we know

$$y_3(t) = t \cdot x_3(t)$$
$$= t\left[a\, x_1(t) + b\, x_2(t)\right]$$
$$= a\, t \cdot x_1(t) + b\, t \cdot x_2(t)$$
$$\boxed{y_3(t) = a \cdot y_1(t) + b \cdot y_2(t)}$$

29/8/17

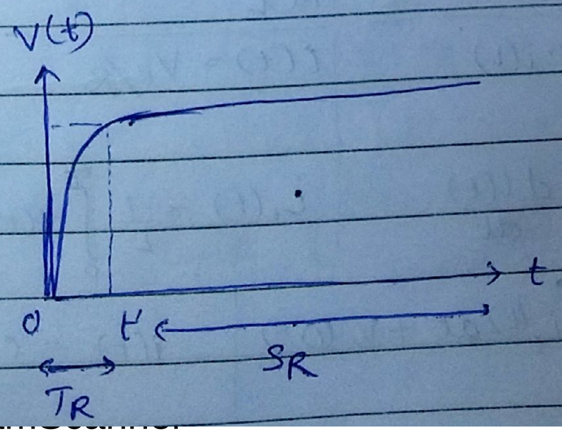
UNIT - II

Transient Response

The values of V and I during the transient period are known as transient response. It depends upon the network elements alone and independent of the sources

* Steady State Response

The values of V and I after the transient has died out, are known as steady state response. It is also defined as the part of the total time response which remains after the transient response has passed. It depends on both element and source.



Elements	$t = 0^+$ TR	$t = \infty$ SR
R		
L	OC	SC
C	SC	OC

$\rightarrow X_C = \dfrac{1}{\omega C} = \dfrac{1}{2\pi f C} = \dfrac{T}{2\pi C}$

$\rightarrow X_L = \omega L = 2\pi f L = \dfrac{2\pi L}{T}$

* <u>Zero State Response</u>

Find $y(t)$ when initial states or conditions are zero.

* <u>Zero Input Response (Natural Response)</u>

Find $y(t)$ when $x(t) = 0$

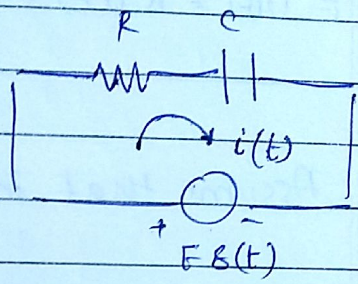
(Find output when input is zero)

Element	KVL	KCL
R	$V_R = R \cdot i(t)$	$i(t) = V_R / R$
L	$V_L = L \cdot \dfrac{d\,i(t)}{dt}$	$i_L(t) = \dfrac{1}{L} \int_0^t v(t)\,dt + i_L(0^+)$
C	$V_C = \dfrac{1}{C} \int_0^t i_C(t)\,dt + V_C(0^+)$	$i(t) = C \cdot \dfrac{dV_C(t)}{dt}$

Methods $\longrightarrow$ Classical Method (Time Domain Method)
$\longrightarrow$ Laplace Method

* Q Find impulse response of RC series network

$V_E(t) = V_r(t) + V_c(t)$



$E\delta(t) = R\, i(t) + \frac{1}{C}\int_0^t i_c(t)\,dt + V_c(0^+)$

Let us assume that initially the capacitor is fully discharged

$\Rightarrow E\delta(t) = R\, i(t) + \frac{1}{C}\int_0^t i_c(t)\,dt$

Using laplace both sides

$\Rightarrow E = R \cdot I(s) + \frac{1}{C} \cdot \frac{I(s)}{s}$

$= I(s)\left[R + \frac{1}{sC}\right]$

$\Rightarrow I_s = \frac{E}{R + 1/sC}$

$= \frac{E}{R}\left[\frac{1}{1 + 1/sCR}\right]$

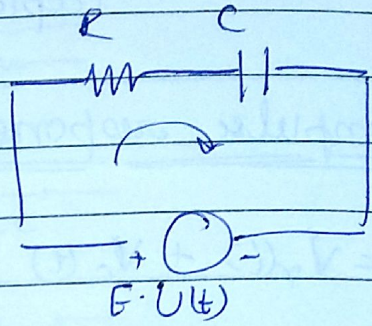
$= \frac{E}{R}\left[\frac{s}{s + 1/RC}\right]$

