Master of Engineering in Engine Systems

The only online Master of Engineering degree program focused on moving the internal combustion industry forward through graduate education of working engineers.

epd.wisc.edu/enginesystems
Students of the MEES program participate as teams in a hands-on NVH assignment during summer residency.
Prospective Student,

Congratulations on taking the next step to advancing your career and considering joining the Master of Engineering in Engine Systems (MEES) program!

This unparalleled program is the only one of its kind in the United States. Known for its quality, value, and impact, it provides a unique learning opportunity for engineering professionals working with internal combustion engines and those interested in leadership roles in the engine industry.

This Master of Engineering degree is specifically designed for professional engineers, allowing integration of your studies with your career. Your faculty are drawn from the university’s Engine Research Center and throughout the engine industry. The varied faculty background provides a blend of fundamental science and practical application.

Take a look at the information inside this brochure to learn more about this exceptional program.

The faculty and staff here at MEES look forward to the opportunity to work with you as we explore together the future of internal combustion engine development.

Sandra Anderson, PhD
MEES Program Director
Department of Engineering Professional Development
University of Wisconsin–Madison

What is the Master of Engineering in Engine Systems?

The Master of Engineering in Engine Systems (MEES) is a three-and-a-half-year graduate engineering program for early to mid-career engineers who are assuming new roles and responsibilities leading engine development projects. The online graduate program is coupled with week-long summer residencies. MEES courses provide a solid foundation in mechanical engineering and program management and will equip you with an understanding of engine development you would otherwise gain only with years of experience.

Engineers from companies that design and manufacture internal combustion engines of all sizes—from lawn mowers to diesel ship engines—will be provided the tools to advance within the internal combustion engine industry.

You will gain broad technical knowledge in:

- Combustion
- Design
- Material science
- Fluid mechanics
- Electronics and control
- Global teamwork

Gain skills for your career—without sacrificing it

MEES is tailored for busy working professionals like you, featuring:

- An online platform accessible to you from anywhere in the world
- Live interactive web conferences
- Flexible learning time outside of the live conferences
- Courses and projects that apply immediately to real-world work
- A comprehensive course outline that keeps you on track for the Master of Engineering degree completion
Become a Leader in the Engine Design Industry

MEES is designed to meet the specific needs of engineers advancing toward leading internal combustion engine development. Virtually every subject in the mechanical engineering curriculum finds application in the engine. To answer the need for broad-based technical knowledge, the MEES curriculum incorporates topics from a wide variety of disciplines, including thermal sciences, design and mechanics, electronics and control, applications and service, and manufacturing. You also develop critical project management and computer problem-solving skills for ensuring project success.

The MEES program provides a solid foundation for various engineering backgrounds, such as those with electrical engineering degrees.

Upon completing the MEES program, you will have the knowledge and skills to:

- Manage the complete development process for a new engine
- Clearly articulate customer and application requirements
- Effectively integrate engine design with the various manufacturing processes
- Select the combustion system, fuel, and engine system configuration that will best fit a particular application
- Lay out a new engine design and identify the critical package dimensions
- Effectively optimize each component, sub-system, and system
- Articulate the capabilities and limitations of each family of analysis tools and each rig and engine experimental technique
- Lead the development and optimization of the air handling and combustion systems for both diesel and spark-ignition engines
- Lead in defining and implementing the durability validation required for a completely new engine
- Coordinate the NVH measurement and optimization for the new engine with total vehicle efforts to meet regulatory requirements and customer expectations
- Integrate the design and development of the engine with the control systems required for fueling, combustion, after-treatment, and engine/vehicle interaction
- Communicate your designs and ideas in a professional and persuasive manner

Apply New Skills Instantly

The MEES program provides you with knowledge that you can apply immediately. Courses are problem-based and application-oriented, providing knowledge that you can use immediately in your current projects while preparing you for future responsibilities and roles.

“Apart from being a well-structured and highly focused engines program, a key benefit of MEES is that it comprises an online community of past and current students who have vast experience and expertise in engine systems.”

Nayan Engineer, MEng, Senior Engineer, Gasoline Engines Test and Development, Hyundai-Kia American Technical Center, Inc.
A Typical Week in the MEES Program

In a typical week your workload will include assigned readings, real-world assignments using computer applications, a live web conference discussion, and online project work. You’ll have great flexibility within each week to complete course activities, but most assignments are due by the end of the week. So while the program is flexible, it includes many regular check-in times and structured support to help keep you on track.

Build Your Professional Network with Others in the Engine Industry

MEES is far different from other online programs. Unlike many online degree programs, which funnel information to students without significant and meaningful interaction, UW–Madison’s MEES program is designed for highly interactive, collaborative learning with peer professionals.

You will proceed through your three-and-a-half years in the program with the same small group of students. MEES students and alumni consistently note this cohort model as the key to their success in the program.

The MEES also emphasizes group projects, which means you will be constantly interacting with your colleagues via online tools like web conferencing, online discussion forums, email, and conference calls. Problem-based assignments are structured to draw out and engage the extensive expertise of fellow students as part of the learning experience.

In addition to group work, there are multiple opportunities to build an extensive network of students, faculty, and alumni within the internal combustion industry—another lasting benefit.

