MILWAUKEE SCHOOL OF ENGINEERING®

FLUID POWER AND MOTION CONTROL PROFESSIONAL EDUCATION SEMINARS

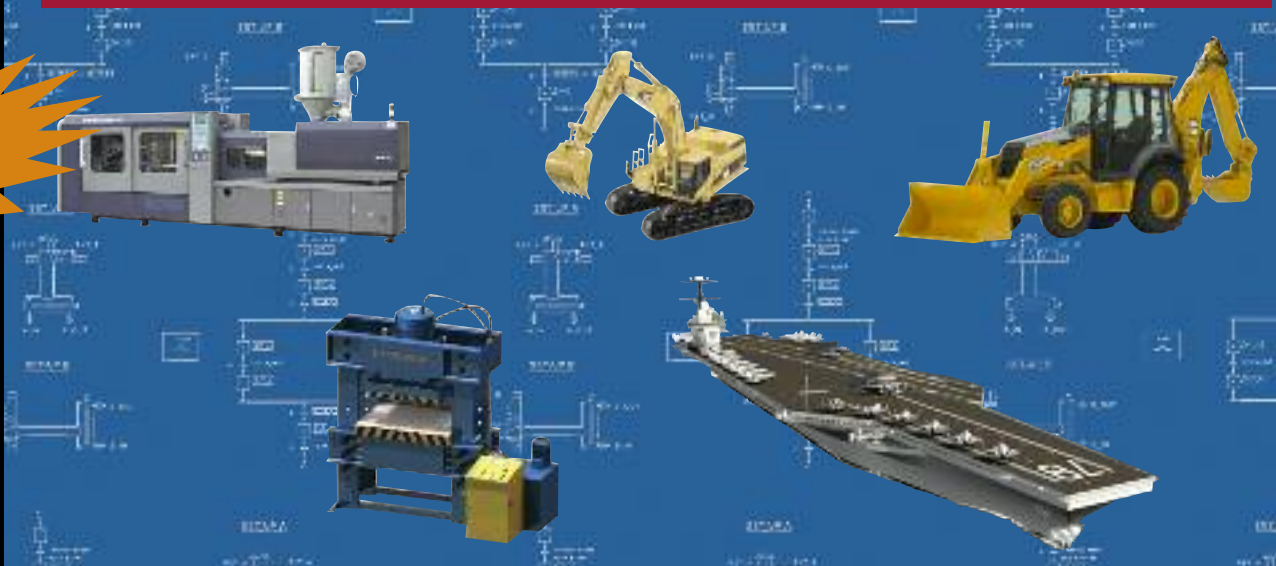
2014

Register online at www.msoe.edu/seminars

- Introduction to Hydraulics
- Electro-Hydraulic Components and Systems
- Service and Operation for Improved Hydraulic Systems Reliability
- Hydraulic Specialist Certification Review
- Hydraulic Systems Modeling and Simulation for Applications Engineers

State-of-the-Art Training Equipment!

Save with Early and Multiple Registration



You will learn fluid power and motion control technology, brand non-biased, using state-of-the-art training hardware and simulation software

PROFESSIONAL EDUCATION

MSOE seminars offer participants the opportunity to explore technological developments and current applications and techniques. The programs are designed to keep practicing engineers abreast of new developments and applications, and also to provide a basic understanding of the technology to new entrants into the field.

On-site seminars:

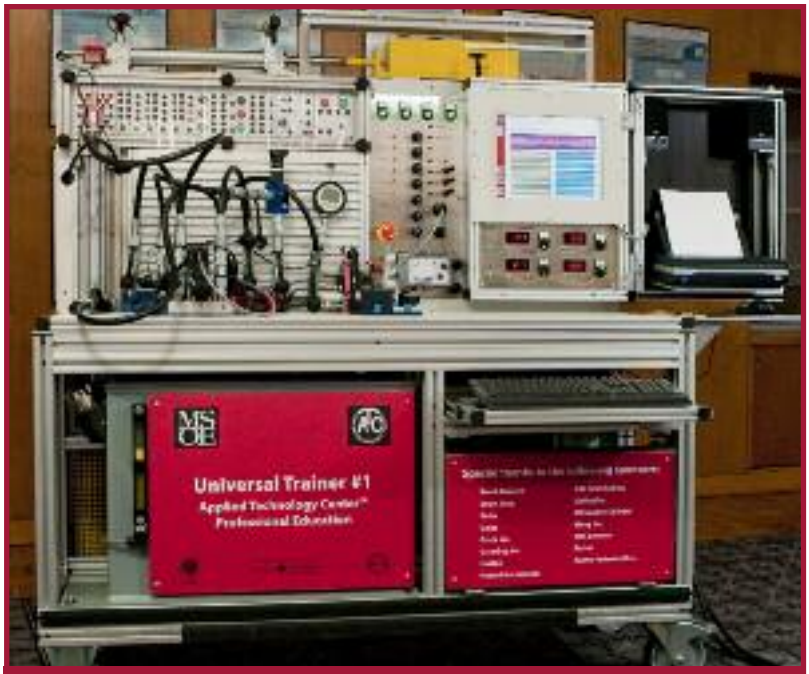
MSOE seminars are available for an on-site presentation at your company. The curriculum may be presented in its original format or be **modified to meet your specific needs.** Confidentiality protected! For more information, contact Dr. Medhat Khalil at (414) 277-7269 or khalil@msoe.edu.

MSOE seminars:

- are based on applied research conducted by scholars.
- use state-of-the-art laboratories with industrial-size equipment.
- use a hands-on approach to reinforce the concepts presented in class.
- are applications-oriented and often customized to the industry or companies of the seminar participants.
- are offered on the basis of strong long-term partnerships, with set objectives and outcomes.

MSOE's seminars are unique in the industry because:

- seminar instructors are experts in their fields, including certified fluid power specialists, Professional Engineers and Ph.D.s.
- attendees are exposed to the latest fluid power research and industry projects being worked on at the Fluid Power Institute™.
- the professional education seminars use the latest software versions of MATLAB®/Simulink® and Automation Studio in the advanced courses.
- attendees can network and build professional relationships while benefitting from training, research and industrial projects.



The Universal Fluid Power Trainer was recently redesigned and developed by MSOE to help mobilize the advanced courses to the customer site.