$= \frac{E}{R}\left[1 - \frac{1/RC}{s + 1/RC}\right]$

$\therefore$ ILT $\Rightarrow$

$i(t) = \frac{E}{R}\left[\delta(t) - \frac{1}{RC} e^{-1/RC}\right]$ Amp

* Q. Find Step Response of RC series ckt



$V_E = V_R + V_C$

$E \cdot U(t) = R\,i(t) + \frac{1}{C}\int_0^t i_c(t)\,dt + V_c(0^+)$

Assume that initially capacitor is fully discharged

$\Rightarrow E \cdot U(t) = R \cdot i(t) + \frac{1}{C}\int_0^t i_c(t)\,dt$

Taking LT

$\Rightarrow \frac{E}{S} = R \cdot I(s) + \frac{I(S)}{CS}$

$\Rightarrow \frac{E}{S} = I(s) * \left(R + \frac{1}{SC}\right)$

$\Rightarrow I(s) = \frac{E}{S\left(R + \frac{1}{SC}\right)}$

$\Rightarrow I(S) = \frac{E}{R}\left(\frac{1}{S + \frac{1}{RC}}\right)$

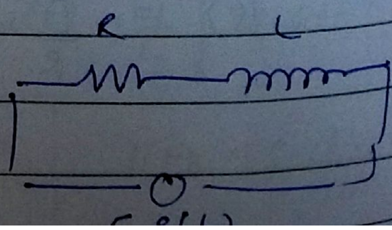
Taking ILT

$\Rightarrow i(t) = \frac{E}{R} e^{-t/RC}$

30/10/17

* Q. Find the Impulse Response of RL series Ckt.

$V_E = V_R + V_L$



$$E\cdot\delta(t) = R\,i(t) + L\cdot\frac{di(t)}{dt}$$

Taking L.T.

$$E\cdot = I(s)\cdot R + L\cdot I(s)\cdot s$$

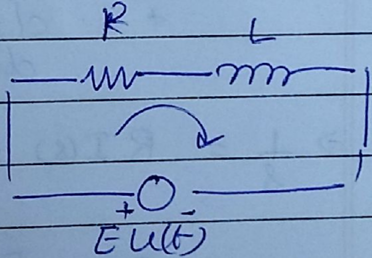
$$= I(s)\,(R + Ls)$$

$$\Rightarrow I(s) = \frac{E}{L}\,\frac{1}{(s + R/L)}$$

Taking L.I.

$$i(t) = \frac{E}{L}\,e^{-Rt/L} \text{ Amp}$$

* Q. Find <u>step response</u> of <u>RL series ckt</u>



$$V_E = V_R + V_L$$

$$E\cdot u(t) = Ri(t) + L\cdot\frac{di(t)}{dt}$$

Taking L.T.

$$\frac{E}{s} = I(s)\cdot R + L\cdot I(s)\cdot s$$

$$= (R + sL)\,I_s$$

$$I(s) = \frac{E}{s\,(R + sL)}$$

$$= \frac{E}{L}\left[\frac{1}{s\,(s + R/L)}\right]$$

$$= \frac{E}{L}\left[\left(\frac{1}{s} - \frac{1}{s + R/L}\right)\cdot\frac{1}{R/L}\right]$$

$$\Rightarrow \frac{E}{R}\left(\frac{1}{s} - \frac{1}{s+R/L}\right)$$

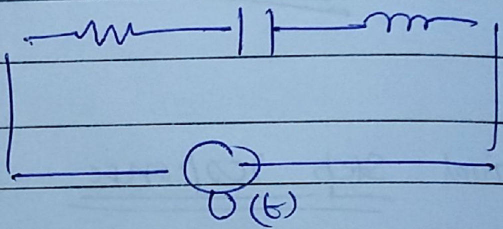
Taking I.L.

$$i(t) = \frac{E}{R}\left(u(t) - e^{-R/L\,t}\right) \text{ Amp}$$

Imp

Q. Find the Step Response of RLC series ckt

Ans Let us assume that initially inductor & capacitor are fully discharged.



$$u(t) = R\,i(t) + \frac{1}{C}\int_0^t i(t)\,dt + L\cdot\frac{di(t)}{dt}$$

$$\Rightarrow \frac{1}{s} = R\,I(s) + \frac{1}{C}\cdot\frac{I(s)}{s} + L\,I(s)\cdot s$$

$$= I(s)\left[R + \frac{1}{Cs} + Ls\right]$$

$$\frac{1}{s} = I(s)\left(\frac{RCs + 1 + Ls^2C}{Cs}\right)$$

$$I(s) = \frac{C}{s^2LC + RCs + 1}$$

$$= \frac{C}{LC\left(s^2 + \frac{sR}{L} + \frac{1}{LC}\right)}$$

$$I(s) = \frac{1/L}{\left(s^2 + \frac{Rs}{L} + \frac{1}{LC}\right)}$$

FREEMIND

Date ______

Page ______

→ Roots.

