

Course Outline (W2024)

ELE801: Electric Vehicles

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|---|---|
| Instructor(s) | Dr. David Xu [Coordinator] Office: ENG320 Phone: (416) 979-5000 x 556075 Email: dxu@torontomu.ca Office Hours: Wednesday 3-5PM |
| Calendar Description | This course introduces architectures and technologies associated with electric, hybrid electric, and plug-in hybrid electric vehicles, including their constituent components. Specific topics include electric and hybrid electric drive trains, energy storage, electromechanical energy conversion and power-electronic drives, vehicle-level modeling and control, and optimization. |
| Prerequisites | ELE 637 or EES 612 |
| Antirequisites | None |
| Corerequisites | None |
| Compulsory Text(s): | 1. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Husain, 3rd Edition, CRC Press, 2021. |
| Reference Text(s): | 1. Modern Electric, Hybrid Electric, and Fuel-Cell Vehicles, M. Ehsani, Y. Gao, and A. Emadi, 3rd Edition, CRC Press, 2018. 2. ELE801 Laboratory Manuals: Available on D2L |
| Learning Objectives (Indicators) | At the end of this course, the successful student will be able to: <ul style="list-style-type: none"> 1. Use numerical and analytical models to analyse and predict performance of electric vehicles. (1b) 2. Use the specialized core engineering knowledge to understand a specific component of an electric vehicle. (1d) 3. Use of Matlab/Simulink as the tool for modeling and analysis of various components or processes within an electric vehicle. (5a) 4. Understand the benefits of electric vehicle to environment and sustainable development. (9a) <p>NOTE: Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).</p> |
| Course Organization | 3.0 hours of lecture per week for 13 weeks 1.0 hours of lab per week for 12 weeks 0.0 hours of tutorial per week for 12 weeks |

| Teaching Assistants | TBA | | | | | | | | | | | | |
|-------------------------------------|--|---------------|--|---------|------|------------|------|-------------------|--|-----------------------------|------|---------------|--------------|
| Course Evaluation | <table border="1"> <thead> <tr> <th colspan="2">Theory</th> </tr> </thead> <tbody> <tr> <td>Midterm</td> <td>25 %</td> </tr> <tr> <td>Final Exam</td> <td>45 %</td> </tr> </tbody> <thead> <tr> <th colspan="2">Laboratory</th> </tr> </thead> <tbody> <tr> <td>Laboratory: 3 labs 10% each</td> <td>30 %</td> </tr> <tr> <td>TOTAL:</td> <td>100 %</td> </tr> </tbody> </table> <p>Note: In order for a student to pass a course, a minimum overall course mark of 50% must be obtained. In addition, for courses that have both "Theory and Laboratory" components, the student must pass the Laboratory and Theory portions separately by achieving a minimum of 50% in the combined Laboratory components and 50% in the combined Theory components. Please refer to the "Course Evaluation" section above for details on the Theory and Laboratory components (if applicable).</p> | Theory | | Midterm | 25 % | Final Exam | 45 % | Laboratory | | Laboratory: 3 labs 10% each | 30 % | TOTAL: | 100 % |
| Theory | | | | | | | | | | | | | |
| Midterm | 25 % | | | | | | | | | | | | |
| Final Exam | 45 % | | | | | | | | | | | | |
| Laboratory | | | | | | | | | | | | | |
| Laboratory: 3 labs 10% each | 30 % | | | | | | | | | | | | |
| TOTAL: | 100 % | | | | | | | | | | | | |
| Examinations | <p>Midterm exam is scheduled for the #7 week (3 Hrs duration), closed book with a formula sheet (covers Weeks 1-6 of lecture and laboratory material)</p> <p>Final Exam, during exam period, 3 hours, closed book with a formula sheet (covers Weeks 8-13 of lecture and all laboratory material).</p> | | | | | | | | | | | | |
| Other Evaluation Information | Three projects involving the modelling, analysis, and simulation of electric vehicles. Lab experiments are to be done in partners and the write-ups are handed to your TA during the scheduled lab time as indicated on the course content schedule. | | | | | | | | | | | | |
| Teaching Methods | The lectures from tablet will be posted in D2L. | | | | | | | | | | | | |
| Other Information | None | | | | | | | | | | | | |

Course Content

| Week | Hours | Chapters / Section | Topic, description |
|------|-------|--------------------|--|
| 1 | 3 | | Introduction: electric vehicle fundamentals and history |
| 2 | 3 | | Vehicle Mechanics: roadway fundamentals, forces and propulsion power |

| | | | |
|----|---|--|--|
| 3 | 3 | | Architectures and design of EV and HEV: structures of EV and HEV, powertrain |
| 4 | 3 | | Powertrain sizing: Vehicle performance analysis, Power plant sizing, power rating, Maximum tolerable tractive force Structure and sizing of HEV |
| 5 | 3 | | Design of EV powertrain: model of separately excited DC motor and Power Converters for DC motor drives |
| 6 | 3 | | Design of EV powertrain: Controller Design |
| 7 | 3 | | Midterm |
| 8 | 3 | | Battery basics, battery pack, battery management system |
| 9 | 3 | | AC Motor Drives for EV I: AC machine models |
| 10 | 3 | | AC Motor Drives for EV II: Vector control of AC machines |
| 11 | 3 | | Power Converters I: EV powertrain converters, on-board battery chargers |
| 12 | 3 | | Power Converters II: Off-board chargers, charging level and charging stations |
| 13 | 3 | | Hybrid electric vehicle control strategy |

