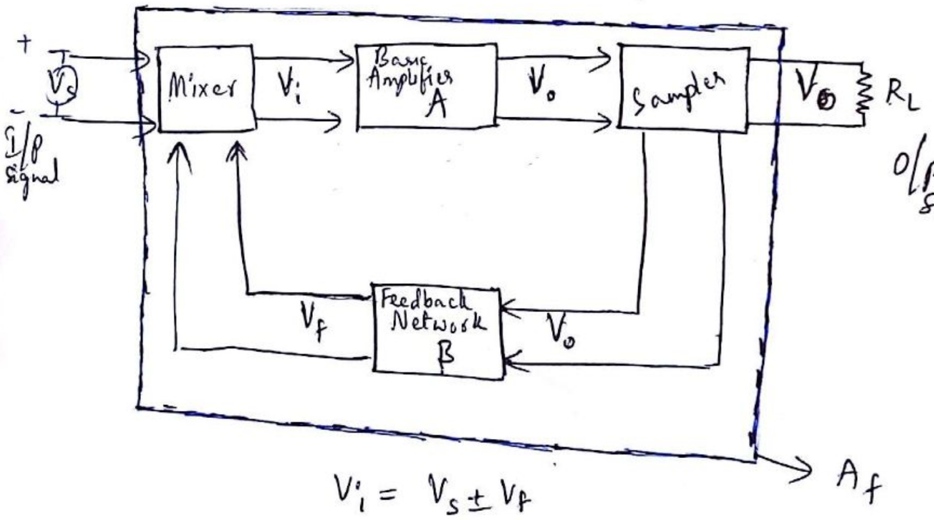
31/8

Unit III

Feedback Amplifier
- concept
- characteristics of negative feedback
- Types of -ve feedback amplifiers

Oscillators
- principle
- RC Oscillator
  - Phase shift Oscillator
  - Wein bridge "
- LC Oscillator
  - Hartley Oscillator
  - Colpitt "

Block Diagram of Feedback Amplifier :-



$V_i = V_s \pm V_f$

+ if both are inphase

− if both are out of phase

if $V_i = V_s + V_f \rightarrow$ then +ve feedback amplifier

$V_i = V_s - V_f \rightarrow$ then -ve feedback amplifier

Gain of basic amplifier, $A = \frac{V_o}{V_i}$

Gain of Feedback network, $\beta = \frac{V_f}{V_o}$

Gain of amplifier with feedback, $A_f = \frac{V_o}{V_s}$

Positive feedback :- (Regenerative FeedbAck)

If Feedback Signal V_f is inphase with the I/p signal V_s then that amplifier is called as positive feedback amplifier

$$V_i = V_s + V_f$$

Negative feedback :- (Degenerative feedbAck)

If the feedback signal V_f is out of phase with I/p signal V_s then that amplifier is called as negative feedback amplifier.

$$V_i = V_s - V_f$$

+ve feedbAck ($V_i = V_s + V_f$)

$$A_f = \frac{V_o}{V_s} = \frac{V_o}{V_i - V_f} = \frac{1}{\frac{V_i}{V_o} - \frac{V_f}{V_o}} = \frac{1}{\frac{1}{A} - \beta} = \frac{A}{1 - A\beta}$$

$V_s \to V_i - V_f$

loop gain $\leftarrow$ If $A\beta = 1$ then $A_f = \infty$ oscillats

-ve feedback ($V_i = V_s - V_f$)

$$A_f = \frac{V_o}{V_s} = \frac{V_o}{V_i + V_f} = \frac{1}{\frac{V_i}{V_o} + \frac{V_f}{V_o}}$$

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

Advantages of -ve feedback :-
① $Z_i \uparrow$
② $Z_o \downarrow$
③ Bandwidth ↑
④ Non linear distortion ↓

Characteristics of negative feedbAck Amplifier :-

① Gain
② Gain Stability
③ Increased Bandwidth
④ Increased I/p Impedence
⑤ Decreased O/p Impedence
⑥ Decreased non linear distortion

① Gain :-

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

If $A\beta >> 1$ then

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

② Gain stability :-

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

$$\frac{dA_f}{dA} = \frac{1}{(1+A\beta)^2}$$

$$= \frac{1}{(1+A\beta)(1+A\beta)}$$

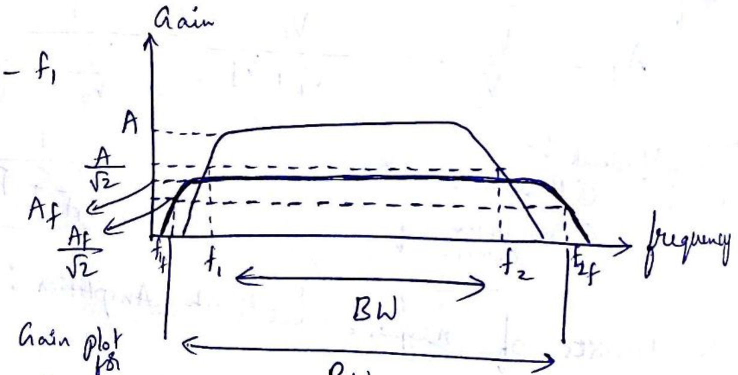
$$\therefore \frac{dA_f}{dA} = \frac{1}{1+A\beta} \cdot \frac{A_f}{A}$$

$$\Rightarrow \frac{dA_f}{A_f} = \frac{1}{1+A\beta} \cdot \frac{dA}{A}$$

$$\therefore \frac{\left(\frac{dA_f}{A_f}\right)}{\left(\frac{dA}{A}\right)} = \frac{1}{1+A\beta} \rightarrow \text{sensitivity}$$

③ Increased Bandwidth :-

Bandwidth = $f_2 - f_1$



Gain plot for

— → Basic Amplifier

— → Gain plot for feedback amplifier

Now Gain ↓

$$f_{1f} = \frac{f_1}{1+A\beta}$$

$$f_{2f} = f_2(1+A\beta)$$

④ Increased I/

Z_i

Z_i

⑤ Decreased

⑥ Decreased

Types of neg

① Voltage series

② voltage shunt

③ current seri

④ current sh

Voltage Sampler

① Voltage S

V_s

④ Increased I/p Impedence :-

$Z_i \rightarrow$ Impedence of Basic Amplifier

$Z_{if} \rightarrow$ " " Feedback amplifier

$$Z_{if} = Z_i(1 + A\beta)$$

⑤ Decreased O/p Impedence :-

$$Z_{of} = \frac{Z_o}{1 + A\beta}$$

⑥ Decreased non linear distortion :-

$$D_f = \frac{D}{1 + A\beta}$$

D → Noise of basic amplifier.

