INSTRUCTOR
Dr. J.S. Cotton, JHE-212a, ext. 24899, cottonjs@mcmaster.ca
I am usually available through the day for consultation; you are welcome to drop by my office. 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 TEXT BOOK
- Avenue Website - You can view and download course information from this site.

LECTURES
Tuesday, Thursday, Friday 8:30 - 9:20 @ BSB B138
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. Wednesday 11:30 - 12:20 hours @ BSB B138

ASSESSMENT
1. Students will be provided with assignments (not graded).
2. In first week students in groups of 2 or 3 will be assigned an energy technology for assessment in first month students will write individual argument and counter arguments on a specific issue related to the technology (2 pages). The students will debate the argument (week of Feb. 1st) 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 presented 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 term paper will be provided to entire class.
4. The final-term examination will cover the entire course including the students’ lectures.

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. The course of action for missed mid-terms with Associate Dean’s approval is the weight of the mid-term will be re-distributed to the final exam.

Tutorial (Debate and Presentation) and Assignment Participation 10%
Technology Debate (Position Paper 10%, Oral Debate 10%) 20%
Term Paper (15% for Written Paper and 15% for Oral Presentation) 30%
Written term paper (10 pages) with final oral presentation.
RETScreen Renewable Energy Assessment Project 10%
Final Exam 30%
COURSE CONTENT

<table>
<thead>
<tr>
<th>Course Content</th>
<th>Topics</th>
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| **1 Energy Resource Assessment** | 1. Sustainable Energy: The Engine of Sustainable Development  
1.1 Defining Energy—Scientific and Engineering Foundations  
1.2 Aspects of Energy Production and Consumption  
1.3 National and Global Patterns of Energy Supply and Utilization  
1.4 Environmental Effects of Energy—Gaining Understanding  
1.5 Confronting the Energy-Prosperity-Environmental Dilemma  
1.6 Mathematical Representations of Sustainability |
| **2 Estimation and Evaluation of Energy Resources** | 2. Units and Measurements: Energy and Power  
2.1 Comparison of Different Forms of Energy  
2.2 The Energy Lifecycle  
2.3 Estimation and Valuation of Fossil Mineral Fuels  
2.4 Lessons for Sustainable Development |
| **3 Technical Performance: Allowability, Efficiency, Production Rates** | 3. 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 |
4.2 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  
6.3 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. 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 form 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.

TEACHING ASSISTANTS

Chantel Millar millac@mcmaster.ca
Brendan Sullivan sullivbj@mcmaster.ca

ASSIGNMENT AND PROJECT SUBMISSIONS

All homework should be submitted in the ‘drop-box’ marked with the course code ME 4004 located in front of Mech Eng wing 3rd floor before 13:30 hours on the due date. The assigned TA for the homework will pick the assignments up at 13:30 hours on each due date. NO late submissions will be accepted without permission from the Associate Dean’s Office.
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.

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.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at: www.mcmaster.ca/academicintegrity.

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

TURNITIN.COM

In this course we will be using a web-based service (Turnitin.com) to reveal plagiarism. Students will be expected to submit their work electronically to Turnitin.com and in hard copy so that it can be check for academic dishonesty. Students who do not wish to submit their work to Turnitin.com must still submit a copy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com/ All submitted work it subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, etc.). To see the Turnitin.com Policy, please go to: www.mcmaster.ca/academicintegrity.