$$\alpha, \beta = \frac{-\frac{R}{L} \pm \sqrt{\frac{R^2}{L^2} - \frac{4.1}{LC}}}{2}$$

$$= \left(-\frac{R}{L} \pm \sqrt{\frac{R^2}{L^2} - \frac{4}{LC}}\right) / 2$$

$$\therefore \alpha = -\frac{R}{2L} \pm \sqrt{\left(\frac{R}{2L}\right)^2 - \frac{1}{LC}}$$

Case I: Both α & β are real and not equal

$$\Rightarrow \frac{R}{2L} > \frac{1}{\sqrt{LC}}$$

$$\therefore I(s) = \frac{V/L}{(s+\alpha)(s+\beta)}$$

By partial fraction

$$= \frac{K_1}{s+\alpha} + \frac{K_2}{s+\beta}$$

$$\therefore K_1 = \left.\frac{V/L}{s+\beta}\right|_{s=-\alpha}$$

$$= \frac{V/L}{\beta-\alpha}$$

$$\Rightarrow \boxed{K_1 = \frac{V}{L(\beta-\alpha)}}$$

$$K_2 = \left.\frac{1/L}{s+\alpha}\right|_{s=-\beta}$$

$$= \frac{1/L}{\alpha-\beta}$$

$$\Rightarrow \boxed{K_2 = \frac{1}{L(\alpha-\beta)}}$$

$$\therefore I(s) = \frac{L}{(\beta-\alpha)\cdot L\cdot(\alpha-\beta)}$$

$\therefore$ Taking I.L.

$$i(t) = \frac{e^{-\alpha t}}{(\beta-\alpha)L} + \frac{e^{-\beta t}}{(\alpha-\beta)L}$$

$$\Rightarrow i(t) = \frac{1}{(\beta-\alpha)L}\cdot\left(e^{-\alpha t} - e^{-\beta t}\right) \text{ Amp}$$

→ Case II: $\alpha = \beta$

let $\alpha = \beta = \gamma$

$$\therefore I(s) = \frac{1}{L(s+\gamma)^2}$$

$\therefore$ Taking I.L.

$$i(t) = \frac{1}{L}\, t\cdot e^{-\gamma t} \text{ Amp}$$

→ Case III : When the roots are imaginary

$$\frac{R}{2L} < \frac{1}{\sqrt{LC}}$$

$$\alpha = \beta^*$$

$$\alpha = A_0 - jB$$

$$\beta = A_0 + jB$$

$$\therefore I(s) = \frac{1/L}{(s+A_0-jB)(s+A_0+jB)}$$

$$= \frac{K_3}{(s+A_0-jB)} + \frac{K_4}{(s+A_0+jB)}$$

$$K_3 = \left.\frac{1}{L(s+A_0+jB)}\right|_{s=-A_0+jB}$$

$$\Rightarrow \boxed{K_3 = \frac{1}{2iLB}}$$

$$K_4 = \left.\frac{1}{L(s+A_0-jB)}\right|_{s=-A_0-jB}$$

$$\Rightarrow \boxed{K_4 = \frac{-1}{2iLB}}$$

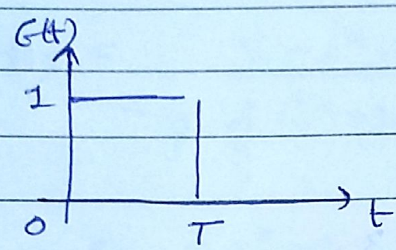
$$\therefore I(s) = \frac{1}{2iLB(s+A_0-jB)} - \frac{1}{2iLB(s+A_0+jB)}$$

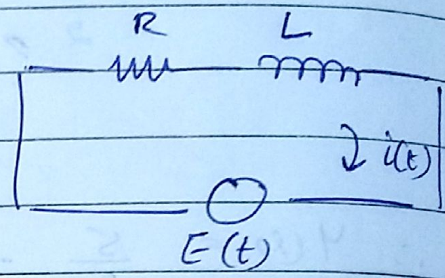
$$Y(s) = \frac{k_1}{s} + \frac{k_2}{s+4}$$

$$= \frac{12}{s} - \frac{9}{s+4}$$

4/7/17

Response of RL-ckt with pulse input





$$E(t) = R\,i(t) + L\frac{di(t)}{dt}$$

$$\Rightarrow E\cdot[u(t) - u(t-T)] = R\,i(t) + L\cdot\frac{di(t)}{dt}$$

Taking L.T.

