GEORGIA INSTITUTE OF TECHNOLOGY
School of Civil & Environmental Engineering

CEE 6331 – Biological Processes **Spring 2019**

GT Catalog Description
Microbial growth kinetics and bioenergetics, theory, modeling, and application of biological processes employed in water, wastewater, and hazardous waste treatment systems as well as site bioremediation.

Educational Objectives
This course is designed to introduce graduate students to fundamental biological phenomena and processes, bioenergetics and kinetics of microbial growth, and the mathematical description of major biological treatment processes. Upon completion of this course, the student will have demonstrated an understanding of:

(1) factors that govern biological treatment processes;
(2) bioreactor design and operation; and
(3) mathematical description and modeling of major biological processes of environmental importance.

Prerequisites: CEE 6311 or consent of instructor

Instructor: Dr. Spyros G. Pavlostathis
3204 ES&T Bldg.; 404-894-9367; spyros.pavlostathis@ce.gatech.edu
CEE Website: http://www.ce.gatech.edu/people/faculty/961/overview

Lecture: T & Th 3:00 – 4:15 PM; Coll of Computing 102

Office Hours: By appointment (E-mail)

Resources:

- Required: Rittmann and McCarty (2001). *Environmental Biotechnology: Principles and Applications*. McGraw-Hill, New York, NY.

- Optional: Metcalf & Eddy, Inc. (2014). *Wastewater Engineering – Treatment and Resource Recovery*, 5th ed., McGraw-Hill, New York, NY.

  Grady, Daigger, Love, and Filipe (2011). *Biological Wastewater Treatment*, 3rd ed., IWA Publishing, London, UK.

  Henze, van Loosdrecht, Ekama, Brdjanovic (2008). *Biological Wastewater Treatment – Principles, Modelling, and Design*. IWA Publishing, London, UK.

  Henze, Gujer, Mino, van Loosdrecht (2000). *Activated Sludge Models ASM1, ASM2, ASM2d, and ASM3*. IWA Task Group on Mathematical Modelling for Design and Operation of Biological Wastewater Treatment; Scientific and Technical Report No. 9; IWA Publishing, London, UK.

- Other: Supplementary material will be available through the GT Library (material on reserve) and course website (https://canvas.gatech.edu/)

  Material developed in class will not be posted on the course website

Requirements and Grading

1. **Quizzes:** Closed book/notes quizzes will be given throughout the term at unannounced dates.

2. **Homework:** Homework assignments will be given throughout the semester and must be handed in at the start of class on the due date. Homework assignments will not be accepted after that time, unless a prior arrangement has been made with the instructor. You may work alone or in groups to complete the homework assignments, but you should solve each problem and turn in your own solutions. If you do work in groups, write the names of the people you worked with at the top of the homework set.

3. **Class Participation:** Class participation and active discussion during class time is very important. Students are expected to: attend each class, prepare for each class by reading the material assigned for each topic prior to class, actively participate in class discussions, and ask/answer questions regarding the material being covered.

4. **Examinations:** A mid-term, 1.5-hour examination will be given during the semester; date to be announced later. A final, non-comprehensive examination will be given during finals period. Make-up exams will not be given.

5. **Term Project:** Each student will participate in one, semester-long modeling project in the area of biological processes conducted by a student group (4-5 students per group). The specific modeling project will be selected by the student group in consultation with the instructor. The deadline for choosing and submitting a one-page typed outline of the project, including corresponding literature reference(s) is January 31. Project progress reports (each up to 5 typed pages) are due on February 28 and March 28. The due date for the final, project report is April 26 (CoB). Project reports will not be accepted beyond this deadline. Each student group will give an oral presentation of their work on April 23 (Tentative schedule) and will prepare a 2-page typed summary of the project, hard copies to be distributed to all students at the time of the presentation.

6. **Grade Determination:** The final grade will be calculated as follows:

Quizzes	10% (Bonus)
Homework	15%
Mid-term Exam	30%
Final Exam	30%
Term Project	25%

Academic Honor Code Issues

Georgia Tech Honor Code

Students in this class are expected to abide by the Georgia Tech Honor Code and to avoid any instances of academic misconduct, including but not limited to:

1. Use of cell phones during class. Place cell phones in your bag and turn them off/manner mode.

2. Possessing, using, or exchanging improperly acquired written or oral information in the preparation of homework, class project, and exams.

3. Use of material that is wholly or substantially identical to that created or written by another individual or group (including *Plagiarizing)*.

4. False claims of performance or work that have been submitted by a student.

The following information is provided by the Georgia Tech Honor Advisory Council:

1. Plagiarism:

Plagiarizing is defined by Webster's as "to steal and pass off (the ideas or words of another) as one's own: use (another's production) without crediting the source." If caught plagiarizing, you will be dealt with according to the GT Academic Honor Code.

2. Tests/Quizzes:

Cheating off of another person's test or quiz is unethical and unacceptable. Cheating off of anyone else's work is a direct violation of the GT Academic Honor Code, and will be dealt with accordingly.

For any questions involving these or any other Academic Honor Code issues, please consult http://www.policylibrary.gatech.edu/student-affairs/academic-honor-code

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COURSE SYLLABUS (Tentative)

LECTURE HOURS	TOPIC
2	Introduction
	PART I: BIOLOGICAL PHENOMENA
1.5	Modeling of Biological Treatment Processes/Systems – Basics
1	Enzyme Kinetics
1	Microbial Growth (Review)
3	Kinetics of Microbial Growth & Substrate Utilization
1	Reactors (*Review*)
3	Continuous Culture Processes (Suspended-growth)
4	Bioenergetics and Stoichiometry of Microbial Growth
1.5	***MID-TERM EXAM***
	PART II: BIOLOGICAL TREATMENT PROCESSES & APPLICATIONS
5	Activated Sludge/Membrane Bioreactors
2	Trickling Filters (Attached-growth)
2	Nitrification
2	Denitrification
1	Phosphorus Removal
6	Anaerobic Treatment Processes
3	Biosolids Management (*Overview*) (Tentative)
3	Bioenergy Production (Tentative)
1.5	***Project Presentations***
43.5	