THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

ENGINEERING

Department of Electrical and Computer Engineering

ELECTENG 209: Analogue and Digital Design

Analogue Lab Assignment II

1. Using LTSpice determine the output voltage of the op-amp circuit shown below. Verify your results through circuit theory. Why do you observe a distorted/clipped output (i.e. output is not an amplified sinusoidal waveform)? What can be done to rectify this issue - discuss three alternatives methods that can be used along with their advantages and disadvantages.

(0.2 marks)

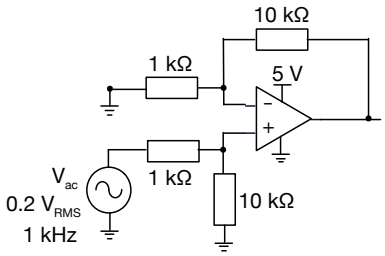

Fig. 1 An op-amp circuit

2. Using LTSpice simulate the frequency response of the filter circuit shown below. Verify your results through circuit theory. What would be the effect on frequency response if capacitances were increased by 20 times? How would the increase in capacitance affect the amplified output waveform? Why? How can we make it a 2nd order filter?

(0.2 marks)

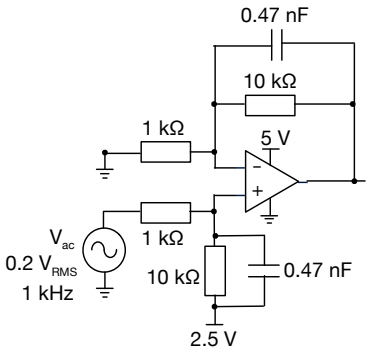

Fig. 2 A first order filter circuit

3. Setup LTSpice to simulate the 5 V regulator circuit shown below. Examine and comment on the voltages across C_s and R_L. Stating your assumptions, derive an expression to approximate the voltage ripple across C_s. Investigate the effect on the voltages when R_L is set to 30 Ω. What changes can you make to the circuit to maintain output steady at 5 V when R_L is 30 Ω? What's the purpose of R_s? What are the benefits and disadvantages of using a full-wave rectifier oppose to a half-wave rectifier in your design? Why is it recommended to use a 5 V supply in your design?

(0.2 marks)

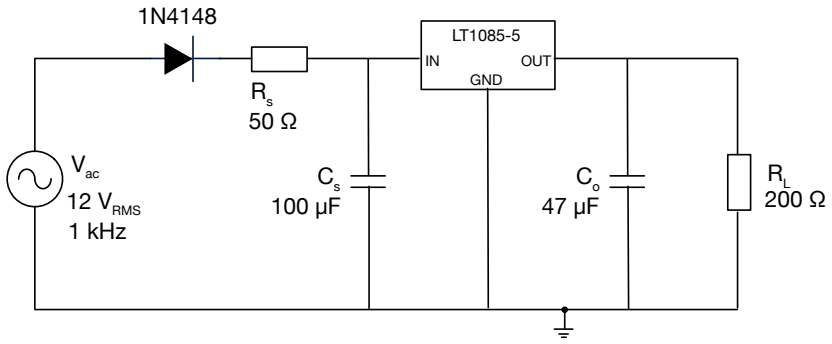

Fig. 3 A regulator circuit

4. Assuming that you use the values derived for voltage divider circuit in Q6 of 'Lab Assignment I' for R_a and R_b, determine the resistor values R_3, R_1 and R_2 of the level-shifting circuit shown below to produce an output voltage signal that has an offset of 2.5 V and a peak-peak voltage of about 4.5 V. Make sure to select resistor values from the E12 series. Simulate and verify your design. Do we use resistors in the range of ohms, Kilo-ohms or Mega-ohms? Discuss issues relating to using resistor values that are too large or too small?

(0.2 marks)

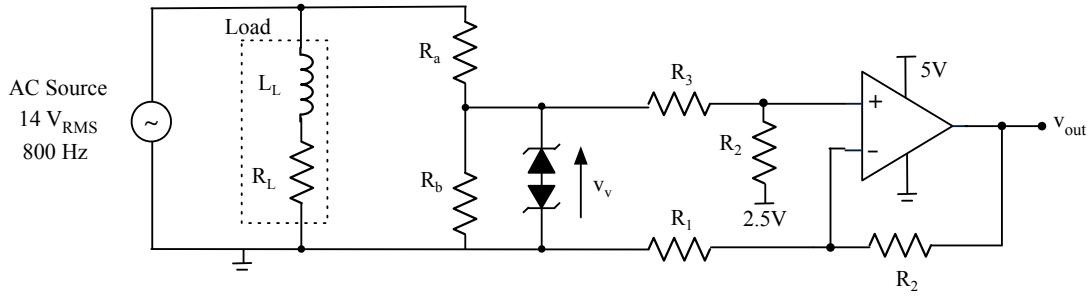

Fig. 4 Voltage sensing circuit

5. Assuming that you use the value derived for resistive shunt in Q5 of 'Lab Assignment I' for R_s, determine the resistor values R_1 and R_2 of the differential amplifier circuit shown below to produce an output voltage signal that has an offset of 2.5 V and a peak-peak voltage of about 4.5 V (at maximum load). Make sure to select resistor values from the E12 series. Simulate and verify your design. What will happen if the corresponding

resistor pairs of the differential amplifier are not equal to each other? What will happen to the output when the load decreases (i.e. load resistance increase)? How can you improve the accuracy of measurements under light loads?

(0.2 marks)

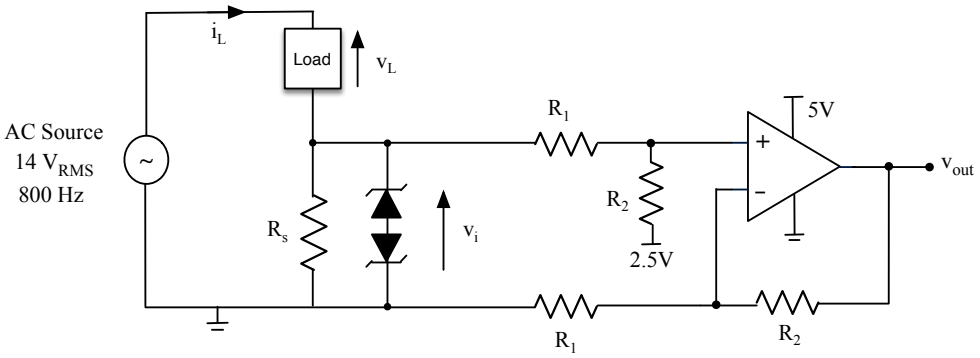

Fig. 5 Voltage sensing circuit