Universal Fluid Power Trainer

Four identical state-of-the-art fluid power and motion control training units have been developed and recently developed. The machines are universal, transportable, compact and are designed to be used for professional education programs at the customer's site. The prototype design was funded by CCEFP-ERC, and has been engineered to:

- cover a variety of disciplines, including hydraulics, electro-hydraulic, pneumatic, electro-pneumatic and electro-mechanical.
- include controlled parameters: position (linear and rotary), speed (linear and rotary), pressure, force and torque.
- include a controlled axis (linear and rotary) for each discipline.
- include controlled parameters: position (linear – angular), flow (linear – angular) and pressure, force and torque.
- feature state-of-the-art software, HMI loaded with MATLAB®/Simulink®, Automation Studio and custom-made software.
- feature a hydraulic power supply and a variable displacement pump with a flexible and interactive pump control mode of the user's choice.
- include a manual and automated setting of the maximum working pressure and/or flow rate.
- deliver safety warnings in case of oil overheating, cavitation, low oil level or filter clogging.
- feature an automated sub-systems test wizard.
- feature smart and interactive maintenance and troubleshooting test wizards.

For more information:
Dr. Medhat K. Bahr Khalil
Director of Professional Education & Research Development
www.msoe.edu/seminars
Tel: (414) 277-7269 • Cell: (414) 940-2232
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Welcome

The incredible capabilities of software and digital computation are redefining the applications of fluid power and motion control. Major improvements in performance are possible through excellent virtual system prototyping, which leads to reliable system design and manufactured products.

MSOE offers short courses and certificate education that improve the knowledge and capabilities of engineers to effectively use these new tools. Authentic hands-on laboratory experiments using the redesigned, versatile Universal Trainer reinforce theory and simulations. These are supplemented with excellent notes and lectures involving animation plus interactive questions and professional discussion. The very active applied research programs in MSOE's Fluid Power Institute™, plus MSOE's renowned academic programs and faculty, form the basis for excellence! The academic environment ensures true education independent of specific manufacturers. Advanced fluid power research in the United States is being conducted through the National Science Foundation and fluid power industry-sponsored Engineering Research Center for Compact and Efficient Fluid Power, led by a consortium of universities of which MSOE is a member. Learn more about it online at www.fperc.org.

Help others learn about these unique seminars at MSOE. I look forward to having you visit the exciting, expanding MSOE campus.

Tom Bray
Dean of Applied Research

Tom Bray
Dean of Applied Research

MSOE: A UNIVERSITY THAT WORKS

At Milwaukee School of Engineering®, theory is brought to life and reinforced for students through extensive integration of laboratory experimentation. Understanding theoretical concepts and knowing how to apply them is key to the success of MSOE graduates. Established in 1903, MSOE has enjoyed a long history of interdependence with business and industry. Industrial support in the form of scholarships, laboratories and facilities, and involvement and counsel enables MSOE to provide educational solutions and graduates to meet industry needs. MSOE is a close-knit university nestled within a vibrant downtown neighborhood. The 20-acre, user-friendly campus is located in a historic district downtown, just blocks from beautiful Lake Michigan.

MSOE APPLIED TECHNOLOGY CENTER™

The Applied Technology Center™ (ATC) is the research arm of MSOE. It serves as a technology transfer catalyst among academia, business, industry and governmental agencies. The close association between MSOE and the business, and industrial community has long been one of its strengths; applied research serves as a renewable resource in this linkage. In addition to the Fluid Power Institute (FPI) and professional education, the ATC is organized into several "centers of excellence:"

NATIONAL FLUID POWER ASSOCIATION NFPA MEMBER

- Rapid Prototyping Center (RPC)
- NanoEngineering Lab
- Construction Science and Engineering Center
- Photonics and Applied Optics Center
- Center for BioMolecular Modeling (CBM)
- Midwest Energy Research Consortium (MWERC)

For more information: www.msoe.edu/research

ELECTRO-HYDRAULIC MOTION CONTROL LABORATORY

MSOE's fluid power seminars merge classroom theory with intense, practical laboratory sessions. The state-of-the-art laboratory contains four advanced workstations, each specifically designed for the individual interested in gaining a detailed and thorough understanding of all aspects of fluid power, including electrohydraulic system design. Seminar participants use servo and proportional valves in tests and systems, and make system interconnections. Computers collect data that facilitate the construction and analysis of feedback control systems. This Electrohydraulic Motion Control Laboratory is not found at any other educational institution in the world.

FLUID POWER INSTITUTE™

FPI™ at MSOE

The FPI at MSOE is one of the leading academic fluid power research laboratories in the nation. Established in 1962, FPI is a leader in motion control and fluid power education research and evaluation.

Test and Evaluation Programs

FPI conducts testing and evaluation for some of the largest hydraulic companies in the world, including Caterpillar, John Deere, Husco, and Parker Hannifin, as well as system evaluation for the U.S. military. The institute has specialized equipment for pump, valve, motor, cylinder and filter testing. FPI has specialized equipment for most hydraulic component evaluations and has the capacity to operate a wide variety of hydraulic components under a wide range of pressure and flow conditions. It also has the instrumentation and expertise to safely control and monitor endurance tests 24 hours a day seven days a week. Tests can be conducted in accordance with appropriate NFPA, ANSI, SAE, ISO and MIL standards.

Laboratory Capabilities

- Test Cell 1: 150HP, 65 gpm, 5,000 psi
- Test Cell 2: 450HP, 120 gpm, 6,500 psi
- Test Cell 3: 200HP, 65 gpm, 5,500 psi
- Test Cell 4: 100HP, 13.5 gpm, 15,000 psi
- Test Cells 5 and 6: 50HP, 8 gpm, 10,000 psi
- Test Cell 7: 200HP hydraulic motion testing
- 60,000 psi static burst pressure chamber
- 1,000 psi filter center tube collapse chamber

Engineering Services

The key to developing a reliable, available and maintainable fluid power system is to make it an integral part of the engineering process, and to eliminate failures and failure modes through identification, classification, analysis and removal or mitigation. When developing fluid power systems, it is imperative to select the right activities and to conduct those activities at the right time. The engineering faculty and staff at FPI are experts in fluid power, and can help you develop highly reliable, available and maintainable fluid power systems and components. We can assist in developing your fluid power application from a simple design to an efficient and reliable hydraulic or pneumatic system.

200 HP dynamometer with electrical regeneration capabilities used for testing energy efficient fluids.

Tribology Services

The FPI has been a leader in contamination analysis and filtration technology for decades. In the 1980s, FPI pioneered the use of automatic particle counters in hydraulic fluid analysis. In the 1990s, FPI pioneered the development of surgically clean fluids for initial-fill applications. In the 2000s, FPI was the very first to use Atomic Force Microscopy in wear particle analysis. FPI's role as a practitioner and educator in these areas has truly advanced the fluid power industry. Our current research thrust incorporates the study and formulation of energy-efficient hydraulic fluids–an endeavor funded by a grant from the National Science Foundation and industry partners.

