Fall 2012

ENGG*4260: WATER AND WASTEWATER TREATMENT DESIGN

Instructor: Dr. Hongde Zhou — Room 2411, ext. 56990, hzhou@uoguelph.ca
Office hour: Friday 10:30AM to 11:30AM or via e-mail

GTA: Zebo Long: VIM 123 ext, 53872, zlong@uoguelph.ca
Office hour: Tuesday 4:00 to 5:00PM

Lecture Times: MWF: 11:30AM to 12:20PM, MACK 121

Labs: Thursday: 2:30 to 4:20PM, MACK 231

Prerequisites: ENGG*3100, ENGG*3590
Note: If you do not meet these requirements, see the instructor immediately.

COURSE OBJECTIVES

The purpose of this course is to provide the students with the theories and practices for the planning, design and operation of commonly used wastewater treatment facilities. Emphasis will be placed on integrating individual unit operations and processes to achieve multiple treatment objectives while satisfying the given constraints. On successful completion of this course, you will be able to:

1) properly identify the critical issues and challenges in planning, design and operation of modern wastewater treatment facilities to meet not only current but also anticipated regulatory requirements,
2) develop reasonable working knowledge and hands-on experiences that can be used to devise and design the efficient, cost-effective treatment and water reuse systems, and
3) gain the independent learning skills and enhance your ability to work effectively in teams through PBL format.

COURSE DESCRIPTION

The course is mainly centered on three representative design projects in the field of wastewater treatment. They are:

1) Activated sludge processes
2) Attached biofilm processes
3) Sludge processing, utilization and disposal

To complement these projects, the institutional, technological and environmental considerations governing wastewater discharge and the common approaches to estimate wastewater generation will be reviewed. The applicability and limitations of these treatment technologies to resolve the current and emerging challenges such as the disinfection of resistant microorganisms, biological nutrients, toxic synthetic organic compounds, water reuse and resource recovery will be highlighted.

COURSE OUTLINE

Topics	Weeks	Chapters
0 – Introduction:, ▪ Course outline ▪ Wastewater treatment and reuse: overview	0.5	
I - Fundamentals of Wastewater Treatment and Reuse ▪ Wastewater sources and flow rates ▪ Physical, chemical and biological characterization ▪ Treatment objectives ▪ Introduction to wastewater treatment process selection	1	1, 2
II – Wastewater Microbiology ▪ Role and classification of microorganisms ▪ turbidity ▪ Microbial growth kinetics ▪ Types of biological treatment processes	1	6.1 to 6.5
III – Suspended Growth Biological Treatment Processes ▪ Activated sludge process analysis and control ▪ Aeration selection and design ▪ Secondary settling ▪ Biological nutrient removal processes	3	6, 8
Midterm		
III – Attached Growth Biological Treatment ▪ Attached growth kinetics and mass transfer limitation ▪ Tricking Filter ▪ Rotating biological contactors ▪ Hybrid processes	2.5	7
V – Tertiary Treatment and Water Reuse ▪ Health and environmental concerns in water reuse ▪ Technologies and systems for water reclamation ▪ Water reuse and applications	1.5	10, 11
IV – Sludge Processing, Utilization and Disposal ▪ Sources, quantities and Characteristics ▪ Regulations for the utilization and disposal ▪ Anaerobic digestion ▪ Other sludge processing ▪ Land application	2.5	12 to 16
Final Exam		

COURSE FORMAT: PROBLEM BASED LEARNING (PBL)

The course will be mainly offered in PBL format. Thus, it is essential that you are ACTIVELY engaged in the meetings and TEACH each other. The PBL is only effective through frequent interactions with your peers. Through these interactions you will strengthen your own understanding through the frequent feedback from your peers and through the explanations to your peers. Note that we will help your meetings, we will help your teaching, we will answer questions - we will NOT run your meetings, we will NOT make your decisions.

Maximum group size is four students. Some groups of three may be permitted depending on the final numbers in the class. You may choose the group members but the members of your group for the first two projects should be completely different from those for the last two projects.

COURSE EVALUATION

Design Reports (3)	**50%**
Assignments	**10%**
Midterm	**15%**
Final Exam	**25%**

Design Reports. Each project report must meet the requirements and formats specified in the course handout in order to achieve the perceived course objectives. The report should be technically sound, CLEARLY readable, and concise. Don't use your spare time to create a huge report!

Quizzes/Final Exam. All the quizzes and final exam will be open-book. You are allowed to bring the textbook, the course notes and non-communicating calculator **but not the submitted project reports and assignments**.

Other Policies. You must achieve a passing grade on the project design component to pass the course. If you fail to do so, your final grade will be equal to that failing percentage.

If you miss a design report or quizzes/assignments and have an acceptable, properly written excuse, the weight of the missed component will be added to the weight of the final exam.

Late submission of the project reports will be devalued by 50% per every day.

You may appeal any mark within one week after it has been posted on the course website with the written reasons for remarking.

Please also note that university policy specified in University Calendar will be followed strictly.

REQUIRED TEXTBOOK

WEF and IWA, (2003). *Wastewater Treatment Plant Design*. Edited by A. Vesilind, Water Environment Federation, Alexandria, VA.

Notes and selected publications on pertinent topics will be posted on the course website throughout the semester.

REFERENCE BOOKS

1 Davis, M.L. (2010). Water and Wastewater Engineering: Design Principles and Practice. McGraw Hill, Inc., New York, NY.

2 Droste, R.L. (1997). *Theory and Practice of Water and Wastewater Treatment*. John Wiley & Sons, New York, NY, 800p.

3 Grady, C.P.L., Jr., Gaigger, G.T. and Lim, H.C. (1999). *Biological Wastewater Treatment*. 2nd edition, Marcel Dekker, New York, NY, 1076p.

4 Henze, M., van Loosdrecht M.C.M., Ekama, G.A., Brdjanovic, D. 2008. *Biological Wastewater Treatment: Principles, Modelling and Design.* IWA Publishing, London, UK, 511p.

5 Metcalf & Eddy, Inc. (2003). *Wastewater Engineering: Treatment and Reuse*, 4th edition, McGraw Hill, Inc., New York, NY, 1796p.

6 Metcalf & Eddy, Inc. (2006). *Water Reuse: Issues, Technologies and Applications*, McGraw Hill, Inc., New York, NY, 1570p.

7 Qasim, S.R. (1999). *WastewaterTtreatment Plants: Planning, Design, and Operation*. Technomic Pub. Co, Lancaster, PA, 1107p.

8 *Recommended Standards for Wastewater Facilities*. 1997 Edition, The Great Lakes – Upper Mississippi River Board of State and Provincial Public health and Environmental Managers, Albany, NY.

9 Reynolds, T.D. and Richards, P.A. (1996). *Unit Operations and Processes in Environmental Engineering*, 2nd Edition, PWS Publishing Co. Boston, MA, 798p.

10 Viessman, W. Jr., Hammer, M.J., Perez, E.M. and Chadik, P.A. (2009). *Water Supply and Pollution Control*. Pearson Prentice Hall,,U pper Saddle River, NJ, 843p.

11 WEF and ASCE, (1998). *Design of Municipal Wastewater Treatment Plants*, Vol. 1, 2 and 3, 4th Edition, Alexandria, VA.

REFEREED JOURNALS

1 Water Research
2 Water Environment Research
3 American Water Works Association Journal
4 Journal of Environmental Engineering, ASCE
5 Environmental Science & Technology