ECE 410 Design Project Guide Spring 2012

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Design Project Schedule

- Draft Proposals: Monday, March 26 (in class)
- Lab 8: by Friday March 30 (in lab progress check & proposal discussion)
- Proposals: Monday, April 2 (in class) (final Proposal due)
- Lab 9: by Friday April 6 (in lab check off, Phase 1)
- Lab 10: by Friday April 20 (in lab check off, Phase 2)
- Final Demo: by Wednesday April 25 (in lab final demonstration)
- Design Day Presentation Contest: Friday April 27th
- Individual Reports and Additional documentation - Monday April 30th
  - submit reports in lecture during scheduled final exam period

Design Project Overview
Design projects will be completed in 3-person teams during the final five weeks of class. To organize the activities of the design team, a *Design Project Proposal* is required which will list all cells to be designed and assign a team member to each design/simulation task. To assist groups in preparing effective and useful proposals, you must prepare a draft proposal and discuss it with a TA for feedback on your circuit design ideas and project organization plan. To ensure teams make sufficient progress over the six-week design period, Labs 8-10 will be organized to check off your efforts. By *Lab 8*, design teams should have completed roughly 30% of their overall design goals and verify this through the standard check-off procedure. Although you are free to organize your efforts as you wish, normally teams would show a complete ALU design and simulation at Lab 8 and solid progress into layout or register file design. By *Lab 9*, roughly 60% of your tasks should be completed, with teams nominally showing all schematic design complete, all functions verified with simulations, and some layout done. By *Lab 10* (one week after exam 2), all layout should be completed and preliminary post-layout simulations should be ready. Lab 8-10 check offs must be preformed with a TA by the dates listed above. Ideally all team members will be present, but fewer can do the check offs if necessary.

At the end of the design phase, all members of the team must meet in the lab with the instructor to demonstrate the completeness and quality of their design project. Be prepared to show everything, including final layouts and final timing measurements. After this *Final Demo*, no schematic or layouts can be modified, although you are allowed to run some additional simulations, measure circuit performance, and save figures, provided you open cells in read-only mode.

Following the design effort, reports will be written according to the guidelines covered below and must include specific information defined in the Project Description. It is preferred that project reports be submitted electronically to the instructor (email to **nicleysh@msu.edu**), but

printed copies are acceptable. Project reports can be submitted any time after the Final Demo but must be turned in by 12pm on the following Thursday of finals week.

Deliverables

Design Project Proposal (due in class Monday, March 26 (draft) & Monday April 2 (final))
Each group must write a Design Project Proposal which briefly but thoroughly outlines the team's plan to complete the project. Details are provided below. You must first submit a draft proposal (March 26) and then meet with the TA sometime that week to 1) demonstrate program on the design project (Lab 8 check off) and 2) discuss your draft proposal (Proposal check off), receiving feedback you will use to complete the final proposal. You will need both a Lab 8 Grading Sheet and a Proposal Grading Sheet when you meet with the TA. Expect the check off to take more time than previous labs, ~15 minutes per group. Final proposals, updated from draft form, must be turned in by the following Monday (April 2).

Lab 8 (in lab Friday March 30)
As described under Design Project Proposal, you must meet with the TA by the deadline above.

Lab 9 (in lab Friday April 6)
By the deadline above, at least one member of your team must meet with the instructor/TA to demonstrate what you have accomplished thus far. The team member(s) are required to have a copy of their proposal and point out where they have met and failed to meet their work plan schedule. This meeting will be similar to a lab check off, but may take 15 minutes or so. It gives each team an opportunity to ensure they are making sufficient progress and ask questions about future tasks. A Design Project Grading Sheet must be submitted during the meeting. You will be assigned 0-10 points for completeness and 0-10 points for quality, counting toward your design project grade.

Lab 10 (in lab Friday April 20)
By the deadline above, at least one member of your team must meet with the instructor/TA to demonstrate what you have accomplished since Lab 9. A Design Project Grading Sheet must be submitted during the meeting.

Final Demonstrations (in lab by Wednesday April 25)
Demonstrations to the instructor will take place in a computer lab and should be attended by all team members. The team should prepare for the demonstration BEFORE the scheduled demo by having 1-2 computers ready to show schematics/layouts/simulations in Cadence. The team will be given ~20 minutes to present their design during which they should point out any unique or interesting features of their design. Following this, each member of the team will individually be given 1-2 minutes to describe his/her contributions to the design project. The TA and instructor will then verify the final DRC and LVS have been passed and will perform simulations on the final cell to verify proper operation of several test cases. A sign-up sheet will be passed out in class for each team to select a time slot. After Final Demonstration, design files can not be edited in any way and can only be opened in read-only format to extract figures, take measurements, or run simulations for use in your report.

Project Report
In previous semesters, the design projects were documented in project reports. This semester the projects will be presented as poster presentations during engineering design day. Any simulations or deliverables that do not fit within the 30" x 48" poster should be printed and

stapled to the individual reports. Each team member must also complete an *individual project analysis* using the format from the group lab (Lab 6).

Individual Project Analysis

In addition to the design project report, each person must submit a 1-page Individual Project Analysis. This should describe your learning experience, any problems you had, etc. You must include a Teamwork Assessment with comments on the effectiveness of your team including a teamwork assessment table listing, in your opinion, ***the % effort for each team member*** (where the total of all team members equals 100%). Because of the change over from a required report to a poster style presentation, there may also be deliverables that do not fit neatly within the poster layout. These should be printed and stapled to the individual ***report of the individual who completed them***. In specific, all team members should participate in the simulations and timing analysis. Please print the simulations you personally performed, and staple them to your individual report. If you do not have any additional items stapled to your report, I will assume that you did not participate in the final analysis.

Design Day Poster Presentation Contest

As a part of Engineering Design Day, each team will create a poster with a large size color printout of their design, and will present it during Design Day. The poster presentation will take the place of the final report for the documentation of the completed design project. The characteristics and data path deliverables listed below from the project description must therefore be included in the poster:

- slowest logic function and propagation delay for that function (ALU)
- slowest arithmetic function and propagation delay from that function (ALU)
- slowest propagation delay of the data path (ALU + Shifter)

Propagation delays are measured from clock edge to last output transition. (50% - 50%)

- physical area of the complete data path layout
- total number of transistors in the data path (available from the final LVS output)
- total, static, and dynamic power consumption for a full read and write cycle during an ADD and Shift_Left_2 operation.

	Data Path
1	select schematics that demonstrate your design effort
2	a truth table of control inputs and ALU/shifter functions
3	functional simulations, including loading data from memory, perform XOR, A+B, and A-B operations on the data, and saving the result to another register in the register file.
4	final data path layout and any smaller cell layouts that you feel you did an exceptional job optimizing
5	discussion of LVS process, what problems did you have, how did you solve them, etc.
6	post layout simulations showing propagation delays as specified above
7	table of cell specifications including -measured cell width, height, and area, number of transistors, and total area/transistor -measured performance characteristics (worst-case delays and power)

Grading

10%	Quality of Proposal	30%	Lab 8-10 Evaluations
30%	Final Demo Evaluation	20%	Poster Presentation/Quality
10%	Individual Effort		

Estimated Project Effort Distribution

In the past, many groups have vastly underestimated the time required to complete the layout, pass LVS on the final cell, and especially the time needed to perform simulations. A rough estimate of how your time is likely to be distributed is:

25% Planning & Schematic Design	35-40% Layout/LVS
25-30% Simulations	10% Poster/Reports

Thus, proposing to perform only schematic design by Lab 9 would doom your project to failure or at the very least leave you with many sleepless nights in the final weeks. If you use the Proposal preparation week effectively, you should be able to nearly complete the entire schematic design and have a lot of layout done by Lab 9.

Design Project Proposal Guidelines

Each team must prepare a Design Project Proposal which is a brief (~5 pages) description of your group's project and a plan of how your efforts will be organized. The proposal must also provide a time schedule for finishing tasks that should be followed in order complete your project on time. The proposal should include the following:

Cover Sheet

Pick a creative and descriptive title for your project (e.g., Spartan-12 or some clever acronym) and display it on a cover page along with the following information: "ECE 410 Design Project Proposal", "Michigan State University", the proposal due date, and a list of team members.

Project Overview

Describe the circuits to be constructed and include diagrams with captions as necessary. This should demonstrate some planning by your team and not just repeat what is in the Project Description. Summarize project goals and design specifications.

Summary of Design Challenges

Outline the unique and challenging aspects of your project and define what makes this project worth completing. Highlight any features/performance you plan to implement that is beyond the requirements.

Work Plan

Outline the tasks that you plan to complete highlighting the tools and methods that will be used to accomplish your goals. This section will be the bulk of your proposal and should demonstrate your team has thoroughly considered the project and knows what needs to be accomplished to complete the project. Preliminary circuit schematics for key blocks can be included. ALU function truth table must be shown.

Work Plan Schedule

Provide a full list of the cells, layouts, simulation results, etc. that will be completed for your project. For planning purposes, this list should be as detailed as possible. Indicate which team members will be primarily responsible for each task. Specify which tasks will be completed during each phase of the project (Labs 8-10). The table below shows how you could organize this information, but you are not required to follow this exact format. You should plan to complete everything by Lab 10, leaving only final improvements before the Final Demo.

Lab 8 Tasks		Team Member
	task 1	
	*	
	task n	
Lab 9 Tasks		
	task 1	
	*	
	task n	
Lab 10 Tasks		
	task 1	
	*	
	task n	