Many of the world's largest equipment manufacturers use FPI to test new hoses, tubes, cylinders, coolers, reservoirs, pumps, bearings and valve assemblies to determine the type and size of manufacturing contamination, left in the component as received by the customer. Through the use of advanced diagnostic methods such as ferrography, atomic force microscopy, stereomicroscopy and laser particle imaging, early detection and root-cause analysis are possible.

For more information, visit www.msoe.edu/fpi.

INTRODUCTION TO HYDRAULICS

This 27-hour seminar is designed to acquaint individuals with the fluid power field and provide a practical working knowledge of this important and growing industry. This program features laboratory sessions where participants will gain practical experience working with actual fluid power components and systems. Specifically, laboratory sessions will treat the disassembly, inspection and assembly of individual components, as well as system design examples.

Who Should Attend?

This program is intended for individuals with limited exposure to fluid power, including engineers, technical sales personnel, technicians and management personnel.

Objectives

Upon completion, participants should be able to:

- identify the distinguishing features of hydraulic systems.
- recognize hydraulic components by symbols and read schematics based on ISO standards.
- analyze hydraulic circuits from a schematic drawing using animated schematics modeled by Automation Studio.
- explain the operation and applications of pumps, motors, valves, cylinders, rotary actuators and accumulators.
- utilize continuity and energy balance equations.
- understand the basic configuration and operation of hydrostatic transmissions.

Laboratory Sessions

Participants will have an opportunity to build hydraulic circuits and analyze data on state-of-the-art hydraulic trainers.

Topical Outline

- Hydraulic systems overview.
- Basic concepts review.
- Hydraulic pumps and motors.
- Hydraulic valves overview.
- Hydraulic accumulators.
- Hydraulic circuits for basic applications.

"This seminar will help me in the future with customers and help with troubleshooting."

Aaron Schaefer
KTI Hydraulics Engineering

Save with Early and Multiple Registration

Introduction to Hydraulics

Dates
I. Jan. 6-10, 2014
II. May 5-9, 2014
III. Nov. 17-21, 2014

Standard Fee $2,240

Early Registration Fee $2,040
I. By Dec. 6, 2013
II. By April 5, 2014
III. By Oct. 16, 2014

Fee for Multiple Registrants From the Same Company $1,840

CEUs 2.7

Instructor
Dr. Medhat Khalil

Program
Day 1 Session 9 a.m. - 4 p.m.
Lunch Reception Noon - 1 p.m.

Day 2-4 Sessions 9 a.m. - 4 p.m.
Lunch on your own Noon - 1 p.m.

Day 5 Session 9 a.m. - Noon
Box Lunch provided

Continental breakfast served daily.
Beverages/snacks provided throughout the day.

Location
MSOE
Milwaukee

ELECTRO-HYDRAULIC COMPONENTS AND SYSTEMS

This 27-hour seminar is designed to cover the knowledge of electro-hydraulic components including solenoid operated valves, proportional valves, servo valves and amplifiers. The seminar also covers the technicalities of in-field tuning of open-loop and closed-loop electro-hydraulic systems. The state-of-the-art Universal Fluid Power Trainers are used to demonstrate the theory presented.

Who Should Attend?

Application engineers, system integrators, motion control engineers, sales engineers, field engineers and end users of electrohydraulic components.

Objectives

Upon completion, participants should be able to:

- recognize the difference in construction, principle of operation and characteristics between ON/OFF valves, proportional valves and servo valves.
- apply real-time control technique for EH systems and perform in-field tuning to adjust the system performance.
- read the basic electronic schematics of the proportional/servo valve amplifiers.
- make the best selection of the components required to build open- and closed-loop electro-hydraulic control systems.

Laboratory Sessions

- Circuits for on/off valve operation.
- Electro-hydraulic pump controls.
- Electro-hydraulic cylinder position control.
- Electro-hydraulic motor speed control.
- Proportional and servo valve characteristics measurement

Topical Outline

- Hydro-mechanical vs. electro-hydraulic solutions.
- Electro-hydraulic system application.
- Switching valves—construction and operation.
- Switching valves—circuits for basic functions.
- Proportional valves
- Servo valves.
- Valve selection for an electro-hydraulic controlled actuator.
- Electro-hydraulic system design considerations.
- Control electronics for electro-hydraulic systems.
- Electro-hydraulic valves commissioning and maintenance.

"I have better knowledge of valve structures, various valve type responses and how they are controlled, and how the valve structures work."

Class Participant

Save with Early and Multiple Registration

Electro-Hydraulic Components and Systems

Dates
Jan. 27-31, 2014

Standard Fee $2,240

Early Registration Fee $2,040
By Dec. 27, 2013

Fee for Multiple Registrants From the Same Company $1,840

CEUs 2.7

Instructor
Dr. Medhat Khalil

Program

Day 1 Session	9 a.m. - 4 p.m.
Lunch Reception	Noon - 1 p.m.
Day 2-4 Sessions	9 a.m. - 4 p.m.
Lunch on your own	Noon - 1 p.m.
Day 5 Session	9 a.m. - noon
Box Lunch provided	

Continental breakfast served daily.
Beverages/snacks provided throughout the day.

Location
MSOE
Milwaukee

SERVICE AND OPERATION FOR IMPROVED HYDRAULIC SYSTEMS RELIABILITY

This 27-hour seminar focuses on the topics that must be considered to maximize hydraulic system reliability. The introduced topics can be broadly classified as service-related and operational-related. In the service topics, maintenance, troubleshooting and failure analysis techniques will be discussed. In the operational-related topics, hydraulic fluids, contamination control and filtration technology will be discussed.

Prerequisites

A fundamental understanding of hydraulics systems and components is necessary. MSOE's Introduction to Hydraulics seminar is an excellent preparation.

Who Should Attend?

Filtration, maintenance and design engineers; fluid power sales professionals; multi-craft maintenance personnel; millwrights; pipe fitters, plumbers; mechanics; machinery maintenance mechanics and electromechanical repair technicians. If you're responsible for the ongoing operation of a fluid-power system, or if you manage or train workers who are, this seminar can show you what you need to know to keep the systems up and running.

"I gained a better understanding of cavitation and the difference in oil and the additives."

