AY24-1 Chemical Engineering Course and Program Brief

LTC Sam Cowart

LTC John Belanger

Dr. Simuck Yuk

MAJ Jeff Chin

MAJ Patrick Bowers

CPT Sam Lowell

Dr. Enoch Nagelli

Dr. Andy Biaglow

COL Corey James

MAJ Caspar Yi

MAJ Galen Mandes

07 April 2023

Agenda

- Course Briefings
  - CH363
  - CH365
  - CH459
  - CH485
  - CH350
- Bioengineering course update
- ABET and Advisory Board Update (14 APR 23)
- Recruiting/Mentorship plan for inbound faculty
- 5-year teaching plan

CH363: Separations Processes

Course Director: COL James

Course Supervisor: Dr. Yuk

Credit Hours: 3.5 (BS=0, ET=3.5, MA=0)
Prerequisites: CH362
Co-requisite: None
Lessons: 30 @ 75 min, 7 @ 120 min
Special Requirements: None

This course covers methods for the physical separation of chemicals. Topics include dew point and bubble point calculations, adiabatic flash, distillation, chromatography, liquid-liquid and gas-liquid absorption/stripping. Students are taught the significance of staging of unit operations. Heavy emphasis is placed on theory of operations, numerical methods of solution, and simulation.

Topics – by Chapter

Separation Process Principles, 4th Ed., by J.D. Seader, E.J. Henley and D.K. Roper

- Introduction to Separations/DOF Analysis (Ch. 1)
- Vapor-liquid, gas-liquid, solid-liquid, flash(Ch. 4)
- Cascading configurations (Ch. 5)
- Designing trayed towers and packed columns (Ch. 6)
- Optimizing towers and columns (Ch. 7)
- Liquid-liquid extraction (Ch. 8)
- Multi-component distillation (Ch. 9)
- Capstone Project

Course Assessment – Items from Section III

Sustain:

- Technical Writing: Written Research Paper
- Capstone project – Ties all key concepts together. Assesses communication outcome.
- ChemCAD use in concert with theory/ every day CHEMCAD

Improve:

- Need extra distillation lesson in block 3; topic needs more treatment and fits better in block 3
- Improve cadets' reliance on the text as a resource
- **More** instructor problems for HW/ less book problems

Assessment – Graded Events

8 Problem Sets @ 40 pts each:	320	13.3%
4 *In-Class Prob. Sets @ 75 pts each:	300	12.5%
3 *WPRs @ 200 pts each:	600	25.0%
1 *Research Paper @ 100 pts:	100	4.2%
7 *Labs @ 40 pts each:	280	11.6%
1 *Term End Exam @ 500 pts:	500	20.8%
1 *Capstone	300	12.5%
Total:	2400	
*Individual Points :	1820	75.8%

CH365: Chemical Engineering Thermodynamics

Course Director: Dr. Biaglow

Course Supervisor: LTC Cowart

Credit Hours: 3.0 (BS=0, ET=3.0, MA=0)
Prerequisites: CH363, CH364, MA366, MC312
Co-requisite: None
Lessons: 40 @ 55 min
Special Requirements: None

This course covers the body of thermodynamic knowledge necessary for understanding modern chemical process simulation. Students learn the theory behind the thermodynamic methods used in the software. The course includes calculus- and numerical-based thermodynamics approaches for determining the properties of substances, solutions, and multiphase mixtures. Topics include equations of state, pure component properties, transport properties, properties of mixtures, fugacity, excess properties, activity coefficients, and phase equilibria. The problems in the course emphasize engineering applications. Topics covered in class are related to real systems through the use of chemical process simulators.

Topics – by Chapter

Chemical Engineering Thermodynamics, Smith, van Ness, Abbott, and Swihart, 9th Edition (2021)

- Introduction (Ch. 1)
- First Law (Ch. 2)
- Equations of State (Ch. 3)
- Heat (Ch. 4)
- Entropy and Second Law (Ch. 5)
- Fluid Properties (Ch. 6)
- Equilibrium (Ch. 10)
- Solution Thermodynamics (Ch. 11)

Course Assessment – Items from Section III

Sustain:

Writing project - resume exercise involved intense use of instructor time for iterative writing, but introspection is important for cadets.