Advance Your Learning at Residencies

Each August, you will attend the weeklong residency on the UW–Madison campus. Here you will meet your MEES classmates and instructors face-to-face, while you dive into intensive coursework and group project work that corresponds with your fall and spring courses. The program also brings in expert speakers—engineers with considerable experience and success in their industry.

Highlights of student residency include visiting the Engine Research Center and networking with current students, faculty and staff in the engine industry.
The Benefits of Being a Badger

As a student in the MEES program, you will be a UW–Madison graduate student in every respect and earn a Master of Engineering degree with the same academic stature as face-to-face degrees awarded by UW–Madison.

- UW–Madison is among the top three U.S. universities in research spending
- The United States Distance Learning Association (USDLA) recognized MEES with the 2009 21st Century Best Practices for Distance Learning award

Join an Award-Winning Program

The University of Wisconsin–Madison has been recognized as one of the top 10 best online graduate engineering programs for three years in a row by U.S. News & World Report.

U.S. News & World Report’s ranking recognized UW–Madison’s graduate engineering programs for:
- Peer reputation
- Student engagement
- Faculty credentials and training
- Student services and technology
- Admissions selectivity

Student Perks

Though you will only visit the UW–Madison campus briefly each summer, you will enjoy the status as a graduate student of the university, with benefits including:

- Student pricing on products such as computer software
- Discounts to select UW–Madison recreational sport facilities when in Madison, such as the University Ridge golf course
- Access to student support services
- Access to the UW–Madison academic libraries, which offer you 10% of the world’s library resources

During your summer residency, you’ll have time in the evenings to explore the beautiful UW–Madison campus and surrounding city with your cohort members, including the State Street pedestrian mall, Camp Randall, the State Capitol building, and the Memorial Union Terrace overlooking Lake Mendota.
Earn a Master of Engineering Degree from a Top Institution in Engine Research

The value of your degree depends on the curriculum and the reputation of the university granting the degree. The University of Wisconsin–Madison is recognized worldwide for its commitment to education excellence and its leadership in engine research at the renowned Engine Research Center and the Powertrain Control Research Laboratory.

Home of MEES, the Department of Engineering Professional Development in the College of Engineering is one of the nation’s oldest and largest continuing education programs for professional engineers. Annually, the department delivers more than 300 continuing education courses in engineering, design, operations, production, maintenance, management and planning to more than 11,000 students. Additionally, it offers eight of internationally acclaimed professional master’s degree programs. These programs consistently rank among the top 10 in the country.

The Engine Research Center
The Engine Research Center (ERC) is devoted to fundamental research on spark ignition and diesel engines. The Center has a distinguished record of research and education pertaining to internal combustion engines and advanced propulsion systems. The ERC’s projects involve fluid mechanics, heat transfer, combustion, sprays, emissions and health effects, lubrication, and powertrain systems.

Powertrain Control Research Laboratory
The Powertrain Control Research Laboratory conducts research and trains engineers in powertrain system modeling, nonlinear engine diagnostics, and powertrain control. The research conducted in this laboratory is highly interdisciplinary, bringing together the thermal sciences, controls, dynamic analysis, design, and system identification disciplines in a systems approach.

Engine Research Opportunities
MEES students will have regular access to the research at the ERC through the Engine Seminar Series. Both on-campus graduate students and MEES students will make presentations on research projects and participate in online discussions. MEES students will be able to view recordings of the on-campus presentations and use an online conferencing system to make their presentations. The series provides opportunities for MEES students to become involved in research at the ERC and to collaborate with on-campus students on various projects.

Immediate Benefits for You and Your Employer

Your employer, and the engine industry as a whole benefit, when, through the MEES program, you gain new, critical skills and improve your effectiveness as an engineering leader. Many MEES students have used their new skills and knowledge to benefit their organizations before they even graduate, making the MEES program an investment with immediate returns. Supervisors also appreciate that their engineers can gain these skills with little or no effect on availability for assignments or travel.
Be One of the Leading Organizations that Supports MEES

The following leading-edge companies have had or currently have a participant in the MEES program. These organizations have shown a commitment to moving the internal combustion engine industry forward by supporting their employees throughout the program.

America Honda  
Motor Co., Inc.  
Arctic Cat, Inc.  
Attwood Marine Corp.  
AVL Powertrain Engineering  
Boeing Co.  
Borg Warner  
Bosch US  
Bridgeport and Port Jefferson Steamboat Co.  
Briggs and Stratton  
Caterpillar, Inc.  
Cessna Aircraft Co.  
Chrysler Group LLC  
Continental Motors  
Cummins, Inc.  
Daimler AG  
Dominica Electricity Services Ltd.  
Dresser-Rand  
Eaton Corp.  
Electro-Motive Diesel  
Fairbanks Morse Engine  
Ford Motor Company  
Generac  
General Electric  
General Motors Corp.  
Goodyear Tire & Rubber Company  
Hamilton Sundstrand  
Harley-Davidson Motor Co.  
Honeywell Turbo Technologies  
Hughes Engineering Solutions  
Hyundai-Kia Motors  
Ilmor Engineering  
Indian Railways IAV  
International Truck and Engine Corp.  
John Deere  
L3 Communications Combat Propulsion  
Mahle Powertrain  
Mercury Marine  
MotoTron Corp.  
Naval Sea Systems  
NACCO Material Handling Group  
Navistar Inc.  
PACCAR Inc.  
Peterbilt Motors Co.  
Polaris Industries  
Ricardo  
Southwest Research Institute  
S&S Cycle  
Teledyne Continental Motors Inc.  
US Air Force  
Vronay Engineering Services Corp.  
WE Energies
MEES Curriculum

