AY26-2 Chemical Engineering Course and Program Brief

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Dr. Simuck Yuk
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ABET Engineering Technology Accreditation Commission

Agenda

- Course briefings
  - CH300 - *Intro. to Biomedical Engineering*
  - CH362 - *Mass & Energy Balances*
  - CH364 - *Chemical Reaction Engineering*
  - CH367 - *Intro. to Automatic Process Control*
  - CH400 - *Chemical Engineering Professional Practice*
  - CH402 - *Chemical Engineering Process Design*
  - CH450 - *Bioengineering Modeling & Analysis*
- Inbound chemical engineering faculty update
- Teaching slate (5 year projected)
- Program updates
  - Lab updates, ABET Advisory Board, & instructor observation

CH300: Introduction to Biomedical Engineering
Course Director: Dr. Yuk
Course Supervisor: Dr. Nagelli

Credit Hours: 3.0 (BS=2.0, ET=1.0, MA=0)
Prerequisites: CH102, MA205
Co-requisite: None
Lessons: 30 @ 75 min
Special Requirements: None

This course provides a basis for understanding the application of engineering principles to problems in medicine and biology. It provides preparation for future graduate work in medical school, biomedical engineering, and chemical engineering. Specifically, the objectives of the course are: (1) to introduce the field and how it relates to other fields of engineering and science, (2) the develop the ability to apply mathematics, science, and engineering to solve problems, (3) to develop an understanding of the impact of engineering solutions on the medical field and society, and (4) to understand current topics within the field.

Topics – by Chapter

TEXT: Introduction to Biomedical Engineering, 3rd Edition, by John Enderle and Joseph Bronzino; Academic Press, 2012 & Physical Biology of the Cell, 2nd Ed by Rob Phillips

- Part I: Molecular and Cellular Properties (Ch.1, Ch.2, & Ch.3 of Enderle Text and Ch.2, Ch.3, & Ch.4 of Phillips Text)
- Part II: Cellular Considerations (Ch.4, Ch.5, Ch.8, and Ch.13 of Enderle Text)
- Part III: Downstream Considerations (Ch.10, Ch.11, Ch.12, Ch.14, Ch.15 of Enderle Text)

Course Assessment – Items from Section III

Sustain:

- Continue using the current textbooks, which effectively support the course learning outcomes.
- Introduce new PSs designed to strengthen conceptual connections between biological and chemical engineering principles.
- Maintain the capstone design project on bio scaffold systems to highlight and assess the students' engineering design skills.

Improve:

- Increase emphasis on Mathematica applications, demonstrating how biological and biomedical problems can be formulated and solved through computational coding.
- Schedule a course evaluation and feedback session at the end of Lesson 30.

Assessment – Graded Events

6 PSs @ 50 pts each	300	21.4%
2 WPRs @ 200 pts each	400	28.6%
1 Capstone Design Project	200	14.3%
1 TEE	500	35.7%
Total:	**1400**	
*Individual Points :	1400	100%

*Lab staff requirements: No direct support from lab staff needed

CH362: Mass and Energy Balances

Course Director: MAJ Tobergte

Course Supervisor: Dr. Yuk

Credit Hours: 3.5 (BS=0, ET=3.5, MA=0)
Prerequisites: CH102 or CH152
Co-requisite: None
Lessons: 40 @ 55 min, Labs: 7 @ 120 min
Special Requirements: None

Introduction to mass and energy balances in single phase and multiphase, nonreactive and reactive systems. Course topics include an introduction to engineering calculations and process variables, use of computers in solving chemical engineering problems, fundamentals of material balances in single-phase and multi-phase systems, energy balances on nonreactive and reactive processes, applications of combined material and energy balances, introduction to chemical engineering unit operations, and a general introduction to the field of chemical engineering.

