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## ECE 32100

### Electromechanical Motion Devices (Fall 2015)

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<b>Instructor</b>	Dionysios Aliprantis, Associate Professor, ECE
<b>Contact</b>	WANG 2055, (765) 494.4434, dionysis@purdue.edu
<b>Office hours</b>	Monday 10–11 am Thursday 3–5 pm and by appointment
<b>Classroom</b>	Neil Armstrong Hall of Engr 1010, MWF 2:30pm–3:20pm
<b>TA</b>	Steven Lo, (949) 331.5205, lo8@purdue.edu
<b>TA office hours</b>	Monday 3:30–5:30 pm (EE 208) Tuesday 9–10 am, 11 am–12 noon, 3–5 pm (Wang 2014) Wednesday 9–10 am (Wang 2014), 3:30–5:30 pm (EE 208) Thursday 9 am–12 noon, 3–5 pm (Wang 2014) Friday 9–10 am (Wang 2014), 3:30–5:30 pm (EE 208)
<b>Web page</b>	N/A; material will be posted on Blackboard Learn
<b>Revision</b>	August 24, 2015

**Catalog Description:** The general theory of electromechanical motion devices relating electric variables and electromagnetic forces. The basic concepts and operational behavior of DC, induction, brushless DC, and stepper motors used in control applications are presented.

#### **Learning Objectives:**

1. Analyze/design electromagnetic circuits/devices.
2. Understand the concepts and principles of electromagnetic [electromechanical?] energy conversion.
3. Understand the concept of time-varying transformations in the analysis of time-varying systems.
4. Analyze dc machines.
5. Understand converters for dc drives.
6. Analyze brushless dc machines.
7. Analyze induction machines.

**Prerequisites:** ECE 20200 [Linear Circuit Analysis] and (PHYS 24100 or PHYS 27200 or PHYS 25100 or PHYS 26100) or (PHYS 27100 and PHYS 27101) [Electricity and Magnetism] and ECE 25500 [Intro to Electronic Analysis and Design; may be taken concurrently]

**Required Text:** “Electromechanical Motion Devices,” by Paul Krause, Oleg Wasynczuk, and Steven Pekarek, Wiley/IEEE Press, second edition, 2012, ISBN: 978-1-118-29612-7.

Also available online (through Purdue network):

<http://ieeexplore.ieee.org/xpl/bkabstractplus.jsp?bkn=6266783>

<http://onlinelibrary.wiley.com/book/10.1002/9781118316887>

**Tests:** There will be four midterms and a final (comprehensive) exam during the semester. Midterm dates are as follows:

- Midterm 1    Friday, Sep. 25
- Midterm 2    Friday, Oct. 23
- Midterm 3    Monday, Nov. 23
- Midterm 4    TBD [same day as final exam]

The fourth midterm will be during your final exam time (during the first hour). *The worst exam grade (out of 5) will be automatically dropped.* You will be assigned a (random) designated seat at the beginning of each exam. Exams may be video-taped, to ensure that no cheating takes place.

**ABET:** Every student needs to satisfy all ABET outcomes of this course. See: <http://tinyurl.com/q9tk48h>, and <http://tinyurl.com/nnt8nhm>. To this end, a special sixth exam will be assigned towards the end of the semester as a take-home exam. This test will be graded orally during the instructor office hours. If answers are incorrect, the students will be asked to revise & resubmit, until all answers are correctly answered. **Failure to complete this exam means that you get an ‘F’!**

**Homework:** There will be regular homework assignments that will be posted on the Web. Assignments will be collected *at the beginning of class*. This policy will be strongly enforced. If, for any reason, you are unable to submit your assignment by the beginning of class, you are welcome to return it early via email. *The two worst homework grades will be automatically dropped.*

**Missed or Late Work:** In general, missed or late work will not be accepted. If, for some unforeseen circumstance, you are unable to complete on time, please contact me as soon as possible.

**Class ID:** Each student will be assigned a random identifier between 100,000 and 999,999. This will help mitigate grading bias, and will simplify the delivery of graded work back to students. When submitting homework/exams, you should only use this ID number! *Do not write your name or Purdue ID on your assignments!*

**Course Grading Policy:**

Homework		20%
Exams		80%

Letter grades will be determined by the following guidelines:

$\geq 95\%$	A+
$\geq 85\%$	A
$\geq 80\%$	A-
$\geq 75\%$	B+
$\geq 70\%$	B
$\geq 65\%$	B-
$\geq 60\%$	C+
$\geq 55\%$	C
$\geq 50\%$	C-
$< 50\%$	F

**Communication:** Feel free to communicate with me in any way that is convenient to you (after class, during office hours, phone, email), for questions about the course material or assignments.

**Students with Disabilities:** Students with disabilities must be registered with Disability Resource Center (<http://www.purdue.edu/studentssuccess/specialized/drc/>) before classroom accommodations can be provided. If you are eligible for academic accommodations because you have a documented disability that will impact your work in this class, please schedule an appointment with me as soon as possible to discuss your needs.

**Calculator Policy:** During exams, you are allowed to use the ECE-approved Texas Instruments TI-30X IIS scientific calculator: <https://education.ti.com/en/us/products/calculators/scientific-calculators/ti-30x-iis/tabs/overview>. This is an inexpensive calculator with a 2-line display, a fraction feature, one or two-variable statistics, simple conversions, and basic scientific & trigonometric functions. Students are encouraged to familiarize themselves with the use of this calculator well in advance of any exam.

