Bachelor of Technology Partnership

Course Outline

1. COURSE INFORMATION

Session Offered	Fall 2016	
Course Name	Renewable Energy Technology I	
Course Code	ENR TECH 4RE3	
Date(s) and Time(s) of lectures	Wednesdays, 6:30 pm – 9:30 pm	
Program Name	Bachelor of Technology	
Calendar Description	Outline the design, installation and commissioning of Fuel Cells, Biomass and geothermal powered systems. The environmental and economic impacts of such technologies. Federal and provincial rules, regulations, and legislation.	
Instructor(s)	Dr. Reyad Al-Taie	E-Mail: altaier@mcmaster.ca Office Hours & Location:

2. COURSE SPECIFICS

Course Description

Instruction Type

Code	Type	Hours per term
C	Classroom instruction	36
L	Laboratory, workshop or fieldwork	
T	Tutorial	
DE	Distance education	
	Total Hours	36

Resources

ISBN	Textbook Title & Edition	Author & Publisher
ISBN: 13 978-0-471-74148-0	Fuel Cells Fundamentals	R. O'Hayre, S. Cha, W. Collela, and F. Prinz John Wiley & Sons, 2nd edition
9780080982069	Geothermal Power Plants	Ronald DiPippo Elsevier Science, 3rd edition

Other Supplies	Source

Prerequisite(s)	ENRTECH 3EP3, 3HT3, 3TD3 and one of ENRTECH 3MF3 or ENGTECH 4TF3 and registration in Energy Engineering Technologies
Corequisite(s)	
Antirequisite(s)	
Course Specific Policies	
Departmental Policies	Students must maintain a GPA of 3.5/12 to continue in the program. In order to achieve the required learning objectives, on average, B.Tech. students can expect to do at least 3 hours of "out-of-class" work for every scheduled hour in class. "Out-of-class" work includes reading, research, assignments and preparation for tests and examinations.

	Where group work is indicated in the course outline, such collaborative work is mandatory. The use of cell phones, iPods, laptops and other personal electronic devices are prohibited from the classroom during the class time, unless the instructor makes an explicit exception. Announcements made in class or placed on Avenue are considered to have been communicated to all students including those individuals that are not in class. Instructor has the right to submit work to software to identify plagiarism.	
3. SUB TOPIC(S)		
Week 1	**Introduction** • Discuss Course Structure, Evaluation, and Outline • Introduction to Renewable Energy in Ontario • Ontario Energy Supply Mix	
Week 2	**Electrochemistry** • Redox reactions • Galvanic Cells • Cell Potential	
Week 3	**Fuel Cells – Part I** • Technology, History and Basic principles • Theoretical Maximum Open Circuit Voltage Based on Gibbs Free Energy • Fuel Cell Efficiency	Textbook 1 Ch. 1 Ch. 2
Week 4	**Fuel Cells - Part II** • Theoretical Open Circuit Voltages at Different Operating Temperatures & Pressures • Different Types of Voltage Losses During Operation • Fuel Cell Operating Voltage Characteristics	Textbook 1 Ch. 3
Week 5	**Fuel Cells – Part III** **Solid Oxide and Molten Carbonate Fuel Cells** • Operating Principles and Characteristics • Advantages and Disadvantages • Commercial Products and Applications	Textbook 1 Ch. 8 Ch. 9
Mid-term Recess: Monday, October 10 to Sunday, October 16, 2016		

Week 7	**Fuel Cells – Part IV** **Phosphoric Acid and Proton Exchange Membrane Fuel Cells** • Operating Principles and Characteristics • Advantages and Disadvantages • Commercial Products and Applications	Textbook 1 Ch. 8 Ch. 9
Week 8	**Midterm**	
Week 9	**Geothermal Energy – Part I** • Introduction to Geothermal Energy • Dry Steam Geothermal Power Plants	Textbook 2 Ch. 1 Ch. 7
Week 10	**Geothermal Energy – Part II** • Single Flash Geothermal Power Plants • Double Flash Geothermal Power Plants	Textbook 2 Ch. 5 Ch. 6
Week 11	**Biomass – Part I** • Introduction to Biomass Energy • Advantages and Disadvantages of Biomass-fired Electricity • Different Types of Biomass-to-Electricity Conversion Processes	
Week 12	**Biomass Energy – Part II** • Ontario Power Generation's Biomass Energy Plan • Biomass thermal plant efficiency • Biomass Gasification Technologies	
Week 13	**Course Review**	
Classes end: Wednesday, December 7, 2016 Final examination period: Friday, December 9 to Thursday, December 22, 2016 All examinations MUST be written during the scheduled examination period.		
List of experiments		
Lab 1		
Lab 2		
Lab 3		
Lab 4		
Lab 5		
Lab 6		
Mid-term Recess: Monday, October 10 to Sunday, October 16, 2016		
Lab 7		

Lab 8	
Lab 9	
Lab 10	
Lab 11	
Lab 12	

Note that this structure represents a plan and is subject to adjustment term by term.
The instructor and the University reserve the right to modify elements of the course during the term. The University may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes.

4. ASSESSMENT OF LEARNING *including dates*	Weight
Assignments	10
Mid-term test	30
Project	10
Labs	
Final examination (tests cumulative knowledge)	50
TOTAL	**100%**

Percentage grades will be converted to letter grades and grade points per the University calendar.

