Fall 2008 ENGG*6680 Advanced Water and Wastewater Treatment

Instructor: Dr. Hongde Zhou **Office:** Room 1341
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Lectures/ Discussion: Monday or Friday: 9:30 am to 12:30 pm (?)
THRN 204

Office Hours: Open door or via email

COURSE OBJECTIVES:

The purpose of this course is to provide students the theory and practices of selected advanced treatment technologies that either have been used or have shown great promise in water and wastewater treatment. Samples and case studies will be provided with emphasis on the latest developments from recent research and engineering practice to highlight their limitations and future research needs. On successful completion of this course, you will be able to:

1) identify the most critical issues and challenges that limit the use of conventional treatment processes in planning, design and operation of modern water and wastewater treatment facilities,
2) develop in-depth knowledge and hands-on practical experiences that can be used to devise and design effective alternative treatment systems to meet not only current but also anticipated regulatory requirements, and
3) enhance the independent learning and critical thinking skills.

The contents of the course are built on the knowledge of conventional treatment processes covered by ENGG*4260. Only brief reviews will be provided to recap their basic concepts, process principles, practical applications in water and wastewater treatment.

COURSE OUTLINE:

The course mainly consists of six subjects: enhanced coagulation, membrane filtration, ozonation and advanced oxidation processes, UV disinfection, biological nutrient removal, and natural treatment systems. Emphasis will be placed on their applications in removing natural organic matter, taste and odour compounds, resistant microbial pathogens, harmful disinfection by-products, emerging organic micropollutants and biological nutrients (N and P).

Following is a tentative schedule of lectures. Subject to the class interests, additional topics may be considered.

Lectures	Topic
0.5	**Orientation and Course Outline**
1.5	**Review** Water and wastewater quantity and characteristics Regulations Overview of conventional water and wastewater treatment processes Basic principles of process engineering
3	**Enhanced Coagulation and Softening** NOMs in water NOM-particle interactions between coagulated flocs and softening precipitates Applications of enhanced coagulation and softening in water treatment
4	**Ozonation** Review to water disinfection Ozonation chemistry and mass transfer Design and application of ozonation processes in water and wastewater treatment
5	**UV Disinfection** UV source and measurement UV disinfection applications in water and wastewater treatment Introduction to computational fluid dynamics for UV disinfection design
6	**Advanced Oxidation Processes (AOPs)** Types of AOPs Reaction mechanisms and applications with organic compounds Ozonation and AOPs by-product formation, implications and control
7	**Membrane Filtration I** Types of membrane filtration Mass transport involved in membrane filtration Membrane system operation, maintenance and monitoring Membrane filtration applications in water treatment
8	**Membrane Filtration II** Membrane bioreactor (MBR) configurations Fouling mechanisms and control in MBR Tertiary membrane filtration processscess
9	**Biological Nutrient Removal (BNR) Processes** Nitrification-denitrification processes Bio-P processes
10	**Biological Nutrient Removal (BNR) Processes (continued)** Simultaneous nitrogen and phosphorous removal processes Application of activated sludge models for BNR processes
11	**Presentations**
12	**Presentations (continued) and Review**
13	**FINAL EXAMINATION: TBD**

MARK DISTRIBUTION

Assignments + design projects (2):	30 %
Term paper and presentation:	30 %
Final Exam:	40 %

Note that a 30% reduction in score will be imposed for the assignments up to the delay of three days, and 100 % reduction for one-week delay.

REFERENCES

*Metcalf & Eddy, Inc. (2003). Wastewater Engineering: Treatment, Disposal and Reuse, 4rd edition, McGraw Hill, Inc., New York, NY, 1819p.

*AWWA. (1999). Water Quality and Treatment: A Handbook of Community Water Supplies, 5th edition, McGraw Hill, Inc.

Grady, C.P.L., Jr., Gaigger, G.T. and Lim, H.C. (1999). Biological Wastewater Treatment, 2nd edition, Marcel Dekker, New York, NY.

Kawamura, S. (1991). Integrated Design of Water Treatment Facilities, John Wiley & Sons, Inc., New York, NY, 658 p.

Langlais, B., Reckhow, D.A., and Brink, D.R. (1991). Ozone in Water Treatment: Application and Engineering. Lewis Publishers, Michigan.

Mallevialle, J., Odendall, P.E., and Wiesner, M.R. (1996). Water Treatment Membrane Processes. McGraw-Hill, New York, New York.

MWH. (2005). Water Treatment Principles and Design, John Wiley & Sons, New York, NY, 1948p.

Rittmann, B. and McCarty, P. (2001). Environmental Biotechnology: Principles and Applications. McGraw-Hill, New York, New York.

Stumm, W. and Morgan, J.J. (1996). Aquatic Chemistry. John Wiley & Sons, New York, NY, 1022p.

WEF. (1998). Biological and Chemical Systems for Nutrient Removal, Water Environment Federation, Alexandria, VA.

WEF-ASCE. (1998). Design of Municipal Wastewater Treatment Plants, Vol. 1 and 2, 4th edition, Alexandria, VA.

WEF-ASCE-EWRI. (2005). Biological nutrient removal operation in wastewater treatment plants. WEP Press, Alexandria, VA. 597p.

WEF. (2006). Membrane Systems for Wastewater Treatment. WEP Press, Alexandria, VA. 284p.

SUGGESTED JOURNALS

Water Research
American Water Works Association Journal
Water Environment Research
Journal of Environmental Engineering
Environmental Science and Technology
Journal of Membrane Science; Ozone Science & Engineering, Water Science & Technology

Note: No standard textbook is required, but the reading materials from various scientific publications will be assigned periodically.