The Chinese University of Hong Kong
Department of Computer Science and Engineering
CENG2030 Fundamentals of Embedded System Design

Lab 4: Basic Circuit Analysis

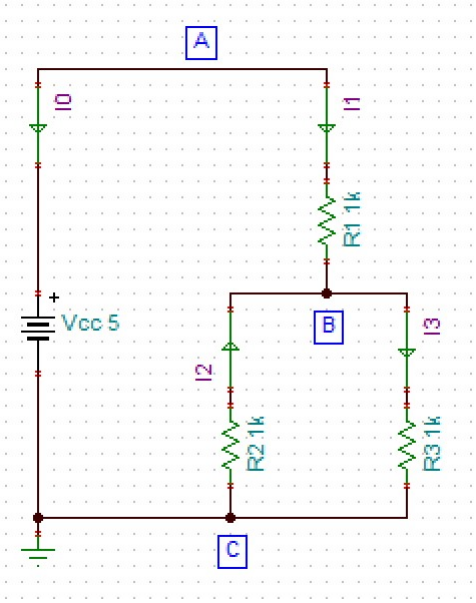
Submission Instructions:

- In this lab, the file created by using TINA will have the file extension **.TSC**
- Answer all the questions in the Answer Sheet in **.DOC** format
- Compress (zip/rar) your files to one single file, and name it with your SID such as **lab4_1155xxxxxx.zip**
- **5 marks** will be deducted for wrong format of filename

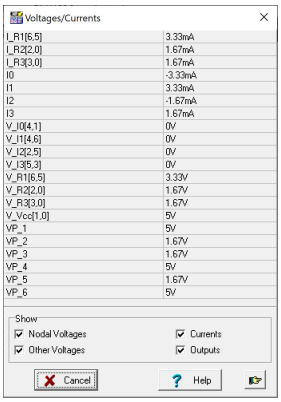
- Upload the zip file **on or before 23:59** on the lab day
- **10 marks** per day will be deducted for late submission

1. KVL and KCL

Construct the following resistive circuit using TINA. It consists of 5V **Battery**, 1k ohm **Resistors**, and **Current Arrows** which define the directions of the currents, I0, I1, I2, and I3.



Select **Analysis: DC Analysis: Table of DC results**. Determine the results of the following measurement according to the content of the table.

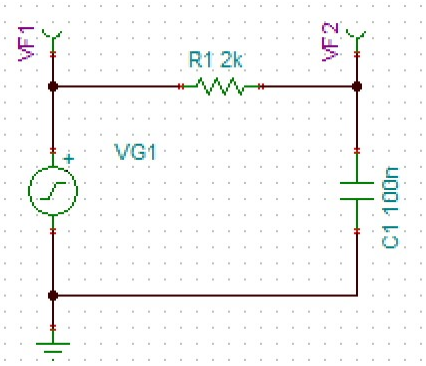


a. Voltage measurement
   i. Measure the absolute value of voltage Vcc across the nodes A and C
   ii. Measure the absolute values of voltages V1 across R1, V2 across R2, and V3 across R3
   iii. Write down the absolute values of the voltages on the answer sheet
   iv. Write down an equation of Vcc in terms of V1, V2, and/or V3

