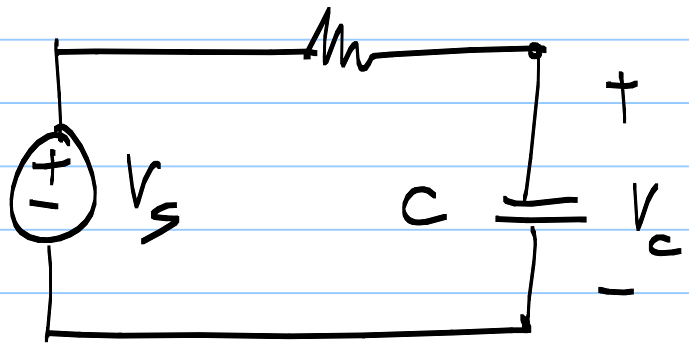
EE2015

18/9/2017



$$RC\frac{dV_c}{dt} + V_c = V_s$$

$$\frac{dV_c}{dt} + \frac{V_c}{RC} = \frac{V_s}{RC}$$

highest derivative = 1st derivative

First order diff. eq

Linear D.E

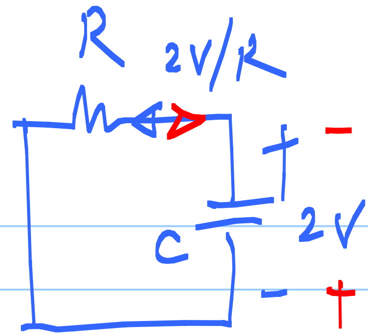
Constant coeff.

