

**Rutgers University, Department of Electrical and Computer Engineering**  
**ABET COURSE SYLLABUS**  
**COURSE: 14:332:411**

<b>Course Catalog Description:</b>	14:332:411 Electrical Energy Conversion (3) Principles of magnetic circuit concepts, transformers, DC machines, synchronous machines, induction machines, special purpose machines
<b>Pre-Requisite Courses:</b>	14:332:222
<b>Co-Requisite Courses:</b>	None
<b>Pre-Requisite by Topic:</b>	1. Electrical circuit theory 2. Basic electromagnetic theory
<b>Textbook &amp; Materials:</b>	Electric Machinery Fundamentals by Stephen J. Chapman 5th edition, 2011, ISBN 978-0-07-352954-7
<b>References:</b>	1. A. E. Fitzgerald, C. Kingsley, S. D. Umans, "Electric Machinery", 6 <sup>th</sup> edition, 2003
<b>Overall Educational Objective:</b>	1. To introduce the principle of converting electrical energy to mechanical energy and vice versa via electromagnetic field. 2. To introduce different machines, their operating principle and the analysis of key characteristics. 3. To provide the basis for further study of electric machines.
<b>Course Learning Outcomes:</b>	A student who successfully fulfills the course requirements will have demonstrated:  1. An ability to understand the principle of converting electrical energy to mechanical energy and vice versa via electromagnetic field. 2. An ability to the operation and analysis of transformers. 3. An ability to the operation and analysis of DC motors and generators. 4. An ability to the operation and analysis of synchronous motor and generator. 5. An ability to the operation and analysis of induction motor. 6. An ability to identify advantages and disadvantages of different machines.
<b>How Course Outcomes are Assessed:</b>	1. Mid-Term Exams (50 %) 2. Final Exam (50 %)

N = none    S = Supportive    H = highly related

Outcome	Level	Proficiency assessed by
(a) an ability to apply knowledge of Mathematics, science, and engineering	H	HW Problems, Quizzes, Exams
(b) an ability to design and conduct experiments and interpret data	S	Design problems in HW, Exams
(c) an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	N	
(d) an ability to function as part of a multi-disciplinary team	N	
(e) an ability to identify, formulate, and solve ECE problems	H	HW Problems, Quizzes, Exams
(f) an understanding of professional and ethical responsibility	N	
(g) an ability to communicate in written and oral form	S	HW Problems
(h) the broad education necessary to understand the impact of electrical and computer engineering solutions in a global, economic, environmental, and societal context	N	
(i) a recognition of the need for, and an ability to engage in life-long learning	S	Lectures, subsequent courses
(j) a knowledge of contemporary issues	N	
(k) an ability to use the techniques, skills, and modern engineering tools necessary for electrical and computer engineering practice	H	HW Problems
Basic disciplines in Electrical Engineering	H	HW, Quizzes, Exams
Depth in Electrical Engineering	S	HW, Quizzes, Exams
Basic disciplines in Computer Engineering	N	
Depth in Computer Engineering	N	
Laboratory equipment and software tools	N	
Variety of instruction formats	S	Lectures, Office hour discussions

### Topics Covered week by week:

- Week 1-2** Introduction to the course, basic concepts, magnetic field, magnetic circuit, voltage/force induction, basic linear machine
- Week 2-4** Basic theory of transformer, equivalent circuits, open-circuit, short-circuit analysis, efficiency and phasor analysis, per-unit system, autotransformer, three phase transformer, quiz 1
- Week 5-6** Electromechanical energy conversion principles, Machine classification, AC machines, DC machines concepts
- Week 7-8** DC machine fundamentals, voltage/torque induction, commutation, windings, power losses and analysis, inter-poles compensating windings, DC motor starting
- Week 9-11** AC machine fundamentals, rotating magnetic field, MMF and flux distribution, induced voltage/torque, power flow and losses, quiz 2
- Week 11-13** Polyphase synchronous generator, speed, equivalent circuit, phasor diagram, power and torque analysis, transients, operation of synchronous motors
- Week 13-15** Induction motor, concepts, equivalent circuit, power, torque, speed analysis, motor starting, induction generator
- Week 16** Review, Final Exam

**Computer Usage:** Occasional use of *Matlab*.

**Laboratory Experiences:** None

**Design Experiences:** ~15% of the homework. Some homework problems are design-oriented problems.  
~15% problems in the Exams are design related.

**Independent Learning Experiences:**

1. Homework assignment
2. Occasional use of *Matlab*.
2. Testing (Quizzes, Exams)

**Contribution to the Professional Component:** 1. College-level mathematics and basic sciences: 0.5 credit hours  
2. Engineering Topics (Science and/or Design): 2.5 credit hours  
3. General Education: 0 credit hours  
Total credits: 3

**Prepared by:** P. Sannuti and K. Sheng

**Date:** June 2011