PROC 5071: Process Equipment Design I

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Website: **Brightspace (D2L) page on online.mun.ca**

COMMUNICATION

- The Brightspace system will be the medium of communication between students and the instructor. Please use the **Brightspace course email**.
- Important updates on the course will be posted on the course page. It is the responsibility of the students to **regularly check** for course related information on the **course page**.

CALENDAR ENTRY:

PROC 5071 Process Equipment Design I introduces the principles of unit operations, grouped into four sections: fluid mechanics, heat transfer, mass transfer and equilibrium stages, and operations involving particulate solids. Design and operation fundamentals of unit operations equipment: size reduction, filtration, evaporation, drying, crystallization, and humidification.

CO: PROC 5001/ENGI 5601
LH: at least four 2-hour sessions per semester
PR: PROC 4021/ENGI 4621, PROC 4025/ENGI 4625

Credit Value: 3 Credits
Accreditation Units: 40 Combined Educational Hours; Focus: 75% Engineering Sciences, 25% Engineering Design

SCHEDULE:	Lectures: TR 1:00-2:15		Brightspace Online Room
	Lab:	W 9:00-12:00	Brightspace Online Room

RESOURCES:

TEXT BOOK

- W. L. McCabe, J. C. Smith, P. Harriott. (2005). Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill, New York, USA. ISBN-13: 978-0-07-284823-6

REFERENCE

- D. Green and R.H. Perry. 2007. Perry's Chemical Engineers' Handbook, 8th Edition, McGraw-Hill. ISBN-13: 9780071422949

COURSE SCOPE:

Process Equipment Design I will introduce you to the more applied aspects of process equipment. Some equations will be derived but you make more use of the already derived theoretical equations and empirically found correlations for solving engineering problems related to:

1. **Particulate solids handling equipment (McCabe, Smith and Harriott, chapters 28 & 29)**
   a) Properties of Solids and Particles (chapter 28)
   b) Size reduction (chapter 28)
   c) Separations (chapter 29)
      i. Screening
      ii. Filtration (cake filters, clarifiers, gravitational settling)
2. **Mass transfer equipment (McCabe, Smith and Harriott, chapters 19 & 24)**
   a) Drying of Solids (chapter 24)
   b) Humidification (chapter 19)
3. **Fluid handling equipment (McCabe, Smith and Harriott, chapters 7, 8 & 9)**
   a) Flow Past Immersed Bodies (chapter 7)
   b) Agitation and Mixing of Solids in Liquids (chapter 9)
4. **Heat transfer equipment (McCabe, Smith and Harriott, chapters 15 & 16)**
   a) Heat Exchangers (chapter 15)
   b) Evaporation (chapter 16)

OVERALL EDUCATIONAL OBJECTIVE:

To study the fundamentals of unit operations and design of related process equipment.

LEARNING OUTCOMES:

At the end of this course, students should be able to:

	LEARNING OUTCOMES	GRADUATE ATTRIBUTES. LEVEL OF COMPETENCE	Methods of Assessment
1	Describe the basic principles of operation of different unit operation equipment.	KB-A	Assignments, Exams, Lab Report
2	Classify different types of unit operations.	PA-A	Exams, Assignments
3	Select proper equipment to achieve desired objectives.	Inv-D, Impact-D	Exams, Assignments
4	Design equipment to achieve specific functionality.	Des-D, Impact-D	Exams, Assignments
5	Use laboratory equipment to obtain process data; analyze data to characterize operation.	Tools-D	Lab Reports
6	Participate effectively in a team.	Team-A	Lab Reports, Peer Assessment
7	Communicate effectively both orally and in writing.	Comm-D	Lab Reports

See www.mun.ca/engineering/undergrad/graduateattributes.pdf for more information on the 12 Graduate Attributes you are expected to be proficient in upon graduation. Each Graduate Attribute for each learning outcome is rated at a level of proficiency between 1 and 3 (I=introductory, D=intermediate Development, A=Advanced Application).

ASSESSMENT:

Assignments	20% (5% each on 4 assignments)
Laboratories	30% (See the lab manual for details)
Midterm 1	10%
Midterm 2	15%
Final Exam	25%

- The **dates** of exams and assignment submission are listed on the last page of this outline.
- For **late** submission of an assignment, a deduction of **20%** marks for each day will be applicable.
- If a student fails to attend an exam without any prior notice, a mark of **zero** will be counted.
- If a student cannot attend either of the midterm exams with prior notice and a valid reason, the percentage allocated to the item will be **transferred** to the final exam.
- All exams will be **open-book** and **online** administered through Brightspace; supplementary pages with necessary information will be supplied as required.
- Laboratory schedules and **due dates for report submissions** are provided in the laboratory manual.

ONLINE CLASSROOM POLICIES:

- A class is a learning community; although you are physically separated, please use useful communication channels to keep in touch with fellow students, to study together and learn from each other.
- You are strongly encouraged to attend every lecture, share your knowledge and understanding, and participate in the problem solving activities.
- Use of video is optional; however, it is encouraged that you use the audio communication tool for asking and answering questions. The chat option can also be used for the same purposes.
- All lectures will be recorded and posted on the course webpage. Your video, audio and chat inputs will be part of the recordings. However, the recorded videos will not be used for any other purposes and will not be posted anywhere else.
- Although online, everyone should follow the etiquettes for classrooms. Everyone should be respectful to others, their opinions as well as time.
- To minimize audio noise, it is suggested that you keep your microphone muted unless you are communicating with the instructor or answering and asking questions.