Troy Davis
Charter Steel

Objectives

Upon completion, participants should be able to:

- identify appropriate hydraulic fluids for given applications.
- extract fluid samples from operating hydraulic systems for fluid sample analysis.
- interpret the results of a fluid sample analysis.
- explain the effects of contaminants on hydraulic systems.
- evaluate the differences of filter ratings and specifications.
- select an appropriate filter for specific applications.
- understand cost-effective filtration.
- plan and schedule hydraulic system maintenance.
- significantly reduce the system leakage through a better handling and understanding of hydraulic systems seals and conductors.
- utilize a logical approach for hydraulic systems troubleshooting.
- identify hydraulic system failure and the approach to solve it.

Topical Outline

- Hydraulic system safety.
- Hydraulic fluids.
- Hydraulic fluid seals.
- Filtration technology and contamination control.
- Basic concepts of hydraulic system maintenance.
- Hydraulic conductors.
- Hydraulic reservoirs.
- Hydraulic heat exchangers.
- Hydraulic measuring instrument.
- Maintenance of hydraulic cylinders.
- Maintenance of hydraulic pumps and motors.
- Maintenance of hydraulic valves
- Maintenance of hydraulic accumulators.
- Hydraulic components failure analysis.
- Hydraulic system troubleshooting.

Service and Operation for Improved Hydraulic Systems Reliability

Dates
Feb. 17-21, 2014

Standard Fee $1,920

Early Registration Fee $1,820
By Jan. 17, 2014

Fee for Multiple Registrants From the Same Company $1,720

CEUs 2.7

Instructors
Dr. Medhat Khalil
Paul Michael, CLS
Thomas Wanke, CFPE

Program

Day 1 Session	9 a.m. - 4 p.m.
Lunch provided	Noon - 1 p.m.
Day 2-4 Sessions	9 a.m. - 4 p.m.
Lunch on your own	Noon - 1 p.m.
Day 5 Session	9 a.m. - Noon
Lunch provided	

Continental breakfast served on daily.
Beverages/snacks provided throughout the day.

Location
MSOE
Milwaukee

Save with Early and Multiple Registration

HYDRAULIC SPECIALIST CERTIFICATION REVIEW

Sponsored by the International Fluid Power Society, IFPS, http://www.ifps.org/

What is the IFPS Hydraulic Specialist Certification?

It is a certification granted by IFPS based on passing a three-hour written test provided and proctored by IFPS. For more information, please visit: www.ifps.org/certification/index.htm

Objectives:

It is a three day review session held and provided by MSOE followed by the certification exam on the fourth day. The objective of the course is to provide instructions and review the basics of hydraulics to maximize the chance of passing the exam. It is a non-CEU program, meaning MSOE will not grant credit units or a certificate. Study material is based on the IFPS study guide.

Who should attend?

It is designed for candidates who are involved in hydraulic system sales, design, modeling and supervising system operation.

Topical Outline:

- Job Responsibility 1.0: Apply hydraulic circuits to perform desired tasks.
- Job Responsibility 2.0: Analyze loads and motion.
- Job Responsibility 3.0: Select components for hydraulic applications.
- Job Responsibility 4.0: Prepare bills of material and schematics.
- Job Responsibility 5.0: Recommend fluid, fluid conductors and fluid filtration.
- Job Responsibility 6.0: Analyze and troubleshoot hydraulic systems.

Notes

- Review session and exam can be taken to a customer's site for a minimum of 10 registrants.
- Please consider bringing a pencil, eraser and nonprogrammable scientific calculator. Reference handbook will be distributed.
- Review session fee does not include exam fee. **It is the responsibility of the attendees** to apply for the exam, pay the exam fee at IFPS and obtain study manual no later than two weeks before the review session.
- Register for the exam online at www.ifps.org/certification/index.htm or call (800) 308-6005 x14

Save with Early and Multiple Registration

Hydraulic Specialist Certification Review

Dates
July 8-11, 2014

Standard Fee $840

Early Registration Fee $790
By June 8, 2014

Fee for Multiple Registrants From the Same Company $740

Instructor
Dr. Medhat Khalil

Program

Day 1 Session	9 a.m. - 4 p.m.
Lunch reception	Noon - 1 p.m.
Day 2-3 Sessions	9 a.m. - 4 p.m.
Lunch on your own	Noon - 1 p.m.
Day 4 Session	9 a.m. - Noon
Box lunch provided	(exam day)

Continental breakfast served daily.
Beverages/snacks provided throughout the day.

Location
MSOE
Milwaukee

HYDRAULIC SYSTEMS MODELING AND SIMULATION FOR APPLICATION ENGINEERS

This 27-hour seminar focuses on the technique of building mathematical models with the least amount of design parameters needed. This technique is designed to help application engineers who are responsible for modeling systems at large. The simulation process of a component is based on existing data published by the component manufacturer or subsystem dynamics identified experimentally.

Who Should Attend?

Hydraulic component designers, application engineers, system integrators, electrohydraulic motion control engineers, and end users of fluid power components and systems. Familiarity with Laplace transforms, block diagrams and state space is desirable for portions of the dynamic analysis.

Objectives

Upon completion, participants should be able to:

- evaluate the importance of component sizing and simulation in the design process.
- apply principles of steady state and limited dynamic characteristics in both time domain and frequency domain.
- discuss different modeling approaches and levels for hydraulic components and systems.
- discuss the differences between simulation packages available in the market.
- exercise knowledge using MATLAB®/Simulink® to build mathematical models, define the simulation parameters, run a simulation and analyze the results.

Laboratory Sessions

This seminar involves many laboratory exercises including software simulation. Some of these include component performance capturing experimentally, identify its dynamics, use the identified dynamics in building the component model.

Topical Outline

- Introduction to Physical System Modeling and Simulation.
- Dynamic Systems Modeling, Simulation and Analysis Review.
- Hydraulic Components and Systems Modeling Approaches.
- Fluid Properties Modeling.
- Hydraulic Conductors Modeling.
- Hydraulic Pumps Modeling for Application Engineers.
- Hydraulic Motors Modeling for Application Engineers.
- Hydraulic Cylinders Modeling for Application Engineers.
- Hydraulic Valves Modeling for Application Engineers.
- EH Cylinder Position Control System Modeling.
- EH Motor Speed Control System Modeling.

"This seminar provides several different approaches to modeling hydraulic components."

