SOLA 2052, S2 2014 Outline

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The new (and the old) tutors

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Your goal this semester

- Goal of this semester:

  Drive a 12V DC motor using your solar panel and do something useful with it.

- How will you get there:
  - You will be required to design, simulate and implement a boost converter that should be able to output **12V and supply 0.5A** when powered by the solar cell module designed and constructed in S1.
  - You will design the circuit based on guided labs that you will complete in the first 5 weeks of the session.
  - The circuit will be built based on simple design equations.
  - You will simulate your proposed circuit using a computer circuit simulator
  - You will implement this circuit on a breadboard.
  - The circuit will be able to take the solar panel output as its input and feed a motor with a 12V DC voltage.

- The bonus design challenge (for up to 3 points) is energy storage to power a 1W lamp for 15 minutes (solar panel is not connected). **No off-the-shelf batteries allowed!**

- Other possible improvements to your circuit (for up to 2 points) could be feedback control, single battery operation, minimum circuit footprint… You name it!

Marking scheme

Assessment	Weight
Prelab worksheets	**10%**
Practical work quiz	3%
Circuit work quiz	5%
Group circuit design report	10%
Design trials – system (maximum lift)	4%
Design trials – system (water pumping)	6%
Design trials – budget	2%
Final group report on component design choices unit testing sequences, and post-trial performance evaluation.	20%
Session 2 Total	Out of 60%
SOLA2052 Grading (i.e. The Combined Session 1 & Session 2 Mark)	Out of 100%

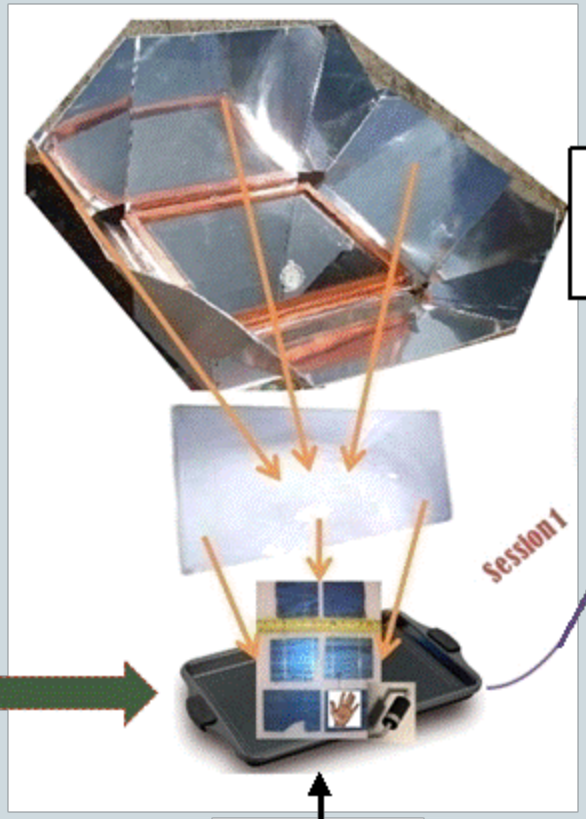
Tentative Schedule SOLA2052 S2 2012

Week	Lab (Monday 10am-1pm)	Assessments/ to do
1	No lab class in the first week	
2	LAB 0: Mastering **LTspice**	
3	LAB 1: **PWM** circuit: calculations & simulations	Buy components for PWM
4	LAB 2: **PWM** circuit: construction and testing.	
5	LAB 3: **Boost** circuit: calculations & simulations	Practical Work Quiz
6	LAB 4: **Boost** circuit: construction and testing.	Buy components for boost circuit.
7	LAB 5: Full circuit calculations & simulations including solar cell and variable load.	
8	LAB 6: **PWM & Boost** circuit integration and testing. 1st iteration	Buy components for full circuit testing.
9	LAB 7: **PWM & Boost** circuit integration and testing. 2nd iteration	
10	LAB 8: System design, testing & optimisation	Group Circuit Assignment
11	ASSESSMENT: DESIGN TRIAL DAY 1	Trial Day Circuit Work Quiz
12	ASSESSMENT: DESIGN TRIAL DAY 2	Backup Trial Day Final Report Due

