ENV E 325 Chemical and Physical Processes

Winter 2025 - January 06,2025 to April 09,2025

Class time: Tuesday, Thursday 11:00-12:20 Location: ETLC E1-008

Instructor:

Mohamed Gamal El-Din, PhD, P.Eng
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7-285 Donadeo Innovation Centre for Engineering
Office Hours: Tuesdays, from 10:00 am to 10:45 am and from 12:30 pm to 2:30 pm (by appointment)

Course Description:

*3.8 (fi) (either term, 3-0-3/2) Theory of chemical and physical processes and their application in environmental engineering.

Prerequisites: ENV E 220. Corequisites: CIV E 290 or STAT 235, CIV E 295, CIV E 330. Credit cannot be obtained for both ENV E 222 and ENV E 325

Course synchronous and asynchronous content delivery schedule:

TA Information:

- Bouthaina Aoudi (aoudi@ualberta.ca)
- Hadi Mokarizadeh (mokariza@ualberta.ca)
- Md Rashid Al Mamun (mdrashi1@ualberta.ca)

TAs' Office Hours:
- Mondays from 10 am to 12 pm (NREF 2-022 for questions related to the lectures)
- Fridays from 2:00 pm to 4:00 pm (NREF 2-022; for questions related

Lab Sections:

Section	Day	Time	Location
LAB H11	Monday	14:00 - 16:50	NREF 2-010
LAB H12	Monday	14:00 - 16:50	NREF 2-010

Course Objectives & General Content:

An introduction to the theory and application of the concepts and fundamentals of physical and chemical treatment processes used in the practice of Environmental Engineering. Biological processes are introduced in a separate course. Although the applications will be mainly in the drinking water and municipal wastewater treatment area, the concepts are applicable to many other areas of Environmental Engineering.

You will learn how to apply basic theory to solve simple design problems. You will also be introduced to approaches, unit operations and processes as well as equipment used in water and wastewater treatment practice and to concepts of process and facility design. These fundamental skills will be applied in the Facility Design course.

Through the laboratory component of the course, you will be exposed to the concept of using physical experiments to derive crucial design information. You will also continue to practice and develop your technical writing skills through preparation of laboratory reports

Learning Outcomes:

By the end of this course, students should be able to:

1. Understand the concepts and principles of important physical and chemical processes in environmental engineering, such as coagulation and flocculation, sedimentation, filtration, and disinfection.
2. Know what major physical and chemical treatment processes will be needed in typical water and wastewater treatment plants.
3. Use mass balance to analyze a plug flow or complete mix flow reactor with first order reaction.
4. Calculate the volume of sedimentation basin, as an important preliminary design parameter, in typical water and wastewater treatment.
5. Calculate the volume or surface area needed, as an important preliminary design parameter, in typical drinking water filtration.
6. Determine the dosage needed for disinfection of drinking water.

Marking Scheme:

This course is a Credit (CR) or Fail (F) course. Requirements for a student to earn credit:

Assignments: 10 %
Laboratory: 20 %
Mid-term: 20 % (February 13, 2025 at 11:00 am - 12:20 pm)
Final Exam: 50 % (April 24,2025 at 8:30 am - 10:30 am)
Total: 100%

Additional Notes

• Assignments will be deposited in the assignment box at 4:30 pm on the due date. Late assignments and laboratory reports will penalized at the rate of 20% of the total assignment or laboratory mark per weekday.
• Laboratory reports are to be handed in to the assignment box laboratory. If that Monday is a holiday, then the due date will be the Tuesday immediately after that Monday.
Late reports will be penalized 20% per day.

Calculator Policy

Only approved non-programmable calculators are permitted in examinations. Any calculator taken into an examination must have a sticker identifying it as an acceptable non-programmable calculator (gold sticker). Students can purchase calculators at the University Bookstore with the stickers already affixed. Calculators purchased elsewhere can be brought to the Student Services where the appropriate sticker will be affixed to

the calculator.

Text and References (Recommended):

Metcalf & Eddy, Inc. 2013. Wastewater Engineering: Treatment and Resource Recovery, Fifth Edition. G.Tchobanoglous, H. Stensel, R. Tsuchihashi, and F. Burton (eds.). McGraw-Hill Inc., New York, (ISBN 978-0-07-340118-8).

Website:

eClass

Previous Examples of Evaluative Materials:

Course information and syllabus, lecture handouts, lecture notes, assignments, example spreadsheets, etc. will be available on eClass.

