Write short Notes on :

1. Types of filter :

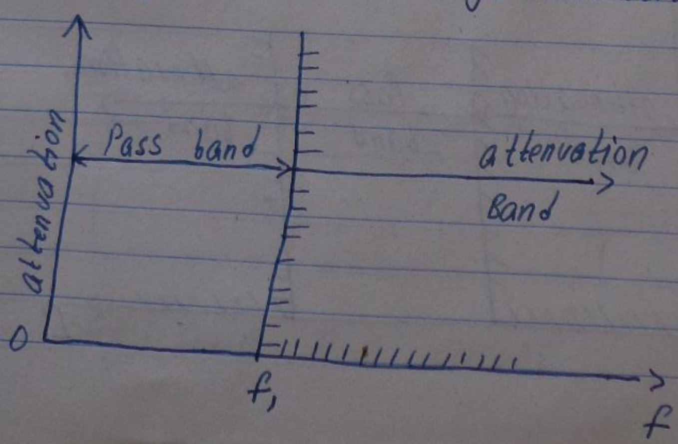
An electric wave filter or filter is an electric network which passes or allows unattenuated transmission of electric signal within certain frequency range and stops or disallows transmission of electric signal outside this range.

Types of filters are:

a) Low pass filters
b) High pass filters
c) Band pass filters
d) Band elimination filters.

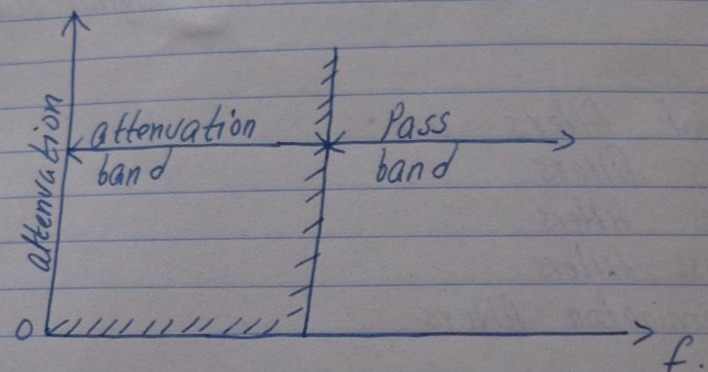
a) Low pass filters:

These filters reject all frequencies above a specified value. In this type of filter, the pass band extends from zero to cut-off frequency f_1 in which region attenuation is zero. The attenuation band extends from cut off frequency f_1 to infinity and in this range attenuation is large.



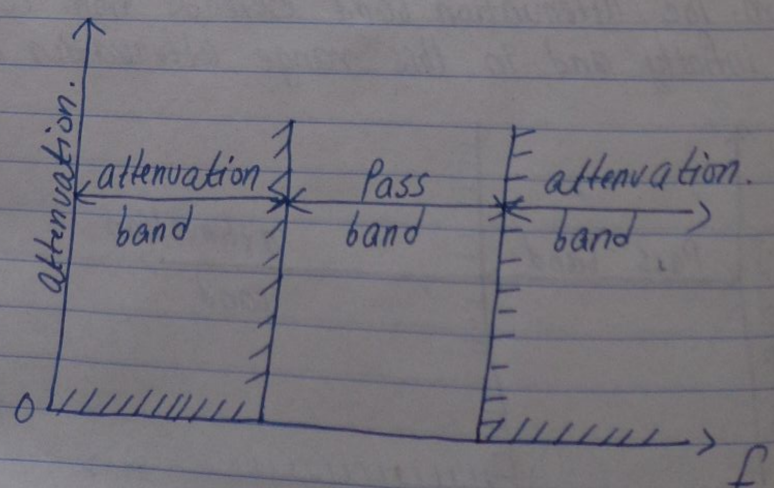
b. High pass filters:

These filters reject all frequencies below a specified value. The pass band extends from cut-off frequency to infinity and attenuation band lies below cut-off frequency.



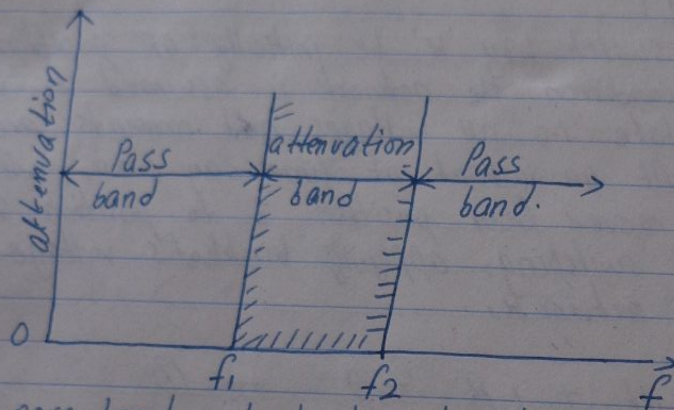
c. Band pass filters:

A band pass filter passes or allows transmission of a band of frequencies and rejects all frequencies beyond this band.



d. Band elimination filter :

A band elimination filter rejects or disallows transmission of a limited band of frequencies but allows transmission of all other frequencies.



The pass band extends beyond cut-off frequency f_2 and below cut off frequency f_1.

