AY25-1 Chemical Engineering Course and Program Brief

LTC Sam Cowart

COL Corey James

Dr. Simuck Yuk

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Dr. Andy Biaglow

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03 April 2024

Agenda

- Course Briefings
  - CH363
  - CH365
  - CH459
  - CH485
  - CH350
- Bioengineering minor update
- ABET and Advisory Board Update (12 APR 24)
- 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:

- Capstone project – Ties all key concepts together. Assesses communication outcome.
- ChemCAD use in concert with theory/ every day CHEMCAD
- Use of sub-basement for demos (absorber and distillation columns)

Improve:

- Review/rewrite labs
- Review/rewrite problem sets
- Improve cadets' reliance on the text as a resource with daily questions
- **More** instructor problems for HW/ less book problems
- Renew focus on NTUs

Assessment – Graded Events

8 Problem Sets @ 30 pts each:	240	14%
3 *In-Class Prob. Sets @ 100 pts each:	300	14%
3 *WPRs @ 200 pts each:	600	28%
7 Labs @ 30 pts each:	210	10%
1 *Term End Exam @ 500 pts:	500	23%
1 Capstone	300	14%
Total:	2150	
*Individual Points :	1400	65%

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 – grading intense, but introspective for cadets.

Capstone project – calculate solution properties and compare to CC. Course obj. score (in activity) increased over last AY from 3.03 to 4.28/5 and student outcome score (comm.) from 3.80 to 4.55/5 (added writing assignment).

Improve:

More emphasis on Ch 11, specifically excess properties. Include excess Gibbs energy in capstone project. Include Aspen+

Communication Develop grading rubric for capstone writing assignment.

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:	2020	83.82%

CH459: Chemical Engineering Lab

Course Director: Dr. Nagelli

Co-Instructor: Dr. Yuk

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 Effect Evaporator
5. Distillation
6. Carbon Dioxide Absorber

Course Assessment – Items from Section III

Sustain:

Integration of SWE – DIST EXSUM (Individual Submission)

SO3 (communication) decreased of last AY from 4.6 to 4.3/5.0

Updated guidance documents for each lab with specific direction for calculations

Continue to update HW for each experiment – Pull from Textbook and new problems

Improve:

Use Laplace Block Diagram where controls is obvious for cadets conducting experiments

Re-integrate roles/duties specific for each experiment

SO4 (teams) decreased from last AY from 4.9 to 4.4/5.0

Assessment – Graded Events

6 *Pre-Lab HWs @ 25 pts ea.	150*	4.0%
1 *Exec. Sum + Lab **(SWE)**	200*	6.7%
1 *SWE IPR	25*	0.83%
5 Exec. Sum/Poster/Report @ 100 pts	500	16.7%
5 IPRs @25 pts ea.	125	4.16%
5 Lab Execution @ 100 pts ea.	500	16.7%
2 *WPRs @ 400 pts each:	800*	26.7%
1 *Term End Exam @ 700 pts:	700*	23.3%
Total:	3000	
*Individual Points :	1875	62.5%

CH485: Heat and Mass Transfer

Course Director: LTC 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, diffusion, and radiation (9 lessons)
  - Special cases (curved geometries, composites, membrane diffusion, transient heat & mass transfer) (4 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)
- Continue Arnold Cell Lab (different apparatus)
- Continue Convective H/T Lab – repair interface

Improve:

- Continue to revise problem sets – Too much reliance on old solutions.
- Build bench of alternate labs
  - Wetted wall column
  - Membrane gas diffusion (air separation)

Assessment – Graded Events

9 *Problem Sets @ 50 pts each:	450	20%
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	12%
1 *Term End Exam @ 500 pts:	500	22%
Total:	2255	
*Individual Points :	1975	88%

CH350: Introduction to Bioengineering

Course Director: Dr. Yuk

Course Supervisor: LTC Cowart

Credit Hours: 3.0 (BS=1.0, ET=2.0, MA=0)
Prerequisites: CH102, MA205, and 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

1) *Bioprocess Engineering Basic Concepts,* 3rd Ed., by Michael L. Shuler, Fikret Kargi, Matthew DeLisa, Prentice Hall.
2) *Quantitative Fundamentals of Molecular and Cellular Bioengineering,* by K. Dane Wittrup, Brice Tidor, Benjamin J. Hackel, and Casim A. Sarkar, The MIT Press.

