

## **INSTRUCTOR**

Dr. J.S. Cotton, JHE-212a, [cottonjs@mcmaster.ca](mailto:cottonjs@mcmaster.ca)

I am usually available through the day for consultation via TEAMS. Please email me if you would like to see me at a particular time.

## **OBJECTIVES**

Assessment of current and future energy systems, covering resources, extraction, conversion with emphasis on meeting regional and global energy needs in a sustainable manner.

## **CALENDAR DESCRIPTION**

Mech Eng 4O04: Assessment of current and future energy systems, covering resources, extraction, conversion with emphasis on meeting regional and global energy needs in a sustainable manner. Different renewable and conventional energy technologies will be presented and their attributes described within a framework that aids in evaluation and analysis of energy technology systems in the context of political, social, economic, and environmental goals. Three lectures, one tutorial;

## **PRESCRIBED TEXTBOOK**

- Sustainable Energy: Choosing Among Options, Second Edition, 2012, Jefferson W. Tester, Elisabeth M. Drake, Michael J. Driscoll, Michael W. Golay, and William A. Peters.
- Avenue Website - You can view and download course information from this site.

## **COURSE WEBSITE**

Avenue to Learn: <http://avenue.mcmaster.ca/>

- Avenue - You can view and download course information from this site.
- Students are expected to stay abreast of announcements and schedule changes made in lectures and posted on Avenue to Learn.

## **COURSE FORMAT AND EXPECTATIONS**

The course is organized as follows:

- 3 classroom - live lectures per week
- 1 tutorial 1 hours/week
- ~5 assignments
- formal debate
- term project and 20 min presentation
- RETScreen Energy Assessment project

## **LECTURES**

Tuesdays, Thursdays and Fridays 8:30 - 9:20pm – HH 102

Students are expected to stay abreast of announcements and schedule changes made in lectures and posted on Avenue

## **TUTORIALS**

Tutorial participation during technology debates and student presentations is a mandatory aspect of course assessment. Tuesday 1:30am - 2:20pm hours – HH 217

## ASSESSMENT

1. Students will be provided with approximately 5 assignments.
2. In the first week students in groups of 2 or 3 will be assigned an energy technology for assessment. In the first month students will write individual arguments and counter-arguments on a specific issue related to the technology (2 pages). The students will debate the argument (week of Feb. 5th) and be assessed on quality of discussions and debriefing. For example a topic of debate would be: "Garbage as a fuel is environmentally friendly!"
3. For the same energy technology student groups will write a term paper and their attributes described within a framework that aids in evaluation and analysis (Topics 1-6) of energy technology systems in the context of political, social, economic, and environmental goals. Students will present a 20 min presentation at an undergraduate conference level to class and the term paper will be provided to the entire class.
4. The RETScreen Renewable Energy Assessment Project will assess the feasibility of retrofitting a home towards net zero carbon.

The following distribution of marks will be used unless there is a valid and compelling reason to use an alternative weighting. Missed assignments and tests will have a grade of zero entered without legitimate and documented reason.

Assignments	20%
Technology Debate (Position Paper 10%, Oral Debate 10%)	20%
Term Paper (20% for Written Paper and 20% for Oral Presentation) Written term paper (10 pages) with final oral presentation.	40%
RETScreen Renewable Energy Assessment Project	20%

## DEBATE, PROJECT, PRESENTATION, ASSIGNMENT SUBMISSIONS

All homework should be submitted in the Avenue Assignments by 11:59pm on due date. NO late submissions will be accepted without permission from the Associate Dean's Office (MSAF).

## TEACHING ASSISTANTS

Chantel Millar [millac@mcmaster.ca](mailto:millac@mcmaster.ca)  
Ethan Chariandy [chariane@mcmaster.ca](mailto:chariane@mcmaster.ca)

## **COURSE CONTENT**

### **1 Energy Resource Assessment**

- 1.1 Sustainable Energy: The Engine of Sustainable Development
- 1.2 Defining Energy—Scientific and Engineering Foundations
- 1.3 Aspects of Energy Production and Consumption
- 1.4 National and Global Patterns of Energy Supply and Utilization
- 1.5 Environmental Effects of Energy—Gaining Understanding
- 1.6 Confronting the Energy-Prosperity-Environmental Dilemma
- 1.7 Mathematical Representations of Sustainability

### **2 Estimation and Evaluation of Energy Resources**

- 2.1 Units and Measurements: Energy and Power
- 2.2 Comparison of Different Forms of Energy
- 2.3 The Energy Lifecycle
- 2.4 Estimation and Valuation of Fossil Mineral Fuels
- 2.4 Lessons for Sustainable Development

### **3 Technical Performance: Allowability, Efficiency, Production Rates**

- 3.1 Relation to Sustainability
- 3.2 Methods of Thermodynamic Analysis Applied
- 3.3 The Importance of Rate Processes in Energy Conversion
- 3.5 Time Scales
- 3.6 Energy Resources and Energy Conversion

### **4 Local, Regional and Global Environmental Effect of Energy**

- 4.1 How Energy Systems Interact with the Environment
- 4.2 Adverse Environmental Effect Over Local and Regional Length Scales
- 4.4 Global Climate Change: Environmental Consequences over Planetary-Length Scales
- 4.5 Attribution of Environmental Damage to Energy Utilization
- 4.6 Methods of Environmental Protection
- 4.7 Environmental Benefits of Energy
- 4.8 Implications for Sustainable Energy

### **5 Project Economic Evaluation**

- 5.1 Time Value of Money Mechanics
- 5.2 Current versus Constant Dollar Comparison
- 5.3 Simple Payback
- 5.4 Economy of Scale
- 5.5 Allowing for Uncertainty
- 5.6 Accounting for Externalities
- 5.7 Energy Accounting

### **6 Energy Systems and Sustainability Metrics**

- 6.1 Historical Notes
- 6.2 Energy from a Systems Perspective
- 6.3 Systems Analysis Approaches
- 6.4 Measures of Sustainability
- 6.5 Drivers of Societal Change
- 6.6 General Principles of Sustainable Development
- 6.7 The Challenge to Society

### **7. Specific Energy Technologies – Student Assessment**

- 7.1 Hydropower
- 7.2 Nuclear Energy
- 7.3 Wind Energy
- 7.4 Solar Thermal Energy
- 7.5 Solar Photovoltaic Energy
- 7.6 Geothermal Energy
- 7.7 Biomass and Ethanol
- 7.8 Tidal and Current Energy
- 7.9 Fuel Cells
- 7.10 Fusion Energy
- 7.11 Energy Storage

## **LEARNING OUTCOMES:**

Upon successful completion of the course the student are expected to demonstrate the ability to:

1. Identify and understand the trade-offs that are the foundation of sustainability approaches to energy systems.
2. Explore and quantify the energy resources, conversion process limitations and human consumption.
3. Consider and quantify the environmental impacts of energy supply and utilization including pollution and climate change agents.
4. Appraise the approach of integrating the quantification of “externalities” of energy systems into economic models for assessing an energy technology. This includes including the cost incurred by society at large evaluated on a total lifecycle basis into the levelized cost of producing energy from a certain technology.
5. Evaluate, assess and debate a specific issue related to an energy technology and merits of the level of sustainability of an energy option.
6. Evaluate energy technologies and system design alternatives for a specific engineering project based on complex interactions of technology, local/global, environmental, social, cultural and economic systems using RETSCREEN.

## **ACADEMIC INTEGRITY**

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy](https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/> The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

## **AUTHENTICITY / PLAGIARISM DETECTION**

**Some courses may** use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to [www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity).

## **COURSES WITH AN ON-LINE ELEMENT**

**Some courses may** use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

## **ONLINE PROCTORING**

**Some courses may** use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

## **CONDUCT EXPECTATIONS**

As a McMaster 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.

## **EQUITY, DIVERSITY, AND INCLUSION**

Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your Instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you. The Department of Mechanical Engineering is committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our Department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Undergraduate Chair, Academic Advisor or to contact the Equity and Inclusion Office .

### **ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES**

Students with disabilities who require academic accommodation must contact [Student Accessibility Services \(SAS\)](#) at 905525-9140 ext. 28652 or [sas@mcmaster.ca](mailto:sas@mcmaster.ca) to make arrangements with a Program Coordinator. For further information, consult McMaster University's [Academic Accommodation of Students with Disabilities](#) policy.

### **REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK**

McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

### **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.

### **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.

### **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.