (Ω)

2. Inductor :-

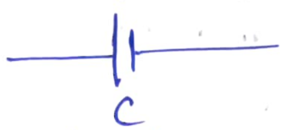
An Inductor is a passive electrical component that stores energy in its magnetic field when current flows through it.

symbol :- 

unit :- Henry (H).

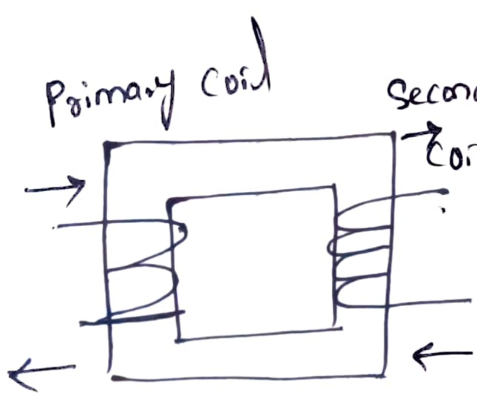
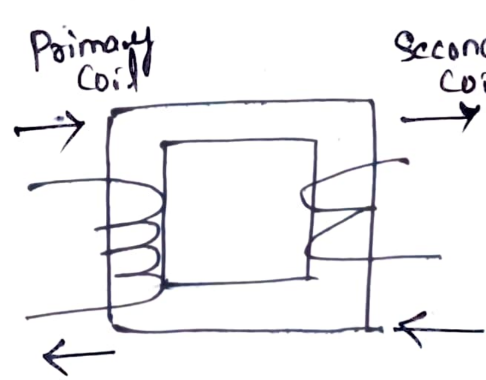
3. Capacitor :-

A capacitor is a passive electrical component that stores energy in the form of an electric field.

symbol :- 

unit :- Farad (F)

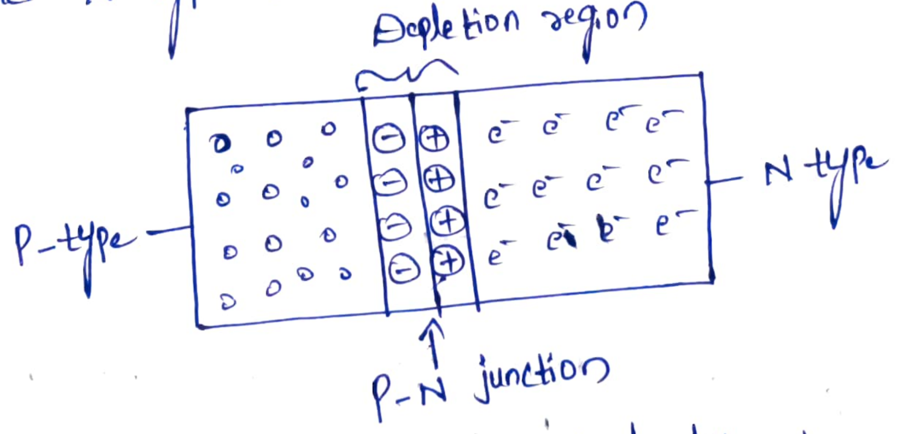
2(b) Ans :-

Step-up Transformer	Step-down transformer
	

1. The current in the Primary coil is more than that in the Secondary coil.	1. The current in the primary coil is less than that in the secondary coil
2. The no. of turns in the Primary coil is less than that in the Secondary coil.	2. The no. of turns in the Primary coil is more than that in the secondary coil.
3. It is used to convert a low AC Voltage into a high AC voltage.	3. It is used to convert a high AC Voltage into a low AC voltage.

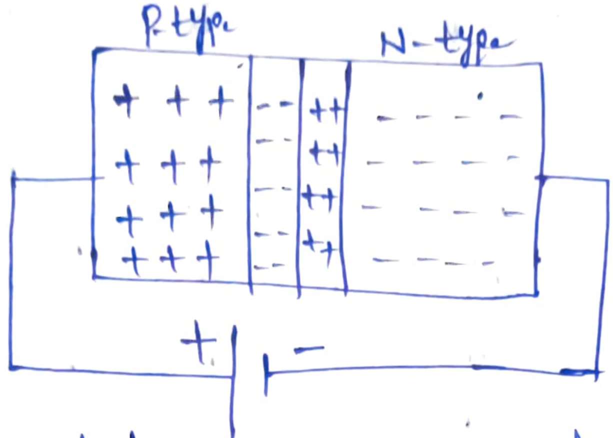
3(a)
Ans:- P-N junction diode :-

- The P-N junction diode is formed between the P-type and N-type semiconductors.