- Introduction (Ch 1, Shuler et al)
- Enzyme Kinetics (Ch 2-3, Shuler et al; Ch 2-3, Wittrup et al)
- Central Dogma to Molecular Biology (Ch 4-5, 8, Shuler et al)
- Cell Growth (Ch 6-7, Shuler et al)
- Bioreactor Selection (Ch 9-10, Shuler et al)
- Bioprocess Consideration (Ch 11-13, Shuler et al)

Course Assessment – Items from Section III

Sustain:

1. TEE – required to access the Cadets' understanding of overall course contents.
2. Capstone Project – development of bioreactors based on the material balance applied for cellular system.

Improve:

1. General – switch out the core problems in the problem sets and WRPs.
2. Capstone Project – need the realistic data for Cadets to process for Bioreactor project.

Assessment – Graded Events

Requirement	# of Event	Points/Event	Total Points	%
Problem Set	6	50	300	20
Instructor Points	4-5	Varies	50	3
Capstone IPR	1	50	50	3
Capstone Presentation	1	100	100	6
Capstone Paper	1	200	200	14
WPR	2	200	400	27
TEE	1	400	400	27
TOTAL (*Individual Points = 1500 (100%))			**1500**	**100**

Bio-engineering Courses - Milestones

- 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**
  - 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
  - ET credits formally approved
- Get courses in Redbook
- Establish Bioengineering minor
  - Internal review; will push to curriculum committee this semester
- Get Bioengineering sequence approved
- Review for ABET-compatibility

- **ABET Record Year is AY26**
  - Keeping CDs with experience in respective course in AY26-1/26-2
  - PEV Visit: Fall 2026
  - Focus Areas: Bioengineering Electives for Majors, FEE Performance, and Program/Course Assessments

- **Chemical Engineering Program Instructor Observation (AY24-2)**

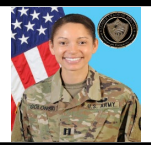
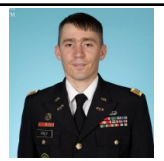
Instructor	Course	Teaching Hours		Observer	Week of	Possible Lessons
Dr. Biaglow	CH402 ChemE Process Design	C1, D1		Dr. Nagelli	12-16 FEB	13, 14
LTC Cowart	CH364 Chem Reaction Engineering	C1, D1		Dr. Yuk	12-16 FEB	13, 14
COL James	CH367 Process Control	H2, I2		LTC Cowart	12-16 FEB	13, 14, 15
Dr. Yuk	CH450 Bioengineering Modeling	I2		Dr. Biaglow	12-16 FEB	13, 14, 15
Dr. Yuk	CH300 Biomedial Engineering	G2		Dr. Nagelli	12-16 FEB	13, 14, 15
Dr. Nagelli	CH400 ChemE Professional Practice	E1, F1		Dr. Biaglow	12-16 FEB	13, 14
MAJ Mandes	CH362 Mass & Energy Balances	A1, B1		LTC Cowart	12-16 FEB	13, 14
Instructor	**Course**	**Teaching Hours**		**Observer**	**Week of**	**Possible Lessons**
CPT Tobergte	CH101 General Chemistry I	A2B2, C2D2, J2E2		LTC Cowart	12-16 FEB	13, 14, 15
MAJ Bowers	CH101 General Chemistry I	C2D2, J2E2		Dr. Yuk	12-16 FEB	13, 14, 15
CPT Lowell	CH101 General Chemistry I	A1B1, C1D1, E1F1		Dr. Biaglow	12-16 FEB	13, 14

