SUMMER ISSUE; VOL. 2

POWERTRAIN TECHNOLOGY
EDUCATION & TRAINING GUIDE

August – December 2017

FEATURED COURSES

- **NEW!** Continuously Variable Transmission (CVT) Systems: Technology and Applications Overview | Page 8
- **NEW!** Gasoline Engine Calibration Engineering Academy | Page 32
- Diesel Engine Technology Engineering Academy | Page 22
- Emissions-Related OBD Systems | Page 56
- Hybrid and Electric Vehicle Engineering Academy | Page 66

PLUS—Explore Related Power & Propulsion Technology Resources on pages 77-79!

HOW DO YOU STAY UP-TO-DATE AND SECURE TIMELY INFORMATION IN YOUR TECHNOLOGY AREA?

Look to SAE International as your most critical resource for lifelong training and professional development. In this issue of the ***Power and Propulsion Technology Education and Training Guide***, you'll find an extensive portfolio of courses designed to keep you ahead of the industry.

PLUS - don't miss the suggested Related Power and Propulsion Technology Resources on page 77. We've selected key SAE books, standards, journals, and technical events to further your professional development and deepen your technical knowledge.

THIS GUIDE INCLUDES PROFESSIONAL DEVELOPMENT RESOURCES THAT EXPLORE THE FOLLOWING TOPICS

- Fuels and fuel delivery
- Emissions control and the environment
- Hybrid and Electric Vehicle technology including electric powertrain and battery
- Powertrain/drivetrain
- Internal combustion engines including gasoline and diesel fuel

EARN A CERTIFICATE OF ACHIEVEMENT FROM SAE

SAE multi-course certificates provide an outline of courses designed to extend your understanding in a specific technology area. When reviewing SAE education and training material, watch for the certificate icon. It indicates which courses are part of an SAE multi-course certificate program. For a list of programs, visit **training.sae.org/credentialing/certificate**.

WHY SAE? WHAT OUR CUSTOMERS ARE SAYING

"A great 2 day seminar to learn the basics of modern diesel engines. Clear and concise presentation style of Mr. Khair makes this course a must for students of modern diesel engines."
(In reference to Diesel Engine Technology - page 21)
Mark Sellnau, Senior Staff Research Engineer, Delphi Research Lab

"The course material was current and highly informative. The instructor was an excellent communicator. I am looking forward to putting my new knowledge into practice!"
(In reference to Improving Fuel Efficiency with Engine Oils - page 61)
Christian C. Longacre, Development Engineer, BorgWarner

SAE CUSTOMER SERVICE

Contact SAE Customer Service for any questions concerning schedules, fees, locations, or registration.

1-877-606-7323 (US and Canada) or
+1-724-776-4970 or
CustomerService@sae.org

A LEARNING FORMAT TO FIT EVERY NEED

As the world's leader in offering access to the most extensive, multi-sector source of knowledge and expertise, SAE International provides the mobility engineering training and education needed to turn your challenges into solutions.

What is your learning need?
SAE International offers a variety of learning formats to accommodate diverse learning styles. Explore classroom, live and online, and on demand courses.

Many courses are offered in multiple formats to fit your exact need. Be sure to watch for the icons that identify the format available for each course.

Seminars or workshops available as similar live, online web seminars or on demand courses, will feature icons and information about the schedule and fees for all platforms.

CATALOG KEY
Look for the icons below with the course descriptions. The icons indicate delivery formats for the course and whether the course is part of an SAE Certificate program.

Many courses are available in multiple formats. In addition to finding courses that fit your technology need, look for courses with icons that fit the way you want to learn.

CLASSROOM
Indicates that course is an instructor-led seminar or workshop offered in a classroom setting

LIVE, ONLINE
Indicates this course is an instructor-led Web Seminar offered live and online via telephone and internet connection

ON DEMAND
These offerings are available online anytime the participant would like to access the course through the internet

CERTIFICATE
This icon indicates that this course is part of an SAE International curriculum-based, multi-course certificate.

ACTAR LOGO
This icon indicates the course is an ACTAR approved course. For more information on ACTAR and ACTAR accredited courses, visit training.sae.org/seminarsinfo/actar

As an IACET Accredited Provider, SAE International offers CEUs for its programs that qualify under the ANSI/IACET Standard.

TABLE OF CONTENTS

To help you better plan your training, we schedule live course offerings as far in advance as possible. The content in this resource guide reflects the most accurate information available at the time of publication. Rarely, unforeseen circumstances may force a change to the schedule. Early registration ensures that you not only have a spot in your selected course but are notified of any changes. For the most-up-to-date listing of scheduled courses, visit training.sae.org/calendar/

SAE International reserves the right to cancel offerings and cannot be held responsible for costs incurred beyond registration fees.

SAE CREDENTIALING - ELEVATING KNOWLEDGE

SAE International offers curriculum-based, multi-course certificates programs Intended to provide a guide towards deeper knowledge in a specific area, SAE's multi-course certificates outline required courses that offer foundational knowledge of the subject. Some certificate programs also feature additional electives designed to broaden your exposure to more specific aspects of the technology studied.

In addition to the Continuing Education Units (CEUs) awarded, successful completion heightens your expertise within the field and earns you an SAE credential recognizing your achievement. PLUS—completion of many of the multi-course certificate programs equates to graduate credits towards the SAE/Kettering University 20-credit Certificate in Automotive Systems and Kettering's 40-credit M.S in Mechanical Engineering.

The following certificate programs have courses found in this issue of the Power and Propulsion Education and Training Guide. Visit training.sae.org/credentialing/certificate for more information on all of the SAE multi-course Certificate Programs.

Watch for the certificate icon to indicate course titles that are part of an SAE multi-course certificate.

DIESEL TECHNOLOGY CERTIFICATE PROGRAM

This certificate equips engineers with a solid understanding of diesel engines, emissions and aftertreatment strategies, and related components including fuel injection and air management. The program requires completion of courses that address these areas and offers further depth through a menu of electives.

The required courses are:

- Common Rail Diesel Fuel Injection – Page 17
- Diesel Engine Technology – Page 21
- Turbocharging Internal Combustion Engines – Page 40
- Advanced Diesel Particulate Filtration Systems - Page 46

Choose one elective:

- Diesel Engine Noise Control Web Seminar or Web Seminar RePlay – Page 20
- Engine Failure Investigation and Analysis - Page 24
- Variable Valve Actuation : Design and Performance Impact on Advanced Powertrains – Page 42
- Exhaust Gas Recirculation (EGR) for Diesel Engines – Page 44
- Exhaust Flow Performance and Pressure Drop of Exhaust Components and Systems – Page 50
- Selective Catalytic Reduction for Diesel Engines – Page 58

Completion of the Diesel Engine Technology Engineering Academy can be used as a substitute for Diesel Engine Technology and one elective.

For more information visit: **training.sae.org/credentialing/**

SI ENGINE CERTIFICATE PROGRAM

This certificate is designed to familiarize engineers with key spark ignition engine components and technologies and how they function as a system. By completing the certificate, engineers can acquire fairly deep engine expertise and, at the same time, earn an SAE credential.

All of the following courses are required:

- Internal Combustion Systems: HCCI, DoD, VCT/VVT, DI and VCR – Page 28
- Powertrain Selection for Fuel Economy and Acceleration Performance – Page 30
- The Basics of Internal Combustion Engines – Page 38
- Turbocharging Internal Combustion Engines – Page 40

Choose one elective:

- Automotive Heat Transfer – Page 18
- Gasoline Direction Injection (GDI) Engines – Page 26
- Variable Valve Actuation : Design and Performance Impact on Advanced Powertrains – Page 42
- Exhaust Flow Performance and Pressure Drop of Exhaust Components and Systems – Page 50
- Combustion and Emissions for Engineers – Page 54
- Fundamentals of Automotive Fuel Delivery Systems – **training.sae.org/seminars/c0303/**

For more information visit: **training.sae.org/credentialing/**

TRANSMISSION/DRIVETRAIN CERTIFICATE PROGRAM

This program familiarizes engineers with key drivetrain components and how those components function as a system. By completing the certificate, engineers can increase their expertise within the drivetrain body of knowledge and, at the same time, earn the SAE Certificate of Achievement.

All of the following courses are required:

- A Familiarization of Drivetrain Components – Page 10
- Fundamentals of Modern Vehicle Transmissions – Page 12
- Powertrain Selection for Fuel Economy and Acceleration and Performance – Page 30
- Fundamentals of Automotive All-Wheel Drive Systems – Page 74
- Introduction to Gears - **training.sae.org/seminars/c0822/**

For more information visit: **training.sae.org/credentialing/**

NEW! TRANSMISSION ENGINEERING ACADEMY

The Transmission Engineering Academy covers the passenger car and light truck principles necessary to effectively understand, develop, specify and start the design process. Topics include advances in manual, automatic, automated manual, and continuously variable transmission technology, materials and processes applicable to the major components within these transmissions, calibration of these systems unto themselves and integration into the full vehicle powertrain. This is an intensive learning experience comprised of multiple industry experts who lead lecture and structured practical sessions, including a team-solved case study problem, production and / or test facility tours and a comprehensive hands-on workshop. Two evening sessions are included. Course materials include a copy of the textbook, *The Automotive Transmission Book*, by Robert Fischer.

Special Course Features: As a precursor to the in-person portion of the academy, attendees are required to complete a pre-assessment and six 90-minute on demand courses*. The intent of this advance work is to help the attendee ensure readiness and to start their exposure to new and enabling technologies. Results of the pre-assessment will be shared with the lead instructor to help customize the learning experience to specific attendee needs.

LEARNING OBJECTIVES

By attending this course, you will be able to identify or describe:

- Several new and emerging technologies within the transmission engineering field
- Specific transmission terminology, design and development processes
- Key issues facing transmission designers, calibrators and integrators
- The fundamental technical reasons and limitations of transmission technology in terms of efficiency, NVH, service life and drivability (i.e. operator satisfaction)
- Calibration techniques, methods and outcomes and assess the affectivity of the results
- The key aspects of transmission integration into the modern vehicle powertrain
- The function, limitation and concerns with lubrication as it applies to transmission operation
- Emerging transmission technologies, their optimum application, limitations, cost implications and as a function of regulation and operator expectation

WHO SHOULD ATTEND

This engineering academy will be especially valuable for engineers who design, calibrate and/or integrate any common style transmission into the following types of vehicles: passenger cars, light trucks, light duty off-highway vehicles, light duty farm machinery, and military vehicles.

PREREQUISITES

The following mandatory courses will be available, as recordings, to take at your convenience, before the academy:

- Infinitely Variable Transmissions (IVTs) Using a Toroidal Traction Variator
- Performance and Use of Polymer Plain Bearings in Transmission Design
- New Mechanical Shifting Devices in Automotive Transmissions

CONTENT HIGHLIGHTS

- Materials and Processing
- Lubrication–Chemistry & Formulation; Specification; Using the 'Wrong Lubricant'; Types
- Emerging Technologies–NuVinci Continuously Variable Planetary (CVP) Technology
- Wet Clutch–Operation, Design, & Control
- Kinematics–Concept of the Stick Diagram & the Lever Diagram; Use as a means to Optimize Packaging
- CVT Push-Belt–Definition & Operation; Design Elements, Features, Considerations
- CVT Pull-Chain–Definition & Operation; Design Elements, Features, Considerations
- Rotational Inertia Workshop
- Transmission Charge Pump–Specifications & Operational Requirements; Design Aspects & Attributes
- Torque Converter–Operation; Effect of Transmission System Operation
- System Dampener–Operation; Effect of Transmission System Operation; Hands-On Workshop
- Automated Manual and Dual-Clutch Transmissions–Benefits; Design & Application; Powertrain Integration Issues
- Dual-Mass Systems As Applied to Dual Clutch Transissions–Definition & Description; Application Considerations
- Transmission Calibration and Communication–Objectives, Function, and Requirements
- Energy Management Through the Transmission–Energy and Its Forms; Parasitic Losses

INSTRUCTORS

See the course web page for a complete list of instructors.

I.D.# ACAD11

SCHEDULE

Upcoming dates are being scheduled. Check the course web page for the most up-to-date information.

FEES

List:	$3,865
Members	
Classic:	$3,479
Premium:	$3,285
Elite:	$3,092

FIVE-DAYS/4.2 CEUS

View the complete course description and register: training.sae.org/academies/acad11/

NEW! CONTINUOUSLY VARIABLE TRANSMISSION (CVT) SYSTEMS: TECHNOLOGY AND APPLICATIONS OVERVIEW

This eight-hour web seminar provides a thorough survey of all technologies that are considered applicable to automotive powertrains.

Continuously Variable Transmission (CVT) technology is both a theoretical and practical option that addresses a number of system level improvement opportunities within the automotive and mobility industries. Although this technology has been available for many years and is now fully matured as a production ready technology, it is often not fully understood. This web seminar presents a focused view of CVT technology in all its forms and implementations. The aim of this course is to provide a more complete understanding of all the technologies that are considered continuously variable and to order them in terms of their automotive applicability. Time will be spent discussing application strategies, control and communication requirements with the rest of the powertrain, durability and lubricant requirements.

This eight-hour web seminar provides a thorough survey of all technologies that are considered applicable to automotive powertrains. These technologies will be reviewed within the contexts of both the other CVT technologies and suitability. Finally, the requirements of the device will be discussed and contrasted to appropriateness for use in a modern automotive application.

LEARNING OBJECTIVES

By attending this web seminar, you will be able to:

- Recognize all technologies classified as continuously variable
- Explain the fundamentals of friction and lubrication applied to mechanical power transmission
- Discuss the meaning and use of the functional properties of current lubricant technology
- Represent the concept of friction-required and friction-not-required as applied to mechanical power transmission
- Summarize the function and operation of all major CVT technologies
- List the requirements of CVT and Traction specific lubricants

WHO SHOULD ATTEND

This course is intended for anyone who is not familiar with the function, requirements, and application of continuously variable transmission technology to modern passenger vehicle transmission systems. including, but not limited to design engineers and managers, vehicle powertrain and driveline designers, component suppliers, powertrain and driveline test and development engineers, and design services managers.

CONTENT HIGHLIGHTS

- Review of the Various CVT Strategies
- Comparison of 'Stepped' vs. 'Stepless' Transmission Technology
- Concept of 'friction required' transmissions (i.e. belt / chain CVT, Toroid, etc.) versus 'friction not required' technology (i.e. gears, etc.)
- Conceptual and functional differences between mechanical power transmission systems that require friction to operate and those that do not
- Vehicle Powertrain Optimization Example
- The systemic effect of stepped versus stepless power transmission powertrain performance
- Develop a model of the theoretical optimum functional requirement of a transmission
- Technology overview of belt style CVT (i.e. push / pull) and requirements of lubricant (CVT oil)
- The specifics of a belt style CVT; most commonly based on a 'push' belt technology, and the requirements of the lubricant to support expected performance levels
- Technology overview of chain style CVT (i.e. pull)
- Technology overview of toroidal style CVT and the requirements of the lubricant (traction oil)
- Technology overview of sphere style CVT

INSTRUCTOR

William Mark McVea
President and Principal Engineer, KBE+, Inc.

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I.D.# WB1616

SCHEDULE
October 3-12, 2017
Live Online

FEES

List:	$640
Members	
Classic:	$576
Premium:	$544
Elite:	$512

FOUR, 2-HOUR SESSIONS/.8 CEUS

Get the complete course information and register:
training.sae.org/webseminars/wb1616/

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A FAMILIARIZATION OF DRIVETRAIN COMPONENTS

An efficient, robust, and quiet running drivetrain is as essential to customer satisfaction as styling and interior creature comforts. In this seminar, you will be exposed to various methods that can be used to accomplish this goal. Designed to help you visualize both individual components and the entire drivetrain system, this seminar focuses on the terms, functions, nomenclature, operating characteristics and effect on vehicle performance for each of the drivetrain components. Attendees will receive an introduction to the various components of the drivetrain. This course also provides insight into: the structure and function of each component; vehicle integration; and related noise, vibration and harshness issues. You will be equipped to evaluate the space requirements, mounting needs, clearances required, and effect on vehicle response for each component. Attendees will receive a copy of James Halderman's book, *The Automotive Technology, 4th Ed*.

"An informative seminar for general introduction to the drivetrain components and terminology for any one entering the drivetrain industry."

James Lee
Friction Material Manager
Sulzer Euroflamm US, Inc.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Discuss both practical and technical aspects of smoothing clutch operation by incorporating cushion and torsional dampers
- Compare different types of transmission synchronizers, automatic transmission torque converters, hydraulic clutch operation and epicyclic gear trains
- Describe the interaction of gear ratios and vehicle performance as related to engine horsepower and torque curves
- Explain phasing and mounting of propeller shafts as related to torsional excitation and secondary couple loads
- Review different types of differentials
- Compare common misconceptions of limited slip devices to their actual performance
- Recognize four-wheel drive systems and the need for an inter-axle differential
- Appraise electronic control of torque through braking and clutching devices
- Evaluate the total drivetrain package as a system

WHO SHOULD ATTEND

This seminar is intended for engineers now working with passenger car, sport utility, truck, bus, industrial, and off-highway vehicles who have had minimal prior experience with the total drivetrain.