Source-free circuit

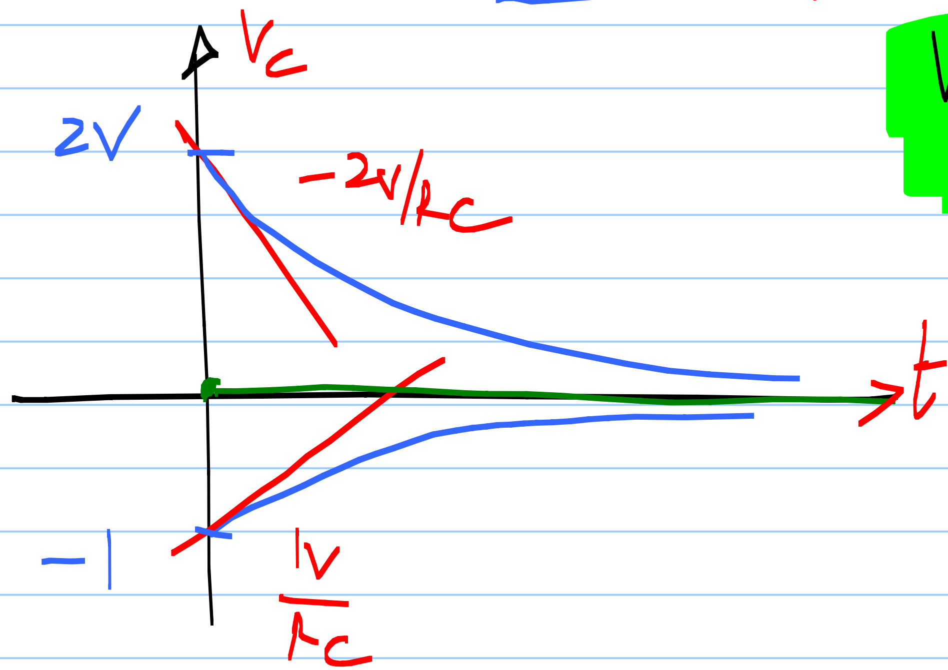
$$V_s = 0$$

$$\frac{dV_c}{dt} + \frac{V_c}{RC} = 0$$

$$\frac{dV_c}{dt} + \frac{V_c}{RC} = 0$$

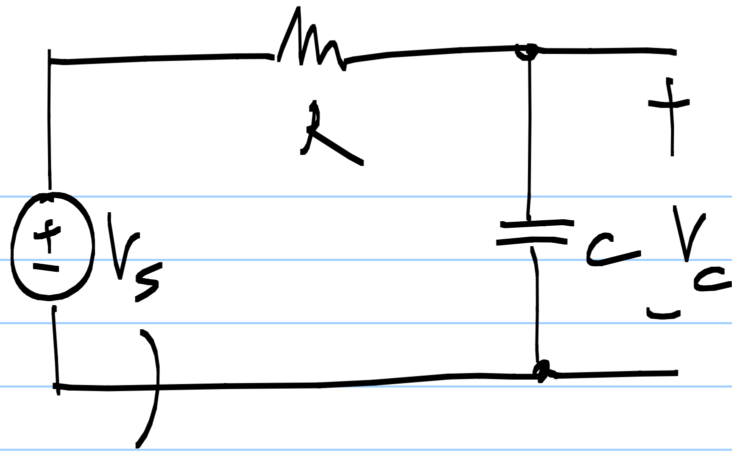


$$\frac{dV_c}{dt} = -\frac{1}{RC} \cdot V_c$$



$$V_c \sim V_c(0) \exp\left(-t/RC\right)$$

Initial condition (state) of the system



constant with time

$$v_{c_1}(t) = v_{c_1}(0)\exp\left(-t/RC\right)$$

$$v_c(t) - V_s = \left(v_c(0) - V_s\right)\exp\left(-t/RC\right)$$

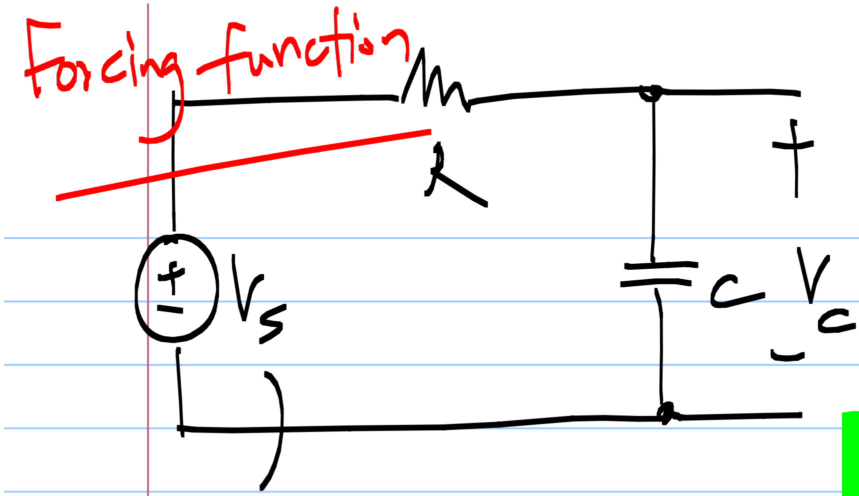
$$v_c(t) = V_s + \left(v_c(0) - V_s\right)\exp\left(-t/RC\right)$$

