Course Catalog Description: 14:332:411 Electrical Energy Conversion (3)
Principles of magnetic circuit concepts, transformers, DC machines, synchronous machines, induction machines, special purpose machines

Pre-Requisite Courses: 14:332:222

Co-Requisite Courses: None

Pre-Requisite by Topic: 1. Electrical circuit theory
2. Basic electromagnetic theory


Overall Educational Objective: 1. To introduce the principle of converting electrical energy to mechanical energy and vise 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.

Course Learning Outcomes: 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 vise 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.

How Course Outcomes are Assessed:
1. Mid-Term Exams (50 %)
2. Final Exam (50 %)
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

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