OZA DHAIRYA M (F-43).

Tutorial - 5

① Calculate the cut-off or breakpoint (f_c) for a simple passive high pass filter consisting of an 82 pf capacitor in 240kΩ R

→ $$f_c = \frac{1}{2\pi \times R \times C}$$

$$= \frac{1}{2 \times 3.14 \times 82 \times 10^{-12} \times 240 \times 10^{3}}$$

$$= \frac{10^9}{2 \times 3.14 \times 82 \times 240}$$

$$= \underline{8.091 \text{ KHz}}$$

② For the 1st order butter worth HPF Calculate R if C = 0.0047 μF, f_c = 10 KHz

→ $$f_c = \frac{1}{2\pi RC}$$

$$R = \frac{1}{2\pi f_c C}$$

$$= \frac{1}{2 \times 3.14 \times 10 \times 10^{3} \times 0.0047 \times 10^{-6}}$$

$$= \frac{10^3}{2 \times 3.14 \times 10 \times 0.0047}$$

$$= 3.3879 \text{ K}\Omega$$

③ Design a HPF circuit for 10KHz cut-off frequency.

→ $f_c = 10KHZ$

→ R can vary from 1-10 kΩ

① Let's take 10 kΩ

∴ $C = \frac{1}{2\pi R \cdot f_c}$

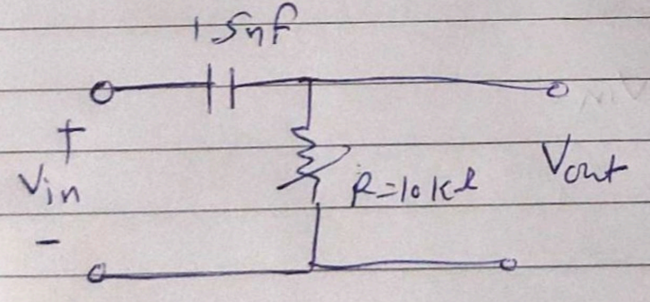
$= \frac{1}{2 \times 3.14 \times 10 \times 10^3 \times 10 \times 10^3}$

$= 1.59nf$

Now, Reverse

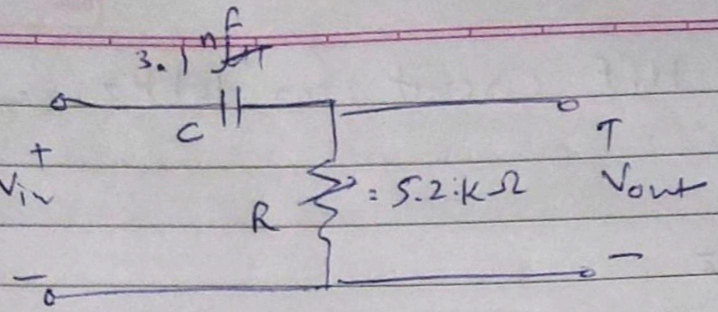
$f_c = \frac{1}{2\pi RC} = \frac{1}{2 \times 3.14 \times 10^4 \times 1.5 \times 10^{-7}}$

$= 10.61\ k\Omega$.



② Let's take 5 kΩ

∴ $C = \frac{1}{2\pi R f_c} = 3.18nf$ ∴ Reverse $f_c = 5.2\ k\Omega$

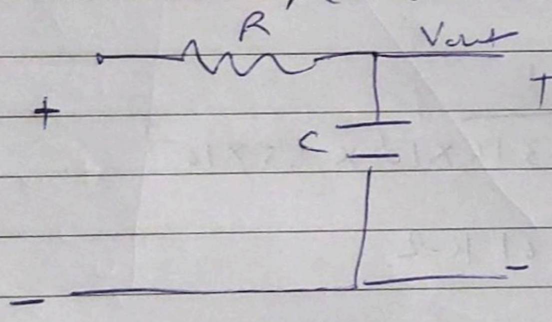


Variable Resistance

for 10 kΩ → 1.59 nf → 10.61 kΩ
5 kΩ → 3.18 nf → 5.21 kΩ

(5) A Low pass filter circuit consi of A resistor of 4.7 kΩ in series with a Capacitor of 47nf is connected across 10V. V_{out} = (?)

(i) f = 100 Hz , (ii) 10000 Hz



→ $V_{out} = \dfrac{X_C}{\sqrt{X_C^2 + R^2}} \times V_{in}$

Now $X_C = \dfrac{1}{WC}$

$= \dfrac{1}{2 \times 3.14 \times 100 \times 47 \times 10^{-9}}$

$= \dfrac{10^7}{2 \times 3.14 \times 47} = 33.879$ KΩ

$$V_{out} = 10 \times \frac{33.879 \times 10^3}{\sqrt{(33.879)^2 + (4.7)^2} \times 10^3}$$

$$= \underline{9.9 \text{ Volt}}$$

(ii) f = 10 KHz

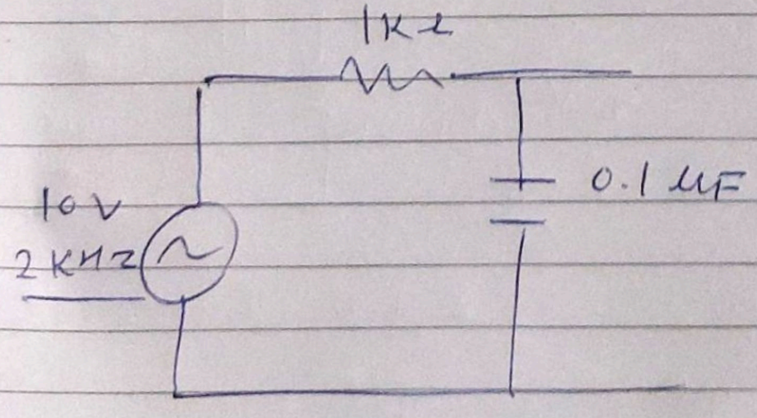
$$X_c = \frac{1}{2 \times 3.14 \times 10 \times 10^3 \times 47 \times 10^{-7}}$$

