**CVEN 4464 - Environmental Engineering Processes**

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GOALS: To understand a) reactor design and analysis for engineering treatment systems and natural systems, and b) modelling of above systems.

PREREQUISITES: Fundamentals of Env. Engr and Fluid Mechanics (or equivalent)

TEXT: Water Quality Engineering : Physical/ Chemical Treatment Processes (Ch 1 – 5)

Mark M. Benjamin and Desmond F. Lawler

Wiley Custom Publishing

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Additional handouts from other sources. All handouts will be posted.

WEBSITE: D2L. Check regularly.

**COURSE GRADING**

Summary:

|  |  |  |
| --- | --- | --- |
| Assignment | 4464 (%) | 5464 (%) |
| Homework | 30 | 20 |
| In Class Exercises | 20 | 15 |
| Midterms (2 exams) | 20 | 20 |
| Project | 10 | 20 |
| Cumulative Final Exam | 20 | 25 |

Course letter grades will be assigned on the basis of this scale:

A: complete or near-complete mastery of the course material, completion of all assignments, and consistent participation in class

B: thorough understanding of the course material, completion of all assignments, and consistent participation in class

C: insufficient understanding of the course material, one or two incomplete assignments, or lack of participation in class

D: poor understanding of the course material, three or four incomplete assignments, or lack of participation in class

F: no understanding of the course material, five or more incomplete assignments, or frequent (unexcused) absence from class

**Remember: Instructors don’t give grades, students earn grades**. If you earn an A, you will get an A; however, if you earn a failing grade, you will get a failing grade. **DO NOT COUNT ON A CURVE,** I don’t expect to use one.

**Homework**: Homework assignments and due dates are listed on the schedule. **Homework is due in class or in the TA’s mailbox on the 4th floor by 10:00 AM of the due day.** The lowest homework grade will be dropped. Late homework will be penalized by 25% for each day late, including weekends. Coordinate submittal of late homework with the TA, **do not put it somewhere and expect us to find it.** More specific homework requirements are listed on a separate page titled “Homework Requirements.”

**In-class Exercises.** Throughout the semester we will occasionally work a progression of problems together in small teams in the classroom. The results of the exercise will be graded.

**Exams:** The exams will be held during class time. You may **NOT** use your cell phone as your calculator. Absences will only be excused with acceptable documentation (prior approval from the **Instructor**, doctor’s note, police report, etc.). The final exam will be comprehensive.

**Projects:**

CVEN4464: Teams of 4 to 5 students will make a proposal for an experimental design to collect data in order to solve some environmental problem. The written report will be ~5 pages. The team will submit both draft and final versions. More details will be provided in the assignment.

CVEN5464: The project will be working with the City of Boulder’s engineering staff at the 75th Ave. Wastewater Treatment Plant. The project will consist of planning, executing, and analyzing a tracer study on their solids contact basins. A plant tour outside of normal class hours is also required.