Guideline questions for midterm and final exam preparation, as evaluative course materials, will be provided to all students prior to each exam and a review session will follow.

Did you know that the University of Alberta has various low-to-no-cost services to help students succeed? Visit http://www.deanofstudents.ualberta.ca/ for information about the academic, wellness, and various other support services available to U of A students. It's never too early or too late to seek help!

ENV E 325 - CHEMICAL AND PHYSICAL PROCESSES

LECTURE SCHEDULE

Topics	Text Chapter Metcalf & Eddy Chapter* and Handouts
Course Syllabus	Handout
Introduction to Water and Wastewater Treatment	Handout
Topic 1: Chemical Kinetics and Reactor Theory	Chapter 4 and Handout
Topic 2: Water and Wastewater Quantities and Quality	Chapter 2, Chapter 3 and Handout
Topic 3: Water and Wastewater Treatment Processes	Handout
Topic 4: Coagulation and Flocculation	Chapter 6 and Handout
Topic 5: Sedimentation	Chapter 5 and Handout
Topic 6: Filtration	Chapter 11 and Handout
Topic 7: Gas Transfer	Chapter 5 and Handout
Topic 8: Adsorption	Chapter 11 and Handout
Topic 9: Ion Exchange	Chapter 11 and Handout
Topic 10: Disinfection	Chapter 12 and Handout
Topic 11: Membranes	Chapter 11 and handout
Mid-Term Exam	**Thursday, February 13, 2024; from 11:00 am to 12:20 pm; Location: ETLC E1-008**
Final Exam	**Thursday, April 24, 2024; 8:30 pm to 10:30 pm; Location: TBD**

*Metcalf & Eddy, 2003

ENV E 325 - CHEMICAL AND PHYSICAL PROCESSES

LABORATORY REPORT MARKING SHEET

Item	Total
Cover Page • Course number (**0.5**), lab number (**0.5**), lab title (**0.5**), student names and IDs (**0.5**)	**2**
Introduction • Provide a brief description of what the report addresses and background (**2**) • Describe the objectives of the experiment (**2**)	**4**
Methodology • Provide a brief description of the methods used (refer to the standard methods or to the lab handout for the details) (**2**) • Describe any important changes in the written procedure (**1**)	**3**
Results • Present reduced data (i.e., not raw data) in tables or figures (**3**) • Explanatory text describing the results (**2**)	**5**
Discussion • Explain and comment on the results (**2**) • Explain the significance of the results and any deviations from expected values (**2**) • Discuss potential sources of error that might explain any deviations you observed (**2**) • Provide answers to discussion questions (**2**)	**8**
Conclusions • Provide a brief statement of main conclusions (significant findings) (**3**)	**3**
References • Listing of the citations referred to in the body of the report (**1.5**) • Format of references (**1.5**)	**3**
Appendices • Raw data, sample calculations, lab handout, etc. (**1**) • Appendices should be referred to in the body of the text (**1**)	**2**
Overall Quality • Neatness (**2**), organization (**2**), formatting (**2**), spelling (**2**), and grammar (**2**)	**10**
TOTAL	**40**

ENV E 325 - CHEMICAL AND PHYSICAL PROCESSES

LABORATORY NOTEBOOK MARKING SHEET

Item	Total
• **Table of contents** on the first few pages	**5**
• **Each page** must be **numbered** and **dated**	**5**
• Use **pen** to record data and notes, and **do not erase erroneous entries**, simply cross them out	**5**
• Even though lab exercises may be performed in groups, **each student must record all measurements** required for the exercise	**5**
• At the end of each lab, each student must have his or her **lab book checked by the lab instructor, lab technician or the TA**	**5**
• **Overall Quality**: completeness and organization	**15**
TOTAL	**40**

LAB REPORTS:

- Each team (made of four students) will prepare and submit a laboratory report for each of the laboratories (excluding the field trip). The students may work as larger groups in the laboratory and may share data sets. However, **reports must be submitted by teams of Four**.
- **Laboratory reports are to be submitted online before 11:59 pm one week after the laboratory**. If that Monday is a holiday, then the due date will be the Tuesday immediately after that Monday.
- Late lab reports will be **penalized 20% per day**.
- Lab reports must be typed or produced on a word processor.
- There is no minimum or maximum length for the laboratory reports, but a typical report should be about 2 to 4 pages (not including the cover page), depending upon the number of tables or graphs. *Quality should be emphasized over quantity.* A good report is complete and concise. The report should be 1.5-line spacing, on paper 8.5 × 11 in. with 1-in. (2.5 cm) margins. Typing should be on one side of the page only.

