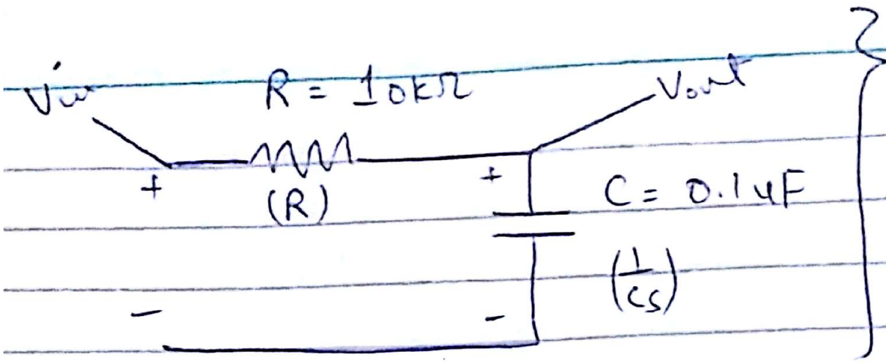
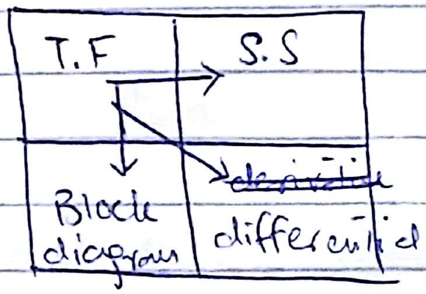



System

Step 1 Modeling
Physical → Engg world.

Physical world. (System) $\xrightarrow{\text{VDL, KVL, KCL, Newton's laws}}$




Voltage divider Rule :- (Transfer function)

$$V_{out}(s) = \frac{1/Cs}{R + \frac{1}{Cs}} V_{in}(s)$$

$$V_{out}(s) = \frac{1}{RCs + 1} V_{in}(s)$$

$$H(s) = \frac{V_o(s)}{V_i(s)} = \frac{1}{RCs+1} = \frac{1/RC}{s + 1/RC}$$

(standard form)

$$H(s) = \boxed{\frac{1/RC}{s + 1/RC}} = \boxed{\frac{1}{RC} e^{-t/RC}}$$

system in t.f

system in time domain

i) $K = 1/RC$

ii) zero $z_1 = \infty$ $\quad p_1 = -1/RC$

# Differential Equation

$$\frac{V_o(s)}{V_i(s)} = \frac{1/RC}{s + 1/RC} \qquad (\text{T.F})$$

$$V_o(s)\left(s + \frac{1}{RC}\right) = \frac{1}{RC} V_i(s)$$

$$\dot{V}_o + V_o\left(\frac{1}{RC}\right) = \frac{1}{RC} V_i$$

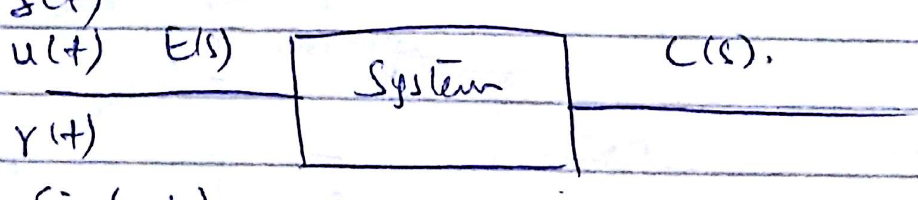
$$\boxed{\frac{d}{dt} V_o(t) + \frac{1}{RC} V_o(t) = \frac{1}{RC} V_i}$$

(differential form of System)

## System Responses

1) Impulse Response
2) Unit Step Response
3) Ramp.
4) Sinusoidal.

⋮




sin(ωt)

↑

Vi

Using System Transfer function :-

$V_i = u(t)$.

$V_i(s) = \frac{1}{s}$.

$$\frac{V_o(s)}{V_i(s)} = \frac{1}{RCs + 1}$$

$$V_o(s) = \frac{1}{RCs+1} \times \frac{1}{s}.$$

Using Partial fraction

$$\frac{1}{s} \times \frac{1}{(RCs+1)} = \frac{A}{s} + \frac{B}{RCs+1}.$$

$$1 = A(RCs+1) + B(s).$$

$s = 0$

$$1 = A.$$

$s = -1/RC$

$$-RC = B$$

$$V_o(s) = \frac{1}{s} + \frac{-RC}{RCs+1}$$

$$= \frac{1}{s} - \frac{1}{s + 1/RC}$$

$$\boxed{V_o(t) = \left(1 - e^{-t/RC}\right) u(t)}$$

| (t) | $V_o(t)$ |
|---|---|
| 1msec | → |
| 2msec | → |
| 3msec | → |
| 4msec | → |
| 5msec | →. |

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