Course alpha, number, title: ME 445 Automotive Powertrain Design

Required or elective: Elective

Course (catalog) description: Design of powertrain systems including piston ring assembly, combustion and induction systems, and transmissions. Performance emission tradeoffs with emphasis on emission control. Detailed design study required.

Prerequisite(s): (ME 444)

Textbook(s) and/or other required material: Introduction to Internal Combustion Engines Third Edition Society of Automotive Engineers Author: Richard Stone

Class/Lab schedule: Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered: 
a. Valvetrain Systems 
b. Induction Systems 
c. Combustion Chamber Design 
d. Induction & Exhaust System Design 
e. Flow Losses in Internal Flow Systems 
f. Turbo/Super-Charging 
g. Sound & Noise in Intake/Exhaust Systems

Course learning objectives: 
- Knowledge of basic engine operating principles and definition of performance parameters.
- Detailed understanding of engine valvetrain design and valve timing effects on performance, fuel efficiency, and emissions tradeoffs. Variable Valve Timing (VVT) schemes.
- Intake and Exhaust System Tuning Methods for commercial and racing applications; Helmholtz Resonator Theory. Effects of engine design parameters and operating conditions on performance and fuel efficiency.
- Quasi-One-Dimensional Modeling theory and application. – learn and apply a commercial CAE code to optimize IC engine tuning and cam phasing.
- Develop written and oral technical presentation skills through homework and team semester projects involving application of practical CAE analysis tools.
- Understanding of Variable Induction (VIS) and Exhaust (VES) System Design Alternatives
- Knowledge of flow losses in engine intake and exhaust systems; Basic definitions and design parameters of importance. Develop ability to calculate pressure drop across real world intake and exhaust systems.
- Modeling combustion and heat transfer. Knock and octane effects.
- Basics and Modeling of Turbo- and Super-Chargers
- Knowledge of induction and exhaust noise generation; Basic definitions of sound.
Resonator and Muffler designs.

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.

(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—0
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—0
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1

Contribution to professional component: 40% Engineering Science 60% Engineering Design

Person(s) who prepared this description: James M. Novak

Date of Preparation: 2009, updated 2014