



**WISCONSIN**  
UNIVERSITY OF WISCONSIN-MADISON

Department of Engineering  
Professional Development

The University of Wisconsin–Madison offers courses at your location focusing on performance development of internal combustion engines. Curriculum for course topics is designed by UW–Madison faculty and industry experts, and in cooperation with the Engine Research Center (ERC). The University’s ERC has a long and distinguished record of research and education pertaining to internal combustion engines and advanced propulsion systems.

Our staff will work with you to tailor our programs to meet your development goals.

<b>Performance Development of Internal Combustion Engines</b>			
<b>Topic</b> <i>(Each session is approximately 1 hour 10 minutes)</i>	<b>Three-day course</b>	<b>2-day spark-ignition course</b>	<b>2-day compression-ignition course</b>
<b>Introduction</b>	X	X	X
<b>Developing a New Engine</b> <ul style="list-style-type: none"> <li>▪ Torque and power</li> <li>▪ Efficiency</li> <li>▪ Prioritizing product attributes</li> </ul>	X	X	X
<b>Torque Curve and Applications</b> <ul style="list-style-type: none"> <li>▪ Diesel versus spark-ignition</li> <li>▪ Shaping the torque curve</li> <li>▪ Example applications</li> </ul>	X	Reduced	Reduced
<b>Assessing the Engine in Pressure-Volume Coordinates</b> <ul style="list-style-type: none"> <li>▪ The pressure-volume diagram and indicated work</li> <li>▪ The pumping process</li> <li>▪ Friction and parasitic losses</li> </ul>	X	X	X
<b>Determining Displacement</b> <ul style="list-style-type: none"> <li>▪ Estimating displacement requirements</li> <li>▪ Supercharging versus displacement</li> <li>▪ Trends in the design variables</li> </ul>	X	X	X
<b>Air-Handling Optimization</b> <ul style="list-style-type: none"> <li>▪ Intake and exhaust dynamics</li> <li>▪ Valve event timing</li> <li>▪ Port and valve development</li> </ul>	X	X	Reduced
<b>Turbocharging and Supercharging</b> <ul style="list-style-type: none"> <li>▪ Hardware design</li> <li>▪ Engine matching</li> <li>▪ System considerations</li> </ul>	X	Reduced	X
<b>Fuels</b> <ul style="list-style-type: none"> <li>▪ Fuel chemistry and energy</li> <li>▪ Performance measures and refining</li> <li>▪ Alternative and bio-fuels</li> </ul>	X	Reduced	Reduced
<b>Combustion I</b> <ul style="list-style-type: none"> <li>▪ Heating values</li> <li>▪ Combustion chemistry</li> <li>▪ Rich and lean combustion</li> </ul>	X	X	X
<b>Combustion II</b> <ul style="list-style-type: none"> <li>▪ Diffusion and pre-mixed flames</li> <li>▪ Combustion equilibrium</li> <li>▪ Combustion kinetics</li> </ul>	X	X	X
<b>Spark-Ignition Combustion</b> <ul style="list-style-type: none"> <li>▪ Operating characteristics</li> <li>▪ The flame front</li> <li>▪ Knock</li> </ul>	X	X	



**Performance Development of Internal Combustion Engines** *continued*

<b>Topic</b> (Each session is approximately 1 hour 10 minutes)	<b>Three-day course</b>	<b>2-day spark-ignition course</b>	<b>2-day compression-ignition course</b>
<b>Diesel Combustion</b> <ul style="list-style-type: none"> <li>▪ Operating characteristics</li> <li>▪ Ignition delay and heat release</li> <li>▪ The diesel flame</li> </ul>	X		X
<b>Optimizing Engine Efficiency</b> <ul style="list-style-type: none"> <li>▪ Idealizations and constraints</li> <li>▪ Closed-cycle considerations</li> <li>▪ Open-cycle considerations</li> </ul>	X	X	X
<b>Exhaust Emission Considerations</b> <ul style="list-style-type: none"> <li>▪ Regulated emissions and health effects</li> <li>▪ Measurement requirements</li> <li>▪ Trends and challenges</li> </ul>	X	X	X
<b>Emission Mechanisms and Control</b> <ul style="list-style-type: none"> <li>▪ Gaseous hydrocarbons and CO</li> <li>▪ Oxides of nitrogen</li> <li>▪ Particulate</li> </ul>	X	Reduced	Reduced
<b>Spark-Ignition System Development</b> <ul style="list-style-type: none"> <li>▪ In-cylinder optimization</li> <li>▪ Aftertreatment</li> <li>▪ Direct-injection</li> </ul>	X	X	
<b>Diesel System Development</b> <ul style="list-style-type: none"> <li>▪ Fuel injection and combustion chamber geometry</li> <li>▪ Exhaust gas recirculation</li> <li>▪ In-cylinder optimization</li> </ul>	X		X
<b>Lean Aftertreatment</b> <ul style="list-style-type: none"> <li>▪ Oxidation catalysts</li> <li>▪ Particulate traps and regeneration</li> <li>▪ Lean NO<sub>x</sub> control systems</li> </ul>	X		X
<b>Global Perspectives</b> <ul style="list-style-type: none"> <li>▪ Carbon and hydrogen economies</li> <li>▪ Economics and efficiency</li> <li>▪ Alternative engines</li> </ul>	X	X	X

For more information about courses available at your site, including optimal group size and costs, contact:

Michael J. Andrie, Program Director

Phone: 800-462-0876; 608-263-1615

Email: mandrie@wisc.edu

Website: epd.engr.wisc.edu/2012onsiteengine