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Date:

Final Term Paper

Circuit system - II

Name: ASHFAQ AHMAD

Reg NO: 19PWCSE1795

Section: B

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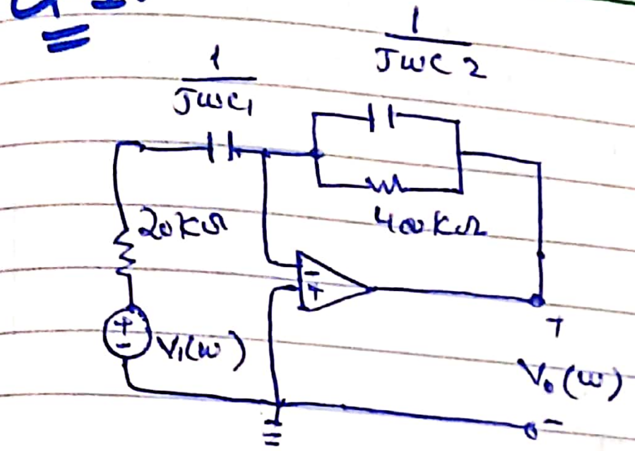
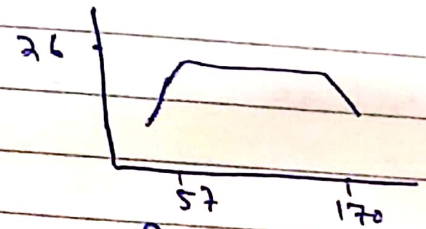
Q1:



$C_1 = ?$ $\qquad C_2 = ?$



my Reg. No = 19PWCSE1795

$$\omega_1 = \left(\frac{1+7+9}{3}\right) \times 10$$

$$\boxed{\omega_1 = 57}$$

$$\omega_2 = (1+7+9) \times 10$$

$$\boxed{\omega_2 = 170}$$

There are two corner frequences 57 & 170 and both are poles.

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the magnitude of asympote before w_1 is $1 \times 20db$ so the network function contain a term $J\omega$

$$H(\omega) = \frac{K(j\omega)}{\left(1+\frac{j\omega}{57}\right)\left(1+\frac{j\omega}{170}\right)} \quad \text{--- eq (1)}$$

Now we find network function of given circuit.

As KCL at node b/w C_1 & C_2

$$\frac{V_i}{10k\Omega + \frac{1}{j\omega C_1}} = -\left[\frac{V_{out}}{\frac{1}{j\omega C_2}} + \frac{V_{out}}{400k\Omega}\right]$$

$$\frac{V_i}{\frac{10kj\omega C+1}{j\omega C_1}} = -\left[V_{out}\left(j\omega C_2 + \frac{1}{400k\Omega}\right)\right]$$

$$\frac{j\omega C_1 V_i}{1+10kj\omega C} = -V_{out}\left(\frac{400k\Omega j\omega C_2 + 1}{400k\Omega}\right)$$

Solving for $\frac{V_{out}}{V_i}$

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$$\frac{V_{out}}{V_i} = \frac{-j\omega C_1}{1+10kj\omega C_1}\left(\frac{400\,k\Omega}{1+400\,k\Omega j\omega C_2}\right)$$

$$H(\omega) = \frac{-400kj\omega C_1}{(1+10kj\omega C_1)(1+400kj\omega C_2)}$$

Now compare this with eq(1)

$$\Rightarrow K = -400kC_1$$

$$\frac{1}{57} = 10\times10^3\,\Omega C_1$$

$$C_1 = \frac{1}{57\times10^4}\,F$$

$$C_1 = 0.018\times10^{-4}\,F$$

$$C_1 = 1.8\times10^{-6}\,F$$

$$\boxed{C_1 = 1.8\,\mu F}$$

$C_2 = ?$

$$\frac{1}{170} = 400kC_2$$

$$C_2 = \frac{1}{170\times400\times10^3}$$

$$C_2 = \frac{1}{68000\times10^3}$$

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$$C_2 = \frac{10^{-6}}{68} F$$

$$C_2 = 0.0147 \times 10^{-6} F$$

$$C_2 = 14.7 \times 10^{-9} F$$

$$\boxed{C_2 = 14.7\ nF}$$ Ans

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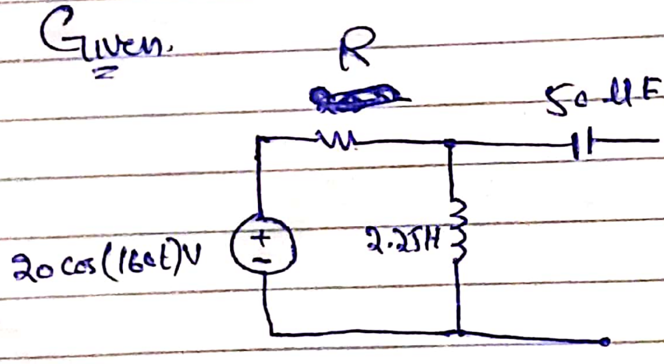
Q No Q(5)

