West Virginia University, Department of Civil and Environmental Engineering

Principles of Biological Waste Treatment

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Fall 2014

LECTURE DAY/TIME/ROOM	TR 9:30-10:45/G84 ESB
FORMAT	3 hour lecture, 3 credit hr
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COURSE OBJECTIVE

The purpose of this course is to gain familiarity with biological waste treatment principles. This course will primarily focus on biological treatment processes in water and soil. However the course focus on the integration of fundamental concepts will allow the student to extrapolate the lessons learned in the course to other specialties in environmental engineering such as hazardous waste remediation in soils, sediments, groundwater and industrial waste treatment. At the completion of the course you will be familiar with 1) growth and degradation kinetics, 2) biochemistry fundamentals, and 3) molecular biology. You will also gain experience in critical thinking skills, communication skills and laboratory procedures. During the course you will get a chance to tour local facilities (for example wastewater treatment plants) that will provide you with a real world view of environmental engineering and biological treatment processes.

EXPECTED LEARNING OUTCOMES

At the completion of this course you will be:

1. Familiar with the principles of biological treatment processes
2. Familiar with growth and degradation kinetics modeling
3. Familiar with molecular biological methods useful to biological waste treatment
4. Familiar with major biochemical processes important to biological waste treatment

GRADING POLICY

Weighted average grades will be calculated based on the following distribution:

Manuscript reviews and discussion	35%
Homework assignments	35%
Midterm exam	15%
Final exam	15%

Final grades will be based on 90%, 80%, 70%...corresponding to A, B, C, … The instructor reserves the right to curve up, e.g., upwards to a higher grade than earned on this scale. A one page, 8.5"X11" sized, double sided page of notes is allowed for exams. Review periods prior to exams will be scheduled upon request by the class. Assignments are due at the beginning of the assigned period. Assignments turned in after the beginning of class will lose 10% of their value per workday late. Late assignments will not be accepted after the material is returned to the class.

MANUSCRIPT REVIEWS/JOURNAL CLUB

Periodically a 1 page review of published manuscripts will be required (see course outline below). Each student will be required to submit a one page critical review of the chosen manuscript following accepted guidelines. Guidelines will be presented, but any review format is allowable as long as a thorough and thoughtful review and discussion of the manuscript is presented. Additionally, each student will be

required to present a summary of one manuscript orally during class (5-10 minute summary) and lead the discussion (10 minute discussion).

REQUIRED TEXT
There is no required text, however reading assignments as indicated in the course outline will be placed on the eCampus website or provided in class. These readings should be completed prior to the scheduled lecture.

PREREQUESITES
CE347 or Instructor's consent

ATTENDANCE POLICY
You are expected to attend all classes. If you have a specific problem with attendance, notify the instructor prior to class, unless the emergency is such that this is not possible. Consistent with University guidelines, students absent from regularly scheduled examinations because of authorized University activities will have the opportunity to take them at an alternate time. Make up exams for absences due to other reasons will be at the discretion of the instructor.

PLAGARISM AND ACADEMIC DISHONESTY STATEMENT
Don't do it! Students found engaging in plagiarism, cheating or forgery during any assignment or test will be subject to the conduct code policies of the University that can be found on-line at http://www.arc.wvu.edu/rightsa.html.

SOCIAL JUSTICE STATEMENT
"West Virginia University is committed to social justice. I concur with that commitment and expect to foster a nurturing learning environment based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.
If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with Disability Services (293-6700)."

HOMEWORK
Homework assignments are an integral part of the learning experience and will be carefully graded. A good homework solution will feature the following elements:

1. **Problem setup**: All given information, as well as the values of additional constants (and their sources), should be listed. A sketch or diagram should be provided where appropriate. A brief statement of the problem objective should be included.
2. **Equations**: The governing equations relevant to the solution of the problem should be written in algebraic form BEFORE substituting any numbers. If the equation must be derived, show all work. All relevant chemical reactions should be written and balanced.
3. **Assumptions:** List explicitly any assumptions necessary to solve the problem.
4. **Solution**: Present all work in a manner than can be understood by an engineering colleague. If the solution involves a programmable calculator spreadsheet or graphical technique, briefly describe the logic behind your solution approach.
5. **Answers**: Clearly indicate answers (e.g., box, underline, circle, or highlight). Include both the correct number of significant figures and the relevant units for each answer.

TENTATIVE COURSE OUTLINE

Date	Topic	Reading	Homework	Manuscript Topic
8/19 & 8/21	Introduction, Basic Microbiology	Bungay, 2009, Env. Processes (pp. 1 to 15)		Kinney, 2006, Organics in biosolids
8/26 & 8/28	Biochemistry, Microbial Ecology	Irvanov, 2010 Microbial Ecology (pp. 19-49 & 63-78)		Cai, 2013, P removal SBR
9/2 & 9/4	Molecular Biology, Metabolism	Okafor, 2011, Molecular Biology	Set #1	Talbot, 2008, molecular methods review
9/9 & 9/11	Growth kinetic modeling			Contreras, 2000, growth kinetics food industry wastewater
9/16 & 9/18	Degradation kinetic modeling		Set #2	Joss, 2006, biodeg kinetics PPCPs
9/23 & 9/25	Activated sludge systems	Wang, 2009, Activated sludge processes (pp. 207 to 238)	Set #3	Bengtsson, 2008, PHA from wastewater
9/30 & 10/2	**Exam #1** No class 10/2			
10/7 & 10/9	Nitrification & denitrification SBRs	Lin, 2009, Nitrification-denitrificaiton (pp. 539 to 573) Wang, 2009, SBR (pp. 459 to 487)		Baytshtok, 2008, electron donors denitrifyers
10/14 &10/16	**Fall recess (10/14)** biofilms	Costerton, 2007, biofilms (pp. 1 to 43)	Set #4	Satoh, 2004, biofilm reactor nitrification-denitrificaiton
10/21 & 10/23	Fluidized bed bioreactors	Fitch, 1998, Fixed film systems		Mulder, 1995, Anamox FBR
10/28& 10/30	Trickling filters	Wang, 2009, Trickling filters (pp. 307 to 403)	Set #5	Gabriel, 2003, biotrickling filter H_2S
11/4 & 11/6	**No class (11/4) go vote!** Membrane Bioreactors	Wang, 2011, Membrane bioreactors (pp. 129 to 147)	Set #6	Garcia, 2012, nanomaterial effect on wwtp
11/11 & 11/13	In-situ bioremediation	Hawumba, 2010, Bioremediation		Vrionis, 2005, Uranium bioremediation in-situ
11/18& 11/20	Soil remediation	Vidali, 2001, Bioremediation	Set #7	Fenoll, 2011, biosolarization effect on insecticides
Week 11/24	**Happy Thanksgiving!**			
12/2 & 12/4	Constructed wetlands	Constructed wetlands for wastewater treatment	Set #8	Seeger, 2011, bioremediation benzene, MTBE, constructed wetlands
12/9 & 12/11	Review & **Final Exam**			

General Guidelines for Critical Reviews

There are two goals for the critical review exercises:

1. Become familiar with the literature in the field of biological waste treatment.
2. Develop the capacity to critically review scholarly papers in a thorough and quantitative manner. You may be called upon to do this as an academic reviewing manuscripts submitted to a journal, or as a professional who must decide on the validity and applicability of a particular research result to your work.

Papers to be reviewed are typically selected to be good examples of literature in this field, so don't feel that you have not been successful if you do not find any major points to criticize. However, even the best published papers have some errors (either of omission or commission). Overall, your review will be evaluated for the following features:

- **Specificity**. Can I tell exactly what you mean? Would an author be able to respond to your comments?
- **Economy**. Do you convey your point in the minimum number of words? The text of these reports should not be very long, 1-3 pages of text (single-spaced) are probably sufficient plus any graphs or tables you generate. This important thing is to spend time thinking about the work and checking the calculations reported.
- **Thoroughness**. Do you comment on all important aspects of the work?
- **Evidence of understanding of the paper**. Do you appear to understand the main points the author is trying to convey?
- **Quality of the theoretical review**. Is your review of the chemistry/hydrology/etc. theoretically sound?
- **Quality of the quantitative review**. Are your calculations well documented and properly performed?

Your review should cover each of the major sections of the paper, but not necessarily in equal measure. The following should be viewed as suggested items to look for in your review

Abstract (5%). Does the author convey the most important elements of the work in the abstract? Does it provide an accurate indicator of what the paper is about?

Introduction/Background (10%). Is the problem well motivated? Is the objective of the work clearly stated? Are the statements in the background section accurate? Are models clearly defined and formulated?

Methods (15%). Are the experimental methods and computational approaches described completely? Are there any flaws or weaknesses with the approach taken? Are any important measurements not taken or reported? Can you suggest any improvements to the laboratory procedures or the computational approach?

Results (50%). This is the most important section of the paper and hence of your review. Can you verify the reported results? Do the results violate any chemical principles? Are there better ways to present or describe the results? Are tables and graphs clear and meaningful?

Discussion (15%) Do the authors place their work in the proper context? Does the discussion add to your understanding of the results and how to apply them to environmental problem solving?

Extras (5%). Some points are reserved