Mechatronics course 2010
Individual test on Electric Energy Conversion

Name: .....

You may answer directly on these pages, or write another document with your answers arranged according to the numbers of the questions below. Please feel free to ask Henriette or Mats if there are things that are unclear! Mats is working in Lund weeks with even numbers.
Deadline: The answers should be delivered *by mail* to Henriette.Weibull@iea.lth.se *or on paper* to Henriette or stud.exp. at IEA, one stairs up in the M-building, before Thursday the 4th of February. You can get feedback on your task on lecture on the 5th of February, 13-15. Please fill in suitable time slot for yourself in the doodle link on the home page!

Background:

You are about to design a portable motor driven equipment to be used for a limited time without guaranteed connection to the electric power grid. The equipment thus needs batteries.

Assume that the battery voltage needed is less than 20 V and that the power grid supplies 230 V 50 Hz AC.

1) How would you arrange the charging circuit for the battery if you want the cheapest and simplest possible solution? Make a circuit diagram and explain in writing what components you have chosen and for what purpose they are there.

2) What is the main drawback for the power grid with that circuit?

3) What charging circuit would you use with high requirements on the line current and the requirement for galvanically isolated battery when charging? Make a circuit diagram and explain in writing what components you have chosen and for what purpose they are there.

4) What kind of transducers shall be used for the control system?

Assume that the electric motor drive needs no speed control, but that running at the battery voltage level is enough to reach a suitable speed for the application, e.g. it is an electric grass trimmer.

6) What kind of electric motor would you use? Motivate in writing with price and complexity of control circuit, if any.

7) If the equipment was to be used in an area with a risk of having explosive gases in the atmosphere, would that change your choice of motors, and if so, why? Motivate!

Assume that the motor drive needs to be speed controlled in both directions of rotation.

8) If you use a DC motor, what components do you need for high efficiency speed control? Motivate your choice of sensors and power electronics.

Assume that the lifetime requirements, without service, are very high.

9) What motor would you select, and why?

Assume that the equipment is to be used as an "impact drill".

10) Can you think of any electrically controlled solution to obtain that function?

Assume that you are free to "taylor make" the design of the electric drive motor for the particular needs of your application.

11) Compared to buying a stock electric machine, what are the main benefits of a taylor made design?

Assume that you want to design an electric drive with analogue position, speed, and torque control of a DC motor.

12) Show a principle solution of the control loops.

13) What kind of sensors do you need?

14) Which variable(s) will you control?