**TENTATIVE SCHEDULE** (Check D2L for Updates)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Wk** | **Date** | **Topic** | **Reading** | **HW Assn.** | **HW Due** |
| 1 | 8/25 | Introduction | Syllabus |  |  |
| 8/27 | Advection, Diffusion & Dispersion | pg 3-7 | HW1: 1.1-6 |  |
| 8/29 | Mass Balances | pg 7-18 |  |  |
| 2 | 9/1 | LABOR DAY – NO CLASS |  |  |  |
| 9/3 | Mass Balances | Pg 18-20, 25-26 |  |  |
| 9/5 | F1 – Mass Balances |  |  |  |
| 3 | 9/8 | RTDs | Pg 29-37 | HW2: 2-2,7 |  |
| 9/10 | RTDs | Pg 37-42 |  |  |
| 9/12 | Ideal RTDs | Pg 42-48 |  | HW1 |
| 4 | 9/15 | PFR with dispersion | Pg 48-55 |  |  |
| 9/17 | CFSTRs-in-series | Pg 55-57 |  |  |
| 9/19 | F2 – RTDs |  |  |  |
| 5 | 9/22 | Segregated Flow Model, Indices | Pg 57-62 | Project |  |
| 9/24 | Interpreting Reactor Behavior | Levenspiel |  |  |
| 9/26 | Equilization | Pg 63-71 | HW3 | HW2 |
| 6 | 9/29 | Estimating Dispersion | Handout |  |  |
| 10/1 | Design of Reactors for Low Disp. | Handout |  |  |
| 10/3 | F3 – Review |  |  |  |
| 7 | 10/6 | **Midterm 1 – Through CH2** |  |  |  |
| 10/8 | Reaction Kinetics | Pg 81-88 |  |  |
| 10/10 | Reaction Kinetics | Pg 88-99 | HW4 |  |
| 8 | 10/13 | Reaction Kinetics | Pg 107-116 |  | HW3 |
| 10/15 | Reaction Kinetics | Pg 114-116 |  |  |
| 10/17 | F4 – Kinetics |  |  |  |
| 9 | 10/20 | CFSTR with Reaction | Pg 121-123 | HW5: CH4 |  |
| 10/22 | PFR with Reaction + comparison | Pg 123-130 |  |  |
| 10/24 | CFSTRs in Series + Reaction | Pg 130-135 |  | HW4 |
| 10 | 10/27 | PFRs with dispersion & Reaction | Pg 135-141 |  |  |
| 10/29 | Non steady-state Performance | Pg 141-147 |  |  |
| 10/31 | F5 – Reactors w/Reactions |  |  | DFT PRJ |
| 11 | 11/3 | Diffusive Mass Transfer | Handout | HW6 |  |
| 11/5 | Estimating Diffusion Coefs |  |  |  |
| 11/7 | F6 – Review |  |  | HW5 |
| 12 | 11/10 | **Midterm 2 – Thru CH4** |  | HW7 |  |
| 11/12 | Intraphase Mass Transfer |  |  | HW6 |
| 11/14 | Interphase Mass Transfer |  |  |  |
| 13 | 11/17 | Gas Transfer | Chapter 5 |  |  |
| 11/19 | Gas Transfer |  |  |  |
| 11/21 | Gas Transfer |  |  | HW7, PRJ |
|  |  | Fall Break |  |  |  |
| 14 | 12/1 | MT Applications (PTA) |  | HW8: GT |  |
| 12/3 | MT Applications (Mem), **FCQs** |  |  |  |
| 12/5 | MT Applications (Ads, IX) |  |  |  |
| 15 | 12/8 | Particles |  |  | HW8 |
| 12/10 | Particles |  |  |  |
| 12/12 | F7 – Review |  |  |  |
|  | 12/18 | Cumulative Final Exam (10:30-1:00 FLMG 157) | | | |

**COURSE POLICIES**

1. This course contains a combination of concepts and quantitative relationships. Your success in this class is entirely up to you. Ways to succeed:

* Come to class, pay attention, take notes (if I write it on the board, I expect it to be in your notes). On flip days, participate in your group and ask questions of your group if you don’t understand something.
* Read the text. This textbook is excellent, but the material is dense. You will likely have to read it multiple times. I recommend reading the chapters before we talk about each subject in class, paying particular attention to the overall concepts and any new vocabulary. Review sections as necessary to help get you through the homeworks. Then read the chapter in its entirety before the exams as studying – this is when it will likely all fall into place for you. This is a lot I realize, and in most courses you probably got away with ever reading the text. The secret to success here is no secret, the stratification of grades in this class will come from those willing to put in the effort versus those that don’t.
* Demonstrate sustained effort on homework – consult notes, text, example problems, discussion boards, and classmates when you don’t understand something.
* When that doesn’t work, come to office hours – they are included in your tuition, use them! It helps me to know what you are struggling with, particularly in preparation for the review sessions. This does; however, require you to start homework early. Also, I don’t see near enough students asking about past assignments that they did poorly on.

