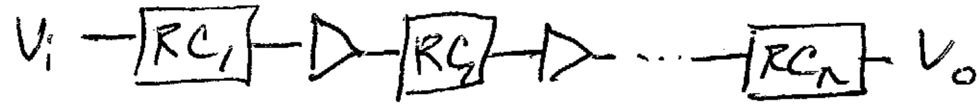
Shifting n independent & equal RC poles



Starting from the 2nd & equal pole solution

$$\frac{1}{\sqrt{2}} = \frac{1}{\sqrt[n]{\sqrt{2}}} \times \frac{1}{\sqrt[n]{\sqrt{2}}} \times \cdots = \frac{1}{\sqrt{1+(\omega RC)^2}} \times \cdots$$

By symmetry

$$\frac{1}{\sqrt[n]{\sqrt{2}}} = \frac{1}{\sqrt{1+(\omega RC)^2}} \quad \text{and as } \sqrt[n]{\sqrt{2}} = \sqrt{1+(\omega RC)^2}$$

Now

$$(\sqrt[n]{\sqrt{2}})^2 = 1+(\omega RC)^2$$

$$\sqrt{(\sqrt[n]{\sqrt{2}})^2 - 1} = 2\pi x f_c RC$$

Again $2\pi f_c RC = 1$

$$x = \sqrt{(\sqrt[n]{\sqrt{2}})^2 - 1}$$; This looks like a Russian Nesting Doll

Breakout the calculator!!

$n=3,\ x=0.5098,\ \frac{1}{x}=1.961$

$n=4,\ x=0.435,\ \frac{1}{x}=2.2989$

$n=5,\ x=0.3856,\ \frac{1}{x}=2.593$

Conclusion: If we want $f_c = 10Hz$ and we have 3 equal & independent RC poles; we calculate the RC values using $1.96 f_c$.

Using a 1μf capacitor $R = \frac{1}{2\pi 1.96 f_c C} = 8.12k$ ohm

<u>Checking our work</u> any 1 RC at $f_c = \frac{1}{\sqrt{1+(2\pi f_c RC)}} = 0.89076$

for the system $(0.89076)^3 = 0.707 = \frac{1}{\sqrt{2}}$ ✓