B.Tech III Sem
Chemical Engg.

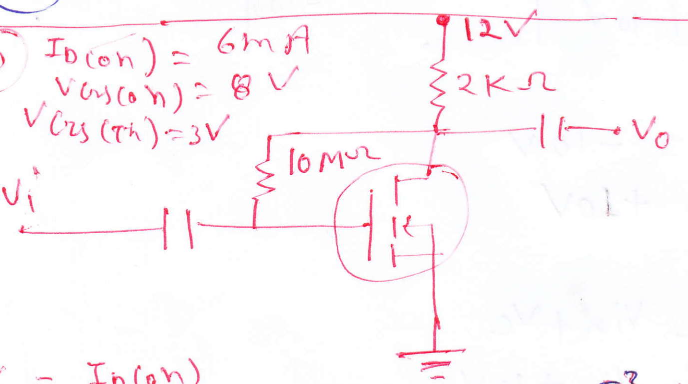
Solution End Sem Exam-2013

Basic Electronic Engineering

Section A

1. Very high
2. c – Low for bias greater than V_D and High for bias less than V_D
3. a – Unipolar
4. –ve – gate Voltage
5. Unity (1)
6. d – 2 μA
7. d – $I_{DSS}/4$
8. a – increase
9. c – SCR
10. a – Varing, width

(10) $I_{D(on)} = 6\,mA$
$V_{GS(on)} = 8\,V$
$V_{GS(Th)} = 3V$

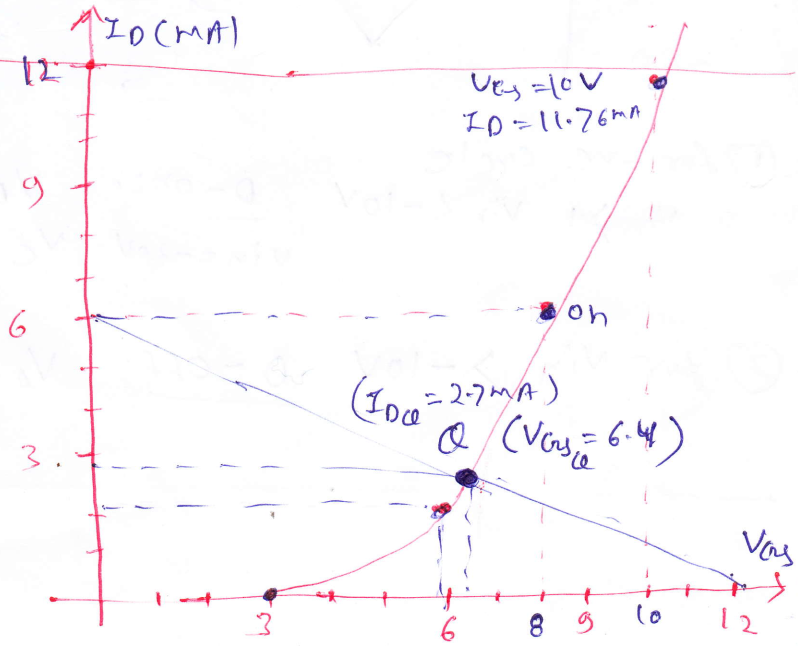


$$K = \frac{I_{D(on)}}{(V_{GS(on)} - V_{GS(Th)})^2} = 0.24 \times 10^{-3}\,A/V^2$$

