SIGNALS & SYSTEMS

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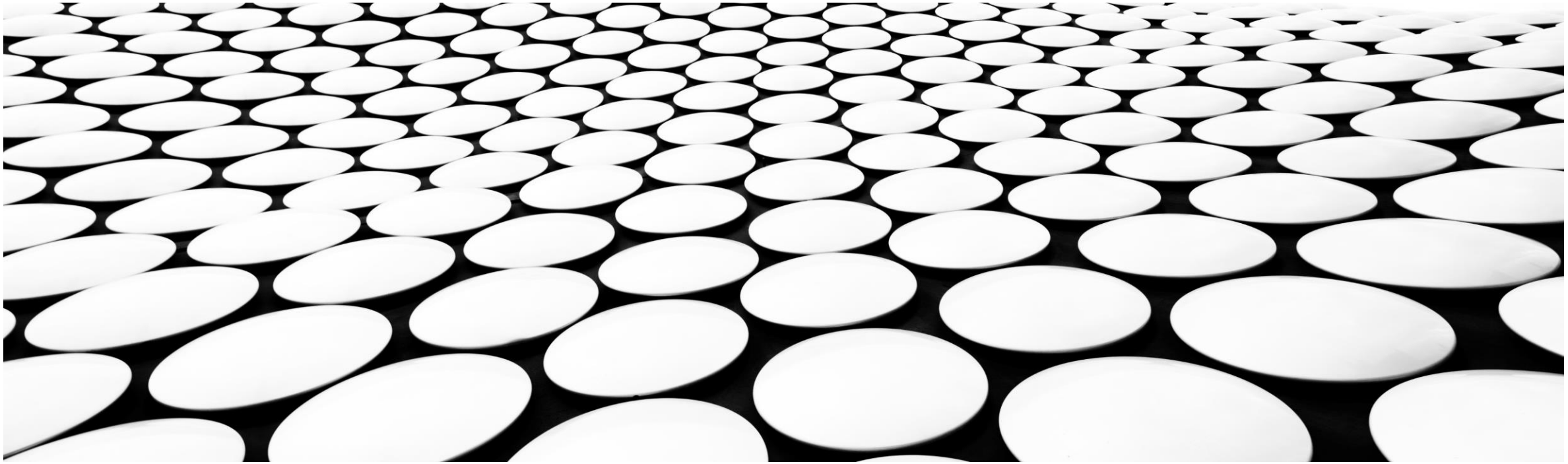
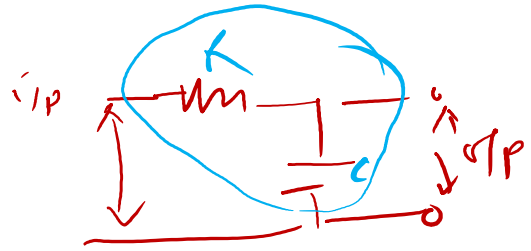
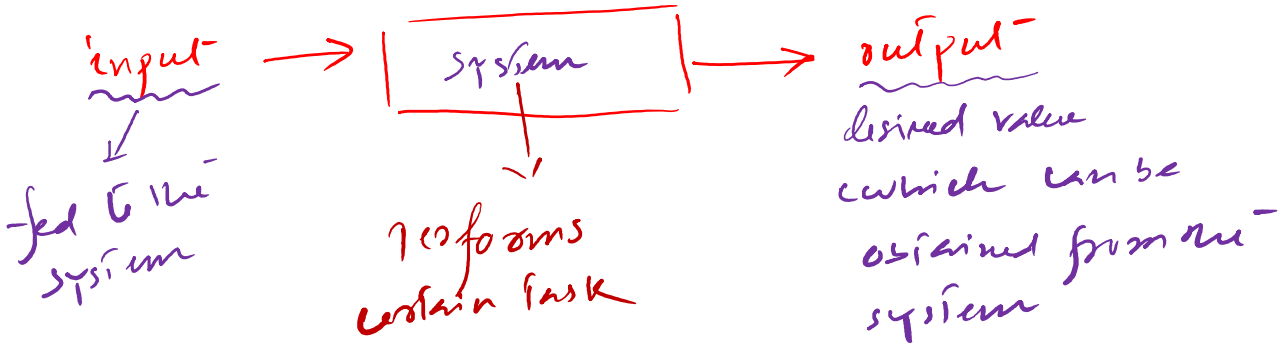


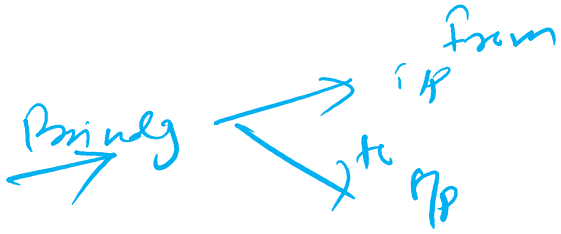
System :-

what is system?





