ECE 3300: Electrical Machinery
Required Course

2006-2007 Catalog Data: Three-phase analysis. Analysis and design of transformers, electromechanical devices, and machines.
Credit: 4 hours (3 hours lecture, 3 hours laboratory).
Prerequisites: ECE 3100 and ECE 3610.

Textbook(s) and/or Required Materials:
1. P. C. Sen, Principles of *Electrical Machinery and Power Electronics*, 2nd edition, John Wiley & Sons, Inc., 1997.
2. Kelemen, J. A., 2003. *ECE 3300 Laboratory Manual*, 2nd ed., WMU IEEE Student Branch.
3. Scientific calculator.

Recommended Materials:
1. Digital multimeter, 0-500V, 0-10A, DC and AC.

Reference Materials:
1. Fitzgerald, Kingsley and Umans, *Electrical machinery, 6th* ed., McGraw-Hill, New York, 2003.
2. Say, *Alternating Current Machines*, 5th ed., Halstead Press, John Wiley & Sons, Inc., 1983.

Course Coordinator: Joseph A. Kelemen, Associate Professor, ECE

Instructor (Fall 2006): Joseph A. Kelemen, Associate Professor, ECE

Prerequisites by Topic:
1. Differential equations.
2. Network analysis.
3. Fourier series.
4. Electric and magnetic fields.
5. Technical report preparation.

Course Objectives: (ABET Learning Outcomes[1])

ABET learning outcomes assigned to this course by ECE assessment plan: b and g.

1. to analyze, construct and test steady-state AC single and three-phase circuits. Compare predicted vs. measured values of voltages, currents and power and determine measurement uncertainties (a, b, e);
2. to analyze, test and develop a steady-state AC model for magnetic hysteresis and eddy current effects (a, b, e);
3. to use nameplate data, determine and apply necessary tests, and use test data to develop a 60 Hz circuit model for a commercial power transformer (a, b, e, k);
4. to analyze, design and test a bank of single-phase transformers to supply an unbalanced three-phase load (a, b, c, e);
5. to analyze, test and develop a coupled circuits model for a transformer (a, b, e);
6. to design, test and analyze data for a single-phase transformer (a, b, c, e, k);
7. to test, analyze data and develop non-linear models for DC machines (a, b, e);
8. to test a three-phase squirrel cage induction motor and use data to develop a classical circuit model. Use the model and Mathcad to predict motor performance for speeds from zero to synchronous (a, b, e, k);
9. to test a synchronous generator and use the data to develop a linear and non-linear circuit model (a, b, e, k).

1. The relevant ABET learning outcomes a-k, are included in parenthesis.
2. Refer to ECE 3300 "Course Report" F2006, and "Course Report" for S-2007.

ECE 3300 (Cont.)

Topics:

1. Steady-state AC circuit analysis (2 classes)
2. Three-phase circuits, balanced and unbalanced wyes and deltas (5 classes)
3. DC and AC magnetic fields, circuits and materials (6 classes)
4. Transformers, single-phase, auto and three-phase (6 classes)
5. Principles of electromechanical energy conversion (6 classes)
6. DC machines (6 classes)
7. Induction motors (5 classes)
8. Synchronous machines, cylindrical rotor (4 classes)

Evaluation:

1. Examinations (68%) 2. Laboratory (25%) 3. Homework (7%)

Laboratory Projects and Learning Outcomes[1]:

1. Laboratory Safety and Equipment Familiarization (1 week)
2. Balanced and unbalanced three-phase loads (2 weeks)
3. AC magnetics, Faraday's and Ampere's Laws (1 week)
4. Transformer open and short-circuit tests (1 week)
5. Three-phase transformer and load (1 week)
6. Coupled magnetic circuits (1 week)
7. Power quality, magnetic saturation (1 week)
8. DC generators (2 weeks)
9. DC motor (1 week)
10. Three-phase induction motor tests (1 week)
11. Three-phase synchronous generator tests (1 week).

Computer Usage:

Students are encouraged to use mathematics software packages for homework and laboratory assignments. MATHCAD is required for Fourier analysis, induction motor modeling with performance predictions and word processor is required for reports.

Contribution to Professional Component:

ABET professional component content as estimated by faculty member who prepared this course description:

Engineering Design: 1 credit or 25%
Engineering Science: 3 credits or 75%

Relation of Course to Program Outcomes:

This course provides significant support for:

EE and CE program objectives depth and professionalism
ECE expected learning outcomes: b and g,

Person who prepared this description and date of preparation:

Prepared by: Joseph A. Kelemen Date: 9 January 2007

[1] Student activity in the laboratory includes the ABET learning outcomes a, b, c, d, e, g, i and k. Laboratory experiments three through eleven require written reports from each student.