Steven Gluck
Sauer-Danfoss

Save with Early and Multiple Registration

Hydraulic Systems Modeling and Simulation for Application Engineers

Dates
Dec. 8-12, 2014

Standard Fee $2,240

Early Registration Fee $2,040
By Nov. 8, 2014

Fee for Multiple Registrants From the Same Company $1,840

CEUs 2.7

Instructor
Dr. Medhat Khalil

Program

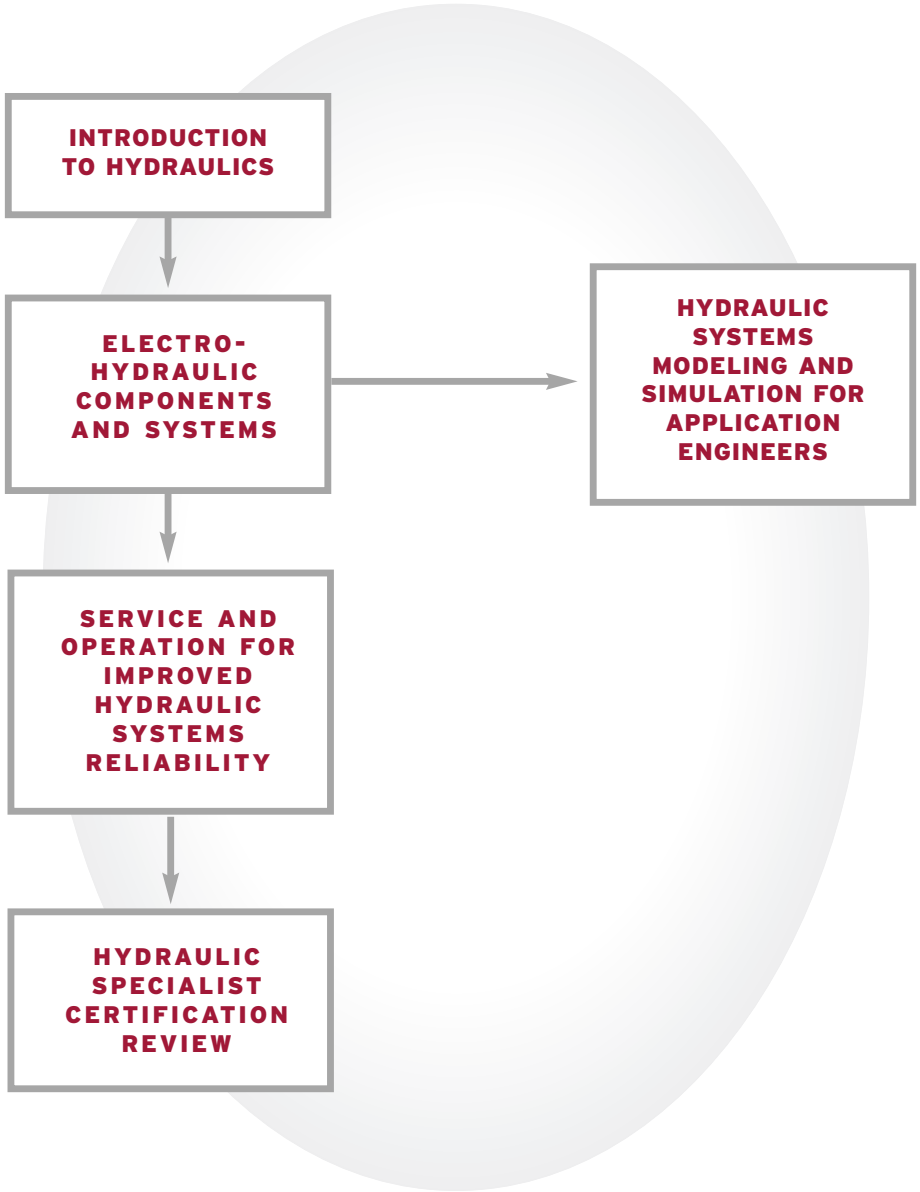
Day 1 Session	9 a.m. - 4 p.m.
Lunch Reception	Noon - 1 p.m.
Day 2-4 Sessions	9 a.m. - 4 p.m.
Lunch on your own	Noon - 1 p.m.
Day 5 Session	9 a.m. - Noon
Box Lunch provided	Noon - 1 p.m.

Continental breakfast served on daily.
Beverages/snacks provided throughout the day.

Location
MSOE
Milwaukee

SEMINAR MATRIX

- The matrix shown here suggests the sequence or paths to follow to master topics in the fluid power field. Depending on your background, career plans and experience, a seminar may be skipped.
- The left path provides a fundamental understanding of fluid power technology that can prepare a person to pass the hydraulic specialist certification exam.
- The right path covers more advanced topics leading up to system design. It requires basic hydraulic knowledge and a higher-level mathematics background.



FACULTY BIOGRAPHIES

Dr. Medhat K. Khalil is the director of professional education. He has a bachelor's degree in mechanical engineering and a master's degree in fluid power engineering from Military Technical College and Cairo University, respectively, of Cairo, Egypt. He earned his Ph.D. in mechanical engineering from Concordia University, Montreal, Canada. Dr. Khalil has completed more than 20 years of experience in fluid power control. Prior to joining MSOE, he was employed as a hydraulic system simulation software developer for CAE Inc. and an adjunct professor for Concordia University, Montreal, Canada. He worked for five years as the technical officer and training manager for Mannesmann Rexroth in Egypt. His current interest is in developing universal fluid power software and hardware controllers. Dr. Khalil is a member of education outreach of the Center for Compact and Efficient Fluid Power, has extensive experience in modeling and simulation of hydraulic systems and designing electro-hydraulic systems. He is a listed consultant by the NFPA. Dr. Khalil was a recipient of the Otto J. Maha Pioneers in Fluid Power Award in 2012. Dr. Khalil has been elected to serve as a board member and Director-at-Large for three years starting in 2014 by the International Fluid Power Society (IFPS).

Paul Michael, C.L.S., is a research chemist in MSOE's Fluid Power Institute. He earned his B.S. in chemistry at the University of Wisconsin-Milwaukee and graduated with distinction from Keller Graduate School of Management. He has more than 30 years of experience in the formulation and testing of hydraulic fluids and lubricants. Paul is an STLE Certified Lubrication Specialist and chairs the NFPA Fluids Committee. In addition to his research in contamination analysis, he is currently investigating energy efficient hydraulic fluids in the NSF funded multi-university Center for Compact and Efficient Fluid Power. Michael was a recipient of the Otto J. Maha Pioneers in Fluid Power Award in 2012.

Thomas Wanke '78,'96, C.F.P.E., is the director of MSOE's Fluid Power Institute, America's leader in fluid power technology research and education. He has more than 40 years of experience in fluid power technology, 38 of which have been at MSOE. Wanke has a bachelor's degree in mechanical engineering technology and a master's degree in engineering with a fluid power specialty option, both from MSOE. He has worked on projects in the following areas: component and system design; development and evaluation; field troubleshooting and failure analysis; and fluids, filtration and contamination control. Wanke is a member of SAE and FPS. He is chairman of the NFPA Technical Board and is Educational Program Co-chairman for IFPE 2014. Tom was a recipient of the MSOE Fluid Power Institute Fluid Power Achievement Award in 2012. He was a recipient of the Otto J. Maha Pioneers in Fluid Power Award in 2011.