ABET Advisory Board Members

No.	Name	Title	Industry - University	Email	Attending?
1	COL(R) Paul Dietrich	Chemical Officer & Refinery Manager	Chemical Officer/Industry	paul@the-dietrichs.com	Yes
2	Prof. Matthew Liberatore	Professor, Chemical Engineering	University of Toledo	matthew.liberatore@Utoledo.edu	Yes
3	Prof. Kelly Schultz	Associae Professor, Chemical Engineering	Purdue University	kmschultz@purdue.edu	Yes
4	Prof. Gautham Krishnamoorthy	Professor, Chemical Engineering	University of North Dakota	gautham.krishnamoort@und.edu	Yes
5	Mrs. Kisondra Tanev	Director, Power & Renewables Investment Banking	Bank of America	kisondra@gmail.com	Yes
6	Mr. Kevin Shipe	Account Manager, Chem E (Old Grad '08), Former Automation Engineer	The Graham Company	kevin.a.shipe@gmail.com	Yes
7	Mr. Michael DeForest	Industry, Chem E (Old Grad '07), Senior Director of Operations,	Fortna	michaeldeforest@fortna.com	Yes
8	Mr. Michael Theising	Industry, Chem E (Old Grad '11), Vice President of Operations	Brenntag Group	m.theising@gmail.com	Yes
9	Prof. Susan Daniel	William C. Hooey Director and Fred H. Rhodes Professor of Chemical Engineering	Cornell University	sd386@cornell.edu, Admin Assistant: ak	Yes
10	Prof. Robert Savinell	Distinguished University Professor, Professor of Chemical Engineering	Case Western Reserve University	rfs2@case.edu	Yes
11	Dr. Lucy Hair	Specialist and Chemical Engineer	Jacobs Engineering at Lawrence Livermore National Laboratory	hair1@llnl.gov	No
12	LTC(R) Matthew Armstrong PhD	Associate Professor (Retired LTC) and Principal Engineer	Fluor Marine Propulsion, Schnectady, NY	armstm@udel.edu	NO
13	COL Aaron Hill, PhD, PE	Deputy Head, Department of Civil & Mechanical Engineering	USMA; CME	aaron.hill@westpoint.edu	NO

Chemical Engineering future faculty updates

- CPT Elizabeth Golonski (AY25)…*sponsor: MAJ Bowers*
- CPT Nigel Rogers (AY25)…*CPT Lowell*
- MAJ Frey (AY25)…*sponsor: LTC Cowart*
- MAJ Ashli Carlson (AY26)*…sponsor: MAJ Frey*
- CPT Stewart (AY26)…*sponsor: CPT Tobergte*
- CPT Denis Glinski (AY26)…*sponsor: CPT Rogers*
- MAJ(P) Plante (AY27)…*sponsor: LTC Cowart*
- CPT Austin Breed (AY27)…*sponsor: CPT Stewart*
- CPT Madison Turner (AY28)…*sponsor: CPT Glinski*
- CPT Blake Koppel (AY28)…*sponsor: CPT Breed*
- MAJ Corrigan (AY28)…*sponsor: LTC Cowart*

	Future Faculty Member	ACS Start	USMA Arrival	School	Cost Category	Research Focus
	**CPT Liz Golonski** (Sponsor MAJ Bowers)	AUG 2022	JUN 2024	Colorado School of Mines	Low	Catalytic membrane reactors
	**CPT Nijel Rogers** (Sponsor MAJ Lowell)	AUG 2022	JUN 2024	Princeton University	High	Soft matter
	**MAJ Joshua Frey** (Sponsor LTC Cowart)	N/A	JUN 2024	N/A	N/A	nuclear fuel cycle material forensic analysis
	**MAJ Ashli Carslon** (Sponsor MAJ Frey)	N/A	JUN 2025	N/A	N/A	Biomedical engineering
	**CPT Christopher Stewart** (Sponsor CPT Tobergte)	AUG 2023	JUN 2025	California Institute of Technology	High	Complex Fluid Mechanics, Transport, Colloids
	**CPT Denis Glinksi** (Sponsor CPT Rogers)	N/A	JUN 2025	N/A	N/A	Bioengineering modeling
	**MAJ Luke Plante** (Sponsor LTC Cowart)	AUG 2023	JUN 2026	Cornell	Low	Bioreactors Wastewater Biofuels
	**CPT Austin Breed** (Sponsor CPT Stewart)	AUG 2024	JUN 2026	Northeastern	Mid	Battery Technology

