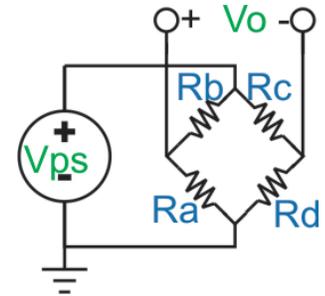


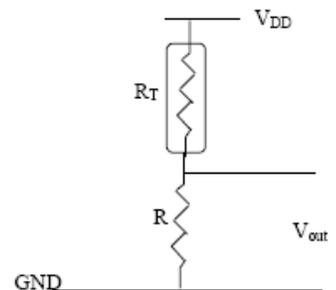
Due: Monday September 24

1. What is the function of a transducer? Give one example of a primary transducer not discussed in class.
2. Describe one example of a sensor that makes a direct measurement and one that makes an indirect measurement. Explain as necessary to clarify how the measurement is direct or indirect. Choose examples from the world around you.
3. What are the four different transducer types (modalities) for measuring displacement?
4. a) What are the two basic materials used for resistive strain gages?  
b) Which of these is most sensitive? Describe in your words what “sensitive” means.  
c) What is a disadvantage of the more sensitive strain gage material?
5. For the 1-element Wheatstone bridge configuration show in p. 13 of the class notes, what is the change in output voltage if R3 changes from 1kΩ to 1.1kΩ? Assume R1 = 10kΩ, R2 = 1.2kΩ, and R4 = 10kΩ and that only R3 changes.

6. You have been assigned to build a sensor using two resistive sensor elements that both exhibit an inversely proportional response to parameter Z given by  $R = R_o - Z \cdot R_o$ . You decided to place the sensors in a Wheatstone bridge shown on the right such that Ra and Rd are sensor elements connected to the negative node of the power supply voltage Vps.
  - a) Assuming  $R_b = R_c = R_o$ , derive the output voltage Vo as a function of parameter Z and Vps.
  - b) Can the bridge be constructed in a way that provides more sensitivity to parameter Z? If so, briefly describe.



7. Briefly describe four different types of temperature sensors.
8. Consider a resistive temperature sensor with a resistive divider readout circuit as shown on the right (copied from p. 13 of the Sensor notes). Assuming the following conditions, sketch/plot the general shape of the single-point output voltage, Vout, vs. time.
  - i) the sensor is on top of the divider, like RT in the figure
  - ii) the sensor resistance increases as temperature increases
  - iii) temperature is decreasing linearly over time



9. Describe some advantages and disadvantages of integrated circuit temperature sensors relative to other types of temperature sensors.
10. Why is radiation thermometry often used in biomedical temperature measurements?
11. What are the three main components of an optical measurement system?
12. Search the internet to find a biomedical sensor that uses MEMS technology. Briefly describe the sensor, its fabrication and its application.