Name (*last, first*)_____ ID_____

ECE 2100

Lab. II-Kirchhoff's Circuit Laws – Rectifier/Wheatstone Bridges

Pre-Lab

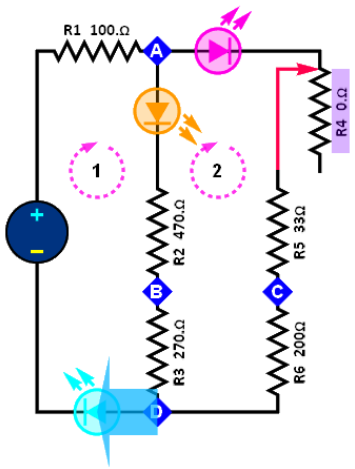
Important note: this is the pre-Lab of Lab II. You can type in the answers, or print out and write in the answers to the questions below and submit when it is due as indicated on the class schedule. To answer the questions, you need to go to the full Lab-II description web pages. 4 pts each question: Q1-Q23, exclude Q11-12 (bonus); Q24: 10 pts; Q25: 6 pts.

1. A rectifier diode bridge can convert AC electricity into DC, which is the purpose of this Lab. True or False. Explain your choice.

2. Diodes (non-light emitting types) are typically used for rectifier bridges. Here we have to use light emitting diode as substitutes because we don't have other types of diodes. True or false. Explain.

3. We want to use LEDs for the rectifier bridge of Circuit 1 in order to make it looks pretty and interesting. Other than that, it has no other purpose. True or False. Explain.

4. If a unidirectional LED in a circuit lights up, we can tell which direction the current flow without having to use the DMM to measure it. True or False? Explain.

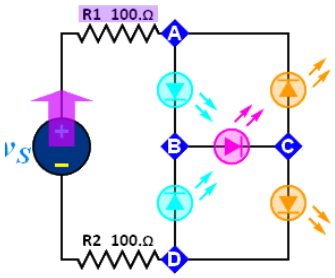


5. In the Mesh Current Method (MCM), as applied to the side figure (which has 2 meshes), there is no definitive current direction because it is purely a convention. If we choose the mesh direction clockwise, a current may be positive, but it would become negative if we choose counter-clockwise. Hence, either:
   a. A LED will emit light or not depends purely on the mesh direction one chooses; OR
   b. The MCM works only with resistor circuits and is not applicable to circuit with diodes or LEDs; OR
   c. I have not learned the MCM yet.

Choose **a, b** or **c**, or **write your own alternative answer**.

6. The purpose of this Lab is to study Kirchhoff's Voltage Law and Current Law as applied to Circuit 1 and Circuit 2. True or False.

7. Consider the rectifier on the side (Circuit 1), write KCL to node B, use the notion i_{BX} for current from node B to node X where X can be A, C, or D. (If you have not learned KCL in other courses, just write so and skip).



8. In Circuit 1 as shown on the above right, if node B voltage is higher than that of node D, there is no current flow (because it is reverse with respect to the diode). Hence, KCL **cannot** be applied to:
   a. Node B only
   b. Node D only
   c. either node B or node D
   d. KCL can be applied to **both** node B and D
   e. None of the above

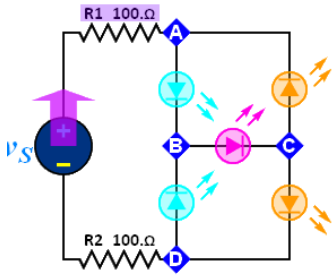
9. Use the App for Circuit 1 (LED rectifier), obtain node voltages A, B, C, D for v_s = 10 V and v_s = -10 V. Calculate all the LED reverse bias voltages that you can find for each case. (You can copy and paste results here, then type in the reverse voltages you find).

10. In general, it is not safe to have more than ~5 V reverse bias on a LED (some can actually take up to ~8, 9 V). In your answer to Q. 9 above, is there any reverse bias that is above the 5-V limit?

11. (bonus) If you remove the LED between node B and node C and Let v_s = 5 V, will there be any LED lighting up? Explain your answer. If you don't know, do this experiment when you do Lab work and find out, then report your finding for bonus (5 pts).

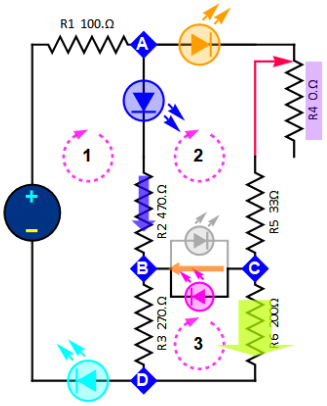
12. (bonus) If you remove the LED between node B and node C and Let v_s = 5 V, what are the voltages of node B and node C. Explain your answer if you have a guess. If you don't know, do this experiment when you do Lab work and find out, then report your finding for bonus (5 pts).

