SCHEME

BAPATLA ENGINEERING COLLEGE:: BAPATLA

III/IV B.Tech (REGULAR/SUPPLEMENTARY) DEGREE EXAMINATION

NOV-2019 FIFTH SEMESTER

CODE :: 14EC/EI 506

PULSE AND SWITCHING CIRCUITS

SUBMITTED BY

B.SURENDRA BABU

ASSISTANT PROFESSOR

DEPARTMENT OF ECE

HEAD OF THE DEPARTMENT

Dr N.VENKATESWARA RAO

PROFESSOR & H.O.D

DEPARTMENT OF ECE

14EC/EI 506

Hall Ticket Number:

III/IV B.Tech (Regular/Supplementary) DEGREE EXAMINATION

November, 2019 — **Common to ECE & EIE**

Fifth Semester — **Pulse and switching Circuits**

Time: Three Hours — **Maximum :** 60 Marks

Answer Question No. 1 compulsorily. (1X12 = 12 Marks)

Answer ONE question from each unit. (4X12=48 Marks)

1. Answer all questions (1X12 = 12 Marks)
   a) Differentiate high pass and low pass RC circuits.
   b) Define rise time.
   c) What is the condition for perfect differentiation in high pass RC circuit?
   d) Draw the circuit diagram of a positive peak clipping circuit.
   e) What are the applications of voltage comparators?
   f) Draw the circuit diagram of a practical clamper circuit.
   g) Write any two applications of Schmitt trigger.
   h) What is the difference between symmetrical triggering and asymmetrical triggering?
   i) Give the expression for pulse width of a monostable multivibrator.
   j) What are the applications of time base generators?
   k) Define displacement error.
   l) Compare voltage and current time base generators.

UNIT – I

2. a) Determine the response of a high pass RC circuit for a square wave input and derive the expression for percentage tilt. 6M
   b) Sketch the output wave forms of a low pass RC circuit for a pulse input when RC>>T and RC<<T. 6M

(OR)

3. a) Derive the expression for rise time and bandwidth of a low pass RC circuit. 6M
   b) An ideal pulse of amplitude 10 V is fed to an RC high pass circuit. The width of pulse is 3μs. Draw the output waveforms for the following lower 3dB frequencies. i) 30 MHz ii) 0.3 MHz 6M

UNIT – II

4. a) Draw the circuit diagram of series and shunt clippers and explain its operation with the help of its transfer characteristics. 12M

(OR)

5. a) Draw the circuit diagram of positive clamper and explain its operation with waveforms. 6M
   b) Design a diode clamper circuit to restore the positive peaks of 1 kHz input signal to a voltage level equal to 5V. Assume that the diode voltage during forward bias condition is 0.7 V. 6M

UNIT – III

6. a) Explain fixed-bias bistable multivibrator. 6M
   b) Draw the circuit of a Astable multivibrator and explain its operation. 6M

(OR)

7. a) Draw the circuit diagram of Schmitt trigger circuit and explain its operation with relevant waveforms. 6M
   b) Design a collector-coupled astable multivibrator for the following specifications: f= 10KHz, Vcc=9V, h_{FE}=20 and I_{CSAT}=20 mA. 6M

UNIT – IV

8. Obtain the relation between Ed, Es, Et. 12M

(OR)

9. a) Draw the circuit of a simple current sweep generator and explain its operation. Derive expression for its slope error. 6M
   b) Explain the working principle of Bootstrap time base generator and derive the expression for its sweep speed. 6M

1. **(1*12=12M)**

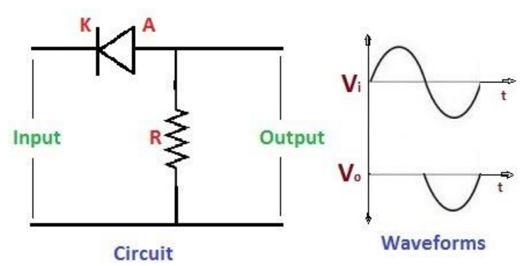
a.)