$$\frac{dv_c}{dt} + \frac{v_c}{RC} = \frac{V_s}{RC}$$

$$v_{c_1} := v_c - V_s$$

$$\frac{dv_{c_1}}{dt} = \frac{dv_c}{dt}$$

$$\frac{dv_{c_1}}{dt} + \frac{v_{c_1}}{RC} = 0$$



Constant with time

$$V_c(t) = V_s + \left(V_c(0) - V_s\right)\exp\left(-t/RC\right)$$

Forced response | Natural response

Steady state response | Transient response

$$V_c(t) = V_s\left(1 - \exp\left(-t/RC\right)\right) + V_c(0)$$

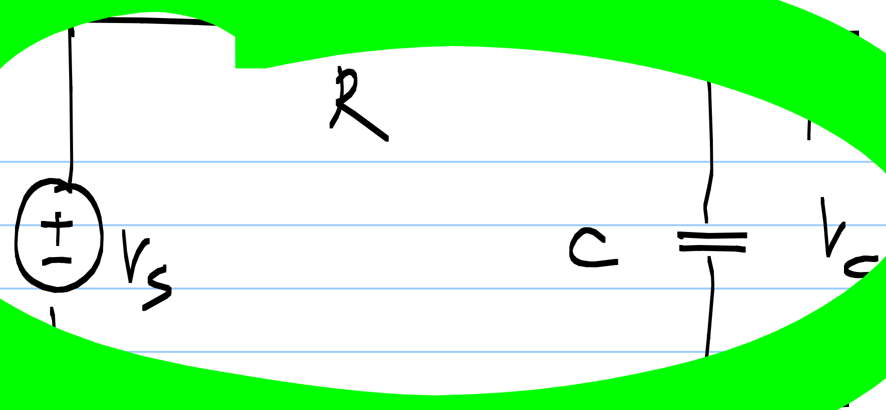
Zero-state response

Zero-input response

Total response: not linear w/ v_s

Zero-input response: linear with $v_c(0)$

Zero-state response: linear with v_s

