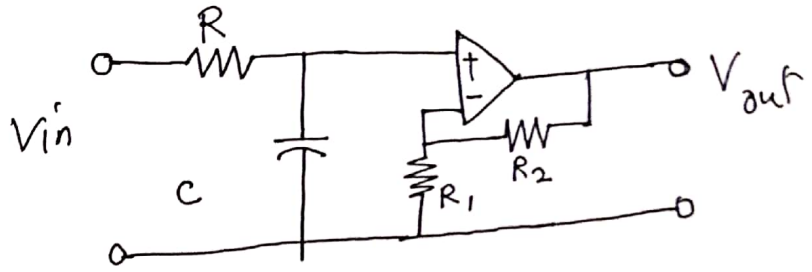
Problem 1 : Design a non-inverting active low pass filter circuit that has a gain of ten at low frequencies and the cut-off frequency is 250Hz.

Soln: Low pass filter circuit is:



The gain for non-inverting amplifier is given as:

$$A = 1 + \frac{R_2}{R_1} = 10$$

Assume a value for resistor R1 of 1kΩ.

So, $R_2 = (10-1) \times R_1 = 9k\Omega$.

The cut off frequency is given as 250 Hz.

So, $\frac{1}{2\pi RC} = 250$.

Assume a value for R as 10 kΩ

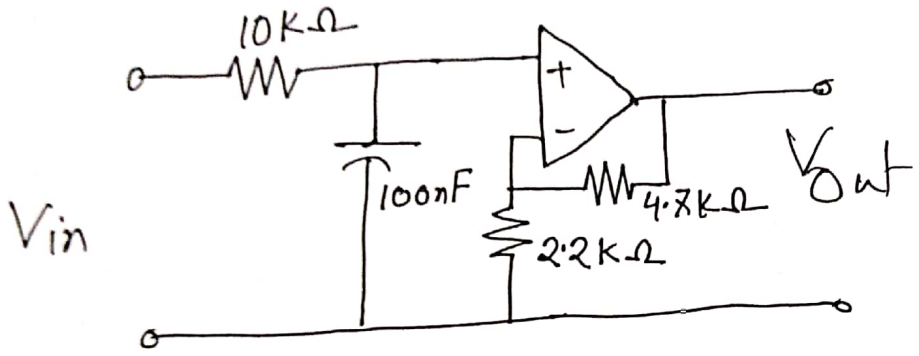
$$\frac{1}{2\pi \times 10 \times 10^3 \times C} = 250$$

So, $C = \frac{1}{2 \times 3.1416 \times 10^4 \times 250} = 6.366 \times 10^{-8} F = 63.6 \times 10^{-9} F$

$= 63.6\ nF$

[1nF = 10^{-9} F]

Problem 2: Find the cut-off or corner frequency for the following filter circuit:



Soln: We know, the cut-off frequency is:

$$f_c = \frac{1}{2\pi RC}$$

$$= \frac{1}{2 \times 3.1416 \times 10 \times 10^{3} \times 100 \times 10^{-9}}$$

[when resistor value is in Ω, capacitor is in F then frequency is in Hz.
10KΩ = 10×10^{3}Ω, 100nF = 100×10^{-9} F]

$$= 159 \text{ Hz}$$

Problem 3: A signal contains frequencies 200Hz, 300Hz, 700Hz and 1KHz. Design an appropriate filter which will pass 700Hz with an amplification of 2.

Sol^n: As the filter allows some middle frequency we need to use a bandpass filter to do this.

Let, first consider the low pass filter. The cut-off frequency will be 700Hz or higher than 700Hz.

Assume, $f_c = 750\,Hz$ [This must be lower than the next unallowed frequency]

So, $$\frac{1}{2\pi R_1 C_1} = 750$$

Let, $R_1 = 1\,K\Omega$

Then, $$C_1 = \frac{1}{2\times 3.1416 \times 1\times 10^3 \times 750} = 0.212\,\mu F$$

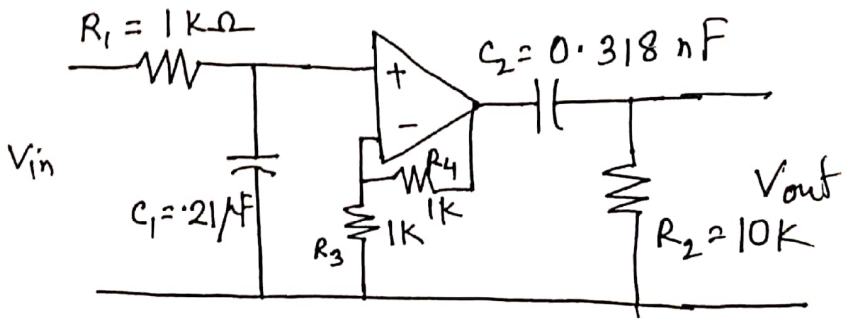
Now, Assume $f_c = 500\,Hz$ for high pass filter:

So, again $$\frac{1}{2\pi R_2 C_2} = 500$$

Let $R_2 = 10\,K\Omega$.

Then $$C_2 = \frac{1}{2\times 3.1416 \times 1\times 10^4 \times 500} = 0.318\,nF$$

The circuit:



Gain is given as 2:

Let, $R_3 = 1K$

So, $1 + \frac{R_4}{1} = 2$

$\Rightarrow R_4 = 1$