Given



Sol

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So

$$R = \left(\frac{1+7+9}{3}\right) \times 10$$

$$R = 57\,\Omega$$

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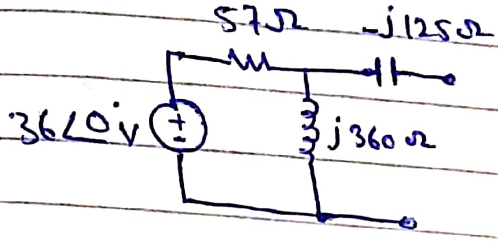
Next we determine open-circuit Voltage V_{oc}.
there is no current in 50μF due to open circuit.



$$Z_C = \frac{-j}{\omega C} = \frac{-j}{60 \times 50 \times 10^{-6}} = \boxed{-j125\,\Omega}$$

$$Z_L = j\omega L = j(60)(2.25) = \boxed{j360\,\Omega}$$

$$V_{oc} = \frac{j360}{57 + j360}\, 36\angle 0 =$$

$$V_{oc} = \frac{360\angle 90}{364\angle 81}(36\angle 0)$$

$$V_{oc} = 0.99\angle 90-81\,(36\angle 0)$$

$$V_{oc} = 35.64\angle 9-0\ V$$

$$V_{oc} = 35.64\angle 9\ V$$

Now we find thevenin Impedance. we will set V=0
So circuit become.

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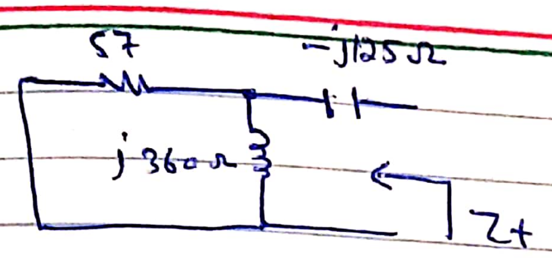


$$Z_t = -j125 + \frac{57(j360)}{57 + j360}$$

$$Z_t = -j125 + \frac{57(360\angle 90)}{364.5\angle 81}$$

$$Z_t = -j125 + \frac{20520\angle 90}{364.5\angle 81}$$

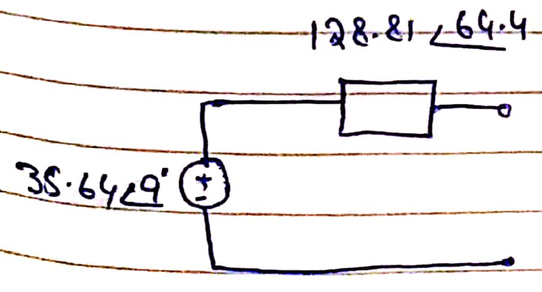
$$Z_t = -j125 + 56.29\angle 9^\circ$$

$$Z_t = -j125 + 55.6 + j8.8$$

$$Z_t = 55.6 - j116.2$$

$$\boxed{Z_t = 128.81\angle 64.4^\circ}$$

The final circuit become.



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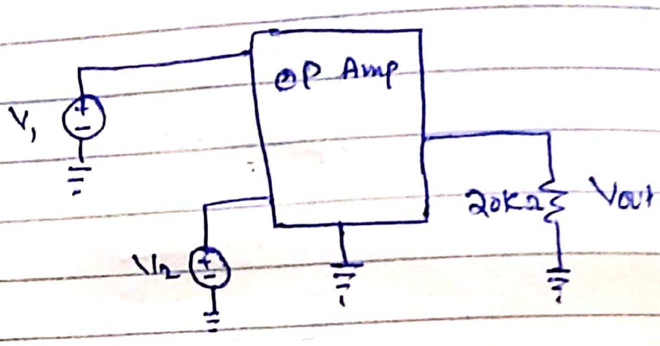
Q4:

Given



$$V_{out} = AV_1 - BV_2$$

Sol

my Reg No = 19PWCSE1795

$$A = \frac{1+7}{2} = \frac{8}{2}$$

$$A = 4$$

$$B = \frac{7+9}{2} = \frac{16}{2}$$

$$B = 8$$

So

$$V_{out} = 4V_1 - 8V_2 \quad \text{———} \quad (1)$$

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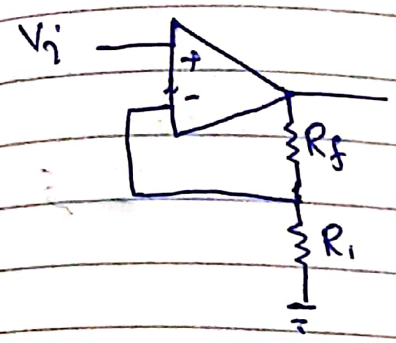
we know that



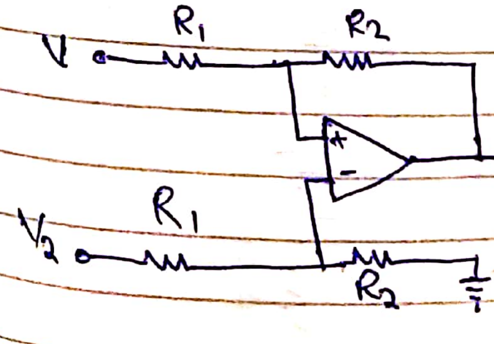
$V_{out}\left(1+\frac{R_f}{R_1}\right)V_i$

So if we connect $R_f = 3K\Omega$ & $R_1 = 1K\Omega$ and V_i as input then,

$V_{out} = 4V_1$,

Also to get $8V_2$, we need to make $R_f = 7K\Omega$ & $R_1 = 1K\Omega$

Now for difference we know that



$V_{out} = \frac{R_2}{R_1}(V_2 - V_1)$

if we keep $R_2 = R_1$ then we get $V_2 - V_1$, Combining all these we get

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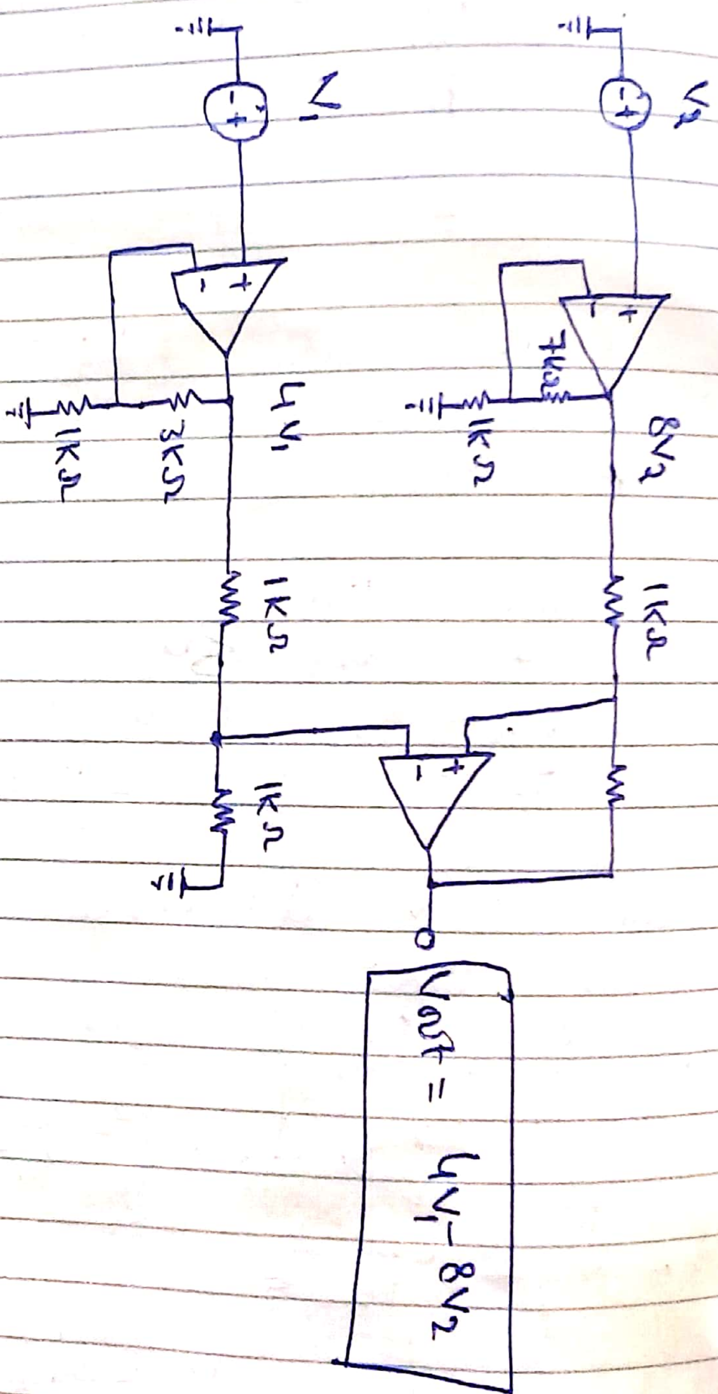

