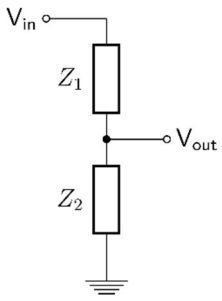
The Chinese University of Hong Kong
Department of Computer Science and Engineering
CENG2030 Fundamentals of Embedded System Design

Homework 1: Circuit Analysis and Operational Amplifier

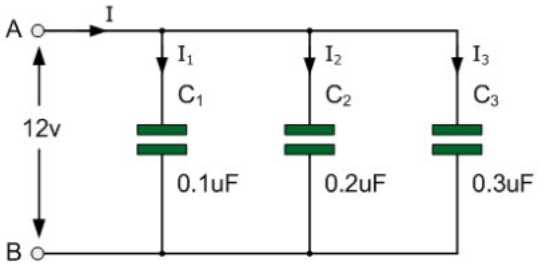
Submission Instructions:

- Answer all the questions **with clear steps**.
- Save your answers in **pdf** file
- Upload the pdf file to **Blackboard** before the deadline stated in Blackboard
- Marks will be deducted for late submission, deduct 10 marks per every 1-hour interval (e.g. deduct 20 marks for 61 minutes late).

1. Given the following voltage divider circuit with Vin=12V, Vout=3V, and Z1=450kΩ. What is the resistance of Z2? [10 marks]

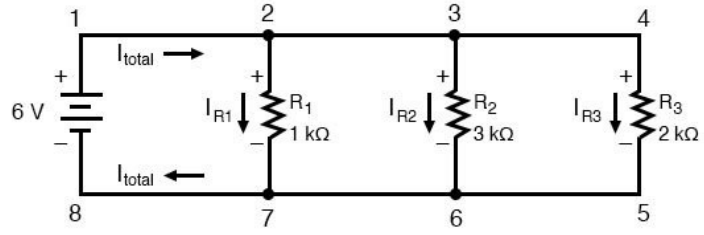


2. Given the following capacitor network. What is the total capacitance between A and B? [10 marks]

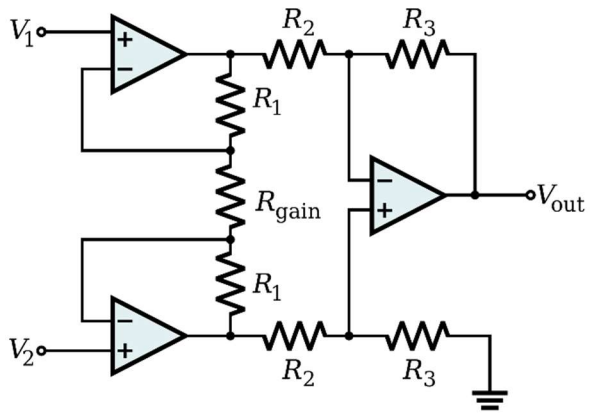


3. If the AC voltage across an inductor is 5cos(2000t)V and the inductance of the inductor is 5μH. Assume the initial current Io=0A, what is the current going through the inductor at time t? [10 marks]

4. Given the following resistor network. What are the total current (i.e. I_{total}) and the currents going through each resistor (i.e. I_{R1}, I_{R2}, and I_{R3})? [20 marks]

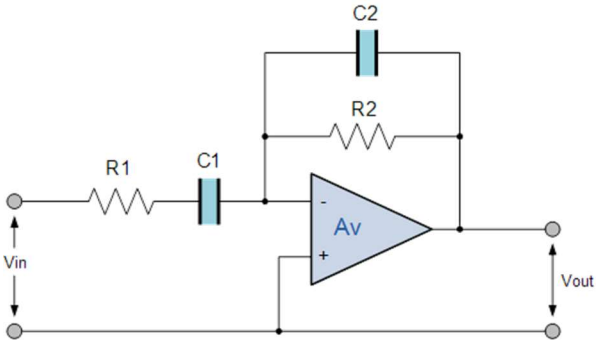


5. Given the following instrumentation amplifier and its gain (Av) as below. Prove the given gain equation with clear steps. [20 marks]



$$A_v = \frac{V_{out}}{V_2 - V_1} = \left(1 + \frac{2R_1}{R_{gain}}\right)\frac{R_3}{R_2}$$

6. Given the following active inverting band pass filter circuit with C1=100nF, C2=1nF, R1=1.6kΩ, and R2=80kΩ. What are the cut-off frequencies (i.e. fc1 and fc2) and the voltage gain (Av)? [15 marks]



7. Can the filter circuit in Question 6 filter out 100Hz noise? Explain briefly. [15 marks]

THE END