PARAMETERS	HIGH PASS FILTER	LOW PASS FILTER
Definition	It is a circuit which allows the frequencies above cut off frequency to pass through it.	It is a circuit which allows the frequency below cut off frequency to pass through it.
Circuit Architecture	It consists of Capacitor followed by a resistor.	It consists of resistor followed by capacitor.
Significance	It is significant when the distortion due to low frequency signal such as noise is to be removed.	It is significant in removing aliasing effect.
Operating Frequency	Higher than the cut off frequency.	Lower than the cut off frequency.
Applications	In audio amplifiers, low noise amplifiers etc.	In communications circuit as anti-aliasing filter.

b.) Rise time:the time required for a pulse to rise from 10 per cent to 90 per cent of its steady value.

c.) RC<<T

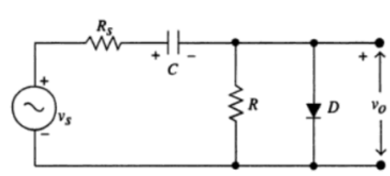
d.)



e.) Null detectors

Zero crossing detector

f.)



g.)

Analog to digital conversion*:* The Schmitt trigger is effectively a one bit analog to digital converter. When the signal reaches a given level it switches from its low to high state.

Level detection*:* The Schmitt trigger circuit is able to provide level detection. When undertaking this application, it is necessary that the hysteresis voltage is taken into account so that the circuit switches on the required voltage.

h.) Symmetrical triggering- single trigger source

Asymmetrical triggering- Two trigger sources are required to induce a transistion

i.) T=0.69RC

j.) CRO,RADAR DISPLAYS,TV

k.) Ed=(Vs-Vs')/Vs

l.) current time base generators:

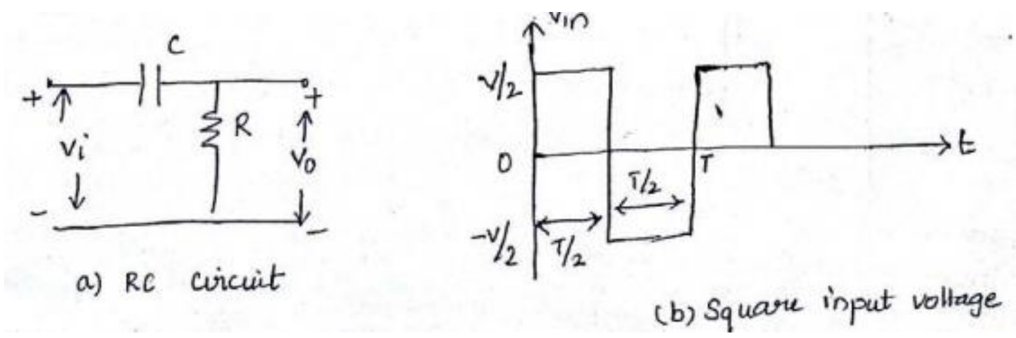
Used in large displays, Electromagnetic deflection

Voltage time base generators:

Used in small displays, Electrostatic deflection.

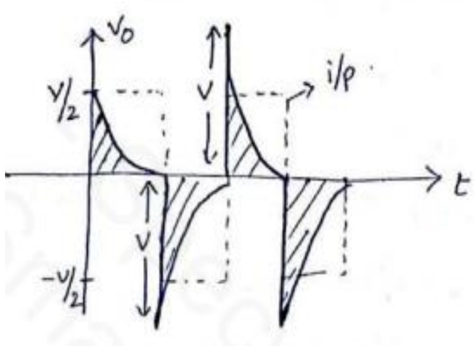
UNIT-1

2 a.)