2. Step response of R-C series circuit: Voltage

Prefer next one using laplace

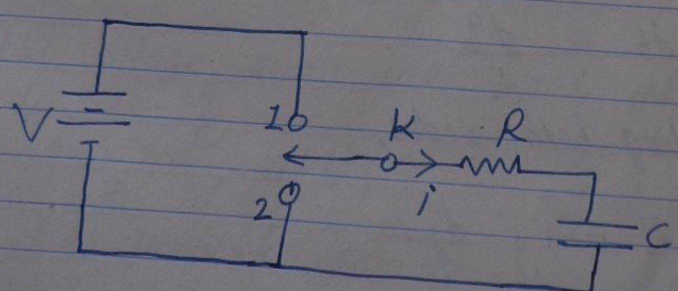


Fig: series R-C circuit.

let, R be resistance of resistor, C be capacitance, K be the switch, i be current flowing in the circuit.

case I:

let switch key 'k' be initially at position 1. In this condition, the network is assumed to be known state i.e, all voltages and currents are known. At an instant of time say $t=0$, switch k be moved from position 1 to position 2.

After switching, applying kirchhof's voltage law to the network,

or, $\frac{1}{C}\int i\,dt + iR = 0$ — (i)

or $\frac{q}{C} + R\frac{dq}{dt} = 0$

or, $\frac{q}{C} = -R\frac{dq}{dt}$

or, $-\frac{1}{RC}dt = \frac{dq}{dt}$

Integrating both sides,

or $-\int \frac{1}{RC}dt = \int \frac{dq}{q}$

$-\frac{t}{RC} = \ln q + \ln C'$ — (ii)

where, ln c' is a constant.

Using initial condition, before switching at $t=0$, charge q across capacitor is given by,

$q_{t=0} = VC$

From (ii),

or $\ln\left(\frac{q}{c'}\right) = -\frac{t}{RC}$

$\therefore q = c' e^{-t/RC}$ — (iii)

At $q = VC$ and $t = 0$,

From eq^n (iii),

$\therefore c' = VC$

Now, eq^n (iii) becomes,

$\therefore q = CV e^{-t/RC}$ — (iv)

Now, voltage across capacitor C at time t is,

$V_C = \frac{q}{C}$

$= V e^{-t/RC}$ — (v)

It gives particular solution.

From eq^n (iv)

$$q = q_0 e^{-t/\tau}$$

or $$\frac{q}{q_0} = e^{-t/\tau}$$

where, q_0 = initial charge across capacitor C.

$\tau = RC$ is time constant of RC network.

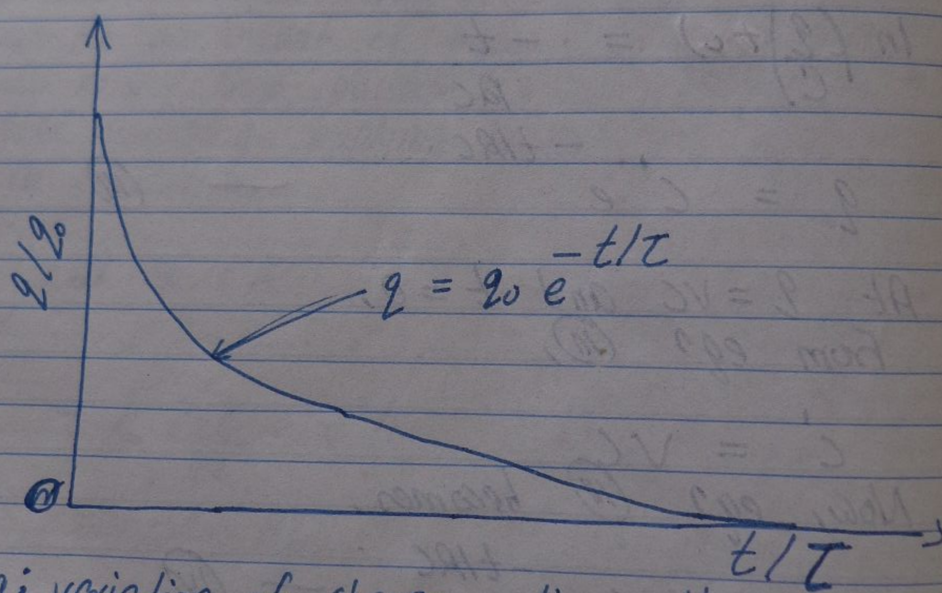


Fig: variation of charge ratio with time.

Case II:

let, initial the switch K be at position 2. Under this condition, there is no charge on capacitor C and there is no voltage across it. let, switch K be moved from position 2 to position 1 at time $t=0$. The entire voltage V now gets applied to RC circuit.

we get.

$$\therefore q = q_0 \left[1 - e^{-t/\tau}\right]$$

$$\therefore i = i_0 e^{-t/\tau}$$

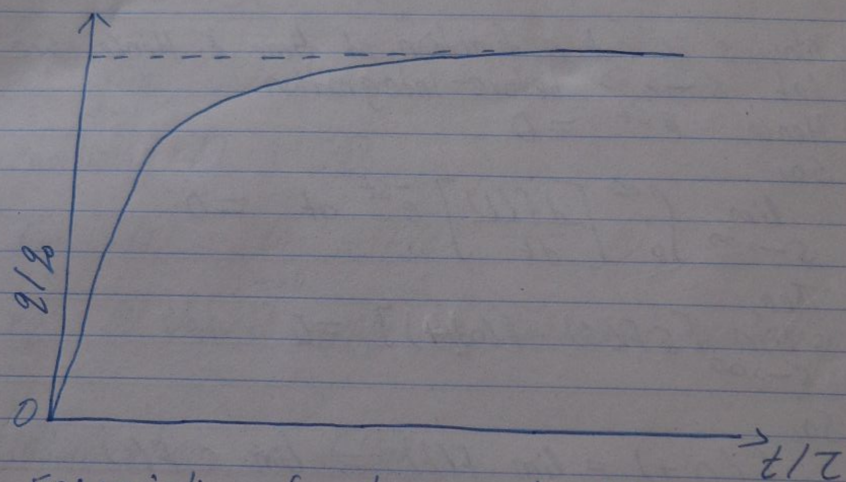


Fig: variation of charge ratio q/q_0 with time.

