Practice Questions for Embedded Systems Quiz 1

Building blocks

1. What are the building blocks of an embedded system? What would be the choice of these building blocks in a car, a glucose meter, a pacemaker, an ingestible electronic capsule?
2. Why do coaxial cables have a metal sheath around them?
3. What is the problem with using breadboards for circuits? Why are PCBs required?
4. What are the attributes of a resistor? How would the choice of resistor vary for a 100k termination resistor vs a 1k resistor to limit current through an LED?
5. Which electronic component is useful for
    a. Changing fan speeds
    b. Cutting off an iron (for clothes)
    c. unlocking your phone
    d. describe a component of your choice and its use
6. What are SMD/PTH components? When would you use an SMD component over a PTH component and vice versa?

Voltage Regulation

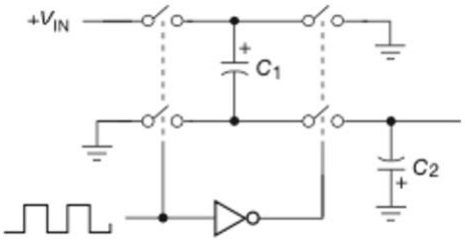
7. You are given a Zener diode with a voltage drop of 2.5V across it at 100mA of current. Design a circuit that can provide a 5V output using negative feedback of an opamp.
    a. Increase the output (current) range of this circuit
    b. Add overcurrent protection to the circuit
    c. Add overvoltage protection on the output of the circuit
    d. How will you ensure that the input power source can be turned off safely?
8. Create an example circuit with 7805 to drive a motor when a switch is pressed. Ensure that reverse emf from the motor doesn't damage the regulator.
9. Consider that you have a constant load, say you're driving a bright light through your circuit but the input to your power supply is from a diesel generator. What kind of characteristics will you look for from your regulator? [High/Low Line/Load Regulation]

$$\text{Load Regulation}(\%) = \frac{\text{Change in Output Voltage from No-Load to Full-Load}}{\text{Full-Load Output Voltage}}$$

$$\text{Line Regulation}(\%) = \frac{\text{Change in Output Voltage for a Given Change in Input}}{\text{Given Change in Input Voltage}}$$

10. What is the difference between linear and switching regulators? What is the reason behind the difference in size for the two types of regulators? Is there a difference in the quality of regulation for the two regulators?

11. In the following charge pump circuit, identify the relationship between input and output voltage:



12. What are technical names for DC to DC step-up, step-down converters? What would be required in order to make these compatible with AC voltage?
13. Is it possible to use a 1.5V AAA cell to power a motor that runs at 6V? If yes, explain how with a sample circuit. You may use block level elements.
14. What is CC-CV charging in batteries? Explain the significance of both phases.
15. Build an example circuit to charge a li-on battery. What is a list of components required for a typical charger?

PCB

16. What the advantages of using a planar structure such as copper boards for a circuit board?
17. What is crosstalk? Distinguish between capacitive, inductive and radiative couplings.
18. What is a power distribution network? Explain the challenges in building a good power distribution network.
19. What are common ways of overcoming inductive coupling on a PCB?
20. What is ground pour? Explain the benefits of the same.
21. Suppose you have some connections with high frequency data being transferred. Explain the precautions that must be taken while routing the same.
22. Is there a difference in the way power, digital signal and analog signals should be routed on a PCB? Please explain the difference and why.
23. What is a typical placement strategy for decoupling capacitors and what is their role?