NOT FOR USE FOR CURRICULAR COURSE CHANGES
REQUEST FOR PROGRAM IMPROVEMENTS

NOTE: Changes to programs may require course changes, which must be processed electronically. Any questions should be directed to Associate Provost David Reinhold at 7-4564 or david.reinhold@wmich.edu

DEPARTMENT: CHP
PROPOSED EFFECTIVE FALL YEAR: 2020

PROPOSED IMPROVEMENTS: Academic Program Proposed Improvements
- ☐ New degree*
- ☐ New major*
- ☐ New curriculum*
- ☐ New concentration*
- ☐ New certificate*
- ☐ New minor*
- ☐ Deletion*

☐ Admission
☐ Graduation
X Revised major
☐ Revised minor
☐ Change in Title
☐ Transfer

☐ Other (explain**)
** Other: Incorporation of WMU Essential Studies Requirements replacing the current general education requirements

Title of degree, curriculum, major, minor, concentration, or certificate: B.SE in Chemical Engineering

Chair, Department Curriculum Committee: [Signature] Date: 10/15/19

CHECKLIST FOR DEPARTMENT CHAIRS/DIRECTORS
- ☐ For new programs and other changes that have resource implications, the dean has been consulted.
- ☐ When appropriate, letters of support from department faculty are attached.
- ☐ When appropriate, letters of support from other departments in the same college are attached.
- ☐ When appropriate, letters of support from other college deans, whose programs/courses may be affected by the change, are attached.
- ☐ The proposal has been reviewed by HIGE for possible implications for international student enrollment.
- ☐ The proposal is consistent with the departmental assessment plan, and identifies measurable learning outcomes for assessment.
- ☐ Detailed resource plan is attached where appropriate.
- ☐ All questions attached have been completed and supporting documents are attached.
- ☐ The proposal is written and complete as outlined in the Faculty Senate guidelines and the curriculum change guides.

Chair/Director: [Signature] Date: 10/15/19

CHECKLIST FOR COLLEGE CURRICULUM COMMITTEE
- ☐ The academic quality of the proposal and the faculty involved has been reviewed.
- ☐ Detailed resource plan is attached where appropriate.
☐ Consistency between the proposal and the relevant catalog language has been confirmed.
☐ The proposal has been reviewed for effect on students transferring from Michigan community colleges.
Detailed information on transfer articulation must be included with undergraduate proposals.
☐ Consistency between the proposal and the College and department assessment plans has been confirmed.
☐ Consistency between the proposal and the College and department strategic plans has been confirmed.
☐ All questions attached have been completed and supporting documents are attached.
☐ The proposal is written and complete as outlined in the Faculty Senate guidelines and the curriculum change guides.

Chair, College Curriculum Committee: ___________________________ Date

NOT FOR USE FOR CURRICULAR COURSE CHANGES
REQUEST FOR PROGRAM IMPROVEMENTS

CHECKLIST FOR COLLEGE DEANS
☐ For new programs and proposed program deletions, the provost has been consulted.
☐ For new programs, letter of support from University Libraries Dean indicating library resource requirements have been met.
☐ When appropriate, letters of support from other college faculty and/or chairs are attached.
☐ When appropriate, letters of support from other college deans, whose programs/courses may be affected by the change, are attached.
☐ The proposal has been reviewed for implications for accreditation, certification, or licensure.
☐ Detailed resource plan is attached where appropriate.
☐ All questions attached have been completed and supporting documents are attached.
☐ The proposal is written and complete as outlined in the Faculty Senate guidelines and the curriculum change guides.

Dean: ___________________________ Date

FOR PROPOSALS REQUIRING REVIEW BY:
GSC/USC; EPGC, GRADUATE COLLEGE, and/or FACULTY SENATE EXECUTIVE BOARD

☐ Return to Dean
☐ Forward to: Curriculum Manager: ___________________________ Date:

☐ Approve ☐ Disapprove *needs review by Chair, GSC/USC: ___________________________ Date
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REQUEST FOR PROGRAM IMPROVEMENTS

1. Explain briefly and clearly the proposed improvement:

   To update the curriculum replacing the current general education requirements with those of Western Essential Studies, the program is modified to remove ECON 2010 from the program requirements. The details are attached in the catalog copy with changes tracked suitably. **Updated program content is mainly to address WMU Essential Studies Program requirements.**

2. Rationale. Give your reason(s) for the proposed improvement.

   Modification of the curriculum to meet the requirements of Western Essential Studies, without changing the overall credit requirements of the program or the credit requirements of the different options in the program. The content of ECON 2010 is otherwise met in the program through various other courses. **It is required to remove references to general education requirements and update with WMU Essential Studies Program requirements**

3. Effect on other colleges, departments, or programs. If consultation with others is required, attach evidence of consultation and support. If objections have been raised, document the resolution. Demonstrate that the program you propose is not a duplication of an existing one.

