ELECTRICAL TEAM TRAINING

TASK 2

Problem 1: Bumblebee's Arm

About

After Bumblebee was shot multiple times by Blitzwing in his advanced arm, the motor circuit powering the powerful punch actuator **(supplied by AC voltage from the dynamo on Bumblebee)** was destroyed. This left Bumblebee without his main close-combat weapon and greatly weakened his fighting ability.

Now, stripped of this vital power, Bumblebee faces a daunting challenge, as an engineer, can you help him restore that power so he can fight back and take his revenge?

Requirements

1. **Design** a circuit which takes 220V 50Hz AC as an input and turns it to a 24V DC to drive a 24V-2A Motor with a P-Channel standard level MOSFET while using an external 5V signal to drive it:

   5V → Fully ON
   0V → Fully OFF

   Also, Add an LED indicator which turns ON and OFF based on the state of the motor.

2. **Submit** a documentation which describes:
   - The idea behind your design
   - Criteria on choosing each component (including screenshots from the datasheet)
   - Calculations.

3. Hints:
   - <u>Ideal Transformer Calculations</u>
   - Consider How to drive the p-channel MOSFET
   - Ensuring circuit protection will grant bonus points

Problem 2:

About

Optimus Prime, the heroic leader of the Autobots, depends on advanced cybernetic systems powered by a sophisticated Energon core. To enhance his battle performance and ensure sustained operation during fierce fights, he needs an optimal Energon battery configuration. This configuration must maximize power output while minimizing weight and guaranteeing reliability. With this, Optimus Prime will stand strong against the Decepticons in the war for Cybertron's future.

Requirements

Energon core powers four 12V motors, each drawing 4A continuously, and a camera drawing 0.5A at 12V. The system must operate for at least half an hour on a single charge. You may use more than one battery to meet this requirement, but aim to minimize weight, size, and cost.

Your task is to identify the most suitable battery by balancing cost, performance, weight, and size. Search for suitable batteries in both local (Egypt) and international online stores. Justify your choice and include a factor of safety in your calculations to ensure the system's reliability.

Batteries Session's Bonus Questions

● Answer the questions that are proposed in the Battery Basics session in the submission form.

● Use your understanding of power and energy concepts to calculate your electricity consumption and its cost. Can you reduce it?

Problem 3:

About

After a recent upgrade, Megatron's new Plasma Cannon delivers devastating attacks but demands continuous high power. His onboard module can't sustain it, causing overheating or shutdown mid-battle. As an Energon Systems Engineer, your mission is to optimize the cannon's power supply, prevent thermal overload, and keep it combat-ready at all times.

Requirements

Calculate the power of 24V 15A Supply and see if it can handle the following system

Component index	Characteristics	Quantity
1st	24V – 2A	4
2nd	12V – 24Ω	7
3rd	The energy loss over time follows E(t)=47t	1
4th	2A – 4.2Ω	4
AWG 12	The system is located 10 meters away from the supply, connected using AWG12 wire You will need this: https://www.powerstream.com/Wire_Size.htm	

<u>Submission</u>

- **CAD Design**

  - Submit a CAD design for problem 1 using Multisim or Proteus or any another CAD designing tool.
  - Documentation file for problem 1 MUST be in PDF format
  - Compress all the CAD files for problem 1 into .rar or .zip named 01xxxxxxxx_task2.zip or 01xxxxxxxx_task2.rar, then upload it to your drive and share the link.
  - Ensure that the drive links are set to "public" or "anyone with the link".
  - Submit problem 1 even if the design is not working
  - Any approaches which will introduce protection to the circuit will give bonus points
  - Neat documentation will give bonus points

- For problem 2 and the bonus session's questions, provide answers to these problems within the form itself alongside the session's bonus questions.

- For problem 3, submit your answer as a PDF file in the submission form.

- Submission Link

  https://forms.gle/LVchFZXJeqpQeYEM9

- The Task's deadline is 23/7 11:59 PM.

- <u>**Cheating is severely penalized**</u>