CEE6310 Syllabus

Process Principles in Environmental Engineering

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Instructor Information

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General Course Information

Description

Principles that can be used in the analysis and modeling of environmental engineering processes, including material and energy balances, mass transfer, and reaction engineering.

Course Learning Outcomes

This course is designed to introduce first-year EnvE graduate students to the principles of material balances, mass transfer, and reaction kinetics and reaction engineering. The principles covered are applied to the analysis and modeling of simple environmental engineering systems.

Students will be able to write and solve material balance equations for simple environmental engineering systems. Comprehend the principles of mass transfer and apply them to the development of governing equations for systems of steady-state molecular mass transfer, unsteady-state molecular mass transfer, convective mass transfer, and interphase mass transfer. Given possible reaction mechanisms, construct rate expressions and determine rate constants from experimental data. Write and solve design equations for engineered and natural systems that can be modeled as ideal single isothermal reactors (batch, plug flow, perfectly mixed flow) and multiple reactors. Use tracer experimental data to quantify nonideality conditions in reactive systems and then analyze nonideal systems based on direct application of tracer experimental data and models (dispersion, tanks-in-series).

Prerequisites

Undergraduate calculus, differential equations, and fluid mechanics.

Computer Usage

Spreadsheets (MS Excel); Python; and Mathematcia.

Required Course Materials

All needed information will be presented in class. Two textbooks can be used for reference (either of the two):

1. Clark, M.M., Transport Modeling for Environmental Engineers and Scientists, 2nd Edition, Wiley, 2009.
2. Crittenden, J.C., Trussell, R.R., Hand, D.W., Howe, K.J., and Tchobanoglous, G., MWH's Water Treatment: Principles and Design, 3rd Edition, Wiley, 2012.

Grading Policy:

Grades are composed of three components, weighted according to the distribution below. Final grades are rounded to the nearest whole number. There is no curve. Grades are assigned as stated below:

- Problem sets (6), each account for 5 points towards final grade (30 points in total);
- Midterm exam (1), 30 points.
- Final exam (1), 45 points.
- Grading Scale: A: ≥ 85%, B: 75 - 84%, C: 65 - 74%, D: 50 - 64%

Description of Graded Components

Problem Sets: Due at the beginning of class. Hard copies are preferred. Electronic versions are accepted but will not receive the level of feedback you would get from a hard copy. If you are submitting electronically, upload your entire assignment as a SINGLE PDF ONLY (not multiple files). Any submissions with multiple files or corrupted files will be treated as an incomplete or late assignment. An assignment must be submitted either as a PDF or in-person, not some combination of the two.

Problem sets are designed to both build and test deeper understanding. Each question is more detailed than what you'd have time for in an exam. Exams questions more closely resemble in-class examples. There are only four problem sets. They are not designed to be completed in a single effort. Read the problem sets as soon as they are available. Work on them soon after covering the content in class.

Exams: Exams are in-person, closed-note/book/internet/phone. There are dedicated class periods where you will work with classmates on shorter, exam-type practice problems. No

new material will be presented. This time is to make sure you are keeping up on information, to work out any unclear parts with others and/or me.

Tentative Course Outline

Topic	Approximate number of one-hour lectures
• Material Balances	6.0
• Mass Transfer	16.5
Molecular Diffusion and the Diffusion Coefficient	
Differential Equations of Mass Transfer	
Steady-state Molecular Mass Transfer	
Unsteady-state Molecular Diffusion	
Convective Mass Transfer	
Interphase Mass Transfer	
• Midterm Exam	1.5
• Reaction Kinetics and Reaction Engineering	19.5
Stoichiometry	
Thermodynamics of Reactions	
Reaction Rates	
Analysis of Experimental Rate Data	
Ideal Isothermal Single Reactors	
Batch	
Plug Flow	
Perfectly Mixed Flow	
Multiple Reactors	
Multiple Reactions	
Nonideal Flow Reactors	
• Final Exam	3

Course Policies

Attendance and/or Participation

Attendance is not required but encouraged. Attendance has been the biggest indicator of student success in previous semesters. If you must miss classes, I can provide resources for remote learning.