   **No significant changes foreseen, as we are not increasing the overall credit load for the student in the “gen.ed.” category.**

4. Effect on your department's programs. Show how the proposed change fits with other departmental offerings.

   **No change is expected as we keep all the required courses as well as option credits in the program.**

5. Alignment with college's and department's strategic plan, mission, and vision.

   **Provides broad-based liberal arts education for civil engineering students and supports both ABET requirements and ASCE Body of Knowledge recommendations to ensure we graduate well-rounded civil engineers ready to lead challenges facing our society.**

6. Effects on enrolled students: Are program conflicts avoided? Will your proposal make it easier or harder for students to meet graduation requirements? Can students complete the program in a reasonable time? Show that you have considered scheduling needs and demands on students' time.

   **No effect on enrolled students as they will continue under the catalog year with which they entered. A deliberate transition will occur university-wide to address any issues that arise for current students. They will be taking the same number of program required courses outside of their WES courses and the overall credit hour requirements will not increase.**

7. Student or external market demand. What is your anticipated student audience? What evidence of student or market demand or need exists? What is the estimated enrollment? What other factors make your proposal beneficial to students?

   **No change**

8. Effects on resources. Explain how your proposal would affect department and University resources, including faculty, equipment, space, technology, and library holdings. If proposing a new program, include a letter and/or email of support from the university libraries affirming that the library resource issues have been reviewed. Tell how you will staff additions to the program. If more advising will be needed, how will you provide for it? What will be the initial one-time costs
None. All revisions to the civil engineering program in response to the new WMU Essential Studies Program were coordinated across the college and university through the WMU Essential Studies Program design.

9. List the learning outcomes for the revised or proposed major, minor, or concentration. The department will use these outcomes for future assessments of the program.

**No change to program outcomes. They remain the same as before and they are:**

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
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.
3. an ability to communicate effectively with a range of audiences.
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.
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.
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

10. Describe how this change is a response to assessment outcomes that are part of a department or college assessment plan or informal assessment activities.

**The changes were in response to a university-wide revised general education program.**

11. (Undergraduate proposals only) Describe in detail how this change affects transfer articulation for Michigan community colleges. For new majors or minors, describe transfer guidelines to be developed with Michigan community colleges. For revisions to majors or minors, describe necessary revisions to Michigan community college guidelines. Department chairs should seek assistance from college advising directors or from the admissions office in completing this section.

**This aspect is being addressed by the Director of the WMU Essential Studies Program, the Associate Provost for Assessment and Undergraduate Studies, and the advising staff.**

12. Please offer both "Current Catalog Language" and "Proposed Catalog Language" if there is to be a change in the catalog description for a given program. For the "current" language, please copy and paste relevant language from the most current catalog and for the "proposed" language, please share the exact proposed new catalog language. As possible, bold or otherwise note the key changes in the new proposed catalog language.

Attached.
Chemical Engineering

Return to: Departments and Programs

Program Educational Objectives: Our graduates are expected within a few years of graduation to attain the following career growth, professional development, innovation, and service:

Career Growth: graduates are expected to attain: proficiency in current position, increasing responsibility, divisional recognition, progression or job advancement.
Professional Development: graduates are expected to attain: pursuit of additional educational activities, professional leadership opportunities.
Service: graduates are expected to have involvement in the local community, professional societies, K-12 education, and humanitarian endeavors.
Innovation and entrepreneurship: graduates are expected to attain: expertise in problem solving, new process, device or patent creation or in founding a business.
(For up-to-date educational objectives and learning outcomes, see the program’s web page at http://wmich.edu/pci/academics/chemical.html)

Admission
To be admitted to this engineering curriculum, a student must complete all pre-engineering requirements with a grade of “C” or better. These requirements may be found in the beginning of the College of Engineering and Applied Sciences section of the Undergraduate Bulletin. Students seeking admission to this curriculum must submit an application following procedures established by the department of Engineering and Applied Sciences. Upper level transfer students should complete an application prior to their enrollment. Only students in good academic standing, as defined by the University, will be admitted to this curriculum.