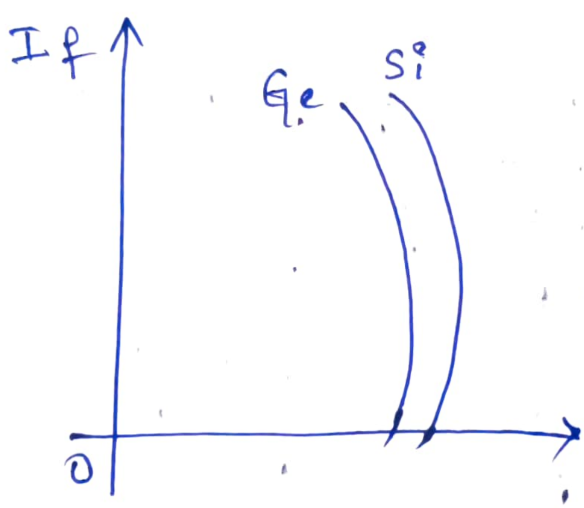
- The P-N junction is created by the Method of Doping.
- The P-side or the positive side of the Semiconductor has an excess of holes, and the n-side or the negative side has an excess of electrons.

1. Forward bias :-



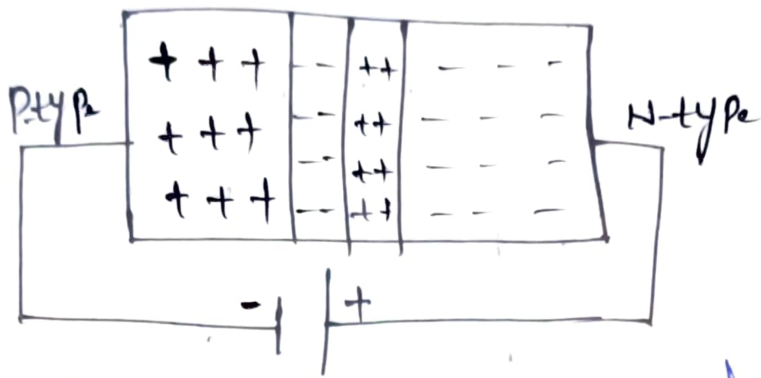
- under forward bias condition applied positive potentials repels the holes in p-type.
- under forward bias condition applied negative potentials repels the electron in n-type.

V-I characteristics :-



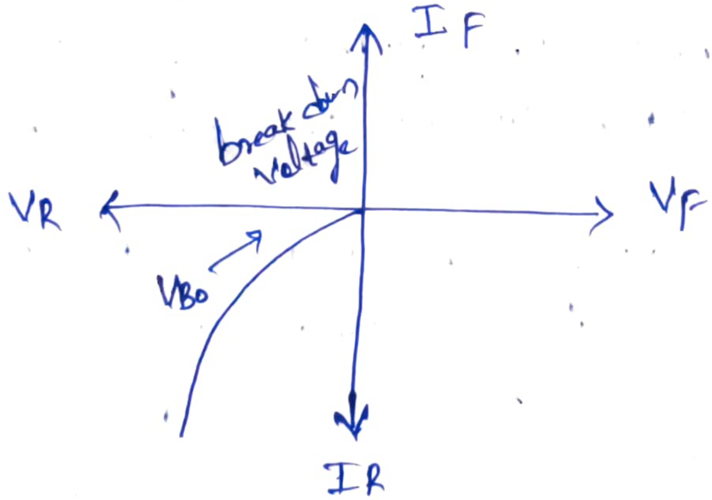
- As the forward voltage V_f is increased the forward current is almost zero.
- For $V_F > V_0$ potential barrier completely disappears and holes cross the junction from p-type to n-type and electron cross in the opposite direction.

2. Reverse bias :-



- under Reverse bias condition, applied positive potential attracts the electrons in n-type region. The electrons move away from the junction.
- under Reverse bias condition, applied negative potential attracts the holes in the p-type region. The holes move away from the junction.