CONTENT HIGHLIGHTS

- Clutch (dry/wet)
  - Pressure Plate
  - Disc
  - Linkage
- Transmission
  - Automatic
  - Torque Converters
  - Manual
- Propshaft
  - Cardan Joints
  - Constant Velocity Joints
- Axle
  - Rigid
  - Steering
  - Independent
  - Gearing
  - Differentials
- Transfer Case
  - Full-time; Part-time
- Wheel Ends
  - Independent
  - Live vs. Dead Spindle
  - Bearing Architecture
- Brakes
  - Disc;
  - Drum
  - Hydraulics
  - Electronic Control of Brakes and Torque
  - Anti-Lock Brake Systems

INSTRUCTOR

Joseph Palazzolo
Chief Engineer of eDrive Systems,
GKN Driveline

I.D.# 98024

SCHEDULE
September 25-26, 2017
Troy, Michigan

FEES

List:	$1,535
Members	
Classic:	$1,382
Premium:	$1,305
Elite:	$1,228

TWO-DAYS/1.3 CEUS
Get the complete course information and register:
training.sae.org/seminars/98024/

ALSO AVAILABLE AS AN ON DEMAND COURSE.

A Familiarization of Drivetrain Components e-Seminar
Convenient, portable, and with core content from the instructor- led seminar, this five and a quarter hour e-seminar option offers an alternative way to receive the same instruction without the expense of travel and time away from the workplace. This e-seminar is divided into seven video modules and a coordinated handbook.

ID# PD1305550N

FEES

List:	$295
Members	
Classic:	$266
Premium:	$251
Elite:	$236

5.25 HOURS/0.5 CEUS

View the complete course description and a video demo:
training.sae.org/eseminars/pd130555on/

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FUNDAMENTALS OF MODERN VEHICLE TRANSMISSIONS

This seminar covers the latest transmission systems designed to achieve the most efficient engine operation. Discussion includes current designs, components and sub-systems, functionality, operation, and inter-relationships between components and systems. Using a manual transmission display, the instructor explains ratios and their function in the driveline. Automatic transmission design will illustrate automatic control and hydro-mechanic decision theory and implementation. "Hands-on" exercises using transmission models and components will supplement theoretical concepts. Mechatronics, toroidal transmission functions, and the future of the automatic transmission will also be discussed. Continuously Variable Transmission (CVT) systems will be the focus on the third day of this seminar.

"I develop many of the chassis components that mate with the transmission. This course helped me to fully understand the components and functionality of the different types of transmissions. "

Jeremy Ling
Product Engineer;
Honda of America Manufacturing

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Explain the development, operational aspects and design principles of passenger vehicle and light truck transmission systems, their major components and sub-systems
- Describe the operational parameters and inter-relationships of each of the sub-systems
- Apply basic design synthesis and analysis techniques for each of the major components and sub-systems
- Compare and contrast 'stepless' to 'stepped' transmission technology
- Identify and describe the function and operation of all major components and sub-systems by participating in hands-on demonstrations
- Recognize the limitations, technological trends, and potential new products under consideration
- Summarize the direction of new passenger car transmission designs and systems

WHO SHOULD ATTEND

This seminar is intended for anyone not familiar with modern vehicle transmission systems.

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CONTENT HIGHLIGHTS

- Overview of Mechanical Power Transmission
- Theory, Function and Operation of Manual Transmission
- Vehicle Powertrain Requirements and Specifications Assessment
- Shift Strategy Analysis and Control System Implementation
- Components and Sub-systems
- Basic Gear Theory and Application Development
- Powerflow Analysis
- Synchronizer Operation and Analysis
- Lubrication and Cooling Requirements Review
- Development and Layout of the "Automatic"
- Functionality
- Extension of Gear Theory to Epicyclic Gear-trains
- Design and Operation of Clutches and Bands
- Application of One-Way/Over-Riding Clutches
- Powerflow Analysis of Torque Converters, Epicyclic Gear Sets
- Review of Shift Strategy
- Implementation of Shift Strategy Through Hydro-Mechanical Control Systems
- Simple Shift Model Analysis
- Lubrication and Cooling Requirements Review
- CVT Design and Operation
- Technological Development of the CVT
- Basic Theory of Friction Drives
- Toroidal Drive Technology
- Functionality and Characteristics of CVT Components, Sub-systems
- CVT Power-Flow
- Mechatronics
- CVT Manufacturing; Future Technologies

INSTRUCTOR

W. Mark McVea
President and Principal Engineer, KBE+, Inc.

I.D.# 99018

SCHEDULE
December 4-6, 2017
Troy, Michigan

FEES

List:	$1,790
Members	
Classic:	$1,611
Premium:	$1,522
Elite:	$1,432

THREE-DAYS/2.0 CEUS

Get the complete course description and register:
training.sae.org/seminars/99018/

ALSO AVAILABLE AS AN ON DEMAND COURSE.

Fundamentals of Modern Vehicle Transmissions e-Seminar
Convenient, portable, and with core content from the instructor-led seminar, this 14-hour e-seminar option offers an alternative way to receive the same instruction without the expense of travel and time away from the workplace. It is an excellent follow-up to SAE's A Familiarization of Drivetrain Components e-Seminar (which is designed for those who have limited experience with the total drivetrain).

ID# PD130419ON

FEES

List:	$695
Members	
Classic:	$626
Premium:	$591
Elite:	$556

14-HOURS/1.4 CEUS

View the complete course description and a video demo:
training.sae.org/eseminars/pd130419on/

FUNDAMENTALS OF GEAR DESIGN AND APPLICATION

This seminar provides a solid and fundamental understanding of gear geometry, types and arrangements, and design principles. Starting with the basic definitions of gears, conjugate motion, and the Laws of Gearing, you are given the tools needed to understand the inter-relation and coordinated motion operating within gear pairs and multi-gear trains. Basic gear system design process and gear measurement and inspection techniques will also be explained.

"Highly recommended; being new to the gear measuring field, the instructor was able to easily make me understand what I previously believed to be a cryptic science."

Jason D. Cron
Instrumentation Specialist
Toyota Motor Manufacturing NA, Inc.

LEARNING OBJECTIVES

By attending this seminar you will be able to:

- Describe the "Law of Gearing," conjugate action and specifically, involute profiles
- Review the various definitions and terms used in gearing
- Identify the function and operation of all gear arrangements
- Appraise preliminary design considerations and the gear system design process
- Explain practical gear measurement and inspection techniques, tools and equipment
- Recognize "Best Practices" in regards to gear system design
- Discuss some of the new and automated gear design systems

WHO SHOULD ATTEND

Powertrain engineers, engineering directors and managers, component suppliers, vehicle platform powertrain development specialists, and those involved in the design and application of geared systems and assemblies. This seminar will appeal to anyone who is interested in gears, gear systems, design development or measurement and inspection techniques.

CONTENT HIGHLIGHTS

- Principles of Gears
- Gear Tooth Action
- Gear Geometry and Nomenclature
- Gear Arrangements
- Preliminary Design Considerations
- Gear System Design Process
- Gear Design Process
- Gear Measurement and Inspection
- Gear Design Systems and Best Practices

INSTRUCTOR

W. Mark McVea
President and Principal Engineer, KBE+, Inc.

I.D.# C0223

SCHEDULE
Upcoming dates are planned for this course. Check the web page for the most up-to-date information.

FEES

List:	$1,405
Members	
Classic:	$1,265
Premium:	$1,194
Elite:	$1,124

TWO-DAYS/1.3 CEUS

Get the complete course description and register: training.sae.org/seminars/c0223/

FIND OUT HOW TO GET THIS COURSE DELIVERED TO YOUR LOCATION. CONTACT SAE CORPORATE LEARNING SOLUTIONS.

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INTRODUCTION TO POWERTRAIN CALIBRATION ENGINEERING

Driven by the need for lower emissions, better fuel economy and improved drive quality, optimized powertrain calibrations are required for the many different vehicle configurations on today's roadways. This course introduces you to the concepts behind optimized powertrain calibrations and how they impact fuel consumption, exhaust emissions, and vehicle performance. You will also gain exposure to the role that the calibration plays in the system level interactions of the various powertrain components.

LEARNING OBJECTIVES

By connecting with this web seminar, you will be able to:

- Describe the role of calibration in powertrain and vehicle performance
- Identify the fundamental requirements that drive powertrain calibration development
- List the major international regulatory agencies
- Identify the driving factors for complexity of powertrain systems
- Identify the powertrain system interactions that are influenced by calibration
- Recognize tools used in the development of powertrain calibrations
- Diagram the high level calibration process flow

WHO SHOULD ATTEND

This course is intended for anyone who would like a better understanding of powertrain calibration and how it influences vehicle performance and drivability.

CONTENT HIGHLIGHTS

- Fundamental requirements driving powertrain calibration
- Overview of the factors driving complexity in powertrain calibration systems
- Overview of some basic powertrain calibration tasks including base engine, transmission, OBD, aftertreatment, vehicle driveability
- Base Engine Calibrations
- In-vehicle validation of dyno cals
- Vehicle-specific Calibrations
- Location-Specific Calibrations
- Altitude (Emissions, startability, drive quality, performance)
- Systems – How they interact
- Calibration Tasks

INSTRUCTORS

See the course web page for complete list of instructors.

"This course is a great starting point for engineers considering a career path in vehicle and engine calibration. It is very insightful and highly recommended."

Eric Zbytowski
EEM Injection Engineering Manager
Walbro Engine Management

I.D.# WB1346

SCHEDULE
Dates are being scheduled for this course. Check the course web page for the most up-to-date information.

FEES

List:	$425
Members	
Classic:	$383
Premium:	$361
Elite:	$340

TWO, 2-HOUR SESSIONS/.5 CEUS

Get the complete course description and register: training.sae.org/webseminars/wb1346/

ACCESS THIS COURSE ON DEMAND AS A WEB SEMINAR REPLAY

SAE Web Seminar RePlays are captures of live Web Seminars. The sessions include participant interaction including question and answer periods with the instructor. A leanring assessment at the end of the course reinforces learning and retention while gauging your understanding.

I.D.# PD331346ON

FEES
See above

5-HOURS/.5 CEUS

Get more information about the Web Seminar RePlay: training.sae.org/replays/pd331346on/

FORD ON DEMAND COURSES

Ford Motor Company and SAE International have joined forces to provide a series of Ford's on demand training courses to automotive engineers worldwide. Ford and SAE International are offering six popular on demand courses on powertrain and problem-solving topics as a way to extend Ford engineering knowledge across the global industry.

POWERTRAIN DRIVEABILITY

This 3-hour Ford on demand course will provide knowledge of Driveability fundamentals. With this knowledge, you can better determine actions to improve the customer's perception of Driveability.

training.sae.org/ford/pd111016on/

POWERTRAIN PERFORMANCE FEEL

This 3.5-hour Ford on demand course is intended to increase the awareness of vehicle Performance Feel issues, target setting process, and the interactions and controls that affect Performance Feel. Improvement in Performance Feel is identified as high priority.

training.sae.org/ford/pd111017on/

POWERTRAIN AS-INSTALLED DRIVELINE SUBSYSTEMS (PAIDS)

This 8-hour course describes the function and major interfaces of powertrain as-installed driveline subsystems. It also discusses Design Verification System (DVS) metrics/performance requirements for each subsystem and how each subsystem affects others.

training.sae.org/ford/pd111014on/

POWERTRAIN AS-INSTALLED STATIONARY SUBSYSTEMS (PAISS)

This 12-hour course discusses hardware design, function, and major interfaces of powertrain as-installed stationary subsystems and Design Verification System (DVS) metrics/performance requirements for each subsystem and how each subsystem affects others.

training.sae.org/ford/pd111015on/

POWERTRAIN CONTROLS (PTC)

This on demand course introduces the critical role played by the powertrain controls system in vehicle performance, fuel economy, driveability, and emissions. The course describes the powertrain controls system components and stimulates systems interaction thinking by emphasizing powertrain controls interactions with internal and external interfaces; and helps you understand powertrain control systems.

training.sae.org/ford/pd111013on/

GLOBAL 8D (G8D)

This 12-hour course is designed to help product development and manufacturing engineers identify and solve problems. Solving problems results in efficient, as well as effective, resolution to 'root causes' of customer satisfaction issues, and helps reduce warranty costs.

training.sae.org/ford/pd111012on/

COMMON RAIL DIESEL FUEL INJECTION

The vast majority of diesel engines employ a high-pressure common rail fuel injection system to increase the engine's fuel-saving potential, emissions reduction, and overall performance. This seminar begins with a review of the basic principles of diesel engines and fuel injection systems and discusses diesel and alternative fuels, followed by current and emerging diesel engine applications. The course is dedicated to the common rail system itself, including a comprehensive overview of the complete system. The instructor introduces you to the main subsystems, including hydraulics and controls, and breaks down the subsystems into their respective components.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Identify the basic principles of diesel engines and diesel fuel injection
- Distinguish the main properties of diesel and diesel alternative fuels
- Compare and evaluate various diesel engine applications
- Describe the main systems and sub-systems of common rail diesel fuel injection and how these systems interact
- Identify the main design features of the common rail components
- Discuss basic common rail control strategies

WHO SHOULD ATTEND

Engineers and other individuals involved in the design, application, and service of common rail diesel engines utilized in mobility.

CONTENT HIGHLIGHTS

- Basic Principles of Diesel Engines & Diesel Fuel Injection
- Diesel and Alternative Fuels
- Applications -- Passenger car; Light- & Heavy-duty; Off-highway
- Common Rail System Overview
- Hydraulic Components; Controls
- Diesel Engine Overview

INSTRUCTOR

Vincent Piacenti
Senior Manager, Robert Bosch LLC

"Great broad, yet basic, overview course of the diesel common rail fuel system."

Glenn Guire
Senior Engineer
L-3 Combat Propulsion Systems

I.D.# C0920

SCHEDULE
August 16, 2017
Troy, Michigan

FEES

List:	$810
Members	
Classic:	$729
Premium:	$689
Elite:	$648

ONE-DAY/0.7 CEUS

Get the complete course description and register: training.sae.org/seminars/c0920/

FIND OUT HOW TO GET THIS COURSE DELIVERED TO YOUR LOCATION. CONTACT SAE CORPORATE LEARNING SOLUTIONS.

+1.724.772.8529
training.sae.org/corplearning

AUTOMOTIVE HEAT TRANSFER

Heat transfer affects the performance, emissions and durability of the engine as well as the design, packaging, material choice and fatigue life of vehicle components. This course covers the broad range of heat transfer considerations that arise during the design and development of the engine and the vehicle with a primary focus on computational models and experimental validation covering the flow of heat from its origin in the engine cylinders and its transfer via multiple paths through engine components. Specifically, the course covers heat transfer design considerations related to the following: engine cooling and lubrication systems as well as bay-to-bay breathing; exhaust system and after-treatment components; tail pipe gas temperatures, as well as thermal interactions between the engine and its exhaust system with the components in the vehicle under-hood and under-body; turbochargers; passenger cabin HVAC system, including windshield de-icing; battery cooling; heat exchangers and challenges associated with predicting thermal mechanical fatigue life of components.

This course covers the broad range of heat transfer considerations that arise during the design and development of the engine and the vehicle with a primary focus on computational models and experimental validation.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Formulate solutions to heat transfer problems to optimize component design for durability and cost
- Make more reliable predictions of engine in-cylinder heat transfer rates (and therefore thermal stresses and fatigue life) for engine components, namely, the cylinder head, piston, cylinder liner, valves and ports
- Optimize design decisions for above engine components by improving trade-offs between material choices, design, durability, packaging, heat flow map and cost
- Specify thermal boundary conditions for under-hood and under-body CFD models early in a vehicle development program when only high level engine and performance metrics have been defined.
- Predict energy losses due to bay-to-bay breathing
- Describe techniques to facilitate thermal management of exhaust aftertreatment devices (DOC, SOC, particulate filters) and tail pipe exit gas temperatures for diesel vehicles

WHO SHOULD ATTEND

This course will be valuable to engine and vehicle engineers dealing with heat transfer issues. Specifically thermal and structural analysis engineers will learn best practices for making reliable analysis predictions. Hardware release engineers will gain a better appreciation of the limits and capabilities of the analysis and measurement technologies that drive their decisions. Vehicle thermal engineers will gain knowledge to assist them in making design and packaging decisions in the early stages of vehicle development. This unique course will give in-depth insights into thermal considerations spanning the entire vehicle, providing subsystem specialists with an overall perspective of the other vehicle system issues and constraints.

CONTENT HIGHLIGHTS

- Engine In-Cylinder Heat Transfer
- Engine Component and Sub-System Heat Transfer
- Exhaust System Heat Transfer
- Heating, Ventilation and Air Conditioning
- Heat Exchangers
- Battery Cooling
- Best Practices and Challenges

INSTRUCTOR

Raj P. Ranganathan
Industry Consultant

VOLUNTEER TODAY

Want to get involved? Volunteer with SAE. Whether you have a little or a lot of time to give, there are a wide variety of projects to choose from.

Here's how it works:

• Go to the Member Connection at connection.sae.org & select the "Volunteer" tab at the top

• View the entire volunteer list and sign up for those of interest to you

• You can also opt into the volunteer pool to be matched with opportunities based on the criteria provided and receive alerts on future openings

I.D.# C1230

SCHEDULE
Upcoming dates are being scheduled. Check the course web page for the most up-to-date information.

