

## Course Outline

### 1. COURSE INFORMATION

<b>Session Offered</b>	Fall 2017
<b>Course Name</b>	Chemical Engineering III: Unit and Process Design
<b>Course Code</b>	PROCTECH 3CE3
<b>Date(s) and Time(s) of lectures</b>	<u>Lecture:</u> Wednesday 11:30 – 13:20 in ETB/238 Friday 15:30 – 16:20 in JHE/A102 <u>Labs:</u> Monday 9-11 or 11-13, or 13-15 in Mohawk i-216
<b>Program Name</b>	Automation Engineering Technology
<b>Calendar Description</b>	This course covers simulation and analysis of integrated process units within a chemical process plant. Key topics covered are: process flow diagrams and simulation models, process analysis using simulation model, rudimentary process optimization and plant simulation.
<b>Instructor(s)</b>	Kostas Apostolou      E-Mail: apostol@mcmaster.ca Office Hours & Location: ETB/207

### 2. COURSE SPECIFICS

<b>Course Description</b>	Reaction kinetic fundamentals and reactor design. Heat Transfer: one dimensional conduction and convection. Heat exchanger calculations. Fluid flow: laminar and turbulent flow; Bernoulli's equation; pressure drop through pipes; pump curves and requirements. Introduction to process simulation software; construction and interpretation of process flow diagrams. Process optimization through simulation.		
<b>Instruction Type</b>	<b>Code</b>	<b>Type</b>	<b>Hours per term</b>
	C	Classroom instruction	38
	L	Laboratory, workshop or fieldwork	24
	T	Tutorial	
	DE	Distance education	
		<b>Total Hours</b>	62
<b>Resources</b>	<b>ISBN</b>	<b>Textbook Title &amp; Edition</b>	<b>Author &amp; Publisher</b>
	ISBN:		
	<b>Other Supplies</b>	<b>Source</b>	
		978-0130473943, H. Scott Fogler, <i>Elements of Chemical Reaction Engineering</i> , Prentice Hall; 4 <sup>th</sup> edition  978-0470501962, Theodore L. Bergman, Adrienne S. Lavine, David P. DeWitt and Frank P. Incropera, <i>Introduction to Heat Transfer</i> , Wiley; 6 <sup>th</sup> edition  978-1-1181-1613-5, Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, Wade W. Huebsch, <i>Fundamentals of Fluid Mechanics</i> , Wiley, 7 <sup>th</sup> edition.	
<b>Prerequisite(s)</b>	PROCTECH 2EC3, 3CT3 and registration in Level IV of Automation Engineering Technology		

<b>Corequisite(s)</b>	
<b>Antirequisite(s)</b>	
<b>Course Specific Policies</b>	<p>The course includes a lecture component and a lab component.</p> <p><b>To pass the course:</b></p> <ul style="list-style-type: none"> <li>• <b>A minimum of 50% for the lab component <u>and</u></b></li> <li>• <b>a minimum of 45% for the lecture component <u>and</u></b></li> <li>• <b>a minimum of 50% in the overall course grade</b></li> </ul> <p><b>are required.</b></p> <p><b>Exams:</b></p> <p><b>Absence from a test without an approved MSAF will result in a grade of zero for the test.</b> If an approved MSAF is submitted, the weight of the missed test will be added to the final exam's weight. In case of multiple missed tests with approved MSAFs, the opportunity to write missed test(s) at an alternate date may be offered, at the discretion of the instructor.</p> <p><b>Practice Problems:</b></p> <p>Practice problems <b>will not be graded.</b> Final answers to assigned problems will be provided. Solutions to assigned problems may be posted</p> <p><b>Lab Sessions:</b></p> <p>Lab coat required for all lab sessions.</p> <p>Lab experiments and rotation, if any, will be outlined during fist class.</p> <p><b>Absence from a lab without an accepted MSAF form will result in a grade of zero for that lab.</b></p> <p>All lab reports are due one week from the day of performing the corresponding experiment. Reports submitted late without an acceptable explanation or prior permission will be penalized by 10% per calendar day.</p>
<b>Departmental Policies</b>	<p>Students must maintain a GPA of 3.5/12 to continue in the program.</p> <p>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.</p> <p>Where group work is indicated in the course outline, such collaborative work is mandatory.</p> <p>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.</p> <p>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.</p> <p>Instructor has the right to submit work to software to identify plagiarism.</p>
<b>3. SUB TOPIC(S)</b>	
Week 1	<p><u>Reaction kinetics:</u> Rate of reaction, rate laws, Arrhenius equation</p> <p>Fogler</p>
Week 2	<p><u>Reaction kinetics:</u> Reaction mechanisms, catalysis</p> <p>Fogler</p>
Week 3	<p><u>Chemical Reactor Design:</u> Batch, CSTR, PFR balance equations</p> <p>Fogler</p>
Week 4	<p><u>Chemical Reactor Design:</u> Examples</p> <p>Fogler</p>