Baccalaureate-Level Writing Requirement
Students who have chosen the Chemical Engineering major will satisfy the Baccalaureate-Level Writing requirement by completing CHEG 4870: Senior Design Project.

Requirements
Candidates for the Bachelor of Science in Engineering (Chemical) degree must satisfy the following requirements set by Western Michigan University:

The requirement of departmental prefixed prerequisite will not be fulfilled with a grade less than “C”. Requency policy must follow the departmental appeal policy (available in the department office). If an exception is granted, that the less than “C” grade be replaced within two regular semesters.
No more than two grades of “D” or “DC” may be presented for graduation.
The Chemical Engineering curriculum requires students to complete a course in General Education Area I, Area II, Area V, and Area VIII. At least two of the General Education Area courses must be at the 3000/4000-level, and courses from any one department may be used to satisfy the Area requirements. Chemical Engineering major: ECON 2010 for Area V.
Students must complete the following program of 135 semester credit hours, which includes the courses in or presented below at the end of the 8-semester example schedule. One emphasis area must be selected and take schedules below are examples leading to graduation in eight semesters, beginning in fall. However, depending on curricular and scheduling needs, the program can take more than eight semesters.

**First Semester (17 hours)**

General Education Area I: Fine Arts*  **Credits: 3 hours**

The following courses are pre-engineering requirements:

- CHEG 1010 - Introduction to Chemical Engineering  **Credits: 3 hours**
- CHEM 1100 - General Chemistry I  **Credits: 3 hours**
- CHEM 1110 - General Chemistry Laboratory I  **Credits: 1 hour**
- IEE 1020 - Technical Communication  **Credits: 3 hours**
- MATH 1220 - Calculus I  **Credits: 4 hours**
  or
- MATH 1700 - Calculus I, Science and Engineering  **Credits: 4 hours**

**Second Semester (18 hours)**

General Education Area III: United States: Cultures and Issues*  **Credits: 3 hours**

The following courses are pre-engineering requirements:

- CHEG 1810 - Introduction to Chemical Engineering Computation  **Credits: 2 hours**
- CHEM 1120 - General Chemistry II  **Credits: 3 hours**
- CHEM 1130 - General Chemistry Laboratory II  **Credits: 1 hour**
- MATH 1230 - Calculus II  **Credits: 4 hours**
  or
- MATH 1710 - Calculus II, Science and Engineering  **Credits: 4 hours**
- PHYS 2050 - University Physics I  **Credits: 4 hours**
- PHYS 2060 - University Physics I Laboratory  **Credits: 1 hour**

**Third Semester (17 hours)**

Emphasis Elective  **Credits: 4 hours**
- CHEG 2810 - Data Acquisition and Handling  **Credits: 1 hour**

Pre-engineering requirement
- IEE 2610 - Engineering Statistics  **Credits: 3 hours**
- MATH 2720 - Multivariate Calculus and Matrix Algebra  **Credits: 4 hours**

Pre-engineering requirement
- PHYS 2070 - University Physics II  **Credits: 4 hours**
- PHYS 2080 - University Physics II Laboratory  **Credits: 1 hour**

**Fourth Semester (19 hours)**

Emphasis Elective  **Credits: 4 hours**
- BIOS 1610 - Molecular and Cellular Biology  **Credits: 4 hours**
CHEG 2611 - Environmental Engineering | Credits: 3 hours  
CHEG 2960 - Material and Energy Balance | Credits: 4 hours  
MATH 3740 - Differential Equations and Linear Algebra | Credits: 4 hours

**Fifth Semester (15 hours)**

General Education Area VIII: Health and Well-being* | Credits: 2 hours  
CHEG 3110 - Unit Operations in Chemical Engineering | Credits: 3 hours  
CHEG 3200 - Chemical Engineering Thermodynamics | Credits: 3 hours  
CHEG 3810 - Computer Modeling and Simulation - Chemical Processes | Credits: 1 hour  
CHEM 4300 - Physical Chemistry I | Credits: 3 hours  
ECON 2010 - Principles of Microeconomics | Credits: 3 hours