a) RC circuit (b) Square input voltage ………2M

case i) : $RC \ll T$ i.e $\tau/T \ll 1$

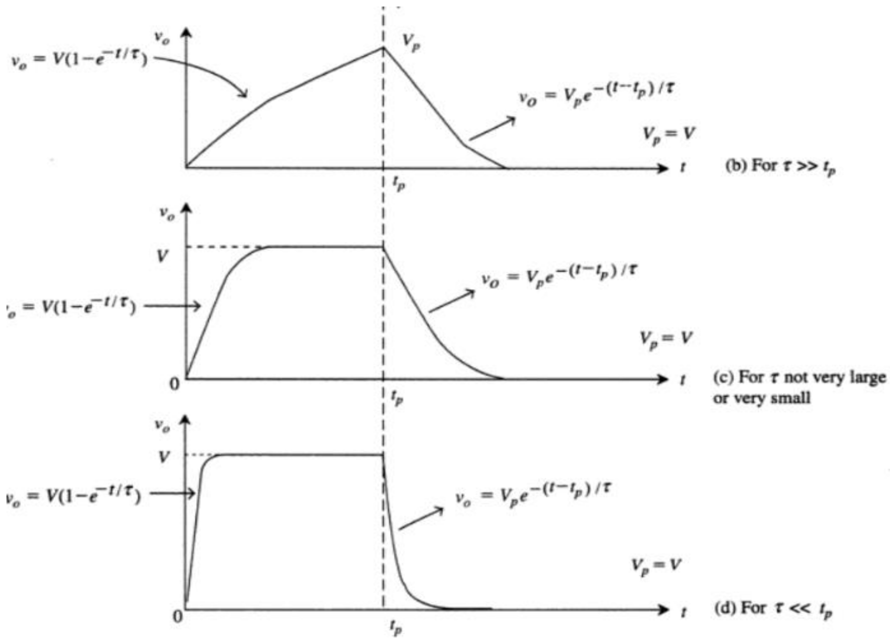


-------1M

Expression for % tilt. ---------3M

$$\% \text{Tilt} = P = \frac{T}{2RC} \times 100$$

2.b)

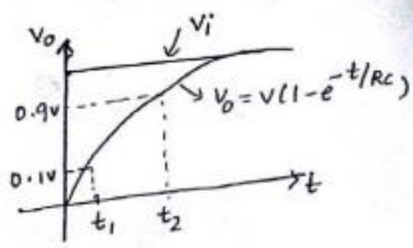


--------6M

3a.)

Rise time (t_r):

The time required for the voltage to rise from 10% to 90% of final steady value is termed as risetime which is denoted by t_r.



$t_r = t_2 - t_1$

At $t = t_1 \Rightarrow V_o = 0.1V$

$0.1V = V(1-e^{-t_1/RC})$

$0.1V = V - Ve^{-t_1/RC}$

$0.1 = 1 - e^{-t_1/RC} \Rightarrow e^{-t_1/RC} = 0.9$

$\Rightarrow -t_1/RC = \log_e 0.9 \Rightarrow +t_1 = -RC\log_e 0.9 \rightarrow (1)$

At $t = t_2 \Rightarrow V_o = 0.9V$

$0.9V = V(1-e^{-t_2/RC})$

$e^{-t_2/RC} = 1 - 0.9$

$\Rightarrow e^{-t_2/RC} = 0.1 \Rightarrow -t_2/RC = \log_e 0.1$

$\Rightarrow t_2 = -RC\log_e 0.1 \rightarrow (2)$

$t_r = t_2 - t_1 = -RC\log_e 0.1 - (-RC\log_e 0.9)$

$= -RC\log_e 0.1 + RC\log_e 0.9$

$= -RC$

$= 2.2RC$

$\therefore$ Rise time is 2.2 times the time constant

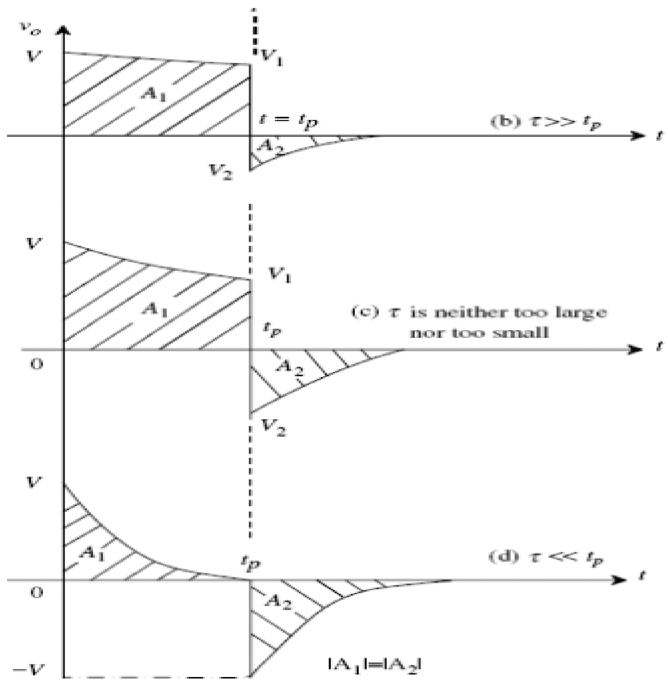
---------5M

Relation b/w Bandwidth & Rise time : $BW = f_2 - f_1$

Since $f_2 >> f_1$ we can assume that $f_2 - f_1 \cong f_2$

$$\therefore \; t_r = \frac{0.35}{f_2 - f_1} = \frac{0.35}{BW}$$ ----------1M

3b.)