$$I_D = K\,(V_{GS} - V_{Th})^2$$

$V_{GS} = 6V \rightarrow I_D = 2.16\,mA$

$V_{GS} = 10V \rightarrow I_D = 11.76\,mA$

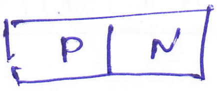


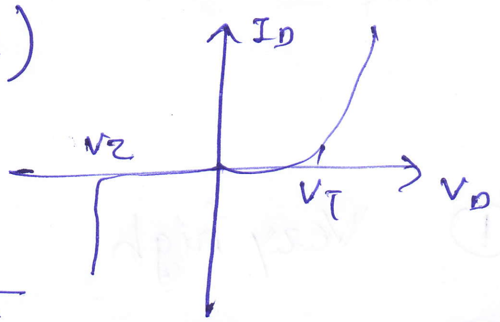
Unit – I

(2) **PN J^n Diode:-**

working. $I_D = I_s(e^{\frac{nV_D}{T}} - 1)$

construction Detail





V-I charac. F.B. $V_D = +ve$

R.B $V_D = -ve$

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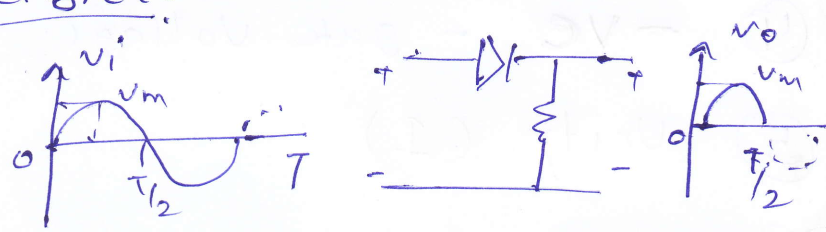
(3) **Half wave Diode rectifier:-**

application:- switch



$V_{dc} = 0.318(V_m - V_T)$

PIV $\geq V_m$

drawback:- $\eta \leq 50\%$.

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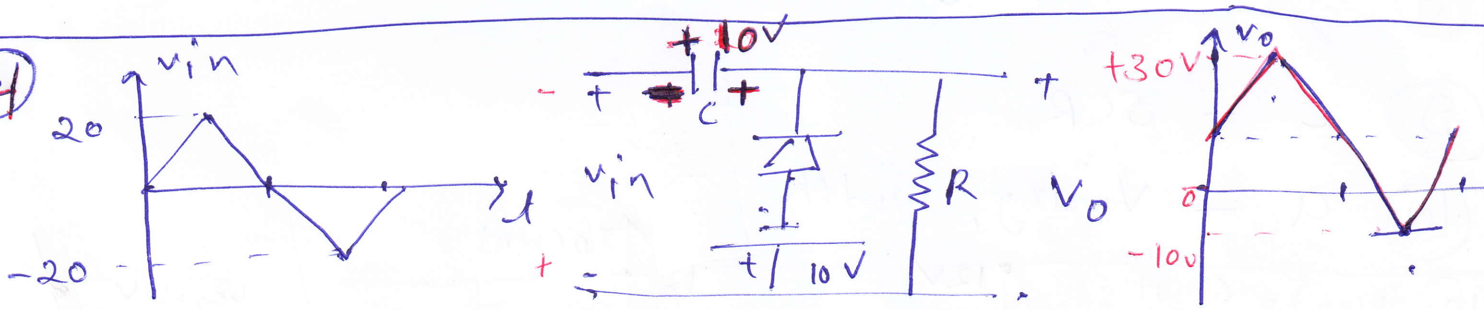
(4)



(1) for -ve cycle $V_{in} < -10V$ D-on:. $V_D = -10V$

$v_{in} = -20V$ $V_C = +10V$

(2) for $V_{in} > -10V$ D-off. $V_0 = V_{in} + V_C$

$= V_{in} + 10V$

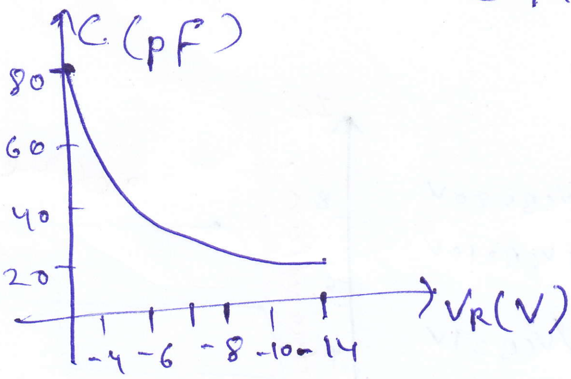
Unit - II

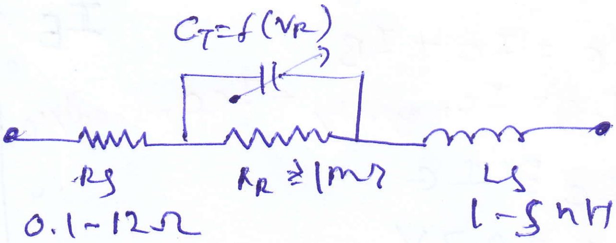
(5) Varactor Diode:-

As RB potential increase in PN J^n the width of depletion region increases which in turn reduces the transition capacitance.

$$C_T = \epsilon \frac{A}{W_d} = \frac{K}{(V_T + V_R)^n}$$

K = const.
V_T = cutin voltage.
V_R = RB voltage
$n = \frac{1}{2}$ for alloy J^n & $\frac{1}{3}$ for diffused J^n.