**Sixth Semester (16 hours)**

General Education Area III: Humanities* | Credits: 3 hours  
CHEG 3120 - Unit Operations in Chemical Engineering II | Credits: 3 hours  
CHEG 3300 - Mass Transfer | Credits: 3 hours  
CHEG 3550 - Bioprocess Engineering | Credits: 3 hours  
CHEM 3750 - Organic Chemistry I | Credits: 3 hours  
CHEM 3760 - Organic Chemistry Lab | Credits: 1 hour

**Seventh Semester (17 hours)**

Emphasis Elective | Credits: 3 hours  
CHEG 4100 - Chemical Reaction Engineering | Credits: 3 hours  
CHEG 4600 - Plant Economics and Project Design | Credits: 3 hours  
CHEG 4830 - Process Control I | Credits: 4 hours  
CHEM 3770 - Organic Chemistry II | Credits: 3 hours  
CHEM 3780 - Organic Chemistry Lab II | Credits: 1 hour

**Eighth Semester (16 hours)**

Emphasis Elective | Credits: 6 hours  
General Education Area IV: Other Cultures and Civilizations* | Credits: 4 hours  
CHEG 4400 - Safety and Hazards Management in Chemical Processes | Credits: 1 hour  
CHEG 4810 - Unit Operations Lab: Fluid Flow, Heat and Mass Transfer | Credits: 2 hours  
CHEG 4870 - Senior Design Project | Credits: 3 hours

**Emphasis Areas**

**Emphasis in Energy Management (17 hours minimum)**

**Required Courses (3 credit hours)**

CHEG 4440 - Energy Management Engineering | Credits: 3 hours

**Elective Courses (choose 14 hours minimum)**
CHEG 5200 - Renewable Energy and Energy Storage Credits: 3 hours
CHEG 5250 - Sustainable Earth Resources Engineering Credits: 3 hours
CHEG 5950 - Topics in Chemical Engineering Credits: 1 to 3 hours
CHP 3100 - Work Experience/Co-op Credits: 1 hour
ECE 2100 - Circuit Analysis Credits: 4 hours
ECE 2110 - Machines and Electronic Circuits Credits: 3 hours
EDMM 1420 - Engineering Graphics Credits: 3 hours
ME 4320 - Thermodynamics II Credits: 3 hours
ME 4330 - Environmental Systems Design in Buildings Credits: 3 hours
ME 4390 - Design of Thermal Systems Credits: 3 hours

**Emphasis in Life Sciences (17 hours minimum)**

Including at least one 3000-level course (not including CHP 3100):

BIOS 1620 - Ecology and Evolution Credits: 4 hours
BIOS 2110 - Human Anatomy Credits: 4 hours
BIOS 2320 - Microbiology and Infectious Diseases Credits: 4 hours
BIOS 2400 - Human Physiology Credits: 4 hours
BIOS 2500 - Genetics Credits: 4 hours
BIOS 3500 - Human Physiology for Majors Credits: 5 hours
BIOS 5310 - Biology of Aging Credits: 3 hours
BIOS 5610 - Pharmacology Credits: 3 hours
BIOS 5970 - Topics in Biological Sciences Credits: 3 to 4 hours
CHEG 5100 - Medical and Biomolecular Engineering Concepts Credits: 3 hours
CHEG 5950 - Topics in Chemical Engineering Credits: 1 to 3 hours
CHEM 3550 - Introductory Biochemistry Credits: 3 hours
CHP 3100 - Work Experience/Co-op Credits: 1 hour

**Emphasis in Pollution Prevention and Sustainability (17 hours minimum)**

**Required Courses (3 credit hours)**

CHEG 4440 - Energy Management Engineering Credits: 3 hours

**Elective Courses (14 credit hours minimum)**

CHEG 5200 - Renewable Energy and Energy Storage Credits: 3 hours
CHEG 5250 - Sustainable Earth Resources Engineering Credits: 3 hours
CHEG 5950 - Topics in Chemical Engineering Credits: 1 to 3 hours
CHP 3100 - Work Experience/Co-op Credits: 1 hour
PAPR 3531 - Wastewater Treatment Systems Credits: 3 hours
ECON 3190 - Environmental Economics Credits: 3 hours
BIOS 2320 - Microbiology and Infectious Diseases Credits: 4 hours
CHEM 2250 - Quantitative Analysis Credits: 3 hours
CHEM 2260 - Quantitative Analysis Laboratory Credits: 1 hour
CHEM 3550 - Introductory Biochemistry Credits: 3 hours
CHEM 3560 - Introductory Biochemistry Laboratory Credits: 1 hour
IEE 3100 - Engineering Economy **Credits**: 3 hours  
**Emphasis in Pulp and Paper (17 hours minimum)**

