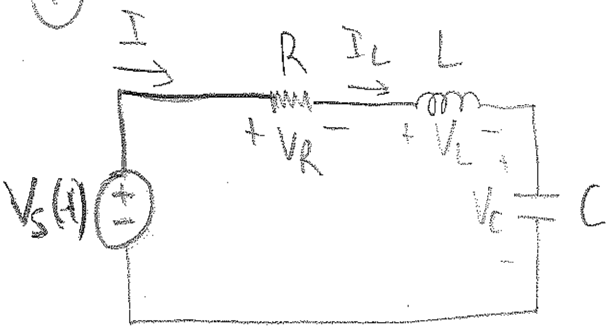
Midterm I [redacted]

(1)



(2) $V_s = V_R + V_L + V_C$ (1) $I = I_L$

$$V_s = RI + L\frac{dI}{dt} + V_C$$ (1) (2)

$$V_s = RI_L + L\frac{dI_L}{dt} + V_C$$

(3) * $$\boxed{\frac{dI_L}{dt} = \frac{V_s}{L} - \frac{V_C}{L} - \frac{R}{L}I_L}$$

(1)

$$C\frac{dV_C}{dt} = I = I_L$$

$$\boxed{\frac{dV_C}{dt} = \frac{I_L}{C}}$$ ** (3)

Take derivative of ** put * inside

(2)

$$\frac{d^2V_C}{dt^2} = \frac{1}{C}\frac{dI_L}{dt} = \frac{1}{C}\left[\frac{V_s}{L} - \frac{V_C}{L} - \frac{R}{L}I_L\right]$$

(5)

$$\frac{d^2V_C}{dt^2} + \frac{1}{LC}V_C = \frac{V_s}{LC} - \frac{R}{LC}I_L \qquad I_L = C\frac{dV_C}{dt}$$ (2)

$$\frac{d^2V_C}{dt^2} + \frac{R}{L}\frac{dV_C}{dt} + \frac{1}{LC}V_C = \frac{V_s}{LC}$$

(3)

or Take derivative of * put ** inside

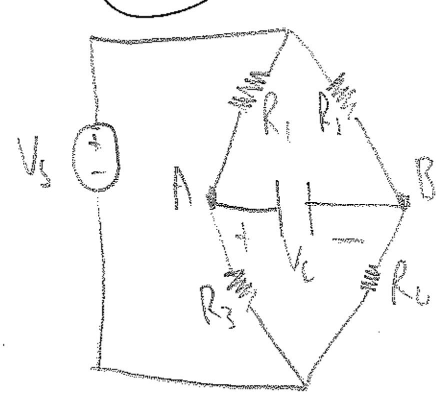
$$\frac{d^2I_L}{dt^2} = \frac{1}{L}\frac{dV_s}{dt} - \frac{1}{L}\frac{dV_C}{dt} - \frac{R}{L}\frac{dI_L}{dt}$$ (2)

$$\frac{d^2I_L}{dt^2} + \frac{R}{L}\frac{dI_L}{dt} = \frac{1}{L}\frac{dV_s}{dt} - \frac{1}{L}\left[\frac{I_L}{C}\right]$$ (5)

(2)

$$\frac{d^2I_L}{dt^2} + \frac{R}{L}\frac{dI_L}{dt} + \frac{1}{LC}I_L = \frac{1}{L}\frac{dV_s}{dt}$$ (3)

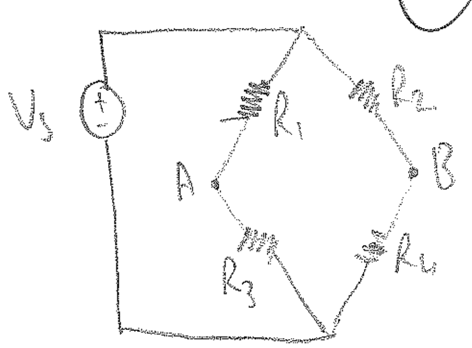
(2) Method II



First find V_{TH} and R_{TH} btw A and B

Diğer türlü gidiş 80
Denklemler 13
Sonuç 5

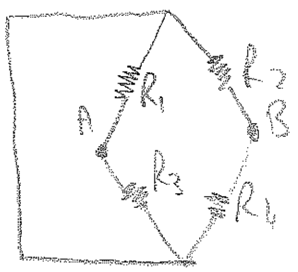
For V_{TH} (10)



$$A = V_S \frac{R_3}{R_1+R_3} \qquad B = V_s \frac{R_4}{R_2+R_4}$$

$$\boxed{A - B = V_{TH} = V_S\left[\frac{R_3}{R_1+R_3} - \frac{R_4}{R_2+R_4}\right]}$$