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Q2:

Given

$f(t) = ??$

$$F(s) = \frac{2s+8}{(s+1)(s^2+as+b)}$$

Sol

My Reg No is 19PWCSE1798

$$a = \frac{1+7}{2} = \frac{8}{2}$$

$\boxed{a = 4}$

$$b = \frac{7+9}{2} = \frac{16}{2}$$

$\boxed{b = 8}$

So,

$$F(s) = \frac{2s+8}{(s+1)(s^2+4s+8)}$$

$$s^2+4s+8 = s^2+2(s)(2) + (2)^2 + 4$$
$$= s^2+4s+4+4$$
$$= (s+2)^2+4$$
$$= (s+2)^2+(2)^2$$

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$$\frac{2s+8}{(s+1)(s^2+4s+8)} = \frac{a_1}{(s+1)} + \frac{a_2 s + a_3}{s^2+4s+8}$$

$$\Rightarrow 2s+8 = (s^2+4s+8)a_1 + (a_2 s + a_3)(s+1)$$

$$\Rightarrow 2s+8 = a_1 s^2 + 4a_1 s + 8a_1 + a_2 s^2 + a_2 s + a_3 s + a_3$$

$$\Rightarrow 2s+8 = (a_1+a_2)s^2 + (4a_1+a_2+a_3)s + (8a_1+a_3)$$

Compare Cofficients

$$a_1 + a_2 = 0$$
$$4a_1 + a_2 + a_3 = 2$$

$$a_1 = 3/2 \quad a_2 = -3/2 \quad a_3 = -5/2$$

$$\frac{2s+8}{(s+1)(s^2+4s+8)} = \frac{3/2}{s+1} + \frac{-3/2\, s - 5/2}{s^2+4s+8}$$

$$= \frac{3/2}{s+1} + \frac{-\frac{1}{2}(3s+5)}{s^2+4s+8}$$

$$= \frac{3/2}{s+1} + \frac{-3/2\,(s+5/3)}{s^2+4s+8}$$

$$= \frac{3/2}{s+1} + \frac{-3/2\,(s+2-1/3)}{s^2+4s+8}$$

$$= \frac{3/2}{s+1} + \frac{(-3/2)(s+2)}{s^2+4s+8} + \frac{1/2}{s^2+4s+8}$$

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$$\frac{2s+8}{(s+1)(s^2+4s+8)} = \frac{3/2}{(s+1)} - \frac{3}{2}\left(\frac{s+2}{s^2+4s+8}\right) + \frac{1/2}{s^2+4s+8}$$

$$= \frac{3/2}{s+1} - \frac{3}{2}\left(\frac{s+2}{(s+2)^2+(2)^2}\right) + \frac{1/2}{(s+2)^2+(2)^2}$$

Now take anti-laplace transformation of b.s

$$\mathcal{L}^{-1}\left(\frac{2s+8}{(s+1)(s^2+4s+8)}\right) = \mathcal{L}^{-1}\left(\frac{3/2}{s+1} - \frac{3}{2}\left(\frac{s+2}{(s+2)^2+(2)^2}\right) + \frac{1/2}{(s+2)^2+(2)^2}\right)$$

Using table we get

$$F(t) = \frac{3}{2}e^{-t} - \frac{3}{2}e^{-2t}\cos 2t + \frac{1}{2}e^{-2t}\,\frac{1}{2}\sin 2t$$

$$\boxed{F(t) = \frac{3}{2}e^{-t} - \frac{3}{2}e^{-2t}\cos 2t + \frac{1}{4}e^{-2t}\sin 2t}$$ Ans

