Birla Institute of Technology and Science, Pilani

EEE F341/INSTR F341 Analog Electronics

Second Semester 2021-2022

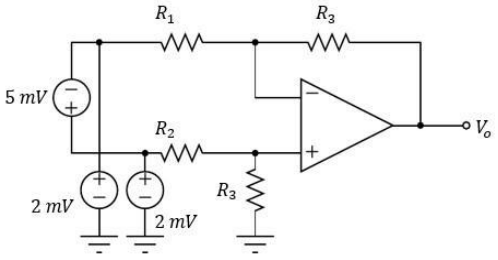
MID-SEMESTER TEST (OPEN BOOK)

Time: 90 min **Max. Marks: 70** **Date: 09-03-2022**

Note: Assume all op-amps have V_{Sat}= ± 10 V, if not mentioned in the question.

[6 M]

Q1. (A) Figure shows a differential amplifier based on an Op- Amp. Suppose that the CMRR of the Op Amp is 100 dB. Assume 4 kΩ input resistance for the differential amplifier with R_1=R_2 and R_3=10kΩ.



Answer the following:

(i). Differential output voltage.

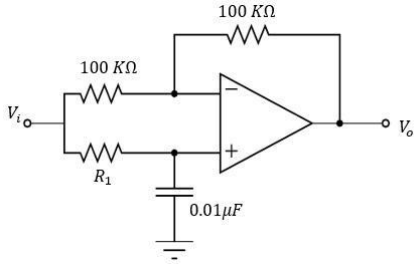
(ii). Common mode output voltage.

[6 M]

Q1. (B). Figure shows an Op Amp based filter circuit. Answer the following: **[6 Marks]**

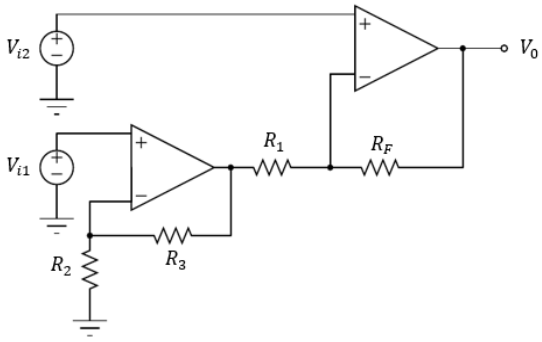
(i) Identify the nature of the active filter and its order. For the given circuit, determine the value of R_1 such that the phase difference between input voltage and output voltage is equal to $\left(\frac{\pi}{2}\right)$ radian. Assume a sine wave input with frequency of 5 KHz.

(ii) For the given circuit, determine the phase difference (in degrees) between V_i and V_o for $R_1 = 100\ K\Omega$.



[9 M]

Q1. (C) Figure shows a two op-amps circuit. In the given circuit, assume $R_1 = R_3 = 560\ \Omega$ and $R_F = R_2 = 5.6\ K\Omega$. Further, $V_{i1} = -2\ V$ and $V_{i2} = -1.5\ V$. Suppose that input resistance $R_i = 2\ M\Omega$ and the open-loop gain A = $2\times10^5\ V/V$ for the IC 741 op amp used in the circuit.



Answer the following:

(i). Determine an expression for voltage gain and compute its value.

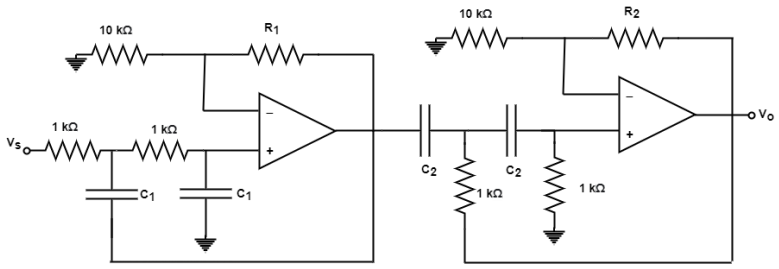
(ii). Obtain expressions for the input resistances R_{i1} and R_{i2}. Compute their values.

(iii). Compute the output voltage.

(iv). Identify the type of the amplifier.

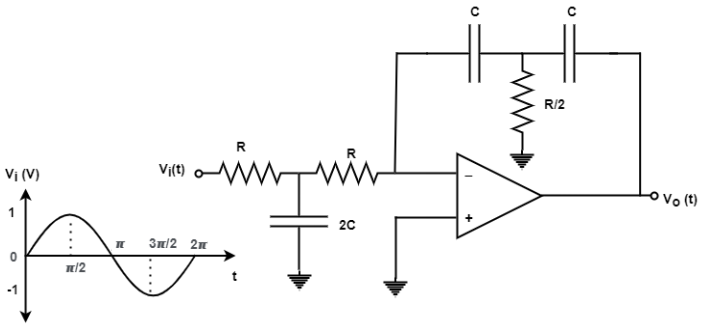
[10 M]

Q2. (A) Find the values of the R_1, R_2, C_1, and C_2 components used in the following circuit to construct a Butterworth bandpass filter having lower cutoff at 1kHz and higher cutoff at 10kHz. Determine the order of the filter. What is the passband gain?



[8 M]

Q2. (B) Find the transfer function of the following circuit and identify the type of operation.



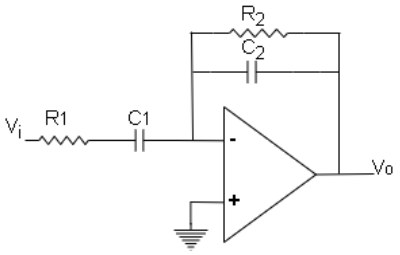
Use R = 10 kΩ and C = 0.01 μF. Draw and label the output waveform $V_o(t)$ for the given input $V_i(t)=\sin 2000\pi t$.

[10 M]

Q2. (C) Design a KHN circuit to realize a bandpass filter with center frequency of 1 kHz and 3-dB bandwidth of 100 Hz. Use, 22 nF capacitor only. Draw the complete KHN circuit, specifying all the component values. Find the center frequency gain. Given $R_1 = R_2 = R_F = 10$ kΩ. **[**

[10 M]

Q3. (A) Design the following band pass filter to have unity voltage gain for the pass band from 300Hz to 30KHz. (Consider C_2 = 1000pF). Also, find center frequency (f_o) and quality factor (Q).



[11 M]

Q3. (B) Design a V-I based electronic voltmeter to show 2MΩ input impedance and can measure DC voltage ranges from 0-1V, 0-5V and 0-20V. Use PMMC having full scale deflection (f_{sd}) as 100**μ**A and meter resistance as 2KΩ. Extend the design for similar ranges of input as RMS ac voltage.
