INDIAN INSTITUTE OF TECHNOLOGY DHARWAD
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Wednesday	**EE 202: Introduction**	Time: 1600 to 1630
03rd Nov. 2021	**to Analog Circuits**	Marks: 15
	Quiz 2 - Part A	

Make suitable assumptions where you deem necessary and state them in the answerbook.

Write the question number clearly before every answer and show the intermediate steps to demonstrate your thought process.

Write page numbers on all your answer sheets.

You should stop writing at 1620. Take pictures of your answer sheet with the page numbers visible and submit it on Moodle before 1830 Hrs. Your submission could be a zip file of all images or a single PDF file. Please note that Moodle submission link will automatically get disabled at 1630. I will not accept any email submissions.

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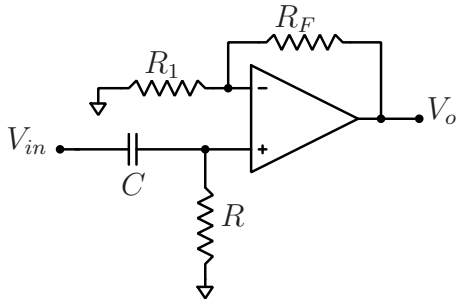
1. Design an active High pass filter with a gain of 15, and a cutoff frequency of XY (where XY are the last 2 digits of your roll number). [8]

Solution: Consider XY=21. We need to design a high pass filter with a gain of 15 and cutoff frequency of 21 KHz. The circuit of a opamp based active high pass filter is as follows:



(2 marks)

The cutoff frequency is given by

$$f_c = 21 \text{ KHz} = \frac{1}{2\pi RC}$$

If we choose $C = 1$ μF, then the value of R can be computed to be 7.578 KΩ.

(3 marks)

To set the gain to 15, let us choose R_F as 18 KΩ and R_1 as 1.3 KΩ (which are standard values of resistors, we will get a gain of

$$Gain = 1 + \frac{R_F}{R_1} = 14.8.$$

(3 marks)

2. An engineer is tasked with designing an amplifier that amplifies a signal that lies between 1 KHz and 3 KHz. In order to selectively amplify this signal, the engineer designed a band pass filter, which is shown in Figure 1. However, when he rigged up the circuit and tested in the lab, he found that it did not work as expected.

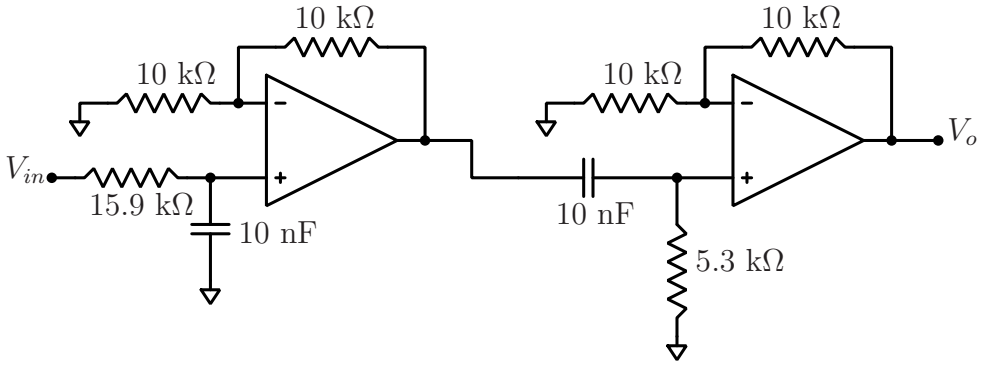


Figure 1: Circuit for question 2.

(a) Can you help him analyze the circuit he has constructed and predict the behaviour of the same? [4]

Solution: In the circuit give, the cutoff frequency of each of the filters is given by

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

For the values of R and C provided, the respective cutoff frequencies are

$$f_c(LPF) = \frac{1}{2\pi RC} = \frac{1}{2\pi 15.9k10n} = 1 \text{ kHz}$$
$$f_c(HPF) = \frac{1}{2\pi RC} = \frac{1}{2\pi 15.9k10n} = 3 \text{ kHz}$$

(2 marks)

For a bandpass filter, the low pass filter cutoff should be higher than the high pass filter cutoff frequency. However, in this case the high pass filter cutoff is lower than that of the low pass filter. Hence, all the frequencies are attennuated, which is why the circuit doesn't work.

(2 marks)

(b) Can you help him correct his design to achieve what he set out to do? [3]

Solution: To correct this circuit, we have to swap the cutoff frequencies of the LPF and HPF, which can be done by swapping the resistor values in the circuit shown.

(3 marks)