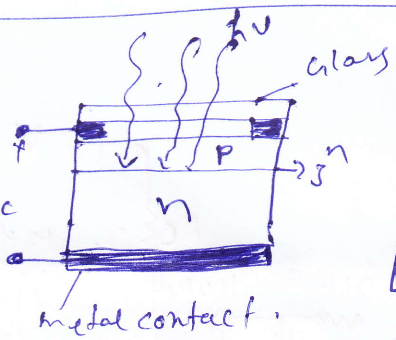


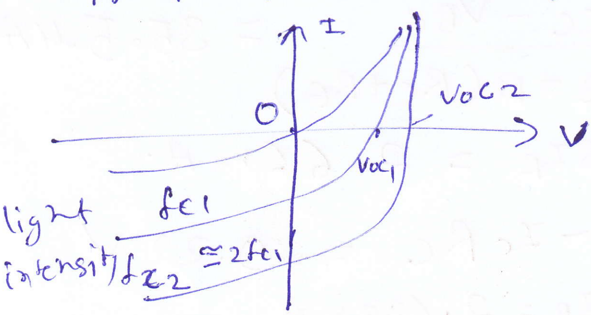
capacitance temp. co-efficient

$$TC_C = \frac{\Delta C}{C_0 (T_1 - T_0)} \times 100\%$$

(6) Photo Voltaic effect:- (Solar cell)

Photon light collide with a valence e⁻ and impart to it sufficient energy to leave the parent atom.
Generated e⁻ - hole pair increase the minority carrier flow which is opposite in direction to forward bias current.



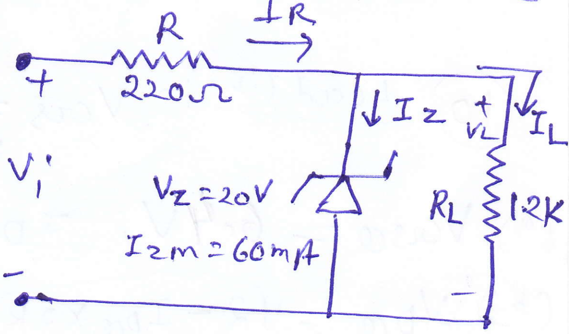


$$V_{max} = \eta V_T \ln\left(1 + \frac{I_s}{I_o}\right)$$

Photovoltaic emf = 0.5 Si
0.1 Ge

$\frac{I_s}{I_o} \gg 1$

(7) Range of V_i for that zener in on state:



$$V_{imin} = \frac{(R_L + R)V_Z}{R_L} = \boxed{23.67\,V}$$

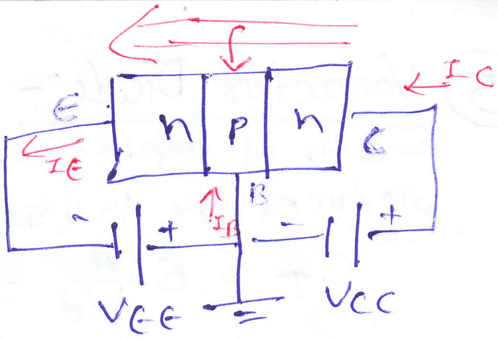
$$I_L = \frac{V_L}{R_L} = \frac{V_Z}{R_L} = 16.67\,mA$$

$$I_{Rmax} = I_{ZM} + I_L = 76.67\,mA.$$

$$V_{imax} = I_{Rmax} R + V_Z = \boxed{36.87\,V}$$

Unit - IV

(8) npn - BJT CB mode:-



(a) Basic Construction (with dia)
(b) Operation
(c) I/p & o/p charc.
(d) current component in Transistor