5. LEARNING OUTCOMES

1. Recognize and evaluate fuel cell, biomass, and geothermal energy technologies
2. Understand the benefits and limitations of using fuel Cell, biomass and geothermal renewable energy
3. Identify safety and operating issues in power plants using Fuel Cell, Biomass and Geothermal energy
4. Understand maintenance issues of main components in power plants using Fuel Cell, Geothermal and Biomass
5. Learn how to read and prepare equipment specifications (fuel cells, turbines, boilers)
6. Perform thermodynamics calculations of fuel cell, geothermal, and biomass power plants
7. Learn how to do research in renewable energy and build a business case for its use

6. POLICIES

Anti-Discrimination

The Faculty of Engineering is concerned with ensuring an environment that is free of all discrimination. If there is a problem, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as soon as possible.
http://www.mcmaster.ca/policy/General/HR/Discrimination_Harassment_Sexual_Harassment-Prevention&Response.pdf

Academic Integrity

You are required to exhibit honestly and use ethical behaviour in all aspects if the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act of 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 kinds of academic dishonesty please refer to the Academic Integrity Policy, located at: http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicIntegrity.pdf .

The following illustrates only three forms of academic dishonesty:
1. Plagiarism. E.g. the submission of work that is not 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.

Requests for Relief for Missed Academic Term Work (Assignments, Mid-Terms, etc.)

The McMaster Student Absence Form is a self-reporting tool for **Undergraduate Students** to report absences DUE TO MINOR MEDICAL SITUATIONS that last up to 3 days and provides the ability to request accommodation for any missed academic work. Please note, this tool cannot be used during any final examination period.

You may submit a maximum of 1 Academic Work Missed requests per term. It is YOUR responsibility to follow up with your Instructor immediately (NORMALLY WITHIN TWO WORKING DAYS) regarding the nature of the accommodation.

If you are absent for reasons other than medical reasons, for more than 3 days or exceed 1 request per term you MUST visit your Associate Dean's Office (Faculty Office). You may be required to provide supporting documentation.

This form should be filled out immediately when you are about to return to class after your absence. http://www.mcmaster.ca/msaf/

E-Learning Policy

Consistent with the Bachelor of Technology's policy to utilize e-learning as a complement to traditional classroom instruction, students are expected to obtain appropriate passwords and accounts to access Avenue To Learn for this course. Materials will be posted by class for student download. It is expected that students will avail themselves of these materials prior to class. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail account, and program affiliation may become apparent to all other students in the course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about this disclosure please discuss this with the course instructor. Avenue can be accessed via http://avenue.mcmaster.ca.

Communications

It is the student's responsibility to:

- Maintain current contact information with the University, including address, phone numbers, and emergency contact information.
- Use the University provided e-mail address or maintain a valid forwarding e-mail address.
- Regularly check the official University communications channels. Official University communications are considered received if sent by postal mail, by fax, or by e-mail to the student's designated primary e-mail account via their @mcmaster.ca alias.
- Accept that forwarded e-mails may be lost and that e-mail is considered received if sent via the student's @mcmaster.ca alias.
- Check the McMaster/Avenue email and course websites on a regular basis during the term.

Turnitin (Optional)

This course will be using a web-based service (Turnitin.com) to reveal plagiarism. Students submit their assignment/work electronically to Turnitin.com where it is checked against the internet, published works and Turnitin's database for similar or identical work. If Turnitin finds similar or identical work that has not been properly cited, a report is sent to the instructor showing the student's work and the original source. The instructor reviews what Turnitin has found and then determines if he/she thinks there is a problem with the work. 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 is 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 http://www.mcmaster.ca/academicintegrity/turnitin/students/

Protection of Privacy Act (FIPPA)

The Freedom of Information and Protection of Privacy Act (FIPPA) applies to universities. Instructors should take care to protect student names, student numbers, grades and all other personal information at all times. For example, the submission and return of assignments and posting of grades must be done in a manner that ensures confidentiality.
http://www.mcmaster.ca/univsec/fippa/fippa.cfm

Academic Accommodation of Students with Disabilities Policy

Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca. For further information consult McMaster's policy for Academic Accommodation of Students with Disabilities
http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicAccommodation-StudentsWithDisabilities.pdf

Students must forward a copy of the SAS accommodation to the instructor of each course and to the Program Administrator of the B.Tech. Program immediately upon receipt. If a student with a disability chooses NOT to take advantage of a SAS accommodation and chooses to sit for a regular exam, a petition for relief may not be filed after the examination is complete. http://sas.mcmaster.ca

Student Code of Conduct

The Student Code of Conduct (SCC) exists to promote the safety and security of all the students in the McMaster community and to encourage respect for others, their property and the laws of the land. McMaster University is a community which values mutual respect for the rights, responsibilities, dignity and well-being of others. The purpose of the Student Code of Conduct is to outline accepted standards of behavior that are harmonious with the goals and the well-being of the University community, and to define the procedures to be followed when students fail to meet the accepted standards of behavior. All students have the responsibility to familiarize themselves with the University regulations and the conduct expected of them while studying at McMaster University.
http://judicialaffairs.mcmaster.ca/pdf/SCC.pdf and http://www.mcmaster.ca/policy/Students-AcademicStudies/StudentCode.pdf