

## ENGINEERING 9605: Water and Wastewater Treatment

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<b>Office Hours</b>	Tuesday and Thursday, 10:30 – 11:30 am
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**Communication**      *It will be easiest in person after class or by using the above email.*

### COURSE DESCRIPTION:

*Overview of global freshwater, regional water supplies and sources of water; water treatment processes including coagulation and flocculation, sedimentation and settling, granular and membrane filtration, and disinfection; overview of centralized and decentralized wastewater treatment; biological wastewater treatment processes focusing on suspended growth processes; design of water and wastewater process components.*

**SCHEDULE:**                      LECTURES: Tuesday and Thursday, 9:00 - 10:15 a.m. in EN 4008

**CREDIT VALUE:**                      3 credits

### RESOURCES:

#### TEXT BOOK

- *Water and Wastewater Engineering: Design Principles and Practice, 2011, Mackenzie L. Davis, McGraw-Hill (hard copy on reserve in QEII Library, TD 345 D36 2011, and unlimited access **Professional** electronic copy through the QEII Library with different chapter numbering).*

#### REFERENCES

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- *Dominguez-Faus, R., Powers, S.E., Burken, J.G., Alvarez, P.J., 2009, The water footprint of biofuels: a drink or drive issue, Environmental Science & Technology, 43(9):3005-3010.*
- *Fane, A.G., Fane, S.A., 2005, The role of membrane technology in sustainable decentralized wastewater systems, Water Science and Technology, 51(10):317-325.*
- *Gikas, P., Tchobanoglous, G., 2007, The role of satellite and decentralized strategies in water resources Management, Journal of Environmental Management, 90:133-152.*
- *Godfray, H.C.J., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F.,*

- Pretty, J., Robinson, S., Thomas, S.M., Toulmin, C., 2010, *Food Security: The Challenge of Feeding 9 Billion People*, *Science*, 327(5967):812-818.
- *Guidelines for the Design, Construction and Operation of Water and Sewage Systems*,  
<http://www.env.gov.nl.ca/env/waterres/waste/groundwater/report.html>
  - Libralato, G., Ghirardina, A.V., Avezzu, F., 2012, *To centralise or to decentralise: An overview of the most recent trends in wastewater treatment management*, *Journal of Environmental Management*, 94:61-68.
  - Pfister, S., Bayer, P., Koehler, A., Hellweg, S., 2011, *Projected water consumption in future global agriculture: Scenarios and related impacts*, *Science of the Total Environment*, 409: 4306-4216.
  - Pretty, J., Robinson, S., Thomas, S.M., Toulmin, C., 2010, *Food Security: The challenge of feeding 9 billion people*, *Science*, 327:812-818.
  - Prud'homme, A., 2011, ***The Ripple Effect: The fate of water in the Twenty-First Century***, Scribner, pp. 435.
  - Schwartz, S.A., 2007, *Trends that will affect your future...and nary a drop to drink*, *Explore*, 3(2):95-97.
  - Tanaka, S.K., Zhu, T., Lund, J.R., Howitt, R.E., Jenkins, M.W., Pulido, M.A., Tauber, M., Ritzema, R.S., Ferreira, I.C., 2006, *Climate warming and water management adaptation for California*, *Climate Change*, 76:361-387.
  - Troyka, L.Q., Hesse, D., 2005, ***Simon & Schuster Handbook for Writers, Fourth Canadian Edition***, Prentice Hall.
  - *Vital Water Graphics*, 2002, United Nations Environment Program, 2002, <http://www.unep.org/dewa/vitalwater/index.html>.
  - Zekai, S., 2009, *Global warming threat on water resources and environment: a review*, *Environmental Geology*, 57:321-329.
  - Zimmweman, J.B., Mihelcic, J.R., Smith, J., 2008, *Global stressors on water quality and quantity*, *Environmental Science & Technology*, 42(12):4247-4254.

#### MAJOR TOPICS:

- Global water, overview of centralized and decentralized wastewater treatment, global warming effects on water resources, water supply and treatment overview, St. John's regional water supply system, water usage and population forecasting (Ch. 2, **General Water Supply Design Considerations**)
- Groundwater and surface water supplies, water quality, stratification of reservoirs
- Coagulation and flocculation, static mixer design, paddle flocculator design (Ch. 3, **Coagulation and Flocculation**)
- Sedimentation, Type I and Type II settling, settling column tests, sedimentation basin design, high rate tube settlers (Ch. 7, **Sedimentation**)
- Filtration

- Granular filtration, granular filter headloss, backwashing bed depth, rapid sand filter design, wash trough design (Ch. 8, **Granular Filtration**)
- Membrane filtration, microfiltration and ultrafiltration, membrane flux, fouling and rejection, dead-end and cross-flow operation (Ch. 9, **Membrane Filtration**)
- Reverse osmosis and nanofiltration, monovalent and divalent ions removal (Ch. 6, **Reverse Osmosis and Nanofiltration**), carbonate buffer system (Ch. 3, **Coagulation and Flocculation**)
- Disinfection, chlorine, ozone and ultraviolet disinfection (Ch. 10, **Disinfection and Fluoridation**)
- Wastewater treatment overview, secondary treatment by suspended growth biological processes, nitrification, denitrification and phosphorus removal, facultative oxidation ponds, oxidation ditch design, sequencing batch reactor (Ch. 16, **Secondary Treatment by Suspended Growth Biological Processes**)

#### ASSESSMENT:

				<b>Proposed Due Dates</b>
Term Paper	30%	Summary	3%	Thursday, January 17, in class
		Full paper	27%	Tuesday, February 12, by 9:00 a.m.
Presentation	20%			Thursday, March 7 and 21
Term test 1	15%			Thursday, January 31
Term test 2	15%			Thursday, March 14
Final exam	20%			Wed, April 11 to Sat. April 20

*The class tests and final exam will be largely numerical problems but could have a theoretical component. For the numerical problems class notes in your own handwriting, printed pages from the textbook, and a scientific calculator only are permitted. If there is a theoretical component it would be closed book.*

*Posted practice problems are available to help in exam preparation as are problems that are solved in the notes. (Missing Term test 1 will increase the weighting of Term test 2 and the final exam by 7.5% each. Missing Term test 2 will increase the weighting of the final exam by 15%.) Weather could delay a final exam but not submission of the final paper which is to be submitted electronically (since an extra week has been already been allowed for the paper submission).*

*During class time, personal laptops, phones and other electronic devices should be turned off. However, phones may be used to photograph figures and tables from the class notes.*

#### ACADEMIC INTEGRITY AND PROFESSIONAL CONDUCT:

The highest level of academic integrity is expected from students. Please consult Memorial University's Code of Student Conduct at <https://www.mun.ca/student/supports-and-resources/respectful-campus/student-code-of-conduct.php>



Any student found to commit an academic offence will be dealt with according to the practices as outlined by the School of Graduate Studies. The related calendar information is available at <http://www.mun.ca/regoff/calendar/sectionNo=GRAD-0029>

**INCLUSION AND EQUITY:**

Students requiring physical or academic accommodations may speak privately to the instructor so that appropriate arrangements can be made. All conversations will remain confidential. Diversity of viewpoints, values, and backgrounds that each class participant possesses enrich the university experience. Insightful and comprehensive class discussion will be possible when dialogue is 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](http://www.mun.ca/student)

One specific resource is the Writing Centre at <https://www.mun.ca/writingcentre/>

**ADDITIONAL INFORMATION:** An effort will be made to visit the Riverhead Wastewater Treatment Plant or the Windsor Lake Water Treatment Plant. Personal Protective Equipment (PPE) is required.