**Oakland University**
**School of Engineering and Computer Science**
**Department of Mechanical Engineering**

## Automotive Powertrain Integration

**COURSE #: ME-5900**
**YEAR:** Winter 2018
**PROFESSOR:** Dr. Edward G. Groff
**PHONE**: (248) 761-9450
**OFFICE:** 473 EC

**CREDITS:** 4
**DAY/TIME:** Tu Th 7:30PM –9:17PM
**CLASS LOCATION:** 204 Elliott Hall
**E-mail**: groff@oakland.edu
**OFFICE HOURS:** Office hours are flexible and available by appointment

**COURSE DESCRIPTION:** This course will examine the engineering tradeoffs involved in meeting the multiple requirements of a particular vehicle during the development process, e.g., fuel economy, driveability, performance, mass, cost, noise & vibration, marketable technologies, assembly, maintenance, safety, style, etc., with a focus on passenger cars. The general layouts of "conventional" powertrains (not hybrid or electric) will be examined. The impact of several subsystems will be discussed in connection with these tradeoffs, including induction, exhaust, coolant, mounting, and fuel. Course materials will be electronic lecture notes provided by the professor and presentations from five expert guest lecturers from the automotive industry. A software package widely used in the industry, GT Suite by Gamma Technologies, will be used for various assignments to study tradeoffs. The course objective is to develop a broad awareness of the tradeoffs involved in developing a vehicle such that an engineer working on a particular aspect of a vehicle might better understand decisions and tradeoffs being made during the development process. A secondary objective is to develop a general capability with the GT Suite software, so results from this software might be interpreted better when presented. The course will draw on basic knowledge of engines, fluid mechanics, and thermodynamics.

**LEARNING OUTCOMES:**

By the end of the course, the successful student will be able to:

- Explain the tradeoffs between various sub-systems required to integrate a conventional powertrain in a vehicle. **(e, h, j, k)**
- List some of the basic design principles used for various powertrain sub-systems such as cooling, crankcase scavenging, fuel, induction, exhaust, and packaging. **(e, h, j, k)**
- Demonstrate the ability to apply GT Suite software to analyze powertrain issues and study sub-system tradeoffs. **( c, e, h, k)**
- Describe the overall capabilities of GT Suite software and its applications the automotive industry. **(c, e, h, k)**
- Design and perform virtual experiments with GT Suite. Analyze results and write summary reports on the findings. **(a, b, d, e, f, g, k)**

**TEXTBOOK:** Postings of Electronic Files on Moodle

**COURSE PREREQUISITES:** BS Degree in ME or equivalent, a course in I.C. Engines is desirable

**COURSE WEBSITE:** The Moodle course management system will be used this semester. You may access the ME 595 website using your OUCA name and password at: https://moodle.oakland.edu. Homework assignments, solutions, announcements, interesting web links and handouts can be found on this site. Please visit the website on a regular basis for course updates.

**TENATIVE COURSE TOPICS:**

| Topic | Reading |
|---|---|
| General Layout of Powertrain Architectures<br>Powertrain Matching to Requirements<br>Packaging<br>Turbochargers (Guest lecturer)<br>Turbocharged Engine Downsizing<br>Integration of Turbocharger Engines<br>Cooling System<br>PCV System<br>Evaporative System<br>Accessory Drive System<br>Fuel Systems (Guest lecturer)<br>Powertrain Mounts<br>Electrical Communication (Guest lecturer)<br>Induction System<br>All-wheel-drive systems (Guest lecturer)<br>Transmissions and Flywheels<br>Quality | As posted in Moodle schedule, materials from Dr. Edward Groff and four Guest Lecturers |

**HOMEWORK:**

• Students are expected to read the relevant Chapter in the posted lecture material prior to class to be in a position to discuss the material and ask questions about the material in class.

• After discussion in lectures, approximately seven tradeoff situations will be studied via GT Suite simulations, literature searches on the Web, etc. and the results summarized in formats provided. Assignment details, grading rubrics, and the expected report format will be posted on Moodle. Students will be provided access to the GT Suite software installed on the SECS server through swipe-card access to room 560 EC. Note: An Oakland University Identification Card, available in Oakland Center, is required for entry to 560 EC.

• You are encouraged to consult with others on homework assignments and may opt to work in teams. Each student is, however, required to hand in his/her individual assignment with the names of students who provided assistance clearly indicated on the front page. Failure to give proper credit for assistance received will be considered plagiarism and will be dealt with in accordance with university policies.

**LABORATORY:**

• GT Suite will be used as a virtual laboratory for several homework assignments. Four class periods will be devoted to illustrating the basics of working with the GT Suit software, with the bulk of the training to be based on tutorials provided with the software.

**EVALUATIONS:**

Evaluations will be based on class attendance and participation, homework assignments, three quizzes given during the semester, and a final exam at the end of the semester. An overall course schedule, assignment due dates, and quiz dates will be posted on Moodle. Class attendance and participation in discussions is essential to receive the greatest benefit from the course.

**GRADING:** The course grade will be calculated as follows:

| | |
|---|---|
| Final exam : | 25 % |
| Quizzes: | 35% |
| Assignments: | 30 % |
| Attendance and class participation: | 10 % |

The grading criteria for individual assignments and exams is based on percentages determined by the professor. Grading rubrics will be provided with some assignments. There is no fixed grading scale for this course; a conversion formula from percentage score to an Oakland University grade will be determined at the end of the course. However, as a guideline, the cumulative course grade, based on a maximum of 100%, will be converted to an Oakland University numerical grade as follows:

95-100% - 4.00
80-94% - 3.0-3.9
70-79% - 2.0-2.9
51-69% - 1.0-1.9
$\leq$ 50% - 0.0

The percentages above, as well as the weighting of the final exam and quizzes, may be adjusted slightly, as significant improvement or decline in student performance throughout the semester and overall class performance will be taken into account in determining the course grade.

**IMPORTANT DATES:**

- January 17 - Last day for "no-grade" drop and last day for 100% semester refund
- February 17 – February 26 – Winter Break
- March 14 - Last day for official withdrawal (W)
- April 17 - Last ME-5900 class
- April 24 - **Final exam – 7:00 – 10:00 PM**

**ACADEMIC CONDUCT:**

Students are expected to read, understand and comply with the Academic Conduct Policy of Oakland University, as explained at http://www.oakland.edu/?id=24228&sid=482. Violations will be taken before the Academic Conduct Committee. Students found guilty of academic misconduct in this course will receive a grade of 0.0 in addition to any penalties imposed by the Academic Conduct Committee. The latest version of the Academic Conduct Committee's procedures is in the Dean's office.

Please note that the use of cell phones, text messaging and laptops is not allowed in this class unless you receive a special dispensation from the instructor.

**LEARNING OUTCOMES: ABET 3 (a-k)**

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environ., social, political, ethical, health, safety, manufactured ability, sustainability
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global economical, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice