ENEL 372 - POWER ELECTRONICS 1

25% Assignment

Model Solar Powered Car

The model solar car comprises a 10W solar panel mounted on an aluminium chassis. Also mounted on the chassis are a dc motor, gearbox and servo. **ONLY** the servo (for steering) may be powered from an auxiliary battery source. You are not allowed to alter any mechanical characteristics of the car. The car requires design and build of electronic hardware to make the dc motor run from the solar panel.

Project Description:

1. Carry out a laboratory investigation to determine the solar panel and dc motor characteristics and hence determine a suitable design strategy.
2. Design and build a buck converter to interface between the solar panel and the dc motor. A breadboard can be used for initial circuit testing, but the final circuit will be mounted on vero-board.
3. Test your vehicle to determine its performance. The vehicle must be able to start moving under its own power as soon as sunlight falls on the panel. Acceleration and top speed are both important and will be assessed over a race of about 10 metres.

Design constraints:

1. A buck converter circuit should be used.
2. Control chip must be the TL494.
3. N-channel MOSFET STP22NF03L should be used.
4. Diode 11DQ03 should be used.
4. Inductor core is of type RM8. You have to wind this yourselves.
5. Maximum capacitance in the circuit is 350 μF

Project Support:

Tutorials:	I will run 2 or 3 tutorial/lectures to help get you going – times to be advised. Each tutorial/lecture will cover different material.
Components:	Semiconductors, inductor cores, and most other components you need are available from Edsel Villa in the Power Electronics lab. Other components are available in the ECE store.
Tools:	Each group must have their own basic set of tools (side cutters, set of screwdrivers and pliers). Soldering irons and other specialised tools will be provided.
Benches:	Benches with power supplies and oscilloscopes are available in the Power Electronics lab during Term 3 and 4, at times to be advised. Do not spread beyond these benches or take equipment from other benches. The Power Electronics lab will also be available during the August break.
Test rigs:	Solar panels and dc motors are available for testing in the Power Electronics Lab.

Practical work (laboratory investigations, design and testing) is to be carried out in groups of 3.

Schedule:

Monday 27 July:	Nominate your groups. Three people per group. Email your nomination to alan.wood@canterbury.ac.nz
Wednesday 29 July:	First day components are issued and lab made available.
Week 2, Term 4:	Group Lab review (10%).
Mon 28 September 5.00pm:	Group Design Report (15%).

Race day, weather and other assessment dependent:

A bonus mark of up to 5% will be awarded to all members of the same group for their cars performance on race day.

1% - car able to start under its own power
2% - car completes one of the race heats
4% - car gains 1st or 2nd place in race heats
5% - car gains 1st or 2nd place in final race

The **lab review will take place in the Power Electronics Lab**. You must bring a copy of your circuit diagram and your design notes to the lab review. A power supply may be used as substitute for the solar panel and a solar car motor will be connected as a load. The marking schedule for the lab review will be based around the following sorts of questions and all members of the same group who attend and participate will receive the same Review mark:

- Explain how you achieve the power supply for your PWM chip.
- Demonstrate how the control signal interacts to change the pulse width.
- Demonstrate the gate signal driving your power MOSFET(s).
- Demonstrate how the gate signal changes with mechanical load.
- Demonstrate the current waveform through your power MOSFET(s).
- Demonstrate the current waveform through your inductor.
- Explain the principle of operation of your control system.
- Demonstrate that you can develop torque on a loaded motor

Note: You should provide loops on your board so that a current probe can easily be inserted to measure inductor current.

Your report must be a group report, which should include all aspects of the design, operation and overall performance of your converter. There will be a late report penalty of 10% per day, unless otherwise pre-arranged.

You must submit to me separately (and individually) by email a rating (out of 10) and a short description of your and your group members' individual contributions to the project. This will be used in the allocation of individual marks.