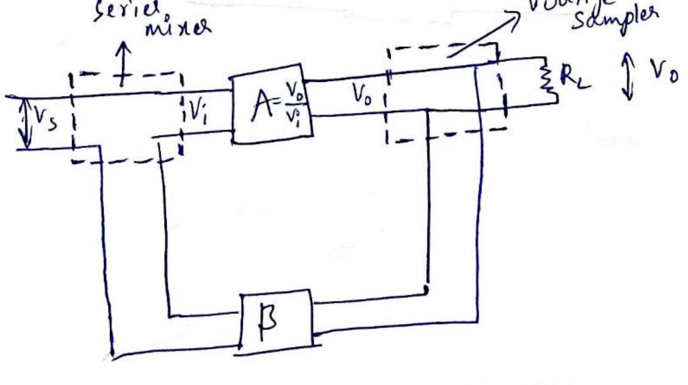
Types of negative Feedback Amplifiers :-

① voltage series " " "
② voltage shunt " " "
③ current series " " "
④ current shunt " " "

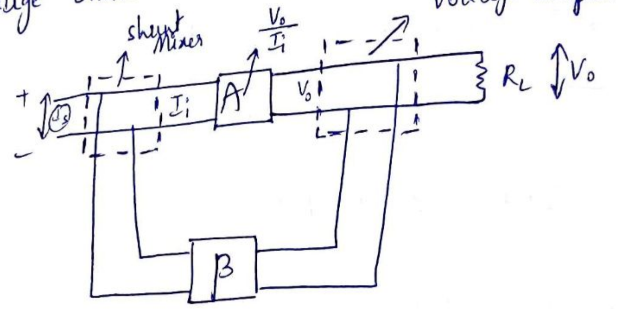
Samplers: Voltage Sampler, current Sampler

Mixer: Series mixer, shunt mixer

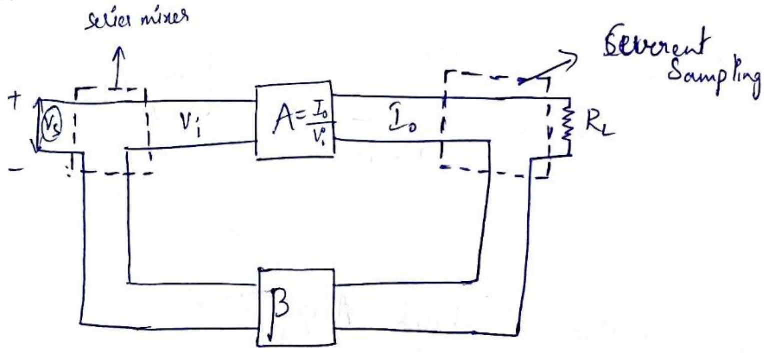
① VoltAge Series



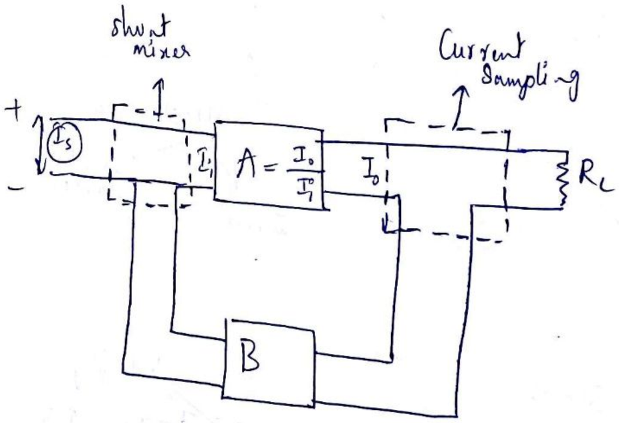
② Voltage Shunt



③ Current Series



④ Current Shunt



Comparison of feedb

	Voltage seri
R_{if}	$R_i(1+$
R_{of}	$\frac{R_o}{(1+A}$

Id
$\infty \Rightarrow$
$0 \Rightarrow$

Oscillators :-
An electro
following condi
Barkhausen criteria
i) The
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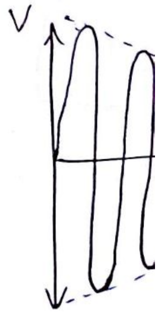
ampli
is
ii) The m
again
of

case(i) :- $A\beta < 1$



Comparison of feedback Amplifiers :-

	$\boxed{\text{Voltage series}}$	$\boxed{\text{current series}}$	$\boxed{\text{voltage shunt}}$	$\boxed{\text{Current shunt}}$
R_{if}	$R_i(1+A\beta) = \infty$	$R_i(1+A\beta) = \infty$	$\frac{R_i}{1+A\beta} = 0$	$\frac{R_i}{(1+A\beta)} = 0$
R_{of}	$\frac{R_o}{(1+A\beta)} = 0$	$R_o(1+A\beta) = \infty$	$\frac{R_o}{1+A\beta} = 0$	$R_o(1+A\beta) = \infty$

Ideal Values
$\infty \Rightarrow$ very high
$0 \Rightarrow$ low

Oscillators :-

An electronic circuit which satisfies the following conditions

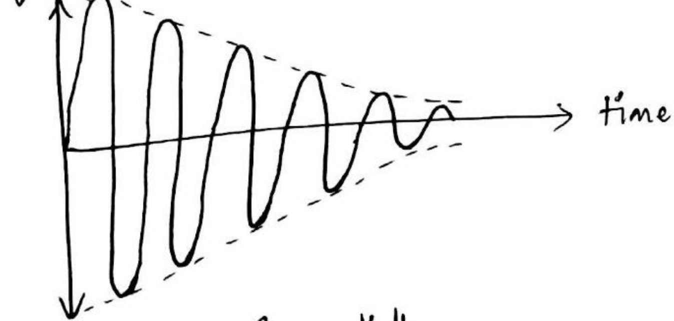
Barkhausen criteria

i) The total phase shift around a loop as signal proceeds from input through amplifier, feedback network back to i/p again is precisely $360°$

ii) The magnitude of product of open loop gain of amplifier (A) and magnitude of feedback factor (β) is unity.