3. Initial and final value theorem:

Initial value theorem:

This theorem states that if $f(t)$ and its first derivative are laplace trasformable, then

$$f(0+) = \lim_{t \to 0^+} f(t) = \lim_{s \to \infty} [s\,F(s)]$$

Proof:

$$\lim_{s\to\infty}\int_0^{\infty}\left[\frac{df(t)}{dt}\right]e^{-st}\,dt = \lim_{s\to\infty}\left[sF(s)-f(0+)\right]$$

Now, s is not a function of time t. Hence, we let $s\to\infty$ before integration.

Hence, $e^{-st} = 0$

So,

$$\lim_{s\to\infty}\int_0^{\infty}\left[\frac{df(t)}{dt}\right]e^{-st}\,dt = 0.$$

Then,

$$\lim_{s\to\infty}\left[sF(s)-f(0+)\right] = 0$$

So,

$$\therefore\ f(0+) = \lim_{t\to 0} f(t) = \lim_{s\to\infty} sF(s)$$

proved.

Final value theorem:

This theorem states that if f(t) and its first derivatives are Laplace transformable, then,

$$\lim_{t\to\infty} f(t) = \lim_{s\to 0} sF(s).$$

proof:

$$\lim_{s\to 0}\int_0^{\infty}\left[\frac{df(t)}{dt}\right]e^{-st}\,dt = \lim_{s\to 0}\left[sF(s)-f(0+)\right] \cdots (i)$$

So,

$$\lim_{s \to 0} \int_0^\infty \left[\frac{df(t)}{dt}\right] e^{-st} dt = \int_0^\infty \left[\frac{df(t)}{dt}\right] dt$$

$$= \lim_{t \to \infty} \int_0^t \left[\frac{df(t)}{dt}\right] dt$$

$$= \lim_{t \to \infty} [f(t) - f(0+)] \quad \text{--- (ii)}$$

combining (i) & (ii),

or, $\lim_{t \to \infty} f(t) = \lim_{s \to 0} s F(s)$ --- (a)

Eq^n (a) doesnot apply for sinusoidal excitation.

4. Classification of filters:

a. According to their frequency characteristic:

i) Low pass filter
ii) High pass filter
iii) Band pass filter
iv) Band elimination /stop filter.

b. According to relation between Z_1 and Z_2.

i) constant-k filters or prototype filter.
ii) m-derived filters.

In constant-k filter, series impedance Z_1 and shunt impedance Z_2 are related by relation

$$Z_1 \cdot Z_2 = k^2.$$

where k is constant.

The m-derived filters, on the other hand, do not have the product $Z_1 Z_2$ equal k^2 but have same characteristic impedance as the corresponding constant-k sections but have much sharper attenuation characteristics.

5. Laplace transform and its advantage:

Today, Laplace transformation is popularly used. The advantages of Laplace transform over classical method are

i) The solution of the differential equations gets greatly simplified.

ii) The method yields in a single operation the complete solution i.e both the particular integral and the complementary function.

iii) Initial conditions get automatically specified in the transformed equation whereas in the classical method these initial conditions have to be separately specified.

iv) Finally the initial conditions get included in the problem in the first step in the analysis rather than in the last step.

The process of using laplace transformation is similar to the process of using logarithms which is also a type of transformation. Use of logarithms simplifies operation such as multiplication, division, raising quantities to power, finding roots etc.

For a given function of time $f(t)$, the laplace transform equals time integration from 0 to infinity of $f(t)\,e^{-st}$, where s is a complex number equal to $(\sigma + j\omega)$. Laplace transform is generally denoted by letter L. The laplace transform of $f(t)$ is generally designated $F(s)$. Thus, we have,

$$L(f(t)) = F(s) = \int_0^\infty f(t)\, e^{-st}\, dt.$$

For a function $f(t)$ to be laplace transformable, it is necessary that,

$$\int_0^\infty |f(t)|\, e^{-\sigma_1 t}\, dt < \infty.$$

for a real positive σ_1.

Some laplace transform are:

i) t

$$L(t) = \int_0^\infty t \cdot e^{-st}\, dt$$

$$= \frac{1}{s^2}\int_0^{\infty} (st)\, e^{-st}\, d(st)$$

$$= \frac{1}{s^2}\int_0^{\infty} x \cdot e^{-x}\, dx \qquad [\because x = st]$$

$$\therefore L(t) = \frac{1}{s^2}$$

ii). t^n

$$L(t^n) = \frac{n!}{s^{n+1}}$$

iii). $L[\sin at] = \frac{a}{s^2+a^2}$

iv. $L[\cos at] = \frac{s}{s^2+a^2}$

v. $L[\sinh at] = \frac{a}{s^2-a^2}$.

vi $L[\cosh at] = \frac{a}{s^2-a^2}$

vii $L(1) = \frac{1}{s}$

6. Network symmetry:

Network symmetry means a network which is symmetrical with respect to the ports. For such symmetrical network, the image impedance is the referred to as the iterative impedance or characteristic impedance and is usually denoted by Z_0. The image transfer constant of a symmetrical network is called propagation constant and is denoted by γ.

