THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Powertrain Dynamics

MECHENG 7236

Credit Hours:
3.00 - 3.00

Course Levels:
Graduate (5000-8000 level)

Course Components:
Lecture

Course Description:
Overview of dynamics and control of automotive powertrain systems. Emphasis on subsystem interactions. Analytical and numerical methods for dynamics of gas exchange, fueling, combustion and exhaust, and mechanical engine and transmission systems.

Prerequisites and Co-requisites:
Prereq: Grad standing, or permission of instructor.

Course Goals / Objectives:

- Review basic principles of the dynamics of mechanical, electrical, fluid and thermal systems
- Understand the overall interconnection of gas exchange, fueling, combustion, exhaust and mechanical transmission systems in the context of a modern automotive powertrain
- Develop mathematical model of gas exchange processes, components and systems in engines. To explore the behavior of these systems analytically and computationally
- Develop mathematical models of fueling systems including pumps, fuel injectors, injected fuel condensation and evaporation, and evaporative fuel emissions. To explore the behavior of these systems analytically and computationally
- Develop mathematical models of ignition, combustion and heat release in engines. To explore the behavior of these systems analytically and computationally
- Develop mathematical models of exhaust emissions formation and of catalytic emission reduction systems. To explore the behavior of these systems analytically and computationally
- Develop mathematical models of force and torque production and transmission in reciprocating engines. To explore the dynamics of engine reciprocating and rotating assemblies analytically and computationally
- Develop mathematical models of cylinder air charge filling, of air and fuel mixture formation and of air-to-fuel ratio dynamics. To explore the behavior of these systems analytically and computationally
- Develop an understanding of the role of fluid couplings and torque converters in handling power transfer between the engine and the drivetrain, including providing torque amplification and smoothness of power transfer
- Develop an understanding of the role of the transmission mechanical system in handling power transfer between the turbine of the torque converter and the vehicle drivetrain, and to implement smooth gear shifts efficiently
- Develop an understanding of how the transmission shift hydraulic system generates shift hydraulic pressure, initiates gear shifts, and performs them satisfactorily
- Use transmission component and subsystem models in an integrated fashion to simulate open loop transmission control strategies and evaluate their effectiveness
- Develop an understanding of continuously variable transmissions as well as transmissions in hybrid electric vehicles

Course Topics:

- To develop mathematical model of gas exchange processes, componentns and systems in engines. To explore the behavior of these systems analytically and computationally.
- To develop mathematical models of fueling systems including pumps, fuel injectors, injected fuel condensation and evaporation, and evaporative fuel emissions. To explore the behavior of these systems analytically and computationally.
- To develop mathematical models of ignition, combustion and heat release in engines. To explore the behavior of these systems analytically and computationally.
- To develop mathematical models of exhaust emissions formation and of catalytic emission reduction systems. To explore the behavior of these systems analytically and computationally.
- To develop mathematical models of force and torque production and transmission in reciprocating engines. To explore the dynamics of engine reciprocating and rotating assemblies analytically and computationally.
- To develop mathematical models of cylinder air charge filling, of air and fuel mixture formation and of air-to-fuel ratio dynamics. To explore the behavior of these systems analytically and computationally.
- To develop an understanding of the geometry and function of fluid couplings and torque converters, and to derive quantitative kinematic and dynamic relationship of mechanical elements to develop mathematical models for their response.
- To model vehicle longitudinal dynamics and to derive equations for vehicle response
- To develop an understanding of the components of shift hydraulic systems and to develop quantitative models of their response, and to discuss open loop transmission control strategies
- To get experience in physical simulation of transmission subsystems using commercial software, and to develop models of continuously variable transmissions as well as transmissions for hybrid electric vehicles

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Designation:
Elective