

**EE-499 INDEPENDENT STUDY – THREE-PHASE AC MOTOR CONTROL  
COURSE SYLLABUS****DESCRIPTION**

This is a hands-on Electrical Engineering elective class which focuses on permanent magnet (PM) three-phase AC electric motor theory, the development of control algorithms for such machines, and the power electronic drives used to energize such machines. A low-power PM machine and power electronics inverter will be analyzed and tested (with time permitting).

**INSTRUCTOR**

Name: Allan Taylor, M.S.E., Lecturer  
Office: 2-703V AB, ECE Dept.  
Hours: **Wed. 10:15AM – 12:20PM**, or by appt.; walk-ins welcome  
Phone: 810-762-9500 ext.5656  
Email: [ataylor@kettering.edu](mailto:ataylor@kettering.edu)

**PREREQUISITES**

MATH-204 (Diff Equations & Laplace Transforms)	PHYS-224/225 (Electricity & Magnetism + Lab)
CE320 (Microcomputers 1 + Lab)	EE320 (Electronics 1 + Lab)

**CO-REQUISITES (AT LEAST 2 OF 4)**

EE342 (Electrical Machines + Lab)	EE432 (Feedback Control Systems + Lab)
EE424 (Power Electronics & Applications + Lab)	EE434 (Digital Signal Processing + Lab)

**SCHEDULE**

Two 120-minute lecture sessions per week.

**For Summer 2016 term: Section 01 meets Tues/Fri 10:15AM – 12:20PM in room 2-703V AB.**

**TEXTBOOK**

There is no required textbook; the following textbooks are recommended as a reference:

- [1] DeDoncker, R., Pule, D., & Veltman, A. (2011). *Advanced Electric Drives – Analysis, Modeling, & Control*. London, New York. Springer Science & Business Media. ISBN: 978-94-007-0179-3.
- [2] Sul, S. (2011). *Control of Electric Machine Drive Systems*. Hoboken, NJ: J. Wiley & Sons. ISBN: 978-0-470-59079-9.

**MATERIALS**

Students will need access to a computer which has the following software packages and licenses installed: MathWorks MATLAB, Altium Designer, TI Code Composer Studio, & National Instruments LabVIEW.

**ATTENDANCE**

To ensure that all students are participating and to avoid issues later in the course, **attendance is mandatory**. Each student is allowed one unexcused absence. If you fail to attend class on two or more occasions during the term your grade may be negatively affected and/or you may be dropped from the class. Repeated or excessive tardiness may also have a negative impact on grades. Students should make every effort to contact the instructor as soon as possible in advance of a known absence or after an unforeseen one.

**ASSESSMENT**

Throughout the course, students will be introduced to a variety of theoretical topics and software packages used to develop simulation materials or design files. Weekly progress reports (8 total) are required from each student as they progress through the course. No exams will be given in this course but students will be required to complete an end-of-term project which focuses on the hardware or software development of an inverter.

**Progress Reports**

Weekly progress reports will be due at class-time on **Tuesday** of each week, and should briefly summarize the student's work through the previous week. Late reports will be accepted but will lose points per unit time.

**Report Guidelines**

- Reports should be 1 to 4 pages in length – any theoretical analyses, developed equations or Simulink models, circuit board design files or images, or summaries of microcontroller software or HMI LabVIEW code should be included.
- The report must have the student's name, day and time of class, and week number in the upper corner.
- All pages must include page numbers and must be stapled together in the upper left corner.
- Reports (and any images or equations within) must be computer generated – handwritten submissions are not allowed.

**GRADING**

All grades will be posted in Blackboard. The weighting and calculation of grades and the letter grade conversion for the course are outlined below:

Progress Reports (8x)	80%	100-95	A	79-77	C+
Term Project	20%	94-90	A-	76-73	C
		89-87	B+	72-70	C-
		86-83	B	69-65	D+
		82-80	B-	64-60	D
	100%			59-0	F

**INSTRUCTOR'S RESPONSIBILITIES**

The following is a list of responsibilities that you may expect from the instructor:

- Provide lectures that reach as broad a range of learning styles as is feasible within the constraints of the amount of material that must be covered and the time available for lectures.
- Be available outside of class for explanations and answers tailored to individual students.
- Grade materials promptly to keep each student's progress on Blackboard up to date.
- Make the student aware of the learning objectives and provide assignments that both teach basic use and application of the objectives.