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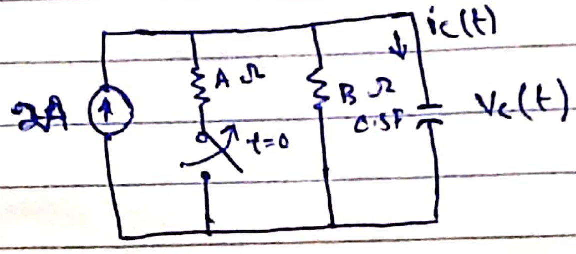
Q3:

Given

$V_c(t) = ?$

$I_c(t) = ?$



Sol

So My Reg NO = 19PWCSE1795

$$A = \frac{1+7}{2} = \frac{8}{2}$$

$$\boxed{A = 4}\,\Omega$$

$$B = \frac{7+9}{2} = \frac{16}{2}$$

$$\boxed{B = 8}\,\Omega$$

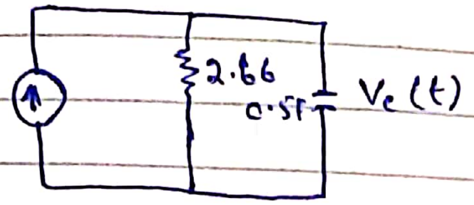
Since 4 Ω & 8 Ω are in prallel so

$$Z_{eq} = \frac{4\times8}{4+8}$$

$$Z_{eq} = \frac{32}{12}$$

$Z_{eq} = 2.66$

Circuit become,

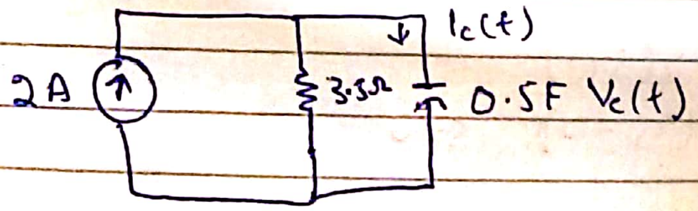


Now

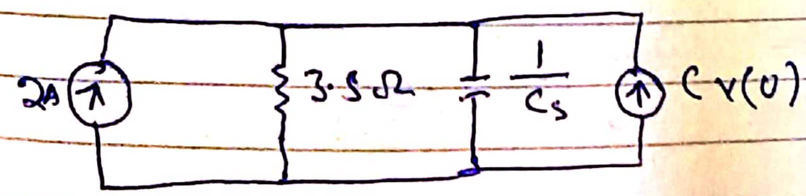
$V_c(0^-) = 2 \times 2.66$

$V_c(0^-) = 5.2$

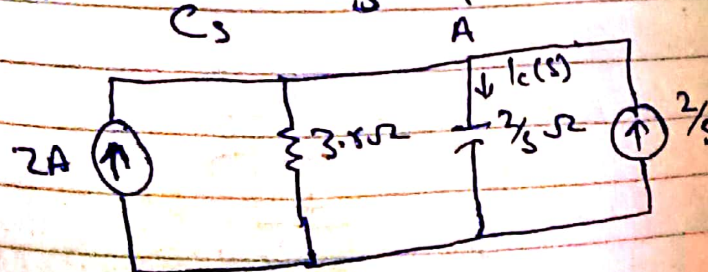
For $t > 0$ the circuit is



Equivalent circuit in S-domain



Where $\frac{1}{Cs} = \frac{2}{S}$ & $Cv(0) = 2/s$



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Apply KCL at node A.

$$2+\frac{2}{s} = \frac{V_c(s)}{3.5} + \frac{V_c(s)}{(2/s)}$$

$$2+\frac{2}{s} = V_c(s)\left[\frac{1}{3.5}+\frac{s}{2}\right]$$

$$V_c(s) = \frac{12(s+1)}{s(3s+2)}$$

using partial fraction method

$$\frac{12(s+1)}{s(3s+2)} = \frac{A}{s} + \frac{B}{3s+2}$$

$$A = \left.\frac{12(s+1)}{(3s+2)}\right|_{s=0}$$

$$A = 6$$

$$B = \left.\frac{12(s+1)}{s}\right|_{s=\frac{-2}{3.5}}$$

$$B = -6$$

$A = 6$ & $B = -6$

$$\therefore V_c(s) = \frac{6}{s} - \frac{6}{3s+2}$$

$$= \frac{6}{s} - \frac{2}{s+2/3}$$