V-I characteristics :-



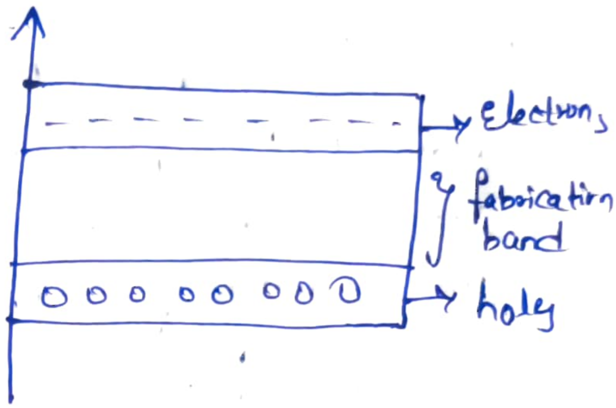
- under R.B.C generated holes in p-region are attracted towards the negative terminal of the battery and electrons are attracted towards the positive terminal.

3(b)

Ans:- **Intrinsic Semiconductor:-**

- Pure semiconductors are called Intrinsic Semiconductors.
- The absence of an electron in band is by a small called "hole".
- Intrinsic semiconductors have equal concentration of electrons and holes under the conditions of thermal equilibrium.

$$\boxed{n = p = n_i}$$



Extrinsic semiconductors:-

- In order to change the properties of intrinsic semiconductor, a small amount of some other material is added to it.
- This process of adding other material to the crystal of intrinsic material to its conductivity.

N-TYPE Semiconductor	P-type Semiconductor
1. It is a donor type	1) It is an acceptor type
2. Impurity atom is penta-valent	2) Impurity atom is trivalent
3. Donor level lies close to the bottom of the conduction band	3. Acceptor level lies close to the top of the valence band
4. Eg: phosphorus, arsenic, antimony etc	4. Eg: Boron, Gallium, Aluminium (Al)

4a) A Full-wave rectifier converts the entire AC waveform (both the +ve & -ve halves) into pulsating DC. It uses either.

1. Center-tapped transformer configuration:

→ Two diodes are connected to a center-tapped transformer.

→ Each diode conducts alternately during the +ve and -ve half cycles of AC i/p.

→ working

i) During +ve half cycle:-

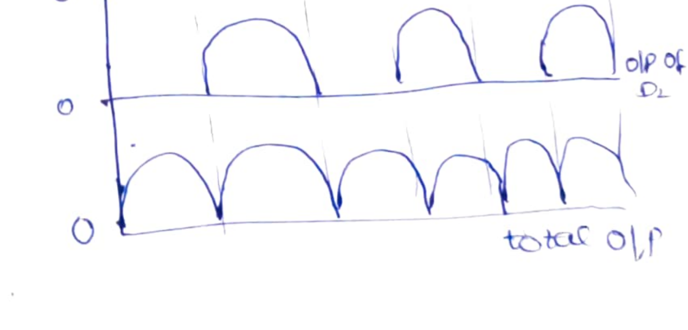
→ i/p AC s/g D_1 & D_2 conduct, allowing current to flow from the i/p to load resistor.

→ Diodes D_3 and D_4 are reverse biased and do not conduct during this half cycle.

ii) During negative half cycle:

→ During -ve half cycle of the i/p AC s/g, diodes D_3 and D_4 conduct while D_1 and D_2 are reverse biased.

→ current flows through load resistor in the same direction as the +ve half cycle, resulting in a continuous DC o/p across the load.



Ripple factor :

$$= \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1}$$

$$= \sqrt{\left(\frac{I_m/\sqrt{2}}{2I_m/\pi}\right)^2 - 1}$$

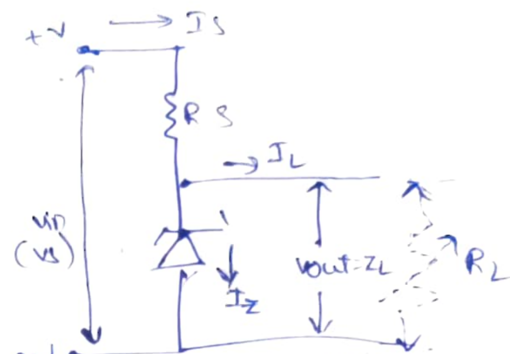
$$= \sqrt{\frac{I_m^2/2}{\frac{4I_m^2}{\pi^2}} - 1} = \sqrt{\frac{\pi^2}{8} - 1}$$

$\gamma = 0.48$

4b) → Zener diodes are used as voltage regulators because they can produce a stable voltage o/p, even when the i/p voltage or load conditions change.