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<th>Course Title</th>
<th>Credits</th>
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<td>CHP 3100</td>
<td>Work Experience/Co-op</td>
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<tr>
<td>CHEG 5950</td>
<td>Topics in Chemical Engineering</td>
<td>1 to 3 hours</td>
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<td>PAPR 1000</td>
<td>Introduction to Pulp and Paper Manufacture</td>
<td>3 hours</td>
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<td>PAPR 2040</td>
<td>Stock Preparation and Papermaking</td>
<td>4 hours</td>
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<td>PAPR 2420</td>
<td>Coating</td>
<td>4 hours</td>
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<td>PAPR 2550</td>
<td>Paper Physics Fundamentals</td>
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<td>PAPR 3030</td>
<td>Pulping and Bleaching</td>
<td>4 hours</td>
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<tr>
<td>PAPR 4300</td>
<td>Surface and Wet End Science</td>
<td>3 hours</td>
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Chemical Engineering

Revised to: Departments and Programs

Program Educational Objectives: Our graduates are expected within a few years of graduation to attain the following in the areas of career growth, professional development, innovation, and service:

Career Growth: graduates are expected to attain: proficiency in current position, increasing responsibility, diversity of job functions, recognition, progression or job advancement.
Professional Development: graduates are expected to attain: pursuit of additional educational activities, professional certifications or leadership opportunities.
Service: graduates are expected to have involvement in the local community, professional societies, K-12 education, industry or humanitarian endeavors.
Innovation and entrepreneurship: graduates are expected to attain: expertise in problem solving, new process, or methods development, in device or patent creation or in founding a business.
(For up-to-date educational objectives and learning outcomes, see the program’s web page at http://wmich.edu/ce/academics/chemical.html)

Admission
To be admitted to this engineering curriculum, a student must complete all pre-engineering requirements with grades of “C” or better. These requirements may be found in the beginning of the College of Engineering and Applied Sciences section of this catalog. Students seeking admission to this curriculum must submit an application following procedures established by the College of Engineering and Applied Sciences. Upper level transfer students should complete an application prior to their first semester of enrollment. Only students in good academic standing, as defined by the University, will be admitted to this curriculum.

WMU Essential Studies Program Requirements

Students who have chosen the Chemical Engineering curriculum will satisfy the WMU Essential Studies Program Requirements as outlined within the course listings below. To satisfy these requirements students take courses in twelve (12) categories. Six (6) of the courses are designated within the civil engineering program requirements and six (6) are free electives which students choose from a list of courses in the corresponding course category. Students will meet the planetary sustainability outcome in CHEG 4870 Senior Design Project and must select a course that satisfies the Diversity and Inclusion outcome when choosing a course in the other six (6) categories.

Requirements
Candidates for the Bachelor of Science in Engineering (Chemical) degree must satisfy the following requirements in addition to those required by Western Michigan University:

The requirement of departmental prefixed prerequisite will not be fulfilled with a grade less than “C”. Requests for exceptions must follow the departmental appeal policy (available in the department office). If an exception is granted, the student will replace the less than “C” grade within two regular semesters.

No more than two grades of “D” or “DC” may be presented for graduation.

Students must complete the following program of 135 credit hours, which includes the courses in one of the Emphasis options below at the end of the 8-semester example schedule. One emphasis area must be selected and taken in its entirety.
are examples leading to graduation in eight semesters, beginning in fall. However, depending on the individual's curricular and scheduling needs, the program can take more than eight semesters.