Capstone project – calculation of properties and comparison with CAD

Improve:

More emphasis on Ch 11, specifically excess properties

Activity coefficient CO 3.03/5. Develop classroom activity. Have some from past iterations; re-introduce.

Communication SO 3.8/5. Develop writing assignment to capstone. Use of writing rubric to assess.

Assessment – Graded Events

1 *Term End Exam @ 500 pts:	500	20.75%
1 *Capstone Design Project @ 300 pts	300	12.45%
3 *Capstone IPRs @ 30 pts each:	90	3.73%
3 *WPRs @ 200 pts each:	600	24.90%
66 *Problems @ 10 pts each:	660	27.39%
1 *SIS Quiz @ 60 pts:	60	2.49%
1 *Writing Assignment @ 200 pts:	200	8.30%
Total:	2410	100.00%
*Individual Points:	2410	100.00%

CH459: Chemical Engineering Lab

Course Director: LTC Belanger

Course Supervisor: Dr. Biaglow

Credit Hours: 3.5 (BS=0, ET=3.5, MA=0)
Prerequisites: CH362/CH363/CH364
Co-requisite: None
Lessons: 40 @ 120 min, 7 @ 120 min
Special Requirements: None

This course provides laboratory experience in selected chemical engineering unit operations, such as gas absorption, evaporation, distillation, liquid-liquid extraction, cooling tower, heat exchanger, and chemical reactors. Process control and process safety are emphasized in laboratory and classroom instruction. Written and oral reports required.

1. Unit Operations of Chemical Engineering, 7th Edition, by Warren L. McCabe, Julian C. Smith and Peter Harriott; McGraw-Hill, 2005.
2. Plant Design and Economics for Chemical Engineers 5th ed., Peters, Max S. and Klaus D. Timmerhaus, McGraw-Hill, New York 2003, ISBN-10: 0071240446

1. Batch and CSTR
2. Cooling Tower
3. Hydrogen Fuel Cell
4. Single/Double Effect Evaporator
5. Distillation
6. Carbon Dioxide Absorber

Course Assessment – Items from Section III

Sustain:

Integration of FEE reference manual
Equipment familiarization videos
Peer performance assessments

Improve:

Unit Ops textbook explicitly tied to experiments and HWs
Updated guidance documents needed for each experiment
Unique learning objectives for individual experiments specified

Assessment – Graded Events

6 Pre-Lab HWs @ 25 pts ea.	150*	4.8%
1 *Exec. Sum **(SWE)**	100*	3.2%
5 Exec. Sum/Poster/Report	500	15.9%
6 *IPRs @25 pts ea.	150*	4.8%
6 *Lab Execution @ 75 pts ea.	450*	14.3%
2 *WPRs @ 500 pts each:	1000*	31.7%
1 *Term End Exam @ 500 pts:	500*	15.9%
Total:	2850	
*Individual Points :	2350	82.5%

CH485: Heat and Mass Transfer

Course Director: LTC Sam Cowart

Course Supervisor: COL James

Credit Hours: 3.5 (BS=0, ET=3.5, MA=0)
Prerequisites: MA364 and ME362
Co-requisite: None
Lessons: 30 @ 75 min, 7 @ 120 min
Special Requirements: None

This course includes the study of the mechanisms of energy and mass transport, with special emphasis on applications in engineering systems. Coverage includes Fourier's Law of Heat Conduction, and Fick's Law of Diffusion, the development of shell energy and species balances, and the use of these equations to solve for temperature and concentration profiles in chemical engineering systems. An important emphasis in the course is the use of transport equations to understand species diffusion, convection, and chemical reaction in equipment design.

Topics

Mass and Heat Transfer, T.W. Fraser Russell, A.S. Robinson, and N.J. Wagner, Cambridge University Press, 2008

- Introduction (1 Lesson)
- Macroscopic mass, energy, and species balances
  - Chemical reactors (2 lessons)
  - Heat exchangers (4 lessons)
  - Mass contactors (2 lessons)
- Microscopic mass, energy, and species balances
  - Conduction and diffusion (9 lessons)
  - Convective heat and mass transfer (7 lessons)
  - Transport Analogies (4 lessons)

Course Assessment – Items from Section III

Sustain:

- Problem solving days prior to WPR/ICPS
- Lesson structure & content (Incorporated radiation heat transfer)

Improve:

- Continue to revise problem sets – Too much reliance on old solutions.
- Improve Lab 6 – Arnold Cell (2nd Arnold Cell)
- Update Lab 7 – Convective heat/mass transfer analysis
  - Wetted wall column
  - Convective heat transfer experiment

Assessment – Graded Events

8 *Problem Sets @ 50 pts each:	400	18%
2 *In-Class Prob. Sets @ 100 pts each:	200	9%
3 *WPRs @ 200 pts each:	600	27%
1 *Writing Assignment @ 200 pts:	225	10%
7 Labs @ 40 pts each:	280	13%
1 *Term End Exam @ 500 pts:	500	23%
Total:	2205	
*Individual Points :	1965	89%

CH350: Introduction to Bioengineering

Course Director: Dr. Simuck F. Yuk

Course Supervisor: LTC Cowart

Credit Hours: 3.0 (BS=0, ET=Under Review, MA=0)
Prerequisites: CH102, MA205, PH202
Co-requisite: None
Lessons: 30 @ 75 min
Special Requirements: None

The purpose of this course is to provide the introductory knowledge for understanding the biotechnology/bioprocessing engineering. Topic includes enzyme kinetics, molecular biology, cell growth, bioreactors, and bioprocesses. The bioprocess control and its application to different biological systems are covered in the classroom instruction. An important emphasis is made on the use of kinetics and process controls on the biological systems for engineering application.

Topics – by Chapter

Bioprocess Engineering Basic Concepts, 3rd Ed., by Michael L. Shulter, Fikret Kargi, Matthew DeLisa, Prentice Hall.

Quantitative Fundamentals of Molecular and Cellular Bioengineering, by K. Dane Wittrup, Brice Tidor, Benjamin J. Hackel, and Casim A. Sarkar, The MIT Press.

- Introduction
- Enzyme Kinetics
- Central Dogma to Molecular Biology
- Cell Growth
- Bioreactor Selection
- Bioprocess Consideration

Course Assessment – Items from Section III

Sustain:

1. Continue use of DeLisa (3rd Ed.).
2. Continue to introduce problem demos.

Improve:

1. Introduce TEE to access the cadets' understanding of course materials
2. Increase number of in-class problem demos.
3. Improve problem sets and WRPs.
4. Increase number of coding-related problems (i.e., Kinetics and Process Models).

Assessment – Graded Events

5 *Problem Sets (50pts/ea.)	250	16%
-- *Instructor Points	100	7%
1 *Capstone Design Presentation	100	7%
1 *Capstone Design Paper	200	14%
2 *WPRs	400	28%
1 *TEE	400	28%
Total:	**1450**	**100%**

Bio-engineering Track - Timeline

- Select Bioengineering AP ✓
- Select Bioengineering T10 ✓
- QA/QC 3.0 ET credit for CH450 ✓
- Pilot/Teach new courses…CH350 & CH300 ✓
- **Curriculum Proposals for CH300 and CH350** ✓
  - Dr. Jones-Kellogg in AARS for pre-review ✓
  - Program internal review complete to address AARS comments ✓
  - COL Burpo & COL James Final Review/Approval before Staffing to all Depts ✓
  - Submit proposals to curriculum committee ✓
- **3.0 ET credit review process for CH300 and CH350** ✓
  - Met with ABET Committee for ET 3.0 for CH300 and CH350 ✓
  - Internal review/revision in progress
- Get courses in Redbook
- Establish Bioengineering track
- Get Bioengineering sequence approved
- ABET-compatibility (minor point)