Week 5	<u>Heat Transfer:</u> One dimensional conduction <b>Test 1 (2 hours – 14%)</b>	Incropera
Mid-term Recess: Monday, October 10 to Sunday, October 16, 2016		
Week 6	<u>Heat Transfer:</u> One dimensional conduction & introduction to convection	Incropera
Week 7	<u>Heat Transfer:</u> Convection & Heat Exchangers fundamentals	Incropera
Week 8	<u>Heat Transfer:</u> Heat Exchanger equations and design	Incropera
Week 9	<u>Fluid flow:</u> Introduction: laminar vs turbulent flow. Bernoulli's Equation <b>Test 2 (2 hours – 14%)</b>	Munson
Week 10	<u>Fluid flow:</u> Application of Bernoulli's equation	Munson
Week 11	<u>Fluid flow:</u> Pressure drop in pipes <b>Test 3 (1 hour – 7%)</b>	Munson
Week 12	<u>Fluid flow:</u> Pump characteristics and curves	Munson
Week 13	<u>Review</u>	
Classes end: Wednesday, December 6, 2016 Final examination period: Friday, December 8 to Thursday, December 21, 2016 All examinations MUST be written during the scheduled examination period.		
<b>List of experiments</b>		
Lab 1	PRO/II: Introduction, demethanization plant	
Lab 2	PRO/II: User-defined component or/and Petrochemical data	
Lab 3	PRO/II: Chiller plant – simulation modification	
Lab 4	PRO/II: CSTR studies	
Lab 5	PRO/II: PFR studies	
Mid-term Recess: Monday, October 9 to Sunday, October 15, 2017		
Lab 6	PRO/II: Lab test	
Lab 7	Unisim Design: Introduction, familiarization Steam power plant design	
Lab 8	Unisim Design: Improved Steam power plant; efficiency.	
Lab 9	Unisim Design: PFR Reactor	
Lab 10	Unisim Design: PID 1 - Tank level control	
Lab 11	Unisim Design: PID 2 - Heat transfer control	
Lab 12	Unisim Design: Lab test	
<p>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.</p>		
<b>4. ASSESSMENT OF LEARNING *including dates*</b>		<b>Weight</b>
Quizzes (online and in-class)		10%
Term Tests		35%
Labs		25%
Final examination (tests cumulative knowledge)		30%

<b>TOTAL</b>	<b>100%</b>
Percentage grades will be converted to letter grades and grade points per the University calendar.	
<b>5. LEARNING OUTCOMES</b>	
1. Combine mass and energy balances to calculate required flowrates and energy inputs in chemical reactors.	
2. Integrate mass balances with reaction rate fundamentals for predicting the extent of reactions in CSTR, PFR, and Batch reactors.	
3. Perform one-dimensional conduction and convection calculations.	
4. Apply heat transfer calculations to the analysis and design of heat exchangers	
5. Use the Bernoulli equation and augment it for calculations in pipes	
6. Demonstrate the importance and use of pump curves	
7. Execute process analysis using PRO/II and Unisim Design	
8. Monitor the transient behavior of industrial processes through process simulation software and critique on the interplay of the control aspects of those processes.	
<b>6. POLICIES</b>	
<b>Anti-Discrimination</b>	
<p>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.</p> <p><a href="http://www.mcmaster.ca/policy/General/HR/Discrimination_Harassment_Sexual_Harassment-Prevention&amp;Response.pdf">http://www.mcmaster.ca/policy/General/HR/Discrimination_Harassment_Sexual_Harassment-Prevention&amp;Response.pdf</a></p>	
<b>Academic Integrity</b>	
<p>You are required to exhibit honestly and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.</p> <p>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.</p> <p>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: <a href="http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicIntegrity.pdf">http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicIntegrity.pdf</a>.</p> <p>The following illustrates only three forms of academic dishonesty:</p> <ol style="list-style-type: none"> <li>1. Plagiarism. E.g. the submission of work that is not own or for which other credit has been obtained</li> <li>2. Improper collaboration in group work</li> <li>3. Copying or using unauthorized aids in tests and examinations.</li> </ol>	
<b>Requests for Relief for Missed Academic Term Work (Assignments, Mid-Terms, etc.)</b>	
<p>The McMaster Student Absence Form is a self-reporting tool for <b>Undergraduate Students</b> to report absences <b>DUE TO MINOR MEDICAL SITUATIONS</b> that last up to 3 days and provides the ability to request accommodation for any missed academic work. Please note, this tool <u>cannot</u> be used during any final examination period.</p> <p>You may submit a maximum of 1 Academic Work Missed requests per term. It is YOUR responsibility to follow up with your Instructor immediately (<b>NORMALLY WITHIN TWO WORKING DAYS</b>) regarding the nature of the accommodation.</p> <p>If you are absent <b>for reasons other than medical reasons</b>, for more than 3 days or exceed 1 request per term you <b>MUST</b> visit your Associate Dean's Office (Faculty Office). You may be required to provide supporting documentation.</p> <p>This form should be filled out immediately when you are about to return to class after your absence.</p> <p><a href="http://www.mcmaster.ca/msaf/">http://www.mcmaster.ca/msaf/</a></p>	

## **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](mailto: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>