Essential Skills for Engineering Productivity

2 credits

Course Objectives
- Set up and understand your online learning environment
- Discuss, identify, and evaluate emerging technologies
- Prepare a learning plan and calendar, and your personal mission statement
- Develop an effective approach to personal information management and workgroup content management
- Learn to work effectively in a virtual team
- Sharpen your ability to create and present information in an efficient, clear, and useful way

Topics
- Weeks 1-8: Setting Up and Communicating Learning at a Distance
- Managing Information
- Developing Technology Skills/Teamwork
- Weeks 8-16: Presenting Technical Information

Thermal Systems Engineering

2 credits

Course Objectives
- Understand the fluid mechanics, thermodynamics, heat transfer, and combustion processes within the internal combustion engine
- Prepare for further advanced topics critical to engine design

Topics
- Thermal Systems Engineering
- First Law of Thermodynamics
- Evaluating Properties and Equations of State
- Second Law of Thermodynamics
- Using Entropy
- Gas Power Systems
- Calculating Efficiency
- Thermodynamics of Combustion
- Combustion Equilibrium
- Adiabatic Flame Temperature
- Energy Equations
- Heat Transfer

Engine Design I

2 credits

Course Objectives
- Identify customer requirements and how these will drive system design. Requirements include regulatory and technological constraints as well as application needs:
  - packaging
  - weight
  - cost
  - performance
  - reliability/durability
  - regulatory
  - production volume
  - life cycle
  - quality
- Explain the interaction between engine, drivetrain, and vehicle in the chosen application and the expected duty cycle
- Broaden your understanding through sharing presentations with other teams

Course Methodology
Your engine design course sequence begins with this guided independent study. You and others in your cohort will be organized into teams of three or four people. Each team will select an application for which they would like to design an engine. Under the guidance of faculty, your team will conduct a comprehensive study of the needs of your chosen market through literature review, customer interviews, customer site visits, and discussions with engine application and field service engineers. Each team will submit a written report and provide a summary presentation to the class. Individual contributions to the team project will be assessed.

“...The program exposes you to a variety of skills such as managing engine programs to engineering technical details along with the tools required for both present and future engine development.”

Dave Rogers, MEng, Design Engineer, Boeing Company

University of Wisconsin Madison
**MEES Curriculum**

**Engine Design II**

4 credits

**Course Objectives**
- Create/develop a basic engine layout utilizing input from the Engine Application Project
- Document the design with sufficient depth (calculation, assumptions, base dimensions) that the concept engine could be assigned to a design team to begin detailed design
- Integrate foundational engineering concepts pertaining to reliability, analysis and test, fatigue, wear, cost analysis, casting and materials, NVH, and bolted joint design into the total engine design process
- Learn and develop methods for making the necessary compromises and tradeoffs during the concept/initial design layout stages of the engine

**Topics**

**Basic Engine Development and Design Validation Concepts**
- Reliability, analysis and test, fatigue and engine wear

**Engine Configuration**
- Displacement
- Number of cylinders
- Fuel/combustion cycle and 2 stroke/4 stroke cycle
- Vibration, engine configuration and balance
- BMEP and aspiration
- Bore and stroke
- Cooling

**Power Cylinder**
- Air requirements, valve arrangement and liner/cylinder wall type
- Cylinder lubrication and wear
- Injectors and spark plugs
- Combustion chamber design

**Lower-end System**
- Connecting rod size and type
- Crankshaft sizing and proportions
- Bearing sizing and power take-off

**Engine Structure**
- Crankcase type, fatigue loading, modal analysis and NVH and bolted joint design
- Cylinder head attachment and main bearing containment
- Bore spacing and deck height
- Engine mounting

**Valve Train and Cam System**
- Type of valve train
- Number and location of camshafts
- Cam drive type and configuration
- Wear characterization and design

**Lubrication and Crankcase Breathing System Capacity**
- Pump type and sump size and location
- Oil drain back and scavenging
- Crankcase ventilation, windage, breathing
- Oil distribution and filtration and cooling

**Cooling System**
- Type (air, oil, coolant)
- Pump drive and location
- Capacity and temperature control
- Circuit design and analysis

**External Gas Handling**
- Intake manifold/system, fuel injector placement, and exhaust manifolds/pipes
- Pressure charging (if applicable)

**Accessory Systems**
- Alternator, starter, and compressor (air, HVAC)
- Additional drives (power steering, hydraulic pump, air pumps)

**Engine Controls**
- Transducers/sensors (speed, TPS, temperature, flow, pressure, fluid levels)
- Wire harnesses, connectors, and control devices (active intake, exhaust, EGR)

**Sealing**
- Static seals, dynamic sealing, and casting integrity
- Service
- Intervals, time required, special tools, and cost of service

**Assembly**
- Number of fastener types, criticality of joints, clamp load control, number of fasteners, and poke-yoke

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“I’m getting to know the other students in the classes through frequent online discussions and group projects. The faculty has been very responsive to my questions and ideas.”

Stephanie Severance, MEES Student
Engine Fluid Dynamics

3 credits

Course Purpose
This course covers the primary gas dynamic and fluid dynamic components related to engine combustion. The purpose is to provide the student with the appropriate background and sufficient analysis skills to understand the design and performance of the air handling equipment. The course focuses on the intake and exhaust systems, port and valve flows, cylinder charging and mixing, and fuel spray delivery.

Course Objectives
• Develop the background understanding and skills for the analysis of the major physical processes that occur in gas dynamic flows, multi-dimensional flows, and fuel sprays
• Study the performance and design of the principle air-handling systems in engine combustion through projects and case studies
• Understand literature and reports on engine air handling and effectively communicate with experts in the field

Topics
Flow Regimes, Thermodynamics
• Sub-sonic and supersonic flow
• 1-D and 3-D flows
• Open and closed flow systems

Mass, Momentum and Energy
• Conservation laws for fluid dynamics

Isentropic Flows
• 1-D steady flow
• Nozzles, area effects
• Choked flows, shocks

Flow Losses
• Friction and fanno flow
• Bends, pipes, valves

Heating and Cooling
• Rayleigh flow and application to EGR cooling

1-D Unsteady Flows
• Pressure waves and method of characteristics

Boundary Conditions
• Inlets, outlets, manifolds, and valves

Turbocharging
• Compressors and turbines

Multi-dimensional Flows
• Turbulence, boundary layers, and mixing

Intake/Exhaust Manifold Flows
• Separation and mixing

In-cylinder Flows
• Swirl, tumble, valves and heat transfer

In-cylinder Two-phase Flows
• Sprays, vaporization and mixing

In-cylinder Modeling
• Diesel fuel injection, and combustion and emissions

Case Studies
• Exhaust system tuning, Intake system ram tuning, EGR effect on diesel emissions, and turbo-boost effect on diesel emissions
Engine Performance and Combustion

**Course Objectives**
- Understand theoretical and practical limits of maximum engine performance
- Analyze engine combustion phenomena from a fundamental thermo-chemical perspective, including effects of mixture preparation strategy, in-cylinder charge motion
- Understand in-cylinder pollutant formation mechanisms, abatement strategies and aftertreatment systems and their implications
- Identify coupling between a single control input and the remainder of the engine system
- Compare and contrast mixture preparation strategies
- Compare and contrast alternative energy conversion strategies

**Topics**

**Heat Engines versus Chemical Conversion Processes**
- Thermodynamics of heat engines and thermodynamics of chemical reactions
- Fundamental limits of heat engines and chemical processes
- Typical partitioning of fuel energy for engine applications

**Chemical Reactions and Chemical Kinetics**
- Systems of chemical reactions and chemical rate equations
- Characteristics times: chemical, flow, engine
- Ignition and extinction

**Flames**
- Premixed and non-premixed
- Flame propagation and flame fluid interactions
- Mass burn rate: engineering models

**Applications to Spark Ignited and Diesel Engines**
- Premixed engines: flame propagation
- Heterogeneous combustion

**Alternative (non-flame) Energy Conversion Processes**
- HCCI, CAI, MK, etc., and fuel cells

**Fuels**
- Global fuel resources, alternative fuels
- Energy content and important physical and chemical characteristics, trace compositions
- Well-to-wheels and well-to-tank assessment

**Emissions**
- Sources of CO, HC, NOx and particulate matter
- Unregulated emissions
- The engine and the atmosphere
- Phenomenological and detailed approaches to assessing emissions
- Strategies for reducing emissions and fundamental and practical limits
- Global warming and greenhouse gas emissions

**Aftertreatment Approaches**
- Three-way catalysts, lean aftertreatment systems, and particulate traps
- Importance of engine exhaust composition

**Integration**
- Connection between “typical” engine control parameters and combustion emission phenomena
- Heat transfer
- Case studies

Research at the Engine Research Center shows the differences in flame structure in conventional and LTC diesel combustion.
Perspectives on Engine Modeling

2 credits

Course Objectives
• Learn an effective framework for using and assessing computer modeling tools and procedures
• Learn how to select the analytical tools most appropriate for any given engine design/development project
• Understand the capability, application, and limitations of the various classes of engine analysis tools
• Understand the complementary use of experiment and analysis
• Appreciate the significance of data format and presentation

Topics
Modeling Framework
Putting Data in Context
Absolute versus Relative Modeling
Computer-Aided Design (CAD)
Finite Element Analysis (FEA)
Kinetic and Dynamic Modeling
Thermodynamic System Modeling
Hydraulic Network Simulation
Multi-Dimensional Fluid Dynamics
Integration of Tools into Engine Projects

Engine Systems and Control Series

5 credits (1 credit in Summer/4 credits in Fall)

Course Objectives
• Gain a deep understanding of Matlab/Simulink® at Residency. This software tool equips the student to develop lumped models of engine and powertrain systems and then design controllers for obtained a desired performance goal. The controller design can be verified through simulations and analysis.
• Gain exposure to fundamental concepts and mathematical tools in control engineering: ODEs, block diagram representations, stability, open-loop versus closed-loop analysis, basic tools used in control design and analysis, robustness. Gain a general understanding of what these concepts and tools are and how they can be used
• Develop an appreciation of steady state and transient behavior of an automotive powertrain and perform control oriented modeling of powertrain sub-systems for the purpose of control and diagnostics
• Examine several engine systems and subsystems with regard to operation, modeling, and control and relate these system control topics to other courses in this degree program

Topics
Matlab/Simulink® for Control Systems
• Introduction to IDE (Integrated Development Environment)
• Matlab Scripting for Analysis and Design
• Modeling Dynamic Systems using Simulink®
• Simulation Settings, Plotting, Reporting

Controls Fundamentals and Tools
• Laplace Transforms and Transfer Functions
• Block Diagrams and Control System Performance
• Poles, Zeros, Stability, and Bode Plots
• Controller Design and Implementation

Engine Control Systems
• SI Engine Systems and Controls
• CI Engine Systems and Controls
• Sensors and Actuators in Engines
• Engine Control from Vehicle Perspective

ECU Development
• ECU and Vehicle Communications
• Development Process, Calibration, and Validation
• Hybrid Vehicle Topologies and Control
• Battery Management Systems

MATLAB and Simulink are registered trademarks of The MathWorks, Inc.

“As a premier organization for the entire distance learning profession, we are honoring the MEES program as a leader in the industry. MEES has raised the bar of excellence…”

Dr. John G. Flores, CEO of the United States Distance Learning Association (USDLA)
MEES Curriculum

Analysis of Trends in Engines: Legislative Drivers & Alternative Fuels

1 credit

Course Objectives
- Understand global trends in transportation demands, energy availability, and emission requirements
- Gain familiarity with the tools and techniques to provide a sound comparative assessment of alternative fuels & engines
- Gain an understanding of legislative drivers for emissions, safety, noise, etc. that directly impact engine design and configuration across a range of engines industries
- Apply best practice in critical data analysis to seek out, evaluate and apply information sources to generate comparative technical & business reviews of engines alternatives

Topics

International Trends
- Engines types and market demand
- Energy availability and usage
- Regulation and legislative drivers

Societal Considerations
- Well-to-wheels analysis, emission sources, and economic incentives

Measurement and Regulation
- Models and regulatory intent, regulatory agencies, and governmental incentives and taxation

Fuels and Refining
- Crude oil distribution and variation
- Alternative fuels, including bio-fuels
- Alternative sources and refining processes

Alternative Engines and Powertrain
- Fuel cells, electric and hybrid vehicles, etc.

Internal Combustion Engine Advances
- Hydrogen and alternate fuel, and alternative combustion processes

Future Projections
- Review of recent studies and comparative assessments

Summer residency will include a tour of the Engine Research Center.
Analysis of Trends in Engines: Powertrain Technologies & Manufacturing Constraints

1 credit

Course Objectives

• Understand the global trends in engines architecture and the influence on performance, emissions, weight, etc.
• Review the development of engines configurations in the context of historical constraints, current investments and future technologies
• Develop lifecycle plans for engine families and variants
• Understand manufacturing constraints related to investment, production volume and quality

Topics

Architecture Trends

• Engine configurations effects
• Development of systems, components & features
• Application types and requirements

Market Requirements

• Market needs, features requirements, and product offering strategy
• Warranty, durability and reliability expectations

Engine Manufacturing

• Engine manufacturing processing technologies
• Effects of volume and quality
• Return on infrastructure investment

Powertrain Strategy

• Strategy decision making, lifecycle planning, and derivatives and variant optimization

“... I was in the Engine Project Management course at the same time I started a new program at work, designing a cooling package for an excavator. I was able to take some of the tools I learned to help drive the program we were working on.”

Emily Book, MEng, PhD student, North Carolina State
Course Objectives

• Learn key project management skills and tools to plan, monitor and control programs, including status/reporting through gate reviews as a mechanism for successful project delivery
• Understand and plan the elements of a structured engine design and development project from concept to production introduction and support
• Identify technical, business and timing risk on a program and plan appropriate risk mitigation actions
• Determine appropriate product development input
• Define resources, skills and facilities required to successfully deliver an engine program to production
• Understand the influence of a particular industry’s operating environment, economic conditions, end-use customer needs, and existing investment/infrastructure on design configuration, product specification, and timing
• Understand the demands of legislative requirements for different markets and industry applications. Demonstrate the effects these requirements have on driving project initiation and execution

Topics

Trends in Engine Projects

• Understanding what is involved in a typical engine project
• Overview of the engines industry, life-cycle planning, and key market and legislative drivers for new projects

Project Scope Definition

• Role of scope definition in good project delivery
• Tools to define scope and establish priorities

Timing Issues

• Establishing a valid timing plan by determining required activities and interdependencies
• Defining project phases
• Gateway processes and the use of sign-off criteria

Project Cost Control

• Establishing a project cost and budget allocation
• Utilizing financial risk management

Resources

• Developing a work breakdown structure

Project Integration

• Developing a cohesive project plan through balancing quality, cost, and timing deliverables
• Consequences of project objective delivery through risk/cost quantification

Procurement

• Types of project proposals and contracts
• Contract legal and risk considerations

People

• Current best practices in establishing a team structure and organization
• Key skills in leadership and team motivation

Project Risk Control

• Identifying potential project risks and developing a mitigation plan
• Risk quantification and tracking techniques

Monitoring and Control

• Reviewing project status, identifying issues and team communication
• Developing a scalable project issue tracking system for effective resolution

Decision-making mechanisms and dispute resolution techniques

Quality

• Role of quality systems and certification
• Undertaking an effective project audit
• Establishing effective quality metrics and dealing with warranty

Communications

• Developing a comprehensive project communications strategy using written reports, status dashboards, project meetings, and electronic/web-based media

Knowledge Management

• Creating a knowledge management environment for effective capture, storage, and retrieval of project best practices
• Utilizing historical project learning into future project planning and capability growth

Group Project Proposal

• Creating a detailed project plan for a full engine program
• Working as a project team to coordinate a cohesive response to a request for quotation and deliver the results in a written report and group presentation
Sandra Anderson, PhD is director of the MEES program. Dr. Anderson spent a number of years in the aerospace industry designing jet aircraft engines. She worked briefly as an assistant professor of mechanical engineering at the University of Detroit Mercy before returning to industry at Ford Motor Company to train power-train designers and engineers in CAD and CAE. She moved quickly to become a training manager for Ford North America and produced Web-based quality training on topics such as the design of experiments. She also worked in the Office of the Technical Fellow, exploring new technologies to automate the product development process and shorten product development time.

Dr. Anderson received a master’s degree from Purdue University in mechanical engineering with emphasis on combustion and a PhD from the University of Oklahoma in aerospace engineering, studying combustion and hypersonic propulsion. In addition, she has an MBA degree from the University of Dallas and is a six-sigma black belt.

Bruce Dennert, MS, MEng is the president and principal engineer of CamCom, Inc, an engineering consulting company specializing in cam profile design, valve train analysis, engineering educational training programs, and custom engineering software. Previous experience includes a 34-year career at Harley-Davidson where he held many powertrain engineering positions including, Principal Engineer–Powertrain Concepts. He also worked at Waukesha Engine in an analytical engineering function. He holds bachelor’s degrees in math and physics from Carroll College, a master’s degree in mechanical engineering from the University of Wisconsin–Milwaukee, and a Master of Engineering in Professional Practice (MEPP) degree from the University of Wisconsin–Madison.
Faculty and Program Committee

**Neil A. Duffie, PhD,** is a professor of Mechanical Engineering and past department chair for the Department of Mechanical Engineering of the University of Wisconsin–Madison. His research interests are in machine, process, and system control, particularly distributed system control. He received his PhD in Mechanical Engineering in 1980 from the University of Wisconsin–Madison, his M.S. in Engineering in 1976, and his BS in Computer Science in 1974. Professor Duffie is a fellow of ASME, CIRP, and SME. He serves on the Council of the CIRP (International Academy for Production Engineering), and is a past president of SME (2008). In 2008, he was Mercator Guest Professor at the University of Bremen, Germany.

**Kevin Hoag, MS,** holds the position of Institute Engineer, Engine, Emissions and Vehicle Research at the Southwest Research Institute and a former program director for the Department of Engineering Professional Development at the University of Wisconsin–Madison. He has more than 35 years of experience in diesel and spark-ignition engine development, sixteen of which were with Cummins Inc., where he held a variety of leadership roles in engine performance and mechanical development. He also has more than fifteen years of experience in course development and teaching in continuing engineering education. Kevin holds a bachelor’s degree and a master’s degree in mechanical engineering from the University of Wisconsin–Madison.

**John L. Lahti, PhD,** is a Staff Controls Engineer at John Deere in Waterloo, Iowa. He has worked at John Deere for three years developing new air system controls for diesel engines. Other experience includes 19 years at General Motors working on hybrid powertrain controls, engine calibration, and engine validation; and two years at Nippondenso working on automotive heating and cooling systems. Dr. Lahti received his PhD in Mechanical Engineering from the University of Wisconsin–Madison in 2004, MSE from the University of Michigan–Dearborn in 1992, and BSME from Michigan Technological University in 1989. He is a registered professional engineer and member of SAE, ASME and IEEE.

"I have seen considerable dedication from the MEES instructors. For example, Brian Price once held a Web conference from a hotel lobby in Moscow at 3 a.m. his time, instead of rescheduling and making it inconvenient for our class. Now that’s a commitment to the students."

Brian White, MEng.
Mark Millard, MS, is the Learning Design and Technologies Specialist for the Department of Engineering Professional Development in the College of Engineering at University of Wisconsin–Madison. Mark serves as the instructional systems and technology resource within the department and helps to coordinate the development and delivery of instructional offerings in the department and strives to provide effective, efficient, and engaging instructional systems that meet the needs of all learners. Mark also co-teaches the Essential Skills for Engineering Productivity course in the MEES program. Prior to joining University of Wisconsin–Madison, Mark was the assistant director of the Office of Instructional Consulting in the School of Education at Indiana University. He holds a BS in experimental psychology from Colorado State University, and an MS in information science with an emphasis in human-computer interaction and learning technologies from Indiana University. Mark is also currently working toward his doctoral degree from Indiana University.

Traci Nathans-Kelly, PhD, earned her PhD in 1997 in English. Concurrently she was Program Director for the Scientific and Technical Communication BS degree at the University of Minnesota, Crookston. She came to the University of Wisconsin to teach in the Technical Communication program, the MEng Management program, and the MEng Engine Systems program. Dr. Nathans-Kelly provides instruction in technical communication, presentation, editing, web design, user manual writing, and others. Currently, she is an editor for IEEE’s “Professional Engineering Communication” series. Additionally, she serves as the IEEE Professional Communication Society’s Press Liaison to Wiley Publishing. She is active in the Society for Technical Communication (STC) as the Manager for the International Technical Communication Special Interest Group. She is a member of the Committee on Global Strategies, and she judges at the international level for the STC Publications contests for scholarly journals and articles, and information materials.
Christine G. Nicometo, MS, has taught technical communication courses for undergraduate and graduate students at the University of Wisconsin–Madison campus since 2003. She received her MS degree in Rhetoric and Technical Communication from Michigan Technological University, where she taught technical communication and English as a Second Language (ESL) courses.

She also taught ESL courses at Finlandia University where she was the director of a federal, TRIO, Student Support Services grant. Her interests lie in discovering how technology alters the ways we communicate, learn, and teach. She has directed nationally funded K-12 technology workshops and is currently the director of the New Educator’s Orientation workshop in the College of Engineering at UW–Madison. Her most recent scholarship is focused on redefining the practice of technical presentations.

Philip R. O’Leary, PhD, PE, is chair of the Department of Engineering Professional Development, University of Wisconsin–Madison. In this role, he directs one of the largest university-based providers of continuing engineering education and has provided leadership in the development of the department’s master of engineering degrees that are delivered at a distance. Dr. O’Leary earned BS and MS degrees in agricultural engineering and a PhD in land resources with a specialization in solid waste disposal, energy, and environmental issues, all from the University of Wisconsin–Madison.
Brian Price, MS, MEng is a lecturer in the School of Engineering & Applied Science at Aston University, UK. He has more than 25 years of experience in leading the design and development of powertrain programs for automotive, aerospace, marine and industrial manufacturers around the world, while holding a variety of technical and commercial leadership positions at Ricardo, Harley-Davidson, Mercury Marine, Cosworth Engineering, Lotus Engineering and Jaguar Rover Triumph. He is a corporate representative on several joint industry and government technology and business steering groups related to engines and low carbon energy. He holds a Master of Science degree in Engineering Design from Loughborough University, UK, and is a graduate of the University Wisconsin–Madison MEng Management program.

Roy Primus, MS is the principal engineer of cycles and systems in the combustion systems organization at the General Electric Global Research Center. He has worked as a reciprocating engine technologist and researcher in the areas of heat transfer, fluid mechanics, combustion, emissions and thermodynamics for more than 30 years. Prior to joining GE in 2002, Mr. Primus worked for Cummins, Inc. where he managed a wide spectrum of analytical and experimental work in the area of diesel and spark ignition (natural gas) engine combustion, emissions, performance, fluid mechanics and heat transfer. Active in SAE, Mr. Primus was awarded Fellow status in 2001. He has been a member of the governing board of the Central States Section of the Combustion Institute and a licensed professional engineer in Indiana. He has a BS degree in mathematics and an MS degree in mechanical engineering from Rose-Hulman Institute of Technology.

Rolf Reitz, PhD is a Wisconsin Distinguished Professor. Before joining the University of Wisconsin Engine Research Center in 1989, he spent six years at the General Motors Research Laboratories, three years as a research staff member at Princeton University, and two years as a research scientist at the Courant Institute of Mathematical Sciences, New York University. Dr. Reitz’s research interests include internal combustion engines and sprays. He is currently developing advanced computer models for optimizing fuel-injected engines. He is a consultant to numerous industries and has won major awards for his research, including the SAE Harry L. Horning award (three times) and the ASME Soichiro Honda medal and Internal Combustion Engine Award. He has authored and co-authored more than 400 technical papers on aspects of engine research. He received his PhD degree in mechanical and aerospace engineering from Princeton University.

Christopher Rutland, PhD has been a faculty member at the University of Wisconsin–Madison since 1989 and is currently the graduate associate chair of the Department of Mechanical Engineering. He received his PhD degree in mechanical engineering from Stanford University in 1989. Dr. Rutland’s research interests are in simulation of internal combustion engines and turbulent reacting flows. He works in developing largely eddy simulation models for IC engine simulations and system simulation to study after-treatment devices. He consults for a variety of industries, including engine and automotive companies. He has served on numerous review panels for the US Department of Energy, the US Air Force, and the National Science Foundation.

“The vision of the MEES program is to provide the highest quality of graduate engineering education to working professionals and move the internal combustion engine industry forward.”

Dr. Sandra Anderson, MEES Program Director
**Faculty and Program Committee**

**Thomas W. Smith, MS** is a Program Director in the Department of Engineering Professional Development. His continuing education programs focus on technical leadership and he teaches in the areas of information management and virtual teams. He works closely with outside organizations in the development of engineering competency models and conducts workshops on this topic. He is also a delegate to the International Standards Organization (ISO) 55000 Technical Committee on Asset Management. He has published extensively in the area of distance education and continues to participate in conferences and meetings on this topic. Mr. Smith received his BS degree from Dartmouth College and MS degree from the University of Wisconsin–Madison.

**Bapi Surampudi, PhD**, has more than 20 years of experience in the powertrain controls industry. In addition to the 17 years he has spent on the staff of Southwest Research Institute (SwRI), he has worked at Caterpillar, Combat Vehicle Research and Development in India, and Tata consulting Engineers in India. In his role at SwRI, he has built control systems for engines, transmissions, hybrid vehicles, and autonomous vehicles. His academic background includes a PhD from Texas A&M University, a Master of Technology from IIT Madras India, and a BS from REC Surathkal in India. He is a senior member of IEEE and a member of SAE.

**Other Key Faculty**

Dr. **Dave Foster** (retired) and Dr. **Jaal Ghandhi**, tenured professors and internal combustion engine researchers, contributed greatly to the development of the MEES program and curriculum. Research performed by these professors and their students is available to MEES students through recorded weekly presentations by graduate students.
Need More Information?

For information about the MEES program, curriculum, and benefits, contact:
Dr. Sandra Anderson
MEES Program Director
866-529-4967 or 608-890-2026
sandra.anderson@wisc.edu

For questions about the application process, tuition, admissions requirements, accommodations for disabilities, and financial aid, contact:
Shainah Greene
Graduate Programs Coordinator
608-262-0468
shainah.greene@wisc.edu

Tuition and Fees

For current tuition information, visit mees.engr.wisc.edu/meestuition. The program is four credit hours per semester, for seven semesters plus two semesters of one credit each for a total of 30 credit hours.

This fee includes tuition, Web access to courses, residency registration, toll-free access to Web conferencing, and full access to UW–Madison library resources.

Admission requirements

Admission to the MEES program is based on the following:

- A BS or similar degree from a program accredited by the Accreditation Board for Engineering and Technology (ABET) or the equivalent*

- A minimum undergraduate grade-point average of 3.0 (on a scale where 4.0 = A) or the equivalent for the last 60 semester hours (Applicants with less than a 3.0 may be admitted at the discretion of the department)

- Applicants whose native language is not English must provide scores from the Test of English as a Foreign Language (TOEFL). The minimum acceptable score on the TOEFL is 580 on the written version, 243 on the computer version, or 92 on the Internet version

- For international applicants, a degree comparable to an approved US bachelor’s degree

The MEES program does not require applicants to submit scores from the Graduate Record Examination (GRE).

Application Deadline

Application Cycle:
January 1–June 1

The MEES Admissions Committee accepts applications year-round and begins the application review process in January. Admission decisions are made from January 1 until June 1, or until all spots in the incoming class are filled, whichever occurs first. Applications are considered in the order received. It is in your best interest to submit materials well in advance of the deadline.

Tuition Reimbursement

If you company offers tuition reimbursement based on an annual basis, please note that although the program duration is completed in three-and-a-half years, the curriculum is spread out over four calendar years.

Be one of an exclusive number of participants entering this year.

Financial Aid

Student loans are available for this program. All MEES students who are US citizens or permanent residents are eligible to receive some level of funding from the federal Stafford loan program. These loans are available to qualified graduate students taking at least four credits per semester (as the MEES program is structured). Visit the University of Wisconsin Office of Financial Aid at finaid.wisc.edu to learn more.

Apply Today!

1. Download the MEES Application Checklist at epd.wisc.edu/enginesystems.

2. Contact the Graduate Programs Coordinator Shainah Greene to inform her of your intent to apply for admission. Shainah can be reached by e-mail at shainah.greene@wisc.edu, or by phone at 608-262-0468.

3. Complete the required items listed on the application checklist.

*Equivalency to an ABET-accredited program: Applicants who do not have a bachelor’s degree from an ABET-accredited program may also qualify for admission to the program. Such applicants must have a BS in science, technology, or a related field with sufficient coursework and professional experience to demonstrate proficiency in engineering practice. Registration as a professional engineer by examination, if achieved, should be documented to support your application. Contact the MEES director of student services, henderson@epd.engr.wisc.edu or 608-262-0133 to discuss any questions regarding your qualifications and the MEES requirements.
Master of Engineering in Engine Systems

epd.wisc.edu/enginesystems

"MEES provides not only a method to learn more about engines, but a way to meet others who share the same enthusiasm. The professors and fellow students become friends that you can count on for advice."

Alan Thomason, Current Student, Plymouth Machine Integration, LLC