**Attendance:** Students are expected to be present for every meeting of the classes in which they are enrolled. An attendance sign-up sheet will be circulated every time. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts or absences can be anticipated, such as for many University sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email, phone, or by contacting the main office of the department that offers the course. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, the student or the student's representative should contact the Office of the Dean of Students. For more information, please see: [http://www.purdue.edu/studentregulations/regulations\\_procedures/classes.html](http://www.purdue.edu/studentregulations/regulations_procedures/classes.html).

**Grief Absences:** Purdue University recognizes that a time of bereavement is very difficult for a student. Grief Absence Policy for Students (GAPS): Students will be excused for funeral leave and given the opportunity to earn equivalent credit and to demonstrate evidence of meeting the learning outcomes for missed assignments or assessments in the event of the

death of a member of the student's family. For more information, please see: [http://www.purdue.edu/studentregulations/regulations\\_procedures/classes.html](http://www.purdue.edu/studentregulations/regulations_procedures/classes.html).

**Military Absences:** Purdue recognizes that those who are actively serving in the reserves or National Guard of the United States are required by their military contract to attend mandatory training with failure to attend punishable under law.

**Academic Dishonesty:** Purdue prohibits “dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty.” [Section B-2-a, Code of Student Conduct: [http://www.purdue.edu/studentregulations/student\\_conduct/regulations.html](http://www.purdue.edu/studentregulations/student_conduct/regulations.html)]. Furthermore, the University Senate has stipulated that “the commitment of the acts of cheating, lying, and deceit in any of their diverse forms (such as the use of ghost-written papers, the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest.” [University Senate Document 72-18, December 15, 1972].

Incidents of academic misconduct in this course will be addressed by the course instructor and referred to the Office of Student Rights and Responsibilities (OSRR) for review at the university level. Any violation of course policies as it relates to academic integrity will result minimally in a failing or zero grade for that particular assignment, and at the instructor's discretion may result in a failing grade for the course. In addition, all incidents of academic misconduct will be forwarded to OSRR, where university penalties, including removal from the university, may be considered. This means that **cheating may lead to an 'F' for the course**. For more information, please see: <https://www.purdue.edu/odos/osrr/responding-to-academic-dishonesty-brochure/>.

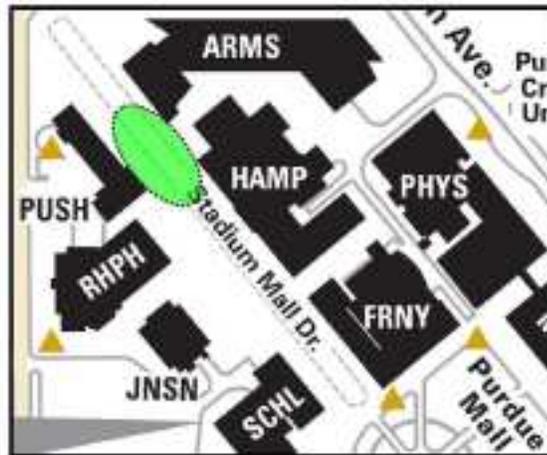
**Violent Behavior Policy:** Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity. See <http://www.purdue.edu/policies/facilities-safety/iva3.html> for more information.

**Emergencies:** In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Any changes will be posted on the course website. You are expected to read your @purdue.edu email on a frequent basis. Also please review emergency preparedness plans that can be found here: [http://www.purdue.edu/emergency\\_preparedness/](http://www.purdue.edu/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:

- To report an emergency, **call 911**.

- To obtain updates regarding an ongoing emergency, sign up for **Purdue Alert text messages**: <http://www.purdue.edu/emergency>.
- There are nearly 300 **Emergency Telephone Systems** 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 to the PUPD.
- If we hear a **fire alarm** during class we will immediately suspend class, evacuate the building, and proceed outdoors.
  - **Do not use the elevator.**
  - Our primary Emergency Assembly Area is the area east of the Purdue University Student Health Center (PUSH) and west of Hampton Hall of Civil Engineering (HAMP) as indicated by the green safe-zone oval shown on the map below.  
*Please stay clear of all emergency vehicles and personnel.*



- If we are notified during class of a **Shelter in Place requirement for a tornado** warning, we will suspend class and shelter in room 1010 (our classroom).
- 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.

**Nondiscrimination:** 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 University views, evaluates, and treats all persons in any University related activity or circumstance in which they may be involved, solely as individuals on the basis of their own personal abilities, qualifications, and other relevant characteristics.

Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or status as a veteran. The University will conduct its programs, services and activities consistent with applicable federal, state and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in Purdue's Equal Opportunity, Equal Access and Affirmative Action policy which provides specific contractual rights and remedies. Additionally, the University promotes the full realization of equal employment opportunity for women, minorities, persons with disabilities and veterans through its affirmative action program.

Any student who believes they have been discriminated against may visit <http://www.purdue.edu/report-hate> to submit a complaint to the Office of Institutional Equity. Information may be reported anonymously.

#### TENTATIVE SCHEDULE OF LECTURES

# of Weeks	Topic	Reading
2	Magnetic circuits	Ch. 1 and lecture notes
2	Electromechanical energy conversion	Ch. 2
2	Stepper motors	Ch. 9
2	DC machines	Ch. 3
1	Windings and rotating magnetomotive force	Ch. 4
2	Reference frame theory	Ch. 5
2	Permanent-magnet ac machines	Ch. 8
1	Transformers	Ch. 1.5
2	Induction machines	Ch. 6