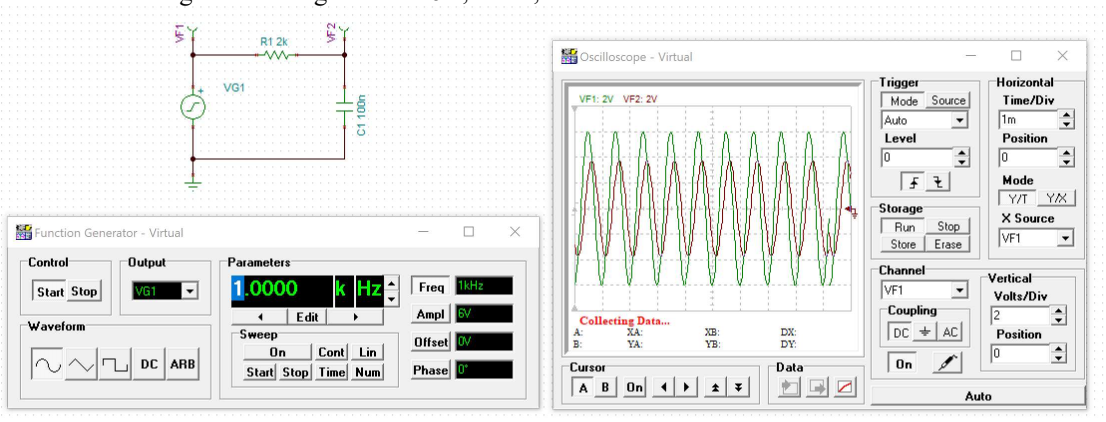
b. Current measurement
   i. Measure the currents I0, I1, I2, and I3 according to the current flow directions as defined in the circuit diagram
   ii. Write down the currents on the answer sheet
   iii. Write down an equation of I0 in terms of I1
   iv. Write down an equation of I1 in terms of I2 and I3

2. Passive Low Pass Filter

Construct a first order Low Pass Filter (LPF) as shown below, where R1 = 2kΩ, and C = 0.1μF = 100nF.

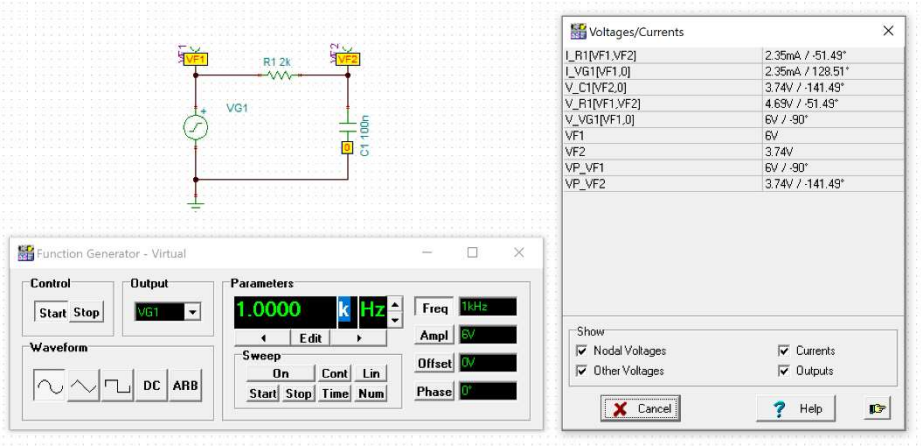


a. Frequency Response
   i. To observe the frequency response of the circuit, inject a sine wave at VG1 using Function Generator, and check both input VF1 and output VF2 using Oscilloscope
      1. Use the function generator to generate a 6V, 1kHz, sine wave



      2. Use the Oscilloscope to monitor both VF1 and VF2. At **Channel**, turn both VF1 an VF2 **On**. By adjusting Horizontal (1m s./Div) and Vertical (2 V/Div) scales, you should be able to display two sine waves as show above. As you can see, when the input is at 1kHz, the output amplitude is reduced from 6V to less than 4V.

3. To observe the output amplitude precisely, we can use **Analysis: AC Analysis** to observe the output voltage **VP_VF2 = 3.74V** instead of using oscilloscope.



