ECGR6090/8060 Design of Renewable Energy Electromagnetic Devices

Course Description

This course will introduce students to the modern and classical methods used by engineers to design renewable energy electromagnetic devices, specifically electromagnetic machines. The course will be separated into two main sections. The first section of the course will review electromagnetic field theory and introduce the theory behind the finite element method. The second section will review the theory behind magnetic circuit modeling of electric machines. The emphasis will be placed on permanent magnet and induction machine design.

Course Lecturer

Jonathan Bird
Tel: 704-687-8595   Email: j.bird@uncc.edu
Office Hours: Wednesday 2-4pm, or just stop by

Lecture Room: Woodward 120
Lecture Time: Monday and Wednesday, 2:00-3:15pm
Office: WH-210F

Teaching Assistant's Office Hours

No teaching assistant

Recommended Course Prerequisite

ECGR 4143 Electric Machines
ECGR 3121 Introduction to Electromagnetic Fields
ECGR 3183. Computer Organization and Programming Languages (programming skills)

Course Textbook

Boldea I. *Variable Speed Generators*, CRC Press, 2005

Gieras J. F., *Permanent Magnet Motor Technology Design and Applications*, 3rd Edition, CRC Press 2010.

Krishnan R., *Permanent Magnet Synchronous and Brushless DC Motor Drives*, CRC Press 2010

Sadiku M. N. O. *Numerical Techniques in Electromagnetics,* 2nd Edition, 2001 CRC Press

Bastos J. P. A., Sadowski N. *Electromagnetic Modeling by Finite Element Methods*, Marcel Dekker, 2003

Tomczuk B. Z . *Linear Synchronous Motors, Transportation and Automation Systems*, 2nd Ed., CRC Press 2011

All books available free from: http://www.crcnetbase.com/page/engineering_ebooks

Class Topics

• Field Modeling Methods for Electromagnetic Devices
 ▪ Classification of PDE's, Boundary conditions,
 ▪ Review of electromagnetic theory: magnetostatics, quasi statics, magnetic scalar potential, magnetic charge
 ▪ Variational Method: calculus of variations, solving variational problems, PDE's expressed as a variational problem, Ritz's method, weighted-residual methods, point-collocation method, least-squared method, Galerkin method.
 ▪ Finite Element Method: illustrated example, shape functions, step-by-step solution procedure
• Magnetic Circuit Based Modeling of Electromagnetic Devices
 ▪ Permanent magnet material
 ▪ Modeling using permanent magnet material, analytic approach, graphical approach
 ▪ PM rotor types
 ▪ Hybrid PM machines
 ▪ Double Fed Induction Generators
 ▪ Winding of machines
 ▪ Carter's coefficient
 ▪ Eddy current loss in conductors
 ▪ Core loss

Grading

The final grade will be determined as follows:

Homework	40%
Projects	50%
Presentations	10%