Department of Chemical Engineering

ChE 490 CHEMICAL ENGINEERING LABORATORY 4 (Fall, 2022)

COURSE DESCRIPTION AND OBJECTIVES

ChE 490 Chemical Engineering Laboratory 4 involves the experimental investigation of chemical engineering unit operations through traditional laboratories and open-ended project laboratories, focusing on solving practical chemical engineering experimental, design, and simulation problems through the integration of fundamental unit operation concepts and pilot-scale lab experiments. The primary objectives of this course are (1) to reinforce the understanding and applications of chemical engineering theories to the performance of authentic unit operation processes through hands-on experience, and (2) to integrate the unit operation theories and experimental observation into practical chemical engineering design and simulation. Some other additional objectives can be found in the learning outcomes of the projected-based laboratory on Page 12 of the lab manual.

LABORATORY INSTRUCTOR

Name	Office & email	Office Hour and Labs
John Zhang	DWE 2530B, x35815 *m78zhang@uwaterloo.ca*	Email any time for questions for all the labs, and email for appointment or Teams meeting on weekdays.
Cheryl Newton	DWE 2530A, x35809 *cheryl.newton@uwaterloo.ca*	Emails or messages on Teams on weekdays, 8am~4pm, for Labs E1, E2, E5, A2, A3, C2

TEACHING ASSISTANTS

Name	Lab assignment	Office Hour	Email
Abhishek Mishra	E6, B3, C3	Appointment by email	*abhishek.mishra@uwaterloo.ca*
Tola Titcombe	E1, E2, C2	Appointment by email	*aatitcombe@uwaterloo.ca*
Huiyi Yang	E5, A2, A3	Appointment by email	*h427yang@uwaterloo.ca*
Fred Rezazadeh	E3, B1, B2	Appointment by email	*fred.rezazadeh@uwaterloo.ca*
Yue (Carol) Yu	E4, A1, C1	Appointment by email	*y284yu@uwaterloo.ca*

LAB COURSE MANUAL AND REFERENCES

1. Zhang, M., and Newton, C., ChE 490 Chemical Engineering Laboratory 4, Fall 2022, available on LEARN.

2. Green, D. W. and Southard, M. Z., "Perry's Chemical Engineers' Handbook", 9th ed., McGraw-Hill, 2019, electronic version is available at: ***https://www-accessengineeringlibrarycom.proxy.lib.uwaterloo.ca/content/book/9780071834087***
3. Sinnott, R. K., "Coulson and Richardson's Chemical Engineering Volume 6 - Chemical Engineering Design", 4th ed., Elsevier, 2005. Electronic version of the book is available on Knovel site at: ***https://subjectguides.uwaterloo.ca/c.php?g=695419&p=4931331***
4. Coker, A. K., "Ludwig's Applied Process Design for Chemical and Petrochemical Plants", Chapter13, Volume 2, 4th ed., Elsevier, 2010. Electronic version of the book is available at: ***http://www.accessengineeringlibrary.com/subject/chemical_engineering***
5. References specific to individual experiments are available in the lab manual.

COURSE CONTENTS

- The laboratory course consists of one regular lab experiment and two project-based labs as a lab series (see Page 4).
- All the available lab series in the lab course formed based on (1) overall equivalent workload and difficulty level with all the lab series and (2) full coverage of the three unit operation areas: Chemical Reaction Engineering, Separation Processes, and Mass and Heat Transfers.
- Each lab group will select one of the lab series in the course, and will start the term with the regular lab and then proceed with two project-based labs.
- Lab handouts for all the regular labs are available in the lab manual. The prelude and theoretical details of the handouts are intended to set a foundation for the development of project-based labs for which only a project statement is provided.

LAB GROUPS AND SCHEDULES

- You form your own lab group of 4 with anyone in your lab section or stream, and your labs will be scheduled on your lab day if the overall schedule permits. Alternative arrangements are possible on a case-by-case basis.
- Two weekly in-person lab sessions: 9:30 to 16:20 on Tuesdays and Thursdays.
- See Page 4 for a tentative lab schedule, and you can sign up your lab group and select your lab series at: ***https://docs.google.com/document/d/1MM_f8x-4vtoLjirTbLTlbZq5KWqel4lZ6j39nawlv84/edit?usp=sharing***

LAB ATTENDANCE, SAFETY, AND PERFORMACE

- Lab attendance is required of all students in each group. If there is a compelling reason you cannot make it to the schedule lab session, you must contact the instructor prior to the lab session so that alternative arrangement can be made.
- Lab attendance and performance will be counted as part of the lab grade.
- When attending in-person lab session, you must obey the general lab safety rules summarized in the lab manual (Pages 3~4) and any lab specific safety instructions, along with the Covid 19 safety protocols such as mask wearing if required. Lab safety is part of the lab attendance mark, and failing to obey all the lab safety rules and Covid 19 safety protocols can result in an expulsion from the in-person lab.

- As a deep understanding of lab equipment, process, and experimental observation is paramount for data analyses and design for the unit operation labs, active participation of all the lab activities through hands-on operation as well as active observation and interaction is strongly encouraged.
- Lab participation is also a perquisite for lab report.

LAB REPORTS

- Group full lab reports for the regular experiment and project-based labs (see detailed lab report requirements and marking scheme on Page 6 of the lab manual).
- The lab reports of regular experiments are due two weeks from the scheduled lab day by 11:59 pm. The prelab project proposals for the project-based labs are due on the schedule lab days and the final reports due two weeks after the lab days by 11:59 pm. All lab reports must be submitted electronically to the designated folders on LEARN.