System is nothing but - circuit / combination / arrangements of different blocks / elements to perform specific tasks for a given i/p to produce a desired o/p.



Classification of systems -

1) Static and dynamic systems.
2) Causal and non-causal systems.
3) Time variant and time invariant systems.
4) Linear and non-linear systems.
5) Stable and unstable stable.

:- Static and dynamic systems:-

A system is said to be static if the o/p of the system depends only on the present value of i/p.

→ dynamic system → o/p of the system depends on → past
→ sometimes present
→ future

$y(t) = 2x(t)$ → Expⁿ of a system.

present value of i/p

$t = 0 \rightarrow y(0) = 2x(0)$

$t = 1 \rightarrow y(1) = 2x(1)$

$t = -1 \rightarrow y(-1) = 2x(-1)$

→ stands for static system.

$V = IR$

$I = \frac{1}{R}V$

Examples of Dynamic system

$$y(t) = x(t) + x(t-1)$$

Time shifting.

$t = 0 \Rightarrow \quad y(0) = x(0) + x(-1)$

$t = 1 \Rightarrow \quad y(1) = x(1) + x(0)$

$t = -1 \Rightarrow \quad y(-1) = x(-1) + x(-2)$

$y(t)$ of the system depends on present value as well as the past values of the systems

$\Downarrow$

Dynamic

Capacitor

$$U = \frac{1}{2} CV^2 = \frac{1}{2} \frac{Q^2}{C} = \frac{1}{2} QV$$

$y(t) = e^{-(t+1)}\, x(t)$

(anything)

e ⟶ Always constant no.

$\rightarrow$ coefficient of $x(t)$

Static system ⟶ Memoryless system

Dynamic System ⟶ system having memory.

$y(t) = x(2t)$ ⟶ (time scaling)

$t = 0 \Rightarrow y(0) = x(0)$ ⟶ present

$t = -1 \Rightarrow y(-1) = x(-2)$ ⟶ past

$t = 1 \Rightarrow y(1) = x(2)$ ⟶ future

} Dynamic

$y(t) = \frac{dx(t)}{dt}$

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Voltage drop across the inductor $\Rightarrow V_L = L\frac{di}{dt}$ → Mag. Energy

Electric Energy ← capacity, $V_C = \frac{1}{C}\int i\,dt$

X Resistor, $V_R = R\,i$

1st derivative → slope

$y = mx$ $\quad m = \frac{dy}{dx}$

Integration value → dynamic

Time scaling
Time shifting
} ⇒ dynamic system ⇐ { Integration → Integral value
differentiation → derivative value.

Causal and Non-causal systems:-

Causal:- O/p of the system is independent of future value of i/p but can be dependant on present and past values of i/p.

$y(t) = x(t) \longrightarrow$ Causal

All practical / Real time systems. $\Rightarrow$ causal system.

physically realizable system.

$y(t) = x(t) + x(t-1)$

$t = 0 \Rightarrow y(0) = x(0) + x(-1)$ (present, past)

$t = 1 \Rightarrow y(1) = x(1) + x(0)$

$t = -1 \Rightarrow y(-1) = x(-1) + x(-2)$

Non-causal → o/p of the system depends on the future value of the i/p.

$$y(t) = x(t+2)$$

$t = 0 \Rightarrow y(0) = x(2)$ → future → Non-causal

$$y(t) = x(t) + x(t-1) + x(t+1)$$ → Non-causal

- $y(t)$ → o/p
- $x(t)$ → present value
- $x(t-1)$ → past value
- $x(t+1)$ → future value

Anti causal → o/p sample depends on future value of the i/p

$y(t) = x(t+2)$ → Anti causal

↓

No present or past values of i/p are involved.