MAINTAINING A LABORATORY BOOK:

- Good record keeping is essential to professional laboratory practice and research and even in this age of computers, the laboratory notebook is the primary method of recording information. In fact, the laboratory notebook becomes a legal document that may be called upon in legal proceedings. The students will practice the art of good record keeping by maintaining a laboratory notebook.
- Each student must obtain a hard covered record book to record all data and notes collected during the laboratory session.
- The lab book must have a **table of contents** on the first few pages and **each page** must be **numbered** and **dated**.
- Use **pen** to record data and notes, and **do not erase erroneous entries**, simply cross them out.
- Even though lab exercises may be performed in groups, **each student must record all measurements** required for the exercise.
- At the end of each lab, each student must have his or her lab book checked by the lab instructor, lab technician or the TA. A grade will be assigned to the lab book at the end of the course.

SAFETY:

- You will be working with and near dangerous chemicals and biohazards.
- Safety glasses and gloves will be provided and must be worn.
- Lab coats are **mandatory**. You should bring your own lab coat.
- Use of contact lenses is not allowed.
- Food or drinks are not allowed in the laboratory.
- Open toe shoes or sandals are not permitted in the laboratory.

ENV E 325 - CHEMICAL AND PHYSICAL PROCESSES

ADDITIONAL COURSE REFERENCES

1. Reynolds, T. and Richards, P. 1996. *Unit Operations and Processes in Environmental Engineering*, Second Edition. PWS Publishing Company, Boston, MA (ISBN 0-534-94884-7)
2. MWH. 2005. *Water Treatment Principles and Design*, Second Edition. Crittenden, J.C., Trussell, R.R., Hand, D.W., Howe, K.J., Tchobanoglous, G. (eds.). John Wiley & Son Inc., Hoboken, New Jersey, 1948 p. (ISBN 0-471-11018-3) [electronic resource].
3. Water Environment Federation (WEF). 2005. *Upgrading and Retrofitting Water and Wastewater Treatment Plants*. Manual of Practice No. 28, WEF Press, McGraw-Hill, New York, NY , 230 p. (ISBN 0-07-145303-2) [electronic resource].
4. Water Environment Federation (WEF). 2008. *Industrial Wastewater Management, Treatment and Disposal*, Third Edition. Manual of Practice No. FD-3. WEF Press, McGraw-Hill, New York, NY. 568 p. (ISBN 978-0-07-159238-3) [electronic resource].
5. Water Environment Federation (WEF). 2010. *Design of Municipal Wastewater Treatment Plants*, Fifth Edition. WEF Manual of Practice No 8, ASCE Manual and Report on Engineering Practice No 76, American Society of Civil Engineering, VA, USA (ISBN 9780071663588) [electronic resource].
6. Masters, G.M., Ela, W.P. 2008. *Introduction to Environmental Engineering and Science*, Third Edition. Pearson Prentice Hall, New York, NY, 708 p. (ISBN: 0-13-601837-8).
7. Nazaroff, W.W., Alvarez-Cohen, L. 2001. *Environmental Engineering Science*. John Wiley & Son, Inc., New York, NY, 690 p. (ISBN: 0-471-14494-0).
8. Weber, W.J. 2001. *Environmental Systems and Processes, Principles, Modeling and Design*. Wiley-Interscience, John Wiley & Sons, New York, NY, 556 p. (ISBN 0-471-40518-3).
9. Droste, R.L. 1997. *Theory and Practice of Water and Wastewater Treatment*. John Wiley & Son, Inc., New York, NY, 800 p. (ISBN 0-471-12444-3).
10. Mihelcic, J.R., Zimmerman, J.B. 2010. *Environmental Engineering, Fundamentals, Sustainability, Design*. John Wiley & Son Inc., New York, NY, 695 p. (ISBN-13 978-0-470-16505-8).
11. Viessman, W. Jr. and M.J. Hammer. 2009. *Water Supply and Pollution Control*, Eighth Edition. Pearson Prentice Hall, New York, NY, 843 p. (ISBN 9780132337175).
12. Snoeyink, V.L., Jenkins, D. 1980. *Water Chemistry*. John Wiley & Son. Inc., New York, NY, 463 p. (ISBN 0-471-05196-9).
13. Stumm, W., Morgan, J.J. 1996. *Aquatic Chemistry*. Chemical Equilibria and Rates in Natural Waters, Third Edition. A Wiley-Interscience Publication, John Wiley & Sons, Inc., New York, NY, 1022 p. (ISBN 0-471-51184-6).
14. Alberta Environmental Protection. 2012. *Standards and Guidelines for Municipal Water Works, Wastewater and Storm Drainage Systems*. Alberta Environment and Parks, Government of Alberta (can be downloaded from: https://open.alberta.ca/publications/5668185).
15. Health Canada. 2022. *Guidelines for Canadian Drinking Water Quality – Summary Table*. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario (can be downloaded from https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html)