Topics – by Chapter

Elementary Principles of Chemical Processes, Felder, Rousseau, Bullard, 4th Edition (2016)

- Introduction to Chemical Engineering (Ch. 1)
- Introduction to Engineering Calculations and Process Variables (Ch. 2 & 3)
- Single and Multi-unit Material Balances (Ch. 4.1-4.5)
- Reactive System Material Balances (Ch. 4.6-4.10)
- Multiphase Systems (Ch. 6)
- Energy Balances on Non-reactive Sys (Ch. 5, 7, 8)
- Energy Balances on Reactive Sys (Ch. 9)

Course Assessment – Items from Section III

Sustain:

Keep recently added hands-on ME-balance lab and optimization block

Keep lesson 2 Quiz to emphasize CH101, CH102 and math concepts

Improve:

Add a review lesson before the TEE

Add FE Exam-type problems to WPRs; execute WPRs during lab blocks to allow more time and depth

Add in-class cadet briefs of problems from the problem sets (cadets desired more chances to brief their work)

Show examples of solving ME-balance questions in Python

Assessment – Graded Events

Requirement	#	Pts	Total	%	Change from Last Year
*TEE	1	200	200	20%	Same
*WPRs	3	90,100,100	280	29%	Same
*Lesson 2 Quiz	1	10	10	1%	Same
*In-class Problem Sets	4	40	160	16%	Same
*Problem Sets	8	20	160	16%	Same
*Labs	7	10-15	80	8%	Same
*Research Paper	1	50	50	5%	Same
Capstone Presentation	1	50	50	5%	Same
Total:			1000		
*Individual Submission:			950		**95%**

*Lab staff requirements: Familiarization Brief, HFC & Heat Exchanger Lab

CH364: Chemical Reaction Engineering

Course Director: Dr. Nagelli

Course Supervisor: LTC Cowart

Credit Hours: 3.5 (BS=0, ET=3.5, MA=0)
Prerequisites: CH362
Co-requisite: None
Lessons: 40 @ 55 min, 7 @ 120 min
Special Requirements: None

This course studies the effects of chemical reaction kinetics on systems of engineering significance. It introduces selection and operation of commercial chemical reactors, emphasizing chemical kinetics and transport phenomena. It studies currently practiced engineering techniques associated with each of these reactors. Topics covered in this course include ideal reactors; batch, CSTR and PFR, isothermal and non-isothermal. Other topics may include catalytic reactors, bioreactors, transient and steady state reactor design, pressure drop in reactors, recycle, stability, and numerical methods.

Topics – by Chapter

Textbook*: Elements of Chemical Reaction Engineering*, Fogler, Prentice Hall, 6th Edition (2020) – *7th edition TBP 2025*

- Mole Balances (Ch. 1)
- Conversion and Reactor Sizing (Ch. 2)
- Rate Laws (Ch. 3)
- Stoichiometry (Ch. 4)
- Isothermal Reactor Design (Ch. 5, 6)
- Collection and Analysis of Rate Data (Ch. 7)
- Multiple Reactions and Bioreactors (Ch. 8, 9)
- Catalysis & Catalytic Reactors (Ch. 10)
- Non-isothermal Reactor Design (Ch. 11, 12)

Course Assessment – Items from Section III

Sustain:

- Continue to focus on non-isothermal reactor design.
- Maintain additional lesson (in-class problem solving) dealing with CSTR heat effects before the TEE.
- Joint Capstone with CH367 focus on controls with reactor design.

Improve:

- Performance on major graded events (WPRs & TEE) was low on non-isothermal reactors.
- Revise capstone project to include non-isothermal CSTR as option
- Revise problem sets every AY.

Assessment – Graded Events

3 WPRs @ 200 pts each:	600	29%
10 Problem Sets @ 50 pts each:	500	24%
7 Labs @ 40 pts each:	280	13%
1 Capstone Project @ 200 pts:	200	10%
1 Term End Exam @ 500 pts	500	24%
Total:	2080	
Individual Submission:	1800	87%

*Lab staff requirements: No direct support from lab staff needed

CH367: Intro. to Auto. Process Control

Course Director: COL James

Course Supervisor: Dr. Biaglow

Credit Hours: 3.0 (BS=0, ET=3.0, MA=0)
Prerequisites: CH459, CH485, CH365
Co-requisite: None
Lessons: 30 @ 75 min
Special Requirements: None

This course covers the principles necessary to understand the automatic control of chemical processes. Students learn the current mathematical models and mechanical details of various control elements, including sensors, transmitters, actuators, and controllers. Application of mathematical models will be covered with dynamic modeling techniques as well as real-time training using process simulators. The course will also cover tuning of controllers as well as safe response to process upsets. A capstone project will involve dynamic modelling of an integrated process control system.