Dr. Daniel Williams is a professor in MSOE's Mechanical Engineering department. He earned his bachelor's degree in mechanical engineering from the University of Wisconsin-Platteville and his master's degree and Ph.D. in mechanical engineering from the University of Wisconsin-Madison. Williams has more than 20 years of industry engineering experience. He worked for two years as a design engineer at Snap-On Tools Corporation in Kenosha, Wis. Following graduate studies, Williams worked for 18 years in John Deere's Construction & Forestry Division in Dubuque, Iowa, where he specialized in machine systems simulation–hydraulics, drive train, rigid body dynamics and controls–and control design. Dan has also been a member of the full-time faculty at Loras College in Dubuque, where he taught courses in the electromechanical engineering program for five years.

SEMINAR INFORMATION

How to Register
MSOE offers four convenient ways to register: mail, phone, fax or website. To ensure maximum seminar quality, enrollment is limited. Please note the discount applicable for registering early and for multiple registrations from the same company. Advance registration is required and may be accomplished by:

- **Registering Online at:**
  www.msoe.edu/seminars
- **Mailing Registration Form and Seminar Fee to:**
  Applied Technology Center
  Milwaukee School of Engineering
  1025 North Broadway
  Milwaukee, WI 53202-3109
- **Phone**
  (414) 277-2492 or (800) 332-6763 x2492
- **Faxing Registration Form to:**
  Attn: Professional Education Office
  Fax: (414) 277-7470

Seminar Fee Includes
The seminar fees include a customized seminar manual and/or textbooks, handout materials, daily continental breakfast, break refreshments and lunch reception.

Location and Parking
The Applied Technology Center - Professional Education Office is located in Room S-140 in the Allen-Bradley Hall of Science, 432 E. Kilbourn Avenue. Access the building from the State Street side.

Upon receipt of your registration, you will be mailed a confirmation letter with specific location information. Parking is available on campus in the MSOE Milwaukee Street Lot A on the northwest corner of State and Milwaukee Streets (see map on last page).

Seminar Room S-100
Classroom/lab dedicated for professional education, especially fluid power.

Cancellation Policy
MSOE reserves the right to cancel a seminar if minimum enrollment is not met. Please be informed that payment is due three weeks before the seminar, by credit card or by check. If payment is not received by the due date, your registration is not guaranteed. Cancellations before payment due date will be fully refunded.

Cancellations three weeks before the seminar are subject to a $200 cancellation fee with a refund of the remainder. Cancellations two weeks before the seminar date are subject to a $400 cancellation fee with a refund of the remainder. Cancellations one week before the seminar are subject to a $600 cancellation fee and the remaining funds will be used as a credit towards any future seminar (subject to availability).

Payment
Payment may be made via check (payable to MSOE), MasterCard, VISA, American Express, Discover or by forwarding a purchase order, from which MSOE will invoice. A discount is applicable for each registrant if two or more individuals from the same company register at the same time or for early registration.

Continuing Education Unit
A certificate of participation will be awarded documenting the number of continuing education units (CEUs) earned for participating in the seminar. One CEU is awarded for 10 contact hours. The CEU is a nationally recognized standard unit of measurement awarded for participation in a continuing education experience under responsible sponsorship, defined objective and qualified instruction.

What to Wear
Dress casual and comfortable. Look up Milwaukee weather forecast to plan your trip. www.weather.com, zip code 53202.

What to Bring
Scientific Calculator

Questions?
Phone: (414) 277-2492
Fax: (414) 277-7470
Email: learn@msoe.edu
Website: www.msoe.edu/seminars

Center for Compact and Efficient Fluid Power

The Center for Compact and Efficient Fluid Power (CCEFP) is a National Science Foundation (NSF) Engineering Research Center, funded for a five-year period with $17.5 million from NSF, $3.5 million in membership dues from participating companies, and $3 million from participating universities.

The center is a network of researchers, educators, and industry working together to transform the fluid power industry—how it is studied, applied and taught. Fluid power is used in a wide range of industries, including manufacturing, transportation, aerospace, construction, agriculture and medical devices. Nearly all U.S. manufacturing plants rely on fluid power in their production of goods.

The work of the center will have profound societal impact, bringing dramatic change to fluid power applications now found in a broad spectrum of industries. Examples of innovative technology that will result from CCEFP research include devices that improve mobility for the ailing and elderly, autonomous rescue and service robots and fluid-powered portable hand tools.

Research

The CCEFP has four research goals: to dramatically improve the energy efficiency of fluid power in current applications; to improve the efficiency of transportation by developing fuel efficient hydraulic hybrid vehicles; to develop untethered portable human-scale fluid power devices; and to make fluid power clean, quiet, safe and easy to use. The research needed to realize these goals is being conducted in three coordinated thrust areas and demonstrated in five test beds. Thrust areas include Thrust 1 - Efficiency, Thrust 2 - Compactness, and Thrust 3 - Effectiveness. Center research is demonstrated in three test beds: an excavator, SUV (Small Urban Vehicle) and fluid power-assisted orthoses.

Education

The center's network and research enable the development and delivery of innovative education and outreach programs relevant to fluid power to middle and high school students, undergraduate and graduate students, engineers, industry practitioners, and the general public. Some highlights:

- Working with Project Lead The Way to add fluid power content to PLTW's engineering curriculum for middle and high schools, now taught nationwide.
- Revising undergraduate curriculum so all mechanical engineers understand fluid power.
- Developing specialized fluid power courses for graduate and advanced undergraduate students.
- Building an industrial internship program for undergraduate and graduate students.
- Collaborating with the Science Museum of Minnesota in the development of permanent and traveling fluid power exhibits.
- Producing a documentary on fluid power, in conjunction with Twin Cities Public Television.
- Working with tribal colleges in Minnesota and Wisconsin to promote engineering among Native American students and to provide mentoring services.

Industrial Collaboration/Technology Transfer

More than 60 fluid power manufacturers, distributors, and suppliers have become supporting members of the center—an unprecedented demonstration of industry support. In addition, many of these companies contribute equipment and provide project champions who actively work with universities on project and test bed research.