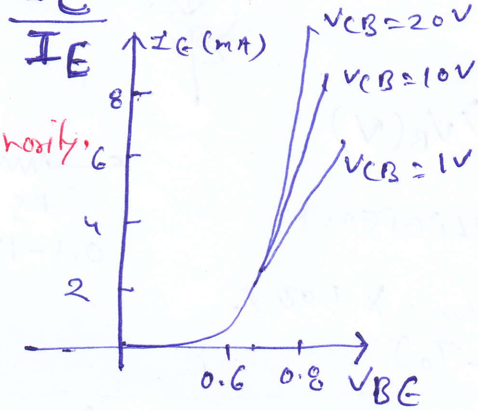
(e) current gain $\alpha = \frac{I_C}{I_E}$

$I_E = I_C + I_B$

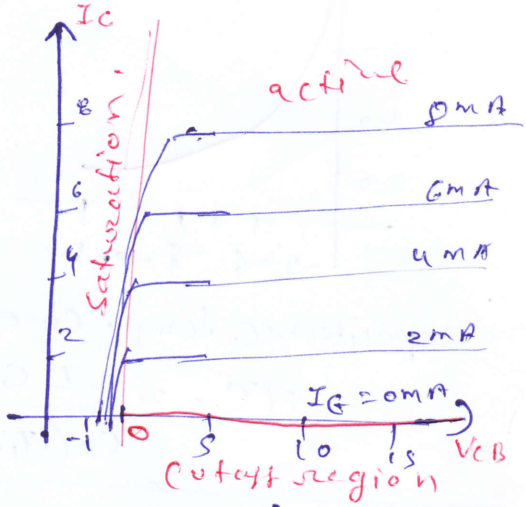
$I_C = I_{C\,majority} + I_{CO\,minority}$

$I_C \cong I_E$

$V_{BE} = 0.7V$

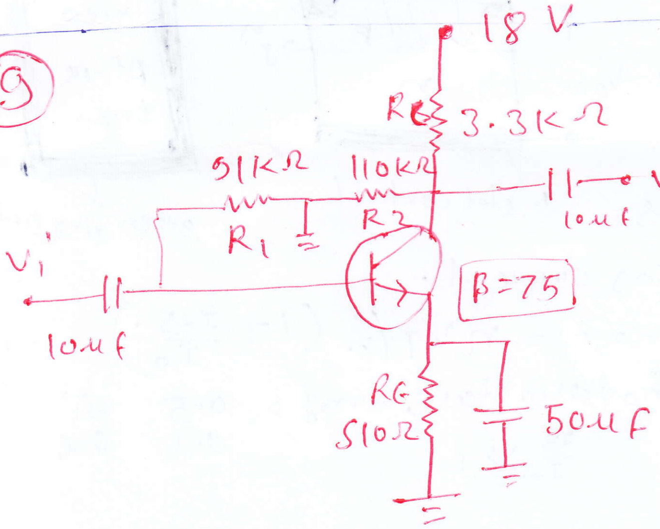


(I/p)



(o/p)

(9)