Topics – by Chapter

Process Dynamics and Control, Seborg, Edgar, Mellichamp, Doyle 4th Edition (2017)

- Introduction to Process Control (Ch. 1)
- Developing Chemical Process Models (Ch. 2,3,4,7)
- Dynamic Response of Chemical Processes (Ch. 5,6)
- Designing Feedback Controllers (Ch. 8,12)
- Control System Instrumentation and Final Control Elements (Ch. 9)
- Dynamic Behavior and Stability (Ch. 11)
- Feedforward, Ratio Control, and Advanced Topics (Ch. 15, 16, 18)

Course Assessment – Items from Section III

- Sustain the capstone with CH364
- Explore using python to model processes and controllers as it provides more flexibility.

Assessment – Graded Events

Term End Exam (TEE)	1	500	500	25%
Written Partial Reviews (WPRs)	3	250	750	37.5%
Problem Sets	7	50	350	17.5%
Daily Questions/Quizzes	30	5	150	7.5%
Capstone	1	250	250	12.5%
		Total	2000	100%
		Individual	1400	70%

*Lab staff requirements: No direct support from lab staff needed

CH400: Chemical Engineering Professional Practice

Course Director: LTC Cowart

Course Supervisor: Dr. Nagelli

Credit Hours: 1.5 (BS=0, ET=1.5, MA=0)
Prerequisites: CH459, CH485, CH365
Co-requisite: None
Lessons: 20 @ 55 min
Special Requirements: None

The course will meet on 1-Days (E1 & F1) and will cover topics such as ethics, continuing education, and global and social issues within chemical engineering. Special emphasis will be placed on preparation for the Fundamentals of Engineering Exam using practice problems and graded practice exams. The course also covers professional plant engineering using plant simulators and mock exercises to teach proper troubleshooting and response techniques.

Topics – by Chapter

FEE Supplied-Reference Handbook Ed. 10.5 (July 2025)
FE Chem. E sample questions + solutions

- Mass & Energy Balances
- Chemical reaction engineering
- Thermodynamics
- Heat Transfer
- Mathematics/prob. & stat.
- Engineering Sciences
- Safety, Health and Environmental
- Fluid mechanics/Dynamics
- Ethics & Prof. Practice
- Mass Trans & Separations
- Chemistry & Biology
- Solids Handling
- Economics
- Process Design
- Process Controls
- Materials Science

Course Assessment – Items from Section III

<u>Sustain</u>:

Voluntary attendance for FEE failures; reinforce additional practice time before retaking the exam

Continue to go over all graded events before FEE

FEE on 12,16-19, 23 MAR (all before Spring Break)

<u>Improve</u>:

Increase cadet survey submission; 50% response in 25-2

Allow multiple attempts on problem sets (online system)

Continue to update Quizzes/WPRs; allow corrections

Assessment – Graded Events

10 Problem Sets @ 25 pts each:	200	21.05%
10 Quizzes @ 25 pts each:	250	26.31%
2 Practice Exams @ 50 pts each:	100	10.52%
1 WPR @ 200 pts each:	200	21.05%
2 SSI Exercises @ 100 pts each:	200	21.05%
Total:	950	
Individual Submission:	**950**	**100%**

*Lab staff requirements: Process simulator software purchase for FEE preparation & professional development

CH402: Chem. Eng. Process Design

Course Director: Dr. Biaglow

Course Supervisor: Dr. Nagelli

Credit Hours: 3.5 (BS=0, ET=3.5, MA=0)
Prerequisites: CH459, CH485, CH365
Co-requisite: None
Lessons: 40 @ 55 min, 7 @ 120 min
Special Requirements: None

This course provides a capstone experience that brings together material from previous courses to examine contemporary problems in chemical engineering process design. The course provides instruction in the conceptual design of processes to achieve design goals, as well as the economic optimization of the process. The course emphasizes the use of computer simulations, theory of unit operations, process control, safety, environmental and economic factors. The effect of changes in design on the process economics will be investigated. Written and oral design reports for the capstone design project are required.

