ECE61016 Power Electronic Converters and Systems

Lecture Set 0
Course Policies and Syllabus

S.D. Sudhoff

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Comments

- ## What This Course is About
  - Waveform-level modeling, average-value modeling, and control design of power electronics converters and systems of converters.

- ## What This Course is Not About
  - Survey of many different types of power converters

- ## Flavor
  - Fairly rigorous
  - Emphasis on development of analysis and control design techniques

Topics

- Basic Tools (2 weeks)
  - Time Domain Simulation
  - Single and Multi-Objective Optimization

- DC-DC Conversion (3 weeks)
  - Buck Converters
  - Waveform-Level Modeling of DC-DC Converters
  - Average-Value Modeling of DC-DC Converters
  - Control Design Case Study: Ship Service Converter Module

Topics

- ## DC-AC Conversion (3 weeks)
  - Quick Review of Three-Phase Bridge Inverter
  - Waveform-Level Modeling
  - Average-Value Modeling
  - Control Design Case Study: Ship Service Inverter Module
  - *Common Mode Current Case Study: PV Inverter Module*

- ## AC-DC Conversion (1 week)
  - Active Rectifier Based Generation
  - Review of Permanent Magnet AC Machine
  - Control Design Case Study: PMAC DC Generation System

Topics

- Passive Rectifier Conversion (3 weeks)
  - Line-Commutate Converters (LCC)
  - Operation of LCC from Ideal Source
  - Isolated DC/DC Converters
  - Synchronous Machine / LCC Systems
  - Control Design Case Study: WRSM Based DC Generation System

- System Stability (2 weeks)
  - Negative Impedance Instability
  - Review of Stability Definitions
  - Immittance Based Stability Analysis
  - Methods of Measuring and Calculating Impedance

- Exams & Final Project (1 week)

Course Text

- Papers, handouts, lectures notes distributed from the course web site

- *Analysis of Electric Machinery and Drive Systems, 3rd Edition*, by Krause, Wasynczuk, Sudhoff, Pekarek (This book is used lightly, but it is the ECE61000 book so students should have it anyway)

Before You Take This Course

- Prerequisites by Course
  - ECE610*, ECE602, ECE382

- Prerequisites by Topic
  - Basic knowledge of power electronics
    - Synchronous machines*
    - Reference frame theory*
    - Three-phase inverters*
    - Some exposure to power electronics
  - Basic knowledge of control
    - Frequency domain techniques
    - State-space

- Software
  - Matlab & Simulink

*If you are in ECE61000
now, you will be fine

Contact Information

- Instructor: Professor S.D. Sudhoff
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  - E-mail: sudhoff@purdue.edu
  - Phone: 765-494-3246
- Course Web Site
  - http://cobweb.ecn.purdue.edu/~sudhoff/
- Area Web Site
  - https://engineering.purdue.edu/ECE/Research/Areas/PEDS
- Secretary: Christine (Chris) Ramsey
  - Office: Wang 2080
  - E-mail: cramsey@purdue.edu
  - Phone: 765-494-6442
- Office Hours:
  - If I'm in my office

Homework/Projects

- On campus: homework should be turned in on paper at the beginning of class on the due date.
- Off campus: homework should be turned in as a single PDF file or word filed of the form HWX_by_JaneDoe.pdf mailed to sudhoff@purdue.edu by 10:00 pm of your local time.
- Homework will occasionally be somewhat different for on and off-campus students when logistically necessary. This will be indicated on a per-problem basis.
- Homework will be assigned approximately every other week.
- You may freely discuss your homework with other students; however, individual work is expected.
- Late homework will be docked 15 points per day late until I post the solution (typically 3 days). After that it won't be accepted.

Exams and Final Grade

- There will be three 50 minute exams (one of which is during the final exam period). There will be equal weighting of the exams. The final exam is not directly cumulative.

- Final grade will be average of homework score (not all of which are weighted equally) and exam scores. (50% homework, 50% exams)

Exam Policies

- No computers, cell-phones, calculators, PDAs, slide rules, abacus, rulers, etc., except as noted.
- One 8.5 by 11 inch piece of paper (both sides) allowed for each exam.
- If I can see any course materials other than the crib sheet, it is considered cheating (I do not even want to see a closed book – put all books in a closed opaque backpack)
- Do not look past your own desk. Hats with front brims are not allowed.
- Digital watches are not allowed.
- Exams will be curved on a per test basis.
- Regrade should be requested within 2 weeks of date the graded assignment/exam are released if a regrade is needed.

Cheating

- At minimum, cheating will result in a zero on the assignment in question.
- All instances of cheating, even suspected cheating, will be reported to the ECE Assistant Head for Education and the Assistant Dean of Students
- Exams may by photographed/videotaped

Background

- BSEE, Purdue, 1988
- MSEE, Purdue, 1989
- PhD, Purdue, 1991
- P.C. Krause and Associates, 1991-1993
- University of Missouri – Rolla, 1993-1997
- Purdue, 1997 –

Background

- Interests (Technical)
  - Electromechanical Devices
  - Power Magnetics
  - Applied Automatic Control
  - Power Electronic Based Systems
  - Evolutionary Computing / Optimization Techniques
  - Automated Design

- Interests (Non-Technical)
  - Distance Running
  - Amateur Astronomy
  - Bad Science Fiction

Disclaimer on Policies

- In the event of a worldwide pandemic, asteroid impact, global flood, sharknado, invasion of space-alien homework-eating cyborg super beagles, or other such event, class policies may be adjusted midcourse. Information will be posted on course web site in such a case.

Emergency Preparedness

- To report an emergency, call 911. To obtain updates regarding an ongoing emergency, sign up for Purdue Alert text messages, view www.purdue.edu/ea.

- There are nearly 300 Emergency Telephones outdoors across campus and in parking garages that connect directly to the PUPD. If you feel threatened or need help, push the button and you will be connected immediately.

- If we hear a fire alarm during class we will immediately suspend class, evacuate the building, and proceed outdoors. Do not use the elevator.

- If we are notified during class of a Shelter in Place requirement for a tornado warning, we will suspend class and shelter in the basement.

- If we are notified during class of a Shelter in Place requirement for a hazardous materials release, or a civil disturbance, including a shooting or other use of weapons, we will suspend class and shelter in the classroom, shutting the door and turning off the lights.

- Please review the Emergency Preparedness website for additional information. http://www.purdue.edu/ehps/emergency_preparedness/index.html

Motivation