FEES

List:	$1,275
Members	
Classic:	$1,148
Premium:	$1,084
Elite:	$1,020

TWO-DAYS/1.3 CEUS

Get the complete course description and register: training.sae.org/seminars/c1230/

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DIESEL ENGINE NOISE CONTROL

This course provides an in-depth overview of diesel engine noise including combustion and mechanical noise sources. In addition, the instructor discusses a system approach to automotive integration including combining sub-systems and components to achieve overall vehicle noise and vibration goals.

LEARNING OBJECTIVES

By connecting with this web seminar, you will be able to:

- Identify and analyze commonly occurring diesel engine noise sources
- Understand how analytical and experimental techniques can be used to solve diesel noise issues
- Prescribe appropriate noise control analysis and solutions for specific diesel engine NVH issues

WHO SHOULD ATTEND

This web seminar is ideal for those wishing to understand the root causes of many diesel engine noise issues and how to use this understanding to better diagnose and control diesel engine-related noises.

CONTENT HIGHLIGHTS

- The Basics of Diesel Engine Noise
- Combustion Noise Forcing Functions
- Combustion Mode Switching
- Mechanical Forcing Functions in Diesels
- Separating Combustion and Mechanical Noise Sources
- Strategies for Reducing Forcing Functions
- Surface Radiated Noise
- Exterior Covers: Radiated Sound and Simulation Modeling
- Gear Train Noise Issues and Countermeasures
- Drive-By Noise Contribution
- Diesel Engine Design Considerations for Low Noise
- Application Noise Issues

INSTRUCTOR

Thomas Reinhart
Program Manager, Southwest Research Institute

"This was a great web seminar for introduction into engine noise sources and paths, as well as techniques used to improve engine NVH quality."

John Roxworthy
Sound Development Engineer
Caterpillar, Inc.

I.D.# WB1041

SCHEDULE
August 15-17, 2017
Live Online

FEES

List:	$425
Members	
Classic:	$383
Premium:	$361
Elite:	$340

TWO, 2-HOUR SESSIONS/.4 CEUS

Get the complete course description and register: training.sae.org/webseminars/wb1041/

ACCESS THIS COURSE ONLINE AND ON DEMAND AS A WEB SEMINAR REPLAY.

SAE Web Seminar RePlays are captures of live Web Seminars. The sessions include participant interaction including question and answer periods with the instructor. A leanring assessment at the end of the course reinforces learning and retention while gauging your understanding.

I.D.# PD331041ON

FEES
See above

4-HOURS/.4 CEUS

Get more information about the Web Seminar RePlay: training.sae.org/replays/pd331041on/

DIESEL ENGINE TECHNOLOGY

As diesel engines become more popular, a fundamental knowledge of diesel technology is critical for anyone involved in the diesel engine support industry. This course explains the fundamental technology of diesel engines starting with a short but thorough introduction of the diesel combustion cycle, and continues with aspects of engine design, emission control design, and more. An overview of developing technologies for the future with a comprehensive section on exhaust aftertreatment is also included. The instructor's book, *Diesel Emissions and Their Control*, co-authored with W. Addy Majewski, is included with the seminar.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Summarize the technological advances in modern diesel engines
- Evaluate the sources of emissions from diesel engines and the influence of engine component design on curbing these emissions
- Explain diesel exhaust aftertreatment systems and their effectiveness in reducing emissions
- Recognize the importance of fuel injection parameters to performance and emission control

WHO SHOULD ATTEND

You should attend this seminar if you are involved in diesel engine support industries such as catalytic converters, lube oils, gaskets, and turbocharger suppliers, and if you are not well versed with diesel engines although they play a major role in your career's survival.

CONTENT HIGHLIGHTS

- The Case for the Diesel Engine
- The Diesel Combustion Process
- Basic Types of Diesel Engines
- General Characteristics of DI & IDI Engines
- The Diesel Fuel Injection System
- Air Management - Supercharging & Turbocharging
- Emissions Formation in Diesel Engines
- Emission Standards—Europe; North America
- Steps Towards the Modern Diesel Engine
- Current and Future Technologies

INSTRUCTOR

Magdi Khair
Consultant, Magdiesel Technologies

"Great insight into opportunity offered by diesel technology to address fuel economy issues."

Joseph Griffin
Staff Engineer
GMPT

I.D.# 93014

SCHEDULE
October 3-4, 2017
Troy, Michigan

FEES

List:	$1,675
Members	
Classic:	$1,508
Premium:	$1,424
Elite:	$1,340

TWO-DAYS/1.3 CEUS

Get the complete course description and register: training.sae.org/seminars/93014/

ALSO AVAILABLE AS AN ON DEMAND COURSE.

Diesel Engine Technology e-Seminar

Convenient, portable, and with core content from the instructor-led seminar, this e-Seminar option offers an alternative way to receive the same instruction without the expense of travel and time away from the workplace.

I.D.# PD130812ON

FEES

List:	$645
Members	
Classic:	$581
Premium:	$548
Elite:	$516

13-HOURS/1.3 CEUS

View the complete course description and a video demo: training.sae.org/eseminars/pd130812on/

DIESEL ENGINE TECHNOLOGY ENGINEERING ACADEMY

This Engineering Academy covers the diesel engine engineering principles and practices necessary to effectively understand a modern diesel engine. Types of engines addressed include naturally aspirated, turbocharged, pre-chamber, open chamber, light duty, and heavy duty. It is an intensive learning experience comprised of lecture and structured practical sessions, including a team-solved case study problem. Evening sessions are included. Attendees will receive a copy of the textbook, *Diesel Emissions and Their Control*, by lead instructor Magdi K. Khair and W. Addy Majewski.

Practical Component
This Academy includes several practical activities, including a team-solved case study and a technical facility tour.

Pre-Academy Activity
Prior to the Academy, you will be asked to complete a pre-assessment. Results will be shared with the lead instructor to help customize the learning experience to specific attendee needs.

"Greatly strengthens and increases your understanding of diesel engine technology and its methods for meeting the demands of industry and environmental regulations. As an engineer relatively new to the diesel engine industry, my competence and appreciation for, diesel engine technology has improved significantly because of this Academy."

Christopher A. Brown
Senior Project Engineer
Daimler

LEARNING OBJECTIVES

By attending this course, you will be able to:

- Articulate basic diesel engine terminology and principles
- Describe the key features of the basic types of diesel engines
- Compare various diesel fuel injection systems and their components
- Analyze the effects of different fuels on engine performance and longevity
- Compare the function and applicability of various air management systems
- List the various emission standards and testing requirements
- Detail the elements of post-combustion emission control devices
- Discuss emerging diesel engine technologies

WHO SHOULD ATTEND

This academy will be especially valuable for engineers who design diesel engines in passenger cars, light and heavy trucks, off-highway vehicles, and farm machinery.

CONTENT HIGHLIGHTS

- Terminology and Performance Parameters
- The Case for the Diesel Engine
- Thermodynamics
- Fuel Injection Systems
- Fuels Technologies
- Thermodynamics II: Combustion in Diesel Engines
- Diesel Combustion & Emissions in DI Engines
- The Role of Lube Oil in Modern Diesel Engines
- Modern Fuel Systems & Their Applications
- Air Management Systems
- Engine Controls
- On-Board Diagnostics
- In-Cylinder Measures to Control Emissions
- Diesel Exhaust Aftertreatment
- Engine Controls
- Emerging Technologies
- Case Study Team Sessions
- Diesel Facility Tour

INSTRUCTORS

See the course web page for a complete list of instructors.

SAE DIESEL TECHNOLOGY CERTIFICATE PROGRAM

Watch for the certificate icon to indicate course titles that are part of an SAE multi-course certificate program.

Designed to equip you with a solid understanding of diesel engines, emissions and aftertreatment strategies, and related components, the program requires completion of courses that address these areas and then facilitates further depth in aftertreatment technologies through a menu of electives. Complete the Diesel Technology Certificate and earn eight graduate credits towards the SAE/Kettering University 20-credit Certificate in Automotive Systems and Kettering's 40-credit M.S. in Mechanical Engineering. Visit training.sae.org/collegecredit for more information. View the list of required and elective courses and more information on enrolling in this SAE certificate program--training.sae.org/credentialing/certificate/dieseltech.htm

I.D.# ACAD03

SCHEDULE

Upcoming dates are being scheduled. Check the course web page for the most up-to-date information.

FEES

List:	$3,445
Members	
Classic:	$3,101
Premium:	$2,928
Elite:	$2,756

FIVE-DAYS/4.0 CEUS

Get the complete course description and register: training.sae.org/academies/acad03/

ENGINE FAILURE INVESTIGATION AND ANALYSIS

This comprehensive seminar introduces you to the methods and techniques used to understand the types of variables and inputs that can affect engine reliability and then determine the most likely cause of an individual engine or group of engine failures in the field. The seminar begins with a discussion of customer expectations and experiences and how any disconnect between the two can affect the customer's overall perception of an engine's performance and reliability. The seminar then focuses on the concepts of uncertainty and deterministic design, what is a failure, and how a combination of factors from design inputs to supplier variability can affect the reliability of all or just a portion of an engine population. This is followed by a review of the investigative process and analytical methods required to arrive at an objective and thoroughly developed conclusion as to the nature and cause of the failures at issue. The seminar finishes with a review of case studies that involve customer related issues and failures arising due to a variety of inputs including design, manufacturing, duty cycle, and maintenance.

The focus of the course is to understand the fundamental types and sources of inputs that contribute to engine failures and the process and methods used to identify them and determine what, if any, type of corrective actions should be implemented.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Analyze engine failure claim narratives and how they relate to the customer experience
- Explain the concept of uncertainty and how it relates to failures and complaints attributed to an engine system
- Analyze and interpret engine and/or vehicle warranty data
- Reconcile the physical evidence with the narrative and warranty evidence
- Determine the most likely cause of engine failure based on the available evidence
- Reconcile any disconnect between customer expectations and experience and determine what if any corrective actions are required

WHO SHOULD ATTEND

This course has been developed for engineers and technical professionals in all fields related to the investigation, analysis, and root cause determination of engine failures in various types of vehicles and equipment used in both on road and off road applications. Individuals directly involved in the investigation of engine failure and failure related issues will benefit most from this material.

CONTENT HIGHLIGHTS

- The Customer Experience
  - Expectations
  - Perceptions
  - Experiences
  - Metrics
- Uncertainty in Design and Development
  - Design & Development
  - Design Entropy
- Engine Characteristics
  - Creation
  - Components
  - Production
  - Integration
- Contributing Factors
  - Contributors
  - Inputs
  - Controlling Uncertainties
- Investigative Process
  - Goals
  - Evidence
  - Collecting Information
- Analytical Method
  - Analysis Steps
  - Population Identification
  - Analysis Methods
- Selected Case Studies
  - Competing Requirements
  - Oil Consumption
  - Customer Maintenance
  - Engine Integration & Duty Cycle
  - Development Quirks

INSTRUCTOR

Robert Kuhn
Industry Consultant

I.D.# C1344

SCHEDULE
September 21-22, 2017
Troy, Michigan

FEES

List:	$1,370
Members	
Classic:	$1,233
Premium:	$1,165
Elite:	$1,096

TWO-DAYS/1.3 CEUS

Get the complete course description and register:
training.sae.org/seminars/c1344/

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GASOLINE DIRECT INJECTION (GDI) ENGINES

The quest for more efficient, smarter, and environmentally cleaner liquid-fueled spark ignition (SI) reciprocating engines is more alive and intense now than ever before. GDI SI engines have overcome many of the original limitations and are now becoming commonplace. This seminar offers a comprehensive overview of GDI engines. Mixture preparation and the combustion process, with an emphasis on strategies for both homogenous and stratified charge operation and control, including issues related to the direct injection of gasoline into the combustion chamber, and fuel injection system requirements for optimal spray characteristics will be explored. Emission of pollutants, fuel economy and effects of some key design and operating parameters will also be covered. The seminar concludes with an overview of a select list of production and prototype GDI engines.

"It covers every possible attendee, from the one that wants only an overview to the one that needs the most deep detail of GDI engine. Worth the trip I made from Greece. "

Savvas Savvakis
PhD Researcher
Aristotle University of Thessaloniki

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Describe the rationale behind the GDI engine operation
- Analyze the important processes in GDI engines
- Explain liquid atomization, sprays, and injector requirements for successful GDI operation
- Utilize the technology and the logic behind gasoline direct injection
- Estimate and predict effects of key engine design and operating conditions on performance, combustion, and emission in GDI engines
- Communicate effectively with engineers working on fuel injection, combustion and emission aspects of the GDI engine in your firm or with customers
- Effectively contribute to the design of critical components such as combustion chambers, injectors, and emission reduction strategies
- Explain and utilize trade-offs between increasing engine performance and maintaining low emission characteristics

WHO SHOULD ATTEND

This seminar will be especially valuable for engineers, technical and project managers, researchers, and academicians working on the design and development of components for high efficiency and performance of GDI engines as well as those involved in mixture preparation and emission reduction of pollutants from these engines. Environmental engineers desiring to expand their understanding of fuel spray formation and combustion and emissions from GDI engines will benefit.

CONTENT HIGHLIGHTS

- Combustion Systems
- Fuel Injection System
- Fuel Spray Characteristics
- Mixture Formation
- Combustion Process and Control Strategies
- Engine Operating Modes and Fuel Injection Strategies
- Split Injection Strategy
- Combustion characteristics
- Effects of Engine Operating and Design Parameters on GDI Combustion
- Injector, Combustion Chamber, and Intake Valve Deposits
- Emissions of Pollutants - Reduction Approaches
- Fuel Economy
- Select Gasoline Direct-Injection Engines
- GDI Fuel Rail Technology
- Benefits of Turbocharging a GDI engine

INSTRUCTOR

Bruce Chehroudi
Chief Scientist and Group Leader, Advanced Technology Consultants

SI ENGINE CERTIFICATE PROGRAM

Watch for the certificate icon to indicate course titles that are part of an SAE multi-course certificate program.

Designed to familiarize you with key spark ignition engine components and technologies and how they function as a system, completing this certificate delivers a fairly deep level of engine expertise and, at the same time, an SAE credential. Complete the SI Engine Certificate and earn seven or eight graduate credits towards the SAE/Kettering University 20-credit Certificate in Automotive Systems and Kettering's 40-credit M.S. in Mechanical Engineering. Visit training.sae.org/collegecredit. View the list of required and elective courses and additional information on enrolling in this SAE certificate program-- training.sae.org/credentialing/siengine/

I.D.# C1009

SCHEDULE
Future dates are planned for this course. Check the web page for the most up-to-date information.

FEES

List:	$1,790
Members	
Classic:	$1,611
Premium:	$1,522
Elite:	$1,432

THREE-DAYS/2.0 CEUS

Get the complete course description and register: training.sae.org/seminars/c1009/

INTERNAL COMBUSTION SYSTEMS: HCCI, DOD, VCT/VVT, DI AND VCR

This seminar exposes you to the emerging technologies in engine design and operation that can improve operational efficiencies and presents the fundamental science and implementation technology of the various internal combustion engine systems. You will learn how the Engine Control Module (ECM) uses information related to the operational status to implement real-time running efficiency of the engine. You will also learn how the ECM effects changes in the operation of the engine through the control systems that manage its operation. With this understanding, you will be able to derive your own set of improvement criteria that could be made to address the limitations of current engine technology.

"SAE [International's] Internal Combustion Systems course is a perfect overview of available and upcoming engine technologies for design, testing and quality engineers and managers."

Eric Sauck
Product Quality Engineer
Kia Motors America

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- List the typical sensors, the sensory information they collect and describe the use of that information as it addresses improved fuel economy and reduced combustion emissions
- Describe the significance, technology, and application of:
  - Direct Injection (gasoline and diesel)
  - Homogenous Charge Compression Ignition (HCCI)
  - Displacement on Demand Systems
  - Variable Cam Timing & Variable Valve Timing
  - Variable Compression Ratio engine designs
- Explain the fundamental physics of the various technologies
- Specify the operational parameters and inter-relationships of each of the sub-systems of the enabling hardware
- Describe the basic design synthesis and analysis techniques for each of the major operational improvement technologies

WHO SHOULD ATTEND

This intermediate level seminar is appropriate for a number of design and engineering disciplines including: automotive engine design and development engineers, engine test engineers, design service managers, engineering managers, and others who use technical knowledge to meet job expectations.

CONTENT HIGHLIGHTS

- Operation of ECM and Sensor Systems
- Direct Injection (DI) of Both Gasoline and Diesel Fuels
- Homogeneous Charge Compression Ignition (HCCI) Technologies
- Displacement on Demand (DoD) Systems
- Variable Cam and Valve Timing (VCT, VVT)
- Variable Compression Ratio (VCR) Engine Designs
- Use of alternative fuels; dual fuel & multi-fuel engines
- Emerging and New technologies

INSTRUCTOR

W. Mark McVea
President and Principal Engineer, KBE+, Inc.

I.D.# C0613

SCHEDULE
November 1-3, 2017
Troy, Michigan

FEES

List:	$1,745
Members	
Classic:	$1,571
Premium:	$1,483
Elite:	$1,396

THREE-DAYS/2.0 CEUS

Get the complete course description and register: training.sae.org/seminars/c0613/

YOUR CONNECTION TO THE MOBILITY ENGINEERING COMMUNITY

The Member Connection is an online community providing multiple engagement opportunities:

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• Build your professional network, and seek and share advice among industry experts

• Learn about the latest volunteer opportunities all in one place

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And more...