Because of the symmetry with respect to the two ports, we have,

$$Z_{11} = Z_{22}$$
$$y_{11} = y_{22}$$
$$Z_{is} = Z_{os}$$
$$Z_{io} = Z_{oo}$$
$$A = D$$

Also,

$$Z_{i1} = Z_{i2} = Z_0 = \sqrt{\frac{B}{C}} \quad \text{— (i)}$$

and,

$$\theta = \log_e \sqrt{\frac{-V_1 I_1}{V_2 I_2}} = \gamma \quad \text{— (ii)}$$

$$= \log \sqrt{\frac{Z_0 I_1^2}{Z_0 I_2^2}}$$

$$= \log \frac{I_1}{I_2} \quad \text{— (iii)}$$

In general, propagation constant γ is a complex quantity and

let, $\gamma = \alpha + j\beta$ —— (iv)

Here, α = attenuation constant.

β = phase constant, measured in radian.

We know,

$$\gamma = \cosh^{-1}\sqrt{AD}$$

$$= \cosh^{-1} A \qquad [\because A = D]$$

$$= \sinh^{-1}\sqrt{BC}$$

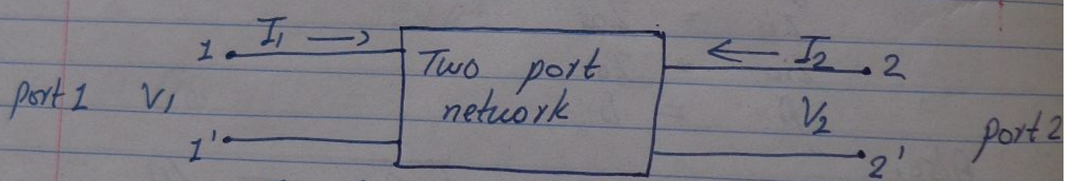


Fig: A two port network.

ABCD parameters in terms of Z_0 and γ

$$A = D = \cosh\gamma$$

Also,

$$\sqrt{BC} = \sinh\gamma$$

From (i),

$$\sqrt{\frac{B}{C}} = Z_0$$

$$\therefore B = Z_0 \sinh\gamma$$

7. **Reciprocity of Network :**

The ratio of response transform to the excitation transform remains the same when we interchange the positions of response and excitation in the network. This is the principle of reciprocity. The networks for which this principle holds are called reciprocal networks.

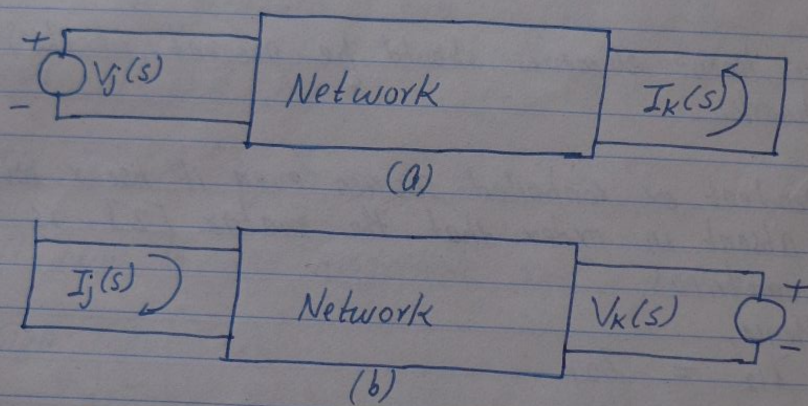


Fig: Network illustrating principle of reciprocity.

These figure shows the loop numbers j and k only. All other loops are enclosed in the block schematically representing the network.

The current $I_j(s)$ equals the current $I_k(s)$. In general for a network with symmetrical impedance matrix,

$$\frac{I_k(s)}{V_j(s)} = \frac{I_j(s)}{V_k(s)} \quad \text{--- (1)}$$

It shows that ratio of response transform to the excitation transform remains the same when we interchange the position of response & excitation in the network.

For a network to be reciprocal, it is evident that the following condition must be satisfied:

i). the network should be initially relaxed.

ii) only linear elements should be present in the network.

iii) dependent or controlled sources even if linear must be absent in order that the matrix [Z] is symmetrical.

Hence,

$Z_{12} = Z_{21}$

$y_{12} = y_{21}$

$AD - BC = 1$

$A'D' - B'C' = 1$

$h_{12} = -h_{21}$

$g_{12} = -g_{21}$

8. Mesh and Nodal Analysis:

A mesh is a loop in an electric circuit which does not contain any other loops within it.

A loop is an electric circuit in a closed path.

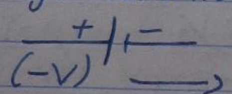
Mesh analysis:

The algebraic sum of the product of current and resistance in a mesh plus algebraic sum of the emf in that mesh is equal to 0.

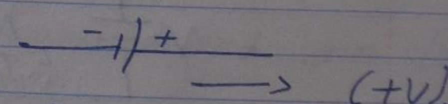
i.e, $\Sigma IR + \Sigma emf = 0$.

It helps to find magnitude and direction of current.

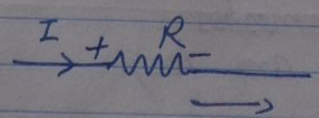
Sign convection:



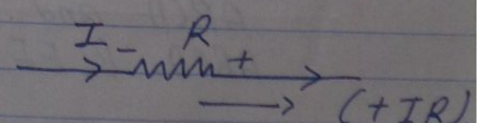
fall in potential



Rise in potential



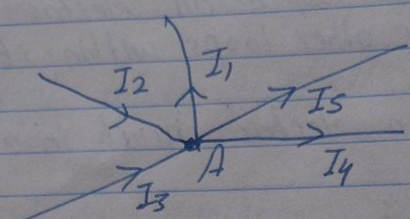
fall in potential (−IR)



Rise in potential

Nodal Analysis:

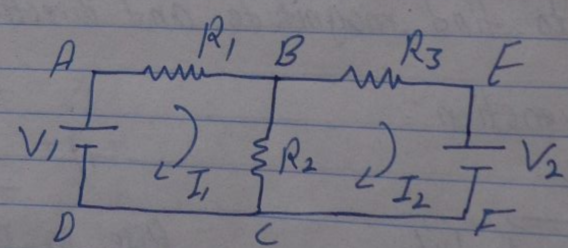
The algebraic sum of incoming and outgoing current at a point or junction or node is equal to 0.