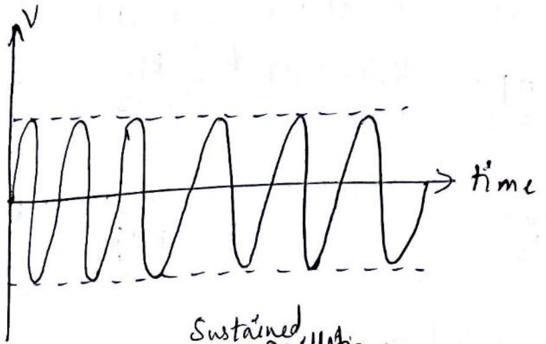
ie, $A.\beta = 1$

case(i) :- $A\beta < 1$



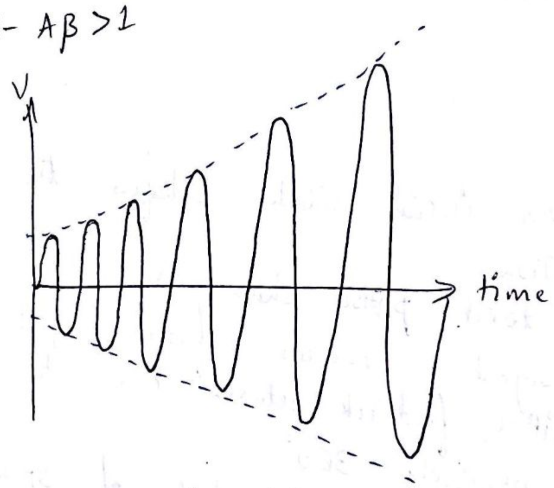
Exponentially decreasing amplitudes

Case 2 :- $A\beta = 1$

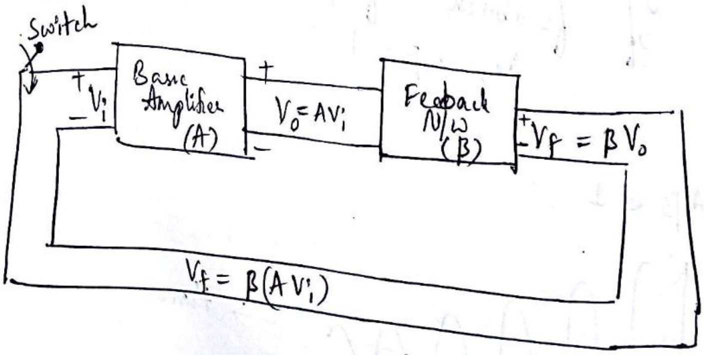


Sustained Oscillations

Case 3 :- $A\beta > 1$



Exponentially Increasing Oscillations



If the cir
provide $A\beta$,
when switch
the circuit
feedback Vol
amplifier

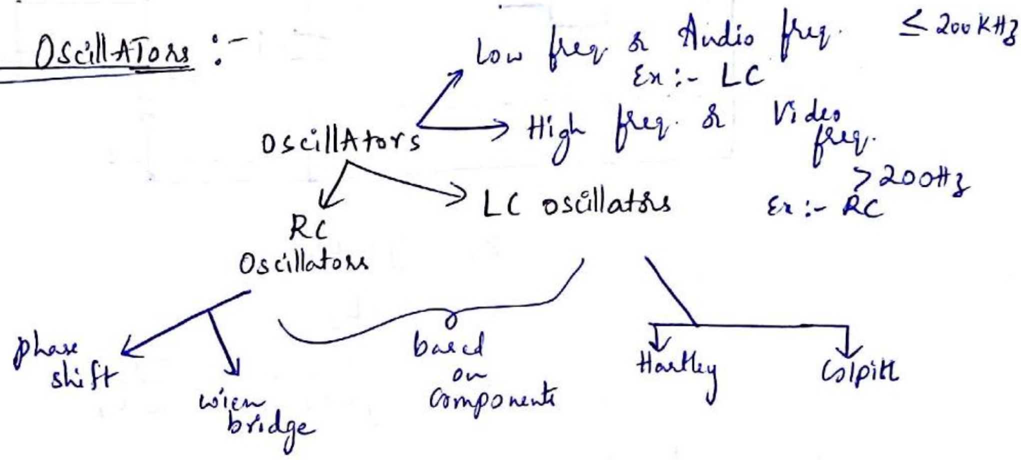
Types of Oscill

phase shift

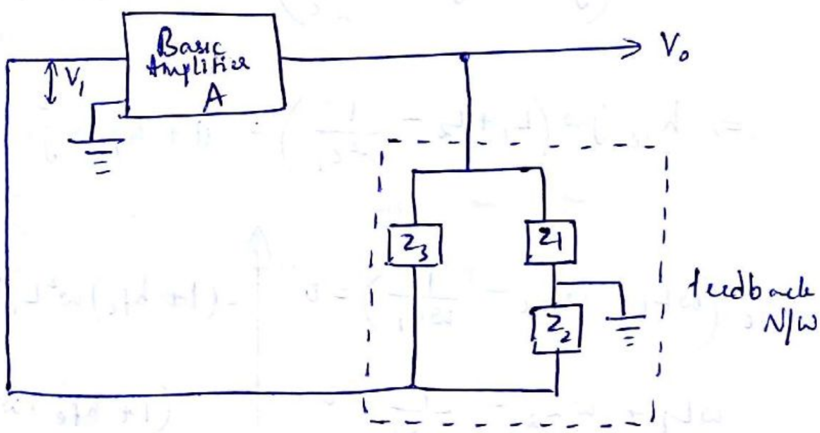
(1) Hartley

If the circuits of basic amplifier and feedback N/w provide $A\beta$, V_f can be made equal to V_i. Then when switch is closed and V_i is removed, the circuit will continue operating since the feedback voltage is sufficient to drive the amplifier.

<u>Types of Oscillators :-</u>



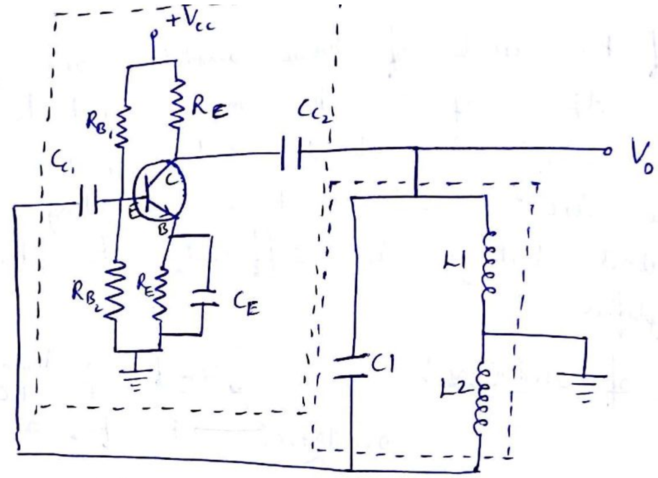
① Hartley Oscillator :-



$\left.\begin{matrix} Z_1 \\ Z_2 \end{matrix}\right\}$ Inductors

Z_3 Capacitor

Basic Amp → CE Amplifier



$$Z_1 = j\omega L_1$$
$$Z_2 = j\omega L_2$$
$$Z_3 = \frac{1}{j\omega C_1} = \frac{-j}{\omega C_1}$$

General freq. eq. is

$$h_{ie}(Z_1+Z_2+Z_3) + (1+h_{fe})(Z_1 * Z_2) + Z_1 Z_3 = 0$$

$$\Rightarrow h_{ie}\left(j\omega L_1 + j\omega L_2 - \frac{j}{\omega C_1}\right) + (1+h_{fe})(j\omega L_1 * j\omega L_2) + j\omega L_1\left(\frac{-j}{\omega C_1}\right) = 0$$

$$\Rightarrow h_{ie}\, j\omega\left(L_1 + L_2 - \frac{1}{\omega^2 C_1}\right) + (1+h_{fe})\, j^2\omega^2 (L_1 * L_2) + \frac{L_1}{C_1} = 0$$

$$h_{ie}\left(\omega L_1 + \omega L_2 - \frac{1}{\omega C_1}\right) = 0$$

$$\omega L_1 + \omega L_2 - \frac{1}{\omega C_1} = 0$$

$$\omega(L_1 + L_2) = \frac{1}{\omega C_1}$$

$$\omega^2 = \frac{1}{(L_1+L_2)C_1}$$

$$\omega = \frac{1}{\sqrt{(L_1+L_2)C_1}}$$

$$-(1+h_{fe})\omega^2 L_1 L_2 + \frac{L_1}{C_1} = 0$$

$$(1+h_{fe})\omega^2 L_2 = \frac{1}{C_1}$$

$$T = \frac{2\pi}{\omega}$$

$$\Rightarrow \frac{1}{f} = \frac{2\pi}{\omega}$$

$$\therefore \omega = 2\pi f$$

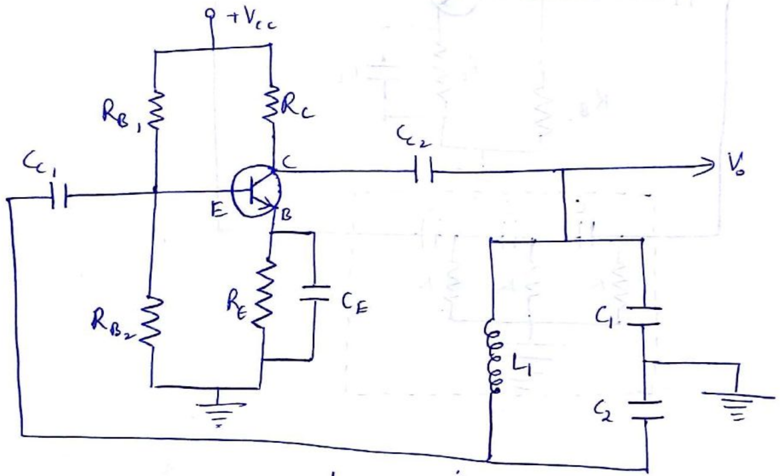
$$f_o = \frac{1}{2\pi\sqrt{(L_1+L_2)C_1}}$$