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POWERTRAIN SELECTION FOR FUEL ECONOMY AND ACCELERATION PERFORMANCE

Developing vehicles that achieve optimum fuel economy and acceleration performance is critical to the success of any automotive company. Many engineers haven't received formal training on the broad range of factors influencing vehicle performance. This seminar provides fundamental understanding through the development of mathematical models describing the relevant physics and through hands-on application of automotive test equipment.

"This is a good course for engineers which will be working on fuel economy. This course provides the physics behind modeling and integration. This should be required training for new engineers (instruction) and old pro's (refreshment)."

Jeffrey Wroblewski
Senior Fuel Economy Engineer
Volvo Group Truck Technology

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Explain the basic operation of the components in an automotive powertrain
- Calculate road loads on a motor vehicle
- Select appropriate gear ratios for a given engine/chassis combination
- Predict the effect of gear selection, body design, and weight on the fuel economy of a vehicle
- Explain and utilize the mathematical models for predicting the acceleration of an automobile
- Explain and utilize the mathematical models for predicting the fuel economy of an automobile
- Use computer software for predicting vehicle fuel economy and performance

WHO SHOULD ATTEND

Automotive engineers involved in the design and development of automotive powertrains.

CONTENT HIGHLIGHTS

- Powertrain Configuration
- Road Load Forces and Power
- Vehicle Coastdown Test
- Vehicle Tractive Effort
- Drivetrain Selection
- Analysis of Power and Torque Flow in Drivetrain Components
- Acceleration Performance Prediction
- Road Load and Acceleration Power Testing Laboratory
- Fuel Economy Prediction
- Demonstration of Vehicle Performance Software

INSTRUCTORS

Dr. Craig J. Hoff
Associate Professor of Mechanical Engineering, Kettering University

Dr. Gregory Davis
Professor of Mechanical Engineering, Kettering University

I.D.# C0243

SCHEDULE
Upcoming dates are being scheduled. Check the course web page for the most up-to-date information.

FEES

List:	$1,370
Members	
Classic:	$1,233
Premium:	$1,165
Elite:	$1,096

TWO-DAYS/1.3 CEUS

Get the complete course description and register: training.sae.org/seminars/c0243/

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P151640

NEW! GASOLINE ENGINE CALIBRATION ENGINEERING ACADEMY

This Academy is designed to provide a foundation for those interested in entering the field of calibration engineering through hands-on exercises and detailed instruction on the base principles of calibration.

Starting with an introduction to calibration and calibration tools, the course covers a range of topics to provide an understanding of general calibration work flow, project management aspects of calibration, developing calibration processes and manuals, establishing calibration project schedules, and incorporating calibration testing. The relationship between software strategy and calibration strategy is also emphasized along with how to read Simulink block diagrams in order to know the software algorithms being calibrated. Various examples of engine control strategies are provided with an explanation of how these strategies would be calibrated. This Academy is intended to be interactive and hands-on so learners are challenged each day with calibration projects. Learners address: target system requirements, details of the software strategy that will be calibrated, how to formulate the calibration process to meet the requirements, and how to run tests that verify requirements were met.

LEARNING OBJECTIVES

By attending this course, you will be able to:

- Read and interpret software strategy from Simulink models
- Establish calibration initial values by understanding software strategy and system physics
- Demonstrate generalized calibration techniques by real time calibration of electronic throttles and gasoline PFI engines
- Relate system requirements to calibration targets
- Demonstrate fundamentals of calibration techniques for PID feedback controls
- Describe base requirements to start an engine from sensors, encoders, fuel delivery, spark timing, and air control
- Calibrate model-based fueling strategy and implement Min Gov RPM control
- Identify uses of real-time adapt strategies and calibrate feedback Pre Cat O2 controller
- Implement calibrations for transient fueling and discuss advanced calibration topics for future learning

WHO SHOULD ATTEND

Mechanical or electrical engineers who are new to the field of calibration engineering, and managers new to calibration positions who need an understanding of general calibration workflow.

CONTENT HIGHLIGHTS

- Basics of Calibration & PID Tuning on ETC
  - Types of calibration parameters – constants, enumerations, tables, maps
  - Calibration tools data management
  - Cal management
  - PID controls explanation
  - ETC strategy review and build files
- Engine Fundamentals & Crank State
  - Engine control basics – fuel, air, and spark
  - Engine walk through – sensors and actuators
  - Encoder basics, angle based outputs, synchronization, TDC offset
  - Engine state machine
  - Crank state strategies and calibrations
  - Cold start crank calibrations
  - Model based fuel strategy
- Run State & Minimum Governor
  - Calibration review of run state strategy
  - Minimum governor explanation and requirements; Minimum governor model and calibration review
- Airflow Estimation & O2 Control
  - Model based estimation – speed density
  - Real time model adapting techniques
  - Speed Density Calibration Project
  - Feedback O2 control & fuel perturbation for catalysts
  - Linear vs. ramp/jump O2 control strategy
- Transient Fueling & Advanced Topics
  - Transient fueling requirements and intake manifold puddling
  - Delta TPS vs Tau-X strategies
  - Emissions Calibrations
  - Calibration equipment for steady-state and vehicle based calibrations
  - Advanced calibration
  - Calibration process and timeline for production release
- Classroom Projects: ETC Tuning Project; Crank State Calibration Project; Minimum Governor Project; Run State Calibration Project; O2 Control Project; Transient Fuel Project

INSTRUCTOR

Jason Tartt
Technical Lead, LHPU

I.D.# ACAD10

SCHEDULE
September 25-29, 2017
Pontiac, Michigan

October 16-20, 2017
Pontiac, Michigan

FEES

List:	$3,995
Members	
Classic:	$3,596
Premium:	$3,396
Elite:	$3,196

FIVE-DAYS/4.0 CEUS

Get the complete course description and register:
training.sae.org/academies/acad10/

NEW! FUNDAMENTALS OF SYSTEM CONTROLS CERTIFICATE OF MASTERY - GASOLINE

Fundamentals of Control Systems – Gasoline is an intense controls apprenticeship designed to give you the skills, confidence, and experience to contribute your first day on the job as a professional controls engineer.

Fundamentals of Control Systems - Gasoline is an intensive, six-week series of gasoline controls courses and exercises using the latest industry tools and standards, including utilization of software technology for Rapid Controls Prototyping. This course, presented by LHPU, covers more than 60 topics in engineering processes. This course also integrates soft skills into the program, coaching students in business etiquette, leadership, stress management and teamwork. Instruction is provided through a curated set of materials and then students apply the concepts learned by completing group projects.

Graduates of the LHPU program receive a Certificate of Mastery in Control Systems from SAE International. Currently, this is the ONLY Certificate of Mastery program in embedded controls offered by SAE International.

LEARNING OBJECTIVES

By attending this six-week training, you will be able to:

- Construct, analyze, and decode a CAN J1939 Protocol message
- Build an embedded controls model, produce a PI controller, characterize a sensor, set up an encoder in MotoHawk and Simulink, run a fuel injector, and define and implement a CAN message in MotoHawk and Simulink
- Build and simulate a system of two PI controllers, each with target management
- Calibrate the simulated system within set performance limits
- Combine information from multiple documents to generate application specific code features (includes CAN messages)
- Combine learned material throughout the course to build an engine control strategy and apply and calibrate on a live 4-cylinder engine, electronic throttle, Port Fuel Injected (PFI) from written specifications
- Test and debug a Simulink/MotoHawk engine control model on an HIL simulator
- Practice the fundamentals of wire harness fabrication
- Prepare and give a presentation and hands-on demonstrations to a live audience

IS THIS COURSE FOR YOU?

The program is designed for recent engineering graduates or experienced engineers interested in a career in controls.

CONTENT HIGHLIGHTS

- Introduction to CAN Communication
- Fundamentals of Control Systems, Code Generation Tools, and Calibration Tools
  - Introduction to MotoHawk
  - Fundamentals of Controls Design and Simulink
  - Introduction to PID Controllers
  - Introduction to Fundamental Mechanics of ETCs
  - Simulating Systems using Simulink (SIL – Software-in-loop)
  - Flashing Models to ECU Hardware and Calibrating using Calibration Tools
  - Controlling Fuel Injectors
- Minimum & Maximum Governor Modelling
  - Learning details of a Supplied Engine Model in Simulink
  - Introduction to Engines & States; Introduction to Speed Limiters
  - Creating an Idle Feedback RPM Controller for the Engine
  - Isolating Engine Operation into Engine States and Applying the Appropriate Controller in each state
  - Adding Pedal-based Engine Control to the Engine Control Strategy
  - Building a Maximum Governor RPM Limiter into the Engine Control Strategy
- Hardware in the Loop Systems
  - Introduction to HiL Systems
  - HiL System Interfaces
  - Fundamentals of Wire Harness Fabrication
  - Applying Test Strategies to HiL Systems
  - Troubleshooting with HiL Systems
- Engine Calibration using Trainee's Software Strategy on a Live Engine and Calibrating this Strategy
  - Basics of Calibration & PID Tuning on ETC and RPM
  - Engine Fundamentals & Crank State Calibration
  - Run State Calibration & Minimum Governor
  - Airflow Estimation and O2 Control

INSTRUCTOR

View course description on the SAE website for information on instructors.

I.D.# CLH1401

SCHEDULE
Check the course web page for the scheduled offerings for this course.

FEES
List: $12,000
Members
There are no member discounts for this course.

SIX-WEEKS

Get the complete course description and register:
training.sae.org/seminars/clh1401/

NEW! FUNDAMENTALS OF SYSTEMS ENGINEERING WITH FUNCTIONAL SAFETY ISO26262

Embedded controls engineers focus their strategies at the system level and their technical know-how to the complex control of the subsystems and components. Skilled embedded controls engineers proficient in strategy development using Simulink are in high demand in the automotive industry. This intensive, six-week course covers Functional Safety and diesel engine controls exercises including the utilization of software technology for rapid controls prototyping. This course, presented by LHPU, covers topics such as, feedback of a PI controller, diesel engine overview, diesel governing strategies, fuel calculations, extensive usage of Simulink and code generation tools, calibration exercises for throttles and idle control, etc.

This course is intended to give students the foundation to implement the ISO 26262 standard. At the end of the course, students should be able to use an Electronic Throttle Control to explain the concepts and demonstrate Functional Safety using the ISO 26262 standard requirements. This course is designed to give students the skills, confidence, and experience to contribute on the first day of their job as a professional engineer.

LEARNING OBJECTIVES

- Construct, analyze, and decode a CAN J1939 Protocol message
- Build an embedded controls model, produce a PI controller, characterize a sensor, set up an encoder in MotoHawk and Simulink, run a fuel injector, and define and implement a CAN message in MotoHawk and Simulink
- Build and simulate a system of two PI controllers, each with target management
- Calibrate the simulated system within set performance limits
- Combine information from multiple documents to generate application specific code features (includes CAN messages)
- Explain ISO 26262 work products, such as Safety Plan, Safety Case, Functional Safety Requirements (FSR), and Technical Safety Requirements (TSR)
- Develop HARA (Hazard Analysis and Risk Assessment) and ASIL (Automotive Safety Integration Level) determinations
- Analyze real-world fault detection for electronic throttle control project
- Validate and test safety requirements and work products such as Test Cases, Traceability Matrix
- Combine learned material throughout the course to build an engine control strategy and apply and calibrate on a live 6-cylinder engine, electronic throttle, Port Fuel Injected (PFI) from written specifications

- Test and debug a Simulink/MotoHawk engine control model on an HIL simulator
- Practice the fundamentals of wire harness fabrication
- Prepare and give a presentation and hands-on demonstrations to a live audience

IS THIS COURSE FOR YOU?

This program is designed for recent engineering graduates who ready to take their next step to become controls and software test engineers.

CONTENT HIGHLIGHTS

- CAN Communication using J1939 Protocol
  - Introduction to CAN Communication
  - Introduction/Overview of ISO 26262
- Fundamentals of Control Systems, Code Generation Tools, and Calibration Tools
  - Intro to MotoHawk
  - Modeling Strategies & Best Practices
  - Control of Hardware through Software
  - Determining HARA / ASIL
- Minimum & Maximum Governor Modeling
  - Introduction to Engines & States
  - Introduction to Speed LImiters
  - Buidling a Maximum Governor RPM Limiter into the Engine Control Strategy
- Hardware in the Loop Systems
  - Introduction to HiL Systems
  - HiL System Interfaces
  - Applying Test Strategies to HiL Systems; Troubleshooting
- Engine Calibration using Trainee's Software Strategy on a Live Engine and Calibrating this Strategy
  - Basics of Calibration & PID Tuning on ETC & RPM
  - Engine Fundamentals & Crank State Calibration
  - Run State Calibration & Minimum Governor

INSTRUCTOR

Check the course web page for information on the instructors for this course.

I.D.# CLH1301

SCHEDULE
Check the course web page for the scheduled offerings for this course.

FEES
List: $15,000
Members
There are no member discounts offered for this course.

SIX-WEEKS

Get the complete course description and register:
training.sae.org/seminars/clh1301/

THE BASICS OF INTERNAL COMBUSTION ENGINES

This seminar covers the most relevant topics - ranging from the chemistry of combustion to the kinematics of internal components of the modern internal combustion engine - for maximum comprehension. You will gain a practical, hands-on approach to the basics of the most common designs of internal combustion engines, as they apply to the gaseous cycles, thermodynamics and heat transfer.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Discuss basic functioning and component interaction in a modern internal combustion engine
- Describe the general thermodynamic concepts governing the operation of an internal combustion engine and its various cycles
- Compare operational differences of various fuels used in internal combustion engines, their availability, and understand the applicability of each
- Discuss the function and operation of all major components and systems within a modern internal combustion engine
- Identify the operational principles behind the timing and working relationships among all internal components, and articulate the importance of this inter-relationship
- Recognize the limitations of the current designs and implementations of the modern internal combustion engine
- Perform a basic assessment and evaluation of new, cutting-edge designs and new powertrain initiatives as they apply to the mobility industry

WHO SHOULD ATTEND

This course is designed for powertrain engineers, component suppliers, vehicle platform powertrain development specialists, and those involved in the application, design and discussion of engines.

CONTENT HIGHLIGHTS

- Fundamental Operating Procedures
- Engine Technology
- Fuel Delivery Systems
- Valve Train
- Component and Event Timing
- Fuels & Combustion; Ignition
- Emissions & Controls
- Thermodynamics
- Energy Conversion Kinematics and Mechanisms

INSTRUCTOR

W. Mark McVea
President and Principal Engineer, KBE+, Inc.

"The course is well-designed and expertly taught. It far exceeded my expectations and is a great introduction to internal combustion engines."

Matt Jackson
Manager
Southwest Research Institute

I.D.# C0103

SCHEDULE
October 30-31, 2017
Troy, Michigan

FEES

List:	$1,395
Members	
Classic:	$1,256
Premium:	$1,186
Elite:	$1,116

TWO-DAYS/1.3 CEUS

Get the complete course description and register: training.sae.org/seminars/c0103/

ALSO AVAILABLE AS AN ON DEMAND COURSE.

Convenient, portable, and with core content from the instructor-led seminar, this option offers an alternative way to receive the same instruction as classroom learning without the expense of travel and time away from the workplace.

I.D.# PD130944ON

FEES

List:	$565
Members	
Classic:	$509
Premium:	$480
Elite:	$452

10-HOURS/1.0 CEUS

View the complete course description and a video demo: training.sae.org/eseminars/pd130944on/

TURBOCHARGING FOR FUEL ECONOMY AND EMISSIONS

This course explores turbocharging for gasoline and diesel engines, including the fundamentals of turbocharging, design features, performance measures, and matching and selection criteria. It discusses the interaction between turbocharging and engine systems and the impact on performance, fuel economy and emissions. Developments in turbocharging technology such as variable geometry mechanisms, two-stage and sequential turbocharging, EGR including low and high pressure loop, and mixed mode systems and novel turbocharging systems are described using figures and data.

LEARNING OBJECTIVES

By connecting with this course, you will be able to:

- Identify the basics of how a turbocharger works, how to measure the appropriateness of a turbocharger, and how to select and match a turbocharger to the needs of your powertrain
- Estimate the impact of turbocharging on performance and emissions
- Anticipate potential issues such as packaging, noise, driveability, reliability, and durability
- List the latest developments in turbocharging technology, their impact on engine performance and emissions, and the use world-wide

WHO SHOULD ATTEND

Beneficial to powertrain development & component development engineers, service engineers, engineering managers, product planners, and those developing product strategy.

CONTENT HIGHLIGHTS

- Fundamentals, Functionality, and Basic Design Features of Turbochargers
- Impact of Turbochargers on Engine Performance, Emissions, and Fuel Economy
- Performance Maps, Selection Criteria, Comparison and Matching of Turbochargers to Engine and Powertrain Needs
- Advanced Issues and Technology
- Turbocharger Noise, Reliability, and Durability Considerations
- Advanced Technology Developments Including Variable Geometry, EGR Systems, and Multi-Stage Turbocharging
- Worldwide Growth in Application of Turbocharging

INSTRUCTORS

Kevin Hoag
Institute Engineer, Southwest Research Institute

Roy J. Primus
Principal Engineer, General Electric Global Research Center

"[This] course provides a great introduction to the basics of turbo operation and how to select an appropriate turbocharger based on engine characteristics."