$$\Rightarrow R\cdot I(s) + L\cdot s\,\frac{I(s)}{\cancel{s}} = \frac{1}{s} - \frac{e^{-sT}}{s}$$

$$\Rightarrow I(s) = \frac{(1-e^{-sT})}{s}\cdot\frac{\cancel{s}}{(R\cancel{s}+Ls)}$$

$$= \frac{1-e^{-sT}}{s\,(R+Ls)}$$

$$= \frac{1-e^{-st}}{Ls\,(R/L + s)}$$

$$\frac{I(s)}{1-e^{-sT}} = \frac{1}{Ls\left(R/L+s\right)} \Rightarrow I'(s)$$

$$\therefore \frac{I'(s)}{L} = \frac{A}{s} + \frac{B}{R/L+s}$$

$$A = \left.\frac{1}{L(s+R/L)}\right|_{s=0} = \frac{1}{R}$$

$$B = \left.\frac{1}{sL}\right|_{s=-R/L} = \frac{-1}{R}$$

$$\therefore I'(s) = \frac{1}{Rs} - \frac{1}{R(s+R/L)}$$

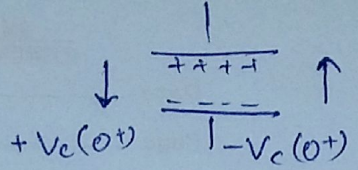
$$\Rightarrow I(s) = \frac{1-e^{-sT}}{R}\left(\frac{1}{s} - \frac{1}{s+R/L}\right)$$

$$= \frac{1}{Rs} - \frac{1}{R(s+R/L)} - \frac{e^{-sT}}{s} + \frac{e^{-sT}}{R(s+R/L)}$$

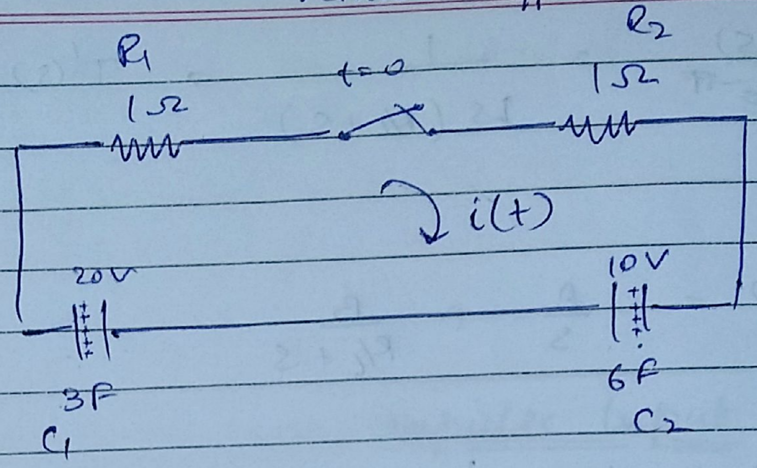
Taking L.I.

$$i(t) = \frac{u(t)}{R} - \frac{e^{-R/L\,t}}{R} - \frac{u(t-T)}{R} + \frac{e^{-R/L\,t}}{R}\cdot\delta(t-T)$$

Q. Solve for $i(t)$ in given ckt. in which 3F capacitor is initially charged to 20 V and 6F capacitor to 10 V where switch is closed at $t=0$



if the case is reversed then only the direction will get changed, magnitude will remain unaffected



$$\frac{1}{C_1}\int_0^t i(t)\,dt - V_{C_1}(0^+) + R_1\, i(t) + R_2\, i(t) + V_{C_2}(0^+) + \frac{1}{C_2}\int_0^t i(t)\,dt = 0$$

$\therefore$ Taking L.T.

$$\frac{I(s)}{sC_1} - \frac{V_{C_1}(0^+)}{s} + R_1 \cdot I(s) + R_2\, I(s) + \frac{V_{C_2}(0^+)}{s} + \frac{I(s)}{sC_2} = 0$$

$$\Rightarrow \frac{I(s)}{s\cdot 3} - \frac{20}{s} + 1\cdot I(s) + 1\cdot I(s) + \frac{10}{s} + \frac{I(s)}{s\cdot 6} = 0$$

$$\Rightarrow I(s)\left(\frac{1}{3s} + 2 + \frac{1}{6s}\right) - \frac{10}{s} = 0$$

