Organization and Marking of the Elective Design Topics (General)

The elective design topics are all undertaken between Weeks 10 and 12 in the laboratory. Unlike the core design topics, the elective topics are undertaken by a team of 3 or (preferably) 4 students. Some of the marks are awarded to the team as a whole, while others are awarded individually.

It is highly desirable for all students in an elective design team to belong to the same tutorial group. While this might not always be achievable, the following factors should be considered when forming teams:

1. There will be no rearrangement of tutorial membership to accommodate the elective design topics. Each student is expected to attend his/her originally assigned tutorial, regardless of elective design team membership.
2. During the tutorials in Week 11 and Week 12, students are expected to discuss ideas, problems and their understanding of the elective design topic they are working on.
3. Roughly half of the tutorial time will be spent discussing these matters in a team huddle. The other half of the tutorial time will be spent exchanging ideas and problem understanding between teams. This requires students to be competent in explaining the design problem that their team faces; it also requires students in other teams to pay close attention and contribute useful suggestions or clarifying questions. It is expected that this monitored interaction between design teams will bring considerable benefits to learning and outcomes.
4. If a team of (say) 4 students is split across two tutorial groups, the responsibilities outlined above effectively become more challenging for the individual students. For example, if only 2 students from a team belong to a given tutorial, they become fully responsibility for explaining the problems and progress of their team to the tutorial. It is not sufficient for individual team members to be familiar only with some aspect of the work that is their primary responsibility. All students in each elective design team need to be familiar with the problems and approaches being employed by the entire team.

As with the other design topics, your individual participation in tutorials is assessed separately and contributes to the tutorial component of your final mark (20% over the duration of the course).

The laboratory component of your assessment for the elective design topics is worth 17% of the marks for the course. This is represented by a mark in the range 0 to 85, which consists of two components: a design outcomes component (up to 50 marks); and an understanding component (up to 35 marks). The design outcomes component is awarded to the team as a whole, whereas the understanding component is individually

assessed. All assessment of the laboratory component of the elective design topics takes place in Week 12 only.

Additionally, 12% of your assessment for the course as a whole is based upon a report that you write as a team and submit by email to d.taubman@unsw.edu.au, no later than 5pm Thursday in Week 13. A draft version of the report must be available from the start of the laboratory session in Week 12. This will form part of the basis for assessment of understanding, as individual team members are interviewed.

An overview of the report structure may be found on the course web-site. Two particularly important elements are the high level decomposition of the design problem into tasks, assigned to individuals, and the technical documentation of each of the design tasks (managed by the individual to whom they have been assigned).

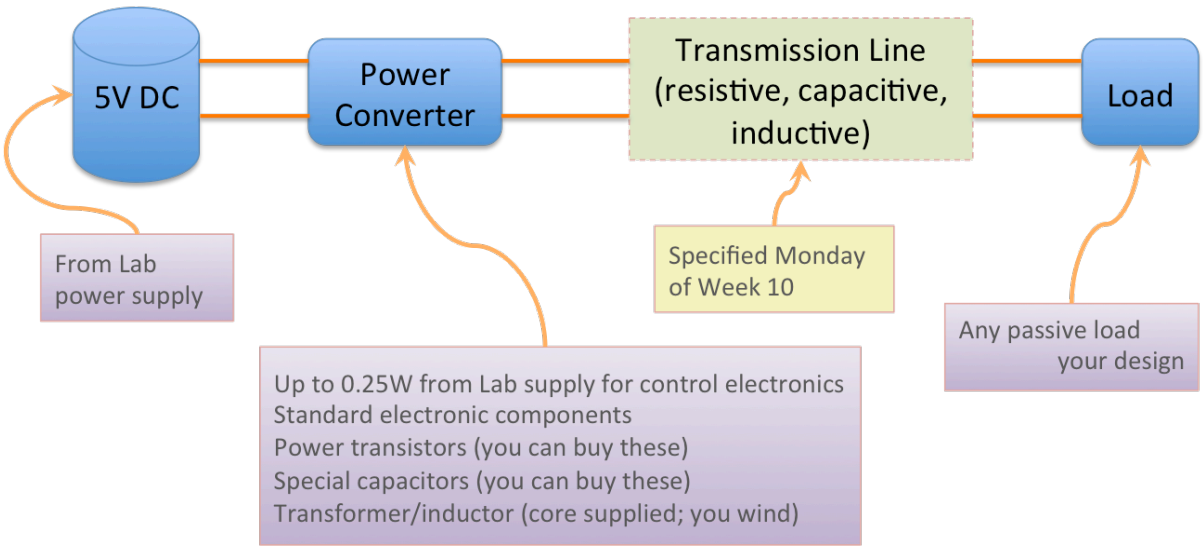
Energy Systems Design Topic

Context and Objectives

For this elective design topic, you will be given a "transmission line" which is a two-port circuit consisting of resistors and capacitors. That is, there are two input terminals and two output terminals. Detailed specifications of the transmission line will be given at the start of Week 10, but for now you need only know that when the output terminals are short circuited, the input impedance of the network will be no smaller than 1 kΩ.

Your primary objective is to design both a power transmission system (the "power converter") and a passive load, such that as much power as possible is delivered from a 5V source (the fixed 5V output from the laboratory power supplies) into the load.

A secondary objective is to maximize the overall efficiency of the power transmission system. A schematic of the setup is shown below:



Constraints

You may use at most one inductive component in your complete design. To this end, you will be provided with two E-cores and a winding former (specifications provided

separately on the course web-site), which you can use to wind your own transformer or inductor. There will be a limited supply of enamelled winding wire provided in the laboratories, or you can source your own winding wire from outside. The only constraints here are those dictated by the geometry of the winding former itself.

You may use any of the "standard" electronic components which have been made available for any of the core design topics in this course, including opamps and simple TTL digital circuits – these are all listed on the course web-site. Of course, you may use the resistors and capacitors found in the lab.

You may supplement these components with the following items, so long as you source and purchase them yourself – the EE&T electronics workshop stock some such component which you can purchase at a very reasonable cost.

1. Discrete power transistors (MOSFET or BJT)
    - NB: integrated circuits are not allowed here; only discrete transistors
2. Power diodes
3. Heat sinks
4. Resistors not found in the laboratory
5. Capacitors not found in the laboratory

You may derive **up to 0.25W** of power from the laboratory power supplies (from any terminals) to support the electronics in your power converter. So long as this does not directly contribute power to the transmission line, it will not be included in the determination of power efficiency.

You may use the signal generator and even the sound-card of a laboratory computer (controlled via Matlab) as part of your power transmission system design.

Your power transmission system must apply **no more than 50Vrms** to the input terminals of the transmission line.

Design Outcome Marks

Write P_L for the total power dissipated in the passive load. Also write P_S for the power provided by the 5V DC supply. Your primary objective is to maximize P_L, while your secondary objective is to maximize P_L/P_S. As mentioned above, P_S does not include the additional power (up to 0.25W) you might use to support electronics in your power transmission system. It is also important that your design be neatly constructed, robust to component tolerances, and capable of handling a short-circuit at the load terminals of the transmission line. Finally, where possible, simpler designs are preferred over complex ones unless the complexity comes with benefits.

Your design outcome marks will be awarded as follows:

- Delivered power (full marks for **X** Watts or better): (____/20)
- Efficiency P_L/P_S (full marks for **E**% or better): (____/10)
- Design principles, elegance, robustness, etc.: (____/12)
- Neatness of construction (must meet objectives first): (____/8)

Note: Values of **X** and **E** are provided together with the transmission line characteristics, on Monday of Week 10. In the event that your design exceeds these performance benchmarks, you may possibly be awarded bonus marks to compensate

for less than perfect performance in other assessment criteria associated with this design topic.

Understanding Marks

- Understanding of system design, trade-offs and choices: (____/10)
- Understanding of individual sub-systems designed: (____/15)
- Understanding of how things could be further improved: (____/10)

Note: the first two items mentioned above must be supported by the draft report provided in the laboratory in Week 12. The draft report must contain at least a close approximation to the final designed hardware. Lab notebooks must provide remaining details by the time of marking.