ECE 5227
Fundamentals of Power Management Integrated Circuits for VLSI Systems

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Course Information

◆ Instructor
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Course Information: Prerequisite

◆ The course requires:

➢ Prereq: 4021 or 5021, or permission of instructor

➢ Grad standing in Engineering or Math and Physical Sciences and permission of instructor

➢ You are also expected to be familiar with basic frequency and s-domain analysis and spectral analysis

◆ Contact the instructor if you are unsure
Course Information: Topics Covered

◆ Section 1: Introduction to Power Management
   Definitions, mains tasks, and challenges in VLSI systems
   Power delivery schemes in VLSI systems
   Programmability and configurability

◆ Section 2: Power regulation performance metrics
   Typical load profiles in VLSI systems
   DC and Transient parameters
   Small-signal AC parameters

◆ Section 3: Linear Power Regulators
   Basic topologies and implementation techniques
   Control loop small-signal analysis and stability
   Power supply rejection considerations
   Fully integrated linear power regulators
Course Information: Topics Covered

◆ **Section 4: Buck Converters**
  - Ideal Operation and Loss Mechanisms
  - PWM & PFM voltage-mode control
  - Small-signal and stability analysis and compensation techniques
  - Current-mode, hysteretic, hysteretic-PFM, and gated oscillator control
  - Implementation examples and performance review

◆ **Section 5: Other Inductor-Based Power Converters**
  - Boost, Buck-Boost, Forward, and Flyback Converters

◆ **Section 6: Battery Chargers**
  - Basic battery operation, characteristics and types
  - Charging schemes, linear and switching chargers
  - Fuel Gauging and Multi-cell chargers
Course Information: Project

- A class project will be assigned, which involves the design of a linear regulator and a buck converter in a 0.18µm CMOS technology.

- The full project assignment document will be posted in the project module in Canvas, including final report requirements.

- Each student is expected to do the entire project on his own and submit a project report through email to the instructor by the end of the semester. Hardcopies will NOT be accepted. Your email must clearly list your name and OSU ID (XYZ.#).
Course Information: Project

◆ Each student must print, sign, and date the NDA agreement titled “MOSIS_academic.nda_non-liaison.pdf”, which is posted in the project module of the class website. **You do not need to fill in the witness part. I will sign that part as the witness**

◆ Each student must scan his/her signed NDA and email it to the instructor as a **PDF file** by the second week of the semester. **Hardcopies will NOT be accepted. Your email must clearly list your name and OSU ID (XYZ.#)**
Course Information: Lab

- There is a lab associated with this class, where you will be characterizing a linear power converter and a buck converter.

- The full lab assignment document will be posted in the lab module in Canvas, including final lab report requirements.

- Each student is expected to do the entire lab on his/her own and submit a lab report through email to the instructor by the end of the semester. Hardcopies will NOT be accepted. Your email must clearly list your name and OSU ID (XYZ.#)
Course Information: Lab

- Note that there will not be a lab in the first few weeks as we need to cover some material in lectures before you can conduct the lab.
- The lab time in the first few weeks will be used to give additional lectures to enable you to start the lab as soon as possible. Additional lectures will be announced in advance on a weekly basis.
Course Information: Grading

- Homework → several assignments will be given throughout the semester. You are not required to submit HW solutions and HW will NOT count towards your grade.

- Quizzes → 10% of total grade
  - Several 15-minutes closed-book closed-notes single-problem quizzes will be given during lecture throughout the semester. The lecture during which each quiz takes place will be announced in advance, along with which lectures each quiz will cover.

- Midterm #1 → 15% of total grade
- Midterm #2 → 25% of total grade
- Project → 35% of total grade
- Lab → 15% of total grade

- Regularly check announcements and the calendar in the class website.
This class will depend on the lecture notes and material the instructor will provide, but there is a required textbook for your own further and additional study.

Springer, 2001
Course Information: Reference Texts

- There are additional recommended textbooks that are very useful


Artech House, 2012

McGraw-Hill, 2009
Important Policies

◆ Academic misconduct

➢ It is any activity that tends to compromise the academic integrity of the university or subvert the educational process. Please see the Code of Student Conduct at http://studentaffairs.osu.edu/csc/ for examples of what constitutes academic misconduct. Please be advised that copying or plagiarizing project or lab reports that may be accessible to you from previous course offering is considered an academic misconduct and will be reported to the Committee on Academic Misconduct (COAM) at OSU. The purpose of the lab and project is NOT to duplicate or copy the work of others, EVEN if that work is available publicly to you through legitimate means. Please keep in mind that the instructor has copies of all project and lab reports from previous course offerings and that he checks every report against previous reports. Moreover, the instructor may conduct random individual-based lab exams to ensure that each student is able to replicate his/her lab results.
Important Policies

◆ Recordings
  ➢ Recording lectures in audio or video is NOT allowed without an explicit permission from the instructor to do so
  ➢ If you obtain an explicit permission to record a lecture (due to travelling to a conference, illness, or similar circumstances), you are required to submit a copy of the recording to the instructor in order for the recording to be made available to the entire class

◆ Distribution of class material
  ➢ Uploading any class material, including lecture notes, HW assignments and their solutions, or project assignments to third party websites (whether for a pay or for free) is not permitted. Please discuss with the instructor if unsure