Physics 476: Modern Electronics for Physicists

Lecture: T R 9:30 - 10:20

Lab: R 12:30 - 15:20pm

Spring 2012

Professor Gary Varner
Updated 3/27/2012

News:

- **CAM file examples (from Matt), and instructions for use [txt]**
- Design reference for those using the Universal Eval (from Xin Gao) [zip]

Group Meeting matrix:

Time Slot	Group	Topic	Design Review	Status	Project/IDL Manifest ID	Comment
12:30 - 12:45	Instructor	Ceramic (Berkeley 8" MCP-PMT)	**27-MAR**	DC fabbed **MB layout**	Ceramic 8" MCP-PMT Motherboard: **IDL_12_016** Daughtercard: **IDL_12_015**	IRS3 daughtercard basis
12:45 - 13:00	Serge/Stephanie	mTC Clock And JTAG In PCI	**20-MAR**	DFM?	mTC-CAJIPCI **IDL_12_006**	diff impedance matching
13:00 - 13:15	Josh/Mich	mTC High Voltage board IRS3 DC carrier	**6-MAR** **1-MAR**	PO? PO?	MtChive HV card: **IDL_12_007** IRS3 DC carr card: **IDL_12_003**	HV wiring -- almost done?
13:15 - 13:30	Keita	rad sensing system	**22-MAR**	**schematics**	FEDDX **IDL_12_005**	Diamond Detectors -- 2x in hand
13:30 - 13:45	Adam/Xiaowen	combined DAC_MON/TARGET_ASIC	**15-MAR**	layout	eKLM Readout **IDL_12_009**	documentation on TARGET4
13:45 - 14:00	Igal/Jared	new FE-I4 readout board (pix4tpc)	**23-FEB**	DFM?	(pix4tpc) DM TPC interface board **IDL_12_011**	4-die version later
14:00 - 14:15	Lauri/Ari	TARGET4 eval board	**16-FEB**	assy/test	TARGET4 eval Daughtercard **IDL_12_004**	documentation on TARGET4
14:15 - 14:30	Vihtori	HV board (& new NIM board)	**1-MAR**	DFM	hv8cb **IDL_12_012**	HV_board.zip
14:30 - 14:45	Janne/Jussi	STURM beam monitoring	**7-FEB**	assy/test	STURM2/Fermionics Motherboard: **IDL_12_001** STURM2 DC: **IDL_12_002**	boards fabricated; assemble and test
14:45 - 15:00	ASIC all/SSL-MCP	open questions on ASIC topics / SSL MCP readout			ASICs	*IDL_ASIC* 'n *hippogrif* good to know
15:00 - 15:15	all	general Q & A				

On Thursday afternoon, break at about 15:25 for Departmental Colloquium

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- Detailed course schedule information **Revised: 1/10/2012**
- Student Learning Objectives posted here

Project Links:

- Ceramic 8" MCP-PMT readout [instructor]
- eKLM Readout (needs acronym) [Adam Goss, Xiaowen Shi]
- pix4tpc (DM TPC interface board) [Igal Jaegle, Jared Yamaoka]
- MtChive (mTC High Voltage board) [Joshua Murillo, Michi Sakai]
- STURM2/Fermionics (overall project page OK?) readout [Janne Himanen, Jussi Kangaskoski]
- mTC-CAJIPCI (mTC Clock And JTAG In PCI) [Serge Negrashov, Stefanie Smith]

- TARGET4 eval Daughtercard (needs acronym) [Ari Parviainen, Lauri Karppinen]
- hv8cb HV board [Vihtori Virta]
- FEDDX (rad sensing system) [Keita Fukushima]

Course Reference Information:

- Class/Lab meets in Watanabe Hall room 221
- Instructor: Gary Varner Office: WAT 333 Laboratory: WAT 214
- e-mail: varner#phys.hawaii.edu, varner#hawaii.edu
- Office Hours: by arrangement in **WAT 214** (**when instructor not already commited**)
- You will need to start your own webpage to document your project, for which SeaMonkey and instructions may be useful
- Direct link to MOSIS website

Grading: Exercises 20%, Final Project 40%, Final presentation 20%, Final report 20%.

Basically the project is the course.

- **Final Presentations: Thursday May 13, 2010, 9:45 - 11:45 a.m.** (to be confirmed...)

Lecture archive:

- First Lecture -- 10-JAN-2012
- Soldering basics; and the Surface Mount version (Robin Caplett) -- 12-JAN-2012
- Intermediate weeks -- largely exercises in running PADS
- An introduction to Crate Standards [PDF]
- Lecture notes of VHDL (Luca) [pdf1] [pdf2]
- VHDL examples (Mike) [zip]

Lab Exercises:

- Exercise zero -- as a warm-up
- First lab -- should be complete
- Exercise 2 and Exercise 3 -- should be complete
- Ex_4 and Ex_5 -- due 2/7
- Ex 6 -- due 2/9
- Ex 7 - 9 -- due by 2/16

Course Syllabus: Physics 476, UH Spring Semester 2012

Instructor: Dr. Gary Varner

Class Hours: T Th 9:30 - 10:20am, Lab Th 12:30 - 15:20 Watanabe 214

week	date	Lecture topics	Laboratory topics	
1	10-Jan	electronics packaging	soldering and hand wiring	
	12-Jan	assembly techniques	prototyping and wire-bonding	
2	17-Jan	Intro to PCB technology	Ex. 0: CAD/CAM	
	19-Jan	Schematic capture (I)	Ex.1: symbols and hierarchy	
3	24-Jan	Schematic capture (II)	Ex. 2: wiring, busses, netlists	
	26-Jan	Schematic capture (III)	Ex. 3: parts/footprints	GSV -> MC
4	31-Jan	Design management	Ex. 4: Libraries and part creation	
	2-Feb	[Electronic standards]	Ex. 5: Placement	
5	7-Feb	Layout (I)	Ex. 6: Routing	
	9-Feb	Layout (II)	Ex. 7: Power and area fills	GSV -> MC
6	14-Feb	Layout (III)	Ex. 8: Artwork generation	
	16-Feb	Design review/submission	Ex. 9: da BOM	
7	21-Feb	Intro to Programmable Logic	Ex. 10: CAD tools	
	23-Feb	CPLDs	Ex. 11: design entry	
8	28-Feb	FGPAs	Ex. 12: user constraints	
	1-Mar	VHDL language	Ex. 13: VHDL	
9	6-Mar	Verilog language	Ex. 14: Verilog	
	8-Mar	Logical simulation	Ex. 15: State table simulation	
10	13-Mar	Intro to analog simulation	Ex. 16: models	
	15-Mar	SPICE simulation	Ex. 17: accuracy, convergence	
11	20-Mar	Conceptual Design Preparation	parts specification	
	22-Mar	Intro to VLSI design	Conceptual Design Review	
12	27-Mar	SPRING	SPRING	
	29-Mar	BREAK	BREAK	
13	3-Apr	Bipolar vs. CMOS	Ex. 18: NAND and NOR	
	5-Apr	Technical Design Preparation	Ex. 19: Amplifiers, parasitics	
14	10-Apr	Large system design	Technical Design Review	
	12-Apr	MOSIS and Fab. Processes	Ex. 20: DRC and submission	
15	17-Apr	Project Theory (I)	Project work	
	19-Apr	Critical Design Preparation	Project work	
16	24-Apr	Project Theory (II)	Critical Design Review	
	26-Apr	Deadline Management	Project work	
17	1-May	Final Design Review Prep.	Final Design Review	
	3-May	The Success of Failures	Project work	
18	9-May	**Tentative:** Final Presentations -- 9:45 - 11:45 am		

Prerequisite: Physics 475, equivalent or premission from instructor

Texts: Horowitz & Hill: *The Art of Electronics*

Johnson & Graham: High-Speed Digital Design: *A Handbook of Black Magic*

Office hours: WAT333 M 10-11, any afternoon in WAT214 by appointment

email: varner@phys.hawaii.edu

Exercises: **Mandatory --** must be completed prior to next lab session

Grading: 20% Exercises

40% Final project

20% Final presenation

20% Final report

PHYS476 Student Learning Outcomes

Successful completion of this course will require students to master the following subject material.

1. Application and reinforcement of basic physics knowledge as applied to Instrumentation problem solving
2. Develop familiarity with Modern electronics, consisting of
    1. Printed Circuit Board Layout
    2. Configurable logic ("firmware")
    3. Integrated Circuit Development
    4. Parts specification and acquisition
3. Application of Modern Electronics to a research level project
4. Introduction to project management
5. Experience with scheduling and completion of tasks
6. Technical risk management through the Design Review process
7. Completion and documentation of completed research instrumentation
8. Presentation of results to peers