Laboratory(L)/Tutorials(T)/Activity(A) Schedule

| Week | L/T/A | Description |
|-------|-------|---|
| 2/3 | Lab 1 | Lab 1 Dynamic and Steady-State Responses of an Electric Vehicle |
| 4/5 | Lab 1 | Lab 1 Dynamic and Steady-State Responses of an Electric Vehicle |
| 6/7 | Lab 2 | Lab 2 DC-Machine-Driven Electric Vehicle |
| 8/9 | Lab 2 | Lab 2 DC-Machine-Driven Electric Vehicle |
| 10/11 | Lab 3 | Lab 3 Battery Pack Management and DC Fast Charger |
| 12/13 | Lab 3 | Lab 3 Battery Pack Management and DC Fast Charger |

University Policies & Important Information

Students are reminded that they are required to adhere to all relevant university policies found in their online course shell in D2L and/or on [the Senate website](#)

Refer to the [Departmental FAQ page](#) for further information on common questions.

Important Resources Available at Toronto Metropolitan University

- [The Library](#) provides research [workshops](#) and individual assistance. If the University is open, there is a Research Help desk on the second floor of the library, or students can use the [Library's virtual research help service](#) to speak with a librarian.
- [Student Life and Learning Support](#) offers group-based and individual help with writing, math, study skills, and transition support, as well as [resources and checklists to support students as online learners](#).
- You can submit an [Academic Consideration Request](#) when an extenuating circumstance has occurred that has significantly impacted your ability to fulfill an academic requirement. You may always visit the [Senate website](#) and select the blue radio button on the top right hand side entitled: **Academic Consideration Request (ACR)** to submit this request.

For Extenuating Circumstances, Policy 167: Academic Consideration allows for a once per semester ACR request without supporting documentation if the absence is less than 3 days in duration and is not for a final exam/final assessment. Absences more than 3 days in duration and those that involve a final exam/final assessment, require documentation. Students must notify their instructor once a request for academic consideration is submitted. See Senate [Policy 167: Academic Consideration](#).

- If a student is requesting accommodation due to a religious, Aboriginal and/or spiritual observance, they must submit their request via the online [Academic Consideration Request \(ACR\) system](#) **within the first two weeks of the class or, for a final examination, within two weeks of the posting of the examination schedule**. If the required absence occurs within the first two weeks of classes, or the dates are not known well in advance as they are linked to other conditions, these requests should be submitted with as much lead time as possible in advance of the required absence.
- If taking a remote course, familiarize yourself with the tools you will need to use for remote learning. The [Remote Learning Guide](#) for students includes guides to completing quizzes or exams in D2L Brightspace, with or without [Respondus LockDown](#)

- [Browser and Monitor, using D2L Brightspace](#), joining online meetings or lectures, and collaborating with the Google Suite.
- Information on Copyright for [Faculty](#) and [students](#).

Accessibility

- Similar to an [accessibility statement](#), use this section to describe your commitment to making this course accessible to students with disabilities. Improving the accessibility of your course helps minimize the need for accommodation.
- Outline any technologies used in this course and any known accessibility features or barriers (if applicable).
- Describe how a student should contact you if they discover an accessibility barrier with any course materials or technologies.

Academic Accommodation Support

Academic Accommodation Support (AAS) is the university's disability services office. AAS works directly with incoming and returning students looking for help with their academic accommodations. AAS works with any student who requires academic accommodation regardless of program or course load.

- Learn more about [Academic Accommodation Support](#).
- Learn [how to register with AAS](#).

Academic Accommodations (for students with disabilities) and Academic Consideration (for students faced with extenuating circumstances that can include short-term health issues) are governed by two different university policies. Learn more about [Academic Accommodations versus Academic Consideration and how to access each](#).

Wellbeing Support

At Toronto Metropolitan University, we recognize that things can come up throughout the term that may interfere with a student's ability to succeed in their coursework. These circumstances are outside of one's control and can have a serious impact on physical and mental well-being. Seeking help can be a challenge, especially in those times of crisis.

If you are experiencing a mental health crisis, please call 911 and go to the nearest hospital emergency room. You can also access these outside resources at anytime:

- **Distress Line:** 24/7 line for if you are in crisis, feeling suicidal or in need of emotional support (phone: 416-408-4357)
- **Good2Talk:** 24/7-hour line for postsecondary students (phone: 1-866-925-5454)
- **Keep.meSAFE:** 24/7 access to confidential support through counsellors via [My SSP app](#) or 1-844-451-9700

If non-crisis support is needed, you can access these campus resources:

- **Centre for Student Development and Counselling:** 416-979-5195 or email csdc@torontomu.ca
- **Consent Comes First - Office of Sexual Violence Support and Education:** 416-919-5000 ext 3596 or email osvse@torontomu.ca
- **Medical Centre:** call (416) 979-5070 to book an appointment

We encourage all Toronto Metropolitan University community members to access available resources to ensure support is reachable. You can find more resources available through the [Toronto Metropolitan University Mental Health and Wellbeing](#) website.