

Fundamentals of Truck and Off-Highway Transmission Systems

A careful review of the mobility industry (i.e. automotive, agricultural, specialty and recreational vehicles, etc.) indicates that there is an apparent lack of development opportunities that explore the fundamentals of Truck and Off-Highway Transmission Systems. This seminar will develop the fundamentals, basic operational principles and design requirements of a transmission system, for the truck and off-highway equipment market segment. It will also develop a basic understanding of the fundamentals of operation and explain the current "state-of-the-art" design of common truck and off-highway transmissions. Transmission systems in current production will be used as a practical example throughout the seminar. Two basic product areas of truck and off-highway transmission systems will be reviewed: Planetary Automatic Transmissions, and Power-Shifted Transmissions.

The functional requirements of the "current" market and the operational needs of its drivers will be used to set the direction for the seminar. Seminar material will be presented in the chronological order in which it was introduced into the marketplace, or as "new" functionality was required in the marketplace. The design advances that satisfied these requirements will be discussed and used to show design progression through to the current state of design.

Specifically, the intent of the seminar is to cover transmission systems used in vehicles ranging from large, heavy-haul pick-up trucks, through commercial busses, through non-articulated delivery trucks, to class 8 "over-the-road" haulers, in the "on-highway" segment. Transmission systems covered in the off-highway equipment segment will include designs with both integrated and separate torque converter and transmission, to designs that provide for Power Take Off (PTO) facilities, through high cumulative speed ratio/large gear ratio combination designs. Current design schematics will be used to show the motivation behind the next evolutionary steps in the development of future designs of transmission systems. All aspects of current designs will be reviewed in depth; the components used, how they operate, and the interrelation of all these components. All functional modes of the major components and sub-systems will be discussed and explained. Based on this working knowledge of transmission components and systems, attendees will work through design specifications, functional modes and considerations of reliability and life for each major sub-system in a transmission system.

The seminar will conclude with a brief discussion of the future of transmission systems and what functional requirements are likely to be expected by the users of the next generation vehicles within this market.

Learning Objectives

The objectives of this seminar are to:

- Become familiar with the major components and systems functions in a modern truck & off-highway equipment automatic transmission
- Learn how to deduce powerflow, relative rotational speeds of various components, and the functional relationships that exist between these components
- Be able to roughly size a truck or off-highway transmission, select the numbers of speed ranges and ratios for each, and assess system efficiency
- Gain an understanding of the operational aspects and design principles of each of the major components and sub-systems of a transmission
- Learn the operational parameters and inter-relationships of each of the sub-systems within the truck transmission
- Discover basic design synthesis and analysis techniques for each of the major components and sub-systems of a transmission
- Be exposed to the direction of new truck & off-highway equipment transmission design trends

Benefits of Attending

By completing this seminar you will:

- Learn the differences between truck and off-highway transmission systems and passenger vehicle systems
- Understand the operational aspects and design principles of each of the major components and sub-systems in the transmission system
- Learn the operational parameters and inter-relationships of each of the sub-systems within the transmission
- Be exposed to basic design synthesis and analysis techniques for each of the major components and sub-systems
- Be exposed to the direction and new technologies of truck and off-highway transmission systems

Who Should Attend

The intended audience for this seminar is powertrain engineers, engineering directors and managers, component suppliers, platform powertrain development specialists, and those involved in the application, design and discussion of engines.

The material covered in this seminar is targeted at a number of design and engineering disciplines:

- Design engineers and engineering managers
- Truck powertrain designers
- Component suppliers
- Powertrain test and development engineers
- Design services managers

Specifically, anyone responsible for:

- Transmissions and system design, development, durability assessment and application
- Application and development of transmission & powertrain technologies
- Management of transmissions and system designers and manufacturers
- Supply of components and sub-systems to transmissions manufacturers.

The seminar will appeal to anyone who is interested in truck or off-highway vehicle operation and design.

Seminar Content

- Theory of Operation
 - Basic transmission layout
 - Main components
 - Common configurations/transmission types
- Development of the "Automatic" Transmission
- Major Components of a Modern Automatic Transmission
 - Torque converter
 - Planetary gearsets
 - Clutch packs and bands
 - Powerflow
- Functionality
 - Torque converter operation
 - Gear systems
 - Gear design considerations -- Type; Layout; NVH (Noise, Vibration and Harshness); Planetary powerflow
- Common gear arrangements and standard design configurations
- Clutches and bands

- One-way/over-riding clutches
- Comparisons to Power-Shift transmissions
- Operational characteristics of power-shift transmissions
 - Components and typical layouts
 - Clutch packs
 - Shift systems
 - Application and duty cycle consideration
- Design Considerations for Over-The-Road Transmissions
 - Process to select the number of speed ranges
 - Select approximate gear ratios for each speed range
 - Calculate losses and efficiencies
 - Power-flow optimization
 - Duty cycle considerations
 - Design for reliability and life
- Design Considerations for Off-Highway Transmissions
 - Process to select the number of speed ranges
 - Select approximate gear ratios for each speed range
 - Calculate losses and efficiencies
 - Design information content of engine curves
 - Duty cycle considerations
 - Design for service, repair and “rebuildability”
- Future Direction of Technologies

Instructor: William Mark McVea

Dr. William Mark McVea is founder and Chief Technical Officer of KBE+, Inc. KBE+ designs and develops complete powertrains for automotive and off-highway vehicles. It also develops and delivers professional seminars for the automotive industry and its supplier base. Dr. McVea holds a B.S. in Mechanical Engineering from the Rochester Institute of Technology, a Ph.D. in Design Engineering from Purdue Univ. and is a licensed Professional Engineer. He was formerly a manager of a CAE group within a tier one, powertrain supplier to world automotive markets; a consulting engineer in vehicle dynamics with Gear Consultants, Inc.; a project manager of traction systems for off-highway vehicles with Clark-Hurth International; and a research laboratory supervisor, developing geared traction devices with Gleason Power Systems, Inc. He has taught and lectured at Purdue, Michigan State and Syracuse Univ. He has published extensively on the topics of transmission systems, automated design assistant systems, knowledge systems and knowledge-based engineering in general. Currently, he is a Professor of Information Technology in the B. Thomas Golisano College of Computing and Information Sciences at the Rochester Institute of Technology.