Netwoork Analysis

Signal → in EC it represent time varring voltage, current or electro-magnetic wave that carries info.

NOTE →

Laplas trans. or

Time domen → Mathmatical tool → frequency domen

fourier tr or z- transf.

Type :

① Periodic → A signal that repeat its value at a regular interval of time.

$$X(t) = (t + T_0)$$

where T_0 → Period

if a signal does not satisfy above eqn called no periodic

② Continuous and descreat signal →
Continious time signal or Analog signal are defined for every value of time for a continuous interval.

Ex - sine wave, cosin, tringular.

Discreat time function are sampled version of continuous time function.
in such function, the independent variable is in discrete form.

$$x(n) = 5^n$$
where $n = 0, 1, 2 \ldots$

even function or (symmetrical)
A signal is said to be even function if inversion of time axis does not change its amplitute.

functions are symmetrical about vartical Axis.

$$x(-t) = x(t)$$

A signal is said to be odd if it is negative of its reflection
$$x(-t) = -x(t)$$

in such signal inversion of time axis invert Amplitude of signal.

Deterministic and random signals :-

Deterministic are those signal which define completly at specified function of time.

whenever A random signal contains uncertain information about their values.
Ex - noise.

Complex frq. :- A frq. which depent on "σ" which control the magnitude of signal and "w" which control rotation of signal.

$$\boxed{X(t) = X_m e^{st}}$$

when $\boxed{S = \sigma + j\omega}$

$\sigma \to$ real part of s known as neper frq.

$w \to$ ration freq.

$$X(t) = X_m \cdot e^{\sigma t} \cdot e^{j\omega t}$$

$$= X_m e^{\sigma t} [\cos\omega t + j \sin\omega t]$$

Case - 1 - when $w = 0$ & σ has certain value then real part

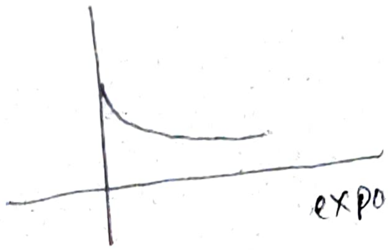
$$\boxed{X(t) = X_m \cdot e^{\sigma t}}$$

$$\boxed{S = \sigma}$$

(i) $\sigma > 0$

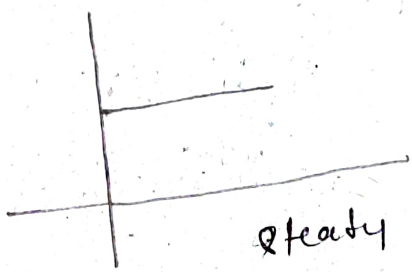
Exponential incr.

(ii) $\sigma < 0$



exponential decr.

(iii) $\sigma = 0$



steady state curve

Case 2 -

when $\sigma = 0$ & w has some certain value then real part

$$x(t) = X_m \cos(wt)$$

and imaginary part

$$x(t) = X_m \sin(wt)$$

sinusoidal steady state curve is obtained.

Case - 3 when both have real value

real part

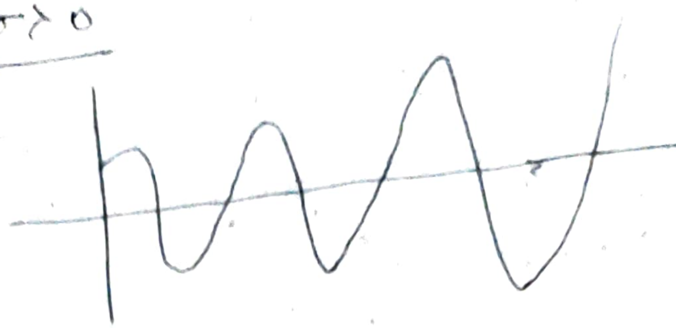
$$x(t) = X_m e^{\sigma t} \cos(wt)$$

Im.