Andrew Giallonardo
Program Engineer
Environment Canada

I.D.# WB1018

SCHEDULE
November 14-16, 2017
Live Online

FEES

List:	$425
Members	
Classic:	$383
Premium:	$361
Elite:	$340

TWO, 2-HOUR SESSIONS/.4 CEUS

Get the complete course description and register: training.sae.org/webseminars/wb1018/

ACCESS THIS COURSE ONLINE AND ON DEMAND AS A WEB SEMINAR REPLAY.

SAE Web Seminar RePlays are audio/visual captures of live Web Seminars. The sessions are unedited and include participant interaction including question and answer periods with the instructor. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

I.D.# PD130944ON

FEES
See above

4-HOURS/.4 CEUS

View the complete course description and a video demo: training.sae.org/replays/pd331018on/

TURBOCHARGING INTERNAL COMBUSTION ENGINES

This seminar covers the basic concepts of turbocharging of gasoline and diesel engines, including turbocharger matching and charge air and EGR cooling, as well as associated controls. The limitations and future possibilities of today's systems are covered, as well as details on how emerging technologies will impact engine/vehicle performance. The seminar's primary focus is on the turbocharger-engine interface rather than detailed turbocharger aerodynamics and design. Advanced technologies such as variable geometry and multi-stage turbocharging, high and low pressure loop EGR systems, assisted turbocharging and turbocompounding are discussed. You will have the opportunity to perform hands-on exercises to gain an appreciation of parametric effects in a wide range of engines.

Need more background? Register for *Diesel Engine Technology* (ID# 93014) or *The Basics of Internal Combustion Engines* (ID# C0103). See course descriptions on pages 21 and 38.

"Top notch course. Roy and Kevin do a great job presenting extensive material that covers everything from stoichiometry equations to current turbo techniques and strategies."

Trent Brown
Powertrain Engineer
Roush Enterprises

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Describe the thermodynamic principles governing the turbocharging of internal combustion engines
- Articulate the critical contribution of turbocharging to modern day diesel engine performance and emission control
- Determine the possible benefits of turbocharging for specific gasoline and heavy and light duty diesel engine applications
- Estimate the appropriate turbocharger characteristics for specific applications based on engine system requirements
- Describe the limitations of current technologies and evaluate new technologies and their possible role in meeting future engine/vehicle system challenges
- Apply the basic principles of matching turbocharger with engine and optimizing overall system for desired performance and emissions

WHO SHOULD ATTEND

This seminar is designed for engineers, managers, and other technical personnel from OEM and support industries concerned with the design and development of optimized diesel and spark ignition engine systems, including performance, fuel economy and emissions for passenger car, light truck and heavy duty engines.

CONTENT HIGHLIGHTS

- Engine-Turbocharger Basics
- Turbocharger Design Features
- Free-floating, Wastegate, Variable Area or Variable Geometry Turbochargers and Controls
- Compressor and Turbine Aerodynamics
- Engine Air and EGR Flow Requirements
- Turbocharger Matching
- Turbocharger Selection Based on Engine System Requirement
- Transient Response Considerations
- Basic Spreadsheet Tools for Engine and Turbocharger Parametric Explorations
- Impact of Turbocharging on Gasoline and Diesel Engine Performance and Emissions
- Charge (Air and EGR) Cooling Systems
- Advanced Concepts in Turbocharging including Design Features of Advanced Concepts

INSTRUCTORS

Kevin Hoag
Institute Engineer, Southwest Research Center

Roy J. Primus
Principal Engineer, General Electric Global Research Center

YOUR CONNECTION TO THE MOBILITY ENGINEERING COMMUNITY

The Member Connection is an online community providing multiple engagement opportunities:

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• Learn about the latest volunteer opportunities all in one place

• Access the Career Counselor series—ten minute videos on soft-skill enhancement such as time management and goal setting strategies

And more...

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I.D.# C0314

SCHEDULE
September 27-29, 2017
Troy, Michigan

FEES

List:	$1,790
Members	
Classic:	$1,611
Premium:	$1,522
Elite:	$1,432

THREE-DAYS/2.0 CEUS

Get the complete course description and register: training.sae.org/seminars/c0314/

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training.sae.org/corplearning

VARIABLE VALVE ACTUATION: DESIGN AND PERFORMANCE IMPACT ON ADVANCED POWERTRAINS

Engine valvetrain systems have become more capable and increasingly more compact in the quest to improve efficiency. Valve control plays a strong role in a number of key areas: turbocharger systems, allowing for better optimization matching across wide engine operating flows; enabling advanced combustion strategies where control over the charge mass and temperature are important; and cold start, where valve timing can be extremely effective for engine warm up compared with other strategies that rely on additional fueling.

This seminar covers the range of Variable Valve Actuation technologies present in the market, their operation principles, and their effect on engine performance. Both gasoline and diesel applications will be covered including how they impact the in-cylinder combustion as well as the aftertreatment. You will have the opportunity to perform hands-on exercises to examine the effects of the engine valve profiles on performance.

"This seminar was an excellent opportunity to get valuable insight into the latest technologies developing in the auto industry."

Abhijit Ramuhalli
Team Lead,
Engine Calibration
Navistar Inc.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Describe and differentiate the variable valve actuation technologies present in the automotive industry
- Describe the defining features of each of these technologies, their requirements for engine design layouts, required actuators, lube oil, and need for control and ECU interface
- Apply basic tools to gage the thermodynamic impact effected by varying the valve profiles: impact on pumping efficiency, resulting charge mass trapped in cylinder, estimated bulk and adiabatic flame temperatures
- Articulate the contribution of valve timing and control over the engine performance and aftertreatment in modern engines in the context of today's emissions standards
- Describe the limitations of current technologies towards more efficient and cleaner engines and the future role of valve actuation and its integration aspects with other advanced powertrain components

WHO SHOULD ATTEND

This seminar is designed for engineers, managers, and other technical personnel from OEMs and support industries concerned with the design and development of optimized diesel and spark ignition engine systems, including calibration, performance, fuel economy and emissions for passenger car, light truck and heavy duty engines. It will be particularly interesting to diesel engineers who will likely adopt some of the technologies developed in the gasoline sector for further improvements in emissions control and gains in fuel economy.

CONTENT HIGHLIGHTS

- VVA Design – Motivation and Objectives
- VVA Timeline
- Basic Engine Definitions
- Variable Valve Actuation Designs
- VVA Case Studies and Impact on Gasoline Engine Performance
- VVA Case Studies and Impact on Diesel Engine Performance
- Engine Brake Systems
- Transient Performance
- Modeling and Controls
- Future Trends

INSTRUCTOR

William de Ojeda
Engineering Director, WM International

I.D.# C1332

SCHEDULE
Future dates are planned for this course. Check the course web page for the most up-to-date information.

FEES

List:	$1,370
Members	
Classic:	$1,233
Premium:	$1,165
Elite:	$1,096

TWO-DAYS/2.0 CEUS

Get the complete course description and register:
training.sae.org/seminars/c1332/

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EXHAUST GAS RECIRCULATION (EGR) FOR DIESEL ENGINES

This seminar explores the advantages and disadvantages of EGR and the most effective implementation of various EGR systems. This seminar begins by defining EGR and why it is used in diesel engines, along with an explanation of the mechanisms by which EGR is able to reduce NOx. The course moves into implementation of EGR systems and examples of these systems on medium and heavy-duty diesel engines. In addition, the impact of EGR on various engine components is discussed and includes EGR coolers, valves and piping. Finally, a section is devoted to the comparison between EGR and SCR and their future roles in reducing NOx emissions, as well as their impact on fuel efficiency and CO2 emissions. Emphasized in this comparison is the use of EGR in novel combustion systems and its ability to reduce emissions in-cylinder.

"Any questions or confusion I had about EGR were finally cleared up. Excellent class and instructor!"

Alan M. Dyrussel
Diesel Technician
Cascade Engineering

LEARNING OBJECTIVES

By attending this seminar you will be able to:

- Define EGR
- Recognize the different types of EGR systems used in diesel engines
- Evaluate the overall advantages and disadvantages of EGR systems in diesel engines
- Identify the impact of EGR on the combustion process
- Identify the impact of EGR on NOx and PM emissions
- Compare and evaluate EGR and SCR systems as a means to meeting emissions regulations

WHO SHOULD ATTEND

This seminar is designed for engineers and managers working in diesel combustion and emissions control technologies.

CONTENT HIGHLIGHTS

- Fundamentals of Exhaust Gas Recirculation
  - Purpose of EGR, and how it works
  - Why EGR is used in diesel engines
- Types of EGR Systems and Implementation
  - HPL EGR
  - LPL EGR
  - Venturi-Assisted EGR
  - Dedicated EGR
- Advantages and Disadvantages of EGR Systems
- Impact of EGR
  - On emissions, fuel economy, and engine wear
- Opportunities for Unique EGR System Implementations
  - Air-Augmented EGR systems
  - EGR filtration systems
- EGR System Design
  - Calculations
  - Modeling and Simulation
- Controls
  - System delay and control
  - Model-Based control system
  - Optimizing for BSFC, smoke, and NEDC
  - Strategy for hybrid EGR
  - Throttle control valve
- Impact of Turbocharging on EGR Performance
- EGR Coolers and Mixers
- Examples of Production EGR Systems
- Issues and Challenges of EGR Implementation
  - Power density
  - Component design
  - Performance and combustion
  - Components
- Effect of EGR on Diesel Combustion
  - Emissions
  - Fuel consumption
  - Torque and power
  - Temperature
- EGR and Selective Catalytic Reduction (SCR) Systems Comparison
  - General comparisons
  - Future roles in reducing emissions

INSTRUCTOR

Magdi Khair
Consultant, Magdiesel Technologies

I.D.# C1214

SCHEDULE
September 11-12, 2017
Troy, Michigan

FEES

List:	$1,370
Members	
Classic:	$1,233
Premium:	$1,165
Elite:	$1,096

TWO-DAYS/1.3 CEUS

Get the complete course description and register:
training.sae.org/seminars/c1214/

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training.sae.org/corplearning

ADVANCED DIESEL PARTICULATE FILTRATION SYSTEMS

As regulations become more and more stringent, diesel particulate filters (DPF) become possibly the most important and complex diesel aftertreatment device. This seminar covers many DPF-related topics and provides you with both a theoretical and applications-oriented approach to enhance the design and reliability of aftertreatment platforms. Topics covered include structure, geometry, composition, performance, applications and optimizations of DPFs. Computer simulation techniques for analysis and optimization of DPF performance are also demonstrated.

"Excellent coverage of an emerging technology by a real expert in the area."

Henry Gysling
Technology Director
Air Flow Catalyst Systems

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Discuss fundamental, moderate and advanced topics on DPF structure, geometry, composition, performance, applications and optimizations
- Formulate porosity, permeability, inertial loss coefficient, flow resistance descriptors, different particulate transport modes (diffusional, interceptive), etc. to develop models for predicting backpressure of DPF
- Recognize different modes of particulate filtration regimes in DPF
- Select, design, utilize and optimize DPF for various light duty and heavy duty aftertreatment applications
- Predict, via modeling and simulations, various important DPF performance features (backpressure, peak regeneration temperature, etc.) as well as to analyze their failure modes and thus enhance the reliability of diesel exhaust aftertreatment platform designs

WHO SHOULD ATTEND

This seminar is designed for engineers, scientists, investigators and consultants involved in researching, developing, applications, designing or optimizing diesel exhaust aftertreatment components and systems. Individuals from technical and regulatory institutions as well as individuals from OEMs, suppliers, emissions service companies, research facilities and universities will gain modern knowledge of diesel filter performance.

CONTENT HIGHLIGHTS

- Porous Media Basics for Diesel Particulate Filters
  - Pore space and structure definitions
  - Simplified representations of structures
  - Flow resistance descriptors
- Filtration Concepts for Diesel Particulate Filters
  - Particle transport and deposition phenomena
  - Continuum filtration theory
  - True-to-the-geometry representations
- Diesel Filter Types: Materials and Configurations in Practice
- Applications, Performance Optimization and Modeling of Diesel Particulate Filters
  - Filter backpressure/particulate loading
  - Filter Regeneration
  - Soot reactivity and structure
  - Simulation Techniques for Diesel Particulate Filters

INSTRUCTORS

Athanasios G. Konstandopoulos
Founder, Aerosol and Particle Technology Laboratory

Mansour Masoudi
Founder, Emissol LLC

I.D.# C0502

SCHEDULE
Future dates are being scheduled for this course. Check the course web page for the most up-to-date information.

FEES

List:	$1,370
Members	
Classic:	$1,233
Premium:	$1,165
Elite:	$1,096

TWO-DAYS/1.3 CEUS

Get the complete course description and register:
training.sae.org/seminars/c0502/

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DESIGNING ON-BOARD DIAGNOSTICS FOR LIGHT AND MEDIUM DUTY EMISSIONS CONTROL SYSTEMS

On-board diagnosis of engine and transmission systems has been mandated by government regulation for light and medium vehicles since the 1996 model year. The regulations specify many of the detailed features that on-board diagnostics must exhibit. In addition, the penalties for not meeting the requirements or providing in-field remedies can be very expensive. This course is designed to provide a fundamental understanding of how and why OBD systems function and the technical features that a diagnostic should have in order to ensure compliant and successful implementation.

Fundamental design objectives and features needed to achieve those objectives for generic on-board diagnostics will be covered. The course will also include a review of the California Air Resources OBD II regulation, providing students with a firm foundation for reading and understanding the requirements, including the in-use rate portion of the regulations and how to properly calculate and output the required rate information. Relationships between the regulation and various SAE and ISO recommended practices will be reviewed. The course will also explore the relationship of the OBD system with the underlying control system.

"Outstanding course. Recommended to anyone involved with emissions."

Homayoun Ahari
Diesel AT Tech Expert
Chrysler

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Articulate the underlying design objectives of on-board diagnostic systems
- Use the latest California Air Resources Board On-Board Diagnostic Regulation for Light and Medium Vehicles to find and apply OBD requirements
- Apply the design features that all diagnostics need for successful implementation
- Design diagnostics to comprehend variation
- Successfully implement algorithms to track in-use rates in accordance with the CARB OBD II Regulation
- Use SAE J1979 to implement generic scan tool support in diagnostic design
- Implement OBD design requirements in control system design

WHO SHOULD ATTEND

This course is designed for engineers involved in either the design or control of on-board diagnostic systems for engines or transmissions for light and medium duty on-road vehicles. In addition, engineers involved in engine and transmission hardware will benefit by obtaining a better understanding of the design of OBD systems.

CONTENT HIGHLIGHTS

- Fundamental Design Objectives for OBD Systems
- Basic Design Features for OBD Systems
- Exercise: "Customers" and their OBD Requirements
- Overview of the World Wide OBD Regulatory Structure
- California Air Resources Board (CARB) Regulatory Process
- How to use the CARB Light/Medium Regulation
- CARB Regulation - an in-depth look at In-use rates & comprehensive component requirements
- Introduction to a Diagnostic Design Process (Box, Graves, Bisgaard, Van Gilder, et al)
- Defining "Good" vs. "Bad" Systems
- Exercise: Defining Good vs. Defective Systems
- Anatomy of an On-Board Diagnostic
- Diagnostic Modeling
- Exercise: Induction System Modeling
- Understanding and Dealing with Variation
- SAE J1979 - An Overview
- Exercise: Finding Information in J1979
- System Design for Diagnosibility
- Overview of Regulatory Requirements Related to OBD
- OBD Certification Process
- The Relationship between the Control and OBD System Design

INSTRUCTOR

John Van Gilder
Technical Fellow, OBD II Development,
General Motors Powertrain Group
or
Igor Anilovich
Diesel OBD II & AECD Leader,
General Motors Powertrain Group

I.D.# C0707

SCHEDULE
November 13-15, 2017
Troy, Michigan

FEES

List:	$1,865
Members	
Classic:	$1,679
Premium:	$1,585
Elite:	$1,492

THREE-DAYS/2.0 CEUS

Get the complete course description and register:
training.sae.org/seminars/c0707/

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EXHAUST FLOW PERFORMANCE AND PRESSURE DROP OF EXHAUST COMPONENTS AND SYSTEMS

Designing more efficient and robust emission control components and exhaust systems results in more efficient performance, reduced backpressure and fuel penalty, and higher conversion efficiency. This course will help you to understand the motion of exhaust flow in both gasoline and diesel emission control components including flow-through and wall-flow devices such as catalytic converters, NOx adsorbers, diesel oxidation catalysts, diesel particulate filters as well as flow through the overall exhaust system. Discussions will also cover: flow recirculation in inlet cones, flow maldistribution and its effect on conversion efficiency in flow throughs, non-uniform particulate deposit in diesel filters, and roots of non-uniformity in flow distribution due to exhaust system design such as bends.

"The material was well organized and presented with numerous references to 'real-world' experience."

Scott MacKenzie
Vice President,
Business Development
ACS Industries

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Describe how exhaust stream is distributed in flow-throughs in gasoline or in diesel emission components and in wall-flow components, including in inlet cones, exit cones, bends, elbows, flow constrictions, and in other components of an exhaust system
- Design exhaust systems yielding higher conversion efficiency, lower backpressure, faster light-off, and optimal performance
- Design diesel particulate filter systems yielding more uniform soot distribution in filters, thus lowering both filter backpressure and its peak regeneration temperature
- Describe connections between flow distribution and thermal performance such as light-off and radial and axial temperature gradients

WHO SHOULD ATTEND

This seminar is intended for engineers, managers, designers, researchers and technical associates who wish to gain deeper insight into developments and optimization of exhaust systems and components. This also includes professionals involved with catalyst and emission components and exhaust sensors.