② Colpitt Oscillator :-

Z_1, Z_2 } Capacitors

Z_3 Inductor

Basic Ampli → CE Amplifier.



$$Z_1 = \frac{1}{j\omega C_1} = \frac{-j}{\omega C_1}$$

$$Z_2 = \frac{1}{j\omega C_2} = \frac{-j}{\omega C_2}$$

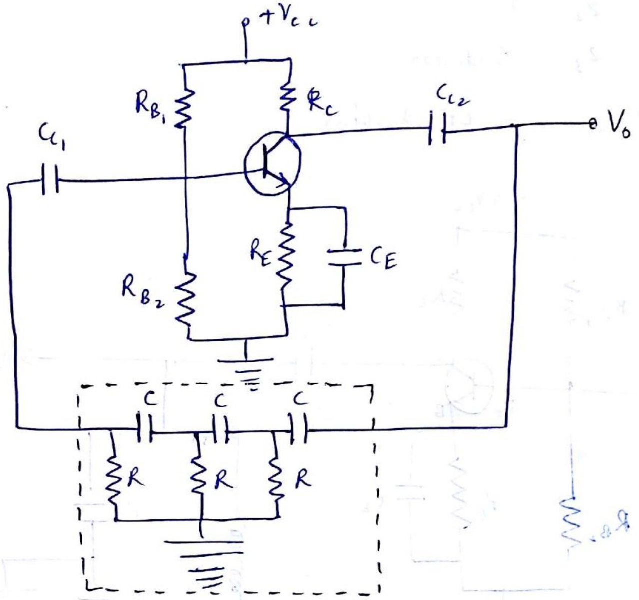
$$Z_3 = j\omega L_1$$

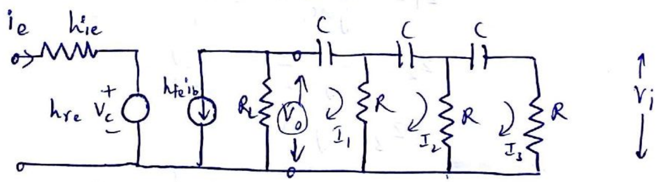
Substituting above values in General freq. eq., we get

$$h_{ie}\left(\frac{-j}{\omega C_1} - \frac{j}{\omega C_2} + j\omega L_1\right) + (1+h_{fe})\left(\frac{-1}{\omega^2 C_1 C_2}\right) + \frac{C_1}{L_1} = 0$$

$$\therefore \quad j\frac{1}{\omega}\left[\frac{1}{C_1} + \frac{1}{C_2}\right] = j\omega L_1$$

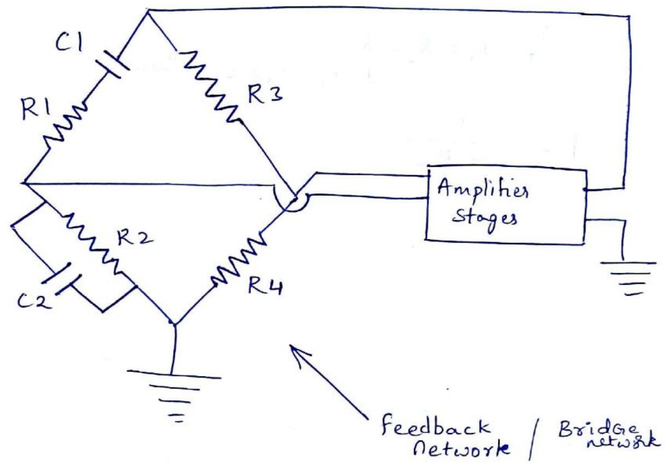
(3) RC Phase Shift





$$V_o = \frac{-j}{\omega C_1} I_1 + R(I_1 - I_2)$$

④ Wein Bridge Oscillator :-



① $\Rightarrow$ $R_1 - \frac{j}{\omega C_1}$

② $\Rightarrow$ $\dfrac{R_2(-j/\omega C_2)}{R_2 - \frac{j}{\omega C_2}}$

③ $\Rightarrow$ R_3

④ $\Rightarrow$ R_4

Under Bridge Balanced Condition

① × ④ = ② × ③

$$\left(R_1 - \frac{j}{\omega C_1}\right) R_4 = \frac{R_2(-j/\omega C_2)}{R_2 - \frac{j}{\omega C_2}} \cdot R_3$$

$$R_1 R_4 - \frac{R_4 j}{\omega C_1} = \frac{-R_2 R_3 j}{\omega C_2 \left(R_2 - \frac{j}{\omega C_2}\right)}$$

$$R_1 R_4 - \frac{R_4 j}{\omega C_1} = \frac{-R_2 R_3 j}{R_2 \omega C_2 - j}$$

$$\frac{R_1 R_4 \omega C_1 - R_4 j}{\omega C_1} = \frac{-R_2 R_3 j}{R_2 \omega C_2 - j}$$

Compare real parts

$$R_2 R_1 \cancel{R_4} \omega^2 C_1 C_2 - \cancel{R_4} = 0$$

$$\omega^2 = \frac{1}{R_1 R_2 C_1 C_2} \qquad \left[\because \omega = 2\pi f\right]$$

$$f = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}}$$

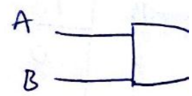
If $R_1 = R_2 = R$ and $C_1 = C_2 = C$ then

$$f = \frac{1}{2\pi R C}$$

1. Digital Syst
   a) LoG
   b) K-
   c) Ha
   d) Ha
2. Operational
   a) Id
   b) Su
   c) Di
   d) In
   e) Ins

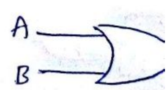
Logic Gates

(1) AND Gate



A
0
0
1
1

(2) OR Gate



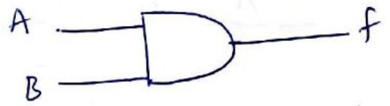
Unit IV

1. Digital System
   a) Logic Gates
   b) K-Maps
   c) Half Adder, full Adder
   d) Half Substractor, Full substractor

2. Operational Amplifiers
   a) Ideal & Practical characteristics
   b) Summer (Summing Amplifier)
   c) Differentiator
   d) Integrator
   e) Instrumentation Amplifier

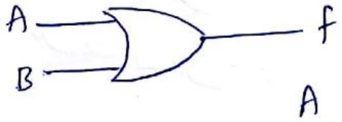
Logic Gates

(1) AND Gate



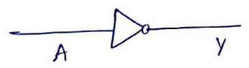
A	B	f
0	0	0
0	1	0
1	0	0
1	1	1

(2) OR Gate



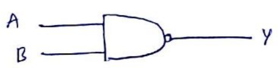
A	B	f
0	0	0
0	1	1
1	0	1
1	1	1

③ NOT Gate (Invertor)



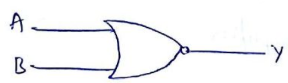
A	Y
0	1
1	0

④ NAND Gate



A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

⑤ NOR Gate



A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

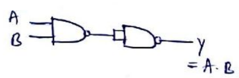
⑥ XOR Gate

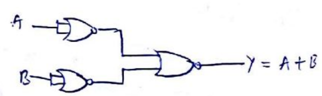
$Y = A \oplus B$
$= A\bar{B} + \bar{A}B$

