

## EEE 473 Electrical Machinery (3) [F]

**Course (Catalog) Description:** Operating principles and modeling of different types of electric machines including DC, brushless DC, induction, permanent magnet and conventional synchronous machines; control aspects of these machines within modern electric drives for applications such as industry automation, energy conservation through variable speed drives, wind generators and electric vehicles.

Course Type: Elective.

**Prerequisite:** EEE 360.

**Textbook:**

N. Mohan, *Electric Machines and Drives: A First Course*, 2012, Wiley

**Supplemental Materials:** <http://myasucourses.asu.edu>

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**Prerequisites by Topic:**

- Introductory physics – basic electromagnetic principles
- Electric networks – dc and ac analysis, three phase circuits, phasors
- Basic linear system theory – transfer functions, bode plots

**Course Objective(s):**

- Students will be able to analyze, select, and control electric machines and understand modern electric drives that are important in today's industry.

**Course Outcome(s):**

- Students will have good understanding of the basic principles of electro mechanical energy conversion
- Students will understand the operating principles, performance characteristics and modeling of conventional machines such as dc motors and dc generators, ac motors and generators, and transformers.
- Students will understand the operating principles and modeling of modern machines such as permanent magnet motors, brushless dc motors, stepper and reluctance motors
- Students will have a basic understanding of machine control using power electronic converters, and be able to design feedback controllers for simple motion control applications

**Course Topics:**

- Mechanical system requirements and electric drives
- Review of magnetic circuits
- Principles of electro mechanical energy conversion
- DC machines – operating principles, constructional details
- Transformers – operating principles, important parameters, test methods

- AC induction and synchronous machines
- Permanent magnet and brushless dc motors
- Stepper motors and reluctance motors
- Modeling and speed control of motors
- Power electronic converters used in electric drives
- Applications of modern machines

**Computer Usage:** Computer usage is significant in this class. Students are encouraged to use Mathcad, Matlab, and/or other standard software packages for solving homework problems. Simulation tools such as PLECS and PSpice are used in a project that accounts for nearly 20% of the grade.

**Laboratory Experiments:** None.

**Course Contribution to Engineering Science and Design:**

- This course contributes to engineering science by teaching students how to apply the theory studied in introductory physics courses to understand and analyze electric machines. New concepts, including space vector methods, for analyzing ac machines are introduced.
- This course has significant engineering design component. For example, as part of the required mini-project, the students need to consider a motion control application, convert the mechanical system requirement to electrical specifications, select and design a suitable electric motor and design suitable controllers to achieve speed or position control.

**Course Relationship to Program Objectives:**

- A.1, E.4 and 3(k): Students utilize modern tools such as the computer to solve problems, and modern methods such as space vector theory to analyze ac machines
- A.2: Students gain an appreciation of how electric machines are used and controlled in a wide variety of applications such as power generation, process industry and automotive applications.
- E.3 and 3(a): Students must apply both mathematics and physics to understand and solve problems in this course.
- E.1, 3(c) and 3(e): Students perform design type analyses and solve engineering problems in homeworks as well as in the mini-project.

Person(s) preparing this description and date of preparation: Raja Ayyanar, Ravi Gorur, Gerald Heydt, February 2015.