

Spring 2016

AME409: Senior Design Project

Department of Aerospace & Mechanical Engineering

University of Southern California

COURSE SYLLABUS

Instructor: Prof. Yan Jin

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Course Section:	28808R (Lecture) 28810R (Tue Lab), 28811R (Thu Lab)
Course Unit:	4 Units
Prerequisite:	Senior Standing
Class Hours:	Lecture: Tues & Thus 1-1:50pm Workshop: Tues / Thus 2-4:50pm
Class Location:	MHP-106 (Lecture), RTH-115 (Lab)
Office Hours:	Thursdays, 11am-12pm
Teaching Assistant:	Hristina Milojevic (milojevi@usc.edu)

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Course Description

This design course focuses on the development and configuration of innovative vehicles and alternative energy systems in the context of the rising energy cost and the increasing pressures for socially responsible engineering. The designer, in addition to having advanced technical skills, needs to understand the integration and interactive optimization of many subsystems, each operating coherently as part of an efficient whole. She/he must use fundamental relationships for critical parameters of weight, strength, power, performance etc., which are less specific, defined and detailed than those learned in other engineering classes. An integrative, holistic approach to the creation of a complete system is taught, as opposed to the reductive analyses associated with specialized disciplines.

The course consists of lectures on essential features of modern technology and interactive workshops, in which small student groups develop preliminary designs of the selected system for that year. For the final presentation the students are required to give a formal briefing to the class.

Course Objectives

Following objectives are set for the students of this class:

- Understand and apply an iterative, integrative and holistic design process.
- Create innovative solutions for assigned design problems
- Comprehend fundamental relationships of vehicle weight power, strength and performance.
- Understand teamwork and work effectively as a team member.
- Clarify and define requirements or a mission statement and develop a design that satisfies the requirements.
- Understand various approaches to reduce or eliminate vehicle emission.
- Analyze power requirement and design a power system to satisfy both power and emission needs.
- Calculate energy requirements and determine specifications of major vehicle components.

- Understand vehicle steering dynamics and design an adequate steering mechanism for desired performance.
- Understand vehicle rolling dynamics and design a suspension system for desired performance.
- Understand the importance of ergonomics in engineering design and address ergonomic issues in the design project

Prerequisite

Senior standing.

Course Work

The class meets for four five hours a week, of which two are lectures while the balance consists of workshop sessions in a design room with computers and boards. Part of the course training involves a specific study of general methods of engineering design and problem solving, encouraging innovation and channeling creativity; the balance consists of the development of the preliminary design of an innovative vehicle.

The workshop sessions, 3 hours per week, are designed for students to complete their work assignments. During the first half of the course, students will work on their assignments and a midterm report as individuals. Teams of 4 to 6 people will be formed with each team developing a different design aimed at the same specification. The design topic is a hybrid PZEV (Partial Zero Emissions Vehicle) for the Los Angeles basin, with alternative low emissions power systems for extended range. Specifications will be outlined in a short document. Students will perform an initial systems analysis and then, after review, revision and approval, complete the Preliminary Design of the vehicle, culminating in a formal engineering report containing text and three view drawings of vehicle airlines, layout, interiors and power, propulsion and systems arrangement.

Course Materials

Course materials will be provided on the course website/blackboard or as handouts.

Grading Requirements

Grades will be based on the Work Assignments (35%), Midterm Report (Performance and Energy) (35%), and Final Project Report (Preliminary Design) (30%).

Course Schedule

Date	Lecture (Tue)	Lecture (Thu)	Workshop (T/Th)	Work Due
1/12 1/14	Course Introduction	Introduction to Engineering Design	Explore Automobiles	.
1/19 1/21	Design Methodology Review	Automotive Systems	Functional Design	Exploration Report
1/26 1/28	Automotive Design Process & 3-V Drawing	Powertrain & Drivetrain	3-V Drawing	Functional Diagram
2/2 2/4	Intro to Automotive Aerodynamics I	Intro to Automotive Aerodynamics II	Powertrain system function structure	3-V Drawing
2/9 2/11	Power Required	Alternative Powers	Power Required Curve (Air drag est. form)	Power Function Structure
2/16 2/18	Power Available	Power Curve and Vehicle Performance	Power Available Curve	Power Required Curve
2/23 2/25	Energy Required	LEV/ZEV and Hybrid Systems	Energy Required	Power Curve
3/1 3/3	Energy System Layout Design	How to Write a Technical Report	Energy System Layout	Energy System Layout Design
3/8 3/10	Energy System Recap	Teamwork	System Integration. Form teams	Energy Study Report (Fri)
3/15 3/17	Spring Break, no class			
3/22 3/24	Beam Theory and Structures	Automotive Chassis	Project Planning	.
3/29 3/31	Steering Dynamics I	Steering Dynamics II	Steering System	Project Planning
4/5 4/7	Steering Dynamics III	Suspension I	Steering System	Ackerman Angle
4/12 4/14	Suspension II	Ergonomics & Package Design	Suspension	Steering Geometry
4/19 4/21	Ergonomics II	Final design layout & Weight schedule	Ergo Design	Suspension
4/26 4/28	Project Briefing (1)	Project Briefing (2)	.	
5/2	Final Design report (PDF file) due 5pm at yjin@usc.edu.			