

ABET COURSE SYLLABUS

ECSE-4260 Physical Design in Microelectronics

Course Catalog Description:	A capstone design course. The conversion of circuit schematics to integrated-circuit chip layouts. Emphasis is on integrated circuits, device design, and the electrical performance of interconnected devices. Projects will involve the use of CAD software for process simulation, electrical analysis, physical placement, and interconnect routing.
Pre-Requisite Courses:	ECSE-2050 Analog Electronics or ECSE-2060 Digital Electronics, ECSE-2610 Computer Components and Operations.
Co-Requisite Courses:	“Senior Standing”, ECSE-2210 Microelectronics Technology, ENGR-4010 Professional Development III
Prerequisites by Topic:	<ol style="list-style-type: none">1. Calculus, linear algebra, differential equations2. Linear-circuit analysis (node and loop equations, steady state and transients, first-order <i>RC</i> networks, power)3. Boolean logic and primitives (gate and circuit)4. Basic analog or digital electronic circuits.5. Competency using a logic simulation (<i>LogicWorks</i> or <i>B²Logic</i>) and a circuit-simulation (<i>Spice</i>) CAD tool.
Textbook & Materials:	<ol style="list-style-type: none">1. <i>Engineering Design for Electrical Engineers</i> Alan D. Wilcox (required)2. <i>B²Spice</i> Circuit Simulation Software, Beige Bag Software (required)3. Quadriple Cloth-Bound Laboratory Notebook (required)
References:	<ol style="list-style-type: none">1. Instructor’s personal electrical engineering library2. RPI Folsom Library3. Internet4. Course web site (www.ecse.rpi.edu/Courses/S06/ECSE4260)
Course Coordinator:	Yannick L. Le Coz
Overall Educational Objective:	The course goal is to provide a practical, culminating (“capstone”) experience in microelectronics physical design (device and circuit simulation, chip layout, and simulated performance verification). Familiarity is gained using a variety of industry-grade CAD tools in the context of a single, semester-long Design Project. The ability to work in teams, and to effectively convey technical results, both by oral presentation and written communication is emphasized. Students are required to furnish three written documents (Individual Proposal, Mid-Term Report, and Final Report). They also must deliver two formal Oral Presentations, towards the middle and end of semester.
Course Learning Outcomes:	<ol style="list-style-type: none">1. Develop the ability to analyze and critically evaluate ideas, including the use of both hand and computer simulations for quantitative support.2. Practice formal oral and written expression and communication (memos, reports, and presentations), both individually and as a member of a team.3. Develop sensitivity to related professional, societal, and ethical issues.4. Develop sensitivity to, and incorporation of, when possible, other non-Electrical Engineering relevant engineering disciplines (“multi-disciplinary design”).
How Course Outcomes are Assessed:	Individual Proposal (10%) Mid-Term Report (20%) Mid-Term Oral Presentation (5%)

Contribution to Team, in Mid-Term Report (5%)
 Final Report (40%)
 Final Report Oral Presentation (5%)
 Contribution to Team, in Final Report (5%)
 Laboratory Notebook (10%)

Relation to EE/CSE/EPE Outcomes:

N = none
M = moderate
H = high

Outcome	Level	Demonstrate Proficiency
	N, M, H	e.g. Exams, projects, HW
Mathematics, science and engineering	M	Design Project
Basic disciplines in Electrical Engineering	N	
Depth in Electrical Engineering	M	Design Project
Basic disciplines in Computer & Sys. Eng.	N	
Depth in Computer and Systems Eng.	M	Design Project
Electromagnetics, electromechanics, power semiconductors	N	
Power system behavior	N	
Electrical energy conve	N	
Conduct experiments and interpret data	N	
Identify, formulate and solve problems	N	
Design a system, component or process	H	Design Project
Communicate in written and oral form	H	Mid-Term and Final Presentations & Reports
Function as part of a multi-disciplinary team	M	Design Project, Team Meetings, Mid-Term and Final Presentation & Reports
Preparation for life-long learning	M	Design Project
Ethical issues; safety, health, public welfare	M	Mid-Term and Final Presentations & Reports
Humanities and social sciences	N	
Laboratory equipment and software tools	H	Design Project
Variety of instruction formats	H	Introductory Mini-Lectures, Team Meetings, Open Shop (consultation with Instructors)

Topics Covered:

1. General, introductory lectures on the semester's Design Project, chosen by the Instructor; includes an overview of design strategies, engineering professional and ethical issues, and multi-disciplinary design—2 or 3 Lectures
2. Team Meeting: individual student updates, regarding their Team Design Project; includes progress, results, and future plans—10 Classes (approx.)
3. Open Shop: individual, small-group, or Team technical Design Project consultation with Instructor and Teaching Assistant—12 Classes (approx.)
4. RMS signal error—1 Mini-Lecture (20 min)
5. Reactive and dissipative power—1 Mini-Lecture (20 min)
6. Thermal analysis of ICs—1 Mini-Lecture (20 min)

Computer Usage:

Students are required to use a logic simulation package (*LogicWorks* or *B²Logic*) and the computer circuit-simulation program *Spice* in carrying through their design. In addition, students often use *Excel*, *MatLab*, *Maple*, and the industry-grade *Cadence IC-Design Suite*. Furthermore, depending on student desires (fabrication, device, circuit, system), any other suitable and available CAD tool can be used in their designs.

Laboratory Experiences:

None

Design Experiences:

1. Participation in a semester-long Design Project, with emphasis on relevant CAD tools, engineering criteria, performance metrics, and verification.
2. Carrying through engineering analyses—both preliminary hand calculations and computer-simulated verification—as part of the initial and ongoing design process.
3. Participation within, student teams (usually of size 3–8), with complementary individual intra-disciplinary design skills (“logic”, “circuit”, “physical-layout”, “system”).
4. Instructor fosters a sensitivity to, and promotes application of, when possible, relevant fields of multi-disciplinary design, along with a consideration of engineering professional and ethical issues.
5. The use, by each student, of at least two IC-CAD tools (*LogicWorks* or *B²Logic*, *Spice*, and, possibly, the *Cadence IC-Design Suite*).
6. Maintenance of a formal laboratory notebook.
7. Written Reports: Individual Proposal, Mid-Term Report, Final Report.
8. Oral Presentations: Mid-Term and Final.

Independent Learning Experiences:

1. The Design Project, itself, and the manner in which the course is structured (Team Meetings, Open Shop), requires a significant amount of individual work: preliminary research, analysis, design, and verification; outside of scheduled class hours.

Class/Lab Schedule:

M Team Meeting, Th Open Shop, 4:00pm–5:20pm

Contribution to the Professional Component:

- | | |
|---|----------------|
| (a) College-level mathematics and basic sciences: | 0 credit hours |
| (b) Engineering Topics (Science and/or Design): | 3 credit hours |
| (c) General Education: | 0 credit hours |

Prepared by:	Yannick L. Le Coz
Date:	25 August 2006