Develop a fundamental understanding of AC machine design to effectively utilize the knowledge in your electric machine design and specification related job duties.

**AC Machine Design Fundamentals**

April 21–23, 2015
Madison, Wisconsin

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Gain a solid introduction to AC electric machine design

Acquire practical calculations needed for machine design

Learn with a building-block approach starting with basic fundamentals

AC Machine Design Fundamentals

April 21–23, 2015
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Please share this brochure with colleagues who may benefit from attending this course.

ENROLL ONLINE TODAY!
Or visit our website.
Advance Your Knowledge

The knowledge and practice of AC electrical machine design is one of the most important critical skill sets for developing competitive electric motors and generators for many applications including industrial applications, electric vehicles, appliances, aerospace, and naval applications.

In this intense three-day introductory course, our experienced academic and industry instructors will help you gain critical knowledge needed for new products or refining existing design. This includes terminology, simple design, and analysis fundamentals.

Who Should Attend

Engineers involved in the design, specification, and integration of components and systems that require an understanding of AC machine design.

Essential information for:
- Electrical engineers
- Mechanical design engineers
- System engineers
- Project engineers
- System integrators
- Program managers
- Technical leaders

Please note: This course will stress fundamentals while highlighting recent developments in AC electric machine design. Attendees should have a bachelor’s degree in engineering or a related science or the equivalent amount of industrial experience.

Achieve Valuable Objectives

This course will make you more effective in your engineering work by helping you achieve:
- The basics of electromagnetic laws applicable to machine design
- Magnetic circuit calculations
- The definition and usage of permeance, reluctance, MMF, and inductances
- Different types of winding designs including concentrated and distributed windings
- Terminology such as winding factors, distribution factors, Carter coefficient, pitch factor
- Fundamentals of loss mechanisms—copper, core, and windage losses
- Mechanical design, vibration, noise, and thermal analysis
- Practical calculations for machine design
- Analytical design techniques
- Finite element analysis with examples

Your Instructors

Dan M. Ionel, PhD, FIEEE, chief engineer, Regal Beloit Corp., and visiting professor of the University of Wisconsin–Milwaukee. Ionel has worked in industrial R&D for Fortune 1000 and FTSE 100 Companies in the US and the UK. His experience includes electric machines and drives with power ratings between 0.002 hp and 10,000 hp.

Thomas M. Jahns, PhD, Grainger Professor of Power Electronics and Electrical Machines, Department of Electrical and Computer Engineering, University of Wisconsin–Madison. Before UW, Jahns spent 15 years with GE Corporate R&D and MIT where he researched electric machines, drive system analysis and control, power electronics integration, and renewable energy.

Robert D. Lorenz, PhD, Mead Witter Foundation, Consolidated Papers Professor of Controls Engineering, Department of Mechanical Engineering, University of Wisconsin–Madison. Lorenz spent 10 years with Gleason Works, Rochester, New York, where he was R&D staff group leader in precision motion control, power control, and integrated sensing. His research interests include high-precision and high-performance real-time controls and advanced integration of control and self-sensing in electrical machines, power converters, and drive system applications.

Donald W. Novotny, PhD, professor emeritus, Department of Electrical and Computer Engineering, University of Wisconsin–Madison. Novotny has been a visiting professor at the Eindhoven Technical University in the Netherlands and a Fulbright lecturer at the State University of Ghent, Belgium. His research interests include variable frequency inverter drive systems and the control of AC machines.

Bulent Sarlioglu, PhD, assistant professor, University of Wisconsin–Madison, and associate director, Wisconsin Electric Machines and Power Electronics Consortium (WEMPEC). Sarlioglu spent 11 years at Honeywell International Inc’s aerospace division, most recently as a staff systems engineer, earning Honeywell’s technical achievement award in 2003 and an outstanding engineer award in 2011. He is the inventor or co-inventor of 16 US patents and many other international patents.

Darren Tremelling, PhD, is with ABB Corporate Research in Raleigh, North Carolina. Tremelling received his PhD from the University of Wisconsin–Madison.
Course Outline

Introduction to AC Machine Design
- Induction, PM, synchronous reluctance, switched reluctance

Sizing Laws
- The influence of size

Power Sizing Equations
- Electric loading
- Magnetic loading
- Shear stress

Winding Types
- Full pitch and fractional windings
- Fractional pitch windings
- Distributed and concentrated windings
- Fractional slot windings

Magnetic Circuits
- Permeance and reluctance
- Multiple circuit paths
- Magnetic circuits with airgaps

Electric and Magnetic Materials
- Permanent magnet types
- Copper and aluminum
- Steel types
- Skin depth

Main Flux Path Calculations Using Magnetic Circuits
- Main magnetic circuit of an induction machine
- Effective gap and Carter’s coefficient
- Effective length
- Reluctance calculations

Leakage Reactance Calculations
- Slot leakage inductance
- Zigzag and differential leakage inductance
- Skew leakage inductance
- End turn leakage inductance

Calculation of Machine Losses
- Eddy current and hysteresis losses
- Friction and windage losses
- Copper losses

Testing and Parameter Characterization

Thermal Analysis and Cooling Systems
- Conduction, convection, and radiation
- FEA, CFD, lumped-parameters equivalent-networks
- Fan ventilation, liquid cooling

Manufacturing Topics
- Laminations, cores, windings, frames, assemblies
- Material and manufacturing tolerances

Vibrations and Noise
- Electromagnetic forces; harmonic components
- Mechanism of transmission
- Mitigation measures

Machine Design Examples
“Back of the Envelope” Calculations to Automated Optimal Computer Design

Finite Element Analysis
- Fundamentals
- Examples

Special Topics—How to Design Machines for Self-Sensing

Course Schedule

Registration and course will be held at Engineering Hall, Room 1610
1415 Engineering Drive
Madison, WI

Day 1
8:00 a.m. to 8:30 a.m.  Registration
8:30 a.m. to 5:00 p.m.  Class

Day 2
8:00 a.m. to 5:00 p.m.  Class

Day 3
8:00 a.m. to 3:30 p.m.  Class
Midmorning and midafternoon refreshment breaks and noon lunch will be provided all three days.