**STUDENT'S RESPONSIBILITIES**

The following describes what is expected of a student who wishes to do well in the course:

- Attend class regularly and inform the instructor in advance if you must miss a lecture.
- Spend a minimum of 2 to 3 hours externally, per hour of lecture, on course activities outside the classroom. These activities include reading the textbook and / or reviewing lecture notes, completing homework assignments, reviewing the course objectives, seeking help with the instructor, etc.
- Begin working on an assignment shortly after it is released. This will enable you to better understand the following lectures and class discussions.
- Monitor your progress in the course through Blackboard.
- **Ask the instructor** if you have questions about *anything* (lecture material, homework questions, your performance in the course, etc.). It is your responsibility to seek help from the instructor when you do not yet feel you fully understand a topic.

**COURSE SCHEDULE****EE-499 Independent Study - Three Phase AC Motor Control**

Summer 2016 - Last Updated 07/07/2016

<b>Week</b>	<b>Date</b>	<b>Topics</b>	<b>Reading</b>	<b>HW</b>
Week 1	12-Jul	Three-Phase Electric Machine Theory		
	15-Jul	Reference-Frame Math & Machine Modeling		
Week 2	19-Jul	Motor Model Development with Simulink		PR01 Due
	22-Jul	Vector Control Simulation with Simulink		
Week 3	26-Jul	Flux Weakening Control for High Speeds		PR02 Due
	29-Jul	Power Electronics Overview of 3ph VSI		
Week 4	2-Aug	PWM Modulation Schemes (S & SV PWM)		PR03 Due
	5-Aug	Intro to Altium Designer IDE		
Week 5	9-Aug	Ref-Dsgn Invrtr Schematics - Power Circuits		PR04 Due
	12-Aug	Ref-Dsgn Invrtr Schematics - Control Circuits		
Week 6	16-Aug	Ref-Dsgn Invrtr PCB Layout - Power Circuits		PR05 Due
	19-Aug	Ref-Dsgn Invrtr PCB Layout - Control Circuits		
Week 7	23-Aug	Texas Instruments Digital Signal Processors		PR06 Due
	26-Aug	Intro to Code Composer Studio IDE		
Week 8	30-Aug	SW PI Controllers & Digital Filters		PR07 Due
	2-Sep	NO CLASS – LABOR DAY		
Week 9	6-Sep	LabVIEW Introduction & HMI Development		PR08 Due
	9-Sep	SW Serial Port Communication		
Week 10	13-Sep	Open-Loop Control Demo of PMAC Motor		
	16-Sep	Advanced Topics – Position Observers		
Week 11	20-Sep	Overflow Day - Work on Term Projects		
	23-Sep	Hands-On Demonstration of Motor Control		

**STUDENTS WITH DOCUMENTED DISABILITIES**

The University will make reasonable accommodations for persons with documented disabilities. Students need to register with the Wellness Center every term they are enrolled in classes. To be assured of having services when they are needed, students should contact the Wellness Center during the first week of each term. Note that it is the student's responsibility to arrange accommodations with each professor.

For more information on "Disability Services," refer to the *Student Life* section of the current Undergraduate Catalog (see page 24). This information is also noted in the Student Handbook (see page 31).

<http://www.kettering.edu/academics/academic-resources/office-registrar/academic-course-catalogs> (pg 24)

<http://www.kettering.edu/current-students/student-life/student-life-resources> (pg 31)

**ETHICS IN THE UNIVERSITY AND ACADEMIC INTEGRITY**

Kettering University values academic honesty and integrity. Cheating, collusion, misconduct, fabrication, and plagiarism are serious offenses. Each student has a responsibility to understand, accept, and comply with the University's standards of academic conduct as set forth in our statement, "Ethics in the University," and "Academic Integrity" as well as policies established by individual professors.

Several clarifications of the policy to note are as follows. Seeking assistance for a graded assignment from others, which includes but is not limited to another group in the class, another student, a tutor, other professors, or any online sources, could be considered cheating and is frowned upon. Allowing another group access to your work (this term or any following term) could also be considered cheating. You may get assistance in understanding course notes and book problems from any source. You may get unlimited assistance in anything from the course instructor.

For more information on "Ethics" and "Academic Integrity", refer to the *Student Life* section of the current Undergraduate Catalog (see page 19). This information is also noted in the Student Handbook (pages 42 - 44).

<http://www.kettering.edu/academics/academic-resources/office-registrar/academic-course-catalogs> (pg 19)

<http://www.kettering.edu/current-students/student-life/student-life-resources> (pg 42 - 44)

**ACADEMIC ASSISTANCE**

In addition to your professors, academic assistance with class work and writing is available from the Academic Success Center (ASC), located in room 3-322 of the Academic Building or contacted at (810)-762-7995 or [academicsuccess@kettering.edu](mailto:academicsuccess@kettering.edu)