



Memo

To: Randy Smith, Vice Provost for Academic Programs, Office of Academic Affairs
From: Rosie Quinzon-Bonello, Assistant Dean for Curriculum and Assessment
Date: March 30, 2023

Re: Program Changes to the Chemical and Biomolecular Engineering BS Program

On March 3, 2023, the College of Engineering Committee for Academic Affairs unanimously approved the following program changes to the Chemical and Biomolecular Engineering BS Program:

- Removal CBE 2345 as a required core course (reduction of 3 credit hours)
- Change to required number of technical elective credit hours from 12 to 15 (gain of 3 credit hours)

There is no change to the total number of credit hours for the degree.

Attached is the proposal that provides details and documentation. Please feel free to contact me should have additional questions.

Yours sincerely,

Rosie Quinzon-Bonello

Cover Letter

Thursday, January 5, 2023

Professor Boyd Panton

Chair of the College Committee for Academic Affairs

Dear Professor Boyd Panton,

We are writing to request that the Committee for Academic Affairs considers the proposed changes to the curriculum for the Department of Chemical and Biomolecular Engineering. The proposed changes include (1) removing CBE 2345 as a required core course (reduction of 3 credit hours); and (2) changing the required number of technical elective credit hours from 12 to 15 (gain of 3 credit hours). The proposed changes will result in no net change in the number of credit hours. We are requesting this change as we work with the Math department to determine how to implement CBE 2345.

We want the proposed changes to be in place for AU 2023. We would like to have this considered as soon as possible so that changes can be made in time for student scheduling for AU 2023.

The reason for the proposed change is that OAA requested we seek concurrence from the Math and Statistics departments. In Fall 2022, we submitted CBE 2345 for concurrence and were granted concurrence from the statistics department, but the math department did not grant concurrence. The math department indicated:

- (1) The topics are mathematical in nature
- (2) Math 3607 covers the content
- (3) Scientific computing is increasingly popular with the potential that more departments will want to offer a course

We have discussed these points in our department. The syllabus for CBE 2345 that we submitted was based on a technical elective course that was being developed in our department. Whereas we had concurrence from other engineering departments, the course did not have university-wide approval. After reviewing the syllabus, we believe that the syllabus needs to be adjusted since (a) the proposed CBE 2345 is expected to be a sophomore level course and the current course was a 5000-level technical elective; (b) the proposed CBE 2345 course is meant to cover computer-based problem-solving methods for Chemical Engineering content; the syllabus needs to reflect the emphasis on Chemical Engineering problems.

We have also reviewed the proposed Math 3607 course and find several challenges to adding this course to our curriculum, including that our students would need to take additional courses as pre-requisites. The Math 3607 course requires: (i) Math 2255, 2415, or 5520H (Differential Equations – 3 credit hours); (ii) Math 2568 or 5520H (Linear Algebra – 3 credit

hours). Please note that Math 5520H appears in both (i) and (ii) and is an Honors class that most of our students would not take. Our students are not required to take either of these courses and instead take Math 2173 as the last math course. These required pre-requisites for Math 3607 would add up to six credit hours to our curriculum, increasing the required number of credit hours from 127 to 133.

We will meet with the Math department to discuss our vision for CBE 2345. We have been working to modify the syllabus over the holiday break. We anticipate meeting with the math department in January to discuss. Since these discussions will take time, we think that it would be best to implement the proposed modifications (i.e., add 3 credit hours of technical elective and remove CBE 2345 as a requirement) so that students have the best outcome.

We do not anticipate a need for a detailed transition plan for this change since CBE 2345 is not currently a required course until AU 2023. The proposed modifications will hopefully happen at the same time that our other approved curriculum modifications will happen (i.e., AU 2023).

The proposed changes were discussed in a faculty meeting before a final vote was recorded to approve the proposed changes with unanimous consent by the faculty (18 votes recorded during the meeting).

Overall, the proposed modification has no impact on the number of credits required for graduation and will allow students flexibility as we make modifications to the curriculum.

If there are any questions, please let us know.

Sincerely,



Nicholas A. Brunelli

Chair of the Curriculum Working Group for Chemical and Biomolecular Engineering

(1) Proposed change: Removal of course – Computational Methods for Chemical Engineers – 3 credit hours (CBE 2345)

Rationale: OAA has indicated that the course requires concurrence from the Math and Stats department. We have received concurrence from the Stats department, but we are working with the math department to gain concurrence for CBE 2345 or identify an alternative course.

Present curriculum: See attached BINGO sheets.

Syllabus for new course: See attached.

(2) Proposed change: Increase the technical elective credit hours from 12 to 15.

Rationale: Our short term goal is to maintain the total credit hours required for graduating from the CBE department at 127. Since we are subtracting 3 credit hours (proposed change 1), this proposed change would increase the technical elective credit hours to maintain the total at 127 credit hours.

Present curriculum: See attached BINGO sheets.

Syllabus for new course: See attached.

Student Information

Name: _____ OSU ID: _____ OSU Admit Term: _____

Phone: _____ Email (*name.number@osu.edu*): _____

Suggested Curriculum

This should be used as a **guide** only. Semester offerings are subject to change.