$V_{CE} = V_C - V_E = 7.845V$

$V_{CB} = V_C - V_B = 7.145V$

$I_B = 35.5\mu A$

$I_B = \frac{V_{CC} - V_{BE}}{R_B + \beta(R_C + R_E)} = 35.5\mu A$

$I_C = \beta I_B = 2.66mA.$

$V_C = V_{CC} - I_C R_C = 9.22V$

$I_E = (1+\beta) I_B = 2.698mA$

$V_E = R_E I_E = 1.375V.$

(10) Load line:- $V_{GS} = V_{DD} - I_D R_D$
$= 12V - I_D (2K\Omega)$

$I_D = 0 \Rightarrow V_{GS} = 12V$

$V_{GS} = 0 \Rightarrow I_D = 6mA$

(a) $V_{GSQ} = 6.4V$, $I_{DQ} = 2.75mA$

(b) $V_{DQ} = 12 - I_{DQ} \times 2k\Omega \simeq 6.4V = V_{GSQ}$

(c) $V_{DS} = V_D - V_S = 6.4V$

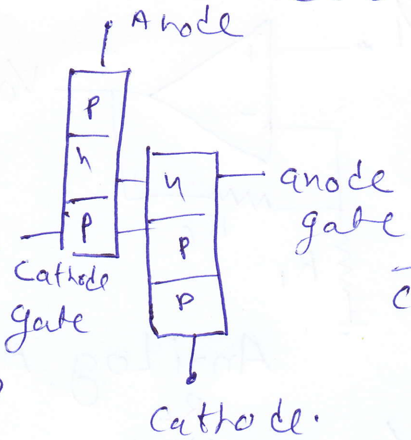
(d) $V_S = 0V$

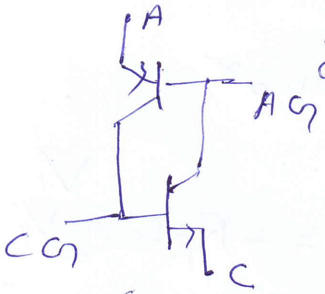
(e) $V_G = V_D = 6.4V$

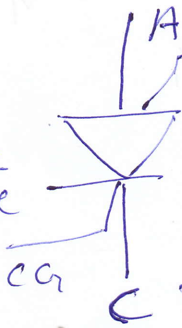
Unit - IV

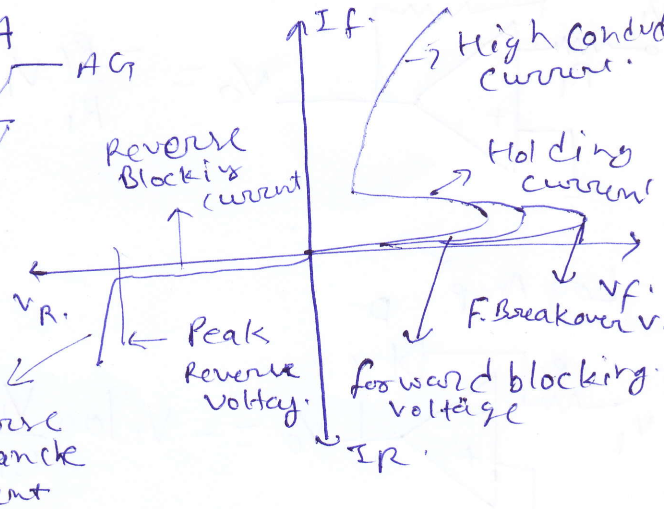
(11) SCS :→ Similar to SCR 4th terminal allow more control to be exerted over the device.

construction
working
charac.
application





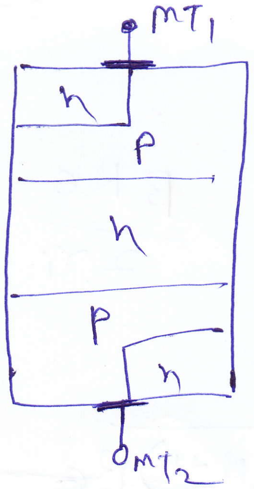


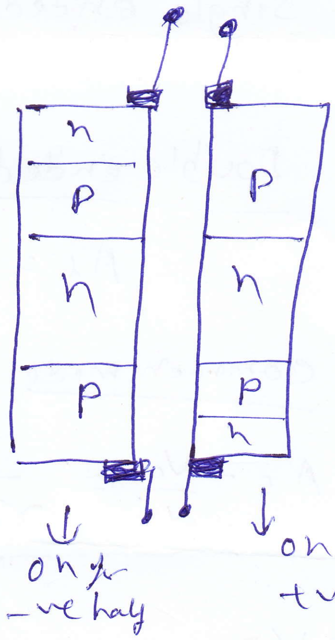


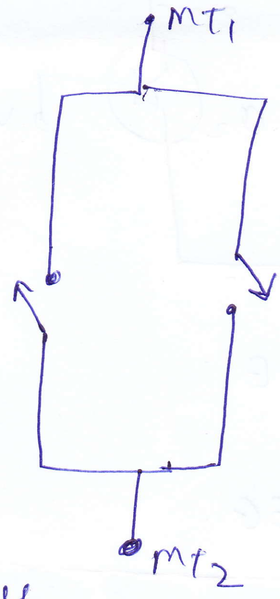
Particularly in the mode of forced commutation where an external signal forces it to turn off while the main current through the device has not yet fallen below.