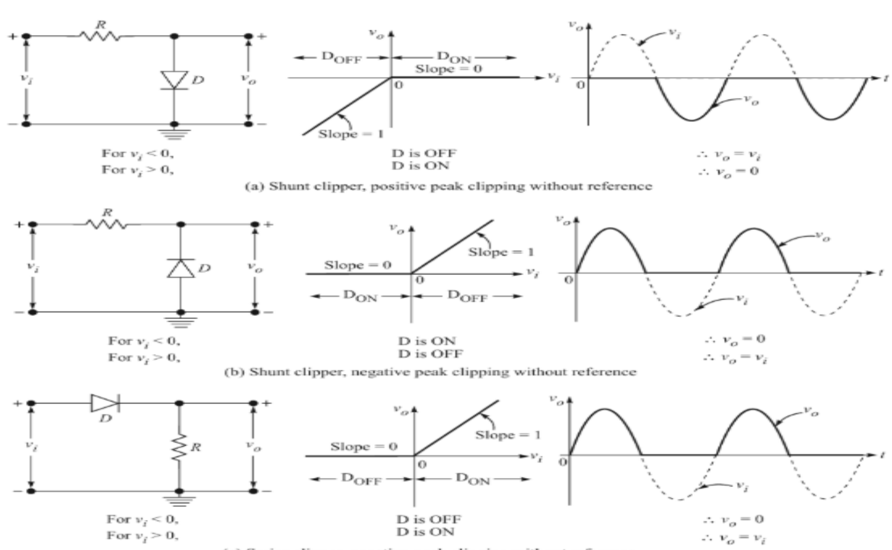
Tp=3us

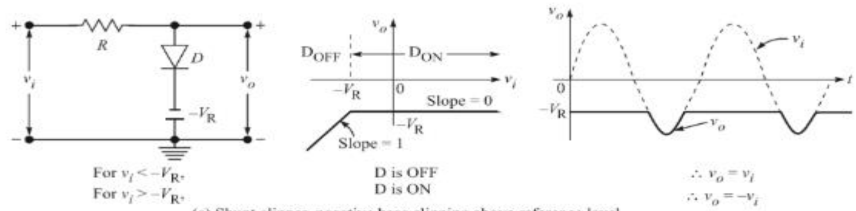
V=10v

F=30MHz and 0.3MHz

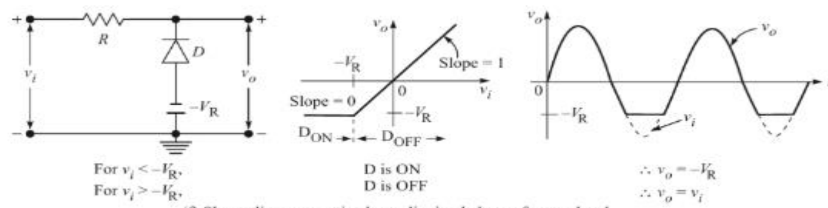
UNIT-II

4.a)



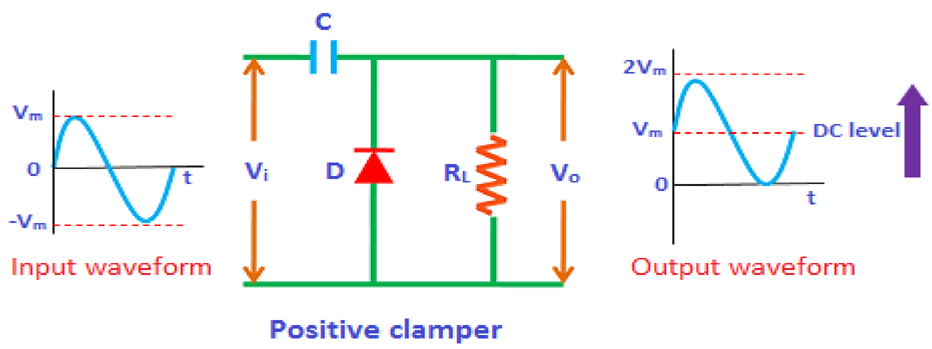


(e) Shunt clipper, negative base clipping above reference level



(f) Shunt clipper, negative base clipping below reference level

5a.)