CONTENT HIGHLIGHTS

- Flow-throughs (e.g. catalytic converters or NOx adsorbers)
  - The basics: flow distribution; roots of and various contributors to pressure drop; effect of geometry; effect of surface area, length and diameter; role of catalyst; etc.
  - How to optimize the performance
  - How to measure the pressure drop
- Wall-flows (e.g. diesel particulate filters)
  - The basics: flow distribution; roots of and various contributors to pressure drop; effect of geometry such as wall thickness, cell density, plugs, and aspect ratio; transport and deposit of particulate in filters and its effect on the filter performance; role of exhaust flow on regeneration
  - How to optimize the performance
  - How to measure the pressure drop
- Inlet and exit cones: flow recirculation in cones and its effect on backpressure and performance (e.g. conversion efficiency, particulate deposit, light-off, etc.)
- Similar analysis of other exhaust system components such as pipes, bends, elbows, and constrictions and expansions in the path of the exhaust flow

INSTRUCTOR

Mansour Masoudi
Founder, Emissol LLC

I.D.# C0235

SCHEDULE
October 6, 2017
Troy, Michigan

FEES

List:	$810
Members	
Classic:	$729
Premium:	$689
Elite:	$648

ONE-DAY/.7 CEUS

Get the complete course description and register:
training.sae.org/seminars/c0235/

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CATALYTIC NOX CONTROL TECHNOLOGIES FOR DIESEL AND GDI ENGINES

Removal of NOx from exhausts is a critical need for emission standards and ambient ozone requirements.

This web seminar examines the various catalytic processes for lean burn applications, including Selective Catalytic NOx Reduction (SCR), NOx Trap Technologies (i.e. LNT, NSR), and the combination of SCR, NOx Trap and Hydrocarbon NOx Reduction (LNC). It focuses in on SCR NOx fundamentals, equipping you with the basic concepts for NOx control and important design parameters for SCR NOx catalyst. The course examines the system design for SCR in diesel applications including passenger cars and heavy duty trucks, including SCR catalysts, SCR integration with diesel particulate filter, key sensor development catalyst durability issues and urea control.

The *Fundamentals of Catalytic Converter Integration for Emission Control Web Seminar RePlay*, is a recommended prerequisite for those with less than three years of experience with catalytic converters. See the course information on page 57.

LEARNING OBJECTIVES

By connecting with this web seminar, you will be able to:

- Define NOx catalysis and identify key acronyms
- Describe in-use issues
- Cite key elements in NOx catalyst design for diesel applications
- Define SCR design for passenger cars and heavy duty applications
- Identify available sensors for SCR catalyst performance monitoring
- Determine where lean NOx traps may be appropriate versus SCR NOx control

WHO SHOULD ATTEND

This course is especially valuable for mechanical, metallurgical and chemical engineers, materials scientists, and chemists involved in the design, operation and calibration of a NOx emission control system for both mobile and stationary source applications. Sales professionals responsible for emission controls, plant managers concerned about meeting new regulations with catalytic controls, and regulators now involved in transmission technologies will also benefit from this web seminar.

CONTENT HIGHLIGHTS

Lean NOx Catalysis

- NOx reduction catalytic approaches
- Lean NOx reduction fundamentals
- Hydrocarbon NOx reduction (LNC)
- NOx traps technologies (LNT, NSR or NAC)
- SCR Cataytic NOx reduction (ammonia based)
- Combination SCR/NOx traps

SCR NOx Catalyst

- SCR NOx catalytic approaches (Vanadia and Zeolite)
- Performance characteristics of SCR NOx catalysts (Vanadia and Zeolite)
- Comparison of commercial issues with lean NOx traps and SCR

SCR Catalyst Design Mobile Applications

- Passenger cars
- Heavy duty systems
- Auxiliary equipment design
- Sensor performance
- Catalyst durability

INSTRUCTOR

Ronald Heck
Independent Consultant

I.D.# WB1237

SCHEDULE
Future offerings are being scheduled for this course. Check the course web page for the most up-to-date information.

FEES

List:	$550
Members	
Classic:	$495
Premium:	$468
Elite:	$440

THREE, 2-HOUR SESSIONS/.6 CEUS

Get the complete course description and register:
training.sae.org/webseminars/wb1237/

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COMBUSTION AND EMISSIONS FOR ENGINEERS

Public awareness regarding pollutants and their adverse health effects has created an urgent need for engineers to better understand the combustion process as well as the pollutants formed as by-products of that process. To effectively contribute to emission control strategies and design and develop emission control systems and components, a good understanding of the physical and mathematical principles of the combustion process is necessary. This seminar brings issues related to combustion and emissions "down to earth," relying less on mathematical terms and more on physical explanations and analogies.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Identify and describe the important processes in combustion and emission
- Identify the formation mechanisms and reduction strategies of pollutant species in combustion systems
- Recognize the effects of engine design and operating conditions on combustion and emission
- Explain the technology and the logic behind after-treatment of pollutants
- Identify the underlying laws and principles used in combustion and emission black-boxed computer programs
- Explain the role chemical kinetics plays in the design of low-emission combustion systems
- Identify design trade-offs between increasing engine performance and maintaining low emission characteristics

WHO SHOULD ATTEND

Engineers working on the design of combustion engine components, software development and application for modeling of thermal-fluid, combustion and emissions processes, and those working on the reduction of harmful pollutants emissions will find this course valuable.

"Dr. Bruce Chehroudi successfully blends theoretical and practical explanations of combustion and emissions subjects to maximize comprehension. This course is an excellent way to steepen the learning curve in this complex and fascinating area of Engineering. Highly recommended; bring your questions!"

Jeremy (Jay) Palko
Engine Systems & Dyno Development Engineer
Chrysler LLC

CONTENT HIGHLIGHTS

- Air Composition
- Concept of "Complete Combustion"
- A/F & Stoichiometric $(A/F)_{ST}$, and (Equivalence Ratio)
- Lean, Rich, Stoichiometric Mixture
- First and Second Law and Applications in Combustion Systems
- Adiabatic Flame Temperature, Heat of Reaction (or Heating Value) and Their Usage
- Thermodynamic and Chemical Equilibrium
- Demonstration Applications of Equilibrium Using Computer Simulation (SuperState)
- Chemical Kinetics
- Reaction Between Gas Molecules and a Solid Surface
- Explosion
- Mechanism of H_2O_2 Reaction
- Oxidation of CO
- Explosion Limits of Hydrocarbons (HC)
- Autoignition and Induction Time Using SuperState
- Flame and its Propagation
- Combustion in SI Engines
- Pollutant Formation and Control
- Exhaust Gas Treatments
- Typical Engine Emission Results
- Emission Measurements
- FTP Emission Standards

INSTRUCTOR

Bruce Chehroudi
Chief Scientist and Group Leader,
Advanced Technology Consultants

I.D.# 97011

SCHEDULE
December 18-20, 2017
Troy, Michigan

FEES

List:	$1,790
Members	
Classic:	$1,611
Premium:	$1,522
Elite:	$1,432

THREE-DAYS/2.0 CEUS

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training.sae.org/seminars/97011/

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EMISSIONS-RELATED OBD SYSTEMS: A DESIGN OVERVIEW

On-board diagnostics, required by governmental regulations, provide a means for reducing harmful pollutants into the environment. The regulations continue to evolve and require engineers to design systems that meet strict guidelines. This seminar provides an overview of the fundamental design objectives and the features needed to achieve those objectives for generic on-board diagnostics. The basic structure of an on-board diagnostic is described along with the system definitions needed for successful implementation.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Articulate the underlying design objectives of on-board diagnostic systems
- Apply the design features that all diagnostics need for successful implementation
- Apply basic design techniques to deal with variation
- Use a diagnostic design template in the development of an on-board diagnostic

WHO SHOULD ATTEND

Engineers involved in engines and transmissions especially the design or control of on-board diagnostic systems for engines or transmissions; engineers new to the area of OBD system design and engineers involved in the design of control systems.

CONTENT HIGHLIGHTS

- Fundamental Design Objectives for OBD Systems
- Basic Design Features for OBD Systems
- Defining "Good" vs. "Bad" Systems
- Exercise: Defining Good vs. Defective Systems
- Anatomy of an On-Board Diagnostic
- Diagnostic Modeling
- Understanding and Dealing with Variation

INSTRUCTOR

John Van Gilder
Technical Fellow, OBD II Development, General Motors Powertrain Group
or
Igor Anilovich
Diesel OBD II & AECD Leader,
General Motors Powertrain Group

"Very informative. Great instructor. Highly recommend this course to anyone who deals with OBD."

Vinay Premnath
Research Engineer
Southwest Research Institute

I.D.# C0708

SCHEDULE
September 25, 2017
Garden Grove, California - *Held in conjunction with the SAE On-Board Diagnostics Symposium-North America*

FEES

List:	$885
Members	
Classic:	$797
Premium:	$752
Elite:	$708

ONE-DAY/0.7 CEUS

Get the complete course description and register: training.sae.org/seminars/c0708/

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FUNDAMENTALS OF CATALYTIC CONVERTER INTEGRATION FOR EMISSION CONTROL

This Web Seminar RePlay explores the main elements of the catalytic converter: the catalyst, the honeycomb, and the housing. Session One covers catalyst fundamentals to equip you with the basic concepts, important design parameters and main elements of the catalyst, the washcoat and the unitary support. The second session adds discussion on catalyst durability and the effects of in-use on the maintenance of catalyst performance. The third and fourth sessions explore the ceramic honeycomb as an integral part of emissions control device.

LEARNING OBJECTIVES

By connecting with this course, you will be able to:

- Define catalysis and identify catalyst acronyms
- Describe in-use issues
- Question catalyst suppliers
- Interpret basic test procedures for catalyst evaluation and cite key elements in catalyst design
- Define honeycomb substrate, the key properties of honeycomb structure, and the performance parameters in terms of cell dimensions
- Validate performance parameters with measured performance
- Describe test methods relevant to in-use conditions

WHO SHOULD ATTEND

This course will be especially valuable for engineers and others involved in the design, operation and calibration of an emission control system for both mobile and stationary source applications. This includes automobiles, trucks, buses, ships, locomotives, stationary engines, small engines, etc.

CONTENT HIGHLIGHTS

- Catalysis
- Catalyst Durability
- Honeycomb Substrates
- Honeycomb In-Use Durability

INSTRUCTOR

Ronald Heck
Independent Consultant

Suresh T. Gulati
Independent Consultant

Catalytic converter design has become a high priority issue with the new more stringent regulations worldwide.

I.D.# PD331142ON

SCHEDULE
On Demand/30-day access

FEES

List:	$640
Members	
Classic:	$576
Premium:	$544
Elite:	$512

8-HOURS/.8 CEUS

Get the complete course description and register: training.sae.org/replays/pd331142on/

SELECTIVE CATALYTIC REDUCTION FOR DIESEL ENGINES

To help meet emissions requirements, the catalyst industry has developed exhaust emission reduction technologies with impressive levels of performance. These technologies include hydrocarbon selective catalytic reduction (SCR), NOx absorber catalysts, and urea SCR. This seminar covers these technologies and discusses use and implementation.

This seminar begins with an explanation of NOx formation in diesel engines and in-cylinder methods for reducing these emissions. The aftertreatment systems for NOx reduction is explained and the advantages and disadvantages of these emission reduction technologies is discussed

The primary focus is on urea SCR and its technology is fully examined. The important chemical reactions and methods for improving SCR performance, by encouraging desirable reactions and avoiding undesirable reactions, are explained. Additionally, the components and control of a urea SCR system are detailed and the necessary sensors for its control are described. The SAE International paper *Laboratory Testing of Urea-SCR Formulations to Meet Tier 2 Bin 5 Emissions* is included in the course materials.

"Mr. Magdi is very knowledgable in SCR for diesel engines. This course was eye opening for me in the aftertreatment technologies."

Charles Davis
Sr. Product Development Engineer
Navistar Inc.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Identify how NOx is formed in diesel engines
- Identify the in-cylinder means for reducing NOx
- Evaluate NOx aftertreatment technologies for diesel exhaust.
- Describe the characteristic of selectivity in catalytic aftertreatment
- Apply selectivity to urea SCR
- Describe the features and components of a complete urea SCR system
- Learn how to optimize the control of a urea SCR
- Distinguish the differences between various catalytic SCR formulations

WHO SHOULD ATTEND

This seminar benefits engineers and technical staff who are developing urea aftertreatment systems for diesel engines, including catalyst engineers who supply NOx aftertreatment systems to the diesel industry. Also benefitting are suppliers of other NOx reducing technologies, such as EGR components and fuel injection systems, as well as on-highway and off-highway diesel engine technical staff.

CONTENT HIGHLIGHTS

- Various vehicle diesel emissions regulations
- NOx Formation in Diesel Engines
- In-Cylinder Means for NOx Reduction
- NOx Aftertreatment Systems for Diesel Engines
- Urea SCR Technology
- Components of the Urea SCR System
- System Calibration and Control Considerations
- Regulatory and Market Considerations
- Urea Production and Distribution
- SCR Options and Configurations for Future NOx Limits

INSTRUCTOR

Magdi Khair
Consultant, Magdiesel Technologies

SAE DIESEL TECHNOLOGY CERTIFICATE PROGRAM

Watch for the certificate icon to indicate course titles that are part of an SAE multi-course certificate program.

Designed to equip you with a solid understanding of diesel engines, emissions and aftertreatment strategies, and related components, the program requires completion of courses that address these areas and then facilitates further depth in aftertreatment technologies through a menu of electives. Complete the Diesel Technology Certificate and earn eight graduate credits towards the SAE/Kettering University 20-credit Certificate in Automotive Systems and Kettering's 40-credit M.S. in Mechanical Engineering. Visit training.sae.org/collegecredit for more information. View the list of required and elective courses and more information on enrolling in this SAE certificate program--training.sae.org/credentialing/certificate/dieseltech.htm

I.D.# C0913

SCHEDULE
Future dates are planned for this course. Check the course web page for the most up-to-date information.

FEES

List:	$1,395
Members	
Classic:	$1,256
Premium:	$1,186
Elite:	$1,116

TWO-DAYS/1.3 CEUS

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EVAPORATIVE AND REFUELING EMISSION CONTROL

This course introduces you to the principles of gasoline evaporative fuel vapor generation from the vehicle fuel tank, fuel vapor storage in activated carbon canisters, and fuel vapor desorption and consumption in engine combustion. It begins with an analysis of gasoline and gasoline/ethanol blends and estimation of their vapor pressures and vapor generation. In-depth analysis of various vapor generations as a function of fuel properties and ambient conditions is presented. Activated carbon canister design, OBD II leak detection, hydrocarbon permeation, and CARB and EPA evaporative test procedures are covered.

LEARNING OBJECTIVES

By attending the seminar, you will be able to:

- Identify sources of evaporative fuel vapor emissions
- Predict effects of ethanol on evaporative emissions
- Estimate diurnal and refueling vapor generation
- Analyze the differences in the test procedures: U.S., Europe, and Asia
- Explain activated carbon canister operation: loading, purging, vapor redistribution, and back-purge
- Identify potential solutions to induction hydrocarbon emissions
- Estimate the effect of altitude on evaporative emissions

WHO SHOULD ATTEND

For engineers in all fields related to the design and development of evaporative and refueling emission control systems including platform fuel system design engineers for fuel tanks, onboard refueling vapor recovery systems, evaporative emission control canisters, fuel vapor lines, vapor purge lines, purge and vent valves, etc.

CONTENT HIGHLIGHTS

- Evaporative and refueling emission control system
- Why and how to control fuel vapor emissions
- Fuel and Fuel Vapor Pressure and Generation
- Carbon Canisters
- Evaporative and Refueling Emission Control System Design
- Hybrid and plug-in hybrid evaporative emission control
- Pressurized/sealed and bladder fuel tank for evaporative emission control
- Evap OBD II leak detection
- Permeation losses - effects of materials, temperature, fuel composition, etc.

INSTRUCTOR

Sam Reddy
Consultant Specializing in Fuel Vaporization and Evaporative Emission Control

"This course has greatly enhanced my understanding, and answered most questions I always had in my mind since I recently started working as an entry level automotive carbon engineer."

Ken Onubogu
Applications Engineer
Mead West Vaco

I.D.# C0928

SCHEDULE
October 10-11, 2017
Troy, Michigan

FEES

List:	$1,370
Members	
Classic:	$1,233
Premium:	$1,165
Elite:	$1,096

TWO-DAYS/1.3 CEUS

Get the complete course description and register: training.sae.org/seminars/c0928/

IMPROVING FUEL EFFICIENCY WITH ENGINE OILS

This course begins with a brief overview of the fuel consumption regulations and global perspective of passenger car lubricants and diesel oil specifications in North America, Europe and Asia. Limitations and advantages of various methods to measure fuel consumption in a variety of bench tests, dyno tests and actual vehicles are presented. Fundamentals of fluid lubrication regimes, as well as detailed aspects of oil formulations which have significant effects on reduction in mechanical friction, such as base oil selection, viscosity grade choice and impact of friction modifiers, are covered. The performance characteristics of fresh oil versus used oil and lubrication of coated surfaces are also discussed.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Describe the effects of mechanical friction on engine efficiency
- Summarize the pros and cons of various test methodologies used to measure engine friction
- Articulate the limitations in various fuel consumption test methodologies
- Select oils based on frictional control performance
- Describe the role of oil degradation on fuel economy and engine wear
- Evaluate lubricant interactions with low friction surfaces

WHO SHOULD ATTEND

This seminar is designed for engineers, scientists, investigators and consultants involved in designing or optimizing mobile or stationary powertrains.