$$= 0.338 \text{ K}\Omega$$

$$\therefore V_{out} = 10 \times \frac{0.338 \times 10^3}{\sqrt{(0.338)^2 + (4.7)^2}}$$

$$= \underline{0.718 \text{ Volt}}$$

(5) For the given LPF find the -3 dB frequency & V_{out} at 2 KHz. Also plot the frequency response characteristics for the given LPF.



$\rightarrow \quad f_c = \dfrac{1}{2\pi RC} = \dfrac{1}{2\times3.14\times1\times0.1\,\mu F}$

$= \underline{1.59\,KHZ}$

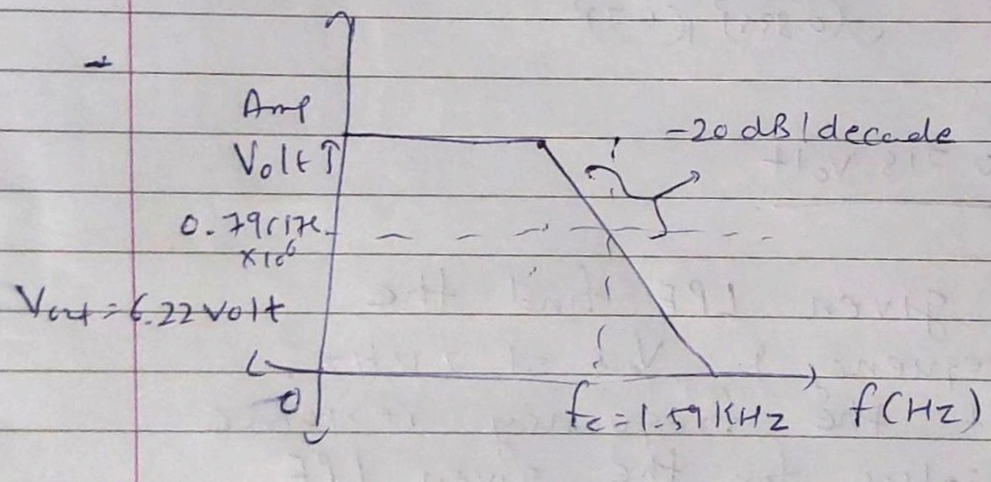
$\rightarrow \quad V_{out} = V_{in} \times \dfrac{X_C}{\sqrt{R^2 + X_C^2}}$ $\qquad X_c = \dfrac{1}{2\pi fC} = \dfrac{1}{2\times3.14\times\cancel{1.5}2\times0.1\,\mu F}$

$\cancel{=7}\ 0.796178\times10^6\,\Omega$

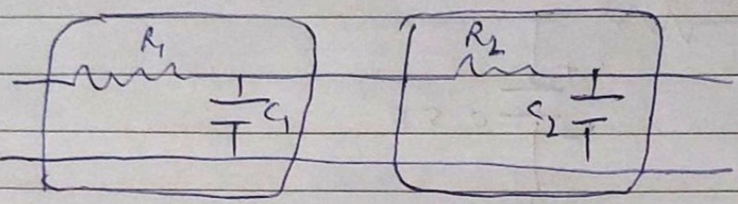
$= 10 \times \dfrac{7.96178\times10^5}{\sqrt{(796.178\times10^3)^2 + (10^3)^2}}$

$= \underline{6.22\,\text{Volt}}$

$\rightarrow$



(6)



→ $$\boxed{f_c = \frac{1}{2\pi\sqrt{R_1C_1R_2C_2}} = \frac{1}{2\pi R_1C_1}}$$

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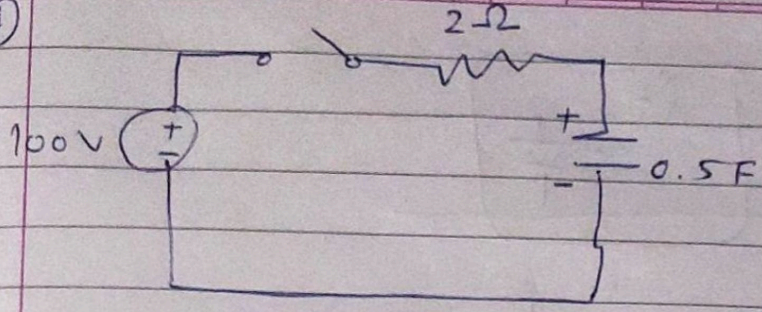

→ $Q = 10\,C$ $\quad i_{1sec} = (?)$

Now, Initially $V = \frac{Q}{C}$

$= \frac{10}{0.5}$

$= 20\,V$

So $I_0 = \frac{100-20}{2}$

$= 40\,A$

Now, $I_{(t)} = i_0 e^{-t/RC}$

$RC = 2 \times 0.5 = 1\,\Omega$

$\therefore I = 40 \cdot e^{-1/1}$

$= \underline{14.71\,A}$