At point A,

$\therefore$ $I_2 + I_3 - I_1 - I_5 - I_4 = 0$

Eg:



Here,

ABCD and BCEF are meshes.
ABCD, BCEF and ADEF are loop.

① Nodal analysis:

Taking point C as ground,

$\therefore$ $\dfrac{V - V_1}{R_1} + \dfrac{V - V_2}{R_3} + \dfrac{V}{R_2} = 0.$

On solving, we can get value of voltage at node B.

(ii) Mesh analysis:

For mesh (i),

$$V_1 - I_1R_1 - (I_1 - I_2)R_2 = 0$$

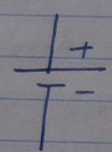
For mesh (ii),

$$V_2 - (I_2 - I_1)R_2 - I_2R_3 = 0$$

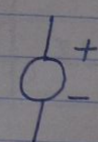
on solving them, we can get current of meshes.

9. Dependent and Independent voltage sources:

∴ Independent voltage source:



or,



Independent voltage source doesnot depend upon other current source or voltage source.

Dependent voltage source:

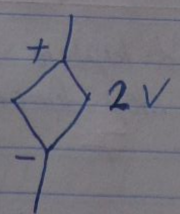


Fig: voltage dependent voltage source.

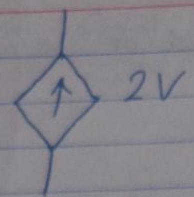


Fig: voltage dependent current source.

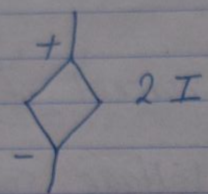


Fig: current dependent voltage source.

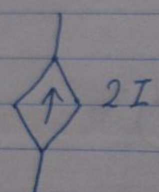


Fig: current dependent current source.

On dependent type of voltage source, voltage source is dependent on current or voltage.

10. Define inverse laplace transform. Find laplace transform of common forcing functions: unit step function, delta function and ramp function. 7

⇒ Inverse Laplace transformation is given by the complex inversion integral.

$$f(t) = \frac{1}{2\pi} \int_{\sigma_1 - j\infty}^{\sigma_1 + j\infty} F(s) e^{st} \, ds.$$

Where, σ is the real part of s.

Symbol L^{-1} is generally used to denote the inverse laplace transformation.

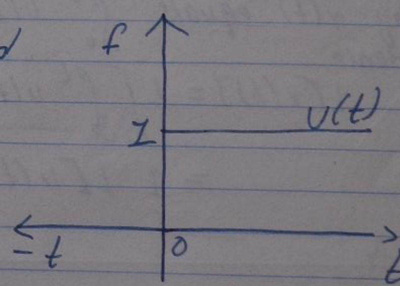
$$L^{-1}[L\{f(t)\}] = L^{-1}[F(s)] = f(t).$$

① Unit step function:

The unit function is defined as,

$$f(t) = \begin{cases} 1, & t \geq 0 \\ 0, & t < 0 \end{cases}$$

It is denoted by $u(t)$.



$$L[u(t)] = \int_0^\infty e^{-st} \, dt$$

$$= -\left| \frac{1}{s} e^{-st} \right|_0^\infty$$

$$= \frac{1}{s}$$

Hence, $L[u(t)] = \frac{1}{s}$

$$L[u(t-a)] = \int_0^\infty 1 \cdot e^{-st} \, dt$$

$$= \left[-\frac{e^{-st}}{s} \right]_a^\infty$$

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$\therefore L[u(t-a)] = e^{-as}\left(\frac{1}{s}\right)$.

(11) Ramp function:

If a time variant current or voltage increases linearly with time, it is known as a ramp function or a linear lamp.

A unit ramp function occuring at $t=0$ denoted by $r(t)$ equals $\int_0^t u(t)\,dt$.

Hence,

$$L[r(t)] = L\left[\int_0^t u(t)\,dt\right]$$

$$= \frac{1}{s}\,L[u(t)] = \frac{1}{s^2}$$

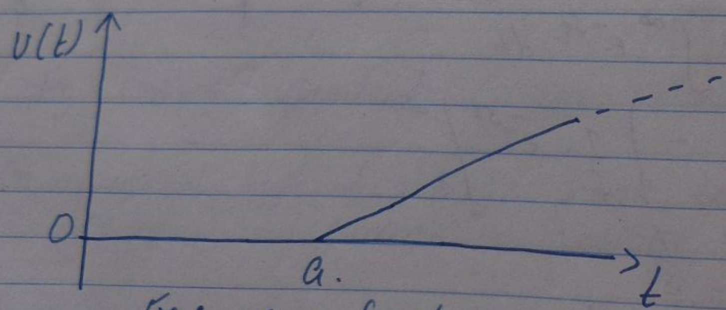


Fig: ramp function.

