MECHENG 566 SAMPLE syllabus
The University of Michigan

Department of Mechanical Engineering

MECHENG 566 Modeling, Analysis and Control of Hybrid Electric Vehicles

Instructor: Huei Peng, Professor, ME, G036 AL, hpeng@umich.edu, 734 936 0352

Objective: To cover the modeling, analysis and control of vehicles with electrified propulsion systems, including electric vehicles, hybrid vehicles, and plug-in hybrid electric vehicles. Introduce the concepts and terminology, the state-of-the-art development, energy conversion and storage options, modeling, analysis, system integration and basic principles of vehicle controls. Upon completion of this course, students should be able to follow the literature on these subjects and perform modeling, design, analysis and development work in this field.

Time: TBD

Office hours: TBD

Prerequisite: Knowledge in Internal Combustion Engine (ME438) and Automatic Control (ME461) are helpful but are not required. The computer package MATLAB/SIMULINK will be used extensively for example problems and homework problems. Therefore, prior experience with MATLAB is strongly recommended.

Website: The course web site will be in Ctools

Grading:

4-6 Homework sets	40%
Midterm	15%
Final Project	45%

Homework: Must be handed in on the due date in class (on-campus students) or uploaded to Ctools before the specified time (distance students). Late homework will be accepted up to 48 hours late with a 20% penalty for each 24 hours (rounded up, i.e., 0 to 24 hours late = 24 hours late). All problem sets (home work assignments) are to be completed on your own. You may discuss homework assignments with your fellow students at the conceptual level, but must complete all calculations and write-up, from scrap to final form, on your own. Verbatim copying of another student's work is forbidden. If you have any questions about this policy, please do not hesitate to contact the instructor.

Project: A team project report is due

Exams: In-class midterm on energy/combustion/control concepts. No make-up examinations will be scheduled.

Course Outline:

Lec.	Lecture contents
1	Introduction, motivation
2	Introduction of electrified powertrain concepts. Final project ideas
3	Energy for Transportation; environmental impact
4	MATLAB-SIMULINK review
5	APUs for hybrid electric vehicles – IC engine fundamentals, challenges and opportunities
6	APUs for HEVs – SI engine processes, performance and fuel efficiency
7	APUs for HEVs – CI engine processes, performance and fuel efficiency
8	APUs for HEVs – Novel combustion modes, synergy with hybrid systems
9	Integrated IC Engines systems: turbo-charging, after-treatment and modeling
10	Modeling of power split devices for hybrid vehicles
11	Power split systems – two mode hybrids
12	Vehicle control hierarchy and power management
13	Driving schedules and impact on electrified vehicle design and control
14	**Midterm**
15	Modeling and analysis of series electric hybrid powertrains
16	Case studies— Optimal design and control of a parallel hybrid vehicle
17	Plug-in hybrid vehicles—energy consumption, emissions and battery sizing optimization
18	Power electronic devices and motors—introduction and modeling
19	Modeling and analysis of split hybrid power-trains
20	Modeling and analysis of split hybrid power-trains
21	Control of split hybrid vehicles
22	Modeling and control issues of batteries
23	Modeling and control issues of batteries
24	Major design issues and consideration of Hybrids
25	Emission issues, environmental impact of hybrids, systems for heavy vehicles
26	Engine-In-the-Loop: A Hybrid Vehicle System Design and Control Tool
27	**Final Project Presentation**