For R_{TH} : (Kill V_s and find the resistance Btw A and B (10)



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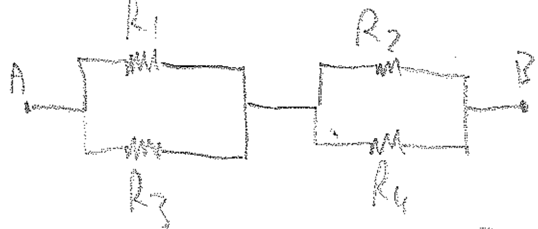
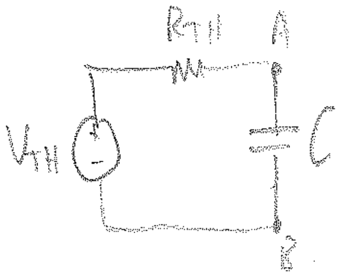


$$R_{TH} = R_{AB} = [R_1 \parallel R_3] + [R_2 \parallel R_4]$$

$$\boxed{R_{TH} = \frac{R_1 R_3}{R_1+R_3} + \frac{R_2 R_4}{R_2+R_4}}$$

Equivalent circuit (5)



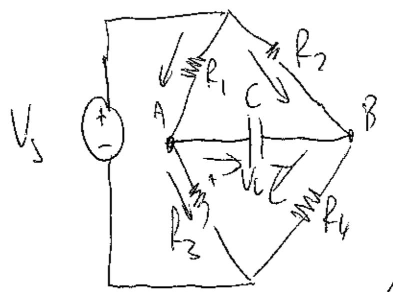
$\xrightarrow{\text{diff}}$ equation

$$V_{TH} = V_C + V_{R_{TH}}$$

$$V_{TH} = V_C + C\frac{dV_C}{dt} R_{TH}$$

$$\boxed{\frac{dV_C}{dt} + \frac{1}{C R_{TH}} V_C = \frac{V_{TH}}{C R_{TH}}}$$

② Method 2



$$\frac{V_s - A}{R_1} = C\frac{dV_c}{dt} + \frac{A}{R_3}$$

$$\frac{V_s - B}{R_2} = \frac{B}{R_4} - C\frac{dV_c}{dt}$$

$$\frac{V_s}{R_1} - C\frac{dV_c}{dt} = A\left[\frac{1}{R_1} + \frac{1}{R_3}\right] \qquad \frac{V_s}{R_2} + C\frac{dV_c}{dt} = B\left[\frac{1}{R_2} + \frac{1}{R_4}\right]$$

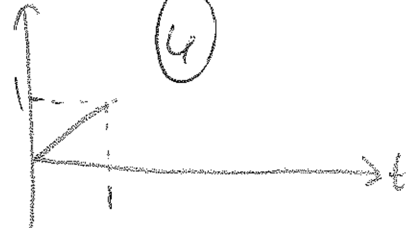
$$\frac{V_s}{R_1} - C\frac{dV_c}{dt} = A\left[\frac{R_1+R_3}{R_1R_3}\right] \qquad \frac{V_s}{R_2} + C\frac{dV_c}{dt} = B\left(\frac{R_2+R_4}{R_2R_4}\right]$$

$$A = \frac{V_sR_3}{R_1+R_3} - \frac{R_1R_3}{R_1+R_3}C\frac{dV_c}{dt} \qquad B = \frac{V_sR_4}{R_2+R_4} + \frac{R_2R_4}{R_2+R_4}C\frac{dV_c}{dt}$$

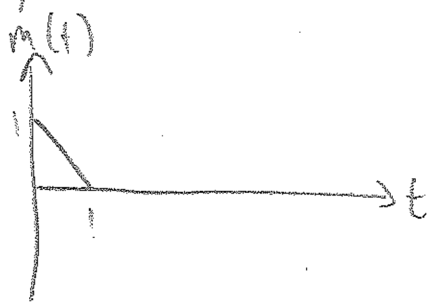
$$A - B = V_c = V_s\left(\frac{R_3}{R_1+R_3} - \frac{R_4}{R_2+R_4}\right) - \left(\frac{R_1R_3}{R_1+R_3} + \frac{R_2R_4}{R_2+R_4}\right)C\frac{dV_c}{dt}$$

$$C\left[\frac{R_1R_3}{R_1+R_3} + \frac{R_2R_4}{R_2+R_4}\right]\frac{dV_c}{dt} + V_c = V_s\left[\frac{R_3}{R_1+R_3} - \frac{R_4}{R_2+R_4}\right]$$