- **ABET Record Year in 2025**
  - Kept CDs with experience in respective course in AY25-1/25-2
  - PEV Visit: Fall 2026
  - Focus Areas: Bioengineering Electives for Majors, FEE Performance, and Program/Course Assessment

- **Chemical Engineering Program Instructor Observation (AY23-2)**

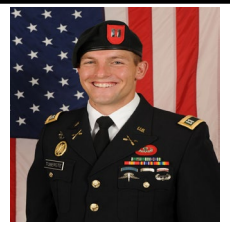
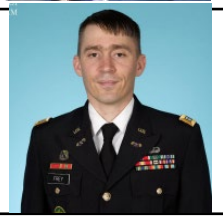
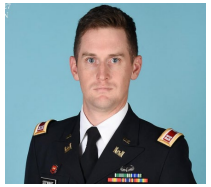
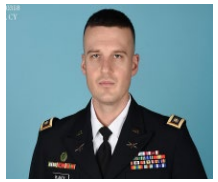
Instructor	Course	Teaching Hours	Observer	Week of	Possible Lessons
Dr. Biaglow	CH402 ChemE Process Design	C1, D1	LTC Cowart	13-17 FEB	12, 13
LTC Cowart	CH362 Mass & Energy Balances	A1, B1	Dr. Nagelli	13-17 FEB	12, 13
COL James	CH367 Process Controls	H2, I2	Dr. Nagelli	13-17 FEB	11, 12
Dr. Yuk	CH364 Chem Reaction Engineering	C1, D1	LTC Belanger	13-17 FEB	12, 13
COL Burpo	CH300 Biomedical Engineering	G2	Dr. Yuk	13-17 FEB	11, 12
COL Burpo	CH450 Bioengineering Modeling	I2	Dr. Yuk	13-17 FEB	11, 12
Dr. Nagelli	CH400 ChemE Professional Practice	E1	LTC Cowart	13-17 FEB	12, 13
Instructor	**Course**	**Teaching Hours**	**Observer**	**Week of**	**Possible Lessons**
LTC Belanger	CH102 General Chemistry II	H1, I1	Dr. Biaglow	13-17 FEB	12, 13
MAJ Bowers	CH101 General Chemistry I	C1D1, E1F1	LTC Cowart	13-17 FEB	12, 13
MAJ Mandes	CH101 General Chemistry I	G2, H2, I2	COL James	13-17 FEB	11, 12
MAJ Yi	CH102 General Chemistry II	H1, I1	Dr. Yuk	13-17 FEB	12, 13
CPT Lowell	CH101 General Chemistry I	A1B1, C1D1, E1F1	LTC Cowart	13-17 FEB	12, 13
Dr. Nagelli	CH101 General Chemistry I	C1D1	LTC Belanger	13-17 FEB	12, 13
MAJ Chin	CH101 General Chemistry I	A1B1, C1D1	Dr. Nagelli	13-17 FEB	12, 13

Chemical Eng. Advisory Board Meeting AY23-2 (14 April 2023)