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------3M

Operation---3M

5b.)

Drop across diode = 0.7 V

Clamping level = $V_R + V_\gamma = 5$ V

$\therefore$ $V_R = 5 - V_\gamma = 5 - 0.7 = 4.3$ V

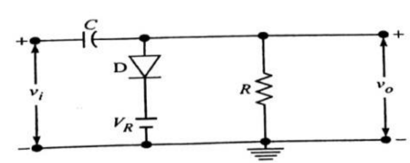
For the diode, let $R_f = 200\ \Omega$ and $R_r = 500$ kΩ

External resistance to be connected is given by

$$R = \sqrt{R_f \times R_r} = \sqrt{200 \times 500{,}000} = 10\ \text{k}\Omega$$

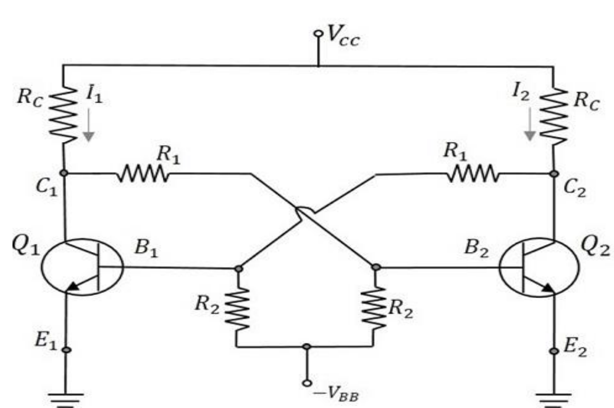
The value of C needed is

$$C = \frac{20T}{R} = \frac{20}{f \times R} = \frac{20}{1 \times 10^3 \times 10 \times 10^3} = 2\ \mu\text{F}$$