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

Basic Gates | Using NAND | Using NOR

AND



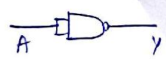


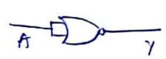
OR

3 no. of NAND gates

2. No. of NOR Gates

NOT





K– Maps

Two – variables $F(x, y)$

$x \backslash y$	0	1
0	00	01
1	10	11

$x \backslash y$	y'	y
x'	$x'y'$	$x'y$
x	xy'	xy

$x \backslash y$		
	m_0	m_1
	m_2	m_3

$$F(x, y) = \Sigma m(1, 2, 3)$$

$x \backslash y$		
	0	1
	1	1

$$F = x + y$$

Three Variables

$x \backslash yz$	00	01	11	10
0	000	001	011	010
1	100	101	111	110

$x \backslash yz$				
	$x'y'z'$	$x'y'z$	$x'yz$	$x'yz'$
	$xy'z'$	$xy'z$	xyz	xyz'

$x \backslash yz$				
	m_0	m_1	m_3	m_2
	m_4	m_5	m_7	m_6

$$F(x, y, z) = \Sigma m(0, 2, 4, 5, 6)$$

$x \backslash yz$	00	01	11	10
0	1			1
1	1	1		1

$$F = z' + xy'$$

$(A+B)' = A' . B' \longrightarrow$ De Morgan's Law.

Half Adder

↳ is a combinational circuit which performs binary addition of two bits and generates sum and carry.

DN	A	B	S	Carry
0	0	0	0	0
1	0	1	1	0
2	1	0	1	0
3	1	1	0	1

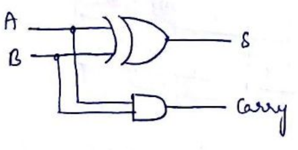
$S = \Sigma m(1, 2)$ $\text{carry} = \Sigma m(3)$

A \ B	0	1
0	$_0$	1 $_1$
1	1 $_2$	$_3$

A \ B	0	1
0	$_0$	$_1$
1	$_2$	1 $_3$

$S = A\bar{B} + \bar{A}B$ $\text{carry} = A.B$

$\therefore \boxed{S = A \oplus B}$ $\boxed{\text{Carry} = A.B}$



} Half Adder.

Full Adder

↳ is a combinational circuit, performs binary addition of three bits and generates sum and carry.

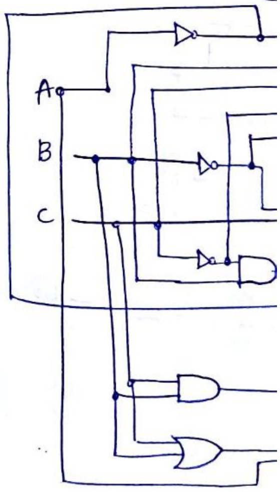
DN A B
0 0
1 0
2 0
3 0
4 1
5 1
6 1
7 1

$S = \Sigma m(1,$

A \ BC: 00 01 11

$S = AB'C' + AB$
$+ A'B'C +$

$= A(B'C' + B$
$+ A'(B$



DN	A	B	C	S	Carry
0	0	0	0	0	0
1	0	0	1	1	0
2	0	1	0	1	0
3	0	1	1	0	1
4	1	0	0	1	0
5	1	0	1	0	1
6	1	1	0	0	1
7	1	1	1	1	1

$S = \sum m(1, 2, 4, 7)$ $\qquad$ $Carry = \sum m(3, 5, 6, 7)$

A \ BC	00	01	11	10
0	(0)	1 (1)	(3)	1 (2)
1	1 (4)	(5)	1 (7)	(6)

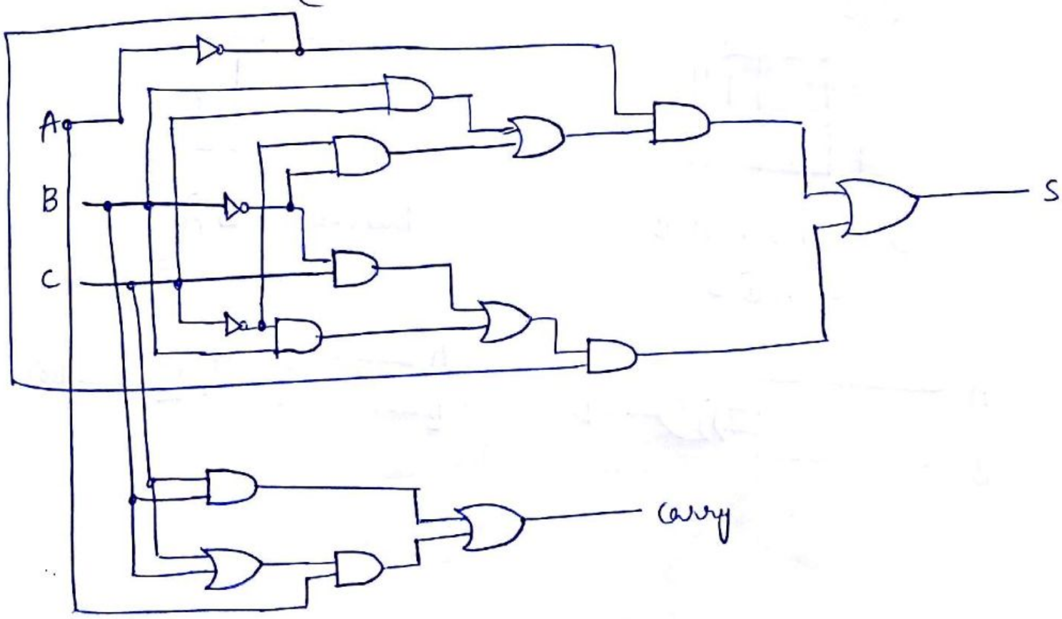
A \ BC	00	01	11	10
0	(0)	(1)	1 (3)	(2)
1	(4)	1 (5)	1 (7)	1 (6)

$S = AB'C' + ABC$
$\quad + A'B'C + A'BC'$

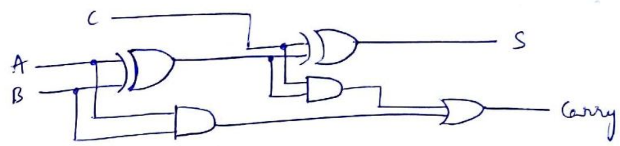
$= A(B'C' + BC)$
$\quad + A'(B'C + BC')$

$carry = AC + AB + BC$

$= A(B + C) + BC$



Full Adder Using Half Adder

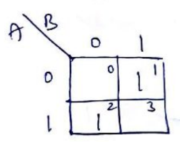


Half Substractor

↳ is a combinational circuit perform binary subtraction of two bits and generates difference and borrow.

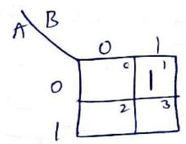
DN	A	B	D	Borrow
0	0	0	0	0
1	0	1	1	1
2	1	0	1	0.
3	1	1	0	0

$D = \Sigma m(1, 2)$

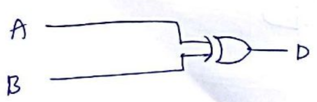


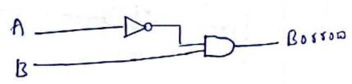
$D = A\bar{B} + \bar{A}B$
$= A \oplus B$

Borrow $= \Sigma m(1)$



Borrow $= A\bar{A}$
$= \bar{A}B$





Full Subtractor :-

↳ is a combinational circuit that performs binary subtraction of three bits and generates difference and borrow.