**First Semester (17 hours)**

The following courses are pre-engineering requirements:

- WMU Essential Studies Level 1: Inquiry and Engagement Course Elective Credits: 3 hours
- CHEG 1010 - Introduction to Chemical Engineering Credits: 3 hours
- CHEM 1100 - General Chemistry I Credits: 3 hours
- CHEM 1110 - General Chemistry Laboratory I Credits: 1 hour
- IEE 1020 - Technical Communication Credits: 3 hours
  *(Satisfies WMU Essential Studies Level 1: Writing Course Requirement)*
- MATH 1220 - Calculus I Credits: 4 hours
- or
- MATH 1700 - Calculus I, Science and Engineering Credits: 4 hours
  *(Satisfies WMU Essential Studies Level 1: Quantitative Literacy Course Requirement)*

**Second Semester (18 hours)**

The following courses are pre-engineering requirements:

- WMU Essential Studies Level 2: Artistic Theory and Practice Course Elective Credits: 3 hours
- CHEG 1810 - Introduction to Chemical Engineering Computation Credits: 2 hours
- CHEM 1120 - General Chemistry II Credits: 3 hours
- CHEM 1130 - General Chemistry Laboratory II Credits: 1 hour
- MATH 1250 - Calculus II Credits: 4 hours
- or
- MATH 1710 - Calculus II, Science and Engineering Credits: 4 hours
- PHYS 2050 - University Physics I Credits: 4 hours
  *(Satisfies WMU Essential Studies Level 2: Laboratory-Science Course Requirement)*
- PHYS 2060 - University Physics I Laboratory Credits: 1 hour
  *(Satisfies WMU Essential Studies Level 2: Laboratory Science Course Requirement)*

**Third Semester (17 hours)**

- Emphasis Elective Credits: 4 hours
- CHEG 2010 - Data Acquisition and Handling Credits: 1 hour
- Pre-engineering requirement
- IEE 2810 - Engineering Statistics Credits: 3 hours
  *(Satisfies WMU Essential Studies Level 2: Oral and Digital Communication Course Requirement)*
- MATH 2720 - Multivariate Calculus and Matrix Algebra Credits: 4 hours
- Pre-engineering requirement
- PHYS 2070 - University Physics II Credits: 4 hours
- PHYS 2080 - University Physics II Laboratory Credits: 1 hour

**Fourth Semester (19 hours)**
- Emphasis Elective  Credits: 4 hours
- BIOS 1610 - Molecular and Cellular Biology Credits: 4 hours
- CHEG 2811 - Environmental Engineering I Credits: 3 hours
  Satisfies WMU Essential Studies Level 2: Science and Technology Course Requirement
- CHEG 2860 - Material and Energy Balance Credits: 4 hours
- MATH 3740 - Differential Equations and Linear Algebra Credits: 4 hours

**Fifth Semester (16 hours)**

- WMU Essential Studies Level 2: Personal Wellness Course Elective  Credits: 3 hours
- CHEG 3110 - Unit Operations in Chemical Engineering I Credits: 3 hours
- CHEG 3200 - Chemical Engineering Thermodynamics Credits: 3 hours
- CHEG 3410 - Computer Modeling and Simulation - Chemical Processes Credits: 1 hour
- CHEM 4900 - Physical Chemistry I Credits: 3 hours
- WMU Essential Studies Level 2: World Language and Cultures Course Elective  Credits: 3 hours

**Sixth Semester (16 hours)**

- WMU Essential Studies Level 2: Societies and Cultures Course Elective  Credits: 3 hour
- CHEG 3120 - Unit Operations in Chemical Engineering II Credits: 3 hours
- CHEG 3300 - Mass Transfer Credits: 3 hours
- CHEG 3550 - Bioprocess Engineering Credits: 3 hours
- CHEM 3750 - Organic Chemistry I Credits: 3 hours
- CHEM 3780 - Organic Chemistry Lab I Credits: 1 hour

**Seventh Semester (17 hours)**

- Emphasis Elective  Credits: 3 hours
- CHEG 4100 - Chemical Reaction Engineering Credits: 3 hours
- CHEG 4800 - Plant Economics and Project Design Credits: 3 hours
- CHEG 4830 - Process Control I Credits: 4 hours
- CHEM 3770 - Organic Chemistry II Credits: 3 hours
- CHEM 3780 - Organic Chemistry Lab II Credits: 1 hour

**Eighth Semester (15 hours)**

- Emphasis Elective  Credits: 6 hours
- WMU Essential Studies Level 3: Global Perspectives Course Elective  Credits: 3 hours
- CHEG 4400 - Safety and Hazard Management in Chemical Processes Credits: 1 hour
- CHEG 4510 - Unit Operations Lab: Fluid Flow, Heat and Mass Transfer Credits: 2 hours
- CHEG 4870 - Senior Design Project Credits: 3 hours

  Satisfies WMU Essential Studies Level 3: Local and National Perspectives Course Requirement and the required Planetary Sustainability outcome.

