Lecture Set 0

ECE32100: Electromechanical Motion Devices
ECE51012: Electromechanics

SYLLABUS (1/15/2021)

S.D. Sudhoff

Spring 2021

Courses

- Courses
  - ECE 32100
  - ECE 51012

- Differences
  - ECE 51012 will have harder/longer homework and projects

- Note
  - Do not take both ECE32100 and ECE51012
  - Do not take ECE51012 after ECE61000

What This Course is About

- Fundamental concepts related to the analysis of electromechanical devices
- Fundamental and quantitative understanding of the operating principals of electromechanical devices
- Some design considerations
- Concentration on the physics, the operating principals, and the modeling

What This Course is **Not** About

- Not about how to pick electromechanical devices from a catalog
- Not about a technology survey
- Not about how to use an equation

Course Objectives

1. Ability to Analyze/Design Electromagnetic Devices
2. Understand Principles of Electromagnetic Energy Conversion
3. Understand Time-Varying Transformations
4. Analysis/Understanding of DC, Brushless DC, Induction Machines
5. Analysis of Power Converters for DC Machines

Topics (Approximate Lectures)

- Magnetically Coupled Circuits (7)
- Energy Conversion (6)
- VR Stepper Motors (3)
- DC Machines (4)
- DC/DC Power Converters (3)
- Rotating MMF (5)
- Reference Frame Theory (2)
- Brushless DC Machines (6)
- Transformers (1)
- Induction Machines (7)

Before You Take This Course

- Prerequisites
  - EE202 and Phys 261
- Also, You Should Be Good At
  - Calculus
  - Basic Linear Algebra
- Matlab will be used heavily (i.e. you will need it for every assignment and project)

Course Text

- P.C. Krause, O. Wasynczuk, S.D. Pekarek, "Electromechanical Motion Devices, 2nd Edition"

- S.D. Sudhoff, "Lecture Handouts for ECE321", available through the course web site

Contact Information

- Instructor: Professor S.D. Sudhoff
  - Office: Wang 2057
  - E-mail: sudhoff@purdue.edu
  - Phone: 765-494-3246
  - Office Hours: See course web site for updates
    - MWF: 2:00-3:00 (Virtual)
    - https://purdue.webex.com/webappng/sites/purdue/dashboard/pmr/sudhoff

- **Course Web Site**
  - http://cobweb.ecn.purdue.edu/~sudhoff/

Contact Information

- Area Secretary: Lori Carte
  - Office: Wang 2080
  - E-mail: ljcarte@purdue.edu
  - Phone: 765-494-6442

- Teaching Assistant: Kiana Ito Pitman
  - E-mail: pitman0@purdue.edu
  - Office hours: See course web site

Piazza

- This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com.
- Find our class signup link at: https://piazza.com/purdue/spring2021/ece321005101012

My Interests

- Electromechanical Devices
- Power Magnetics
- Applied Automatic Control
- Evolutionary Computing / Optimization Techniques
- Automated Design
- Astronomical Imaging

Physical Lecture Attendance

- Look under Brightspace grades, for a column with ‘group’ or ‘lecture attendance group’
- 1 = group one (odd number lecture attendance)
- 2 = group two (even number lecture attendance)
- 0 = you are registered as a distance/video option and should not come to class physically

Homework

- Homework will be turned in via e-mail using a matlab script file.
- Students should e-mail their homeworks to
  - ECE32100: ece32100@purdue.edu
  - ECE51012: ece51012@purdue.edu
- Homework is individualized to a persons key. You can obtain your key from blackboard (check Grades, see 'Homework Key'). This is a positive number which is less than one. Use all four digits.

Homework

- Homework will be assigned on Wednesdays (normally)
- Homework will be collected on the following Wednesday at midnight (normally). Call your score W.
- You will receive feedback on Thursday via e-mail.
- You may resubmit your homework on Friday by midnight (normally). Call your score F.
- Your effective homework score will be =

  maximum(W, 0.4*W+0.6*F)
- In Brightspace, you will see both scores.
- You must submit on Friday to get the solution key (grade is not effected)

Grading of Problems with Scalar Answers

- For a given problem or problem part which has an answer which is a scalar real number
  - For full marks you need to be within plus or minus 1%.
  - If your answer is more than 1% from the solution but less than 5% from the solution, you receive 75% credit.
  - If you your answer deviates from the solution by more than 5%, you receive a zero.
- Variations of this theme will be used for other data types.