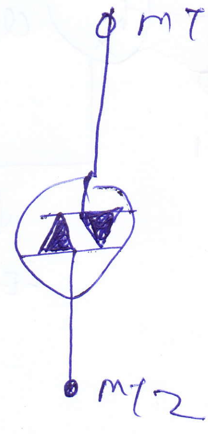
Rectifier, static contactor, Power & Speed control.

(12) DiaC :→ Two terminal bidirectional Semiconductor devices.

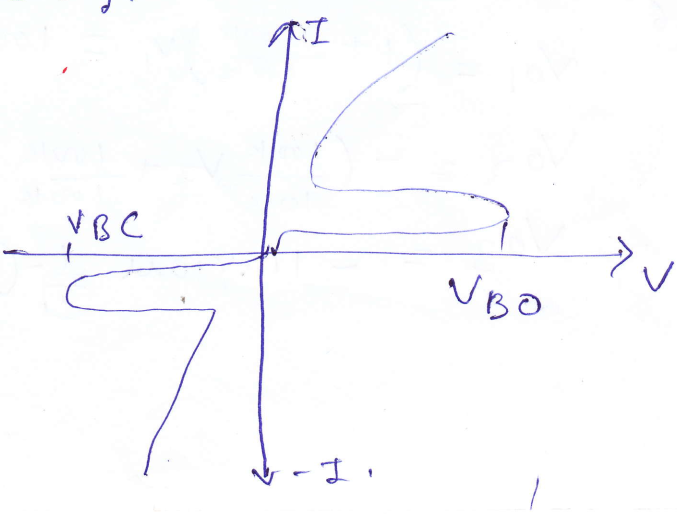






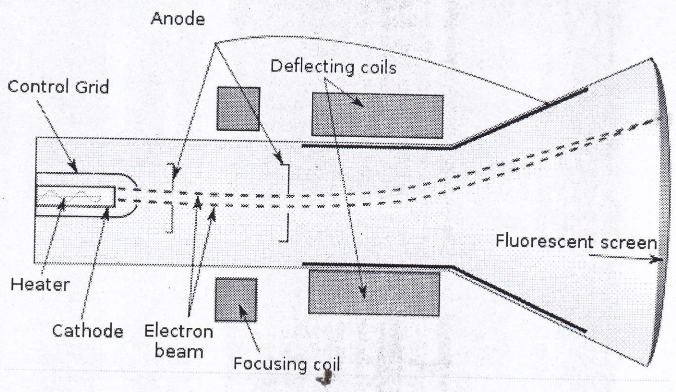


application :- Fan Regulator



(13) CRT :-

Functions of a Cathode Ray Tube and its Applications



Parts of a CRT

- The features of a CRT can be split into 3 main sections: The **electron gun**, the **deflection system** and the **fluorescent screen.**

Electron Gun

- The role of this section is to **produce electrons** at a **high, fixed, velocity**.
- This is done through a process known as **thermionic emission.**
    - A filament in the **cathode** is heated to the point where its **electrons become loose.**
    - An **anode** with a **high voltage** applied to it **accelerates** the electrons towards the screen due to **electrostatic attraction.**
    - On the way, the electrons pass through a series of **control grids** which control the **brightness** of the image produced.
        - The more negative the grid, the darker the image and vice versa.

Deflection system

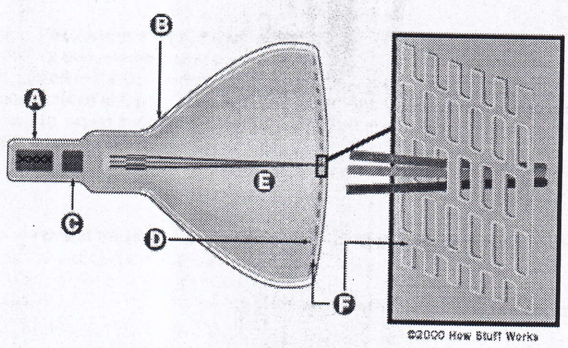
- The role of the deflection system is to **control** the **image produced** by controlling the **position** that the electrons hit the screen.
- It consists of **Two PERPENDICULAR sets** of **Electric/Magnetic fields**.
    - This allows control over both **horizontal and vertical** axes.
    - By controlling the **Voltage applied to the fields**, it is possible to vary the deflection through **Electrostatic force/Motor effect.**

Fluorescent screen

- The role of this part is to **display** where the electrons are hitting the CRT.
- It is a screen coated with a material that **emits light when struck** by electrons.
    - Zinc sulfide or Phosphorus are two commonly used materials.