Late Work

Late work is not accepted. This policy allows me to post solution sets in a timely manner. I provide two "late pass" exception: you may submit one problem set via as a PDF on Canvas up to 24 hr late with no penalty. Upload your assignment as a SINGLE PDF ONLY (not multiple files). Do not email me that you are using your late pass- no explanation or accounting is needed. If you have already used your "late pass", then further late work will not be accepted. If exceptional circumstances cause you to need further extensions or extensions on multiple assignments, contact the Office of Student Life. There is an online form available at https://studentlife.gatech.edu/resources/class-attendance. Medical information should not be emailed directly to a professor.

Regrade

Problem sets are graded by a grader according to an agreed-upon rubric. If you believe the rubric was not accurately applied to your work, you will need to turn our work back in to me in-person the next time class meets along with a note of your concern. I will then review go over the entire assignment (not just the noted question) together with the grader. If more than 1 class has passed since you received your grade, then the regrade window is closed.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the student Code of Conduct.

Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Core IMPACTS

Core IMPACTS is the University System of Georgia's General Education curriculum. If you are teaching a course that counts towards Core IMPACTS, you should include a syllabus statement about the Core area and associated career competencies. This resource

developed by the Center for Excellence in Teaching and Learning and Online Education at Georgia State University includes template syllabus statements for each of the Core IMPACTS areas that you may adapt for your course.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Optional Course Expectations, Policies, and Resources [Remove this heading in your final syllabus and eliminate the separation between the required and optional policies]

[While the following policies are not required, they include important expectations and resources that you may choose to share with your students. Visit our Course Policies page to find more sample policies, information about Georgia Tech specific rules and regulations, and suggestions for what to consider when setting each policy.

As you write this portion of your syllabus, use language that emphasizes your students' role in the process, and aim for a tone that communicates both authority and approachability. Each policy should make it clear what is and is not expected/permissible in this class, what the rationale or motivation behind the policy is, what students need to do in extenuating circumstances, and what the consequences will be if they fail to live up to the expectations laid out in the policy. Finally, your policy should represent something that you are comfortable implementing consistently throughout the course.]

Pre- &/or Co-Requisites

[If applicable, list pre-requisites here. In some instances, you may also want to describe the background knowledge/experience that is most likely to lead to success in your course (this is often relevant in a graduate level seminar and upper-level elective courses).]

Extra Credit Opportunities

[If applicable, include a statement about opportunities for extra credit here. Views on extra credit opportunities vary among faculty. You might decide not to offer extra credit opportunities because you want your students to work hard in class and spend time working on actual assignments, or because you think extra credit lowers academic standards. However, extra credit can also be a good learning opportunity because it gives students an additional chance to learn the material (especially students who are struggling in the course). It also reduces student anxiety and builds their motivation and confidence.]

Collaboration, Group Work, and Use of Generative AI

[The university's Honor Code gives you the job of defining for your students the levels of collaboration that are permitted, as well what outside resources they are permitted to use (on assignments, exams, projects, etc.), and how they are supposed to report their use of those outside resources. You may also choose whether or not and to what extent students may collaborate with Generative AI in their course work. CTL provides guidance and some

adaptable template syllabus statements for use of GenAI in this web resource on Establishing Course Policies. Articulate your policy here.]

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

[Students need to know what your policy is on things like late assignments and missed exams. You should be as clear as possible about your rules and the consequences for your students if they do not follow them. You want to help students focus their efforts appropriately and make it easy for you to be consistent throughout the course. Note also that, at Georgia Tech, some exceptions are made for "approved Institute activities" (e.g., field trips and athletic events) and religious observances. Read more about approved exceptions. Note also that instructors are encouraged to consider the impact of events like the All-Majors Career Fair and off-campus interviews, and to plan accordingly.]