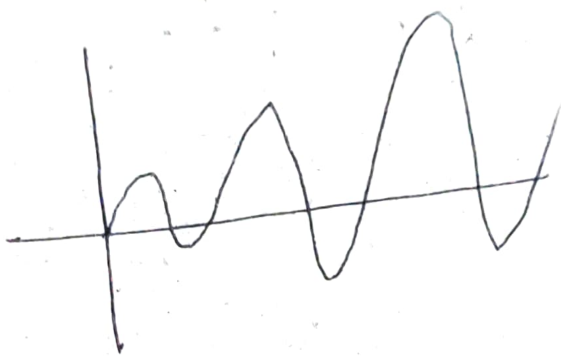
$$x(t) = X_m e^{\sigma t} \sin(wt)$$

(i) when $\sigma > 0$

real part

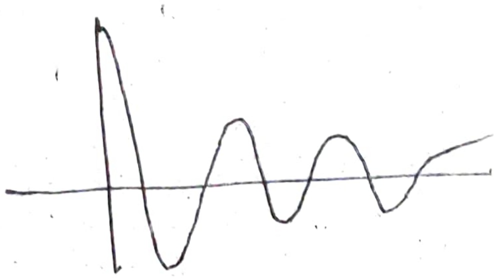


Imagenary

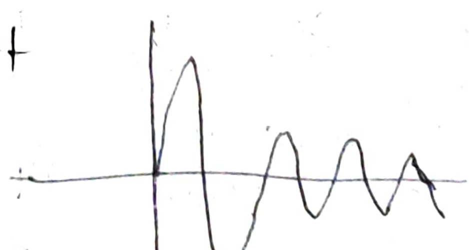


(ii) when $\boxed{\sigma < 0}$

Real part



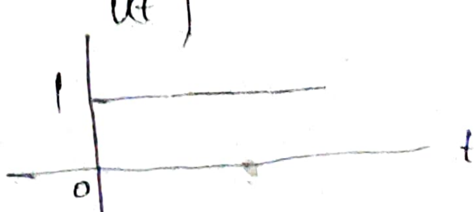
Imagenary part



Standart test signal

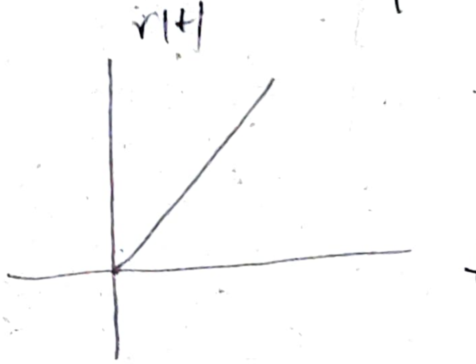
Unit step signal

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



Ramp signal

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



Impulse signal

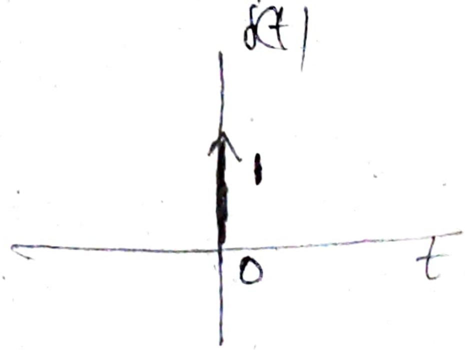
$$\delta(t) = \begin{cases} 0 & t \neq 0 \\ 1 & t = 0 \end{cases}$$

the ideal impulse is the impulse that is zero every where but at origin it is infinitely high, the area of impulse is finite.

Unit impulse signal is mostly widely used the Area of unit impulse signal is 1.

~~i.e area~~

$$\int_{-\infty}^{\infty} \delta(t) \cdot dt = 1$$



Network : Electrical network is an interconn of electrical element such as resistor inductor, capacitor

Network element :-

① Active element : ~~electrical~~ element which are capable of generating electrical energy called Active element.

② Passive element :- those element which consume energy and having tendency to change the form of Applied energy into other form of energy.

Ex of ① - voltage and current source, op. amps. transistor.

Ex of ② resistor, capacitor, inductor.

③ Unilateral :- those element in which direction of current passes through them it changed then properties of circuit also changed.

Ex. diode, transistor.

④ Biletral :- ~~and~~ those element in which direction of current passes do not change the property of circuit.
resistor, conductor, capacitor.

(5) Lumped :-
network in which all the network element are physically separable is known as lumped network.

Ex - Resistor, inductor, capacitor.

Distributed - network in which the circuit element can not be physically separable for analysis.

Ex - transmission line.

transient behaviour of a Networks :-

transient condition :-

(1) steady state condition :-
After transient period, the circuit response reach its stable value and such condition is called steady state condition.

transient period :- when change occurs in any network for a very short duration of time circuit response changes rapidly it may contain peak of very high Amplitude, this period of time is known As transient period.

initial condition of circuit ⇒

the behaviour of any electrical circuit can be examined using deferential eqn.

these eqn are given value of voltage current or derivative of these quantity w.r.t time

$t(0^-)$ ⇒ the time instant at which network is not yet change but about to be changed.

$t(0^+)$ ⇒ instant at which the condition of network is just changed.

- **Resistor** ⇒

$$V = IR$$

- liniar time independent eqn.
- current through resistor changes instantanly if its Applied voltage changes.

- **capacitor** $\left(i = C\frac{dV}{dt}\right)$

fully change capacitor behave like open circuit.

capacitor does not allow sudden change in ~~current~~ voltage.

Inductor →

$$\boxed{V = L \cdot \frac{di}{dt}}$$

Does not allow sudden change in current.

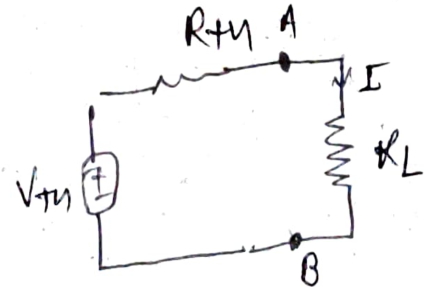
fully charge inductor behave like short circuit so no effect of sudden change in current on inductor.