Applications

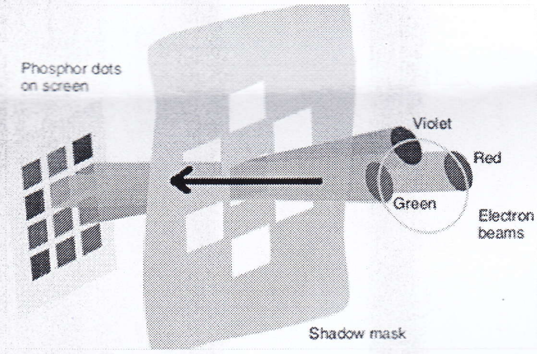
Televisions



- Before LCD or Plasma television, the CRT was used to create a moving image.
- It used the same principle as a CRT, and for **Black and White** televisions, that worked fine.
    - B&W TVs were essentially the same thing as a CRT, as all that's needed is the control of the brightness of the beam.
- A CRT TV works by having the electron beam **"scan"** the screen at an **rate faster than our eyes can perceive.**
    - This means that it shoots across the screen like a machine gun, and the images we see are actually made from many **fluorescent dots.**
    - The fluorescence caused by the beam striking the screen **lasts a bit longer** so that the next scan can be made without the previous image disappearing.
    - It scans twice each time, first filling in the odd "holes" then the even ones.

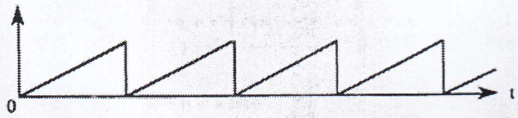
- Each scan is about 1/50 of a second.
- Colour CRT TVs had **3 electron guns** rather than a single one, a **shadow mask**, and a **modified fluorescent screen**.
- The 3 electron guns were needed as there were **three primary colours** (Red, Green and Blue) that could be adjusted in different amounts to create any colour.

- The colours are formed as a result of the **shadow mask**, which is a layer with holes in it that **controls the angle** of the incoming electron beams.
  - This is because the fluorescent screen is separated into **multi-coloured phosphors** that are placed adjacent to each other at small intervals.
  - Thus it isn't actually a single coloured pixel, but rather 3 very small pixels that join together to form a larger dot.



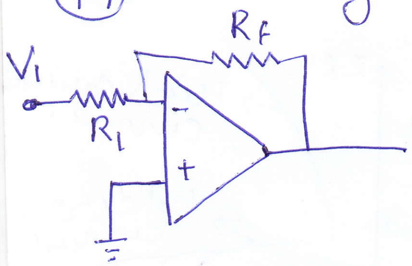
Cathode Ray Oscilloscopes

- A Cathode Ray Oscilloscope (**CRO**) is a diagnostic device that allows one to **"see" voltage.**
- It is essential a Cathode Ray Tube with two perpendicular sets of **deflecting electric plates**.
- The vertical set is where an input voltage is plugged in for the oscilloscope to display.
- However, the horizontal set is connected to a "sweep generator"
  - This is what provides a **constant, but adjustable, timebase** for the sweeping.
  - It essentially creates a "sawtooth voltage."
  - This is what causes the image to be **animated**, and measured with a linear scale.