DN	A	B	C	D	Borrow
0	0	0	0	0	0
1	0	0	1	1	1
2	0	1	0	1	1
3	0	1	1	0	1
4	1	0	0	1	0
5	1	0	1	0	0
6	1	1	0	0	0
7	1	1	1	1	1

$D = \Sigma m(1, 2, 4, 7)$

A \ BC	00	01	11	10
0		1		1
1	1		1	

$D = AB'C' + ABC + A'B'C + A'(BC')$

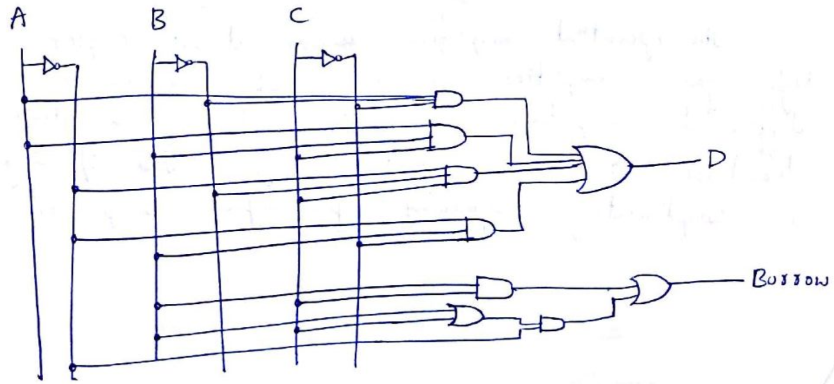
$= A(B'C' + BC) + A'(B'C + BC')$

$Borrow = \Sigma m(1, 2, 3, 7)$

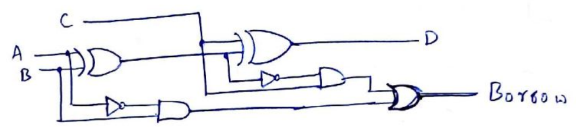
A \ BC	00	01	11	10
0		1	1	1
1			1	

Borrow $= A'C + A'B + BC$

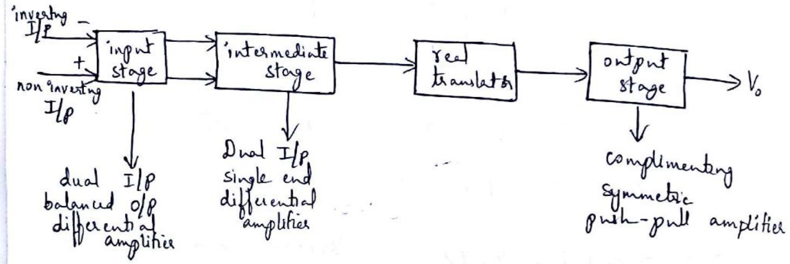
$= A'(B + C) + BC$

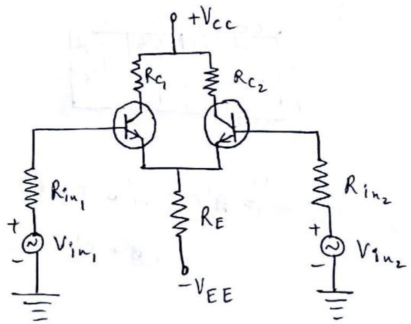


A full subtracts can realized using two half subtractors and a OR Gate



Operational Amplifier :-

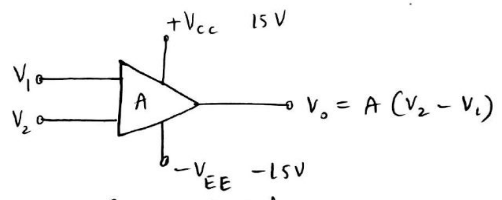




An operational amplifier is a direct coupled high gain amplifier consisting of one or more differential amplifiers and followed by a level translator and an output stage. The O/P stage is complimentary symmetry push-pull amplifier.

Ideal Characteristics :-

1. Voltage Gain A_v is infinite
2. I/p Resistance R_i is infinity
3. O/p resistance R_o is zero
4. O/p voltage is 0 when I/p voltage difference is 0
5. CMRR is infinity $= \frac{A_d}{A_c}$
6. SR is infinity $= \frac{dV_o}{dt}\Big|_{max}$
7. Bandwidth is infinity.



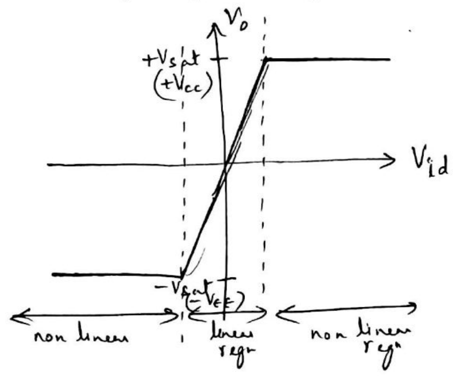
Symatic Symbol.

SR (Screw rate)

The max. rate of change of O/p voltage per unit time.

CMRR (Common Mode Rejection Ratio)

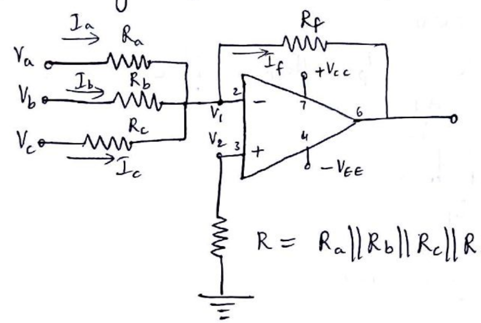
is ratio of differential gain to common mode gain



Transfer Characteristics

Applications :-

① Summing Amplifier



$R = R_a || R_b || R_c || R_f$

$A_V = \infty$

$\frac{V_{II}}{V_{id}} = \frac{1}{0}$

$V_{id} = 0$

$V_2 - V_1 = 0$

$V_1 = V_2$

$V_2 = 0V$

$\Rightarrow V_1 = 0V \quad \because [\quad]$

$R_i = \infty$ so current through inverting and non inverting is zero.

KCL at V_1

$I_a + I_b + I_c = I_f$

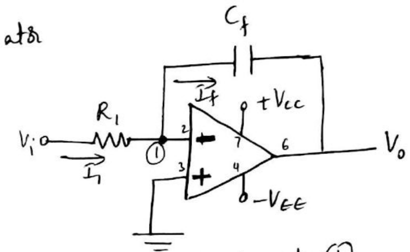
$$\frac{V_a}{R_a} + \frac{V_b}{R_b} + \frac{V_c}{R_c} = -\frac{V_o}{R_f}$$

$$\therefore V_o = -\left[\frac{R_f}{R_a} V_a + \frac{R_f}{R_b} \cdot V_b + \frac{R_f}{R_c} V_c\right]$$