Consider a unit step voltage applied to an inductor L. Then, the inductor current is given by,

$$i_L = \frac{1}{L}\int_{-\infty}^{t} V_L\,dt$$

Now, $V_L = v(t)$

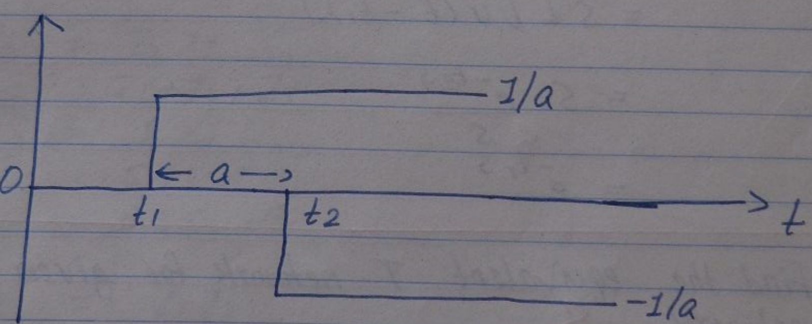
If, $i_L(0+) = 0$, then

$$i_L = \frac{t}{L} \quad \text{for } t > 0$$

Thus, this response current constitutes a ramp function.

(iii) Impulse function:

If a function has only one non-zero value and if this value is infinite, then this function is known as an impulse function.



$$L[\delta(t-t_1)] = \lim_{a \to 0} \frac{e^{-t_1 s} - e^{-t(t_1+a)s}}{as}$$

where, $a = t_2 - t_1$

Hence,

$$L\,\delta(t-t_1) = e^{-t_1 s}$$

Here, t_1 is instant at which the unit impulse appears when $t_1 = 0$. i.e, when unit impulse occurs at $t = 0$.

$$L[\delta t] = 1.$$

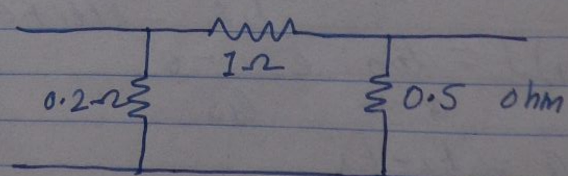
So,

$$L\,\delta(t) = L\left[\frac{d}{dt}u(t)\right]$$
$$= sL[u(t)]$$
$$= s\cdot\frac{1}{s}$$
$$= 1.$$

and,

$$L\,\delta(t-t_1) = L\left[\frac{d}{dt}u(t-t_1)\right]$$
$$= sL[u(t-t_1)]$$
$$= s\cdot\frac{e^{-t_1 s}}{s}$$
$$= e^{-t_1 s}$$

11. Find the equivalent T network for given π network. 8



Soln,

let the equivalent T-network have impedance Z_c in the shunt arm and impedance Z_a and Z_b in the series arms. Then we have

$$Z_1 = \frac{1}{y_1} = \frac{1}{0.2} = 5\,\Omega$$

$$Z_2 = \frac{1}{y_2} = \frac{1}{0.5} = 2\ \Omega$$

$$Z_3 = \frac{1}{y_3} = \frac{1}{1\ S} = 1\ \Omega$$

Hence,

$$Z_a = \frac{Z_1 . Z_3}{Z_1 + Z_2 + Z_3} = \frac{5 \times 1}{5+2+1} = 0.625\ \Omega$$

$$Z_b = \frac{Z_2 Z_3}{Z_1 + Z_2 + Z_3} = \frac{2 \times 1}{5+2+1} = 0.25\ \Omega$$

$$Z_c = \frac{Z_1 Z_2}{Z_1 + Z_2 + Z_3} = \frac{5 \times 2}{5+2+1} = 1.25\ \Omega.$$

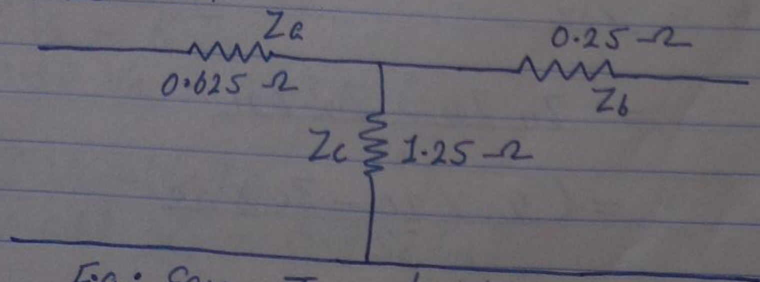
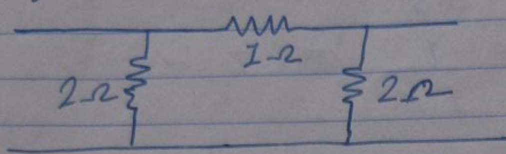


Fig: Eqv. T network.

12b. Find equivalent T network for given π network. 8



Sol^n,
Follow same pattern of Q.N 11 and evaluate yourself.

13. The Z-parameters for a two port network are $Z_{11} = 20\,\Omega$, $Z_{22} = 10\,\Omega$, $Z_{12} = Z_{21} = 30\,\Omega$. Compute the transmission parameters for the network. Hence, write the network eq^n using these two types of parameters. 8

Sol^n,

$$A = \frac{Z_{11}}{Z_{21}} = \frac{20}{30} = 0.67$$

$$B = \frac{\Delta z}{Z_{22}} = \frac{Z_{11}.Z_{22} - Z_{12}.Z_{21}}{Z_{21}} = \frac{(20 \times 10 - 30 \times 30)}{30} = -23.33\,\Omega$$

$$C = \frac{1}{Z_{21}}$$

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

$$= 0.033 \ S$$

$$D = \frac{Z_{22}}{Z_{21}}$$

$$= \frac{10}{30}$$

$$= 0.33$$

Network eq^n using Z-parameter are,

$\therefore \ V_1 = 20 I_1 + 30 I_2$

$\therefore \ V_2 = 30 I_1 + 10 I_2$

Similarly, network eq^n using ABCD parameters are,

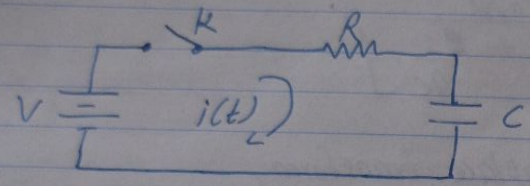
$$V_1 = A V_2 - B I_2$$
$$= 0.67 V_2 + 23.33 I_2$$

$$I_1 = C V_2 - D I_2$$
$$= 0.033 V_2 - 0.33 I_2$$

Exam:

14. Step Response of Series RC circuit:

Consider a series RC circuit as in figure.



let the switch be closed at time $t=0$. Applying kirchhoff's voltage law to the circuit,

$$\frac{1}{C}\int_{-\infty}^{t} i\,dt + iR = V_0\, u(t). \quad \text{— (i)}$$

or $$\frac{1}{C}\int_{0}^{t} i\,dt + \frac{1}{C}\int_{-\infty}^{t} i\,dt + iR = V_0\, u(t). \quad \text{— (ii)}$$

Then, corresponding laplace transform eqn becomes,

$$\frac{1}{C}\left[\frac{I(s)}{s}\right] + \frac{1}{C}\left[q(0+)\right] + RI(s) = V_0\,\frac{1}{s}.$$

or, $$\frac{1}{C}\left[\frac{I(s)}{s} + \frac{q(0+)}{s}\right] + RI(s) = \frac{V_0}{s} \quad \text{— (iii)}$$

Now $q(0+)$ is the charge on the capacitor C at time $t = 0+$. If the capacitor in initially uncharged, then $q(0+) = 0$. Hence, eqn (iii) becomes, or $I(s)\left[\frac{1}{C(s)} + R\right] = \frac{V_0}{S}$

Hence,

$$\therefore I(s) = \left[\frac{V_0/R}{s+\frac{1}{RC}}\right].$$

Taking inverse laplace transform,

$$L^{-1}[I(s)] = L^{-1}\left[\frac{V_0/R}{s+1/RC}\right]$$

$$\therefore i(t) = \frac{V_0}{R} e^{-t/RC} \quad \text{—— (i)}$$

eqn (i) gives complete particular solution.

15.

D. Positive real functions:

A function $T(s) = \frac{N(s)}{D(s)}$ is positive real if the following conditions are satisfied.

i) $T(s)$ is real for s real i.e, $T(\sigma)$ is purely real.

ii) $D(s)$ is Hurwitz polynomial.

iii) $T(s)$ may have poles on the $j\omega$-axis. These poles are simple and the residues, there of are real and positive.

iv The real part of $T(s)$ is greater than or equal to 0 for the real part of s is greater than or equal to 0,

i.e, $Re[T(s)] \geq 0$ for $Re\ s \geq 0$

$Re[T(s)] \geq 0$ for $Re\ s = 0$

$Re[T(s)] \geq 0$ for $Re\ s > 0$

Hence,

$Re[T(j\omega)] \geq 0$ for all ω.

Properties of positive real function:

i) The poles and zeros of a positive real function are real or occur in conjugate pairs.

ii). The highest power of the $N(s)$ and $D(s)$ polynomial may differ at most by unity. This condition prohibits multiple poles or 0's at $s = \infty$

iii). The lowest power of the $D(s)$ and $N(s)$ polynomial may differ by atmost unity. This condition prevents the possibility of multiple poles or zeros at $s=0$.

iv. The poles and zeros of a p.r.f cannot have positive real parts. i.e, they cannot be in the right half of the s-plane.

v. Only simple poles with real positive residues exist on the $j\omega$ – axis.

vi. The difference of two p.r.f is not necessarily p.r.

vii If $T(s)$ is p.r, then $\frac{1}{T(s)}$ is also p.r.

2. Dependent and independent voltage source:

A

Independent sources:

i) Ideal voltage source:

It maintains a constant terminal voltage regardless of the value of the current through its terminal.

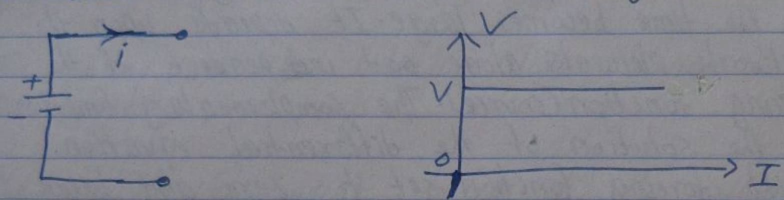


Fig: ideal voltage source & its V-i characteristic

ii) Practical voltage source:

voltage across the terminals of the source keeps falling as the current through it increases. This behaviour can be explained by connecting a resistance r in series with an ideal voltage source.

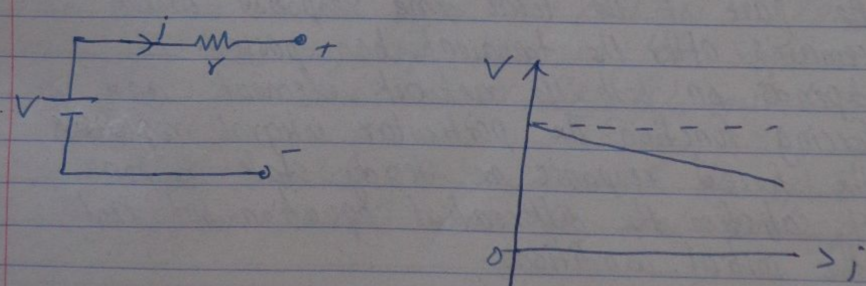


Fig: practical voltage source & it's V-I characteristic.