ASSESSMENT AND GRADE DISTRIBUTION

- Overall grade distribution:
  - Regular lab: 20%
  - Project labs: 70% (each project 35%).
  - Presentation of the first project lab: 10%
  - 1% bonus mark for accessing/participating the course survey at the end of term.
- Grading scheme for the regular labs:
  - Lab quiz: 10%
  - In-lab submission (i.e. Experimental for lab report): 4%
  - Lab attendance and performance: 4%
  - Lab report: 82%
- See detailed grading scheme for project-based labs on Page 14 of the lab manual.

ACADEMIC INTEGRITY AND DISCIPLINE: UW POLICY # 71

- Inappropriate academic behaviors and misconducts such as **plagiarism, cheating, copying, excessive collaboration, and sharing** are strongly prohibited for this laboratory course, and can result in serious consequences of the academic offences. For detailed information, see Procedures Related to Academic Offences and UW Policy 71 at:
  https://uwaterloo.ca/engineering/procedures-related-academic-offences-and-policy-71
- Turnitin, a text-matching software tool, will be used for encouraging academic integrity and detecting downright plagiarism. Your lab submissions will be compared to a large pool of textual materials from, but not limited to, dropboxes in this course, open websites, ejournals etc. If you want to have an alternative to Turnitin, you will need to contact the course instructor in the first two weeks of the term.

ChE 490 Lab Experiments

Lab Code	Project-Based Lab Experiment	Lab Location
A1	PEM Fuel Cell Based Combined Heat-and-Power System for Residential Applications	DWE 1514
A2	Wastewater Treatment through Non-Ideal Flow Reactors	DWE 1514
A3	UV Wastewater Treatment through Advanced Oxidation Process	DWE 1519
B1	Pilot Distillation Operation, Simulation, and Design	DWE 1513
B2	Pilot Distillation Operation, Hydraulics, and Design	DWE 1513
B3	Liquid-Liquid Extraction Column Design for Bioethanol Production	DWE 1520
C1	CO_2 Absorption and Stripping in Pilot Packed Columns	DWE 1513
C2	Optimal Design of Double Pipe Heat Exchanger for Food Processing	DWE 1514
C3	Heat Transfer of Non-Newtonian Fluid in a Jacketed Batch Reactor	DWE 1519
	Regular Experiment	
E1	Double Pipe Heat Exchanger	DWE 1514
E2	Reverse Osmosis	DWE 1514
E3	Boiling Heat Transfer in a Thermosiphon Reboiler	DWE 1513
E4	Membrane Gas Separation	DWE 2526
E5	Unsteady State Operation and Simulation of CSTRs in Series	DWE 1513
E6	Batch and Semibatch Reactors for Exothermic Reaction	DWE 1519

ChE 490 Lab Series

Lab Series	Lab Experiment and Project		
S1	**E5**	**B2**	**C2**
S2	**E4**	**A3**	**C1**
S3	**E6**	**B1**	**C2**
S4	**E3**	**A1**	**B3**
S5	**E1**	**C1**	**A2**
S6	**E2**	**C3**	**A3**
S7	**E4**	**A3**	**C3**
S8	**E1**	**B1**	**A1**
S9	**E5**	**C1**	**B3**
S10	**E2**	**B3**	**A2**

ChE 490 Lab Schedule (Fall 2022)

Lab Group	Sept. 15, Thu	Sept. 20, Tue	Sept. 22, Thu	Sept. 27, Tue	Sept. 29, Thu	Oct. 4, Tue	Oct. 6, Thu	Oct. 11, Tue*	Oct. 13,Thu*	Oct. 18, Tue	Oct. 20, Thu	Oct. 25, Tue	Oct. 27, Thu	Nov. 1, Tue	Nov. 3, Thu	Nov. 8, Tue	Nov. 10, Thu	Nov. 15, Tue	Nov. 17, Thu	Nov. 22, Tue	Nov. 24, Thu	Lab Series
G1	E5										B2								C2			S1
G2				E5								C2								B2		S1
G3	E4										A3								C1			S2
G4		E4								A3								C1				S2
G5	E6										C2								B1			S3
G6				E6								B1								C2		S3
G7		E3								A1								B3				S4
G8			E3								B3								A1			S4
G9	E1										C1								A2			S5
G10		E1								C1								A2				S5
G11	E2										C3								A3			S6
G12		E2								C3								A3				S6
G13			E4										A3								C3	S7
G14				E4								C3								A3		S7
G15			E1										B1								A1	S8
G16				E1						B1								A1				S8
G17			E5								B3										C1	S9
G18		E5								B3										C1		S9
G19			E2										B3								A2	S10
G20				E2								A2								B3		S10
G21		E6								C2								B1				S3
G22	E3										A1								B3			S4
G23			E6										C2								B1	S3
G24				E3								B3								A1		S4
G25			E2										C3								A3	S6
G26		E4										A3								C3		S7
G27			E5										B2								C2	S1
G28		E6									B1							C2				S2
G29			E6								A2										B3	S10
G30																						

*Note: [1]. *Reading Week, Oct. 11 and Oct. 13.*
[2]. Afternoon lab session (13:30~16:30) with the regular labs for Groups 25~30 and may be on mixed lab schedule.

ChE 490 Laboratory Groups (Fall 2022)

Group No.	Group Members and Lab Option	Lab Series
G1		S1
G2		S1
G3		S2
G4		S2
G5		S3
G6		S3
G7		S4
G8		S4
G9		S5
G10		S5
G11		S6
G12		S6
G13		S7
G14		S7
G15		S8
G16		S8
G17		S9
G18		S9
G19		S10
G20		S10
G21		S3
G22		S4
G23		S3
G24		S4
G25		S6
G26		S7
G27		S1
G28		S2
G29		S10
G30		