Year	Autumn	Spring
1	___ CHEM 1210 (<i>Gen Chem I</i>)..... 5 hr ___ MATH 1151 (<i>Calculus I</i>) 5 hr ___ ENGR 1181.xx (<i>Fundamentals of ENGR I</i>) 2 hr ___ ENGR 1100.15 (<i>Engineering Survey</i>) 1 hr ___ General Education 1 hr	___ CHEM 1220 (<i>Gen Chem II</i>)..... 5 hr ___ MATH 1172 (<i>Engineering Math A</i>)..... 5 hr ___ ENGR 1182.xx (<i>Fundamentals of ENGR II</i>)..... 2 hr ___ Engr 1221..... 2 hr ___ General Education..... 3 hr
2	___ CHEM 2510 (<i>Organic Chemistry I</i>)..... 4 hr ___ MATH 2173 (<i>Mathematical Topics for Engineers</i>) 3 hr ___ PHYSICS 1250 (<i>Mechanics, Thermal, Waves</i>)..... 5 hr ___ CBE 2200 (<i>Process Fundamentals</i>)..... 3 hr	___ CHEM 2520 (<i>Organic Chemistry II</i>)..... 4 hr ___ CHEM 2540 (<i>Organic Chemistry Lab I</i>)..... 2 hr ___ CBE 2100 (<i>Chemical Engineering Seminar</i>)..... 1 hr ___ CBE 2345 (<i>Computational Methods for ChE</i>)..... 3 hr ___ CBE 3508 (<i>Thermodynamics I</i>)..... 3 hr
3	___ CBE 2420 (<i>Transport Phenomena I</i>)..... 3 hr ___ CBE 2523 (<i>Separation Processes</i>)..... 3 hr ___ CBE 3509 (<i>Thermodynamics II</i>)..... 3 hr ___ CBE 5779 or Math/Stats Technical Elective 3 hr ___ General Education 3 hr ___ General Education 3 hr	___ CHEM 4300 (<i>Physical Chemistry I</i>)..... 3 hr ___ CBE 3421 (<i>Transport Phenomena II</i>)..... 3 hr ___ CBE 3610 (<i>Kinetics and Reactor Design</i>)..... 3 hr ___ CBE 3730 (<i>Unit Operations Lab I</i>)..... 1 hr ___ Technical Elective 3 hr ___ General Education 3 hr
4	___ CBE 3422 (<i>Transport Phenomena III</i>)..... 3 hr ___ CBE 3731 (<i>Unit Operations Lab II</i>)..... 1 hr ___ CBE 4760 (<i>Process Design, Econ, & Strategy</i>)..... 3 hr ___ Technical Elective 3 hr ___ General Education 4 hr ___ General Education 3 hr	___ CBE 3732 (<i>Unit Operations Lab III</i>)..... 2 hr ___ CBE 4624 (<i>Process Dynamics and Control</i>)..... 3 hr ___ CBE 4755 (<i>Process Safety</i>)..... 2 hr ___ CBE 4764 (<i>Process Sim & Product Eng</i>)..... 3 hr ___ Technical Elective 3 hr ___ General Education 4 hr

Total Hours to complete the degree program = 127

Program Options

Students wishing to complete the biomolecular focus will substitute Biochemistry 4511 in place of Chemistry 2520.

Acceptance Criteria

Acceptance into this program is based on a holistic review of the student's record including an essay. Admission to major is considered only after a student has taken at least 12 credit hours of letter grade in their undergraduate career at OSU and have completed the following courses: MATH 1151, 1172; ENGR 1181, 1182; Chem 1220, (or their equivalents).

Applications are accepted Autumn and Spring semester ONLY. Students must complete the online Major Application the semester in which the student is completing their pre-major requirements (i.e. the semester before the student wants to enter the major).

Technical and Other Electives

Students have the option to complete a biomolecular, environmental, or polymer focus for their technical elective plan. Each focus will require the completion of two approved courses in CBE plus one additional course in CBE or in another department. All students will also be required to complete one math or statistics technical elective.

- ___ CBE XXXX.....(3 hr)
___ CBE XXXX.....(3 hr)
___ CBE 5779 or Math/Stat elective.....(2-4 hr)
___ Additional Course XXXX(2-4 hr)
___ **Total Hours (minimum of 12 are required)**

General Education Requirements

Launch Seminar

GENED 1201 1 hr

Foundations

Complete all of the following.

Writing and Information Literacy 3 hr
Historical and Cultural Studies 3 hr
Social and Behavioral Sciences 3 hr
Race, Ethnicity, and Gender Diversity 3 hr
Literary, Visual, and Performing Arts 3 hr

Thematic Pathways

Citizenship for a Just and Diverse World 4-6 hr
Additional Theme(s) 4-6 hr

B.S. Chemical Engineering Proposed Changes

Student Information

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___ CBE XXXX.....(3 hr)
___ CBE 5779 or Math/Stat elective.....(2-4 hr)
___ Additional Course XXXX(2-4 hr)
___ **Total Hours (minimum of 12 are required)**

General Education Requirements

Launch Seminar

GENED 1201	1 hr
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Foundations

Complete all of the following.