Teaching Slate (5 Year Projected)

Considerations

- Potential for increased sections of all courses especially
- **CH300/350/450**
- **CH459**
- *ChemE Majors:*
  19 (Class '24)
  33 (Class '25)
  29 (Class '26)
  43 (Class '27)

- **ABET Record Year** in AY26 for visit in Fall 2026 (Continuity at CDs in AY26)

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

AY24		AY25		AY26	
AY24-1 (Fall)	AY24-2 (Spring)	AY25-1 (Fall)	AY25-2 (Spring)	AY26-1 (Fall)	AY26-2 (Spring)
CH363 (James)	CH362 (Mandes)	CH363 (James)	CH362 (Tobergte)	CH363 (James)	CH362 (Tobergte)
CH459 (Nagelli)	CH364 (Cowart)	CH459 (Nagelli, Yuk)	CH364 (Cowart)	CH459 (Yuk)	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 (Parker)		CH300 (Yuk)		CH300 (Carlson)
	CH450 (Yuk)		CH450 (Burpo)	* Nagelli (sabbatical)	CH450 (Yuk)
				Carlson (GC)	
			Nagelli (1 Section GC)	Tobergte (GC)	Nagelli (GC 1 section)
Mandes (GC)	Bowers (GC+CD)	Tobergte (GC)	Belanger (GC)	Rogers (GC)	Rogers (GC)
Bowers (GC+CD)	Lowell (GC+OPSO)	Rogers (GC)	Rogers (GC+CD)	Golonski (GC)	Golonski (GC)
Lowell (GC+OPSO)	Tobergte (GC)	Lowell (GC + OPSO)	Lowell (GC + OPSO)	Frey (GC)	Frey (GC)
Tobergte (GC)	Nagelli (GC 1 section)	Golonksi (GC)	Golonksi (GC)	Glinski (GC)	Glinski (GC)
Yuk (GC)	* Burpo (Sabbatical)	Frey (GC)	Frey (GC)	Stewart (GC)	Stewart (GC)

AY27		AY28		AY29	
AY27-1 (Fall)	AY27-2 (Spring)	AY28-1 (Fall)	AY28-2 (Spring)	AY29-1 (Fall)	AY29-2 (Spring)
CH363 (Nagelli)	CH362 (Golonski)	CH363 (Nagelli)	CH362 (Nagelli)	CH363 (Nagelli)	CH362 (Nagelli)
CH459 (Biaglow, Yuk)	CH364 (Cowart)	CH459 (Biaglow, Yuk)	CH364 (Cowart)	CH459 (Biaglow, Yuk)	CH364 (Cowart)
CH485 (James)	CH402 (Biaglow)	CH485 (James)	CH402 (Biaglow)	CH485 (James)	CH402 (Biaglow)
CH365 (Cowart)	CH400 (Nagelli)	CH365 (Cowart)	CH400 (Yuk)	CH365 (Cowart)	CH400 (Yuk)
CH350 (Yuk)	CH367 (James)	CH350 (Corrigan)	CH367 (James)	CH350 (Corrigan)	CH367 (James)
	CH300 (Plante)		CH300 (Plante)		CH300 (Plante)
	CH450 (Yuk)		CH450 (Corrigan)		CH450 (Corrigan)
Glinski (GC)					
Plante (GC)					
Rogers (GC)	Rogers (GC)	Breed (GC)	Breed (GC)	Plante (GC)	Turner (GC)
Golonski (GC)	Frey (GC)	Turner (GC)	Turner (GC)	Turner (GC)	
Frey (GC)	Stewart (GC)	Plante (GC)			
Stewart (GC)	Breed (GC)	Glinski (GC)	Glinski (GC)		
Breed (GC)	Glinski (GC)	Stewart (GC)	Stewart (GC)		

Questions?