Carleton University
Department of Civil and Environmental Engineering

ENVE 5701: Filtration and Membranes in Water Treatment

Objectives of the Course: To present current information, design and evaluation parameters related to filtration and membrane systems in water treatment. Course topics include: rapid & slow-sand filtration, headloss and backwash calculations, biofiltration, low pressure (micro and ultrafiltration), and high pressure (nanofiltration and reverse osmosis) membrane technology.

On-Line Lecture/Meeting Expectations: Please ensure to mute your microphone unless asked to respond to a question. If responding to, or asking a question, your video should be on; at other times you may choose to have your video on or off. Display your full name. The chat function is only for course related questions; any one writing inappropriate comments will be removed from the class. During BreakOut Sessions your video should be on to interact with your classmates and professor.Class Lectures held via Zoom.

Course Instructor: Dr. Onita Basu
Email contact: onita.basu@carleton.ca

Office Hours: online office hours will be set up during the term.

Course Meeting Time: Fridays 2 pm – 5 pm (EST – Ottawa, ON, Canada; online)

Marking Scheme: Journal Summary & Critiques: 25%
Assignments: 30%
Participation 5%
Final Exam: 40%

Journal Summary & Critiques (25%)
Journal articles will be reviewed in class. Each journal article must have a 1-2 page summary (to be completed individually). Submissions are on-line. Journal articles will be discussed in class and participation in the discussion counts towards your final grade.
Journal Submission Grading:

(i) Submit All Critiques = 5/5 – if you miss one critique you will receive 0/5. Note – that all submissions will be checked to ensure they are summaries of the journal article to be reviewed; however only the ones selected for full evaluation (see ii) will receive feedback/comments.

(ii) Two journal critiques will be ***randomly*** selected for review; each journal critique will be out o f 10 (total of 20 marks). Note: if you do not submit the randomly marked journal you will receive 0 for that assignment. There are no switches allowed. Reviewed Journal Critiques = 20/20.

(iii) Whole Class and Break-out sessions will be held during the course for journal discussion and analysis.

Assignments (30%)
Assignment will be completed in groups. There will be 2 marked assignments for the course. Students will take turns presenting solutions to problems provided to the instructor and to the class. Students must delineate the work of their teammates; a group may receive the same mark or different marks depending on the described effort of the individuals in the team. In addition, extra questions with answers will be posted.

In Class Participation (5%)
Will be evaluated based on involvement in journal discussion and assignment presentations.

Submission Timelines:
Submission timelines are firm. No late submissions are accepted. Submissions times will be posted in the CULearn Course Website as well as communicated during class.

Final Exam (40%)
The final exam will be a take home exam/on-line exam and will cover the entire course content, and include analysis of an assigned journal article.

Course Pack: an e-copy of assigned chapters from MWH: Water Treatment: Principles and Design is required for the course. The article titles will be assigned to you, however, it is expected that students will use the Carleton e-library access to obtain the articles after the first two weeks.

Tentative Schedule: please note, with the online blended model some lectures may shift.

Lecture Number	**Lecture Date**	**Comments – general topic coverage**
1/2	Sept 11	Introduction to Class – Overview of Content, Filtration Basics
3/4	Sept 18	Filtration – types, mechanisms, turbidity, intro headloss
5/6	Sept 25	Filtration – headloss, backwash
7/8	Oct 2	Filtration -particle removal, evaluation mechanisms
9/10	Oct 9	Filtration – evaluation mechanism continued, modes of operation
11/12	Oct 16	Online Presentations
13/14	Oct 23	Membranes – Introduction, terminology
no/classes	*Oct 30*	*No Class*
15/16	Nov 6	Membranes – terminology continued, fouling modes
17/18	Nov 13	Membranes – fouling indices, mass balance/LRV/particle capture
19/20	Nov 20	Membranes – basic plant design
21/22	Nov 27	On Line Presentations
23/24	Dec 4	TBD
25/26	Dec 11	Final Exam – Online

- Most classes will also include a discussion of the assigned journal articles

Learning Objectives:

(1) Be able to describe the different types of filtration systems common to drinking water treatment.
(2) Complete headloss and backwash calculations for rapid filter design, understand operating parameters and be able to design and assess the performance of a filter column.
(3) Understand and quantify the various mechanisms that contribute to filter performance and filter evaluation.
(4) Be able to describe the various types of membrane systems in drinking water treatment and describe all relevant membrane terminology.
(5) Be able to describe, explain, and quantify membrane fouling mechanisms and indices
(6) Complete membrane system mass balances and basic membrane module design.
(7) Evaluate and critique various current and relevant articles in the field of filtration and membrane technology.

Course Mode: This is a blended model course.

Blended Courses

An online course where there is a mixture of synchronous meetings and asynchronous activities. This means students need to be prepared to meet some of the time online via web conferencing tools at scheduled days and times. The asynchronous activities are intended to provide flexibility to students when the class is not meeting synchronously. Students are expected to remain up to date with the deadlines and due dates provided by the instructor. The course require reliable high-speed Internet access, a computer, webcam and a headset with a microphone.

Note: I will post mini-lectures and asynchronous content on a weekly basis as well as hosting on-line lectures and discussion on course material. Synchronous meetings will not be recorded thus students are expected to attend and take notes during synchronous meetings.

Academic Integrity: Students should be aware of their obligations with regards to academic integrity. Please review the information about academic integrity at: https://carleton.ca/registrar/academic-integrity/. This site also contains a link to the complete Academic Integrity Policy that was approved by the University's Senate.

Plagiarism: Plagiarism (copying and handing in for credit someone else's work) is a serious instructional offense that will not be tolerated.

Academic Accommodations

– please see link for additional details:

https://carleton.ca/edc/teachingresources/administrative-pedagogy/academic-accommodations/

http://www.carleton.ca/equity/

Carleton University is committed to providing access to the educational experience in order to promote academic accessibility for all individuals.

Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University.

If you need Academic Accommodation, please contact me within the first two weeks of class or as soon as possible upon learning about a requested accommodation.

- **Pregnancy or Religious obligation**: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf
- **Academic Accommodations for Students with Disabilities**: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your ***Letter of Accommodation*** at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (*if applicable*). **Requests made within two weeks will be reviewed on a case-by-case basis**. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam (*if applicable*).
- **Survivors of Sexual Violence:** As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: https://carleton.ca/sexual-violence-support/.
- **Accommodation for Student Activities:** Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf