University of Alaska Fairbanks
Electrical and Computer Engineering Department
EE 608 - Power Electronics Design
Spring 2013

Course Information:

Title:	EE 608 Power Electronics Design (3+3)
Lecture Time:	MWF (11:45AM-12:45PM) in Duckering 202
Lab Time:	M (2:15-5:15PM) in Duckering 202, Duckering 330, and Duckering 216
Prerequisites:	Graduate standing or permission of the instructor

Instructor: Dr. Richard Wies, Associate Professor, ECE Dept.

Office:	Duckering 213
Office Hours:	W 2-3:30PM, TR 10:30AM-12PM or by phone/e-mail
Phone:	474-7071
E-mail:	rwwiesjr@alaska.edu

Required Text: Mohan, Undeland, and Robbins, Power Electronics: Converters, Applications, and Design, 3rd ed., Wiley, 2003.

References: Daniel W. Hart, Power Electronics, McGraw-Hill, 2011.

Other references provided as needed.

Course Description: Analysis and design of power electronic conversion, control and drive systems with emphasis on smart grid applications. Topics will include the theory and application of thyristors, rectifiers, DC-DC converters, inverters, resonant converters, AC and DC switches and regulators, power supplies, DC drives, and adjustable-speed drives. Includes laboratory exercises using power electronic converter boards and a complete power electronics design project.

Course Goals: Students will develop an understanding of power electronic conversion, control and drive systems with emphasis on analysis and design concepts. The course will develop the building blocks for power electronic devices including rectifiers and converters. Analysis will include the use of PSpice and the use of Fourier transforms for determining harmonic content. A major design experience will include a project to build an operational power electronic conversion device using knowledge and skills acquired in earlier course work that incorporates "multiple realistic constraints and engineering standards." The lid the s, an2con49-14.1257 -

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EE 608 – Tentative Lecture/Lab Schedule – Spring 2012

All dates and topics are tentative. Exam dates are subject to change.

MONDAY (LECTURE)	MONDAY (LAB)	WEDNESDAY	FRIDAY

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MONDAY (LECTURE)	MONDAY (LAB)	WEDNESDAY	FRIDAY
Feb. 13 – Lecture #11 DC-DC Switch Mode Converters: Buck-Boost with CCM & DCM – Section 7.5	**Feb. 13 – Lab** **Lab #2: DC-DC Converters: Buck, Boost, and Buck-Boost** – Sections 7.1-7.5 – **Lab #1 Report Due**	**Feb. 15 – Lecture #12** DC-DC Switch Mode Converters: Cùk – Section 7.6	**Feb. 17 – Lecture #13** DC-DC Switch Mode Converters: Full-Bridge (4-quadrant); Bipolar and Unipolar Switching; Voltage Ripple – Section 7.7
Feb. 20 – Lecture #14 DC-DC Switch Mode Converters: Comparison using Switch Utilization Factor; Equivalent Circuits; Reversing Power Flow – Section 7.8	**Feb. 20 – Lab** Snubber Circuits: Diodes, Transistors, & Thyristors – Sections 27.1-27.9 **Lab #3: Switching Characteristics of MOSFETs & Diodes in DC-DC Converters** – **Lab #2 Report Due** – **Progress Report #2 Due: + IEEE Code of Ethics**	**Feb. 22 – Lecture #15** Switching DC Power Supplies: Intro; Overview – Sections 10.1-10.3 DC-DC Converters with Electrical Isolation: Isolation Transformer Excitation & PWM Control – Sections 10.4.1-10.4.1.4	**Feb. 24 – Lecture #16** Switching DC Power Supplies: Flyback Converters – Section 10.4.2
Feb. 27 – Lecture #17 Switching DC Power Supplies: Forward Converters – Section 10.4.3	**Feb. 27 – Lab** **Lab #4: DC-DC Converters: Flyback and Forward Converters** – Sections 10.4.2-10.4.3 – **Lab #3 Report Due**	**Feb. 29 – Lecture #18** Switching DC Power Supplies: Push-Pull, Half-Bridge, Full-Bridge, & Current Source – Sections 10.4.4-10.4.7	**Mar. 2 – EXAM #1** **Cps. 1-3, 5, 7, & 27** **OPEN BOOK** **2 Formulas Sheets**
Mar. 5 – Lecture #19 Switching DC Power Supplies: HF Transformer Design (Core Selection and Design) – Sections 10.4.8, 30.6-30.9	**Mar. 5 – Lab** **Lab #5: Magnetic Component Design: HF Transformers & Inductors** – Sections 10.4.8, 30.1-30.10 – **Lab #4 Report Due** – **Progress Report #3 Due: + Engineering Standards**	**Mar. 7 – Lecture #20** Switching DC Power Supplies: Control Systems (PWM) – Section 10.5	**Mar. 9 – Lecture #21**

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Mar. 19 – Lecture #22 FET Gate & BJT Base Drive Circuits – Sections 28.1-28.7	**Mar. 19 – Lab** **Oral Presentation II: Midterm Progress Report Presentations** – **Midterm Progress Report Due: Design, Schematic, Standards, Final Parts, Budget, Revised Timeline, IEEE Code of Ethics, Concerns**	**Mar. 21 – Lecture #23** Thermal Considerations for Semiconductor Devices: Heat Transfer and Heat Sink Selection – Sections 29.1-29.4	**Mar. 23 – Lecture #24** Phase-Controlled Rectifiers: Thyristor Circuits – Sections 6.1-6.2
Mar. 26 – Lecture #24 Phase-Controlled Rectifiers: Ideal Single-Phase Converters – Section 6.3.1	**Mar. 26 – Lab** **Lab #6: PWM Control & Driver Circuits in Switching DC Power Supplies: Design, Simulation, Construction, & Testing** – **Lab #5 Report Due** – **Progress Report #4 Due: + Engineering Constraints**	**Mar. 28 – Lecture #25** Phase-Controlled Rectifiers: Single-Phase Converters with Source Inductance – Section 6.3.2	**Mar. 30 – Lecture #26** Phase-Controlled Rectifiers: Practical Single-Phase Converters and Inverter Mode of Operation – Sections 6.3.3-6.3.4

Apr. 2 – Lecture #27
Phase-Controlled

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Apr. 16 – Lecture #33 Switch-Mode Inverters: Single-Phase Full-Bridge with Voltage Cancellation; Switch Utilization; Voltage Output Ripple – Sections 8.3.2.4-8.3.2.6	**Apr. 16 – Lab** **Design Project Time**	**Apr. 18 – Lecture #34** Switch-Mode Inverters: Push-Pull Inverters; Switch Utilization – Sections 8.3.3-8.3.4	**Apr. 20 – EXAM #2** **Cps. 6, 10, & 28-30** **OPEN BOOK** **2 Formulas Sheets**

Apr. 23 – Lecture #35
Switch-Mode Inverters:
Three-Phase Inverters and