Maximum power transfer theorm →

DC voltage source will deliver max power to variable load when load resistance is equal to source resistance.

AC voltage source will deliver max power to the variable complex load when load impedance is equal to complex conjugate of source impitence.

Proof →



$$P_L = I^2 R_L$$

$$I = \frac{V_{th}}{R_{th} + R_L} \quad \text{(thevnin theorem)}$$

$$P_L = \left(\frac{V_{th}}{R_{th}+R_L}\right)^2 R_L$$

For max or min first ~~zer~~ derivative will zero.

$$\frac{\partial P_L}{\partial R_L} = 0$$

$$\boxed{R_L = R_{th}}$$

→ Value of Max power transfer.

Put $R_L = R_{th}$ & $P_L = P_{max}$

$$P_L = \left(\frac{V_{th}}{R_{th}+R_L}\right)^2 R_L$$

⇒

$$\boxed{P_{max} = \frac{V_{th}^2}{4R_L}}$$

→ Efficiency of Max power →

$$\eta_{max} = \frac{P_{max}}{P_S}$$

$$P_S = I^2(R_{th}+R_L)$$

$\because R_{th} = R_L$

$\Rightarrow P_{max} = \dfrac{V_{th}^2}{4 R_{th}}$

$\Rightarrow P_s = \dfrac{V_{th}^2}{2 R_{th}}$

$\eta = \frac{1}{2} = 50\%$ Ans.

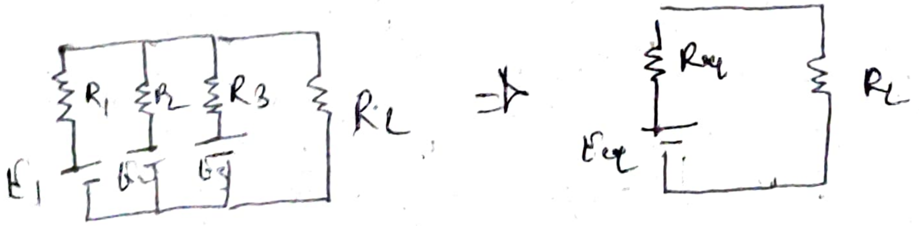
MILLMAN'S THEOREM ⇒

Through the Application of Millman's theorem any parallel voltage sources can be reduced to one.

Steps ⇒ (1). Convert all voltage sources to current source.

(2) Combine parallel current source.

(3) Convert the resulting current source to a voltage source

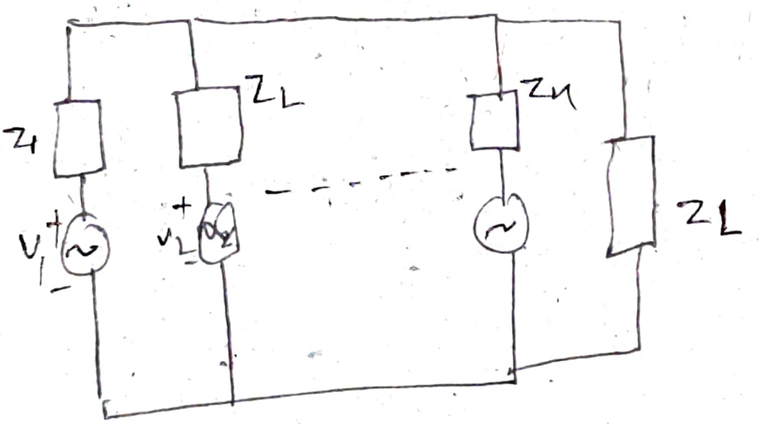


$$E_{eq} = \frac{\frac{E_1}{R_1} + \frac{E_2}{R_2} + \cdots \frac{E_n}{R_n}}{\frac{1}{R_1} + \frac{1}{R_2} + \cdots \frac{1}{R_n}}$$

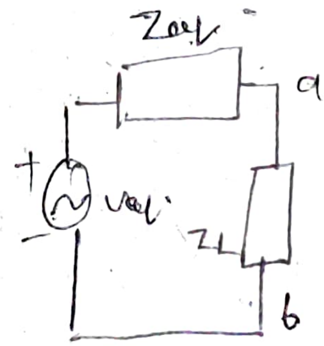
$$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} \cdots \frac{1}{R_n}}$$

for AC Network ⇒

if n number of voltage sources V_1, V_2, V_3 ---- V_n having internal impedance Z_1, Z_2, Z_3, -- Z_n are connected in parrelel Across load Z_L.



⇒



$$V_{eq} = \frac{\frac{V_1}{Z_1} + \frac{V_2}{Z_2} \cdots \frac{V_n}{Z_n}}{\frac{1}{Z_1} + \frac{1}{Z_2} \cdots \frac{1}{Z_n}}$$

$$Z_{eq} = \frac{1}{\frac{1}{Z_1} + \frac{1}{Z_L} + \cdots \frac{1}{Z_n}}$$