Prelab worsheets

- Prelabs are extremely important as this is how you'll understand what is going on in the actual lab practice.
- Prelabs are individually completed and submitted.
- You can work together with your group to solve the problems but YOU SHOULD COMPLETE THE PRELABS INDIVIDUALLY.
- Prelabs that are found to be copies will be marked as zero.

System Outline



PWM Duty Cycle Control Signal Generator

FET Driver Circuit (IC) ?

Boost converter

DC Motor

12V

Session 2

Supply/Line

S1

S2

1.5V to 3V @ MPP

Design Focus

- Session 1 focused on construction, experimentation & instrumentation skills
- Session 2 will focus more on design, fault diagnostics and optimisation
  - Constraints and requirements will be specified
  - But there will be limited guidance from staff
- The skills you developed in S1 will be very useful
- Much of your design work will involve LT Spice IV or Microcap (evaluation version) if you wish.
  - Both will be available for download at Moodle

Design Guides

- You will learn how to design your circuit based on the guided labs that you are required to complete in the first four weeks of tutorials.
- **Complete these labs** to truly understand how the circuits function, and what design constraints you are likely to encounter.
- **Come to the lecture**, circuits will be discussed and hints will be given.
- Begin your own independent research on the circuits you are required to construct.

The Design Process

- Examine the circuits and their components
  - Understand component behaviour
  - Understand behaviour of each circuits
  - Understand the interaction of the different circuits
- Examine design equations to design and size your circuits & components through calculations (using MS Excel, for example).
- Model the behaviour of your circuits in LTSpice
  - Input components you sized with equations
  - Test waveform outputs from different circuits
- Order your parts and build your circuits
- Test your circuits with and oscilloscope to observe behaviour
- Modify designs, re-test in LTSpice, rebuild, re-test

Component Purchasing

- You will be required to identify which circuit components you will require for your circuits
- Each group will have a **$50 budget**
  - This includes circuit parts, test parts (e.g. test motor etc.)
- An additional $50 will be made available if:
  - You take on the bonus design challenge (energy storage).
  - Make improvements beyond the minimum expected for the project.
- **2%** of your assessment mark will come from your ability to minimise the cost of your circuits
- You will specify & order your parts by yourselves
  - We will reimburse you for your costs up to $50/(or $100 if attempting extra points).
- Manage your design process & budget very carefully
  - Errors will be costly to fix and re-ordering is undesirable

Assumed knowledge: ELEC1111

- **ELEC1111 Topics:**
  - Introduction, Circuit Basics Overview + Lab Safety.
  - Ohm's law ⟸
  - Kirchhoff's laws ⟸
  - Power & Energy, Series & Parallel ⟸
  - Node Equations & Circuit analysis ⟸
  - Thevenin & Superposition Theorems
  - Circuit analysis + intro to inductors and capacitors ⟸
  - 1st order Transients
  - Intro to Sinusoidal analysis
  - Transformers
  - Op Amps ⟸
  - Introduction to Telecommunications
  - Digital Logic

Laboratories

- Lab classes will consist in large part of computer work for the first few weeks
- **Bring your laptops to all laboratories**
- **Install** LT Spice (or Microcap) on your laptops so you can work outside of class
  - These will be available on the Moodle page
- You will need to simulate various circuits during the semester so get familiar with the software from day one.

Software Consultation

- You will be using the following software:
  - LT SPICE IV circuit simulator or
  - Microcap (evaluation version) circuit simulator and
- You will encounter challenges with the software.
- If you experience difficulties with the software, please post your queries to Moodle discussion board
- Tutors will be your main contact persons for software advice & issues