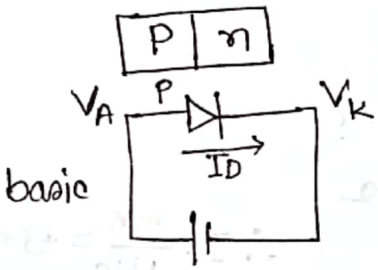
Date: 08-09-2019

Diode:
BJT:
FET:
MOSFET

Reffered Book: Micro electronics
→ Sedra & Smith
Electronics Devices
→ Boylested

#Diode:



Ge, Si, type semiconductor

Ideal diode

$V_A > V_K$ → diode on ($I_D \neq 0$)

$V_A < V_K$ → diode off ($I_D = 0$)

Here, I_D = Diode current

⟹ Diode এর ক্ষেত্রে (Ideal diode) হলে প্রথমে Anode voltage & kethod voltage check করতে হবে, যে কে বড় আর কে ছোট

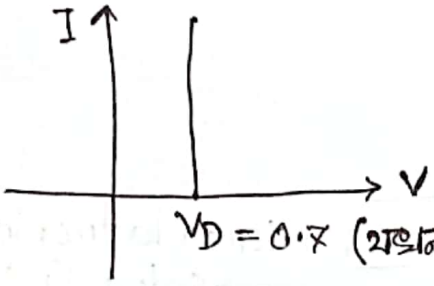
Again, For Silicon (Si) diode

$V_D = 0.7\,V$

Fo Ge diode,

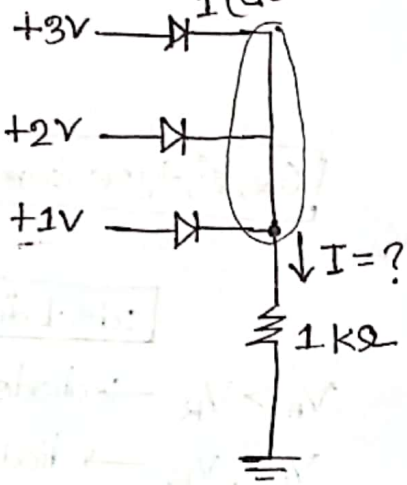
$V_D = 0.3V$

Note: Anode এর চেয়ে kethode এর voltege বেশি থাকলে diode off হয়ে যাবে।



$V_D = 0.7$ (যখন diode on -থাকে) Si type এর ক্ষেত্রে

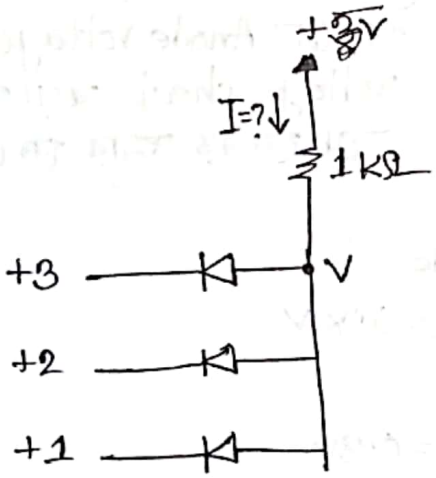
Q.



ধরে নিচ্ছি যে diode টি Ideal type

$\therefore I = \frac{3V}{1k\Omega} = 3mA$

Q:



AND application

lets, I = 0

suppling voltage = +5

I=0 so voltage drop হবেনা,

I=0mA

V=5V

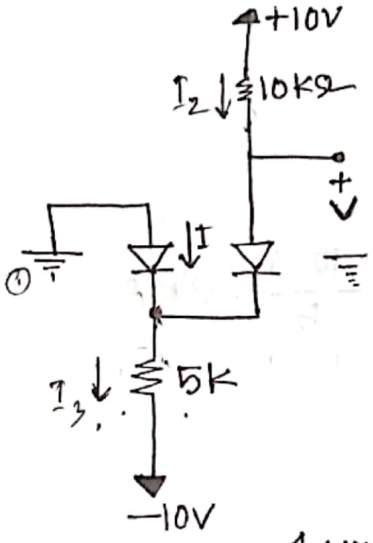
OR Appliation

3V ধরা হলে

$V = 3V$, $V_S = 5V$

$\therefore i = \frac{5-3}{1} = 2mA$

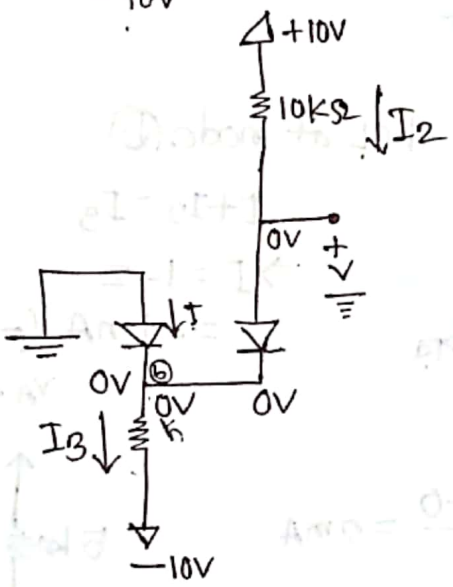
Problem:



V=?, I=?

assume, both diode are conducted

Solve:



Applying KCL at node b

$I_3 = I + I_2$

$\Rightarrow I = I_3 - I_2$

$= 2 - 1$

$= 1\ mA$

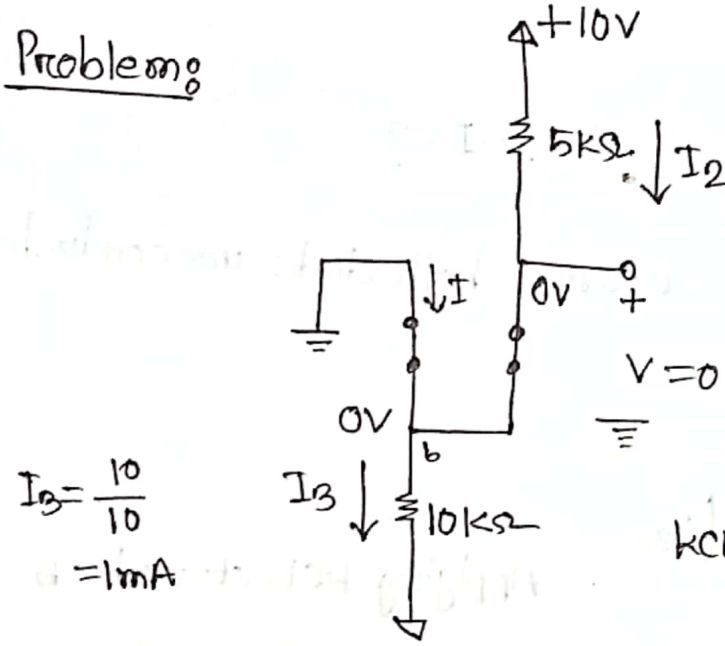
and, V = 0V

$$I_3 = \frac{0-(-10)}{5} = 2\ mA$$

$$I_2 = \frac{10-0}{10} = 1\ mA$$

Note: যদি I=0 হয় তাহলে diode টি incorrect/False

Problem:



KCL at node (b)

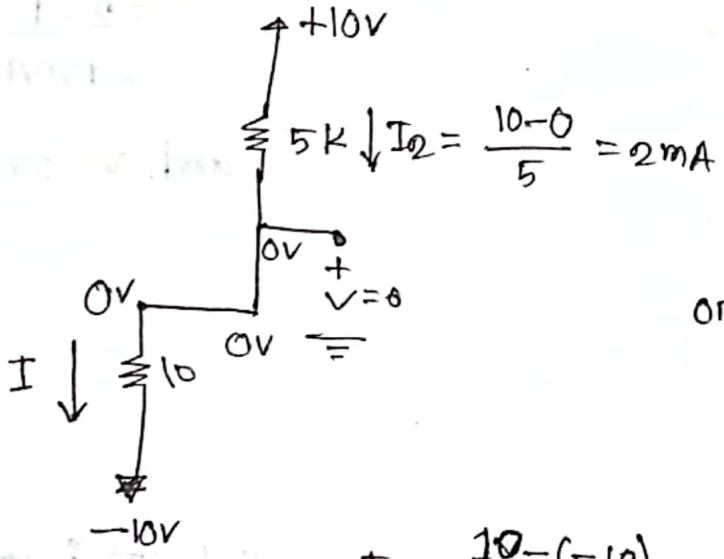
$I + I_2 = I_3$

$\Rightarrow I = 1 - 2$

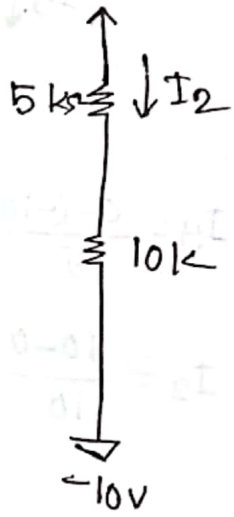
$= -1mA$ (-1) হওয়াতে

$V_A < V_K$ (বাস 2 হওয়াতে)