**Emphasis Areas**

- Emphasis in Energy Management (17 hours minimum)
### Required Courses (3 credit hours)

- **CHEG 4440 - Energy Management Engineering** Credits: 3 hours

### Elective Courses (choose 14 hours minimum)

- **CHEG 5200 - Renewable Energy and Energy Storage** Credits: 3 hours
- **CHEG 5250 - Sustainable Earth Resources Engineering** Credits: 3 hours
- **CHEG 5850 - Topics in Chemical Engineering** Credits: 1 to 3 hours
- **CHP 3100 - Work Experience/Co-op** Credits: 1 hour
- **ECE 2100 - Circuit Analysis** Credits: 4 hours
- **ECE 2110 - Machines and Electronic Circuits** Credits: 3 hours
- **EDMM 1420 - Engineering Graphics** Credits: 3 hours
- **ME 4320 - Thermodynamics II** Credits: 3 hours
- **ME 4330 - Environmental Systems Design in Buildings** Credits: 3 hours
- **ME 4390 - Design of Thermal Systems** Credits: 3 hours

### Emphasis in Life Sciences (17 hours minimum)

Including at least one 3000-level course (not including CHP 3100):

- **BIOS 1620 - Ecology and Evolution** Credits: 4 hours
- **BIOS 2110 - Human Anatomy** Credits: 4 hours
- **BIOS 2320 - Microbiology and Infectious Diseases** Credits: 4 hours
- **BIOS 2400 - Human Physiology** Credits: 4 hours
- **BIOS 2500 - Genetics** Credits: 4 hours
- **BIOS 3500 - Human Physiology for Majors** Credits: 5 hours
- **BIOS 5310 - Biology of Aging** Credits: 3 hours
- **BIOS 5610 - Pharmacology** Credits: 3 hours
- **BIOS 5970 - Topics in Biological Sciences** Credits: 3 to 4 hours
- **CHEG 5100 - Medical and Biomolecular Engineering Concepts** Credits: 3 hours
- **CHEG 5950 - Topics in Chemical Engineering** Credits: 1 to 3 hours
- **CHEM 3550 - Introductory Biochemistry** Credits: 3 hours
- **CHP 3100 - Work Experience/Co-op** Credits: 1 hour

### Emphasis in Pollution Prevention and Sustainability (17 hours minimum)

### Required Courses (3 credit hours)

- **CHEG 4440 - Energy Management Engineering** Credits: 3 hours

### Elective Courses (14 credit hours minimum)

- **CHEG 5200 - Renewable Energy and Energy Storage** Credits: 3 hours
- **CHEG 5250 - Sustainable Earth Resources Engineering** Credits: 3 hours
- **CHEG 5850 - Topics in Chemical Engineering** Credits: 1 to 3 hours
- **CHP 3100 - Work Experience/Co-op** Credits: 1 hour
- **PAPR 3531 - Wastewater Treatment Systems** Credits: 3 hours
- **ECON 3190 - Environmental Economics** Credits: 3 hours
- **BIOS 2320 - Microbiology and Infectious Diseases** Credits: 4 hours
- **CHEM 2250 - Quantitative Analysis** Credits: 3 hours
- **CHEM 2280 - Quantitative Analysis Laboratory** Credits: 1 hour
- **CHEM 3560 - Introductory Biochemistry** Credits: 3 hours
- CHEM 3560 - Introductory Biochemistry Laboratory Credits: 1 hour
- IEE 3100 - Engineering Economy Credits: 3 hours

**Emphasis in Pulp and Paper (17 hours minimum)**

- CHP 3190 - Work Experience/Co-op Credits: 1 hour
- CHEG 5950 - Topics in Chemical Engineering Credits: 1 to 3 hours
- PAPR 1000 - Introduction to Pulp and Paper Manufacture Credits: 3 hours
- PAPR 2040 - Stock Preparation and Papermaking Credits: 4 hours
- PAPR 2420 - Coating Credits: 4 hours
- PAPR 2550 - Paper Physics Fundamentals Credits: 4 hours
- PAPR 3030 - Pulping and Bleaching Credits: 4 hours
- PAPR 4300 - Surface and Wet End Science Credits: 3 hours