NOTES ON ONLINE EXAMS:

- Online exams will typically have both of the following components: (i) short answers and choice type answers (selecting from a list) to be submitted through the Brightspace quiz tool, (ii) detailed answers involving numerical calculations to be written on paper and scanned copy submitted through the assignment tool.
- The two parts will have time allocated separately. Additional time will be allocated for scanning and submission.

ACADEMIC INTEGRITY AND PROFESSIONAL CONDUCT:

Students are expected to conduct themselves in all aspects of the course at the highest level of academic integrity. Any student found to commit academic misconduct will be dealt with according to the Faculty and University practices. More information is available at http://www.mun.ca/engineering/undergrad/academicintegrity.php

Students are encouraged to consult the Faculty of Engineering and Applied Science Student Code of Conduct at https://www.mun.ca/regoff/calendar/sectionNo=ENGI-1789 and Memorial University's regulations relating academic misconduct at https://www.mun.ca/regoff/calendar/sectionNo=REGS-0748

INCLUSION AND EQUITY:

Students who require accommodations are encouraged to contact the Glenn Roy Blundon Centre, http://www.mun.ca/blundon/about/index.php. The mission of the Blundon Centre is to provide and co-ordinate programs and services that enable students with disabilities to maximize their educational potential and to increase awareness of inclusive values among all members of the university community.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

STUDENT ASSISTANCE:

Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at www.mun.ca/student.

NAVIGATE APP FOR STUDENT SUCCESS

Students are encourage to download the Navigate app to help support their success. The app can be found in the Apple app store or Google Play by searching "Navigate Student". The app provides timely university information, including dates and deadlines, allows students to book appointments with various advisors and support services across the university, and establish study groups within courses using the Study Buddies feature. Please note that if you cannot access the app, a desktop version is available by clicking here. If you have any questions about the app, please contact navigateadmin@mun.ca.

Ethical Guideline for Remote Evaluation

Remote evaluations will be un-proctored in Winter 2021, as such it bestows additional responsibilities on the students. In addition to the policies and guidelines outlined in the "Academic Integrity and Professional Conduct", by enrolling in this course you will adhere to the following rules to maintain the integrity of the remote evaluation.

- You will **only access** materials (web and non web based) as specified in each exam instruction.
- You will **not receive** any unauthorized aid on an examination from any person. This includes, but not limited to, peers in your cohort or any other cohort, and expert in the area, paid or unpaid.
- You will **not publish** any question in any website, or any private or public discussion forum.
- You will **not solicit** solution from any paid or unpaid web based tutoring, discussion forum and any other sources.
- You will **not provide** the solution to any of your peers in the cohort or publish the answer in any public or private forum.
- You will **not participate** in any behavior that may be disruptive, unprofessional, or that could reasonably be perceived as academic misconduct.
- If you witness or have knowledge of any unauthorized aid/activity on examination, you will have the moral obligation to **report** this in confidence to the instructor.

Additional Responsibility of Students during Remote Evaluation

Remote evaluations require additional technologies and technical know how. The instructor will provide information about tools; however, it is the responsibility of students to acquire required technologies and know their uses. In addition, students should

- follow the **ethical guidelines**.
- read the **instructions** carefully and adhere to the rules.
- not use the time for **scanning** to answer questions.
- make yourself **familiar with a scanning tool** of your own preference.
- be aware of the **penalty and cut-off time**.
- understand that extending time in the middle of the exam creates uneven playfield for some students, and **refrain from requesting** extra time.
- log on the **meeting room** If allowed by bandwidth, or at least check the meeting room chat window occasionally for any updates.
- **contact the instructor immediately in case of any unexpected event** (e.g., loss of data, internet disruption)

Term wide activities: The course will follow the schedule listed below. Any change of date for the assessment items should be agreed upon by the instructor and the students; such changes will be posted on the course page.

Week	Lecture No.	Date	Activity	Topics to be covered
1				
	1	Jan -7		Course Introduction; Particle size and Shape
2	2	12		Sphericity; Properties of bulk particles
	3	14		Size measurement; WB-Screen Analysis
3	4	19		Size Reduction; Ball mill; Example Problem
	5	21	Assignment 1 due	Filtration concepts and equipment
4	6	26		Mathematical formulation; WB - Filtration
	7	28		WB - Filtration
5	8	Feb - 2		Fluidization concepts and Theories
	9	4		Mathematical formulation
6	10	9	Assignment 2 due	WB - Fluidization; Midterm Review
	11	11	Midterm 1	
7	13	16		Heat exchanger concepts and theories
	12	18		WB – LMTD, Heat transfer coefficient
8	14	23	Winter semester break	
	15	25	Winter semester break	
9	16	Mar - 2		WB-contd.; Overall heat transfer coefficient
	17	4		Mixing concepts and theories
10	18	9		WB - Mixing
	19	11	Assignment 3 due	Scale-up of mixing equipment; WB-Scale up
11	20	16	Midterm 2	
	21	18		Drying concepts, equipment and theories
12	22	23		Mathematical formulation; WB- Drying
	23	25		WB- Drying
13	24	30	Assignment 4 due	Evaporation – concepts; Evaporators
	25	Apr - 1		WB- Single effect evaporator
14	26	6		WB-BPE, enthalpy concentration diagram
	27	8		Final Exam Review