Course Title: Vehicle Performance: Case Studies

Course Length: 3 days, in-person

Time in Class per day (hours): 6 hours

Delivery Options: Company site or at provider

Class Size: Minimum 10 / Maximum 40

Price Per Student: $680.00

Location: Wayne County *or* Company Site

Course Description:

This course provides the knowledge and skills necessary to diagnose, measure and improve vehicle performance. The course covers the areas of basic powertrain performance, chassis design/dynamics, vehicle drive-ability, ride-ability, stability, braking, tire influence, noise, vibration, and harshness. This course also presents an overview of vehicle electronics and IT and their impact on vehicle performance. Additional topics include advanced control concepts in stability/braking, vehicle lighting design and technology. The goal of this course is to provide a greater understanding of vehicle performance through a combination of classroom-based theory sessions, and hands-on computer simulation workshops on case studies.

Course Learning Objectives:

Upon completion of this course participants will be able to:

- Calculate and model the normal road loads acting on vehicles. Model and simulate suspension forces due to road inputs and steady state cornering forces
- Evaluate various suspension types, identifying advantages and tradeoffs. Analyze suspension designs and how they affect vehicle performance
- Apply vehicle dynamics theory to practical evaluation and measurement
- Summarize how vehicle dynamics is related to the voice of the customer
- Identify important vehicle system parameters useful for effective application of vehicle dynamics to chassis development
- List and explain parameters that effect vehicle performance relative to drive-off, braking, directional control, and rollover
- Identify physical measurements needed to effectively apply vehicle dynamics to passenger cars and light trucks
- Explain the balance required between ride, directional control and rollover and the essential process for this balance to be obtained for marketplace vehicles
- Discuss the differences of various acoustic terminologies that are important to solve noise and vibration problems

- Determine the steps of noise and vibration source identification process for a given application. Employ different noise control options to address specific noise and vibration issues
- Understand vehicle electrical system and IT and their impact on vehicle performance
- Describe various vehicle lighting technologies, the latest advancements in lighting technologies and trends in lighting styling

Course Content/Topics:

Vehicle road load, Time-domain metrics of vehicle performance

- Vehicle road load calculations, governing equations of vehicle motions. Definition of vehicle performance and fuel economy. Introduction of modeling and dynamic loads on several case studies

Vehicle Dynamics

- Braking and acceleration: power and traction limited acceleration, braking performance, forces, and systems. ABS and traction control performance characteristics
- Chassis and suspension: including camber, toe effects, suspension characteristics and their effect on tire behavior and vehicle handling. cornering compliance concept, critical speed and characteristic speed definitions, understeer, oversteer, neutral steer, and Ackerman steer angle
- Drive-ability and ride-ability: analysis of common suspensions and steering systems, equations of motion of a rigid body, and unsteady/transient vehicle behavior. Several case studies will be discussed
- Tire mechanics including dynamic tire effects, friction circle and friction ellipse theory, determination of performance parameters, and tire construction and failure modes

Characteristics of Vehicle Noise, Vibration, and Harshness

- Basic concepts and importance of vibration theory to vehicle design
- Causal relationship of factors related to NVH concerns
- NVH diagnostics and relationship of NVH characteristics with ergonomics
- Methods for the control of vibration to help the elimination of noise and harshness, examples by case studies
- Advanced techniques, methodologies and innovations in vehicle noise and vibration refinement

Vehicle Electrical System and IT

- Introduction to vehicle electrical/electronic systems, standards, requirements and future trends.
- Theory, control, construction, assembly and diagnosis of electrical machines.
- Review of resistor, capacitor, inductor and related circuits.

- Overview of diodes, MOSFET, IGBT, application circuits and thermal considerations. Vehicle embedded controller, software architecture and IT.
- Multiplexing and vehicle network.

Vehicle Lighting Technology

- Fundamentals of vehicle lighting and light sources.
- Automotive lamp photometry and optical design.
- Automotive lamp system configuration including design overview, analysis of thermal and venting.
- Advanced optical structures for automotive lamps:
    - Dual-Function HID (Bi-Xenon) lamps
    - Distributive Lighting System (DLS)
    - Adaptive Forward-lighting System (AFS)
    - Night vision system.

Student Final Assessment & Certificate

An exam will be given to the participants during the last hour of lecture on day 3. This final exam consists of several problems covering all the major topics presented in the class. For successful completion of this course, the participant is expected to reach score of at least 75%.

MAGMA short courses are held on a rolling basis, based on industry demand. Please complete this **short form** to express interest for yourself, or your organization.