13. Draw on the circuit on the right if necessary, explain what you will need to do for Part A, Step A.3 and A.4.



14. What are the differences between Step A.3 and Step A.4?

15. The purpose of Wheatstone bridge is to measure an unknown resistor. In the side circuit, which resistor is the unknown one that we wish to find in this Lab?

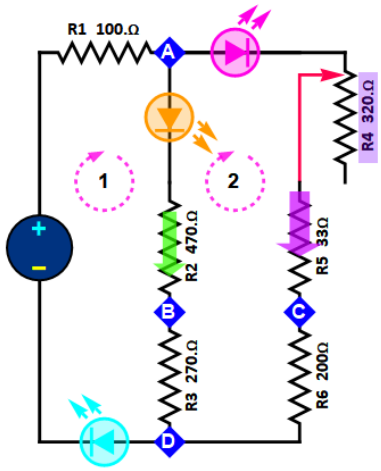


16. Original Wheatstone circuit has no LED. The reason we use LED here is to illuminate the bridge in order to see it in the dark (like in the picture). True or False. Explain why we use LEDs here.

17. In Q. 4 above, it is about unidirectional LED. For Circuit 2, we will use a bidirectional LED or an equivalent parallel, opposite-polarity LED pair. Since this LED element will emit light in either direction, if it lights up, we can tell the presence of a current, but cannot tell the current direction. True or False. Explain.

18. A circuit element you will need for Circuit 2 is the potentiometer. It is used to measure the potential energy of the circuit. True or False. Explain.

19. For Circuit 2, in Part B, describe what you will do in Step B2, and explain in plain English the effect that you will observe (it's about LED 3 – go to the App to find out LED 3).



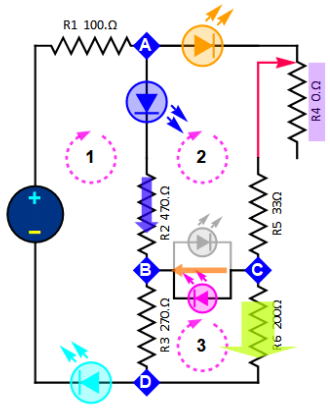
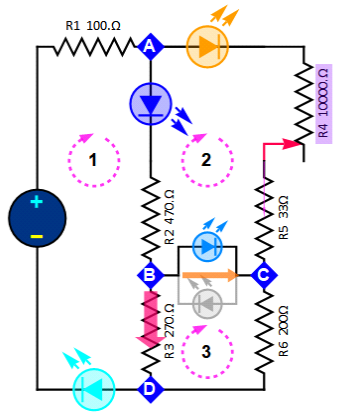
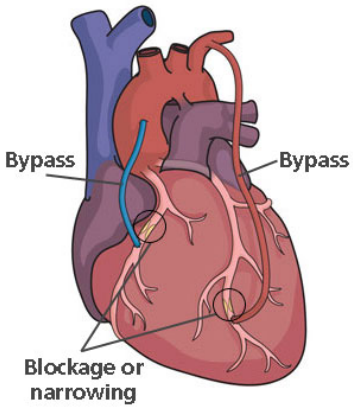
20. Use the App if necessary, **describe and explain** in plain English what happens to voltage of node C relative to that of node B when you vary R4 from 0 to 10 kOhm. (you **describe** what happens, and **explain** why so)

21. What will you do for Step B.3? and is that an objective of this Lab?

22. If you connect a bidirectional LED or an equivalent LED pair between nodes B and C in the above figure, **describe and explain** what happens for the two cases you discuss in Q. 20.

23. What will you do for Step C.3? and is that an objective of this Lab? What is the difference in the objective of Step B.3 vs. Step C,3?

24. (10 pts) In the figures below, consider resistor R6 as the heart muscle that needs power, which means current flow in the circuit. Which one of circuit **a** and **b** that you think most analogous to **c** in the sense that the flowing into the muscle (R6) is blocked, and a bypass is used to supply the current into R6 ?

Fig. **a**	Fig. **b**	Fig. **c**
		

Explain your rational (must explain to get full credit).

25. (6 pts) Find a value for R4 such that vB = vC within 3 digits of precision (use the App). Show your results here. If this is the case, does it matter or not if you bridge or un-bridge B and C with the bidirectional LED or equivalent pair? (This question prepares you for step C.5).