ELEC/TELE/PHTN 4123: Design Proficiency Session 1, 2017

Introduction to the Course

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Overview of 4123

- Objectives:
  - Ensure that you have a minimum level of proficiency
    - Testing!!
  - Plug major holes in your knowledge
  - Increase your confidence
  - Prepare you to make a valuable contribution in the work force

How it Works

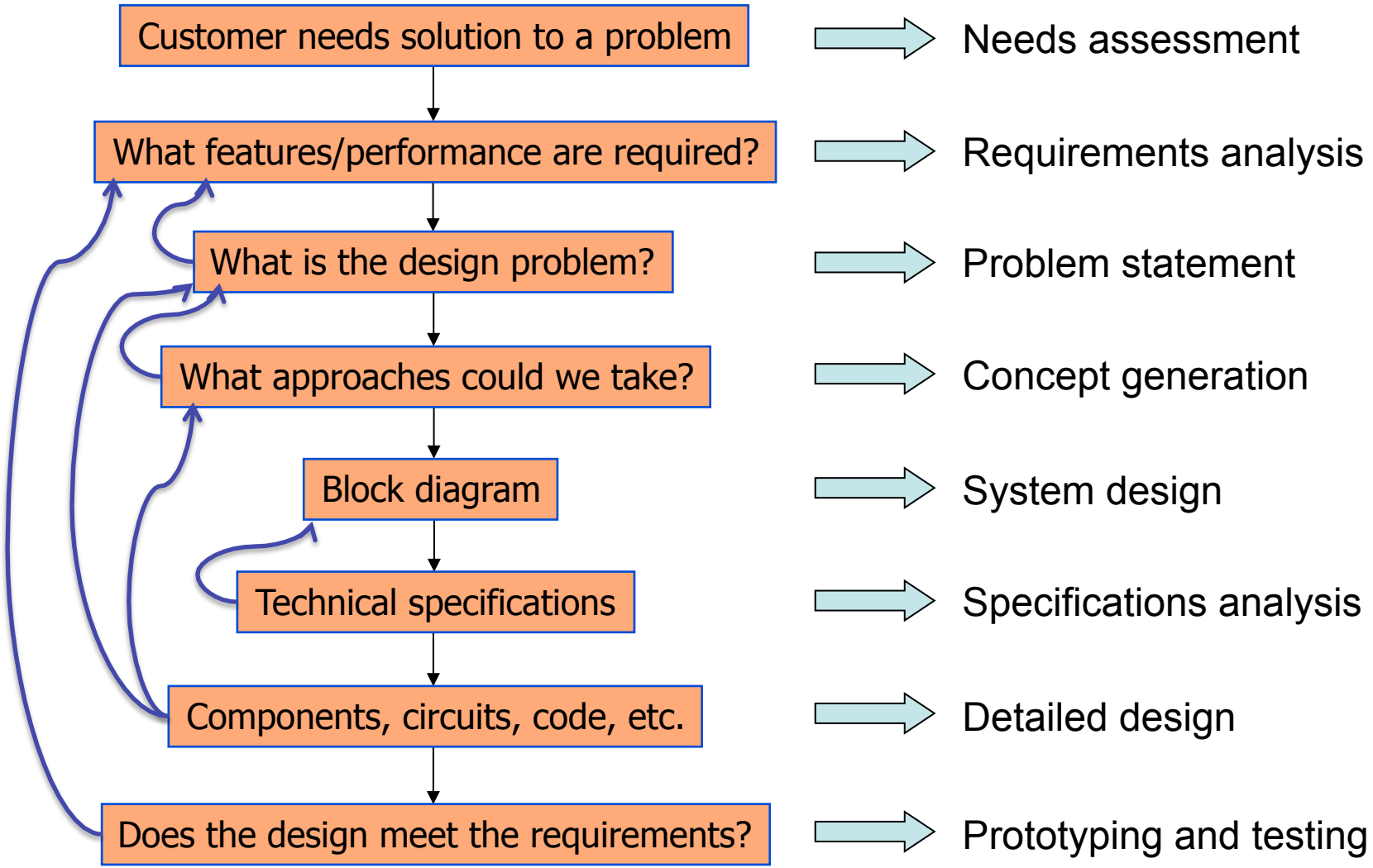
- Lectures: only 4 of these
- Labs: lots of these!
  - 68% of your assessment comes directly from labs
- Tutorials: very important!
  - 20% of your assessment comes from these
- Written reports: not much of this
  - 12% of your assessment comes from a group report

Design Topics

- Core (individual):
  - Electronics (3 weeks)
  - Signal Processing (3 weeks)
  - Control (3 weeks)
- Elective (final 3 weeks, done in groups of 4):
  - Energy systems
  - Telecommunications
  - Data networks
  - NB: Part of the assessment here is still individual

BRIEF REVIEW OF DESIGN PROCESS AND TERMINOLOGY

Typical Design Phases



NB: Iteration is everywhere; only the more interesting paths are shown

Requirements, Specs, Objectives

- Requirements must be satisfied
  - May be stated in non-technical language
- Specifications characterize achieved performance
  - Technical in nature; may be derived from requirements
  - Some specifications may be determined after an initial design is complete
- Design objectives are quantities which should be optimized
  - E.g., power efficiency, communication range, usabiity, etc.