Problem: Diode Pt off হওয়ার পর



or



$$I_2 = \frac{10-(-10)}{10+5} =$$

$$= \frac{10+10}{15}$$

$$= 1.33$$

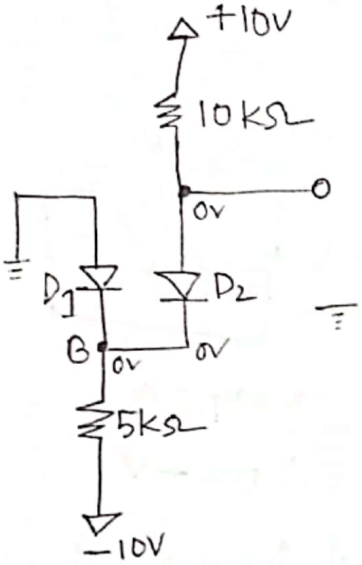
Again, $I = \frac{V-(-10)}{10} = 1.33$

$\Rightarrow V + 10 = 13.3$

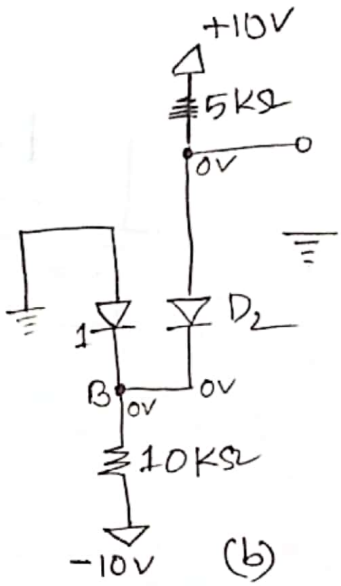
$\therefore V = 3.3\ V$

$I = 0$
$V = 3.3V$
(Ans)

Example 9.2: Assuming the diodes to be ideal, find the value of I and V in the circuits.



(a)



(b)

(a) $\therefore I_{D2} = \frac{10-0}{10} = 1\,mA$

at node B: $I+1 = \frac{0-(-10)}{5}$ $\therefore I = 1\,mA$

(b) $I_{D2} = \frac{10-0}{5} = 2\,mA$

at node B: $I+2 = \frac{0-(-10)}{10}$ $\therefore I = -1\,mA$

Since, this is not possible, our orginal assumption is not correct. We start again D_1 is of and D_2 is on.

$$\therefore I_{D2} = \frac{10-(-10)}{15} = 1{\cdot}33\,mA$$

and the voltage in node B, $V_B = ?$

$$I = \frac{V_B-(-10)}{10} = 1{\cdot}33$$

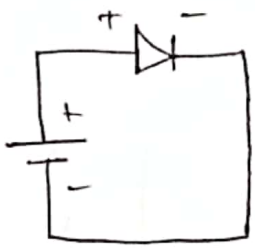
$$\Rightarrow \frac{V_B+10}{10} = 1{\cdot}33$$

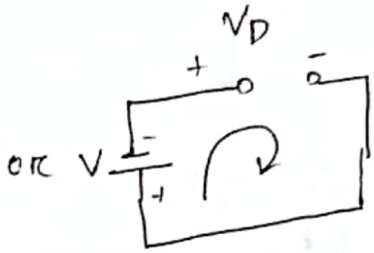
$$\therefore V_B = 3{\cdot}3V$$

03-10-2019 | 03-11-2019

Diode

Rectifier:





$V + V_D = 0$

$V_D = -V$

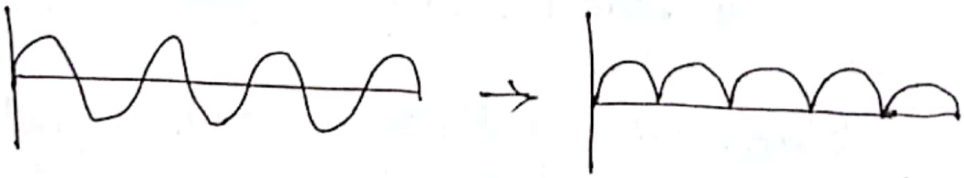
Peak inverse voltage (PIV)

↓ $= V$ (ignore -ve sign)

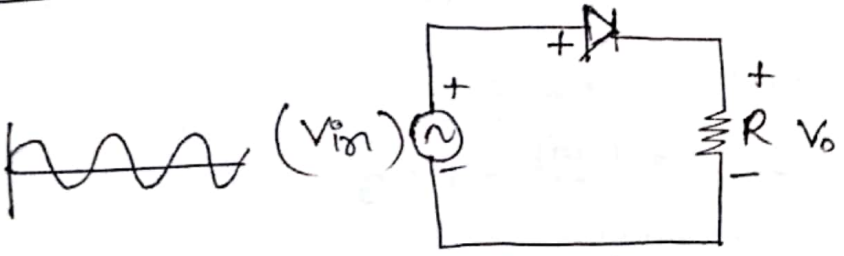
diode এর Maximum volt এর বেশি হলেই diode পুড়ে যাবে।

AC voltage → DC voltage করার জন্য Rectifier দরকার

Rectification → একমুখীকরন।

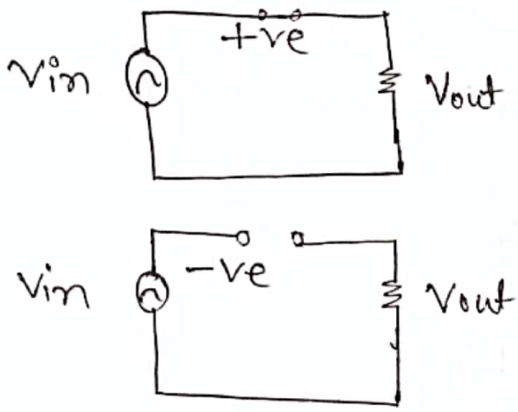


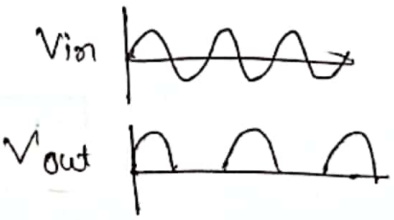
half wave Rectifier :



এখানে diode এ + voltage মানে forword bias মানে input এ যা দিলাম তা ই output হবে

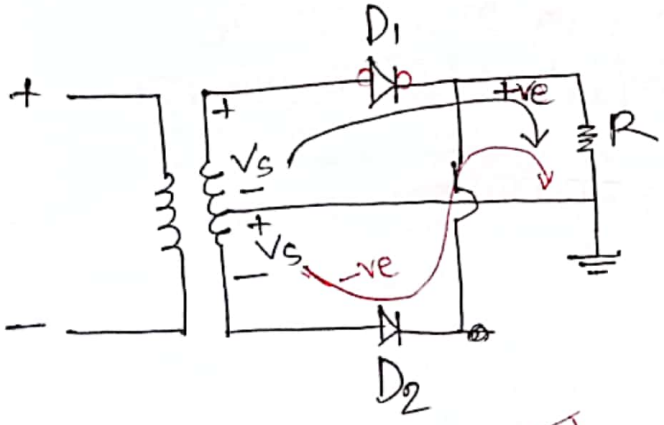
when volt (+ve) or +half cycle:





Q. draw the circuit diagram of ~~a~~ diode with input output voltage.

Full wave Rectifier:



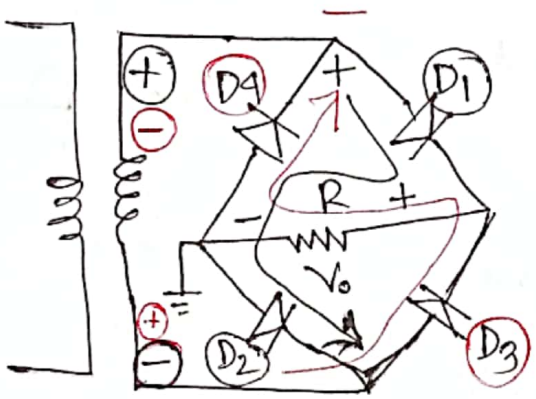
Diode D1 এর Vs 50%.
" D2 " Vs 50%.
S = secondary coil

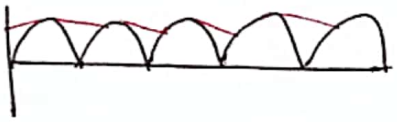
-ve এর ক্ষেত্রে D1 shorted হবে

Full wave Rectifier

(output current) i_{out}:

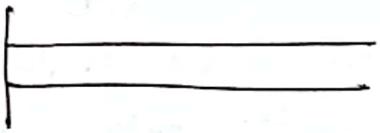
Bridge Rectifier :





pulse setting DC

↓ (capasitor)



pure DC

pulse setting DC থেকে DC এ কনভার্ট করার জন্য capasitor value প্রয়োজন,

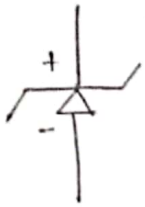
প্রায় DC এ কনভার্ট

How can

How to minimize R.. voltage

Semiconductore physics (self practice)

Zenore Diode:



Zenore diode

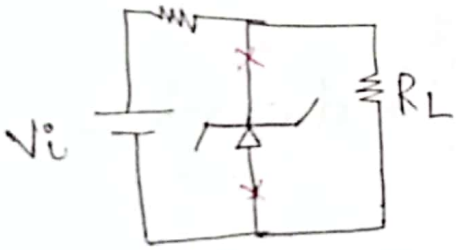
*** Special application of zenore diode:

input যাই হোক না কেন, output সবসময় একটি fixed voltage দিবে/থাকবে,

power rating P_z =,

voltage Rating V_z =

Max zenore current I_{zmax} =



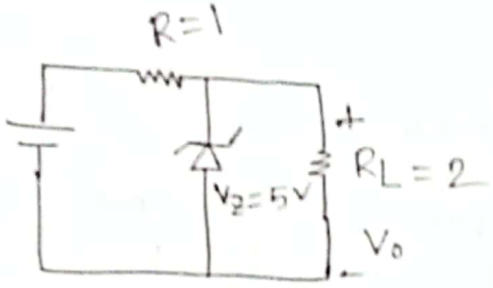
$V_o \geq V_z$ হলেই কেবল zenore diode কাজ করে,

এই topics এর math solve করার সময় প্রথমত বিবেচনা করা যে zenore diode circuit এ আছে,

$$V_o = \frac{R_L}{R_L + R} V_i \qquad V_o = V_z$$

$V_o \geq V_z$ তাহলে zenore diode টি on হবে

Problem:

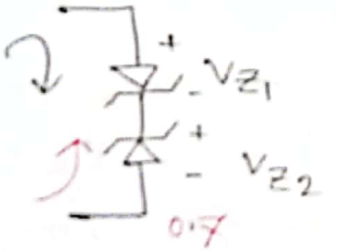


$$i = \frac{10-5}{1} = 5\,mA$$

09-011-2019

Voltage regulator :(voltage controler)

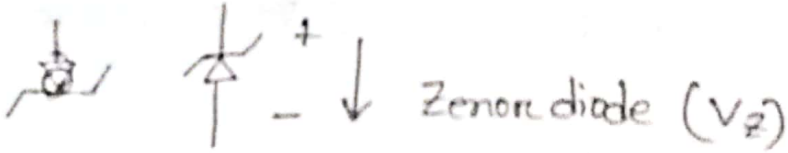
Two back to back zenor diode is used as voltage regulator.

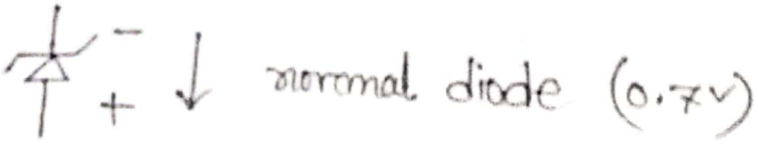


$V = V_{z_1} + V_{z_2}$

normal diode — one directional

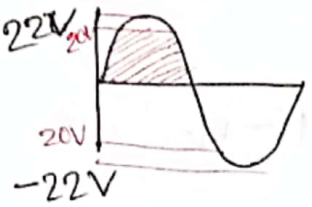
zenor diode — both directional

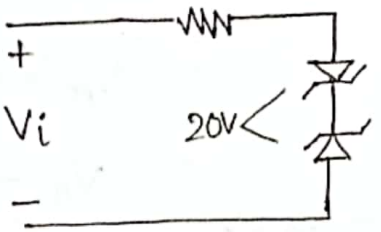




Boildead (Application of diode)

\# Math:

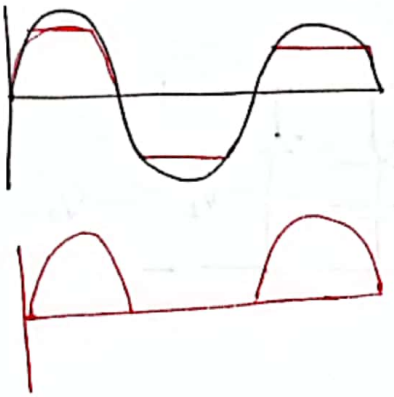




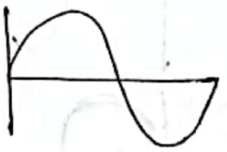
Q. output figure কেমন হবে?

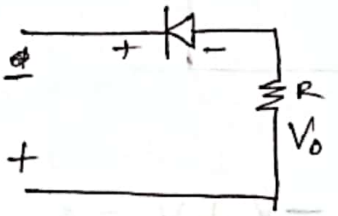
⊞ zenor diode ≤ 20V ⊖ হলে active হবে

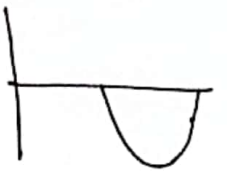
Clippers circuit ; input/output figure drowing :



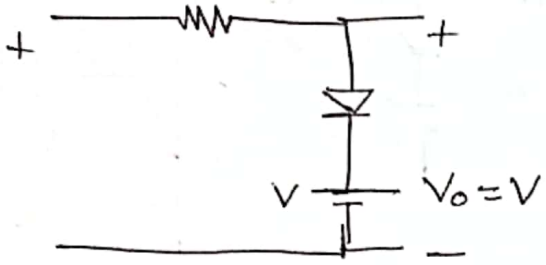
\# drowing output signal :





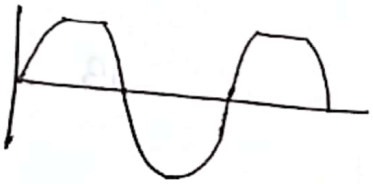


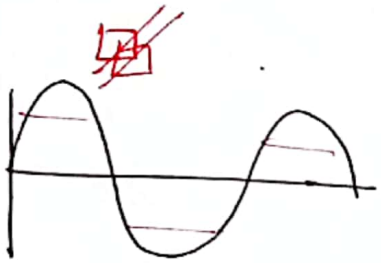
input

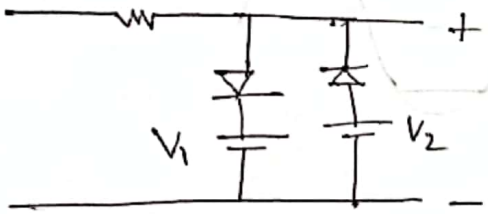


$V_A > V_K$

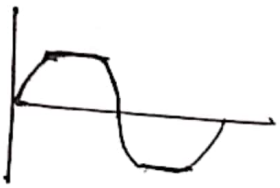
output:

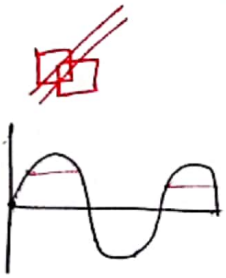


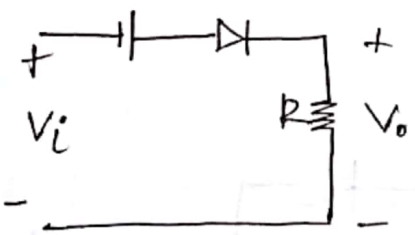


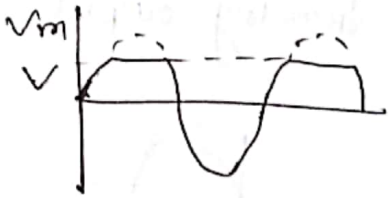


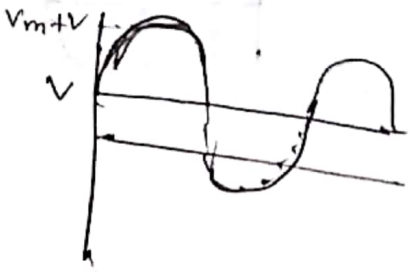
V_o











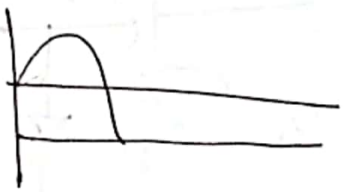
$-V_i - V + V_o = 0$

$\Rightarrow V_o = V_i + V$

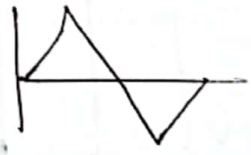
$\Rightarrow V_o = V_m + V$

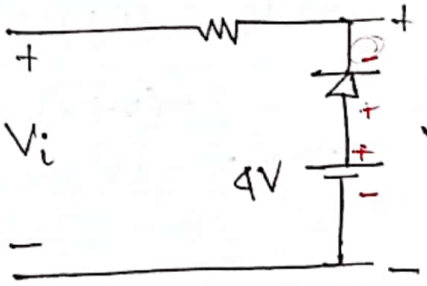
input

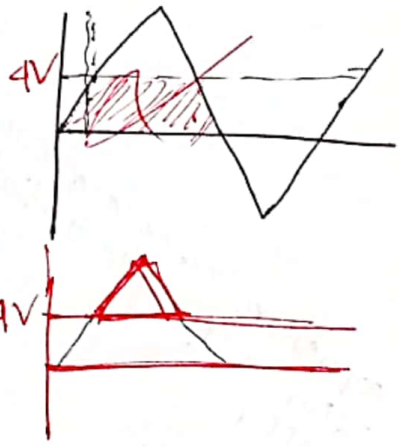
output



circuit drow কর !

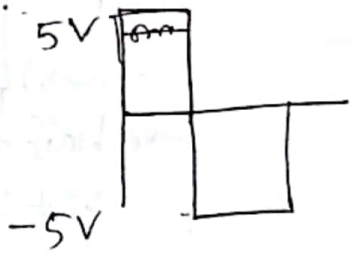


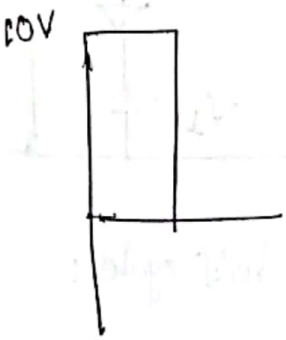


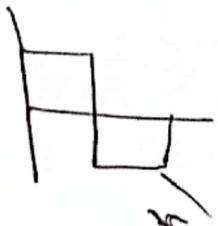


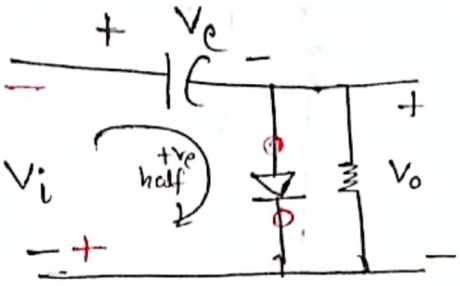
Clampers ckts :

(capacitor, diode, register থাকবে)









+ve half cycle; $V_o = 0$

+ve half cycle: $-V_i + V_c = 0$

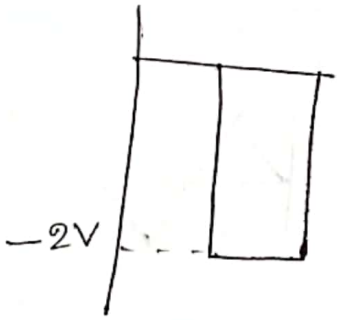
$V_c = V_i = V$

-ve half cycle: $V_i + V_c + V_o = 0$

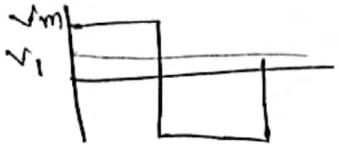
$\Rightarrow V_o = -(V_i + V_c)$

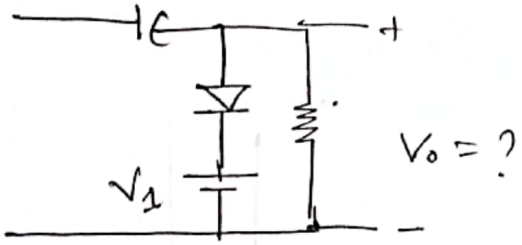
$= -(V + V)$

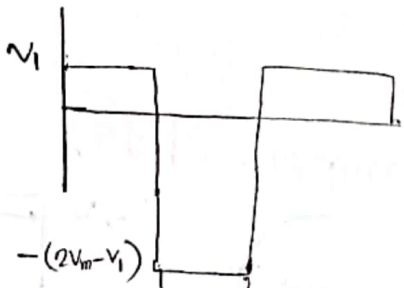
$\Rightarrow V_o = -2V$



capacitor এর cycle এ carg
-হলে এবার cycle এ discharge
-হবে।







+ve half cycle:

$V_o = V_1$

$-V_i + V_c + V_1 = 0$

$\Rightarrow V_c = (V_i - V_1)$

$\Rightarrow V_c = V_m - V_1$

-ve half cycle:

$V_i + V_c + V_o = 0$

$\Rightarrow V_o = -(V_i + V_c)$

$= -(V_m + V_m - V_1)$

$= -(2V_m - V_1)$

Just for teachers

MAC sir:

11-11-2019

Boilsted book → practice

flipers, clumber
halp wave, full wave

short :

pn junction
n, p type semiconductor ✓
energy van diagram
Intrinsic and Extrinsic semiconductor ✓
→ doping ✓
tunnel, photodiode
thervistor

Alexender Sadiku

← OP-Amp

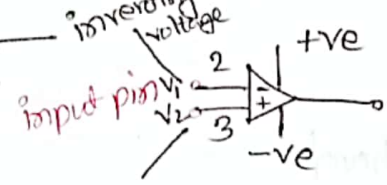
↓

operation Amplifier

যদি OP-Amp ideal হয়,

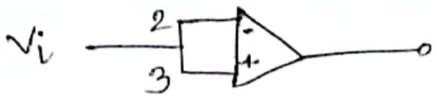
$\frac{V_o}{V_i} = A_c = 0$ হবে

input ও +ve দিলে -ve, -ve দিলে +ve output দিবে



$V_i = V_1 + V_2$

$\frac{V_o}{V_1 - V_2} = A_d$ (differential gain)



$\frac{V_o}{V_i} = A_c$ (common mode gain)

common mode Rejection Ratio = $\frac{A_d}{A_c}$

$DB = 10 \log$ —

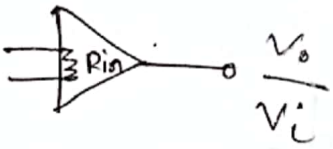
Characteristic of Ideal Op-Amp

(i) Input resistance, $R_{in} = \infty$

(ii) output resistance, $R_{out} = 0$

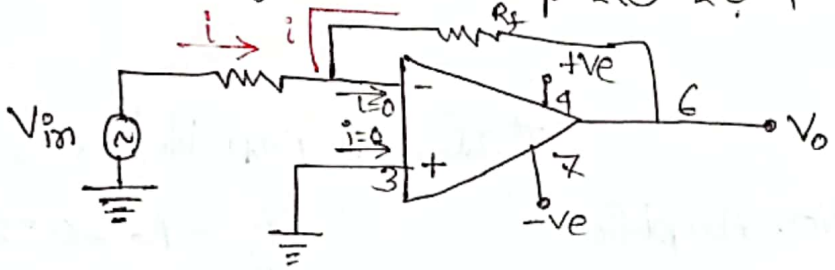
(iii) open loop voltage gain $(A_V)_{OL} = \infty$