$$\Rightarrow I(s)\left(\frac{2+12s+1}{6}\right) = 10$$

$$\Rightarrow I(s) = \frac{6\cdot 10}{(2+12s+1)}$$

$$= \frac{6\cdot 10}{(3+12s)}$$

$$= \frac{20}{4s+1}$$

$$\Rightarrow I(s) = \frac{5}{s+1/4}$$

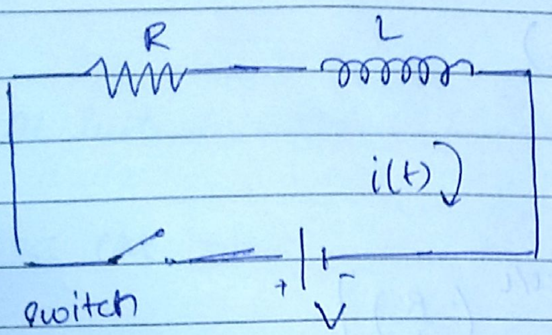
$$= \frac{5}{s+0.25}$$

$\therefore i(t) = 5\cdot e^{-0.25t}$ Amp

Date
Page

Transient Analysis

Transient response of RL series ckt



$$R\,i(t) + L\cdot\frac{di(t)}{dt} = V \quad \text{——— (1)}$$

$$\frac{di(t)}{dt} + \frac{R}{L}\,i(t) = \frac{V}{L} \quad \text{——— (2)}$$

General 1st order Linear Eqn:

$$\frac{dy(t)}{dt} + P\,y(t) = Q$$

$$y(t) = \frac{Q}{P} - K\cdot e^{-Pt}$$

K = any const.

$$i(t) = \frac{V}{R} + K\cdot e^{-Rt/R}$$

Since inductor behave as open ckt. at $t = 0^+$
Similarly at $t = \infty$ inductor behave as short ckt.

$$t = 0^+ \Rightarrow i(t) = 0$$

$$\Rightarrow 0 = \frac{V}{R} + K$$

$$\Rightarrow \boxed{K = -\frac{V}{R}}$$

Scanned by CamScanner

$$\therefore \boxed{i(t) = \frac{V}{R}\left(1 - e^{-Rt/L}\right)} \text{ Amp}$$

$$V_R(t) = R\,i(t)$$

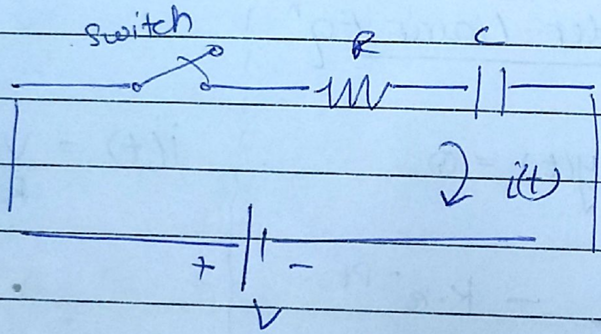
$$\Rightarrow V_R(t) = V\left(1 - e^{-Rt/L}\right)$$

$$V_L(t) = L \cdot \frac{d\,i(t)}{dt}$$

$$= L \cdot \frac{V}{R}\left[0 - e^{-Rt/L}\left(-\frac{R}{L}\right)\right]$$

$$\Rightarrow V_L(t) = V e^{-Rt/L}$$

6/9/17 **Transient Response of RC-series Ckts**



$$V = R\,i(t) + \frac{1}{C}\int_0^t i(t)\,dt$$

Diff wrt t

$$\Rightarrow 0 = R \cdot \frac{d\,i(t)}{dt} + \frac{1}{C} \cdot i(t)$$

$$\Rightarrow R\left[\frac{d\,i(t)}{dt} + \frac{1}{RC} \cdot i(t)\right] = 0$$

$$\Rightarrow \frac{d\,i(t)}{dt} + \frac{1}{RC}\,i(t) = 0$$

Scanned by CamScanner

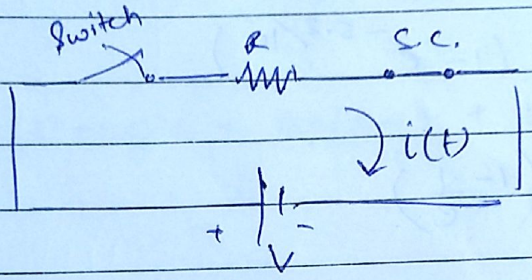
Date
Page

$$i(t) = 0 + K \cdot e^{-t/RC}$$

$$\Rightarrow \boxed{i(t) = K \cdot e^{-t/RC}}$$

At initial condition, capacitor behave as S.C.

