# ECE 724
## Modeling, Control and Design of Electrified Vehicles

COURSE OUTLINE

Please refer to course website for updated information.

## CALENDAR DESCRIPTION

This course covers the modeling, control, and design of electrified vehicles, including hybrid, plug-in hybrid, and pure electric vehicles. The high-level goal of this course is to understand the vehicle model as a testbed for evaluating future design and control ideas.

## SCHEDULE And MODE OF DELIVERY

The material for this course will be delivered through online lectures (which are also recorded). The platform is noted at the end of the line below.

Lecture: Tuesdays 10:00 a.m.- 1:00 p.m. (Microsoft Teams)

## INSTRUCTOR

Dr. Jennifer Bauman
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Office: ITB-A220
Phone: 905-525-9140 ext. 27599
Office Hours: TBD

## COURSE WEBSITE/S

The main course website is Avenue to Learn. All lecture slides and project instructions can be found here. The recorded lectures will be available in the ECE 724 team chat in Microsoft Teams.

## COURSE OBJECTIVES

This course is heavily project-based, with the goal of the main project being to perform a small research study in the electrified vehicle space that utilizes vehicle modeling to investigate design and/or control ideas. By the end of this course, students should be able to:

- create accurate vehicle models validated to real-world data, and use these models to evaluate new ideas.

## ASSUMED KNOWLEDGE

Students must have prior experience using MATLAB and Simulink to be successful in this course. This course is not an introduction to MATLAB/Simulink.

## COURSE MATERIALS

Optional course textbook: "Hybrid Electric Vehicle System Modeling and Control, 2nd Edition" by Wei Liu

## COURSE OVERVIEW

| Week | Topic |
|---|---|
| 1 | Introduction, model types, powertrain architectures, data sources |
| 2 | Standard drive cycles, fuel economy and range, model structure, modeling of: driver, chassis, wheel, final drive |
| 3 | Modeling of: motors, control, power electronics, electrical accessories |
| 4 | Modeling of: batteries, fuel cells |
| 5 | Hybrid energy storage systems, ultracapacitors |
| 6 | Modeling of: engines, transmissions |
| 7 | Control strategies |
| 8 | Control strategies, electrified vehicle design |
| 9 | EV Charging |
| 10 | Student project presentations |
| 11 | Student project presentations |
| 12 | Student project presentations |

A more detailed time line is available in the Week 1 lecture notes on the course web site.

At certain points in the course it may make good sense to modify the schedule. The instructor may modify elements of the course and will notify students accordingly (in class, on the course website).

## ASSESSMENT

| Component | Weight |
|---|---|
| Project Proposal | 10% |
| Assignment #1 | 35% |
| Project – presentation | 5% |
| Project – final report | 50% |
| Total | 100% |

Late submissions of assignments or project report are subject to 10% penalty per day (less than one day is counted as one day).

## CONDUCT EXPECTATIONS

As a McMaster graduate student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

## COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

## ACADEMIC ACCOMMODATIONS OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

## ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term

in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

## EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

## RESEARCH ETHICS

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to http://www.mcmaster.ca/policy/faculty/Conduct/ResearchEthicsPolicy.pdf.

**www.eng.mcmaster.ca/ece**