CONTENT HIGHLIGHTS

- Reducing Fuel Consumption
- Fundamentals of Engine Friction — Gasoline and Diesel Engine
- Methodology — How to Measure Engine Friction; How to Measure Fuel Consumption in Real Life Conditions
- Fuel Economy Derived Lubricant Specifications — N. America, United Europe, Japan
- Lubrication Fundamentals — Lubrication regimes; Stribeck curve
- Lubricant Components — Effects on Fuel Consumption
- Fuel Economy Retention — Impact of used oil on fuel consumption vs. engine wear protection
- Lubrication of Low Friction Surfaces — Coatings; Engineered surfaces
- Impact of Diesel Emission Control Devices on Overall Fuel Consumption

INSTRUCTOR

Ewa A. Bardasz
Fellow, The Lubrizol Corporation

"The course material was current and highly informative. The instructor was an excellent communicator. I am looking forward to putting my new knowledge into practice!"

Christian C. Longacre
Development Engineer
BorgWarner

I.D.# C0914

SCHEDULE
Future dates are planned for this course. Check the course web page for the most up-to-date information.

FEES

List:	$1,445
Members	
Classic:	$1,301
Premium:	$1,228
Elite:	$1,156

TWO-DAYS/1.3 CEUS

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MODERN FLUIDS FOR CRANKCASE ENGINES: AN OVERVIEW

This comprehensive seminar covers the latest developments in lubricating fluids technologies and explores the relationships between lubricating fluids and emissions, after-treatment devices, bio-fuels, and fuel economy.

Fundamentals of crankcase lubrication, including the properties and performance requirements of global base stocks and lubricants are covered in this course. The seminar further explores the need for lubricating systems to possess thermal and oxidative stability sufficient to withstand the rigors of low-heat-rejection, high performance diesel engines or other modern engines equipped with various emission control devices. Case studies are utilized to demonstrate the existence of overlapping phenomena aimed at extending oil life and protecting key mechanical components.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Describe how various classes of additives commonly used in crankcase lubricants impact:
  - wear of bearings, pistons, and piston rings
  - friction and fuel consumption
  - corrosion
  - piston cleanliness
  - swelling of seals
  - hydraulic media in fuel systems, such as hydraulically-actuated electronically-controlled unit injector system (HEUI)
- Recognize the limitations and technical trends in new base stocks and additive technologies
- Compare performance characteristics of lubricants designed for passenger cars manufactured in N. America, Europe or Japan
- Identify key lubricant requirements for protecting heavy duty diesel engines
- Select and optimize fluids for various light duty and heavy duty after-treatment applications
- Recognize differences between API, ACEA, and ILSAC lubricant categories

WHO SHOULD ATTEND

This seminar is designed for engineers, scientists, investigators and consultants involved in designing or optimizing mobile or stationary powertrains. Individuals interested in understanding the role of crankcase fluids in extending useful life of the overall systems, minimizing emissions and reducing fuel consumption will find the seminar beneficial.

CONTENT HIGHLIGHTS

- Introduction to Engine Lubricant Formulations
- Lubrication Fundamentals
- Base Oils; Additives
- Global Lubricant Specifications
- Extended Service Intervals (ESI)
- Fuel Economy
- Global Trends in Emission Specifications and Exhaust Control Systems
- Examples of Lubricant Interactions with Exhaust Systems

INSTRUCTOR

Ewa A. Bardasz
Fellow, The Lubrizol Corporation

I.D.# C0704

SCHEDULE
Future dates are planned for this course. Check the course web page for the most up-to-date information.

FEES

List:	$1,385
Members	
Classic:	$1,247
Premium:	$1,177
Elite:	$1,108

TWO-DAYS/1.3 CEUS

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MOTOR FUEL: TECHNOLOGY, PERFORMANCE, TESTING, AND SPECIFICATIONS

This seminar reviews the fundamentals of motor fuels, combustion and motor power generation. The primary content of the course provides a basic introduction to the technology, performance, evaluation, and specifications of current gasoline, diesel, and turbine fuels.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Describe how fuel compositional variables affect engine performance
- Interpret test data to determine if fuel meets required specifications and regulations
- Determine the purpose and mode of action of performance additives
- List the important processes in motor fuel
- Communicate effectively with others working with motor fuels
- Have a working knowledge of motor fuel composition, properties, and performance

WHO SHOULD ATTEND

Engine design engineers requiring an understanding of the fundamental performance properties of motor fuels and additives; and formulators needing an understanding of the relationships of fuel performance and composition to design fuels and additives to meet needs.

CONTENT HIGHLIGHTS

- Introduction and History of Motor Fuels
- Oxygenated Blend Components and Emissions
- Gasoline Specifications
- Overview of Diesel Fuel; Diesel Specifications
- Alternative Fuels, Future Trends, and Directions
- Gaseous Fuels for Engines
- Racing Fuels
- Future Trends in Fuels

INSTRUCTOR

Kenneth Kipers
Certified Lubrication Specialist and Consultant-Fuels and Lubricants
Adjunct Professor, Richland College

"This course will definitely give you an excellent overview of today's energy concerns and needs."

Michael Mueller
Head, Chemistry Dept.
Rose-Hulman Institute of Technology

I.D.# 98003

SCHEDULE
Future dates are planned for this course. Check the course web page for the most up-to-date information.

FEES

List:	$1,850
Members	
Classic:	$1,665
Premium:	$1,573
Elite:	$1,480

THREE-DAYS/2.0 CEUS

Get the complete course description and register: training.sae.org/seminars/98003/

INTRODUCTION TO HYBRID AND ELECTRIC VEHICLE BATTERY SYSTEMS

This course introduces the concepts of hybrid vehicles, their missions and the role of batteries in fulfilling those requirements. Topics examined include: limitations, trends in development, customer wants and needs, battery system development timelines, comparison of electrochemistries and safety. Current offerings, cost factors, pack design considerations and testing are also reviewed. You will have an opportunity to perform a battery pack analysis exercise using a real world application and are requested to bring a calculator to class.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Capture customer wants and expectations of the battery system
- Identify factors that drive power and energy requirements
- Determine test program structure
- Compare and contrast the newest relevant battery technologies
- Calculate estimates of electric range and quantify the assumptions
- Critically assess media claims of new battery discoveries

WHO SHOULD ATTEND

Professionals recently assigned to their roles or returning to HEV or EV programs. Those involved in all aspects of hybrid vehicle programs and product planners and program managers will benefit.

CONTENT HIGHLIGHTS

- Review of Common Vehicle Product Offerings; Role of the Battery
- Product Liability / FMEA; Failure Modes
- Safety
- Battery Development Cycle; Battery Pack Design
- Cost Factors and System Considerations; Electrochemistry Selection
- Range Estimation (hybrid vs. electric)
- Real-life Battery Analysis Exercise
- Vehicle Trends; Battery Trends, Warranty, Recycling

INSTRUCTOR

Erik Spek
Chief Engineer, TÜV SÜD Canada

The powertrain components of hybrid vehicles, such as the drive motor, motor controller and cooling system are somewhat familiar to the automotive industry, the battery systems are a relatively unfamiliar aspect.

I.D.# C0626

SCHEDULE
October 24-25, 2017
Troy, Michigan

FEES

List:	$1,370
Members	
Classic:	$1,233
Premium:	$1,165
Elite:	$1,096

TWO-DAYS/1.3 CEUS

Get the complete course description and register: training.sae.org/seminars/c0626/

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HYBRID AND ELECTRIC VEHICLE ENGINEERING ACADEMY

This intensive learning experience covers hybrid and electric vehicle engineering concepts, theory, and applications relevant to HEV, PHEV, EREV, and BEV for the passenger car industry. While the theory and concepts readily apply to the commercial vehicle industry as well, the examples and applications used will apply primarily to the passenger car industry.

SAE International Engineering Academies provide comprehensive and immersive training experiences, helping new and re-assigned engineers become proficient and productive in a short period of time.

LEARNING OBJECTIVES

Upon completion of the academy, participants will be able to:

- Define and analyze fundamental electrochemistry of battery operation and performance requirements for HEV, PHEV, EREV and full electric vehicle applications
- Estimate the size of a cell to meet a specific requirement
- Create a cradle-to-grave, or cradle-to-use list of materials used in any type of automotive battery
- Compute the temperature response of battery cell and pack assemblies for a simple model
- Describe the functions performed by a Battery Management System (BMS)
- Explain different approaches to estimating state of charge, state of health, power and energy
- Apply the operation of brushless dc and induction motors to HEV and EV vehicles
- Define the torque speed curves for motors and the application to electric and hybrid electric vehicles
- Describe the features of buck, boost, and Transformer converters
- Compare and contrast the various industry and regulatory standards for hybrid vehicle components, batteries, and charging systems
- Describe the main hybrid and electric vehicle development considerations and performance requirements for various vehicle system
- Identify how to define key vehicle system requirements and select and size system components that best meet those requirements

WHO SHOULD ATTEND

Individuals who already have a basic understanding of hybrid and/or electric vehicles who are seeking to increase their knowledge and understanding of hybrid vehicle system applications, including mechanical and electrical application engineers, design engineers, project managers, and other individuals who are working with or transitioning to hybrid-electric powertrain development, will find this academy particularly helpful.

CONTENT HIGHLIGHTS

- Systems Integration and Analytical Tools
- Safety, Testing, Regulations, and Standards
- Thermal Management for Batteries and Power Electronics
- Battery Management Systems
- Electrochemistry and Battery Materials Design
- Power Electronics
- Electric Motors
- High Voltage Battery Charging Methods & Some Aspects of Battery Pack Design
- Lithium-Ion Battery Design
- Lithium-Ion Battery Modeling
- Thermal Management for Batteries and Power Electronics

INSTRUCTOR

See the course web page for a complete list of instructors.

I.D.# ACAD06

SCHEDULE
December 4-8, 2017
Troy, Michigan

FEES

List:	$3,445
Members	
Classic:	$3,101
Premium:	$2,928
Elite:	$2,756

FIVE-DAYS /3.8 CEUS

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INTRODUCTION TO NVH ASPECTS OF HYBRID AND ELECTRIC VEHICLES

The influx of different hybrid and electric vehicle configurations has brought about unique NVH challenges from a variety of sources. NVH refinement is an important aspect of powertrain development and the vehicle integration process. While developing the NVH behavior of the vehicle is critical to satisfy customer expectations, it is also important to consider the influence of reduced exterior noise levels on pedestrian safety. This seminar introduces participants to basic NVH principles and unique NVH challenges encountered in the development of HEV, ReEV, and EV including engine start/stop behavior, electric motor whine, driveline NVH, body structure, influence of noise from accessories, and sound quality development, as well as potential countermeasures.

While developing the NVH behavior of the vehicle is critical to satisfy customer expectations, it is also important to consider the influence of reduced exterior noise levels on pedestrian safety.

LEARNING OBJECTIVES

Upon completion of this seminar, you will be able to:

- Articulate the basic principles of NVH
- Describe the relative importance of powertrain noise, wind noise, and road noise in the vehicle's interior
- Identify the key sub-components of powertrain noise and means to control them
- Explain the key NVH issues specific to electrified vehicles and means to develop appropriate countermeasures
- Identify key metrics available to assess the NVH performance of electrified vehicles
- Develop an awareness of advanced NVH methodologies available to design the sound character of electrified vehicle

WHO SHOULD ATTEND

Individuals involved with component design/release responsibilities in ICE, electric motor, transmissions, powertrain mounts, vehicle body, and chassis areas will find this course helpful.

CONTENT HIGHLIGHTS

- Automotive NVH Fundamentals
  - Fundamentals of noise, vibration, and sound quality
  - Vehicle NVH
  - Powertrain-induced interior noise
  - Engine noise
  - Transmission noise
  - Driveline noise
  - Intake noise
  - Exhaust noise

- Road-induced noise
- Wind noise
- Vehicle interior noise simulation for powertrain-induced noise
- Vehicle interior noise simulation for road-induced noise
- Vehicle sound quality
- Vehicle exterior noise simulation

- HEV, ReEV, PHEV, and EV NVH
  - HEV, ReEV, PHEV, and EV architecture definition
  - "Road Map" for vehicle NVH development of HEV, ReEV, PHEV, and EV
  - ICE start/stop noise using case study examples
  - ICE start/stop vibration using case study examples
  - Active control for start/stop refinement using case study examples
  - Motor NVH using case study examples
  - HEV/EV driveline NVH using case study examples
  - Power electronics noise
  - Accessory noise
  - Application of powertrain-induced vehicle interior noise simulation
  - Application of road-induced vehicle interior noise simulation
  - Sound character of EV using case study examples
  - Sound character of ReEV using case study examples
  - Exterior noise considerations for EV and ReEV

INSTRUCTOR

Kiran Govindswamy
Director of NVH, Driveline and Vehicle Integration, North American Technical Center of FEV, Inc.

I.D.# C1128

SCHEDULE
November 6, 2017
Troy, Michigan

FEES

List:	$810
Members	
Classic:	$729
Premium:	$689
Elite:	$648

ONE-DAY/.7 CEUS

Get the complete course description and register:
training.sae.org/seminars/c1128/

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SAFE HANDLING OF HIGH VOLTAGE BATTERY SYSTEMS

Electric and hybrid vehicles are becoming more visible on today's roadways and the automotive companies are working hard to make these vehicles as transparent as possible to enhance consumer acceptance. This seminar introduces you to the risks encountered in handling high voltage battery systems and their component parts. With the understanding of these risks, the seminar addresses how to raise awareness and the methods of dealing with those risks. The outcome should be improved avoidance of personal injury, reduced risk of reputation loss and product liability actions and reduced risk of loss of property and time.

The battery system forms a key part of any of these vehicles and is probably the least understood. With practically no moving parts the battery systems show no visible or audible warning of any latent dangers.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Identify the handling risks of the battery system
- Respect the risks and work with them
- Develop a safety program to manage the risks

WHO SHOULD ATTEND

This seminar is primarily intended for vehicle systems, battery and battery systems integration, testing, electrical engineers, and thermal management engineers recently assigned to their roles or returning to hybrid or electric vehicle programs. It will also be beneficial to those involved in the specification, design, development, testing and planning of hybrid vehicle programs. Prototype shop staff will find the safety protocol aspects helpful.

CONTENT HIGHLIGHTS

- High Voltage Batteries
- Risks of HV Batteries
- Risk Management
- High Voltage Issues in Engineering and Manufacturing Environments

INSTRUCTOR

Erik Spek
Chief Engineer, TÜV SÜD Canada

I.D.# C1019

SCHEDULE
October 26, 2017
Troy, Michigan

FEES

List:	$810
Members	
Classic:	$729
Premium:	$689
Elite:	$648

ONE-DAY/0.7 CEUS

Get the complete course description and register: training.sae.org/seminars/c1019/

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- Hybrid and Electric Vehicle
- Gasoline Engine Calibration
- Transmission

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P1776191

HYBRID AND ELECTRIC VEHICLE SYSTEMS

Hybrid Electric Vehicle (HEV), Plug-In Hybrid Electric Vehicle (PHEV), and Battery Electric Vehicle (BEV) technology model offerings and production volumes continue to accelerate with each model year. This three-day practical and applications-based course will concentrate on architectures, operation, functions, and design considerations of the safety, power electronics, energy systems, and failure modes associated with HEV and BEV vehicles, providing an environment in which participants can acquire a solid systems and integration foundation for applying this content to vehicle/systems design. Practical systems and circuit analyses with calculations will be used throughout the course.

Advanced technology vehicle populations are significantly increasing throughout the world, making it vital for engineers, technicians, and educators to have a thorough understanding of these technologies and systems.

LEARNING OBJECTIVES

By attending seminar, you will be able to:

- Identify the different hybrid and electric vehicle (HEV) architectures
- Follow a procedure for safe interaction with high voltage
- Identify the components of HEV safety systems, controls, and diagnostics
- Consider the architectural options for controls and diagnostics
- Identify energy management components and functions
- Identify electric motor components and functions

WHO SHOULD ATTEND

This course is designed for engineers, scientists, and technicians who are involved with the design, development, manufacturing, or service of electrified vehicles or subsystems.