Homework

- The percent of homework you correctly answer over the semester will be calculated.
- Late homework will not be accepted (outside of a verified personal illness/crisis)
- You may publicly discuss homework questions in general terms with other students via Piazza; other than this individual work is expected.

Projects

Tentative Projects:

- Project 1 will involve the design of an electromagnet.

- Project 2 will involve parameter identification of a permanent magnet ac machine.

- Project 3 will involve time-domain simulation of an electric machine.

Exams

- None! (Spring 2021 Only)

Cheating

- Cheating will result in a zero on the homework/project
- All instances of cheating, even suspected cheating, will be reported to the ECE Assistant Head for Education and the Assistant Dean of Students
- Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern.

Satisfying ABET

- This course has five objectives.
- **You must demonstrate a level of achievement in each of these to pass the course.**
- This may be done by satisfying the ABET exam.
- The ABET Exam is a take-home exam is roughly 4 weeks prior to end of semester.

ABET Exam

- It is about the length of a one-hour exam
- It will have an ABET question over each objective
- This exam is to be worked independently
- Every answer must be completely correct to be accepted
- We will grade periodically; and let you know which questions are incorrect
- You must pass the ABET exam to be eligible for a passing grade
- If you get a question wrong, you may rework and resubmit until you get it correct or until 5 pm of the last day of regular classes.
- Late submissions (until the end of final week) will reduce your final grade by one letter grade.

Nominal Course Grade

- Aggregate Score (Assuming ABET Exam Passed)
  - 12 % Project 1
  - 12 % Project 2
  - 12 % Project 3
  - 64 % Homework
- The +/- system for letter grades will be used

Letter Grade Scale

- After rounding your cumulative score to an integer (and assuming ABET passed)
- A-: 90-92, A: 93-96, A+: >= 97
- B-: 80-82, B: 83-86, B+: 87-89
- C-: 70-72, C: 73-76, C+: 77-79
- D-: 60-62, D: 64-66, D+: 67-69
- F: <=59

Disclaimer on Policies

- The course has changed a lot since I taught it last year. I reserve the right to change things if there is a problem. Or if local, regional, or world events require a change. In either case, changes will be posted on the course web site.

Personal Tragedies

- There is much that can go wrong in life, such as death of a family member. If a personal tragedy occurs that prevents the completion of an assignment please contact me.

Nondiscrimination Statement

- **Purdue University is committed to** maintaining a community which recognizes and values **the inherent worth and dignity of every person**; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Purdue's nondiscrimination policy can be found at http://www.purdue.edu/purdue/ea_eou_statement.html.

Student with Disabilities

- **Purdue University strives to make learning experiences as accessible as possible.** If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: **drc@purdue.edu** or by phone: 765-494-1247.

Mental Health Statement

- Purdue University is committed to advancing the mental health and well-being of its students. **If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available**. For help and to speak with a clinician, contact Counseling and Psychological Services (CAPS) at (765) 494-6995 or by going to CAPS' office on the second floor of the Purdue University Student Health Center (PUSH). For urgent situations after hours, on weekends and holidays, call (765) 494-6995 to speak with a clinician. Please see http://www.purdue.edu/caps/ for further information.

Emergency Preparedness

- Emergency preparedness is your personal responsibility. Purdue University is actively preparing for natural disasters or human-caused incidents with the ultimate goal of maintaining a safe and secure campus. Let's review the following procedures:
- **For any emergency text or call 911.**
- There are more than 300 Emergency Telephones (aka blue lights) throughout campus that connect directly to the Purdue Police Department (PUPD). If you feel threatened or need help, push the button and you will be connected right away.
- **If we hear a fire alarm we will immediately evacuate the building and proceed to the Northwest Parking Garage.**
- **Do not use the elevator.**

Emergency Preparedness

- If we are notified of a Shelter in Place requirement for **a tornado warning** we will stop classroom or research activities and shelter in the lowest level of this building away from windows and doors. Our preferred location is the **first floor of WANG**. **The first floor stairwell, restrooms, and janitor area** (on the backside of the elevators) are shelter areas. An alternate EAA is the **tunnel underneath the Northwestern Parking Garage and MSEE Building** if it safe to briefly travel outdoors.
- If we are notified of a Shelter in Place requirement for a **hazardous materials release we will shelter in our classroom shutting any open doors and windows**.
- If we are notified of a Shelter in Place requirement for an **active threat such as a shooting we will shelter in a room that is securable preferably without windows**. Our preferred location is our classroom.

Emergency Preparedness