Inclement Weather and Digital Learning Days

[If a weather-related event affects campus operations, instructors have the discretion to cancel class or pivot to digital instruction. Informed by departmental and/or program considerations, you may choose to include language here that proactively instructs students what they should expect in such an event. Read more about the policy regarding the requirements, procedures, and responsibilities related to Digital Learning Days for Modified Campus Operations. Explore the Digital Learning Day Toolkit to learn more about guidance and tools that will make pivoting to digital learning easier.]

Student Use of Mobile Devices in the Classroom

[To set this policy, think about individual students, the overall dynamic you would like to see at work in your classroom, and your own tolerance of distractions in the classroom. See our Course Policies page for more information about factors to consider when it comes to setting your policy for the use of mobile devices in your classroom.]

Additional Course Policies

[There are a variety of additional policies you might include in your in your syllabus, depending on your specific context and approach to your course. For example, many instructors include at least one of the following policies explicitly on their syllabus (View additional course policy examples):

- *Remote proctoring*
- *Accommodations for religious observances*
- *Food and drink in the classroom*
- *Freedom of expression and guidelines for discussion*

- *Institute-approved absences*
- *Lab safety*
- *Preparation for guest speakers*
- *Re-grading and re-submission*
- *Recording class activities]*

Campus Resources for Students

[Students might not be aware of all available campus resources. In this section you can include specific resources that might help students succeed in your class (e.g., the library, The Communication Center, or Tutoring and Academic Services).

Undergraduate Student Academic Success Resources:

[For undergraduate courses, a sample statement that might be included in your syllabus for this section is "A list of resources for undergraduate students' academic success and information about advising can be found at Success at Tech.]

- Academic Support: Academic Success and Advising (a unit in the Office of Undergraduate Education & Student Success) provides free support for your courses. Students can attend scheduled supplemental review (PLUS) sessions, stop by Drop-In Tutoring, or schedule a one-on-one appointment through Knack. To explore what options work best for you, please visit us online at success.gatech.edu/tutoring, email us at tutoring@gatech.edu, or come see us at Clough Undergraduate Learning Commons, Suite 283.

Graduate Student Academic and Professional Success Resources:

[*For graduate courses, a sample statement that might be included in your syllabus for this section is*

A list of resources for graduate students is given on the Office of Graduate and Postdoctoral Education website. Specific information for current graduate students includes

- Academic Resources such as the Communications Center, Language Institute, Library, Catalog, Registrar, resources for conducting research, Advocacy and Conflict Resolution resources, and how to manage unexpected situations that may impact your academic performance;
- Student Resources such as Campus Services, Child Care/Family programs, Health & Wellness, Career Services, and the Student Resource Guide; and

- *Professional Development such as the programming from the Career Center and other professional development resources and events"*

Student Well-Being:

[Some faculty include resources that support students' mental and emotional well-being. Including these additional resources on your syllabus communicates to students that you care about them and that you are committed to facilitating their academic progress. For all courses, a sample statement that might be included in your syllabus is

At Georgia Tech, we are concerned about your overall physical, social, and mental well-being. A comprehensive list of wellness related resources has been compiled and maintained by the Office of the Vice President for Student Engagement and Well-being (student-resource-guide (gatech.edu)

[More resources on supporting student well-being on the syllabus and beyond are available through the Learning Well Initiative.]

Additional Syllabus Components [remove this heading from your final syllabus]

[Depending on your specific context, as well as your own approach to your course and your teaching, you might decide to add other components to your syllabus. Research suggests that a more detailed syllabus is seen by students as a sign of teaching effectiveness, instructor approachability and flexibility, and as a motivating factor in class preparation. Additional information on your syllabus might include:

- *a statement of your teaching philosophy;*
- *Consider linking to the strategic plan and emphasizing the intention to create a holistic learning environment where all individuals can grow and learn to lead healthy, purposeful, impactful lives;*
- *a statement about the importance of student mental health and well-being.*
- *rationale for your teaching techniques;*
- *grading rubrics;*
- *information about labs, recitations, etc.;*
- *advice on how to succeed in your course.]*