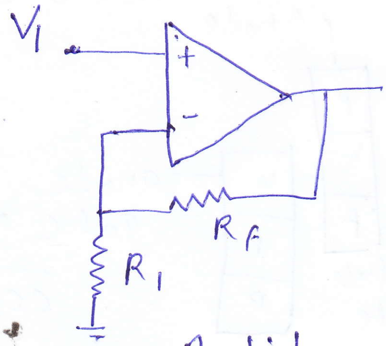
Unit-V

(14) Inverting Ampr



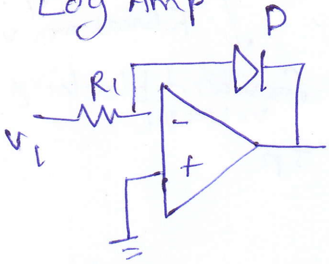
$$V_o = -\frac{R_f}{R_1} V_1$$

Non inverting Ampr



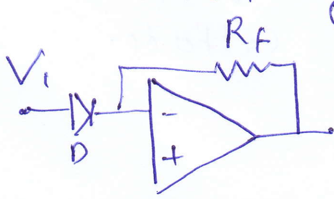
$$V_o = \left(1 + \frac{R_f}{R_1}\right) V_1$$

Log Ampr



$$V_o = -V_T \log \frac{V_1}{I_S R_1}$$

Anti Log Ampr



$$V_o = -R_f I_s e^{\frac{V_1}{V_T}}$$

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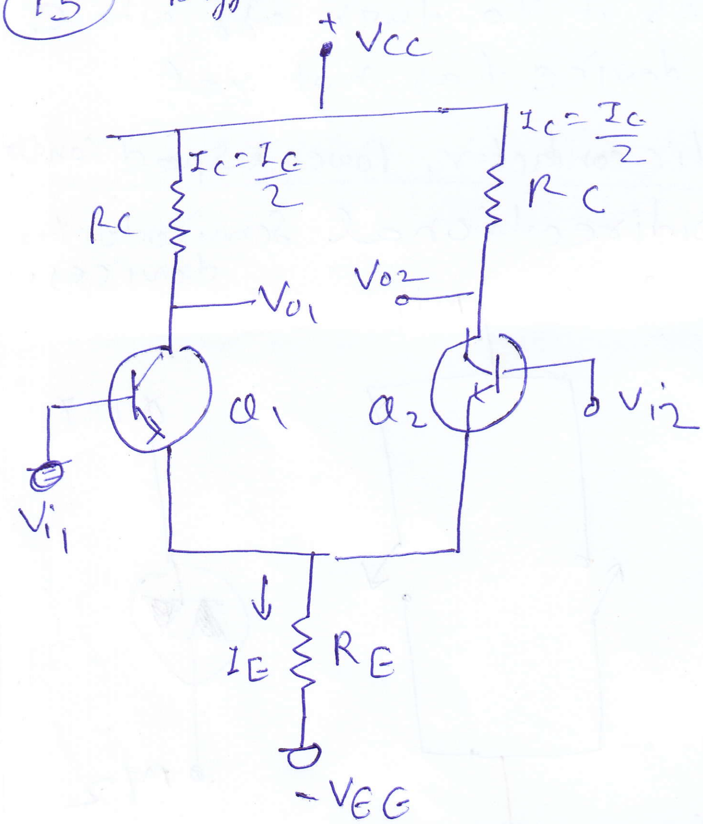
(15) Differential Ampr:-



DC Bias:-

$$V_{o1} = V_{o2} = V_{CC} - I_C R_C$$
$$= V_{CC} - \frac{I_E}{2} R_C$$

AC Operation:-

Single ended: $A_v = \frac{V_o}{V_{i1}} = \frac{R_C}{2r_e}$

Double ended:-

$$A_d = \frac{V_o}{V_d} = \frac{\beta R_C}{2 r_i}$$

Common mode

$$A_c = \frac{V_o}{V_i} = \frac{\beta R_C}{r_i + 2(\beta+1) R_E}$$

---

(16)

$$V_{o1} = \left(1 + \frac{9900k}{100k}\right) V_1 = 100 V_1$$

$$V_{o2} = -\left(\frac{100k}{10k} V_2 + \frac{100k}{100k} 100 V_1\right) = -(100 V_1 + 10 V_2)$$

$$V_{o3} = -1M \times 10\mu \frac{d}{dt}(100 V_1 + 10 V_2) = 1000 \frac{dV_1}{dt} + 100 \frac{dV_2}{dt}$$