CONTENT HIGHLIGHTS

HEV/BEV Systems Operation Modes, Torque Production and Component Contributions

- HEV
- PHEV
- BEV

High Voltage Safety - Personal Protection Equipment

- High Voltage Systems
- Using Meters, Oscilloscopes, Insulation Meters, and HiPot Equipment to Test High Voltage System Components

HEV/PHEV/BEV – Vehicle Safety Systems, Controls and Diagnostics

- Battery Pack Manual Disconnect Systems
- High Voltage Interlock Circuits, Bus Active & Passive Discharge Circuits
- Isolation Fault Detection Circuits
- CAN Parameter ID Structure for Safety Systems and Diagnostics

Rechargeable Energy Management (Battery Pack) Systems, Controls and Diagnostics

- Hardware components
- NiMH, Lithium Battery Families
- Module/cell sensing systems
- Thermal Management Systems
- Battery Pack/Module Testing
  - HEV/PHEV/BEV Power & Energy Testing
  - Automotive Field Experiences with Battery Systems

HEV/BEV – Permanent Magnet (PM) and Induction Machine (IM) Electric Machine and Power Inverter Technologies

- PM and IM Technologies
  - Permanent Magnet Electric Machine Construction/Operation
  - PM/IM Failure Modes
- Power Inverter Technology and Electric Machine Control
  - Power electronics devices: IGBTs and Gate Drives
  - Electric machine controls
  - Power Inverter Testing: Analyzing Waveforms using Oscilloscopes, Current Probes
- dc-dc Converter Systems
- Buck Converter; Buck/Boost Converter
- Testing

INSTRUCTOR

Mark Quarto
Chief Technology Officer, Automotive Research and Design, LLC

I.D.# C1504

SCHEDULE
September 13-15, 2017
Troy, Michigan

FEES

List:	$1,745
Members	
Classic:	$1,571
Premium:	$1,483
Elite:	$1,396

THREE-DAYS/2.0 CEUS

View the complete course description and register:
training.sae.org/seminars/c1504/

FUNDAMENTALS OF AUTOMOTIVE ALL-WHEEL DRIVE SYSTEMS

This seminar provides an introduction to the fundamental concepts and evolution of passenger car and light truck 4x4/all-wheel drive (AWD) systems including the nomenclature utilized to describe these systems. Basic power transfer unit and transfer case design parameters, component application to system function, the future of AWD systems, and emerging technologies that may enable future systems are covered. This course is an excellent follow-up to the SAE course, *A Familiarization of Drivetrain Components* (I.D.# 98024). See the description for this course on page 10.

"A great overview of the AWD market and the systems and devices that are utilized."

Michael F. Chmelko
Account Manager
Hilite International

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Identify front wheel drive and rear wheel drive vehicle architectures
- Identify part time, full time, and on demand all-wheel drive systems
- Explain the benefits of all-wheel drive over two-wheel drive
- Quantify all-wheel drive traction and mobility benefits
- Describe auxiliary axle disconnect systems
- Explain basic vehicle dynamics performance and the effect of AWD on performance
- Identify couplers vs. biasing devices and their basic function
- Describe the differences between mechanical and electrical implementation in AWD systems
- Describe basic control strategies and logic
- Discuss advanced propulsion concepts and systems

WHO SHOULD ATTEND

This seminar is designed for engineers (working with ground vehicles) who need to master AWD componentry, and the function and effect of those components. Engineers new to the 4WD/AWD field, as well as managers, marketing personnel, purchasing professionals and others interested in all-wheel drive fundamentals will benefit from this seminar.

CONTENT HIGHLIGHTS

- Front wheel drive and rear wheel drive vehicle architectures
- Part time, full time, and on demand all-wheel drive systems
- Benefits of all-wheel drive as compared to two-wheel drive
- Quantifying all-wheel drive traction and mobility benefits
- Auxiliary axle disconnect systems
- Basic vehicle dynamics performance and the effect of AWD on performance
- Couplers vs. biasing devices
- Mechanical vs. electrical implementation in AWD systems
- Effects of AWD driveline configuration on NVH and weight
- Basic control strategies and logic
- Advanced propulsion concepts and systems

INSTRUCTOR

Joseph Palazzolo
Chief Engineer – eDrive Systems,
GKN Driveline

I.D.# C0305

SCHEDULE
September 27, 2017
Troy, Michigan

FEES

List:	$810
Members	
Classic:	$729
Premium:	$689
Elite:	$648

ONE-DAY/0.7 CEUS

Get the complete course description and register:
training.sae.org/seminars/c0305/

ALSO AVAILABLE AS AN ON DEMAND COURSE.

Fundamentals of Automotive All-Wheel Drive Systems e-Seminar

Convenient, portable, and with core content from the instructor-led seminar, this 4.5-hour e-seminar option offers an alternative way to receive the same instruction as the live classroom learning without the expense of travel and time away from the workplace. The course offers ten video modules accompanied by a handbook.

I.D.# PD13556ON

FEES

List:	$265
Members	
Classic:	$239
Premium:	$225
Elite:	$212

4.5-HOURS/.5 CEUS

View the complete course description and a video demo:
training.sae.org/eseminars/pd130556on/

HIGH-PERFORMANCE DIFFERENTIALS, AXLES, & DRIVELINES

This comprehensive seminar introduces you to the function and interfaces of axles and their individual components. As we modify cars, it is important to know the trade-offs in the drivetrain system. The theory and practice of axle systems is introduced along with a hands-on style approach to repairing and modifying axles for high performance applications. For this hands-on approach, actual hardware is reviewed.

Upon completion of the seminar, attendees will have a working knowledge of axles, hypoid gearing, and differentials (open and limited slip), along with typical performance enthusiast modifications for race teams and weekend warriors.

LEARNING OBJECTIVES

By attending this seminar, you will be able to:

- Identify vehicle specific axle types
- Evaluate the differences between open and limited slip differential (LSD)
- Distinguish between the different torque transfer characteristics of the different LSD technologies
- Identify how to correctly set and adjust bearing preload and hypoid contact patterns
- Describe how to assemble and disassemble a differential
- Explain the steps to set-up a new gear set and bearings
- Recognize the difference required between typical passenger car applications and high-performance, race style axles

WHO SHOULD ATTEND

Automotive engineers and mechanics who are working in the driveline area including performance shop mechanics and race teams modifying axles for specific applications.

CONTENT HIGHLIGHTS

- Axle Fundamentals
- Axle Housing Types
- Axle Rebuild
- Differentials
- Aftermarket Differentials
- Hypoid Ring and Pinion Gears
- Axle Shafts
- Driveshafts
- Pinion Angle

INSTRUCTOR

Joseph Palazzolo
Chief Engineer, eDrive Systems, GKN Driveline

I.D.# C1113

SCHEDULE
Future offerings are planned for this course. Check the course web page for the most up-to-date information.

FEES

List:	$1,370
Members	
Classic:	$1,233
Premium:	$1,165
Elite:	$1,096

TWO-DAYS/1.3 CEUS

View the complete course description and register: training.sae.org/seminars/c1113/

Enrich your professional development with these related powertrain technology resources from SAE.

BOOKS

INTERNAL COMBUSTION ENGINE HANDBOOK, 2ND ENGLISH EDITION

More than 120 authors from science and industry have documented this essential resource for students, practitioners, and professionals. Comprehensively covering the development of the internal combustion engine (ICE), the information presented captures expert knowledge and serves as an essential resource that illustrates the latest level of knowledge about engine development.

DESIGN AND SIMULATION OF FOUR-STROKE ENGINES

This book provides design assistance with the actual mechanical design of an engine in which the gas dynamics, fluid mechanics, thermodynamics, and combustion have been optimized to provide the required performance characteristics such as power, torque, fuel consumption, or noise emission.

DIESEL EMISSIONS AND THEIR CONTROL

This book will assist readers in meeting today's tough challenges of improving diesel engine emissions, diesel efficiency, and public perception of the diesel engine. It can be used as an introductory text, while at the same time providing practical information that will be useful for experienced readers.

AUTOMOTIVE FUELS REFERENCE BOOK, THIRD EDITION

This book is written for those with an interest in or a need to understand automotive fuels. Because automotive fuels can no longer be developed in isolation from the engines that will convert the fuel into the power necessary to drive our automobiles, knowledge of automotive fuels will also be essential to those working with automotive engines. This long-awaited new edition has been thoroughly revised and updated, yet retains the original fundamental fuels information readers find so useful.

JOURNALS

SAE INTERNATIONAL JOURNAL OF ENGINES

Spotlights innovative and archival technical reports on all aspects of internal combustion engine development including research, design, analysis, control, and emissions.

SAE INTERNATIONAL JOURNAL OF FUELS AND LUBRICANTS

Comprehensive and innovative research in the properties of fuels, lubricants, additives, deposits, and catalysts, and their effects on engine performance, emissions, economy, and environmental implications.

SAE INTERNATIONAL JOURNAL OF ALTERNATIVE POWERTRAINS

Highlights alternative propulsion technologies including electric and hydraulic drives, battery and super-capacitor technology, power electronics, energy storage systems, fuel cell technology, and vehicle integration into Smart Grid.

Enrich your professional development with these related powertrain resources from SAE.

EVENTS

SAE 2017 COMMERCIAL VEHICLE ENGINEERING CONGRESS

September 18-20, 2017
Rosemont, Illinois, USA

The only North American forum which addresses vehicles and equipment spanning the on-highway, off-highway, agricultural, construction, industrial, military and mining sectors. While the content does cover trucks, the need to reduce CO2 emissions and improve vehicle efficiencies for fuel savings is what drives the research and technology across all of these noted sectors and, in turn, makes up the programming of the event.

SAE 2017 ON-BOARD DIAGNOSTICS SYMPOSIUM – NORTH AMERICA

September 26-28, 2017
Garden Grove, (Anaheim), California, USA

This event serves as the platform for uniting automotive and commercial vehicle industry experts who need information and insight into CARB, EPA, and EURO IV/V/VI rules and regulations, and SAE standards associated with light- and heavy-duty emissions controls.

SAE 2017 THERMAL MANAGEMENT SYSTEMS SYMPOSIUM

October 10-12, 2017
Plymouth, Michigan, USA

The SAE 2017 Thermal Management System Symposium continues to expand and enhance its programming content to focus on environmental regulatory requirements and the technologies to meet them. Leading experts from the United States, Europe, and Asia will speak about cutting-edge thermal management technology and regulation compliance strategies.

SAE 2017 INTERNATIONAL POWERTRAINS, FUELS AND LUBRICANTS MEETING

October 16-19, 2017
Beijing, China

This is where the most highly regarded experts in engineering, science and supply gather to update the industry on the latest progress and emerging technologies for powertrains, fuels and lubricants. Thought-provoking keynotes, a comprehensive range of technical sessions, a clean fuels workshop, and abundant networking opportunities provide attendees with direct contact with key industry professionals.

SAE 2017 TRANSMISSION AND DRIVELINE SYMPOSIUM

November 14-15, 2017
Dearborn, Michigan, USA

The source for continuous technical information about the latest innovations of the design, manufacture and operation of these systems in the passenger car and heavy duty markets.

This forum is essential for executives, engineers, researchers and developers working in the global transmission industry.

STANDARDS/PAPERS/SUBSCRIPTIONS

VEHICLE ELECTRIFICATION SUBSCRIPTION

This annual subscription delivers a comprehensive collection of more than 4,500 SAE technical papers, 350 standards, and 13 e-books covering all aspects of electric vehicle design, production, testing, and maintenance. Content is updated regularly, so you'll always have access to the latest research and thinking on this critical topic.

ALTERNATIVE FUELS SUBSCRIPTION

This annual subscription delivers a comprehensive collection of more than 3,600 SAE technical papers, 60 standards, and 8 e-books covering a range of alternative fuels, including compressed natural gas, hydrogen fuel cells, and biodiesel. Content is updated regularly, so you'll always have access to the latest research and thinking on this critical topic.

JPAKS

JPaks are online annual subscriptions that provide a cost-effective and convenient way to access the 2,000+ individual standards in SAE MOBILUS pertaining to passenger cars, trucks, motorcycles, trailers, snowmobiles, agricultural tractors, and other ground vehicles. In addition, JPaks customers can now search and download any of the more than 2,600 historical versions of SAE Ground Vehicle Standards. With JPaks, you buy and download only as many standards as you need. Annual subscription "packs" currently include your choice of up to 10, 15, 25, 35, or 50 downloads.

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2017 LIVE LEARNING SCHEDULE

for the most up-to-date and complete schedule, visit training.sae.org/calendar/

Troy, MI, USA - SAE International Troy Office

Aug 17-18	Design for Manufacture and Assembly (DFM/DFA) – I.D.# C0418
Aug 21-22	New! Fundamentals of Vehicle Suspension Design – I.D.# C1618
Aug 28-30	Managing Engineering & Technical Professionals – I.D.# C0608

Livonia, MI, USA - Effective Training Inc.

Aug 29-30	Fundamentals of GD&T 1994 2-day Workshop – I.D.# ET2401

Tysons, VA, USA - LMI (Logistics Management Institute)

Aug 22-23	New! AS9100:2016 Rev D: Transitioning to the New Requirements – I.D.# C1623

Live Online

Aug 1-10	Vehicle Sound Package Materials – I.D.# WB1204
Aug 15-17	Diesel Engine Noise Control – I.D.# WB1041
Aug 21-25	New! Keys to Creating a Cybersecurity Process from the J3061 Process Framework – I.D.# WB1604
Aug 22-24	Overview and Impact of the Automotive Functional Safety Standard ISO 26262 – I.D.# WB1134

Troy, MI, USA - SAE International Troy Office

Sep 7-8	The Role of the Expert Witness in Product Liability Litigation – I.D.# 92054
Sep 11-12	Exhaust Gas Recirculation (EGR) for Diesel Engines – I.D.# C1214
Sep 14-15	Control Systems Simplified – I.D.# C0525
Sep 14-15	Hybrid and Electric Vehicle Systems – I.D.# C1504
Sep 18-20	Fundamentals of Steering Systems – I.D.# C0716
Sep 21-22	Accelerated Test Methods for Ground and Aerospace Vehicle Development – I.D.# C0316
Sep 21-22	Engine Failure Investigation and Analysis – I.D.# C1344
Sep 25-26	A Familiarization of Drivetrain Components – I.D.# 98024
Sep 25-26	Engineering Project Management – I.D.# 99003
Sep 27	Fundamentals of Automotive All-Wheel Drive Systems – I.D.# C0305
Sep 27-29	Turbocharging Internal Combustion Engines – I.D.# C0314
Sep 28-29	Controller Area Network (CAN) for Vehicle Applications – I.D.# C0120

Ft. Worth, TX, USA - Ft. Worth Convention Center—In conjunction with the SAE 2017 AeroTech Congress & Exhibition

Sep 28	Introduction to Composites Fabrication and Assembly in Aerospace, Space, and Transportation – I.D.# C1311
Sep 28-29	Failure Modes and Effects Analysis (Product & Process) in Aerospace – I.D.# C0939
Sep 28-29	Fundamentals of GD&T 2009 2-day Workshop – I.D.# ET1150
Sep 28-29	Understanding and Supporting Aircraft Accident Investigation and Reconstruction – I.D.# C1143
Sep 29-30	Automated Systems for Aerospace and Space Applications – I.D.# C1313

Orlando, FL, USA - JW Marriot Orlando Grand Lakes—In conjunction with the SAE 2017 Brake Colloquium & Exhibition

Sep 28	The Tire as a Vehicle Component – I.D.# C0101
Sep 28	Introduction to Brake Noise, Vibration, and Harshness – I.D.# C1337
Sep 28	Brake Friction Materials: Testing, Quality and Selection – I.D.# C1020
Sep 29	Tire and Wheel Safety Issues – I.D.# C0102
Sep 29	Brake Noise Problem Resolution – I.D.# C0831

Garden Grove, CA, USA - Wyndham Anaheim Garden Grove—In conjunction with the SAE 2017 On-Board Diagnostics Symposium

Sep 25	Emissions-Related OBD Systems: A Design Overview – I.D.# C0708

Live Online

Sep 7-19	New! Materials Selection Process for Engineering Designs – I.D.# WB1520
Sep 8-25	Fundamentals of Geometric Dimensioning & Tolerancing (GD&T) – I.D.# WB0933
Sep 11-15	Brake System Balance for Passenger Cars and Light Trucks – I.D.# WB1413
Sep 19-21	New! AS9100D:2016 and ISO 9001:2015 Explained – I.D.# WB1617

Sep 26 Introduction to Hybrid Powertrains – I.D.# C0903
Sep 28 Basic Hybrid and Electric Vehicle Safety – I.D.# C0904

Troy, MI, USA - SAE International Troy Office
Oct 3-4 Diesel Engine Technology – I.D.# 93014
Oct 5-6 Leading High Performance Teams – I.D.# C0410
Oct 10-11 Introduction to Advanced High Strength Steel Applications and Manufacturing – I.D.# C1416
Oct 10-11 Evaporative and Refueling Emission Control – I.D.# C0928
Oct 12-13 Corrosion Engineering and Prevention – I.D.# C1217
Oct 12-13 Acquiring and Analyzing Data from Sensors and In-Vehicle Networks – I.D.# C0522
Oct 16-17 New! Cybersecurity: Introduction to Embedded System Exploitation – I.D.# C1524
Oct 18-19 New! Cybersecurity: Software Assurance - Input Validation – I.D.# C1521
Oct 19-20 Design Review Workshop – I.D.# C1306
Oct 23-24 Introduction to Brake Control Systems: ABS, TCS, and ESC – I.D.# C0315
Oct 24-25 Introduction to Hybrid and Electric Vehicle Battery Systems – I.D.# C0626
Oct 25-27 Advanced Vehicle Dynamics for Passenger Cars and Light Trucks – I.D.# C0415
Oct 26 Safe Handling of High Voltage Battery Systems – I.D.# C1019
Oct 30-31 The Basics of Internal Combustion Engines – I.D.# C0103
Oct 30-Nov 1 Strategic Leadership – I.D.# C0620

Livonia, MI, USA - Effective Training Inc.
Oct 25-27 New! Fundamentals of GD&T 2009 - 3-day Public Workshop – I.D.# ET1151
Oct 30-31 Applications of GD&T 2-Day Workshop – I.D.# ET2512

Farmington, CT, USA - Homewood Suites by Hilton
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