$\therefore$ Ckt. $\longrightarrow$



$$\therefore i(0^+) = \frac{V}{R}$$

$$\Rightarrow \frac{V}{R} = K \cdot e^{-0/RC}$$

$$\Rightarrow \frac{V}{R} = K$$

$$\therefore \boxed{i(t) = \frac{V}{R} \cdot e^{-t/RC}} \text{ Amp}$$

$$V_R(t) = R\,i(t)$$

$$\Rightarrow V_R(t) = R \cdot \frac{V}{R} \cdot e^{-t/RC}$$

$$\boxed{V_R(t) = V e^{-t/RC}}$$

$$V_c(t) = \frac{1}{C}\int_0^t i(t)\,dt$$

$$= \frac{1}{C}\int_0^t \frac{V}{R} e^{-t/RC}\,dt$$

$$= \frac{-V}{(RC)^2}\left| e^{-t/RC} \right|_0^t$$

$$\boxed{V_c(t) = (1 - e^{-t/RC})\frac{V}{(RC)^2}}$$

Time const. τ or τ = L/R RC

LT of $\sin at = \frac{a}{a^2+s^2}$ $\cos at = \frac{s}{a^2+s^2}$

Q Find the current in a series RL-ckt. having $R = 2\Omega$ and $L = 10H$, while a DC voltage of 100V is applied. What is the value of the current after 5 sec.

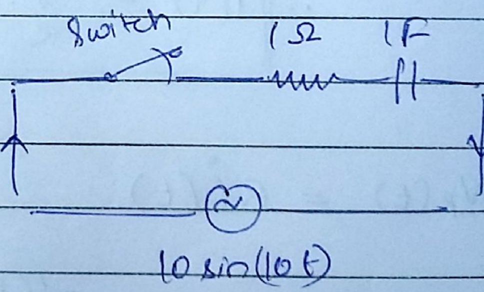
Ans $i(t) = \frac{V}{R}\left(1 - e^{-tR/L}\right)$

$i(5sec) = \frac{100}{2}\left(1 - e^{-5\cdot 2/10}\right)$

$= 50\left(1 - \frac{1}{e}\right)$

$= \underline{31.6 \text{ Amp}}$

Q Find the complete solution for current, using Laplace Transform, assume capacitor is fully discharged initially



$V = R\,i(t) + \frac{1}{C}\int_0^t i(t)\,dt$

$\Rightarrow 10\sin 10t = i(t) + \int_0^t i(t)\,dt$

LT on both sides

$\frac{100}{s^2+100} = I(s) + \frac{I(s)}{s}$

$I(s) = \frac{100\,s}{(s^2+100)(s+1)}$

FREEMIND

Date

Page

By Partial fract.

$$I(s) = \frac{A}{s+1} + \frac{Bs+D}{s^2+100}$$

$$\frac{100s}{(s^2+100)(s+1)} = \frac{A}{s+1} + \frac{Bs+D}{s^2+100}$$

$$100s = A(s^2+100) + Bs(s+1) + D(s+1)$$

$s=-1$

$$\Rightarrow A = \frac{-100}{101} = -0.99$$

$s=0$

$$\Rightarrow D = \frac{100 \cdot 100}{101} = 99$$

$$\Rightarrow B = 0.99$$

$$\therefore I(s) = \frac{-0.99}{s+1} + \frac{0.99s + 99}{s^2+100}$$

$$= \frac{-0.99}{s+1} + \frac{0.99s}{s^2+100} + \frac{99}{s^2+100} \times \frac{10}{10}$$

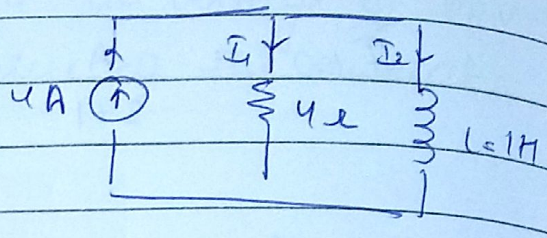
Taking L.I

$$i(t) = -0.99 \cdot e^{-t} + 0.99\cos(10t) + 9.9\sin(10t) \text{ Amp}$$

Q

$I = I_1 + I_2$

$$4 = \frac{V(t)}{R} + \frac{1}{L}\int_0^t V(t)\cdot dt$$



Diff

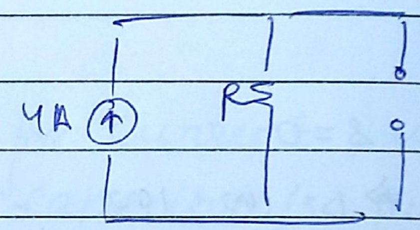
$$0 = \frac{1}{R}\frac{dV(t)}{dt} + \frac{V(t)}{L}$$