University and faculty policies

Respect and professionalism

The Faculty of Engineering is committed to fostering and protecting an equitable, inclusive, and respectful work and study environment in line with University of Alberta policies and professional engineering industry standards.

The faculty prepares students to uphold industry standards to become a Professional Engineer (P.Eng). Therefore, respect, professionalism, and accountability must be upheld within the Faculty of Engineering and the University of Alberta.

Academic integrity and student conduct

The University of Alberta is committed to the highest standards of academic integrity and honesty, as well as maintaining a learning environment that fosters the safety, security, and the inherent dignity of each member of the community, ensuring students conduct themselves accordingly. Students are expected to be familiar with the standards of academic honesty and appropriate student conduct, and to uphold the policies of the University in this respect.

Students are particularly urged to familiarize themselves with the provisions of the Student Academic Integrity Policy and the Student Conduct Policy, and avoid any behaviour that could

potentially result in suspicions of academic misconduct (e.g., cheating, plagiarism, misrepresentation of facts, participation in an offence) and non-academic misconduct (e.g., discrimination, harassment, physical assault). Academic and non-academic misconduct are taken very seriously and can result in suspension or expulsion from the University.

All students are expected to consult the Academic Integrity website for clarification on the various academic offences. All forms of academic dishonesty are unacceptable at the University. Unfamiliarity of the rules, procrastination or personal pressures are not acceptable excuses for committing an offence. Listen to your instructor, be a good person, ask for help when you need it, and do your own work -- this will lead you toward a path to success. Any academic integrity concern in this course will be reported to the College of Natural and Applied Sciences. Suspected cases of non-academic misconduct will be reported to the Dean of Students. The College, the Faculty, and the Dean of Students are committed to student rights and responsibilities, and adhere to due process and administrative fairness, as outlined in the Student Academic Integrity Policy and the Student Conduct Policy. Please refer to the policy websites for details on inappropriate behaviours and possible sanctions.

The College of Natural and Applied Sciences (CNAS) has created an Academic Integrity for CNAS Students eClass site. Students can self-enroll and review the various resources provided, including the importance of academic integrity, examples of academic misconduct & possible sanctions, and the academic misconduct & appeal process. Students can also complete assessments to test their knowledge and earn a completion certificate.

"Integrity is doing the right thing, even when no one is watching." -- C.S. Lewis

The Faculty of Engineering expects an environment free of harassment, discrimination, and bullying. We encourage you to talk to the Office of Safe Disclosure and Human Rights about experiences, questions, or concerns. Additional resources and support for students are attached below.

Engineering students studying in the province of Alberta must also follow the Code of Ethics set by the Association of Professional Engineers and Geoscientists of Alberta (APEGA).

Course outline policies, course requirements, evaluation and grading information can be found in the University Calendar.

Safety during learning activities

In all Faculty of Engineering courses, labs, seminars or other learning activities, safety is of paramount importance. In some cases, laboratory work in a program requires high standards for risk management to keep potential hazards safely under control.

Anyone found to be unable to function safely in the class, lab, seminar or other learning activity may be asked to leave or be removed for their and the safety of other participants and instructors in alignment with the Student Academic Integrity Policy and Student Conduct Policy. As members, or prospective members, of the engineering profession, it is your responsibility to identify and inform the proper authorities of unsafe work.

Audio and video recording

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan.

Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

Only those items specifically authorized by the instructor may be brought into the exam facility. Students must not bring any unauthorized electronic device into an examination room, including cell phones or other devices.

Student services and support

Health & Wellness Support

Counselling and Clinical Services

Free, short-term, appointment-based counselling and psychiatric services. Also offers drop-in workshops. Book an initial consultation. Visit uab.ca/CCS to learn more.