Participating Institutions

- University of Minnesota (lead institution)
- Georgia Institute of Technology (GT)
- Milwaukee School of Engineering (MSOE)
- North Carolina Agricultural and Technical State University (NCAT)
- Purdue University (PU)
- University of Illinois at Urbana-Champaign (UIUC)
- Vanderbilt University (VU)

Outreach Institutions

Science Museum of Minnesota
National Fluid Power Association
Project Lead The Way

Visit www.ccefp.org for more information.

Save with Early Multiple Registration

Register Online at www.msoe.edu/seminars

REGISTRATION FORM

Date _____

Mail or fax to:

Applied Technology Center™
Milwaukee School of Engineering
1025 North Broadway
Milwaukee, WI 53202-3109

Phone: (414) 277-2492
Fax: (414) 277-7470
Email: learn@msoe.edu

Please enroll the individual(s) listed below in: **Fee:**

☐ **Introduction to Hydraulics**
☐ Jan. 6-10, 2014 ☐ May 5-9, 2014 ☐ Nov. 17-21, 2014 _____

☐ **Electro-Hydraulic Components and Systems**
☐ Jan. 27-31, 2014 _____

☐ **Service and Operation for Improved Hydraulic Systems Reliability**
☐ Feb. 17-21, 2014 _____

☐ **Hydraulic Specialist Certification Review**
☐ July 8-11, 2014 _____

☐ **Hydraulic Systems Modeling and Simulation for Application Engineers**
☐ Dec. 8-12, 2014 _____

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Name (Dr./Mr./Mrs./Ms.)

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Company

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Company address

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City/State/Zip

(_____)_____ (_____)_____
Company telephone Fax

Seminar fee(s) of _____ are enclosed. (Make check payable to MSOE)

☐ Company purchase order enclosed. Please invoice accordingly. PO# _____

☐ Charge seminar fee(s) of $ _____ to ☐ MasterCard ☐ VISA ☐ Discover ☐ American Express

Account number _____ Expiration date _____

_____
Signature

Register early or enroll multiple registrants for discounted fees. (Additional registration form on back. For more participants or future registrations, please make copies.)

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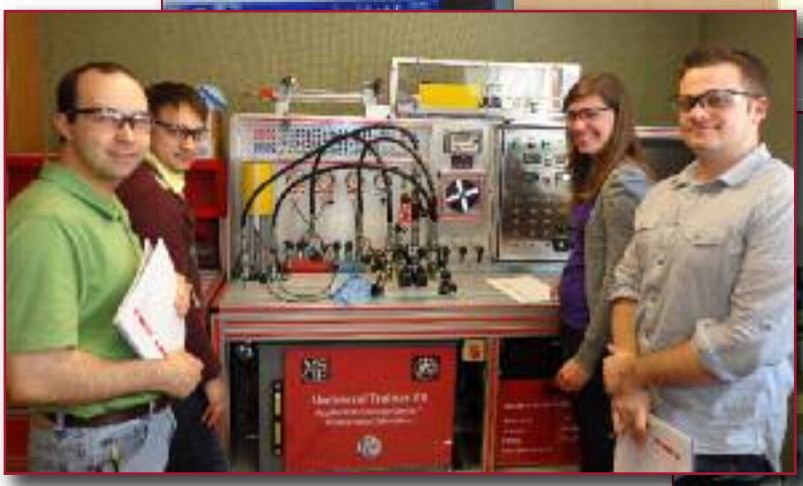
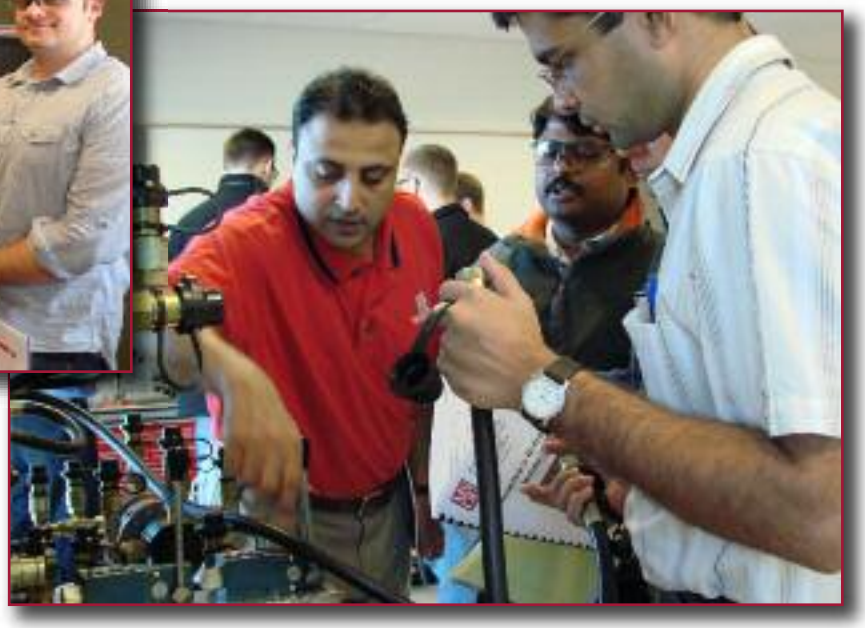
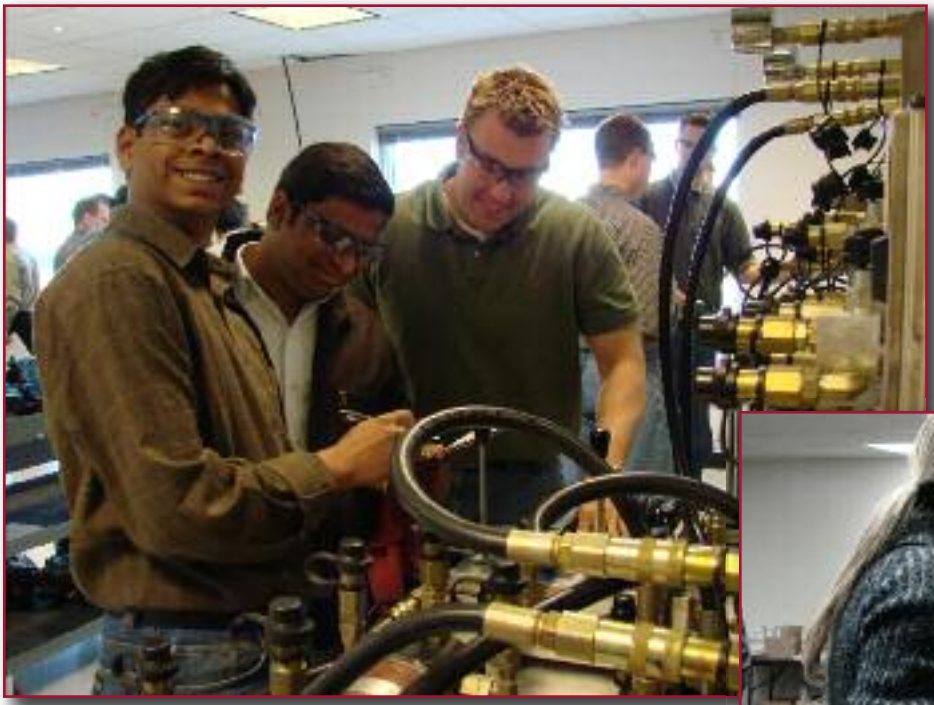






DIRECTIONS TO MSOE

Air Travel to Milwaukee

Book your own flight to Mitchell International Airport (Airport Code: MKE), it is a 15-minute taxi ride to downtown Milwaukee.