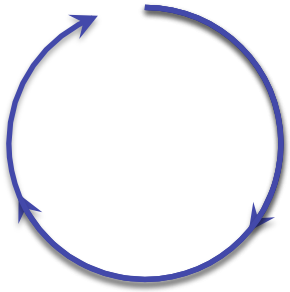
Design Scenarios

- Consulting engineer
- New product design
- Redesign of an existing product
- System engineering
- Design of a sub-system to fit within a larger system design

LEARNING APPROACH

Reflective Cycle

- Week 1 Lecture: Topic intro + Q&A
  - includes post-mortem on previous topic
- Week 1 Lab: Attempt first 1 to 3 tasks
- Week 1 weekend: Reflect on first lab
  - may need to revise relevant fundamentals
- Week 2 Tut: Problems meet solutions
- Week 2 Lab: Fix probs + attempt next tasks
- Week 2 weekend: Reflect on second lab
  - may need to prepare multiple designs for last lab
- Week 3 Tut: Discuss the hardest tasks
- Week 3 Lab: Fix probs + do remaining tasks
- Week 3 weekend: relax if you dare



Partners, Tuts and Elective Groups

- You will share equipment with a lab partner
  - but you do your own design and implementation
  - your partner is assigned in the first week of each topic
    - demonstrators will finalize and record the arrangements
- You will be assigned a tutorial group
  - same group for the whole session
    - see caveat below
  - assigned during Lab 1
    - demonstrators will finalize and record the arrangements
- Elective topics are done in groups of 4
  - all group members should be in the same tutorial
    - minimal rearrangement of tutorials may be required

COMMON PITFALLS

Where the smooth path leads …
… may be the base of a cliff

- Why is the problem statement part of design?
  - This is where you identify the “real problems”
  - A good problem statement includes some statement like: “The most challenging aspect of the design is likely to be …”
- Concept generation focusses on the hard bits
- Detailed design also starts with the hard bits
- Design iteration is mostly due to the hard bits
- Project management also driven by the hard bits
  - hard to know how long they will take
  - have to guess and constantly monitor progress

How can I know what is hard?

- Takes experience and practice
  - Every design course will help / has helped you
  - This design course will help you
- Reflect:
  - At the end of each design task, ask yourself: “What really was the problem?”

Being Precise

- You cannot do design with only a vague idea
  - The end result is necessarily very concrete
- If you start with a fuzzy mental picture
  - Start drawing diagrams to make things clearer
  - Don't stay in high level La La land
    - producing a detailed design will help expose the real issues
- Use a lab notebook
  - Mandatory in this course!!!!
  - Draw schematics, flow diagrams, etc.
  - When debugging
    - sketch your circuit/code, insert numeric values, etc.
  - Record your assumptions, formulae, concerns, …

Use what you have learned

- "Theoretical" material taught in classes
  - is actually useful
- If a problem is hard, it needs structure
  - that is what all your courses have been about
  - mathematics is about structuring a problem
  - many problems are connected by common theory
- Don't separate practice and theory
  - you cannot do the lab properly without some theory
  - you can waste your whole life looking for a solution that is already given by an elegant theory
  - most students badly miss this point

HOW TO SUCCEED IN THIS COURSE

Get it to work

- Quite a bit of the assessment is objective
  - Does it meet the requirements?
  - If it does not work, how can it meet any requirement?
  - 0 is a mark
  - It is not sufficient (or even helpful) to tell the demonstrator *how it was supposed to work*

Prepare outside of the labs

- You need to do a lot of thinking outside the lab
- You have 3 weeks for each topic
  - plenty of time to reflect on problems experienced in one lab session so that you can succeed in the next
- Prepare multiple designs approaches
  - when you get into the lab you may discover a problem you never expected

Contribute in Tutorials

- Don’t just go along like a dummy
- Review relevant materials from previous courses
  - can you draw a control feedback loop correctly?
  - can you recall common transistor/opamp circuits?
  - do you know common filter design methods?
- Listen to the questions others have
  - perhaps this will be your question as well, but you have not gotten there yet
- Reflect on what you have learned
  - so that you can pass it on
- Be generous with your suggestions
  - the success of others does not hurt you in any way

Get your name onto the marking list

- Once you are ready to be assessed for a task
  - let the demonstrator know
  - if you do not get marked during the lab, you may need to start all over again the following week
  - there is no point in complaining that the demonstators were too busy to mark your work
- You are allowed to be re-assessed
  - but you go onto a second (low priority) list
  - if the demonstrators are too busy, your work might not be re-assessed

Collaborate but do not Collude

- Share ideas in tutorials or elsewhere
  - but doing it in tutorials attracts marks
- You will have a lab partner
  - feel free to help each other with debugging or advice
- But, you will be individually assessed
  - individual implementation
  - individual lab notebook
  - individually interviewed
- The demonstrators can easily tell if you are cheating
  - if they even suspect this they can immediately drop you to the bottom of the assessment list

ELECTRONICS TOPIC

6 Tasks

- Starts very simple
  - goal is to ensure proficiency
- Final task is a phase locked loop
  - something to really be proud of!
  - not all students will get there
  - but all students should at least reach task 4
- What do you need for a phase locked loop?
  - simple resistive circuits
  - amplifiers
  - voltage controlled oscillator
  - measurement – we will go digital here
  - feedback
  - … attention to detail ... prepare to be amazed!

General guidelines

- All work is done on your own breadboard
- No free selection of components
  - can only use the small set of designated components
  - this is a design constraint
  - makes it harder to copy a solution you find online
- Final design parameters given in the lab
  - might change from week to week
  - might change from student to student
- You can take out, but you cannot bring in
  - take out populated breadboard, components, lab notes
  - bring in unpopulated breadboard, any components you received last time, plus design and lab notes

Assessment

- Each task can be assessed in any lab
  - but the parameters might change from week to week
- Make your implementation portable
  - You may be asked to go to a set of special workbenches for assessment.