

EE31 Junior Design  
Spring 2019  
Project Design Phase 02A  
Pre-Studio

Assignment Date and Due Date: check Assignment/Due Date Listing  
Pre-studio assignments are to be recorded in your Bound Lab Notebook and reviewed by the instructor at the start of class before starting your design work.

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If you are not sure what to do on this assignment, ask your instructor or TAs.

Pre-studio questions: Motor control

Think:

1. Organize the questions that follow in a think, plan, do, test, reflect, demo iterative process. What thinking do you need to do?
2. What problem are you trying to solve?
3. What is the specific customer requirement that impacts on motor control?
4. What does the customer care about motor control if the swarmbot is autonomous?
5. Will a motor require more current when spinning freely or when propelling a swarmbot?
6. What is the minimum DC current required by the swarmbot's motor if operated at 4.0 volts?
7. If you use a BS170 n-channel MOSFET to control your motor, what is the minimum gate-to-source voltage you need to apply to the gate terminal in order to guarantee that the transistor turns on? (If you do not know, check the data sheet on trunk to determine the answer.) What is the tolerance on this minimum?
8. What is tolerance on the maximum gate voltage that could be applied to the BS170 that still ensures the transistor will be in cutoff?
9. ***What is the maximum current for the analog pins on the Arduino Mega?***
10. Review the various amplifier configurations that you learned in EE-21. Now, starting with a 6-volt power supply, design a circuit using the BS170 MOSFET that allows the Arduino to switch the motor on and off. The MOSFET gate voltage is constrained to the digital output voltage available from the Arduino. As an initial estimate, assume that the operating current of the motor is 250 mA when it is actually propelling the swarmbot (i.e., the motor is delivering some power to the wheels).
11. ***Is it possible to energize the motor directly from the Arduino? Why or why not?***
12. In item 5, how much power is being delivered to the motor? Approximately how much power is wasted in just turning the motor and gearbox? How much power is delivered to the wheels and actually used to propel the swarmbot?

13. What is the milliamp-hours capacity of a 9V battery if the current draw is 100 mA. If the swarmbot draws 200 mA, how long can a swarmbot move in a straight line at full speed? Do calculations for the motor alone and with a one-pound mass swarmbot and two motors. How does the second calculation degrade the battery compared to the first one? You will need to review the datasheet in the file 9V Energizer Battery Datasheet.pdf on trunk.

Plan:

1. Design, sketch and analyze a schematic of the circuit that you will construct during class to meet the posted specification.
2. Design, sketch, and plan out the fixture required to construct the design

Do:

1. Where do you need to do the design?
2. What tasks are necessary to get from design to demo?
3. What questions are not yet answered? Where do you intend to get the answers?

Test:

3. What tests (experiments) will you need to design?
4. Think about the test equipment required to validate and verify your design. What is the best test equipment for this phase of the project?

Reflect:

1. How many things failed?
2. Are you honest about your recording your and your team's failures? What are you afraid of to not list your or your team's failures along the way? What proficiency or skills are you are working to acquire? How do you know you have acquired them?
3. One behavior Junior Design students have is they record only the final result in their design notebooks. They are neat and unblemished. What do you think is the reason that Junior Design students tend to only show their correct answer?
4. What is the value of having cross outs and mistakes documented along side corrections and explanations, or earlier design concepts that did not work along side the one that did work in your design notebook?
5. Who is not telling the whole story? For what reason?
6. How many questions did you ask today? To Whom?

Task Questions:

1. How well did you complete the team design tasks you took responsibility for from the last design phase? What did you do well? What unexpected problems did you have? How did you overcome them? What did you learn?

2. How well did you complete the team bot spec tasks you took responsibility for from the last phase? What did you do well? What unexpected problems did you have? How did you overcome them? What did you learn?
3. What part of the team design tasks for this phase are you planning to take responsibility for this assignment?
4. What part of the team building and testing tasks for this phase are you planning to take responsibility for this assignment?
5. What will you need to learn to complete the team tasks for this phase for which you have taken responsibility?