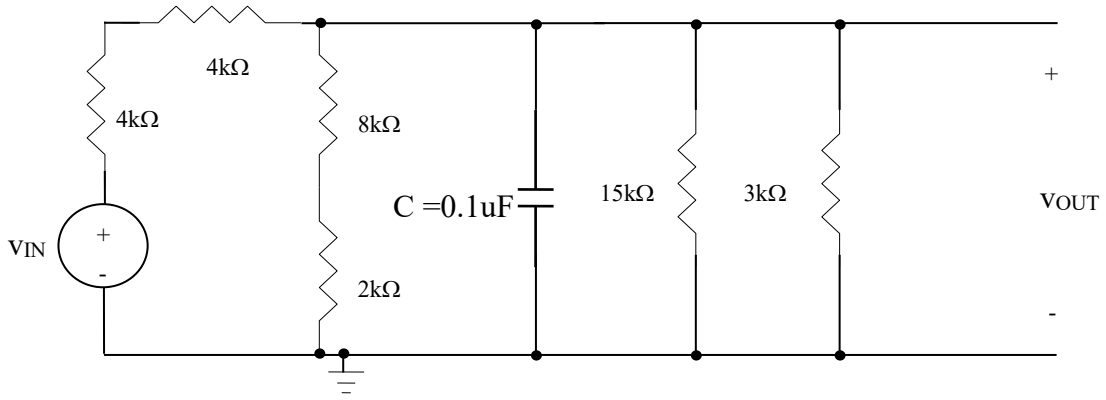
SANTA CLARA UNIVERSITY	ELEN 115 – Spring 2023	S. Krishnan

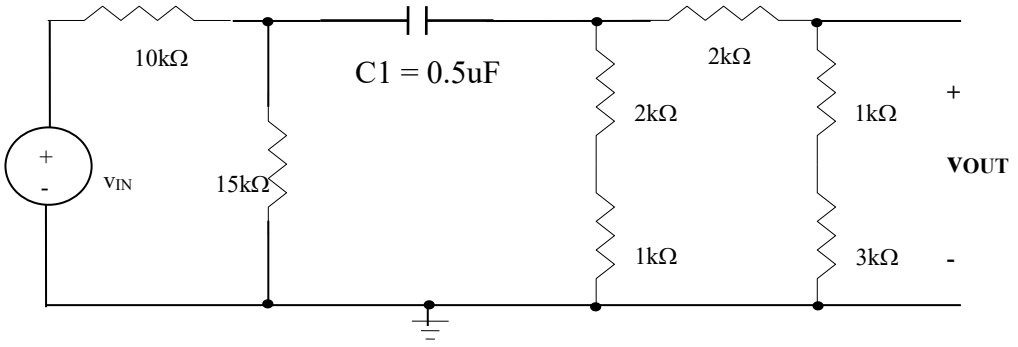
Homework #2 – Single Time constant circuit

1. The filter circuit below has a capacitance C of value 0.1μF.
   (i) Find the value of v_{OUT} / v_{IN} at
      a. $\omega = 0$
      b. $\omega = \infty$
   (ii) From your answer in (i), what type of filter is this circuit?
   (iii) Find the cutoff frequency **in Hz.** Clearly show how you arive at your answer.



   (iv) Draw the amplitude Bode plot of this filter clearly marking the slopes and critical points on the plot.
   (v) If an input $v_{IN}(t) = 2 + 6\sin 400\pi t + \sin(2\pi 10^{12})t$ Volts is given to this circuit, write the expression for the corresponding output voltage $v_O(t)$ as a function of time.

2. For the single time constant circuit in the figure below
(a) Classify the circuit as STC high or low pass for the voltage output $v_{OUT.}$ by finding the gain v_o / v_{IN} at $\omega = 0$ and at $\omega = \infty$
(b) Find the cutoff frequency **in Hz.**
(c) If an input $v_{IN} = 3 + \sin 120\pi t + 9\sin(2\pi 10^{10})t$ Volts is given to this circuit. Write the expression for the corresponding output voltage v_{OUT} as a function of time.
(d) Draw the amplitude Bode plot of this filter clearly marking the slopes and critical points on the plot.



3.

The amplifier circuit below employs an ideal opamp

(a) Derive the expressions for

(i) v_{OUT}/v_{IN}

(ii) the input resistance, R_{in}, seen by v_{IN}

(b) Given that R1 = 5KΩ R2 = 10KΩ R3= 6KΩ R4= 3KΩ R5 = 4KΩ

For input $v_{IN}(t) = 2\sin 2\pi t$, draw $v_{IN}(t)$ and the corresponding $v_{OUT}(t)$.

Clearly indicate all values and label all axes and graphs