3 a $k(t) = r(t) - r(t-1) - u(t-1)$ 4



b



$m(t) = u(t) - r(t) + r(t-1)$ 4

c $f(t) = t^2$ $f(t)\delta(t-1) = f(1)\delta(t-1) = 1\delta(t-1) = \delta(t-1)$

2

4 $\frac{d^2 I_L}{dt^2} + 2\frac{dI_L}{dt} + I_L = 5$ $I_L(0) = 5$ Amper $\frac{dI_L}{dt}(0) = 2\ \frac{\text{Amper}}{\text{sec}}$

2 a $s^2 + 2s + 1 = 0$ characteristic equation

3 b $s_{1,2} = -1$ natural frequencies

13 c $I_{Lp} = K$ $\frac{d^2}{dt^2}K + 2\frac{d}{dt}K + K = 5$ $K = 5$ 3

$I_{Lh} = (A_1 + A_2 t)e^{-t}$ 3

$I_L = I_{Lp} + I_{Lh} = 5 + (A_1 + A_2 t)e^{-t}$ 2

$I_L(0) = 5 = 5 + A_1$ 1 $A_1 = 0$

$\frac{dI_L}{dt} = -(A_1 + A_2 t)e^{-t} + A_2 e^{-t}$ 1 $\frac{dI_L}{dt}(0) = -A_1 + A_2 = 2$ $A_2 = 2$ 2

$I_L(t) = 5 + 2te^{-t}$ 1

7 d $\frac{dI_L}{dt} = 2e^{-t}(1-t)$ $\left.\frac{dI_L}{dt}\right|_{t^* \neq 0} = 0 = 2e^{-t^*}(1-t^*)$ $t^* = 1$ local maximum

3

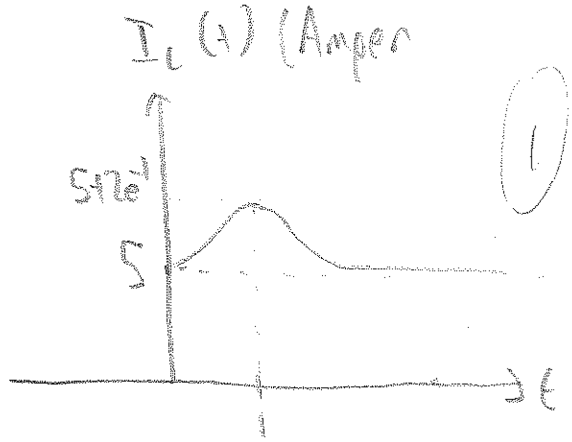
$t^* = 1$

$\hookrightarrow I_L(t^*) = 5+2e^{-1}$ (maximum value) 1

$\lim_{t\to\infty} I_L(t) = 0$

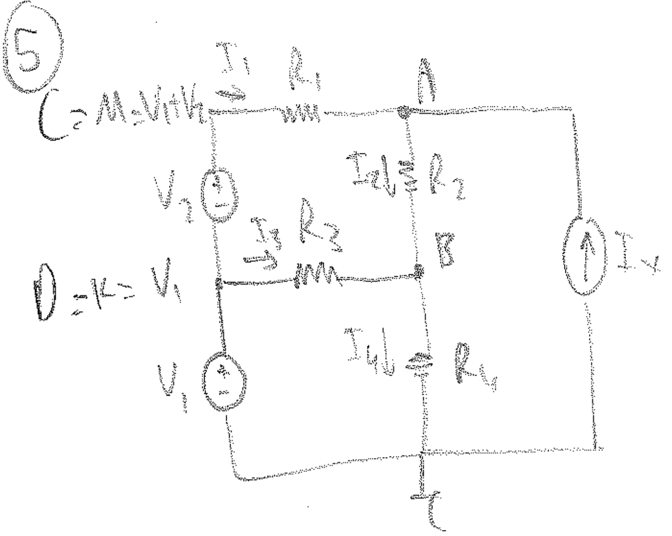
$I_L(0) = 5$ 1

$\frac{dI_L}{dt}(0) = 2$



1

5



a) $C = M = V_1+V_2$ 2

$D = K = V_1$ 2

b) $I_1 + I_x = I_2$ 2

$$\frac{M-A}{R_1} + I_x = \frac{A-B}{R_2}$$

$$\boxed{\frac{V_1+V_2-A}{R_1} + I_x = \frac{A-B}{R_2}}$$ 9

$I_3 + I_2 = I_4$ 2

$$\frac{K-B}{R_3} + \frac{A-B}{R_2} = \frac{B-0}{R_4} \rightarrow \boxed{\frac{V_1-B}{R_3} + \frac{A-B}{R_2} = \frac{B}{R_4}}$$ 8