No.	Name	Title	Industry - University	Email
1	LTC(R) Matthew Armstrong PhD	Associate Professor (Retired LTC) and Principal Engineer	Fluor Marine Propulsion, Schnectady, NY	armstm@udel.edu
2	COL Aaron Hill, PhD, PE	Deputy Head, Department of Civil & Mechanical Engineering	USMA; CME	aaron.hill@westpoint.edu
3	COL(R) Paul Dietrich	Chemical Officer	Chemical Officer/Industry	paul@the-dietrichs.com
4	Dr. Lucy Hair	Specialist and Chemical Engineer	Jacobs Engineering at Lawrence Livermore National Laboratory	hair1@llnl.gov
5	Prof. Matthew Liberatore	Professor, Chemical Engineering	University of Toledo	matthew.liberatore@Utoledo.edu
6	Prof. Kelly Schutz	Assistant Professor, Chemical Engineering	Lehigh University	kes513@lehigh.edu
7	Prof. Gautham Krishnamoorthy	Professor, Chemical Engineering	University of North Dakota	gautham.krishnamoort@und.edu
8	Mrs. Kisondra Tanev	Director, Power & Renewables Investment Banking	Bank of America	kisondra@gmail.com
9	Mr. Donald Glaser	President and Founder	Simulation Solutions	dglaser@simulation-solutions.com
10	Mr. Kevin Shipe	Account Manager, Chem E (Old Grad '08), Former Automation Engineer	The Graham Company	kevin.a.shipe@gmail.com
11	Mr. Michael DeForest	Industry, Chem E (Old Grad '07) Director of Operations,	Fortna	mike@smkpackaging.com
12	Mr. Michael Theising	Industry, Chem E (Old Grad '11), Operations Manager	Brenntag Group	m.theising@gmail.com

Chem. E. future faculty updates

- CPT Louis Tobergte (AY24)… *sponsor: MAJ Mandes*
- CPT Elizabeth Golonski (AY25)…*sponsor: MAJ Bowers*
- CPT Nigel Rogers (AY25)…*CPT Lowell*
- MAJ Frey (AY25)…*sponsor: LTC Belanger*
- CPT Stewart (AY26)…*sponsor: CPT Tobergte*
- MAJ(P) Plante (AY27)…*sponsor: LTC Cowart*
- CPT Austin Breed (AY27)…*sponsor: CPT Stewart*
- MAJ Corrigan (AY28)…*sponsor: LTC Cowart*

	Future Faculty Member	ACS Start	USMA Arrival	School	Cost Category	Research Focus
	**CPT Louis Tobergte** (Sponsor MAJ Mandes)	AUG 2022	JUN 2023	Carnegie Mellon	High	Thesis completed at Leeds: Water
	**CPT Liz Golonski** (Sponsor MAJ Bowers)	AUG 2022	JUN 2024	Colorado School of Mines	Low	Catalytic membrane reactors
	**CPT Nijel Rogers** (Sponsor MAJ Mandes)	AUG 2022	JUN 2024	Princeton University	High	Soft matter
	**MAJ Joshua Frey** (Sponsor LTC Belanger)	N/A	JUN 2024	N/A	N/A	nuclear fuel cycle material forensic analysis
	**CPT Christopher Stewart** (Sponsor CPT Lowell)	AUG 2023	JUN 2025	California Institute of Technology	High	Complex Fluid Mechanics, Transport, Colloids
	**MAJ Luke Plante** (Sponsor LTC Cowart)	AUG 2023	JUN 2026	Cornell	Low	Bioreactors Wastewater Biofuels

Teaching Slate (5 Year Projected)

Considerations

- Potential for increased sections of **CH300/350/450 and CH459** as enrollment grows
- *ChemE Majors:*
  20 (Class '24)
  32 (Class '25)
  30 (Class '26)

- **ABET Record Year** in AY25 for visit in Fall 2026 (Continuity at CDs in AY25)

- Proposal: CPT Golinski & CPT Tobergte – **Teach CH362 in AY26 and AY27**

- **Next PhDs**
  - MAJ Plante (AY27) (Research: Bio-energy)
  - MAJ Corrigan (AY28)