UNIT-III

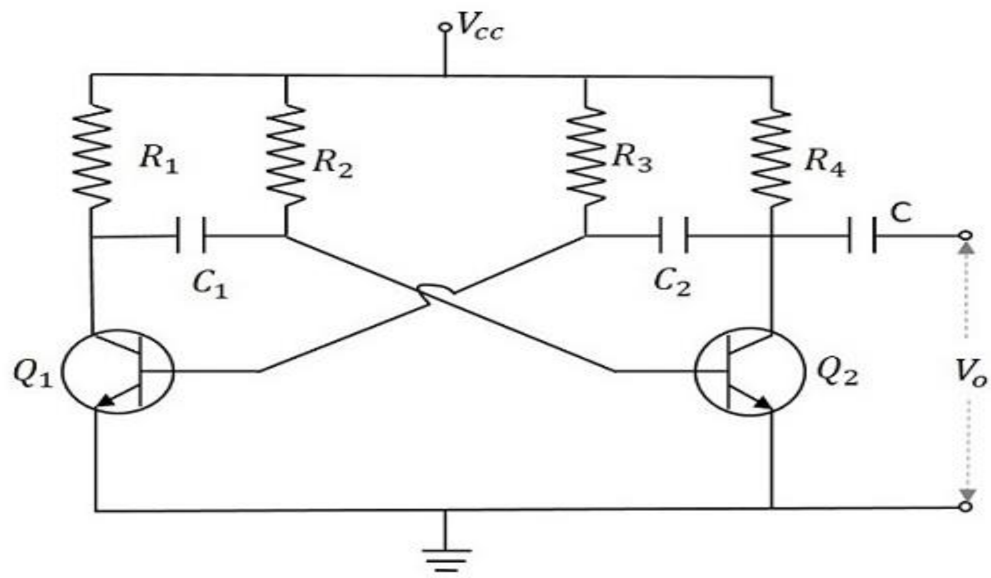
6a.) Fixed-bias Binary



--------2M

Operation------4M

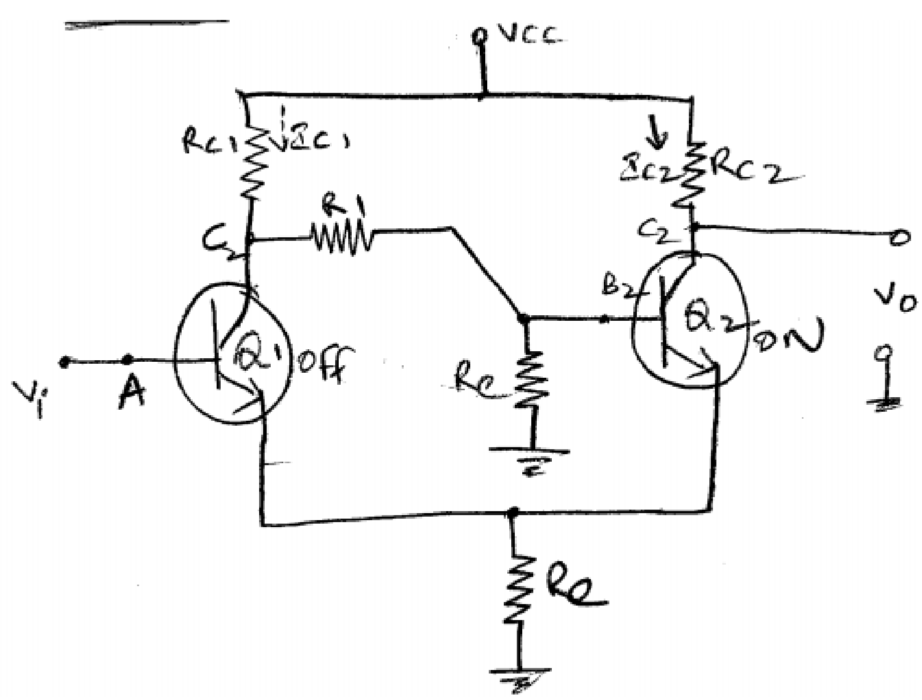
6b.) Astable Multivibrator



-------2M

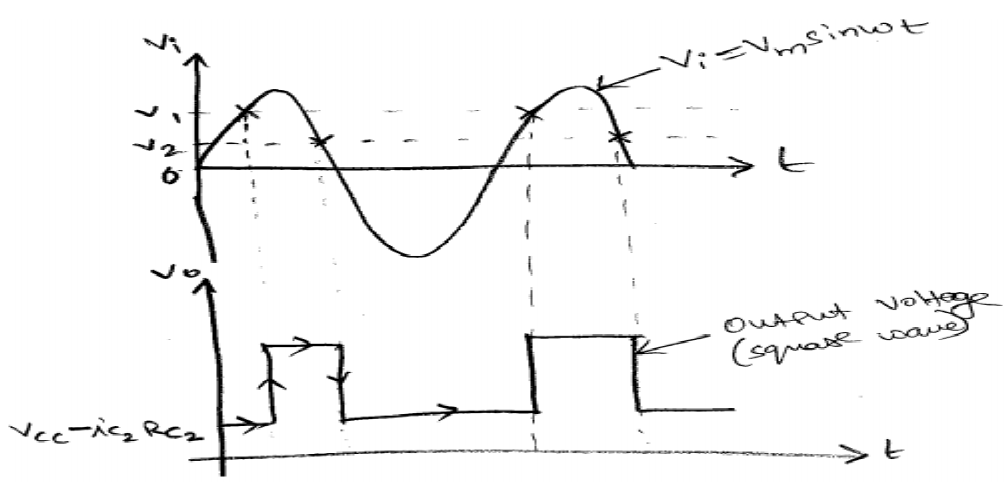
Operation----4M

7a.) Schmitt trigger



---------2M

Operation----3M



----------1M

7b.)