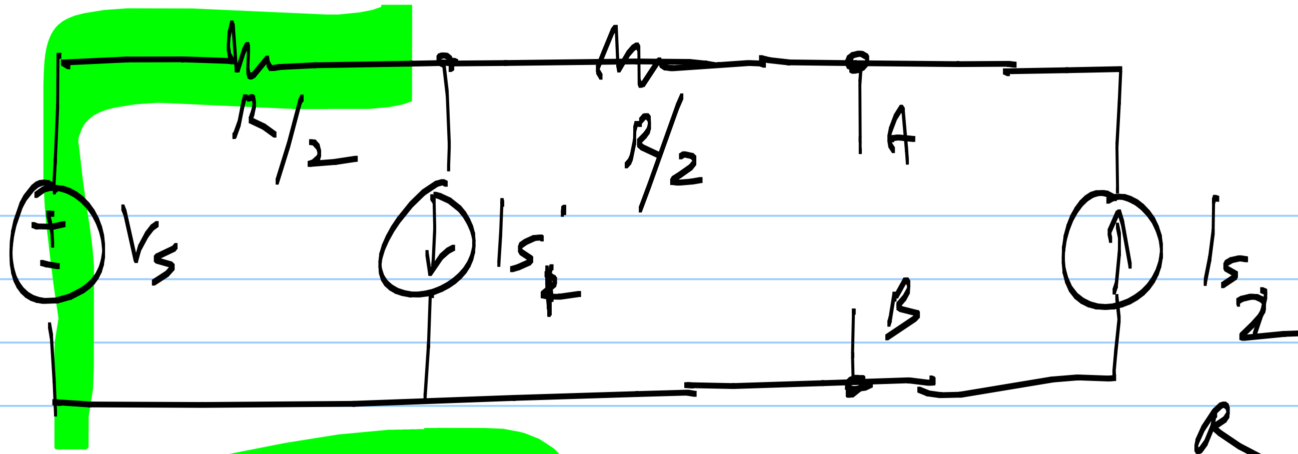


$$\frac{dV_c}{dt} + \frac{V_c}{R} = \frac{V_s}{RC}$$

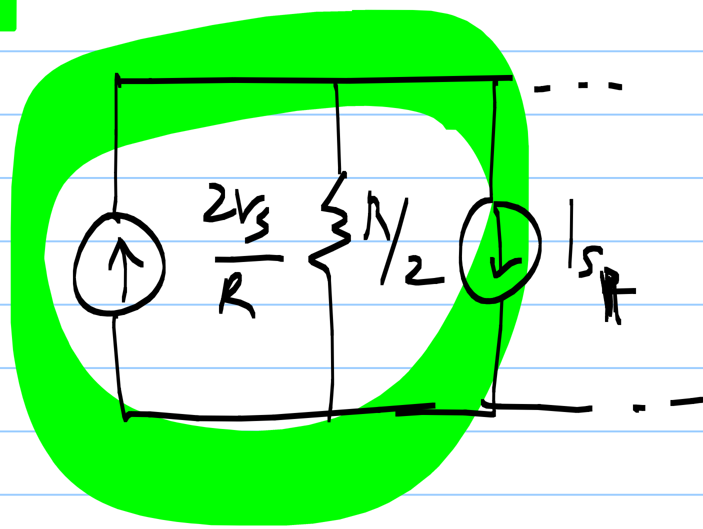
D.E. — with V_c
— with I_1

$$\frac{dV_c}{dt} + \frac{V_c}{RC} = \frac{V_s}{RC} - \frac{I_{s_1}}{2C} + \frac{I_{s_2}}{C}$$

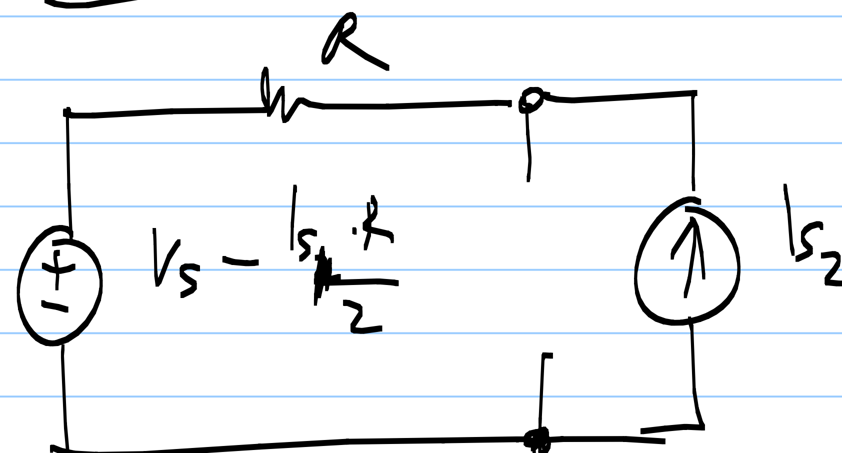
$$\frac{dI_1}{dt} + \frac{I_1}{RC} = \frac{I_{s_1}}{RC} - \frac{I_{s_2}}{RC}$$



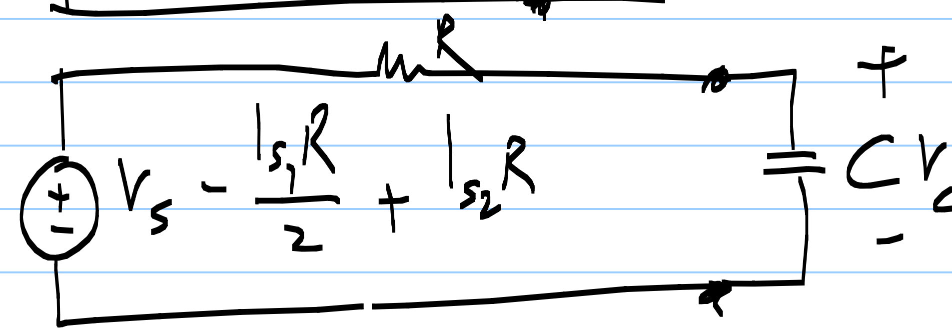
V_s
$R/2$
I_{s_1}
$R/2$
A
B
I_{s_2}



$\frac{2V_s}{R}$
$R/2$
I_{s_1}



R
$V_s - \frac{I_{s_1} R}{2}$
I_{s_2}



R
$V_s - \frac{I_{s_1} R}{2} + I_{s_2} R$
C
V_c
+
-