→ This is possible because zener diodes are designed to have a low, specified reverse breakdown voltage.

→ When the reverse bias voltage exceeds the zener diode's knee voltage, the voltage across the load become constant.



Zener voltage regulator

→ The zener diode's breakdown voltage remains constant for a wide range of currents.

→ Zener diodes are essential components in power supply circuits and voltage regulation applications.

U - III

5a) A transistor can be used as an amplifier because it can control a larger current with a smaller input current or voltage. This process is called amplification.

- A small i/p sig. is applied to the base of the transistor.
- The transistor controls a large current to flow through the collector.
- The result is an amplified o/p sig.

→ Transistors are crucial components of modern electronics and are used in many applications, including: Radio frequency (RF), optical fiber communication (OFC) and Audio amplification.

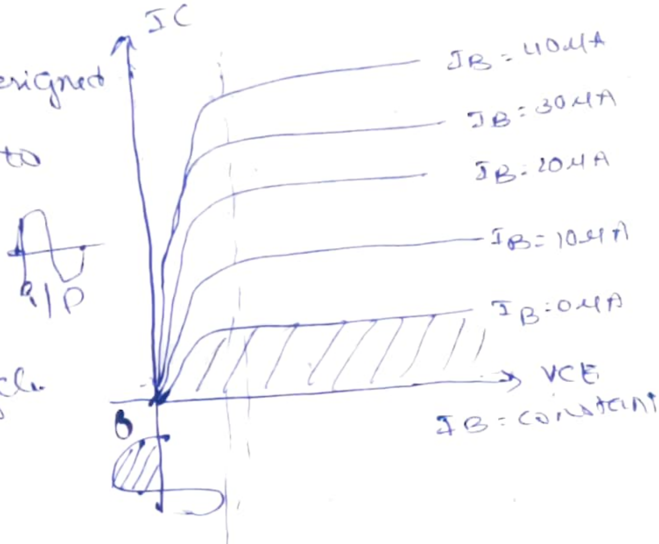
→ Transistors are miniature semiconductor devices that typically have 3 layers or terminals, of semiconductor material.

5b) The operating point can be selected at 3 different positions on the DC load line.

- Near saturation region
- Near cut-off region
- At the center i.e. Active region

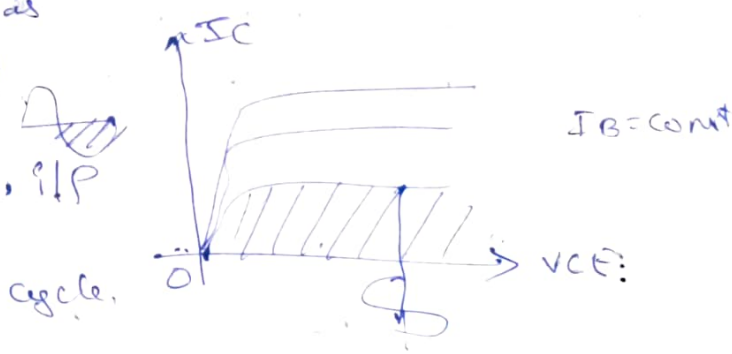
- Near saturation region

→ If biasing circuit is designed to fix Q-point near to saturation region, the collector current is clipped at +ve half cycle.



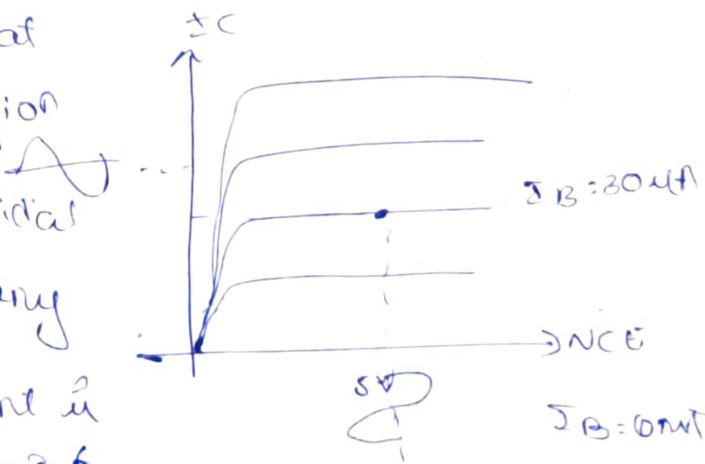
- Near cutoff region.