B. Transient and steady state Response:

The values of voltage and current during the transient period are known as the transient responses. It is also defined as the part of the total time response that goes to zero as the time becomes large. It depends upon the network elements alone and independent of the forcing function (source). The complementary function is the solution of the differential equation with forcing function set to zero and hence the complementary function represents the source-free response or simply free response or natural response or transient response.

The values of voltage and current after the transient has died out are known as the steady state responses. It is also defined as the part of the total time response which remains after the transient has passed. It depends on both the network elements and forcing function. The particular integral represents the forced response or steady state response. It satisfies the differential equation but not the initial conditions.

C. Properties of RL and RC network:

⇒ Properties of RC impedance or R-L admittance function:

i) The poles and zeroes lies on the negative real axis (included origin) of the complex s-plane.

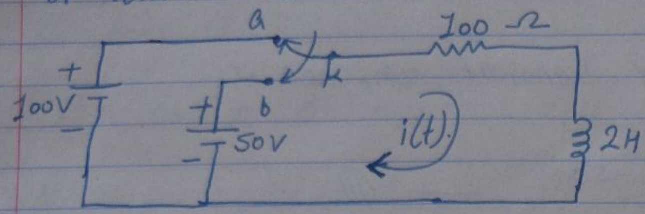
ii) The poles and zero interlace (or alternate) along the negative real axis.

iii) The singularity nearest to (or at) the origin must be a pole i.e. function $Z_{R-C}(s)$ or $Y_{R-L}(s) \to \infty$ with $s \to 0$

iv. The singularity nearest to (or at) the minus infinity $(-\infty)$ must be a 0 i.e. function $Z_{RC}(s)$ or $Y_{R-L}(s) \to 0$ with $s \to \infty$

v. The residues of the poles of $Z_{R-L}(s)$ or $Y_{R-C}(s)$ are real and negative, however the residues of the poles of $\frac{Y_{R-C}(s)}{s}$ or $\frac{Z_{R-L}(s)}{s}$ must be real and positive. while the residues of the poles of $Z_{R-C}(s)$ or $Y_{R-L}(s)$ must be real and positive.

1. A. In the circuit given below, switch k is moved from position 'a' to 'b' at time $t=0$. Find complete response of current $i(t)$ for $t \geq 0^+$.



Sol^n,
Using KVL in circuit for $t = 0^+$,

or $50 = Ri + L\frac{di}{dt}$

or, $50 = 100\,i + 2\frac{di}{dt}$ — (i)

For steady-state response, i is constant because voltage source is constant.

or $50 = 100\,i_f + 2\frac{di_f}{dt}$

or $50 = 100\,i_f + 0$

$\therefore\ i_f = 0.5$ A.

For transient response, required homogenous eq^n is,

or, $100\,i + 2\frac{di}{dt} = 0$

or, $100\,i + 2\,S\,i = 0$

or $100 + 2\,S = 0$

$\therefore S = -50.$

General eqn for transient response is,

$i_t = k e^{+st}$

$\therefore i_t = k e^{-50t}$ —— (II)

Complete response is,

$i(t) = i_f + i_t$

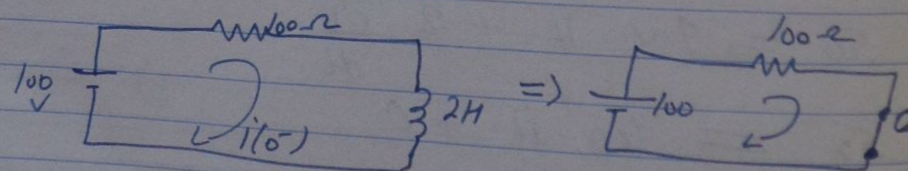
$\therefore i(t) = 0.5 + k e^{-50t}$ —— (III)

When $t=0$ in eqn (III)

$i(0^+) = 0.5 + k$

$\therefore k = i(0^+) - 0.5$ —— (IV)

For $i(0^+) = i(0^-)$,



$i(0^-) = \frac{100}{100} = 1\,A$

$i(0^+) = i(0^-) = 1\,A$

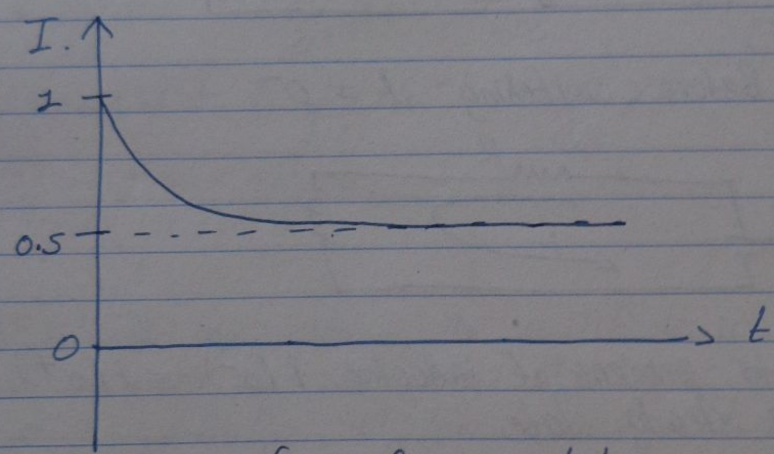
Replacing in eqn (iv),

$$k = 1 - 0.5$$
$$= 0.5$$

So, from (iii),

$$\therefore i(t) = 0.5 + 0.5e^{-50t}$$

Total response $(i(t)) = 0.5 + 0.5e^{-50t}$.



Waveform for Complete response.

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