1. If you must miss a homework deadline or exam due to a medical or family emergency, written documentation of the emergency must be provided. This policy is meant to ensure fairness to other students.
2. Any issues you have with homework or exam grades should be turned in to the **Instructor**, in writing, within one week of the date that the graded item is returned in class (whether or not you are in class that day). Attach a separate piece of paper to your assignment that clearly indicates the problem in question and include a written explanation of your issue. After one week, all grades are final.
3. Communication:

* To You: We will maintain a course webpage on D2L with course information and content. We will also use e-mail (to your @colorado.edu account) to relay time-sensitive information. You are expected to check both of these resources regularly.
* From You: Questions and clarifications about course related content should be posted in the appropriate Google Group forum, so that everyone can join in and benefit. If you would like to discuss personal issues (your success at CU, job/internship search strategy, resume review, etc.), send an email and we will schedule a time to meet outside office hours. All communication should be from your @colorado.edu email address, if you send me an email from another address, I will reply to your @colorado.edu address.

1. If you are enrolled in this course, this syllabus is our official written agreement of the course requirements, expectations, and policies. Read it thoroughly and reread it periodically to be sure you understand all of the policies. It should be your first source of information for the course policies. If there are any changes to the procedures in this syllabus, I will notify you in class and post the revised syllabus.

**HOMEWORK REQUIREMENTS**

Your homework should reflect a professional attitude; I expect your work to be comparable to the work of a new hire at a consulting engineering firm. You get out of the homework what you put into the homework.

All homework must be **neat** and **legible** or it will not be graded.

Use only **one** side of the paper. You can use recycled paper.

**Show your work/calculations** or no partial credit will be given.

* show an example calculation if repeated calculations are made
* Correct numeric answers with no work to support the answer will receive no credit (imagine your boss asking to check your design calculations and you not being able to provide any)
* **show the formula and example calculation if spread sheets are used**

**Units** are required for all final answers and strongly suggested for intermediate calculations (you will get more partial credit because it is easier to identify a mistake).

Carefully **check your calculations**. In practice, it is not acceptable to make many calculation errors, and with homework, you have the time to check yourself. Calculation errors will be graded harshly on homework (some leniency will be made on exams because there is a significant time constraint). Also, review your answers for reasonableness (for instance if you calculation of the length of a basin is 10 miles, you know it is probably not correct).

**Underline** or **box-in** all final answers.

List all assumptions not already stated in the problem.

Leave space between problems (two or three lines).

Significant figures are important.

* Use only **three significant figures** (e.g., 3.23, 0.0323, 32,300 or 3.23x106) in the final answer unless the problem dictates more.

**Staple** all sheets together.

Repeated violations of the above requirements listed in **bold** will result in point deductions.

I encourage you to work in groups. It is more efficient and a better learning experience. However, don’t just copy the work of other’s as you will struggle on the exams.

**CU BOULDER POLICIES**

If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at [dsinfo@colorado.edu](mailto:dsinfo@colorado.edu). If you have a temporary medical condition or injury, see Temporary Medical Conditions: Injuries, Surgeries, and Illnesses guidelines under Quick Links at Disability Services website and discuss your needs with your professor.  
  
**Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, notify the Instructor at least two weeks prior to the conflict so we can make alternate arrangements, if necessary.** See full details at [http://www.colorado.edu/policies/fac\_relig.html](http://www.alumniconnections.com/links/link.cgi?l=5898386&h=137833&e=UCBI-20140814145349)   
  
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[http://www.colorado.edu/policies/classbehavior.html](http://www.alumniconnections.com/links/link.cgi?l=5898389&h=137833&e=UCBI-20140814145349) and at  
[http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student\_code](http://www.alumniconnections.com/links/link.cgi?l=5898390&h=137833&e=UCBI-20140814145349)  
  
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