Topics – by Chapter

Plant Design and Economics for Chemical Engineers, Peters, Timmerhaus, West, 5th Edition (2002)

- Introduction to Process Design (Ch. 1)
- Heat Exchanger Design (Ch. 14)
- Fluid Handling (Ch. 12)
- Flowsheet Synthesis (Ch. 4)
- Cost Estimation (Ch. 6)
- Process Economics (Ch. 7,8)
- Design Project and Reports (Ch. 11)

Course Assessment – Items from Section III

Sustains:

- Emphasis on written "professional quality" reports (communication score about 90% in 1/0 spreadsheet).
- Capstone projects – distillation, methanation of CO_2 – excellent problems. Use of machine learning.
- Use of AIChE contest problem – this year – renewable NG from manure.

Improves:

- Control - Control schemes and ability to draw P&IDs was lower in AY25. Some control loops did not make sense (70% in 1/0 AY25 compared to 96% AY24).
- Safety & Env - Understanding and environmental impact – CHEMCAD tools (77% in 1/0 compared to 73% last AY)
- Integrating IPR results into final reports. Cadets do a nice job on the IPR1 and 2 objectives but then seem to forget that these are important results.
- Energy integration – teach networked exchangers with pinch analysis.

Assessment – Graded Events

10 Problem Sets @ 25 pts each:	250	13.51%
4 Small Design Probs. @ 50 pts each:	200	10.81%
2 WPRs @ 200 pts each:	400	21.62%
1 Design Report @ 400 pts:	400	21.62%
2 IPRs @ 100 pts each:	200	10.81%
4 Quizzes @ 25 pts each:	100	5.41%
1 Term End Exam @ 300 pts:	300	16.22%
Total:	1850	
Individual Submission:	1250	67.57%

*Lab staff requirements: CC, CPI, A+ re-licensing purchases.

CH450: Bioengineering Modeling and Analysis
Course Director: Dr. Yuk
Course Supervisor: Dr. Nagelli

Credit Hours: 3.0 (BS=0.0, ET=3.0, MA=0)
Prerequisites: CH102, MA205
Co-requisite: None
Lessons: 30 @ 75 min
Special Requirements: None

This course provides a broad understanding of bioengineering disciplines to include biomechanics, biomaterials, tissue engineering, biocatalysts, biochemical engineering, and biosensors. Fundamental concepts of molecular kinetics, thermodynamics, and mass transport are applied in problem sets in each bioengineering sub-discipline and capstone design project providing students the opportunity for modeling, analysis, and design from the biomolecular to physiological length scale and across multiple time scales. Modeling software such as MATLAB and Mathematica is extensively used.

Topics – by Chapter

TEXT: Introduction to Biomedical Engineering, 3rd Edition, by John Enderle and Joseph Bronzino; Academic Press, 2012.

- Part I: Biomechanics (Ch. 1 and 4)
- Part II: Biomaterials (Ch. 5)
- Part III: Tissue Engineering (Ch. 6)
- Part IV: Biomedical Enzyme Kinetics (Ch. 7 and 8)
- Part V: Biochemical Engineering (Handouts)
- Part VI: Biosensors (Ch. 10)

Course Assessment – Items from Section III

Sustain:

- Continue using the current textbooks.
- Continue with open-ended problem sets.
- Maintain in-class quizzes to assess the cadets' understanding of fundamental concepts throughout the semester.

Improve:

- Additional emphasis on Mathematica examples to show how to translate the equations into coding.
- Incorporate more realistic, research-informed problems drawn from current biomedical and bioengineering practice, beyond textbook examples.
- Schedule a course evaluation and feedback session at the end of Lesson 30.

Assessment – Graded Events

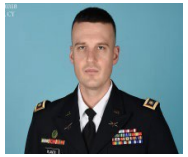
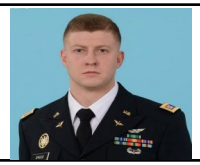
5 *Problem Set @ 25 pts each	500	47.2%
6 *Quiz @ 200 pts each:	180	17.0%
1 *Capstone Design Paper	150	4.1%
1 *Capstone Presentation	50	4.7%
6 *Instructor Points	180	17.0%
Total:	**1060**	
*Individual Points :	1060	100%

*Lab requirements: No direct support from lab staff needed

Inbound Faculty

Chem. E. future faculty updates

- *LTC Plante (AY27)…sponsor: Dr. Nagelli*
- *CPT Austin Breed (AY27)…sponsor: CPT Stewart*
- *LTC Corrigan (AY28)…sponsor: Dr. Nagelli*
- *CPT Madison Turner (AY28)…sponsor: CPT Breed*
- *MAJ Pat Bowers (AY30)…sponsor: LTC Corrigan*

	Future Faculty Member	ACS Start	USMA Arrival	School	Cost Category	Research Focus
	**LTC Luke Plante** (Sponsor Dr. Nagelli)	AUG 2023	JUN 2026	Cornell	High	Biomining of heavy metals
	**CPT Austin Breed** (Sponsor CPT Stewart)	AUG 2024	JUN 2026	Northeastern	High	Electrochemistry & Batteries
	**LTC Trevor Corrigan** (Sponsor Dr. Nagelli)	AUG 2024	JUN 2027	UWash	High	Bioengineering
	CPT Madison Turner (Sponsor CPT Breed)	AUG 2025	JUN 2027	Duke	High	Biomaterials
	MAJ Pat Bowers (Sponsor LTC Corrigan)	AUG 2026	JUN 2029			

Considerations

- Program enrollment
- *ChemE Majors:*
  25 (Class of ’26)
  28 (Class of ‘27)
  27 (Class of ‘28)
- **ABET Record Year in AY26**
  ABET visit in Fall AY27-1
- **Next PhDs:**
  LTC Plante **(**AY27)
  LTC Corrigan (AY28)
  MAJ Bowers (AY30)

AY26		AY27		AY28	
AY26-1 (Fall)	AY26-2 (Spring)	AY27-1 (Fall)	AY27-2 (Spring)	AY28-1 (Fall)	AY28-2 (Spring)
CH363 (James)	CH362 (Tobergte)	CH363 (Lachance)	CH362 (Rogers)	CH363 (Lachance)	CH362 (Nagelli)
CH459 (Yuk, Biaglow)	CH364 (Nagelli)	CH459 (Nagelli)	CH364 (Plante)	CH459 (Nagelli)	CH364 (Plante)
CH485 (Cowart)	CH402 (Biaglow)	CH485 (Plante)	CH402 (Biaglow)	CH485 (Plante)	CH402 (Biaglow)
CH365 (Biaglow)	CH400 (Cowart)	CH365 (Biaglow)	CH400 (Nagelli)	CH365 (Biaglow)	CH400 (Yuk)
CH350 (Yuk)	CH367 (James)	CH350 (Yuk)	CH367 (James)	CH350 (Corrigan)	CH367 (James)
	CH300 (Yuk)		CH300 (Yuk)		CH300 (Corrigan)
**Nagelli Sabbatical*	CH450 (Yuk)		CH450 (Yuk)	**Yuk Sabbatical*	CH450 (Corrigan)
Tobergte (GC)					
Lowell (GC + OPSO)	Lowell (GC + OPSO)	Golonski (GC)			
Golonski (GC)	Rogers (GC)	Rogers (GC)	Golonski (GC)	Stewart (GC)	Glinski (CH101 CD)
Rogers (GC)	Golonski (GC)	Frey (GC)	Frey (GC)	Glinski (CH101 CD)	Stewart (GC)
Frey (GC)	Frey (GC)	Stewart (GC)	Stewart (GC)	Breed (GC)	Breed (GC)
Stewart (GC)	Stewart (GC)	Glinski (CH101 ACD)	Glinski (CH101 ACD)	Turner(GC)	Turner (GC)
Glinski (GC)	Glinski (GC)	Breed (GC)	Breed (GC)		

AY29		AY30		AY31	
AY29-1 (Fall)	AY29-2 (Spring)	AY30-1 (Fall)	AY30-2 (Spring)	AY31-1 (Fall)	AY31-2 (Spring)
CH363 (Nagelli)	CH362 (Nagelli)	CH363 (Lachance)	CH362 (J. Rotator)	CH363 (Lachance)	CH362 (J. Rotator)
CH459 (Yuk)	CH364 (Plante)	CH459 (Yuk)	CH364 (Bowers)	CH459 (Yuk)	CH364 (Bowers)
CH485 (Plante)	CH402 (Biaglow)	CH485 (Bowers)	CH402 (Nagelli)	CH485 (Bowers)	CH402 (Nagelli)
CH365 (Biaglow)	CH400 (Yuk)	CH365 (Nagelli)	CH400 (Yuk)	CH365 (Nagelli)	CH400 (Yuk)
CH350 (Corrigan)	CH367 (James)	CH350 (Corrigan)	CH367 (James)	CH350 (Corrigan)	CH367 (James)
	CH300 (Corrigan)		CH300 (Corrigan)		CH300 (Corrigan)
	CH450 (Corrigan)		CH450 (Corrigan)		CH450 (Corrigan)
Breed (GC)	Breed (GC)	Turner(GC)			
Turner (GC)	Turner (GC)		Turner(GC)		

- **Chemical Engineering Laboratories**
  - Evaporator repairs; steam generator (POCs: Dr. Lundell & Mr. Mathew)

- **ABET Record Year in AY26**
  - Kept CDs with experience in respective course in AY26-1/26-2
  - PEV Visit Fall 2026 (AY27-1)
  - Focus Areas: Bioengineering development, FEE Performance, and Program/Course Assessment

- **ABET Advisory Board Meeting AY26-2 (Friday in April 2026, 10 APR)**
  - Will coordinate dates with Mrs. Costain before contact with Board

- **Chemical Engineering Program Instructor Observation (AY26-1)**

Instructor	Course	Teaching Hours	Observer	Week of
Dr. Biaglow	CH365 Chemical Engineering Thermo	A1, C1	LTC Cowart	6-10 Oct
LTC Cowart	CH485 Heat and Mass Transfer	H2, I2	Dr. Yuk	6-10 Oct
COL James	CH363 Separation Processes	H2, I2	Dr. Biaglow	6-10 Oct
LTC Hummell	CH350 Bioprocess Engineering	G2	Dr. Yuk	6-10 Oct
Dr. Yuk	CH459 Chemical Engineering Lab	C1D1, E1F1	Dr. Biaglow	6-10 Oct
Instructor	**Course**	**Teaching Hours**	**Observer**	**Week of**
MAJ Tobergte	CH101 General Chemistry I	A1B1, C1D1, E1F1	MAJ Lowell	6-10 Oct
MAJ Frey	CH101 General Chemistry I	A1B1, C1D1, E1F1	LTC Cowart	6-10 Oct
MAJ Rogers	CH101 General Chemistry I	A2B2, C2D2, E2F2	Dr. Yuk	6-10 Oct
MAJ Lowell	CH151 (Adv. General Chemistry)	G2, H2	MAJ Tobergte	6-10 Oct
CPT Golonski	CH101 General Chemistry I	A2B2, C2D2, E2F2	Dr. Biaglow	6-10 Oct
CPT Stewart	CH101 General Chemistry I	A2B2, C2D2, E2F2	MAJ Tobergte Y	6-10 Oct
CPT Glinski	CH101 General Chemistry I	A1B1, C1D1, E1F1	LTC Cowart	6-10 Oct

Questions?