AY22		AY23		AY24	
AY22-1 (Fall)	AY22-2 (Spring)	AY23-1 (Fall)	AY23-2 (Spring)	AY24-1 (Fall)	AY24-2 (Spring)
CH363 (Lachance)	CH362 (Cowart)	CH363 (Lachance)	CH362 (Cowart)	CH363 (James)	CH362 (Belanger)
CH459 (Nagelli)	CH364 (Yuk)	CH459 (Nagelli)	CH364 (Yuk)	CH459 (Belanger)	CH364 (Cowart)
CH485 (Cowart)	CH402 (Biaglow)	CH485 (Cowart)	CH402 (Biaglow)	CH485 (Cowart)	CH402 (Biaglow)
CH365 (Biaglow)	CH400 (Nagelli)	CH365 (Biaglow)	CH400 (Nagelli)	CH365 (Biaglow)	CH400 (Nagelli)
CH350 (Yuk)	CH367 (James)	CH350 (Yuk)	CH367 (James)	CH350 (Yuk)	CH367 (James)
	CH300 (Burpo)		CH300 (Burpo)		CH300 (Yuk)
	CH450 (Burpo)		CH450 (Burpo+CME)		CH450 (Yuk+CME)
			Nagelli (1 Section GC)		
Yi (2x GC sections)	Mandes (2x GC sections)	Mandes (GC)	Mandes (GC)	Mandes (GC)	Mandes (GC)
Bowers (GC 3x sections)	Bowers (GC 3x sections)	Yi (GC + ACD+ OPSO)	Belanger (GC)	Bowers (GC+CD)	Bowers (GC+CD)
Mandes (GC 3x sections)	Yi (2x GC sections)	Chin (GC+ ACD+S1)	Chin (GC+CD)	Lowell (GC+OPSO)	Lowell (GC+OPSO)
Chin (2x sections+S1)	Chin (2x sections+S1)	Bowers (GC)	Bowers (GC+ACD)	Tobergte(GC)	Tobergte (GC)
		Lowell(GC)	Yi (GC+CD)	Yuk (GC)	Nagelli (GC 1 section)
		Belanger (GC)	Lowell(GC+OPSO*)	*Nagelli(Sabbatical)	*Burpo (Sabbatical)

AY25		AY26		AY27	
AY25-1 (Fall)	AY25-2 (Spring)	AY26-1 (Fall)	AY26-2 (Spring)	AY27-1 (Fall)	AY27-2 (Spring)
CH363 (Nagelli)	CH362 (Belanger)	CH363 (Belanger)	CH362 (Tobergte)	CH363 (Belanger)	CH362 (Golonski)
CH459 (Belanger)	CH364 (Cowart)	CH459 (Yuk)	CH364 (Cowart)	CH459 (Yuk)	CH364 (Cowart)
CH485 (Cowart)	CH402 (Biaglow)	CH485 (Biaglow)	CH402 (Biaglow)	CH485 (Biaglow)	CH402 (Biaglow)
CH365 (Biaglow)	CH400 (Nagelli)	CH365 (Cowart)	CH400 (Yuk)	CH365 (Cowart)	CH400 (Belanger)
CH350 (Yuk)	CH367 (James)	CH350 (Nagelli)	CH367 (James)	CH350 (Nagelli)	CH367 (James)
	CH300 (Yuk)		CH300 (Nagelli)		CH300 (Yuk)
James (GC)	CH450 (Burpo+CME)		CH450 (Burpo+CME)	James (GC) Yuk (GC)	CH450 (Burpo+CME)
Tobergte (GC - 151)	Tobergte (GC 102)	Nagelli (GC)	Nagelli (GC)	Tobergte (GC)	Tobergte (GC)
Rogers (GC)	Rogers (GC)	Rogers (GC)	Rogers (GC)	Rogers (GC)	Rogers (GC 102)
Lowell (GC+OPSO)	Lowell(GC+OPSO)	Golonski (GC)	Belanger (GC)	Golonski (GC)	Nagelli (GC)
Golonski (GC)	Golonski (GC)	Tobergte (GC)	Golonski (GC 102)	Frey (GC)	Frey (GC)
Frey (GC)	Yuk (GC)	Frey (GC)	Frey (GC)	Stewart (GC)	Stewart (GC)
Yuk (GC)	Frey (GC)	Stewart (GC)	Stewart (GC)	Plante (GC)	Plante (GC - 102)

Questions?