Driving Directions to MSOE

From the north

Take I-43 south to downtown Milwaukee. Then take Hwy 145 east/McKinley Avenue exit (exit # 73 A). Turn left (east) on McKinley; proceed for six blocks. Turn right on Broadway to the specific building or parking lot on campus.

From the south

Take I-94 west/I-43 north to downtown Milwaukee. Continue north on I-43, then take Hwy 145 east/McKinley Avenue exit (exit # 73 A). Proceed on McKinley for six blocks. Turn right on Broadway to the specific building or parking lot on campus.

From the west

Take I-94 east to downtown Milwaukee; then take I-794; exit Jackson/Van Buren (exit # 1 E). Proceed north on Van Buren Street seven blocks to State Street; turn left. Follow State Street to the specific building or parking lot on campus.

Look for signs at parking lot entrances for a campus map.

Exciting Metropolitan Setting

Milwaukee is one of the largest cities in the country with a metropolitan population of approximately 1.7 million residents, yet maintains the intimacy of a smaller community. MSOE's 20-acre campus, located in historic East Town, a vibrant downtown community, is just blocks from beautiful Lake Michigan, the theater district, museums, sports and music venues, parks and shopping. The city also stages more than 50 major festivals and other public gatherings annually.

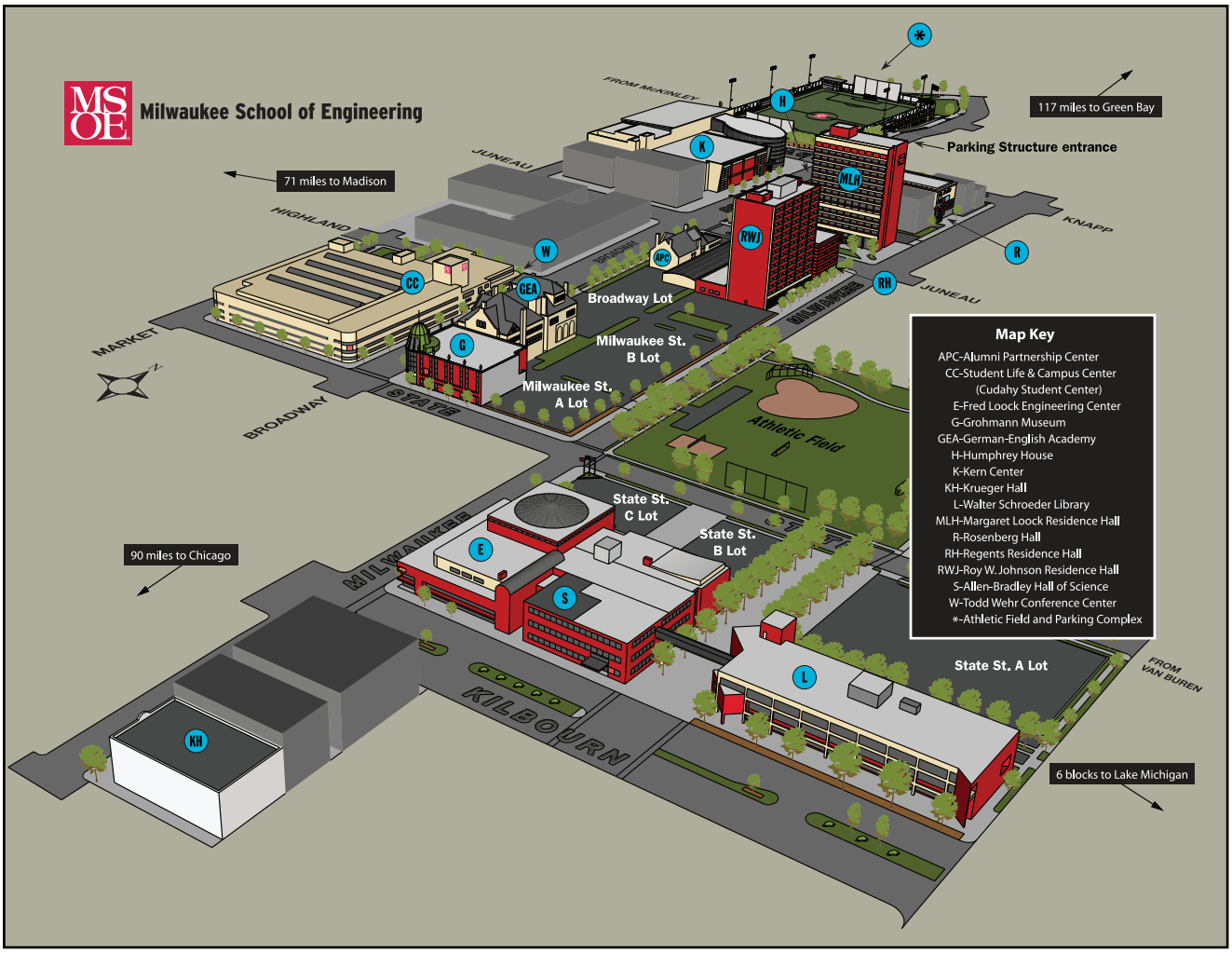
Where to Stay

The following hotels are within a ten-minute walking distance to the seminar location. Mention MSOE when making reservations to receive a reduced rate. These hotels are served by airport shuttles from Milwaukee's Mitchell International Airport.

Hyatt Regency Milwaukee
(414) 276-1234
(800) 233-1234
333 W. Kilbourn Ave.
$119 plus tax per night
www.hyatt.com

The Astor Hotel
(414) 271-4220
924 E. Juneau Ave.
$69 per week night plus tax
www.thehotelastor.com

More information, visit: www.msoe.edu/seminars



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