$$\Rightarrow \frac{dV(t)}{dt} + \frac{R}{L}V(t) = 0$$

$$V(t) = ke^{-R/L\cdot t} \quad V$$

At $t = 0^+$, our inductor device behaves as O.C

$$\therefore V(0^+) = 4\times4$$
$$= 16\ V$$



At $t = 0^+$

$$16 = ke^{-4/1\times0}$$

$$\Rightarrow \boxed{k = 16}$$

$$\therefore V(t) = 16\cdot e^{-4t} \quad V$$

$$i_R(t) = \frac{V(t)}{R} = \frac{16\cdot e^{-4t}}{4}$$

$$i_R(t) = 4e^{-4t} \text{ Amp}$$

$$i_L(t) = \frac{1}{L}\int_0^t V(t)\,dt$$

$$= \frac{1}{1}\int_0^t 16e^{-4t}\,dt$$

$$= \frac{-16}{4}\left[e^{-4t}\right]_0^t$$

$$= 4(1-e^{-4t}) \text{ Amp}$$

$$\frac{\cancel{4t}}{R} = V$$

Taking L.T.

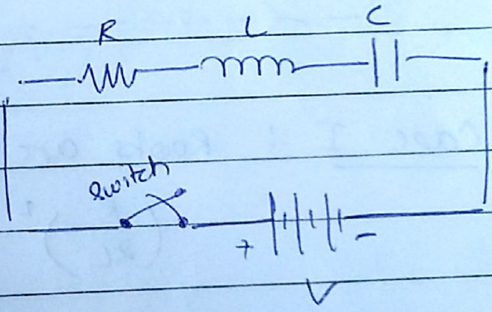
$$\frac{4}{s} = \frac{V(s)}{R} + \frac{V(s)}{s \cdot L}$$

$$\Rightarrow \frac{4}{s} = \frac{V(s)}{4} + \frac{V(s)}{s}$$

$$\Rightarrow V(s) = \frac{4 \cdot 4}{s+4}$$

$\therefore$

<u>Transient response of RLC ckt in DC source</u>



$$R\,i(t) + L \cdot \frac{d\,i(t)}{dt} + \frac{1}{C}\int_0^t i(t)\,dt = V$$

On diff.

$$\Rightarrow R\frac{d\,i(t)}{dt} + L \cdot \frac{d^2 i(t)}{dt^2} + \frac{i(t)}{C} = 0$$

$$\Rightarrow \frac{d^2 i(t)}{dt^2} + \frac{R}{L}\frac{d\,i(t)}{dt} + \frac{i(t)}{LC} = 0$$

$$\frac{d}{dt} \longrightarrow P$$

$$\Rightarrow \left(P^2 + \frac{R}{L} \cdot P + \frac{1}{L}\right) i(t) = 0$$

Date
Page

$\therefore \; p^2 + \frac{R}{L}p + \frac{1}{LC} = 0$

$\Rightarrow \; p = \dfrac{-R/L \pm \sqrt{(R/L)^2 - 4/LC}}{2}$

$$\Rightarrow \boxed{p = \frac{-R}{2L} \pm \sqrt{\left(\frac{R}{2L}\right)^2 - \frac{1}{LC}}}$$

$\therefore \; P_1 = \alpha + \beta$ and $P_2 = \alpha - \beta$

NOTE: Solution for 2^{nd} order linear differential equation

$i(t) = C_1 \cdot e^{P_1 t} + C_2 \cdot e^{P_2 t}$

where C_1 & C_2 are constants

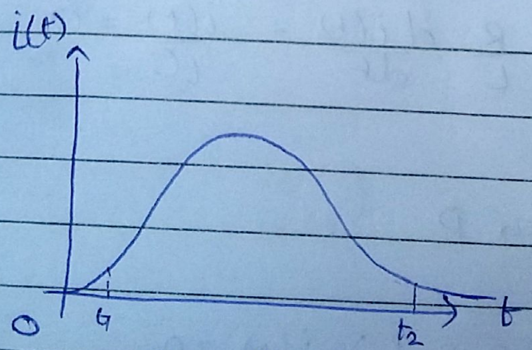
→ Case I : Roots are real & unequal

$\left(\frac{R}{2L}\right)^2 > \frac{1}{LC}$

Over damping situation

$\therefore i(t) = C_1 \cdot e^{(\alpha+\beta)t} + C_2 \cdot e^{(\alpha-\beta)t}$

