Fall 2025

ECE660: Operation and Control of Future Integrated Energy Systems

COURSE COORDINATOR: PROF. MEHRDAD KAZERANI, ECE DEPARTMENT (mkazerani@uwaterloo.ca)

SUMMARY:

The course will provide a comprehensive overview of the structure, control, and operation of the integrated energy systems of the future. The course will be offered in 11 modules, each module discussing a specific aspect of the subject, to provide a broad spectrum of coverage and understanding. The course will provide a multi-disciplinary perspective on the energy system of the future and will be open to graduate students from all engineering streams.

OBJECTIVES:

- ❖ To provide an understanding of the philosophy of smart grids
- ❖ To develop an understanding of the issues and technical aspects of energy systems
- ❖ To develop a multi-disciplinary perspective on future energy systems

Study Material:

- Presentation slides of lectures will be provided.
- Other associated reading material (research papers, etc.) will also be made available.

Examination:

- Written midterm and final exams (25% each): 50%
- Project Work: 50%

  Students opting for AUDIT will have to complete the project work satisfactorily.

STRUCTURE OF THE COURSE AND DELIVERY:

- The course is delivered in modular form. Each module is delivered by a faculty member expert in the topic.
- IN-PERSON LECTURES (WITH THE EXCEPTION OF MODULES 1 AND 11) WILL BE HELD ON WEDNESDAYS, 1:00-3:50 PM, IN EIT 3151/3153, STARTING ON SEPTEMBER 10, 2025.

MODULE	TITLE	INSTRUCTOR	LECTURE SCHEDULE
1	FUTURE SMART ELECTRICITY GRIDS: GENERATION, TRANSMISSION, ACTIVE DISTRIBUTION NETWORKS, AND INTELLIGENT LOADS	MAGDY SALAMA	WEDNESDAY, SEPTEMBER 10TH
2	EVOLVING ELECTRICITY MARKETS AND SYSTEM OPERATIONS	KANKAR BHATTACHARYA	WEDNESDAY, SEPTEMBER 17TH
3	DISTRIBUTED GENERATION	RAMADAN EL-SHATSHAT	WEDNESDAY, SEPTEMBER 24TH
4	TRANSPORTATION ELECTRIFICATION, PART 1	MEHRDAD KAZERANI	WEDNESDAY, OCTOBER 1ST
5	TRANSPORTATION ELECTRIFICATION, PART 2	MEHRDAD KAZERANI	WEDNESDAY, OCTOBER 8TH
6	MICROGRIDS, PART 1	CLAUDIO CANIZARES	WEDNESDAY, OCTOBER 22ND
7	MICROGRIDS, PART 2	CLAUDIO CANIZARES	WEDNESDAY, OCTOBER 29TH
8	INSULATION INTEGRITY IN A RENEWABLE, ZERO-EMISSION, AND ELECTRIFIED ENERGY GRID	SHESHA JAYARAM	WEDNESDAY, NOVEMBER 5TH
9	APPLICATION OF MACHINE LEARNING IN POWER ENGINEERING, PART 1	AYMAN EL-HAG	WEDNESDAY, NOVEMBER 12TH
10	APPLICATION OF MACHINE LEARNING IN POWER ENGINEERING, PART 2	MEHRDAD PIRNIA	WEDNESDAY, NOVEMBER 19TH
11	ENVIRONMENTAL, SOCIAL AND POLITICAL CONTEXT OF FUTURE ENERGY SYSTEMS	JESSIE MA	WEDNESDAY, NOVEMBER 26TH

HOLIDAY: MONDAY, OCTOBER 13, 2025, THANKSGIVING DAY

READING WEEK: SATURDAY, OCTOBER 11, 2025 – SUNDAY, OCTOBER 19, 2025

MIDTERM EXAM: DATE, TIME, AND PLACE TO BE ANNOUNCED **FINAL EXAM:** DATE, TIME, AND PLACE TO BE ANNOUNCED

University Policy

Academic integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check the Office of Academic Integrity for more information.]

Grievance: A student who believes that a decision affecting some aspect of their university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4. When in doubt, please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity to avoid committing an academic offence, and to take responsibility for their actions. [Check the Office of Academic Integrity for more information.] A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate associate dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline. For typical penalties, check Guidelines for the Assessment of Penalties.

Appeals: A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (other than a petition) or Policy 71, Student Discipline may be appealed if there is a ground. A student who believes they have a ground for an appeal should refer to Policy 72, Student Appeals.

Note for students with disabilities: AccessAbility Services, located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.

Turnitin.com: Text matching software (Turnitin®) may be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, therefore students must be given an alternative (e.g., scaffolded assignment or annotated bibliography), if they are concerned about their privacy and/or security. Students will be given due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin in this course.

It is the responsibility of the student to notify the instructor if they, in the first week of term or at the time assignment details are provided, wish to submit alternate assignment.