$f = 10KHz$

$V_{cc} = 9V$

$h_{FE} = 20$

$I_c(sat) = 20mA$

$V_{CE\,sat} = 0.2V$, $V_{BE(sat)} = 0.7V$

$$T = \frac{1}{f} = \frac{1}{10\times10^3} = 0.1ms$$

For symmetric $R_1 = R_2 = R$

$C_1 = C_2 = C$

$$T_1 = T_2 = T/2 = 0.1/2 = 0.05ms$$

$$R_{C2} = \frac{V_{cc} - V_{CE(sat)}}{I_{C(sat)}} = \frac{9 - 0.2}{20\,mA} = 8.9\,K\Omega$$

$\therefore R_{C1} = R_{C2} = 8.9K\Omega.$

$$R_2 = \frac{V_{cc} - V_{\gamma}}{I_{B2(sat)}} = \frac{9 - 0.7}{I_{B2}(sat)} =$$

$$I_{B2} = \frac{I_C(sat)}{h_{FE}(min)} = \frac{20mA}{20} = 1mA$$

$\therefore R_2 = 8.3K\Omega$

$\therefore R_1 = R_2 = 8.3K\Omega$.

UNIT-IV

8.

The Slope or Sweep Speed Error (e_S)

A Sweep voltage must increase linearly with time. The rate of change of sweep voltage with time must be constant. This deviation from linearity is defined as **Slope Speed Error** or **Sweep Speed Error**.

Slope or Sweep speed eror e_s = $\frac{difference\ in\ slope\ at\ the\ beginning\ and\ end\ of\ sweep}{initial\ value\ of\ slope}$

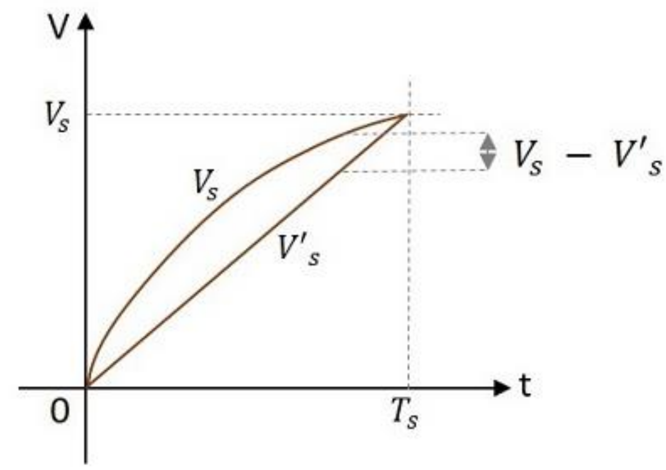
$$= \frac{\left(\frac{dV_0}{dt}\right)_{t=0} - \left(\frac{dV_0}{dt}\right)_{t=T_s}}{\left(\frac{dV_0}{dt}\right)_{t=0}}$$

-----4M

The Displacement Error (e_d)

An important criterion of linearity is the maximum difference between the actual sweep voltage and the linear sweep which passes through the beginning and end points of the actual sweep.

This can be understood from the following figure.



The displacement error $\mathbf{e_d}$ is defined as

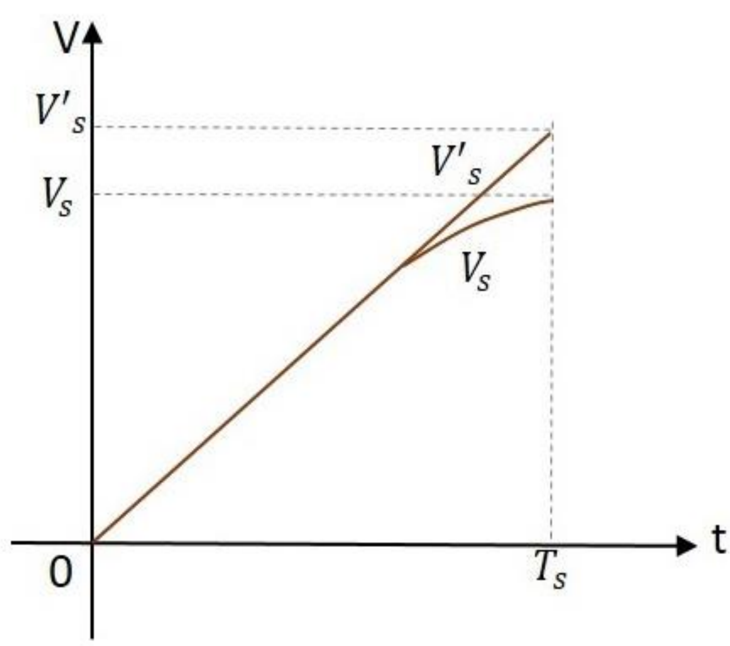
$$e_d = \frac{(actual\ speed) \sim (linear\ sweep\ that\ passes\ beginning\ and\ ending\ of\ actual\ sweep)}{amplitude\ of\ sweep\ at\ the\ end\ of\ sweep\ time}$$

$$= \frac{(V_s - V'_s)_{max}}{V_s}$$

------4M

The Transmission Error (e_t)