$= e^{\alpha t}\left[C_1 e^{\beta t} + C_2 e^{-\beta t}\right]$



Over damping of current

Case II : Roots are imaginary and complex conjugate of each other

$$\left(\frac{R}{2L}\right)^2 < \frac{1}{LC}$$

Oscillation

$\therefore \quad \alpha = {}^{*}\beta$

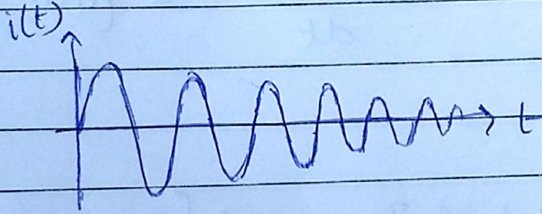
$P_1 = \alpha + j\beta$ & $P_2 = \alpha - j\beta$

$$i(t) = C_1 \cdot e^{(\alpha + j\beta)t} + C_2 e^{(\alpha - j\beta)t}$$

$$= e^{\alpha t}\left[C_1 e^{j\beta t} + C_2 e^{-j\beta t}\right]$$

$$= e^{\alpha t}\left[C_1 \cdot (\cos\beta t + j\sin\beta t) + C_2(\cos\beta t - j\sin\beta t)\right]$$

$$= e^{\alpha t}\left[(C_1 + C_2)\cos\beta t + j\,(C_1 - C_2)\sin\beta t\right]$$



Oscillations

Case III : Roots are equal & real

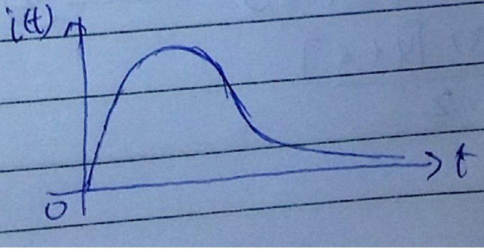
$$\left(\frac{R}{2L}\right)^2 = \frac{1}{LC}$$

Critical damped

$\therefore \quad P_1 = P_2 = \gamma$

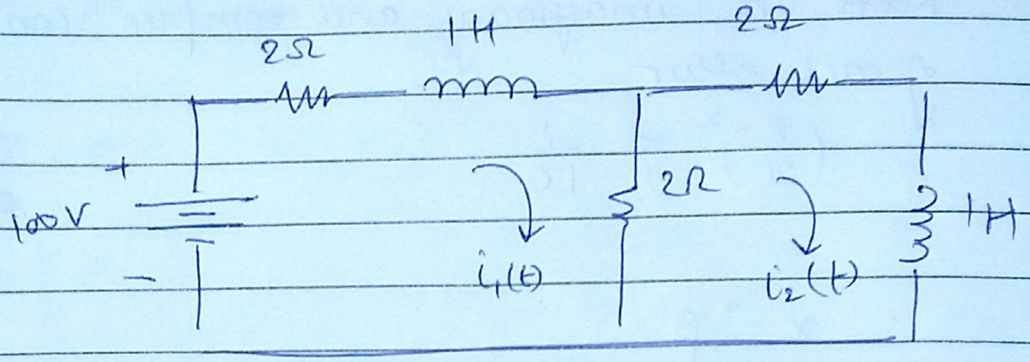
$$i(t) = C_1 e^{\gamma t} + C_2 t \cdot e^{\gamma t}$$

$$= (C_1 + C_2 t)\, e^{\gamma t}$$



critical damped

Q:



Assume that the inductor is initially fully discharged.

$$\cancel{2}\, i_1(t) = 2 i_2(t) + L \frac{di_2(t)}{dt}$$

Mesh 1

$$100 = 2 i_1(t) + \frac{d\, i_1(t)}{dt} + 2[i_1(t) - i_2(t)]$$

Taking L.T.

$$\frac{100}{s} = 2 I_1(s) + s \cdot I_1(s) + 2\{I_1(s) - I_2(s)\}$$

$$\Rightarrow \frac{100}{s} = I_1(s)[4+s] - 2 I_2(s) \quad \text{——— (1)}$$

Mesh 2

$$2 i_2(t) + \frac{d i_2(t)}{dt} + 2[i_2(t) - i_1(t)] = 0$$

Taking L.T.

$$2 I_2(s) + s \cdot I_2(s) + 2[I_2(s) - I_1(s)] = 0 \quad \text{—}$$

$$\Rightarrow I_2(s)(4+s) - 2 I_1(s) = 0 \quad \text{——— (2)}$$

$$\Rightarrow I_1(s) = \frac{I_2(s)[4+s]}{2}$$

FREEMIND

Date

Page

$\therefore$ ① will be

$$\frac{100}{s} = \frac{I_2(s)\,\{4+s\}^2}{2} - 2\,I_2(s)$$

$$\Rightarrow \frac{100}{s} = I_2(s)\left[\frac{(4+s)^2}{2} - 2\right]$$

$$\Rightarrow \frac{100}{s} = I_2(s)\left(\frac{16 + s^2 + 8s - 4}{2}\right)$$

$\Rightarrow$

Scanned by CamScanner