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Historical and Cultural Studies	3 hr
Social and Behavioral Sciences	3 hr
Race, Ethnicity, and Gender Diversity	3 hr
Literary, Visual, and Performing Arts	3 hr

Thematic Pathways

Citizenship for a Just and Diverse World	4-6 hr
Additional Theme(s)	4-6 hr

CBE 2345 (Approved): Computational Methods for Chemical Engineering

Course Description

Application of a diverse set of numerical methods and algorithms to chemical engineering problems including algebraic/differential equation solving, numerical optimization, and fundamental concepts in machine learning. Implementation of these methods in high-level programming languages (Matlab and Python) will also be discussed

Transcript Abbreviation: ChE Comp Methods

Grading Plan: Letter Grade

Course Deliveries: Classroom

Course Levels: Undergrad

Student Ranks: Sophomore, Junior

Course Offerings: Autumn, Spring

Flex Scheduled Course: Never

Course Frequency: Every Year

Course Length: 14 Week

Credits: 3.0

Repeatable: No

Time Distribution: 3.0 hr Lec

Expected out-of-class hours per week: 6.0

Graded Component: Lecture

Credit by Examination: No

Admission Condition: No

Off Campus: Never

Campus Locations: Columbus

Prerequisites and Co-requisites: Pre-req: 2200

Exclusions:

Cross-Listings:

Course Rationale: To meet a future skill demand and to model the programs of several peer institutions.

Please see the curriculum change proposal for more detail.

The course is required for this unit's degrees, majors, and/or minors: Yes

The course is a GEC: No

The course is an elective (for this or other units) or is a service course for other units: No

Subject/CIP Code: 14.0701

Subsidy Level: Baccalaureate Course

Programs

Abbreviation	Description
CBE	Chemical and Biomolecular Eng

Course Goals

introduce students to a variety of different computational methods/algorithms to develop solutions to these types of challenging problems that commonly arise when modeling chemical and biomolecular systems

equip students with the ability to apply and implement these algorithms on a computer using a programming environment (such as Matlab or Python) as well as visualize the corresponding solutions

cover concepts to be applicable within junior and senior level CBE courses and undergraduate research projects, as well as help students read/interpret technical scientific and engineering literature.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Matlab tutorial & errors in computer simulations	3.0							
Linear systems and matrices	3.0							
Eigenvalues, eigenvectors, spectral decomposition	3.0							
Linear algebraic equations (elimination methods)	2.0							
Linear algebraic equations (iterative methods)	2.0							
Nonlinear algebraic equations (Newtons method)	2.0							
Nonlinear algebraic equations (Quasi-Newtons method)	3.0							
Numerical optimization (linear programming)	3.0							
Numerical optimization (nonlinear programming, concepts and algorithms)	2.0							
Random variables & probability distribution functions	3.0							
Conditional random variables & Bayes rule	1.5							
Regression and curve fitting (least squares, regularization, cross-validation)	1.5							
Ordinary differential equations (finite difference, Euler & Runge-Kutta methods, Stability & stiffness)	1.5							
Numerical integration (trapezoidal and Simpsons method, Monte Carlo)	3.0							
Differential algebraic equations (introduction & applications)	1.5							
Differential algebraic equations (index & solution methods)	1.5							
Boundary value problems (shooting methods, finite difference & collocation)	1.5							

Grades

Aspect	Percent
Homework	30%
Midterms	40%
Final exam	30%

Representative Textbooks and Other Course Materials

Title	Author
<i>A Numerical Primer for the Chemical Engineer, 2nd Edition</i>	Zondervan

ABET-EAC Criterion 3 Outcomes

Course Contribution	College Outcome
***	1 an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics - pre-2019 EAC SLOs (a) and (e); (k) is implied

Course Contribution		College Outcome
*	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors - pre-2019 EAC SLO (c); (k) is implied
	3	an ability to communicate effectively with a range of audiences - pre-2019 EAC SLO (g)
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts - pre-2019 EAC SLOs (f) (h) and (j)
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives - pre-2019 EAC SLO (d)
***	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions - pre-2019 EAC SLO (b); (k) is implied
**	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies - pre-2019 EAC SLO (i)

Additional Notes or Comments

Concurrence from CSE:

From: Teodorescu, Radu <teodores@cse.ohio-state.edu>

Date: Thursday, November 11, 2021 at 11:18 AM

To: Chalmers, Jeffrey <chalmers.1@osu.edu>, Brunelli, Nick <brunelli.2@osu.edu>

Cc: Sivilotti, Paul <paolo@cse.ohio-state.edu>

Subject: Re: CBE 2345 Concurrence

Dear Nicholas and Jeff,

On behalf of the CSE Curriculum Committee, I am happy to offer concurrence to CBE 2345 Computational Methods for Chemical Engineering as outlined in the syllabus we received.

Good luck with the course!

Best regards,

--Radu

Radu Teodorescu

Professor

Computer Science and Engineering

The Ohio State University

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Prepared by: Brian Endres