

**ME441/541 Advanced Vehicle Systems**  
**Spring 2023**  
**Syllabus**

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COURSE Tuğçe Yüksel  
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Office Hours: Thursday: 15:40-16:30  
@Zoom

COURSE Sahar Dadashi Farkhandi  
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Office Hours: Monday 12:30-13:30  
@Zoom

COURSE Monday: 8:40 am -9:30 am @ Zoom and FENS L055  
SCHEDULE Tuesday: 4:40 pm-5:30 pm @ Zoom and FENS L029

COURSE This course aims to provide basic concepts towards understanding electrified vehicles. It  
OBJECTIVES aims to provide the students the technical fundamentals to build mathematical models  
of certain vehicle components, and perform simplified analyses on vehicle dynamics,  
battery behavior, energy consumption and power management.

After the course, the students should be able to :

- Identify different electrified powertrain alternatives.
- Understand the working principles and challenges of batteries, fuel cells and super/ultra capacitors.
- Understand the working principles of internal combustion engines and electric motors, their advantages and disadvantages.
- Create simplified vehicle component models in Matlab and Simulink.
- Explain the technical, economic, environmental and social advantages and disadvantages of alternative vehicle technologies.

COURSE The intended content of the class is listed below. There might be small changes  
CONTENT throughout the semester depending on how the class proceeds.

- Week 1 : Introduction to electrified vehicles, comparison to conventional vehicles, advantages, current situation of technology and market, challenges, environmental and policy issues.
- Week 2-3 : Vehicle Dynamics and Performance Fundamentals, Longitudinal Dynamics, Propulsion and Breaking, Modeling Vehicle Performance and Dynamics.
- Weeks 4-5 : Internal Combustion Engines: Fundamentals, types, efficiency maps, fuel economy, emission control.
- Week 6 : Electric Motors, Battery Electric Vehicles: Power and torque generation, types (DC motors, induction motors, SRM), efficiency, BEV powertrain basics, energy consumption calculations
- Week 7-8 : Introduction to batteries: Electrochemical fundamentals, battery types, parameters.
- Week 9 : Batteries cont'd: Li-ion batteries, battery modeling, battery management systems.
- Weeks 10-11 : Hybrid Electric Vehicles: Alternative hybrid powertrain configurations (series, parallel, split), Powertrain simulation, energy management.
- Week 12 : Plug-in Hybrid Electric Vehicles, powertrain simulation
- Week 13 : Fuel cell electric vehicles, fundamentals of fuel cells, types, basic modeling

and powertrain simulation.

- Week 14 : Semester review, example problems. Potential guest speaker from industry.

**COURSE REQUIREMENTS** There is not an officially assigned prerequisite for this course. However students are expected to have background on dynamics, systems modeling and control, and basic electric circuits .

**Matlab and Matlab/Simulink will be used extensively. The course will require you to build models in Matlab and Simulink from scratch (with no prior template given). Therefore experience is strongly recommended.**

There will be no recitations and limited number of problems will be solved in the class. This class assumes that you are interested in the material, that you will spare the time and effort yourselves to practice the concepts that are taught in the class and that you will reflect this to the assignments, exams and (if applicable) term project.

**REFERENCES** There is no official textbook for this course but the following references will be used occasionally:

- Iqbal Husain, *Electric and Hybrid Vehicles-Design Fundamentals, 2<sup>nd</sup> Edition*, CRC Press, 2011.
- Amir Khajepour, Saber Fallah, Avesta Goodarzi, *Electric and Hybrid Vehicles - Technologies, Modeling and Control: A Mechatronic Approach*, Wiley, 2014.
- James Larminie, John Lowry, *Electric Vehicle Technology Explained*, Wiley, 2004.
- Gianfranco Pistoia, *Electric and Hybrid Vehicles-Power Sources, Models, Sustainability, Infrastructure and the Market*, Elsevier, 2010.

Additional materials will be shared at SUCourse when necessary.

**CLASS POLICIES**

- As announced by the university, the classes will be held online from the classrooms mentioned above. Zoom link for the class will be announced through SUCourse and MySU.
- You need to sign in to the Zoom lectures with your SU credentials.
- Students cannot share or post to the Web any document or recording of any of the course material with third parties.
- We are all responsible for creating a safe and inclusive classroom experience for everyone in the class.

**ASSESSMENT & GRADING** ME 441 Grading :

Take-home assignments (30%), Midterm (25%), Final (40%), Quizzes(5%)

ME 541 Grading :

Take-home assignments (20%), Midterm (20% ), Final (25%), Term Project/Paper (30%), Quizzes(5%)

- Midterm will be held online. Rules and details of the online midterm exam will be announced via SUCourse.
- The mode of the final exam will be in-person unless any changes are announced by the university.
- Throughout the semester, random oral exams might be given. You may be called upon to explain your homework/project solution and answer course related questions in a one-to-one meeting with the TA/instructor. Students who fail to explain

their work or answer related questions will get zero (0) credit from the related exam/homework/project.

- Pop-quizzes with short answer questions (3-5 minutes) will be given randomly during classes through SUCourse+. You must be present in the lecture for at least 40 minutes otherwise your quiz will be void. Best 80% of the quizzes will be counted towards your final grade, therefore if you miss a quiz or cannot submit a quiz due to connection problems you can consider it to be among your worst 20%.
- Your attendance and participation in the lectures may affect your final grade, especially for borderline cases. Attendance consists of joining lectures (you must be present in the lecture for at least 40 minutes) and participation in quizzes/polls.
- One make-up examination, covering the whole course material, will be given after the final exam date for the students who missed midterm and/or final examination **due to a valid excuse approved by the Health Services or University.**
- Homework will be distributed via SUCourse+. Zero credit for late homework unless arrangements are made in advance (only with valid excuses). You can discuss the problems/questions with your classmates but **copying work is against University regulations and might result in a grade zero (0).**
- All solutions (homework, exam and quizzes) must be written in a professional manner. You may lose points for poorly written answers.

SUCOURSE+ All announcements will be made through SUCourse+, students are responsible from following the announcements.

DISCLAIMER

- We may have to revise the course plan according to the countrywide reassessment to be made regarding higher education. This is expected to happen at the beginning of April. The content to be delivered is certain but the method of course delivery, the number and dates of exams, and some other details are subject to change.
- Time conflict requests can be accepted for one hour only. Students who are registered to the course with time-conflict override accept the responsibility of any inconvenience that might occur due to missed content and/or (if any) quizzes. No make-up will be available for missed quizzes/content. To get approval for time conflict, you need to send an e-mail stating you are aware of these facts and you accept the responsibility.

ACADEMIC INTEGRITY

- Students are expected to be familiar with and comply with [Sabanci University Academic Integrity Statement](#). Any form of academic dishonesty (plagiarism, copying/using other people's work, attending classes/exams on behalf of other people, etc) will be penalized with a failing grade (i.e., zero points) for the related assignment, quiz, or exam and **disciplinary actions will be taken.**