(iv) Perfect Balance, if $V_{in} = 0$, $V_{out} = 0$



Inverting Amplifier:

Note: Op-Amp দিয়ে যখন Amplifier design করা হয় তখনসবসময় close loop হতে হয়।



(i) No input current

(ii) V_+ and V_- are virtually short.
pin2 and pin 3

$$\frac{V_{in} - 0}{R} = i = \frac{0 - V_o}{R_f} \qquad [0 > V_o$$

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

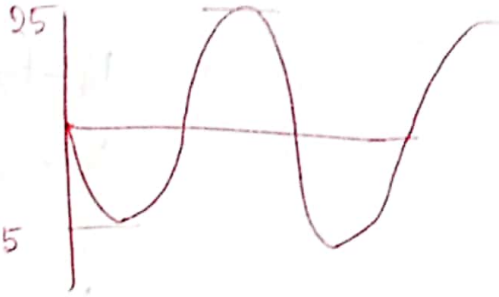
$$\frac{V_o}{V_{in}} = \frac{-R_f}{R}$$

$$|A_V| = \frac{R_f}{R}$$

$$V_o = -\frac{R_f}{R} V_{in}$$

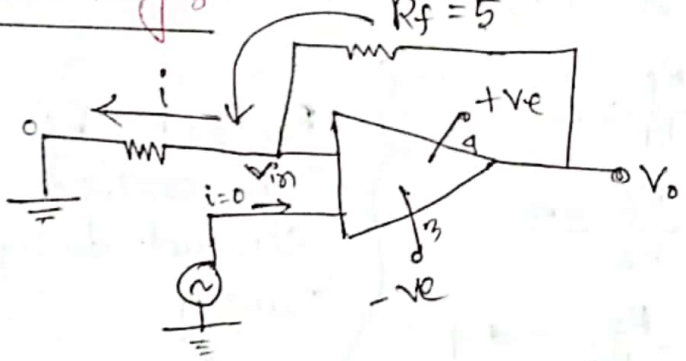
$i = 1$
$R_f = 5$
$V_o = ?$

$$V_o = \frac{-5}{1} \cdot 5$$
$$= -25 \text{ V}$$



inverting বলে +ve থেকে -ve হচ্ছে।

Non Inverting :



$$\frac{V_{in} - 0}{R} = i$$
$$\frac{V_o - V_{in}}{R_f} = i$$

$$\frac{V_{in} - 0}{R} = \frac{V_o - V_{in}}{R_f}$$

$$\Rightarrow \frac{V_o}{V_{in}} = \left(1 + \frac{R_f}{R}\right)$$

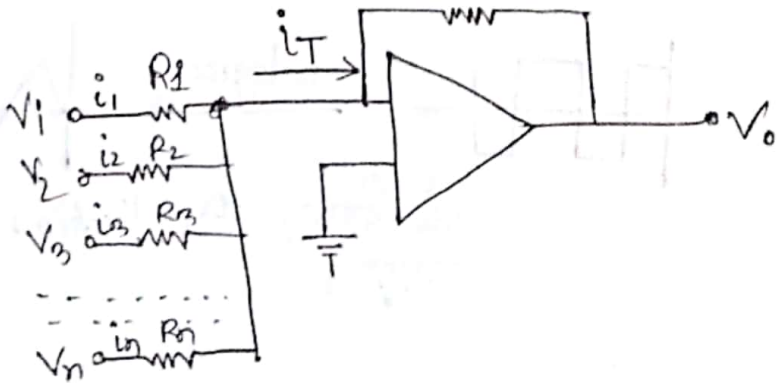
$$AV = 1 + \frac{R_f}{R}$$

$$AV = 20 = 1 + \frac{R_f}{R}$$

$$\frac{R_f}{R} = 19$$

$$R_f = 19$$

Inverting Summer :



$$\frac{0 - V_o}{R_f} = \frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3} \cdots + \frac{V_n}{R_n}$$

$$i_T = i_1 + i_2 + i_3 + \cdots + i_n$$

$$R_1 = R_2 = R_3 = R_f$$

$$V_0 = -R_f\left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3} + \cdots + \frac{V_n}{R_n}\right)$$

$$V_0 = -\left(\frac{R_f}{R_1}V_1 + \frac{R_f}{R_2}V_2 + \frac{R_f}{R_3}V_3 + \cdots + \frac{R_f}{R_n}V_n\right)$$

$$V_0 = -(V_1 + V_2 + V_3 + \cdots + V_n)$$

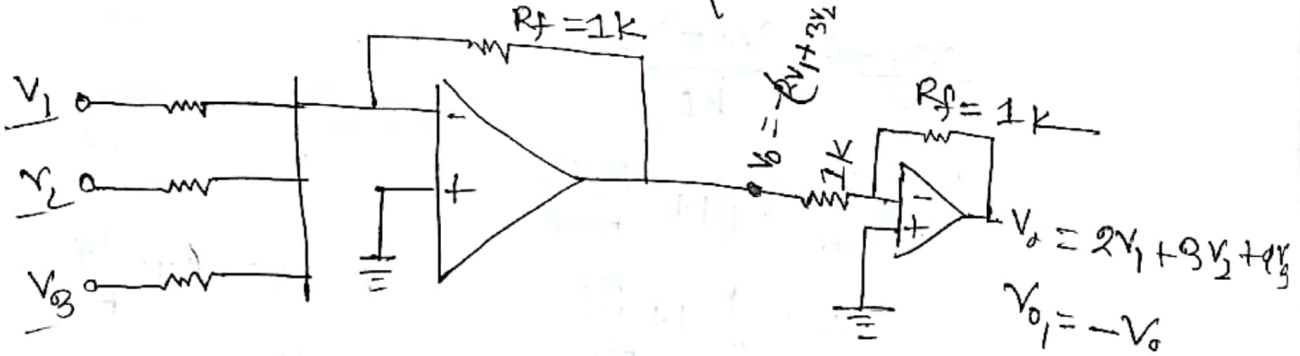
Q $V_0 = 2V_1 + 2V_2 + 4V_3$ এই circuit টি design কর।

$\frac{R_f}{R_1} = 2$

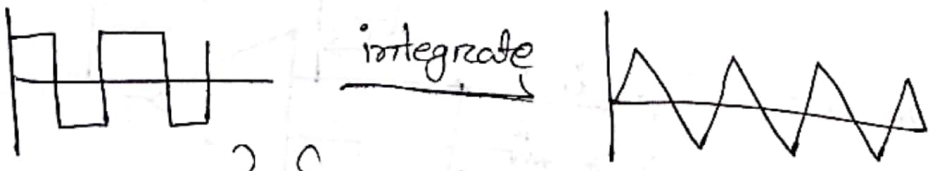
$\frac{R_f}{R_2} = 3$

$\frac{R_f}{R_3} = 4$

R_1, R_2, R_3, R_f এর মান অনুসারে circuit design করা হয়।

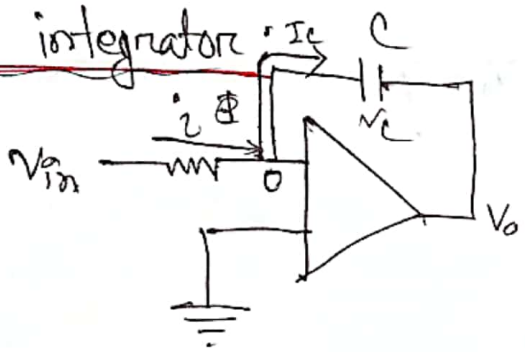


Inverting Integrator:



এই ধরনের Application এর জন্য inverting amplifier ব্যবহার করা হয়।

inverting integrator :



$$i = \frac{V_{in} - 0}{R}$$

$$i_c = C\frac{dV_c}{dt} \quad | \; V_c = 0 - V_o = -V_o$$

$$\frac{V_{in}}{R} = -C\frac{dV_o}{dt}$$

$$\frac{dV_o}{dt} = -\frac{1}{RC}V_{in}$$

$$V_o = -\frac{1}{RC}\int V_{in}\,dt$$

Practice করবে হবে।

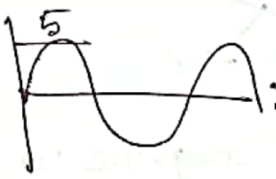
Q $V_{in} = 5\sin\omega t$ ~~or~~

$V_o = ?$ $R = 1K$, $C = 1mF$

$$V_o = -\frac{1}{1}\int 5\sin\omega t\,dt$$

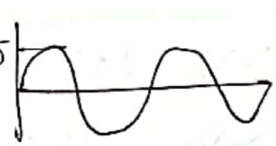
$$= \frac{5\cos\omega t}{\omega} \quad \text{(Ans)}$$

অথবা,



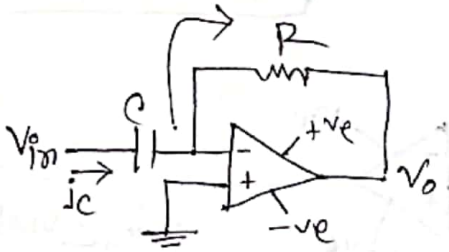
$\therefore V_{in} = 5\sin\omega t$

or,

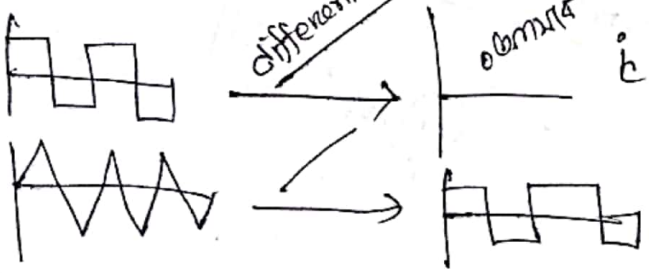


$V_{in} = \frac{1}{\omega}\sin\omega t$

Inverting differentiator :



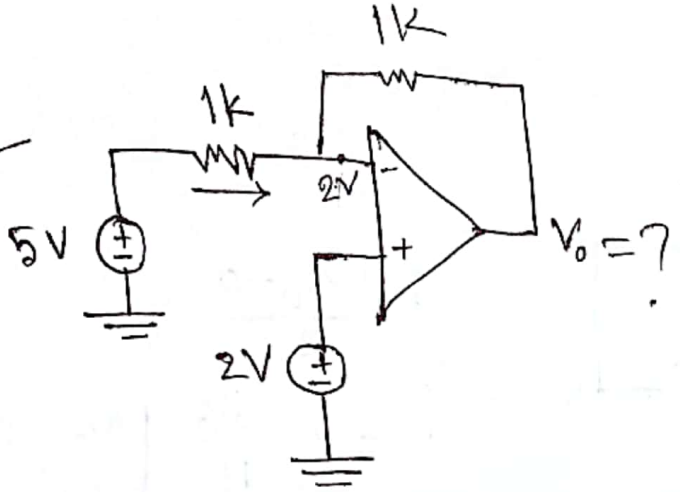
differentiate



$$i = C\frac{dV_{in}}{dt} = \frac{0 - V_o}{R}$$

$$V_o = -RC\frac{dV_{in}}{dt}$$

Q



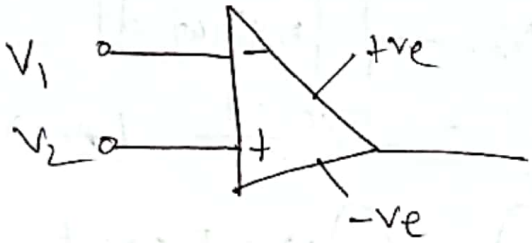
$$I = \frac{5-2}{1} = 3A$$

$$I = \frac{2-V_o}{1} = 3$$

$$\Rightarrow 2 - V_o = 3$$

$$\therefore V_o = -1V$$

Comparator: (input, output ..... open loop

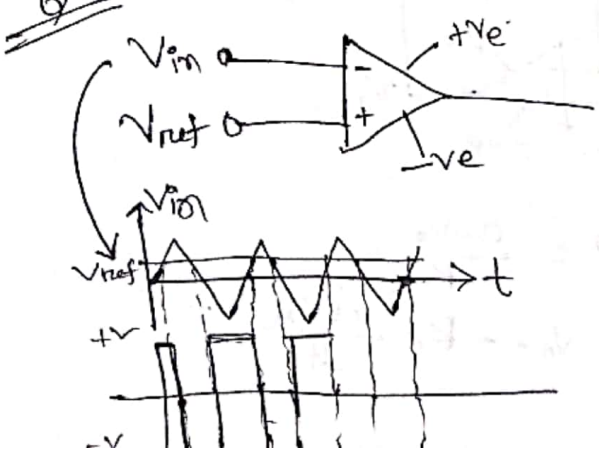


কাজ: V_1, V_2 compare করা,

if $V_1 > V_2$; $V_o = -Ve$
$V_2 > V_1$; $V_o = +Ve$

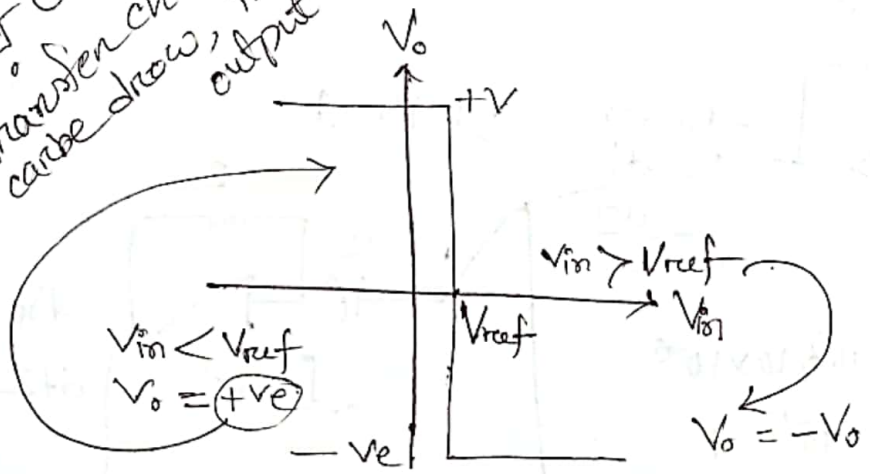
V. V. I

Q

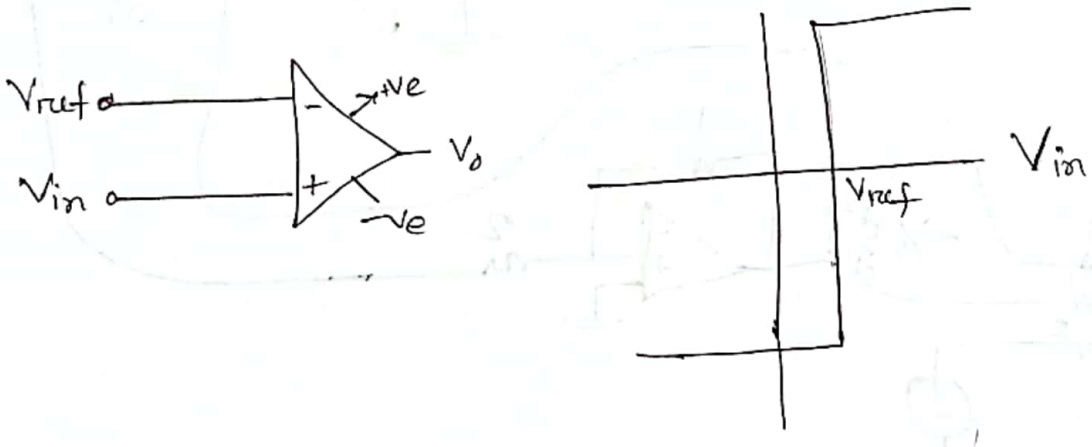


$V_{in} < V_{ref} \rightarrow V_o = +Ve$
$V_{in} > V_{ref} \rightarrow V_o = -Ve$

transfer characteristics curve draw, input, output



transfer charicestics carve



Alexander sadicu → chapter-5 (OP-Amp) practice

Mid এর 2y এর 2

Comput circuit Design:

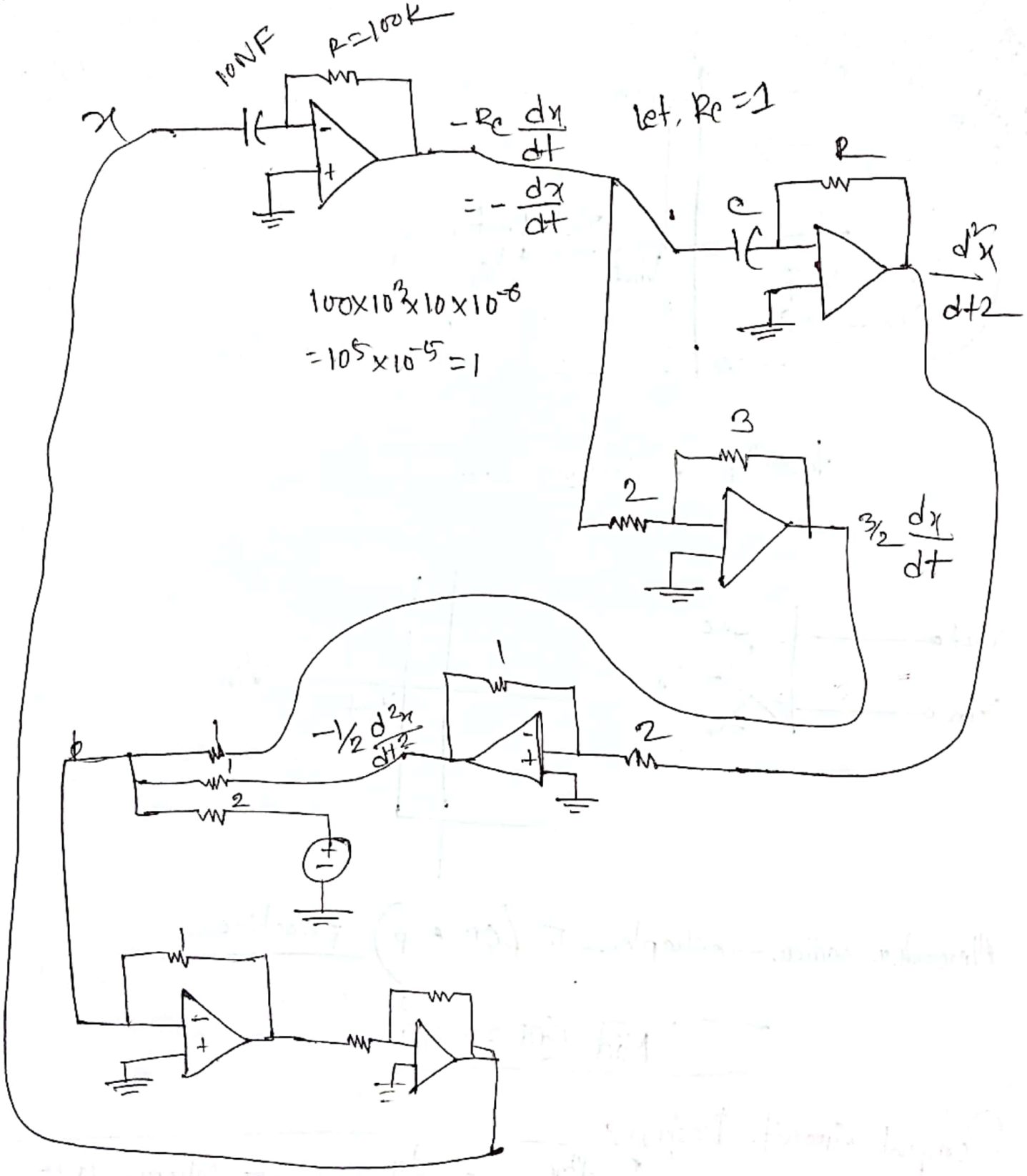
OP-Amp দিয়ে design করতে হবে।

$\frac{d^2x}{dt^2} - 3\frac{dx}{dt} + 2x = 5$ where x is input

$$\Rightarrow 2x = -\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + 5$$

$$\Rightarrow x = -\frac{1}{2}\frac{d^2x}{dt^2} + \frac{3}{2}\frac{dx}{dt} + 5/2$$

25



01-12-2019 Theory ক্লাসের (sir lecture sheet দিবে)

Oscilator: is an electronic ckt that produces a periodic oscillating electronic signal, often a sine wave or a square wave.

→ Oscillator convert DC from Power supply to AC

→ Used in clock, generators, calculators, radio transmitter.

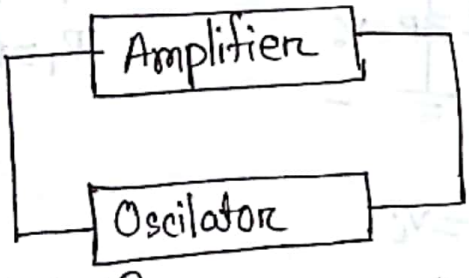
→ Classified by the frequency of their output signal

→ Low frequency Oscillator

→ Audio frequency (20Hz – 20000KHz)

→ Radio frequency (RF)

এমপ্লিফায়ার frequency থেকে specific frequency কে বাছাই করে।



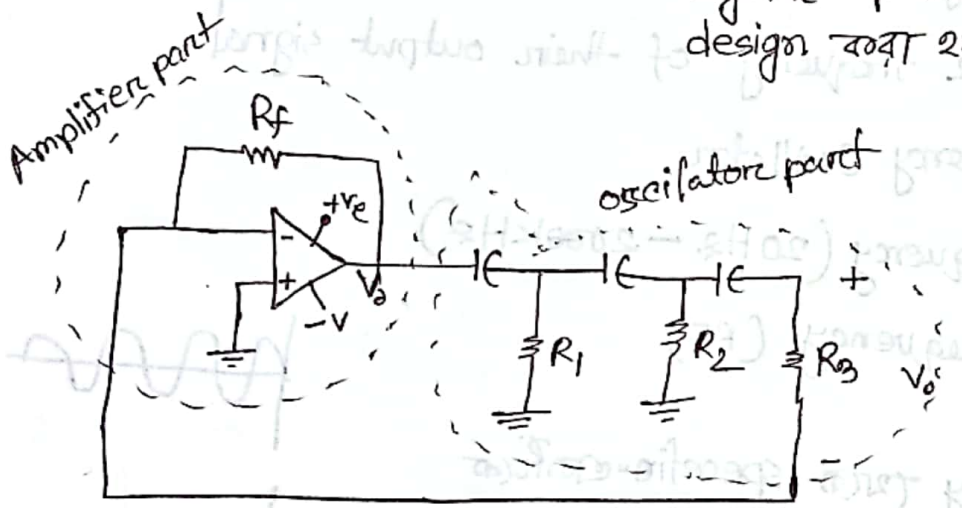
Gain β $A\beta \rightarrow$ Loop Gain

Bark Hussen Criteria V.V.I

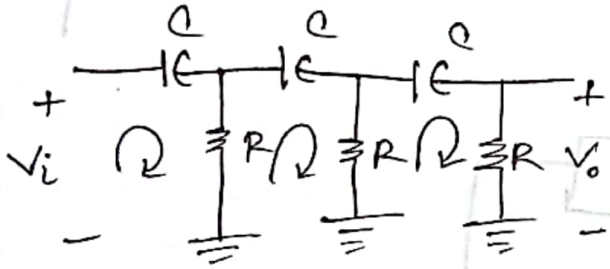
1. Total loop gain must be greater / or equel to 1
$|A\beta| \geq 1$
2. Total phase shift must be 0° or 360°

* Phase Shift Oscillator (RC oscillator)

registor capasitor দিয়ে বরসানি design করা হয়।



$|A| = \frac{R_f}{R}$



$C_1 = C_2 = C_3 = C$

$R_1 = R_2 = R_3 = R$

Mesh Analysis :

loop-1 : $\left(R + \frac{1}{j\omega c}\right) I_1 - i_2 R = V_i$

loop-2 : $\left(2R + \frac{1}{j\omega c}\right) i_2 - i_4 R - i_3 R = 0$

loop-3 : $\left(2R + \frac{1}{j\omega c}\right) i_3 - i_2 R = 0$

$\beta = \frac{V_o}{V_i}$

$$i_3 = \frac{S_3}{S} = \frac{\begin{vmatrix} R+\frac{1}{j\omega c} & -R & V_i \\ -R & 2R+\frac{1}{j\omega c} & 0 \\ 1 & -R & 0 \end{vmatrix}}{\begin{vmatrix} R+\frac{1}{j\omega c} & -R & 0 \\ -R & 2R+\frac{1}{j\omega c} & -R \\ 1 & -R & 2R+\frac{1}{j\omega c} \end{vmatrix}}$$

$$\beta = \frac{V_o}{V_i} = \frac{i_3 R}{V_i}$$

$$\beta = \frac{1}{\left(1+\frac{5}{\omega^2 R^2 C^2}\right) - j\left(\frac{6}{\omega RC} - \frac{1}{\omega^3 R^3 C^3}\right)}$$

180° degree ফেজ শিফট দেওয়ার জন্য imaginary অংশকে 0।

→ For 180° phase shift,

$$\frac{6}{\omega RC} - \frac{1}{\omega^3 R^3 C^3} = 0$$

$$\therefore \omega = \frac{1}{\sqrt{6} RC}$$

$$\therefore f = \frac{1}{2\pi\sqrt{6} RC}$$

$$\beta = \frac{1}{1-\frac{5}{\omega^2 R^2 C^2}}$$

$$= \frac{1}{1-\frac{5}{1/6}}$$

$$= \frac{1}{1-30}$$

$$|\beta| = -\frac{1}{29}$$

$$|A\beta| = 1$$

$$A = 29 = \frac{R_f}{R}$$

Circuit design:

C (.001 MF ≈ .1MF)

R দেওয়া থাকবে

then, R_f ও বের করা যায়।

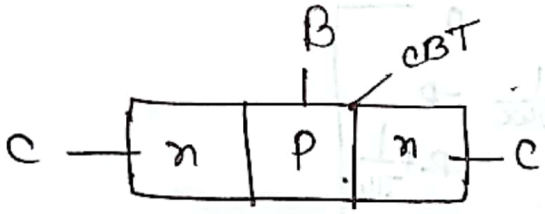
bridge oscillator → self study

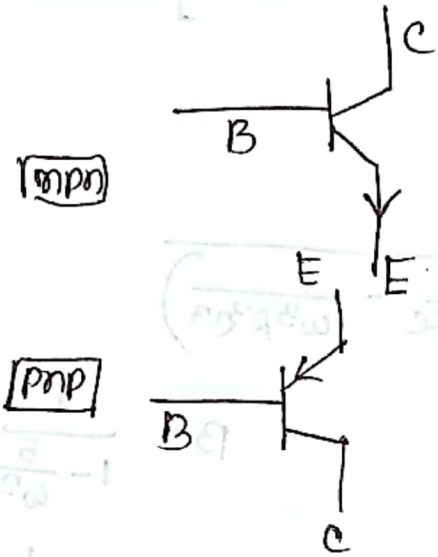
BJT At DC

MicroElectronics → Math প্রাধান্য (প্রচুর)

BJT – (Bipolar junction Transistor)

প্রথমের 4/5 টা Example



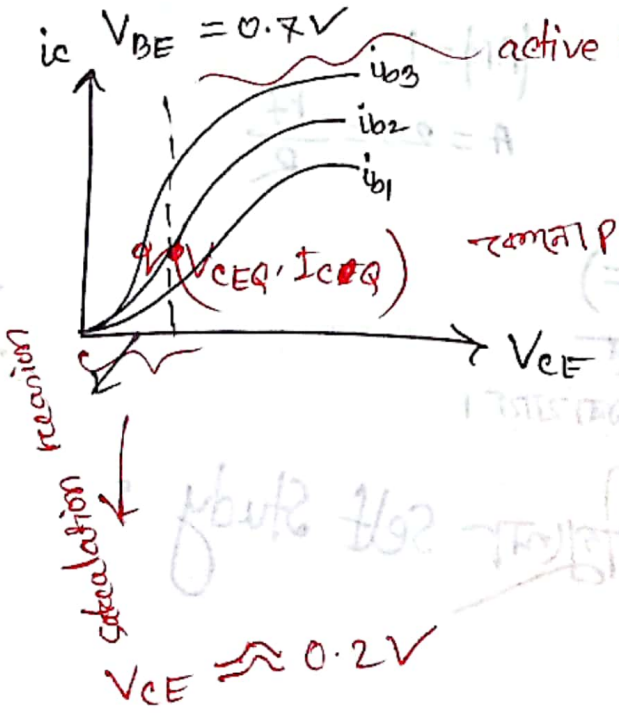


Active/Saturation mode

$V_{BE} = 0.7V$

npn

	EBJ	CBJ	
~~Cut off~~ Cut off ~~Active~~	Reverse	Reverse	
Active	Forward	~~Forward~~ Reverse	(Amplifier)
Saturation	"	Forward	(Switch)



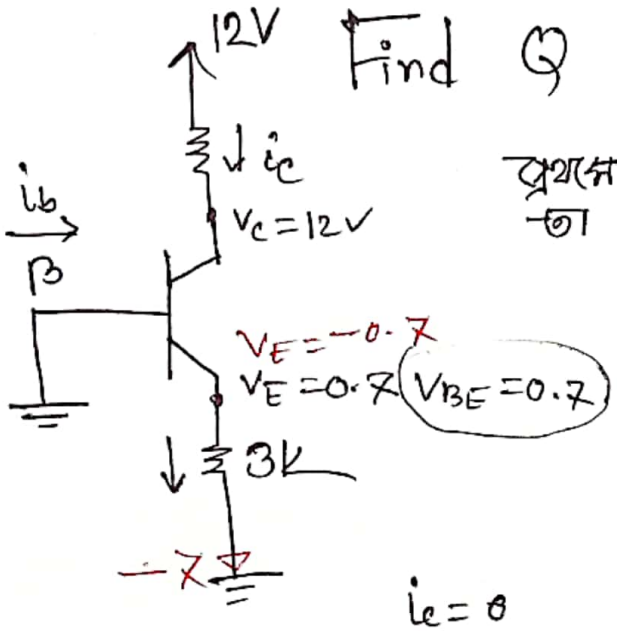
যেকোনো point-এ V_{CE} এবং ic এর value বসিয়ে Q point.

calculation

$V_{CE} \approx 0.2V$

Scanned with CamScanner

Find Q Point



প্রথমে কোন mode এ আছে তা identify করতে হবে।

" ওয়ালা সিম্বল ইগনোর্ড "

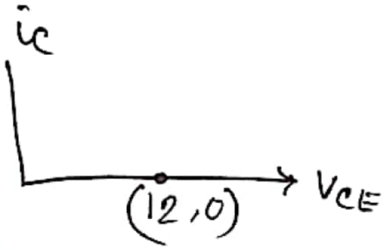
$i_e = i_c + i_b$

$i_e = 0$

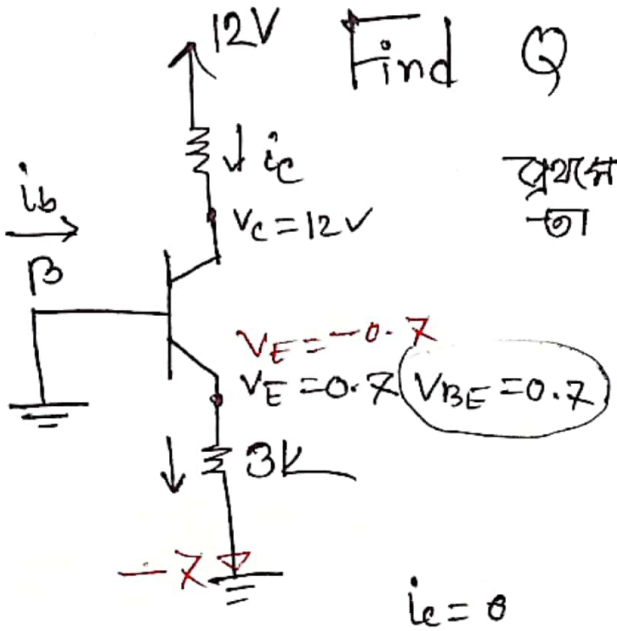
$V_{CE} = V_C - V_E$ (0)

$= 12V$

$i_E = \frac{-0.7 - (-5)}{3}$



Find Q Point



প্রথমে কোন mode এ আছে তা identify করতে হবে।

$i_e = i_c + i_b$

$i_e = 0$

$V_{CE} = V_C - V_E$

V_C ↓ 12V

$i_E = \frac{-0.7-(-5)}{3}$