Earn Your Master’s Degree in Power Electronics While Working Full Time

Earn your UW–Madison Master of Science in Electrical and Computer Engineering (Power Electronics) degree without traveling to campus. This world-class program, delivered at a distance via online pre-recorded lectures, allows you to complete courses from anywhere and makes it easy for you to follow along with classes on a regular semester schedule.

For more information, call Marty Gustafson, Program Director at 608-262-8819, email: mseeapply@engr.wisc.edu or visit distancedegrees.engr.wisc.edu/MSEE.

Wisconsin Electric Machines and Power Electronics Consortium (WEMPEC)

WEMPEC is a consortium of more than 80 sponsoring companies and organizations that supports pre-competitive research in the fields of electric machines, power electronics, controls, and their applications. The consortium organizes seminars, campus technology roadmapping visits, student internships, and an annual review meeting to maximize interaction between students, faculty, and sponsors.

For more information contact:
Professor Robert D. Lorenz
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lorenz@engr.wisc.edu
or
Professor Thomas M. Jahns
608-262-5702
jahns@engr.wisc.edu
University of Wisconsin–Madison
College of Engineering
1415 Engineering Drive
Madison, WI  53706

www.wempec.wisc.edu

Earn Continuing Education Credit

By participating in this course, you will earn 20 Professional Development Hours (PDH) or 2.0 Continuing Education Units (CEU).
Four Easy Ways to Enroll

Internet: epd.engr.wisc.edu/webP725
Phone: 800-462-0876 or 608-262-1299 (TDD 265-2370)
Mail to: The Pyle Center
          Attn: Engineering Registration
          702 Langdon Street
          Madison, Wisconsin 53706
Fax: 800-442-4214 or 608-265-3448

Course Information
Please enroll me in AC Machine Design Fundamentals

☑ Course #P725 April 21–23, 2015 in Madison, Wisconsin
  Fee: $1595
☑ Course #P725 April 21–23, 2015 in Madison, Wisconsin
  WEMPEC Member Fee: $1395
☑ I cannot attend at this time. Please send me brochures for courses.

Personal Information (Please print clearly.)

Name __________________________________________________________
Title __________________________________________________________
Company ______________________________________________________
Address _______________________________________________________
City/State/Zip _________________________________________________
Phone (_______) __________________________ Fax (_______) _______
E-mail _________________________________________________________

Additional Enrollees

Name __________________________________________________________
Title __________________________________________________________
E-mail _________________________________________________________

Billing Information

☑ Bill my company ☑ P.O. or check enclosed (Payable in U.S. funds to UW-Madison)
☑ Card Type: ❑ MasterCard ❑ Visa ❑ American Express
Cardholder’s Name _____________________________________________
WU# ____________________ Exp __________
UW# ____________________ Exp __________

Other Course Opportunities

The Department of Engineering Professional Development conducts a variety of courses that provide current, practical information and approaches. Other courses in the power electronics and electrical machinery series include:

• Introduction to Power Electronics
• Design of Magnetic Components for Power Electronic Circuits
• Permanent Magnet Machines and Drives: Principles, Design, and Applications
• Dynamics and Control of AC Drives
• Introduction to Electrical Energy Storage Devices and Systems
• Introduction to Electric Machines and Drives
• Introduction to EMI/EMC and Best Practices
• PM Machine Boot Camp—Internal PM, Surface PM, and Brushless DC

We also have the following courses available for on-site education:

• Introduction to Power Electronics
• Introduction to Electrical Machines and Drives
• Electromagnetic and Electromechanical Engineering Principles

For information about these courses or to make a suggestion for a course we do not presently offer, call Bulent Sarlioglu, PhD, at 800-462-0876 or email: bulent@engr.wisc.edu

Need to Know More?

Call toll free 800-462-0876 and ask for

Program Director:
Bulent Sarlioglu, PhD, Assistant Professor
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608-262-2703

Program Associate:
Debbie Benell
benell@engr.wisc.edu
608-263-7428

General Information

Fee Covers Notebook, course materials, break refreshments, lunches, certificate, and continuing education credits (PDH/CEU).

Cancellation Policy If you cannot attend please notify us at least seven days prior to the course start, and we will refund your fee. Cancellations received after that date and no-shows are subject to a $150 administrative fee per course. You may enroll a substitute at any time before the course starts.

Location This course will be held at Engineering Hall (Room 1610), 1415 Engineering Drive, Madison, WI. Phone messages: 608-263-3163.

Accommodations We have reserved a block of guest rooms (rates starting at $130, including parking) at The Wisconsin Union Hotel, 1308 West Dayton Street, Madison, WI. Reserve a room online at epd.engr.wisc.edu/lodgingP725 or call 608-263-2600 and indicate that you will be attending this course under group code MACHINE. Room requests after March 20 will be subject to availability. Other fees and restrictions may apply.

We have reserved a second block of guest rooms (rates starting at $139) at HotelRED, 1501 Monroe Street, Madison, WI. To reserve a room call 608-819-8228 and indicate that you will be attending this course under group code AC Machine Design P725. Room requests after March 21 will be subject to availability. Other fees and restrictions may apply.