If $R_f = R_a = R_b = R_c$ then

$$V_o = -\left[V_a + V_b + V_c\right]$$

② Integrator



$V_L = L \frac{di}{dt}$

$V_c = \frac{1}{c} \int i \, dt$

$I = c \frac{dV}{dt}$

From KCL at ①, we get

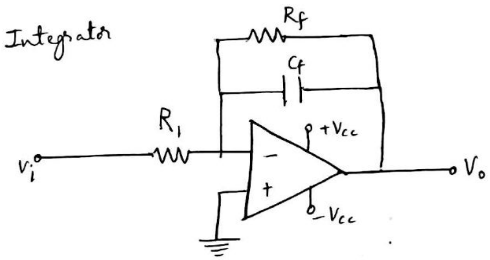
$$I_1 = I_f$$

$$\frac{V_i}{R_1} = -C_f \frac{dV_o}{dt}$$

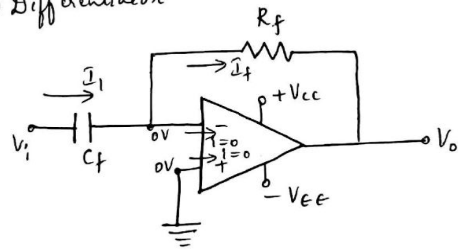
$$\frac{-V_i}{R_1 C_f} = \frac{dV_o}{dt}$$

$$V_o = -\frac{1}{R_1 C_f} \int V_i \, dt$$

Practical Integrator



③ Differentiator



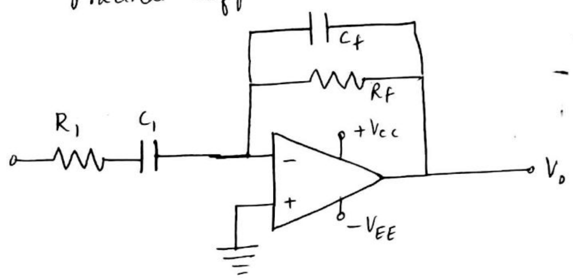
From KCL

$$I_1 = I_f$$

$$C_1 \frac{dV_i}{dt} = -\frac{V_o}{R_f}$$

$$V_o = -R_f C_1 \frac{dV_i}{dt}$$

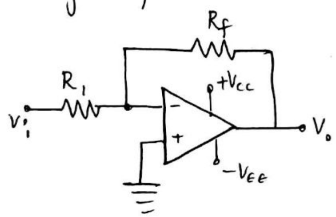
Practical differentiator



Configuration of Operational Amplifier :-

① Inverting Amplifier
② Non Inverting amplifier
③ Differential or difference amplifier
④ ________

① Inverting Amplifier

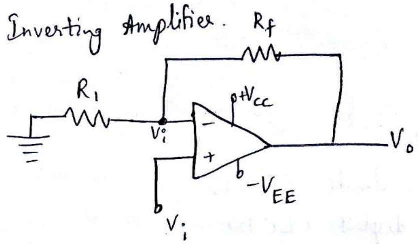


from KCL $\Rightarrow$ $I_1 = I_f$

$$\frac{V_i}{R_1} = -\frac{V_0}{R_f}$$

$$V_0 = -\left(\frac{V_i}{R_1}\right) R_f \Rightarrow -\left(\frac{R_f}{R_1}\right) V_i$$

② Non Inverting Amplifier.



$$V_i = V_o \frac{R_1}{R_1 + R_f}$$

$$\therefore V_o = V_i \left(\frac{R_1 + R_f}{R_1} \right)$$

$$\therefore V_o = V_i \left(1 + \frac{R_f}{R_1} \right)$$

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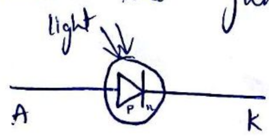
Unit V

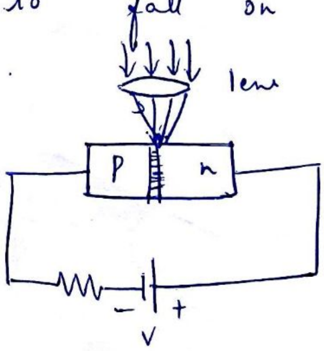
Special diodes
- i) Photo diode
- ii) Photo transistor
- iii) light emitting diode (LED)
- iv) liq. crystal display (LCD)
- v) Silicon Control Rectifier (SCR)
- vi) UniJunction transistor (UJT)

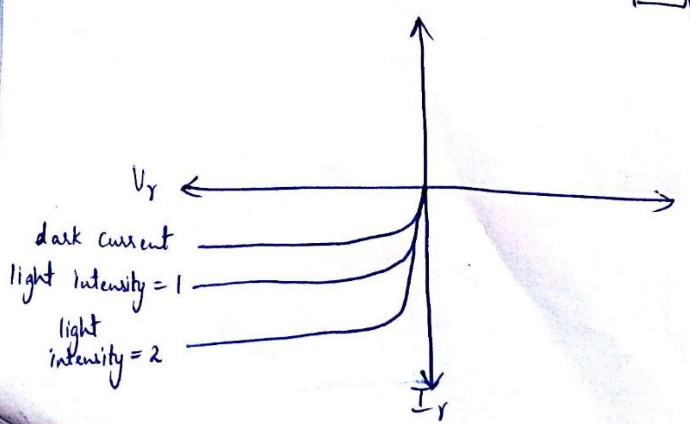
CRO and Applications
Study of Transducers

(1) Photo Diode :- (photo detector)

→ is a light sensitive device which converts light signals into electrical signals and operates with reverse bias. When a rev. biased p-n junctn is illuminated, the current varies linearly with the light flux. The diode is madeup of a semi-conductor p-n junctn kept in sealed plastic cover. The cover is designed so that the light rays are allowed to fall on one surface across the junction.





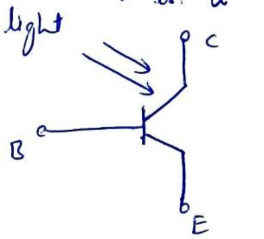


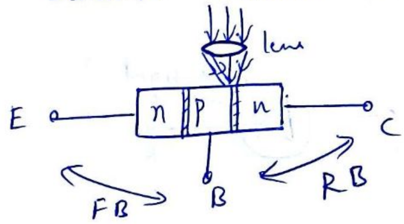
"dark current" is the rev. saturatn current with no applied illumination

Applications :- (i) Alarm systems (ii) Demodulation (iii) Counting Applications (iv) Char. recognition (v) encoders

② Photo transistor :-

→ is a light sensitive collector base p-n junctn

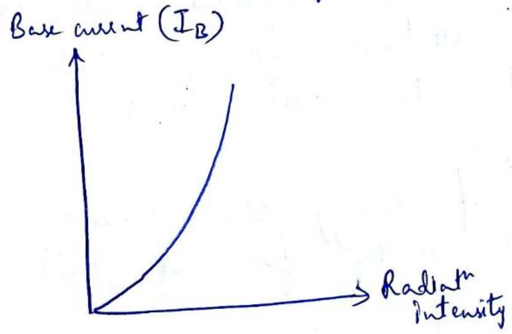




The main diff's. btwn photo transistr and photo diode are

i) The current generation in photo transistor is more than photo diode.

ii) A photo transistr is more sensitive than a photo diode, but it cannot turn on and off as fast.



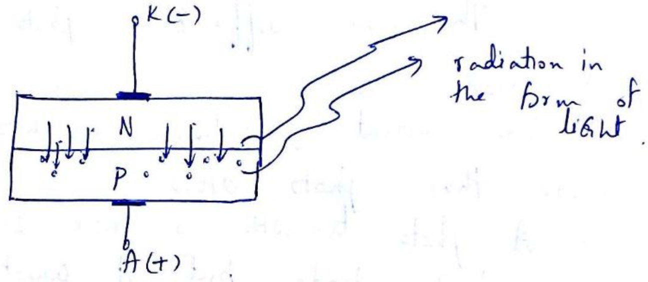
$$I_c = \beta I_B$$

Application :-

Same as that of photo diode.

③ LED

The operation of LED is based on phenomenon of electroluminence, which is the emission of light from a semi conductor under the influence of an electric field



When LED is frwd biased, the electrons and holes move towards the junction and recombinatⁿ takes place. After recombination the electrons lying in conduction bands of n-region fall into holes lieing in valancy band of p-region.

