

Fundamentals of Applied Vehicle Dynamics and Chassis Systems

Course credits (2) and a certificate shall be give to participants who complete the course.

Course Learning Objectives

By attending this course, the participants will be able to fulfil some or all of the following:

- Explain tire-road friction limits and compose the friction circle for a given vehicle system
- Compute fundamental braking response attributes
- Illustrate the physics of turning and calculate lateral weight transfer
- Estimate brake system balance and brake proportioning
- Measure and graph a vehicle's understeer gradient
- Analyze basic anti-lock brake system (ABS) operation
- Discuss the effectiveness and limitations of electronic stability control (ESC) systems
- Demonstrate the interactions of brake, steering, suspension, and powertrain systems
- Calculate the most efficient path for a vehicle to negotiate a given test maneuver
- Comprehend the subtle effects that vehicle positioning has on vehicle speed
- Predict what response characteristics can be influenced by vehicle state
- Define those vehicle dynamic attributes which can be impacted through vehicle selection

Course Schedule (Tentative) (a 10 min tea break midway during every session)

Jan 12 th 2016, Tue 4-6 PM	Course Syllabus and Policies; Introduction: history, vehicle classifications, fundamental approaches to vehicle dynamics modelling
Jan 13 th 2016, Wed 4-6 PM	Acceleration Performance: power train components; power-limited acceleration; traction limited acceleration; transverse weight shift; front wheel drive vs rear wheel drive vs. all-wheel drive vehicles;
Jan 14 th 2016, Thu 4-6 PM	Braking Performance: braking force analysis; brake design and analysis; federal regulation on braking performance; anti-lock braking system; wheel lock-up; tire/road friction; safety and maintenance issues in braking.
Jan 15 th 2016, Fri 4-6 PM	Road Loads: wind drag and car body design, rolling resistance; breakdowns of total road loads; gas mileage analysis and driving styles
Jan 16 th 2016, Sat 9.00-11.30 AM and 1.30-5.00 PM	ADAMS VIEW/CAR training
Jan 17 th 2016, Sun 9.00-11.30 AM and 1.30-5.00 PM	ADAMS VIEW/CAR training
Jan 18 th 2016, Mon 4-6 PM	A mid term examination

Jan 19 th 2016, Tue 4-6 PM	Tire and Tire Dynamics: tire specifications and constructions; tire motion analysis; tire force analysis; tire contact stress analysis; tire vibration analysis;
Jan 20 th 2016, Wed 4-6 PM	Ride: riding comfort; perception of vibration; vibration sources; vibration transmission to the passengers;
Jan 21 th 2016, Thu 4-6 PM	Cornering/steering: lower speed cornering; high speed corner; cornering bicycle model;
Jan 22 nd 2016, Fri 4-6 PM	Chassis and Suspension Systems: general kinematics; vehicle constraint analysis; practical designs; active suspension
Jan 23 rd 2016, Sat 4-6 PM	Final examination

Teaching Faculty

Dr. Echempati earned his Ph.D. in Mechanical Engineering from the Indian Institute of Technology, Kharagpur, India and is a professionally licensed engineer in the state of Mississippi. He is currently a Professor of Mechanical Engineering at Kettering University, in Flint, Michigan, where he teaches in the areas of statics, mechanics of materials and machine design. His specialty courses include: Mechanism Design, Finite Element Analysis, Vehicle Dynamics and Chassis Systems (taught at IIT Gandhinagar), and Sheet Metal Forming. Dr. Echempati's applied research focus is on applications of CAE, finite element analysis to the design of mechanical systems. He has particular expertise and interest in vibrations, dynamics and finite element analysis. He also has interest and expertise in engineering education and published numerous papers in these areas and conducted technical workshops in Brazil and Thailand. He has conducted applied research and provided consulting services to few companies such as General Motors and Chrysler Corporation and their subsidiaries. He is an active member and a recipient of McFarland award of SAE International, Fellow member of ASME, and active member of ASEE. He has been a co-organizer of Body Design and Engineering Session at the SAE International and an associate editor of Passenger Vehicles Journal published by SAE. He is on the review panel on numerous committees, including Gilman Scholarship, NSF and several other national and international technical conferences. He was a two-time recipient of Fulbright Fellowship to enhance STEM education in India and in Thailand. During his non-teaching terms at Kettering University, and as a recipient of Oswald Fellowship, he taught several years in Germany and also in India at the Indian Institute of Technology, Delhi and at IIT Gandhinagar.

Textbooks:

- Fundamentals of Vehicle Dynamics, Thomas Gillespie, SAE Publication.
- The Multibody systems Approach to Vehicle Dynamics, Mike Blundell and Damian Harty, Elsevier, 2004.
- Vehicle Dynamics, Theory and Application, Reza N. Jazar, Springer, 2009, ISBN 978-0-387-74243-4, e-ISBN 978-0-387-74244-1.
- Race Car Vehicle Dynamics, W.F. Milliken and D.L. Milliken, SAE, 1995, ISBN 1-56091-526-9.
- Reimpell, Stoll and Betzler: The Automotive Chassis: Engineering Principles.