When a sweep signal passes through a high pass circuit, the output gets deviated from the input as shown below.



This deviation is expressed as transmission error.

$$\text{Transmission Error} = \frac{(input) \sim (output)}{input\ at\ the\ end\ of\ the\ sweep}$$

$$e_t = \frac{V'_s - V}{V'_s}$$

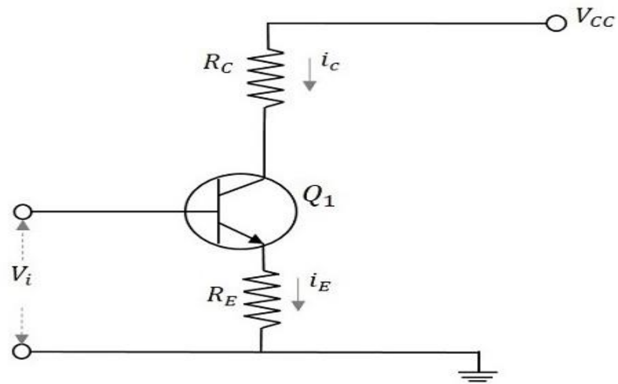
-----4M

9a.)

A Simple Current Time base Generator

A basic simple RC time base generator or a Ramp generator or a sweep circuit consists of a common-base configuration transistor and two resistors, having one in emitter and another in collector. The V_{cc} is given to the collector of the transistor. The circuit diagram of a basic ramp current generator is as shown here under.

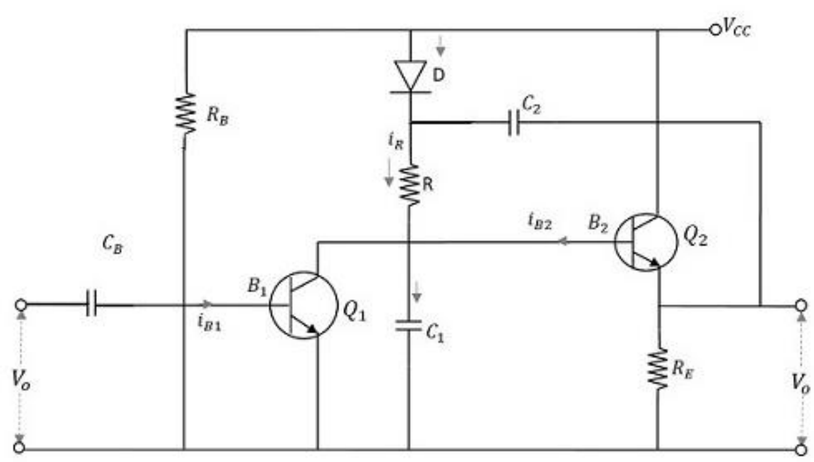
Es= (RL+Rcs)IL/Vcc



9b.)Bootstrap Time Base Generator

The boot strap time base generator circuit consists of two transistors, Q_1 which acts as a switch and Q_2 which acts as an emitter follower. The transistor Q_1 is connected using an input capacitor C_B at its base and a resistor R_B through V_{CC}. The collector of the transistor Q_1 is connected to the base of the transistor Q_2. The collector of Q_2 is connected to V_{cc} while its emitter is provided with a resistor R_E across which the output is taken.

A diode D is taken whose anode is connected to V_{cc} while cathode is connected to the capacitor C_2 which is connected to the output. The cathode of diode D is also connected to a resistor R which is in turn connected to a capacitor C_1. This C_1 and R are connected through the base of Q_2 and collector of Q_1. The voltage that appears across the capacitor C_1 provides the output voltage V_o. ----2M



----2M

Es=Vs/V(1-A+R/Ri) ----2M