4. By changing the frequency of VG1 according to the table in the answer sheet, and measuring the output voltage **VP_VF2**, we can plot a graph of the frequency response of the circuit

ii. Cut-off Frequency

1. By calculation, what is the cut-off frequency, fc, of the LPF?
2. Based on the graph in part iii below, what is the output voltage of VF2 at fc? [Plot the graph before you answer this question]

iii. **Write down the collected data, and plot the frequency response of the circuit on the answer sheet**

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Answer Sheet

Student Name:_____ SID:_____

1. KVL and KCL **[54%]**

a. Create and upload the TSC circuit file. [10%]

b. Voltage measurement

Vcc: _____ [4%]

V1: _____ [4%]

V2: _____ [4%]

V3: _____ [4%]

Equation: Vcc = _____ [4%]

c. Current measurement

I0: _____ [4%]

I1: _____ [4%]

I2: _____ [4%]

I3: _____ [4%]

Equation: I0 = _____ [4%]

Equation: I1 = _____ [4%]

2. Passive Low Pass Filter **[46%]**

a. Create and upload your circuit in TSC file. [10%]
b. Frequency Response

i. Collected Data [12%]

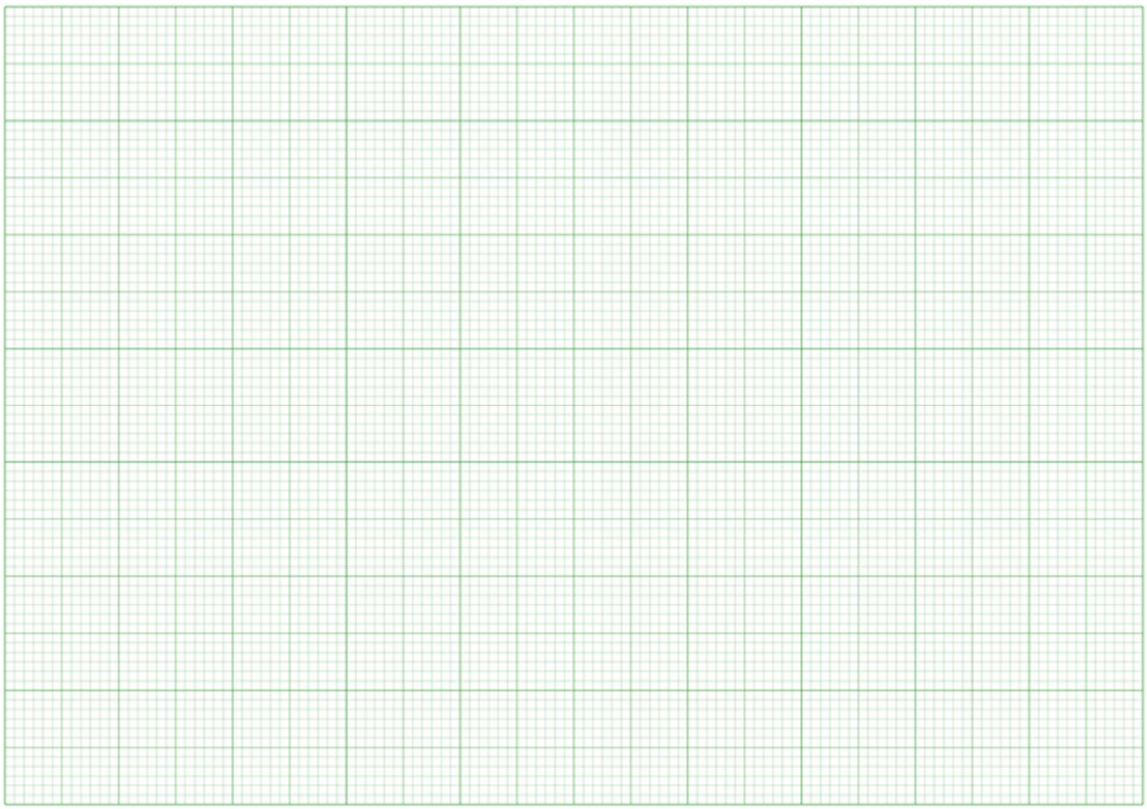
Frequency of Vin (Hz)	50	100	200	500	1k	2k	5k	10k	20k	50k	100k	200k
Vpp of Vout (V)												

i. Cut-off Frequency

fc: $fc = \frac{1}{2\pi CR}$ = _____ [4%]

Vout at fc: _____ [4%]

ii. Graph Plotting [16%]



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