Wellness Supports Social Workers

Free one-on-one support for students in the areas of housing, finances, academics, personal wellness, life skill development, family dynamics, system navigation, and any area of life where there is a desire to invite change. Visit uab.ca/wellness to learn more.

Sexual Assault Centre

Free, anonymous, and confidential drop-in counselling. Visit uab.ca/UASAC to learn more.

The Office of Safe Disclosure & Human Rights (OSDHR)

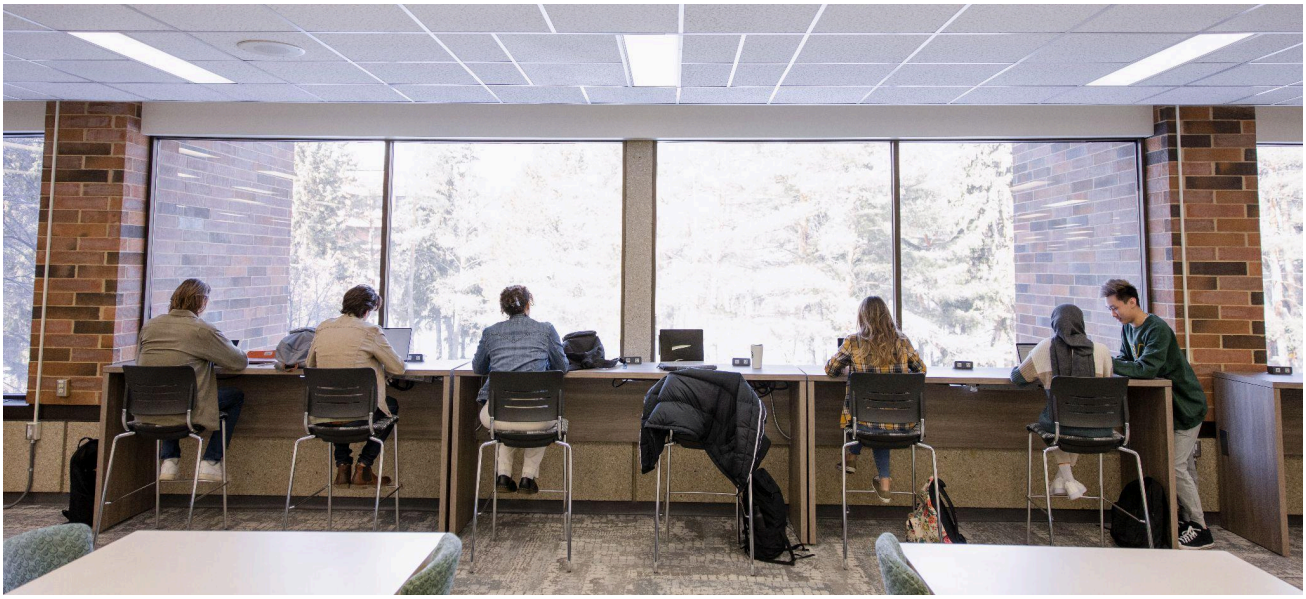
The OSDHR advises confidentially on sensitive issues you may not feel comfortable solving on your own. Contact the OSDHR if you want to get help or to make a report while keeping your privacy. Visit uab.ca/OSDHR to learn more.

HIAR (Helping Individuals at Risk)

If you're worried about someone, contact HIAR, who can help assess risk and connect individuals to support. Learn more at uab.ca/HIAR.

Immediate External Supports

Health Link Alberta: 811
Suicide Crisis Helpline: 988



Academic support

Academic Success Centre
Access to a variety of services to maximize your academic success. Learn more at uab.ca/ASC.

Accessibility Resources
Connects students with disabilities to accommodations. Learn more at uab.ca/Access under accommodations + accessibility.

Decima Robinson Support Centre
Academic support for 100- or 200-level introductory calculus, linear algebra and statistics courses. Visit uab.ca/DSC to learn more.

Engineering Student Success Centre
The Faculty of Engineering provides drop-in tutoring for first-year courses. Visit uab.ca/ESSC to learn more.

Office of the Student Ombuds
Call for complex problems and conflict mediation. Learn more at uab.ca/ombuds.

Financial support

Student Service Centre

For awards and other funding support. Learn more at uab.ca/ask.

Campus Food Bank

The Campus Food Bank Society is an independent charity supporting University of Alberta students, faculty, staff, and alumni for up to five years. For additional information visit their website at campusfoodbank.com.