The difference of energy btwn conductⁿ and valency band radiated in the form of light energy.

The materials used are Galium Arscinite (GaAs), Galium Phosphite (GaP) and Galium Arsicinite Phosphite (GaAsP) for infrared, Green, Yellow colors respectively.

Applications :-
i) seven segment display
ii) Solid state video displays
iii) Alarm systems
etc

④ LCD.
↳ a li...
like a li...
molecular...
with solid...

layer (10μm...
two glass...
deposited...

10μm

Applications :-
i) digital...
ii) watc...
iii) LCD...
iv) Cellu...

⑤ Silicon Cont...

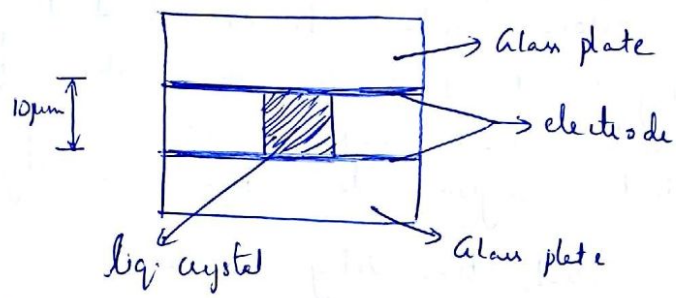
A

(Br... d... Volta...

④ LCD.

↳ a liquid crystal is a material which flows like a liq. at room temperature but whose molecular structure has some properties associated with solids.

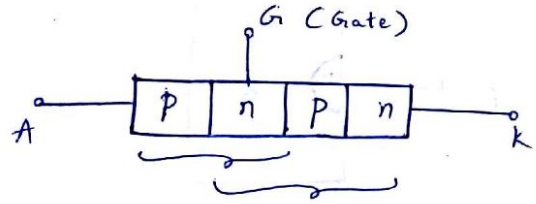
A liquid crystal cell consists of a thin layer (10μm) of liquid crystal sandwiched btwn two glass plates with transparent electrodes deposited on their inner surfaces (inside faces)

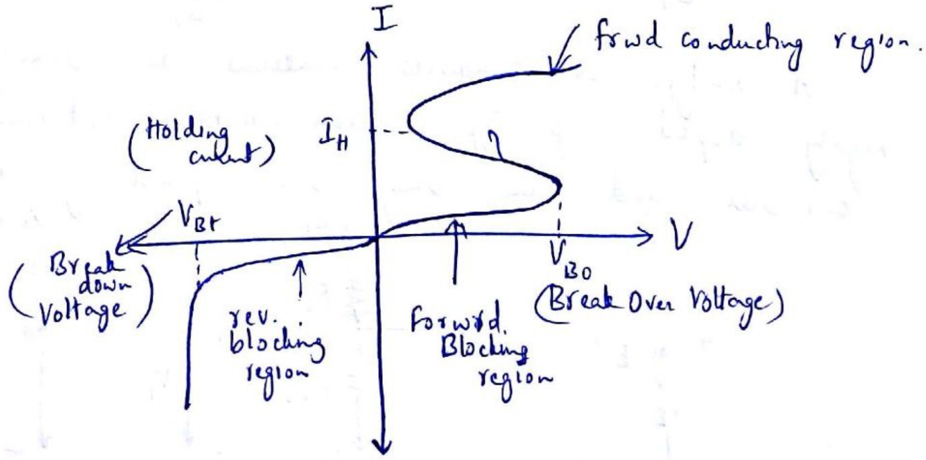


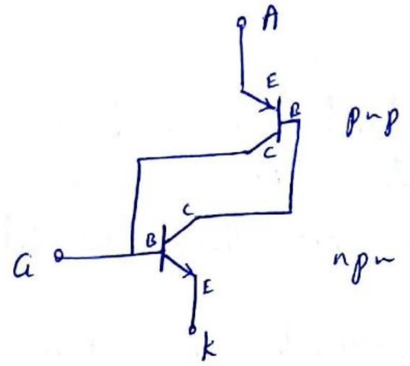
Applications :-

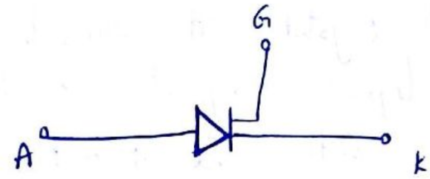
i) digital thermometers
ii) watches
iii) LCD monitors
iv) Cellular phone display

⑤ Silicon Controlled Rectifier :-







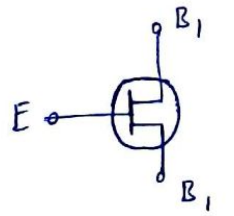


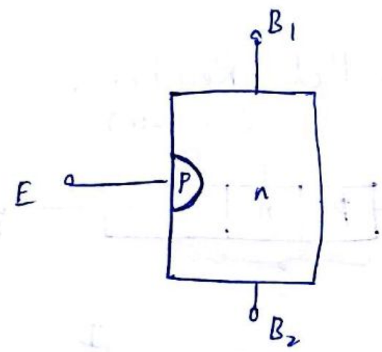
frwd breakover voltage (V_{Bo}) is the voltage above which the SCR enters into frwrd conductⁿ region

Holding Current (I_H) is the value of current below which the SCR switches from frwd conductⁿ region to frwd blocking region

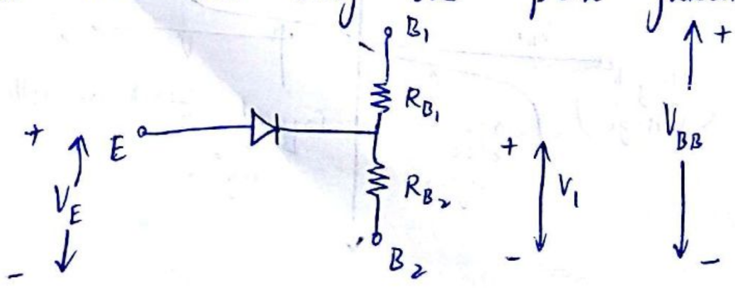
Applicatⁿs :
i) Relay control, time delay circuits
ii) Static switches
iii) Motor controlls
iv) Invertors
v) Battery chargers
vi) heater controls
etc.

⑥ UJT





A n-type semiconductor material is defused with highly doped p-type semiconductor material on one side and has only one p-n junction



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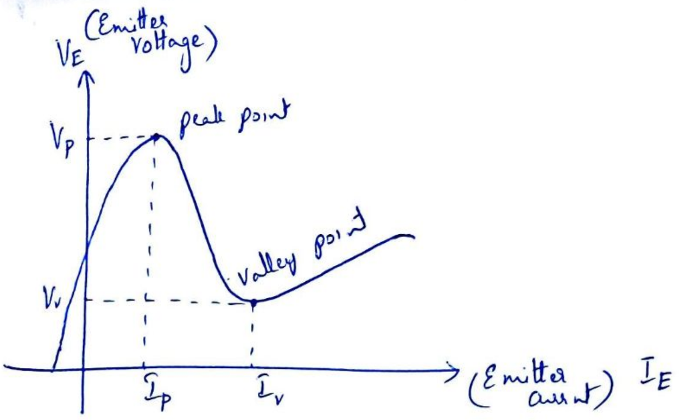

hich

$$V_1 = V_{BB}\left(\frac{R_{B_2}}{R_{B_2} + R_{B_1}}\right) = V_{BB}\,\eta \rightarrow \text{intrensic standoff ratio.}$$