→ If biasing circuit is designed to fix Q-point near to cut-off region, i/p the collector current is clipped at -ve half cycle.



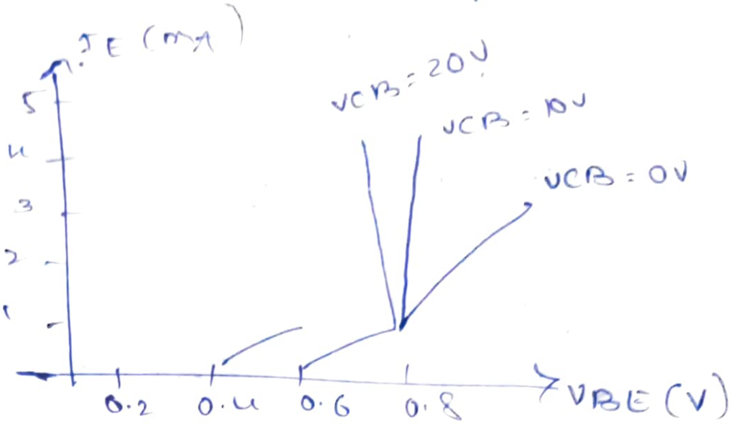
- Near active region:

→ If Q-point is fixed at center of active region the o/p s/g is sinusoidal waveform without any distortion. Thus Q point is the best operating point.



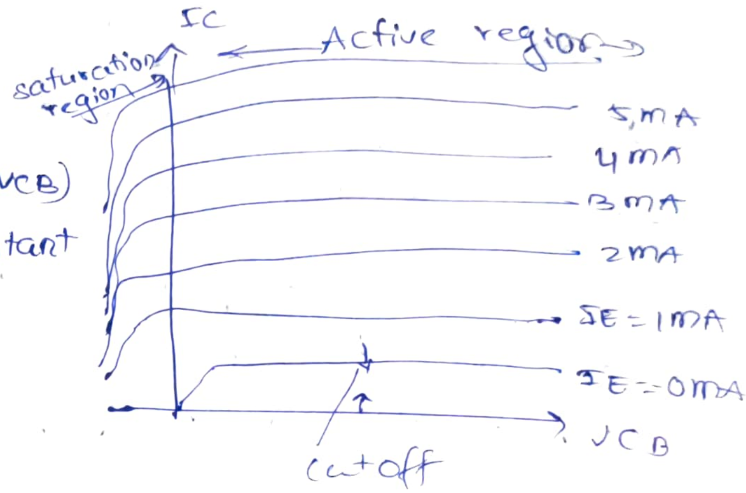
6a) i/p characteristics

→ The variation of the emitter current (IE) with the base emitter voltage (VBE) while the collector voltage (VCB) is held constant



output characteristics

→ The variation of the collector current (IC) with the collector base voltage (VCB) while the emitter is constant remains constant.



Effect of base width modulation :-

→ Recombination of charge carries with in the base region reduces so the base current decreases

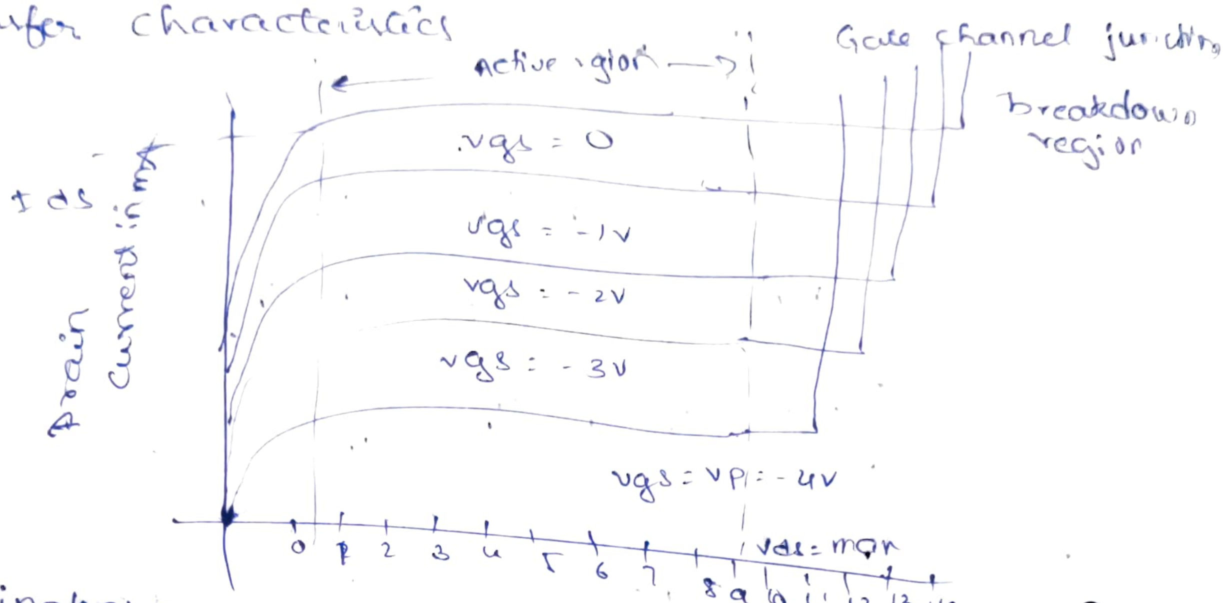
→ concentration of minority carriers increase, so emitter current increases.

6b)

features	fixed bias	Self - bias
stability	low stability (depends on β)	High stability (feedback mechanism)
complexity	simple	moderate complex
power efficiency	Higher efficiency	lower efficiency (due to Re)
Cost	Cheaper	slightly more expensive
application	Basic circuits	Amplifiers, reliable circuits.

UNIT - IV

7a) Basically, the characteristics are of two types: output characteristics, or drain characteristics & transfer characteristics



Terminologies involved in o/p characteristics of JFET

- saturation region: In this region, the JFET operates with low Vds and the current is constant.
- ohmic region :- JFET becomes an ohmic region increasing VDS. The drain current increases with vds.
- Pinched off region: By increasing the VDS, it can lead to a pinch of region.
- Breakdown region: As the voltage of drain source becomes very high then the JFET channels gets breakdown.

7b) In a common gate FET amplifier, the i/p s/g is applied to the source, the o/p is taken from the drain and the gate is fixed. variations in the source voltage controls the drain current impedance, high output impedance, and producing an amplified o/p voltage across the drain load. It has low input impedance, high output impedance, and is ideal for high frequency application

i/p impedance : $z_s = \frac{1}{y_{fs}}$

$z_i = \left(\frac{1}{y_{fs}}\right) \| R_S$

voltage gain :

$V_o = I_d (R_D \| R_L) = y_{fs} v_i (R_D \| R_L)$

$A_v = \frac{v_o}{v_i} = \frac{y_{fs} v_i (R_D \| R_L)}{v_i}$

$$\boxed{A_v = y_{fs} (R_D \| R_L)}$$

8a)

Parameter	BJT	FET
Definition	A type of transistor which uses two types of charge carrier viz electrons and holes for conduction is known as BJT	A type of transistor in which electric field is used to control the flow of current in a semiconductor is known as field.
Control element	BJT is current control element	FET is a voltage control element.
Suitability	BJT suitable for low current applications	FET is suitable for high current applications
Cost	cheaper	relatively expensive
Gain bandwidth product	higher	lower
thermal run away	exists	doesnot exists
thermal noise	more thermal noise	thermal noise in case of FET is much lower

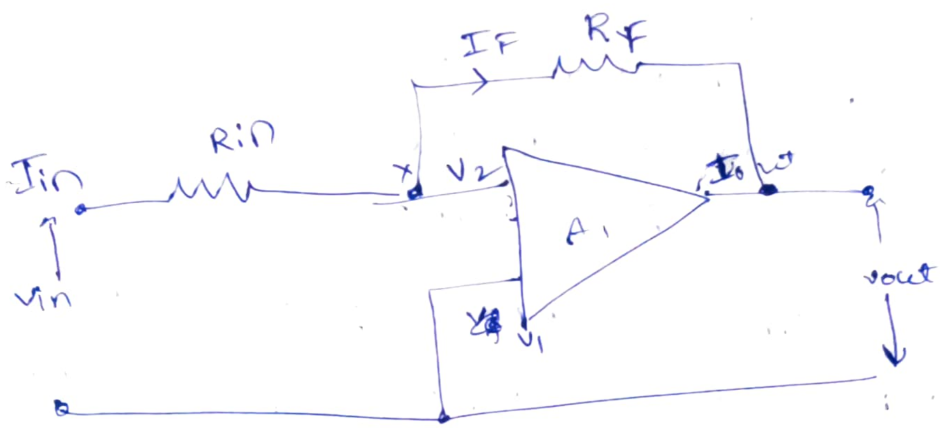
8b) The four biasing methods for MOSFETs are:

- voltage divider bias :- Also known as self-bias or universal bias, this is potential divider bias because it provides a the most common method stable operating point.
- fixed bias : Also known as base resistor biasing
- Drain to gate bias :- A biasing method for MOSFETs
- Self bias :- A JFET biasing circuit that uses a source resistor to help reverse bias the JFET gate.

→ MOSFETs have 3 regions of operation : ohmic / triode region, saturation / linear region and pinch-off point.

UNIT - V

9a)



$A_V = V_{out}/V_{in}$

$V_1 - V_2 = I_{in} R_{in}$ and $V_2 - V_{out} = I_F R_F$

thus $I_{in} = I_f$ we also know that in an ideal op-amp voltage.

10(a)) ideal & practical amp.

characteristics	Practical	ideal.
voltage gain	2×10^5	∞
i/p resistance	2 MΩ	∞
o/p "	75 Ω	0
CMRR	90dB	∞
PSRR	150 µV/V	0
Slew rates	0.5 V/µs	∞

9b) An operational amplifier (op-amp) can be used in both differential mode and common mode.

differential mode :- An op amp amplifies the difference b/w the two voltages on the inputs. this is useful for amplying signals that are opposite at the two inputs, while slightly amplifying signals that are common to both inputs.

Common mode :- An op-amp amplifies the voltage that appears on both i/p terminals with respect to the ground. Ideally, an op amp will reject voltages that appear on both input terminals, resulting in common mode voltage gain of zero.

Due to virtual ground $V_1 = 0$

Also $V_2 = V_1 = 0$

$V_{in} - 0 = I_F R_{in}$ and $0 - V_{out} = I_F R_F$

we combine the last two Equations

$$\frac{-V_{out}}{V_{in}} = \frac{I_F R_F}{I_F R_{in}}$$

so $-V_{out}/V_{in} = R_F/R_{in}$

$$\therefore \frac{V_{out}}{V_{in}} = -R_F/R_{in}.$$

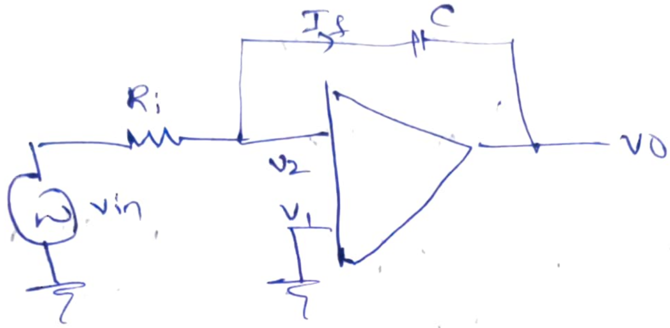
10a)
ab) An operational amplifier (op-amp) works by comparing the voltages at its inverting and non-inverting terminals.

An operational amplifiers works to amplify signals.

- Infinite open-loop gain :- This ensures that the maximum output is obtained.
- Infinite i/p impedance : This allows almost any source to drive the op-amp.
- Zero noise :- The op-amp produces no noise.
- Zero DC offset : The op-amp has no DC-offset
- CMMR : The op-amp has infinite CMRR
- Zero power supply rejection ratio :- The op-amp has zero PSSR.
- Infinite bandwidth : This allows any frequency signal to be amplified without attenuation //

10b) An op-amp integrator performs mathematically integration. It converts a square wave to a triangle wave, a triangle wave to a sine wave, or sine wave to a cosine wave.

Operational amplifier interagator circuit



if $I_{in} + I_f = 0$

$I_{in} = -I_f$

$$\frac{v_{in} - v_a}{R} = -\frac{cd}{dt}(v_o - v_a)$$

where $v_a = 0$

$$\frac{V_{in}}{R} = -\frac{cd}{dt} v_o$$

Integrate the above equation, we get the following

1/R

or

$$V_{out} = -\int \frac{v_{in}}{RC} dt + C$$

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