Chemical Engineering

Dr. Sasidhar Varanasi  
Chair, Department of Chemical Engineering

Dr. Richard Carbonaro, P.E.  
Director, Graduate Program

Mission

The mission of the Master of Science (M.S.) degree in Chemical Engineering is to emphasize practice-oriented knowledge, detailed engineering analysis and design to prepare students for leadership roles in chemical engineering practice. In aid of this mission, the curriculum offers traditional graduate courses complimented by a diverse selection of elective courses taught by industry leaders through the New York Tri-State Area.

Objectives

The Program Educational Outcomes are:

- Students will apply advanced principles of chemical engineering to solve complex engineering problems;
- Students will design engineering solutions to issues and problems in one of the following concentration areas: cosmetic and consumer goods engineering, biopharmaceutical engineering, and sustainable materials engineering;
- Students will conduct fundamental and/or applied research, and improve their oral and written communication skills in the form of presentations, reports and technical memos, as appropriate to the audience.

Admission Requirements

Applicants must possess:

- A baccalaureate degree from a chemical engineering program accredited by the Engineering Accreditation Commission of ABET, Inc., or from a recognized foreign institution; or
- A baccalaureate degree in another area of engineering, chemistry, or closely-related field. Applicants with baccalaureate degrees from these programs will be considered for admission if they present satisfactory grades in Calculus I and II, Chemistry I and II, and Physics I. These students can expect to be admitted as non-matriculated and then matriculate when they have successfully completed the following undergraduate courses with a minimum grade point average of B (3.00) and no grade lower than C (2.00):
## First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHML 207: Process Calculations</td>
<td>3</td>
<td>CHML 208: Principles I (Fluids)</td>
<td>3</td>
</tr>
<tr>
<td>CHML 305: Principles II (Heat Transfer)</td>
<td>3</td>
<td>CHML 209 (Chemical Thermodynamics)</td>
<td>3</td>
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<tr>
<td>CHEM 319/323: Organic I Lecture/Lab</td>
<td>5</td>
<td></td>
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<tr>
<td>MATH 286: Differential Equations</td>
<td>3</td>
<td></td>
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<tr>
<td><strong>Total Credits: 17</strong></td>
<td></td>
<td><strong>Total Credits: 9</strong></td>
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</tbody>
</table>

### Footnotes

1. Required if not completed as part of student's undergraduate degree program.
2. This course is offered fall, winter, spring, and summer sessions. It should be taken as early as possible in the program.

The order in which these courses are taken will be determined by the graduate director on a case-by-case basis. These courses will not satisfy any requirements for the Master of Science in Chemical Engineering degree. Students must complete prerequisite courses before they are permitted to register for graduate courses. Exceptions require the recommendation of the department chair and the approval of the dean of engineering.

## Degree Requirements

All students must complete a minimum of 30 credit hours of graduate course work with a cumulative GPA of 3.0 or better. These hours include three core courses (nine credit hours) and seven additional courses (21 credit hours). The core courses are only offered once per year during the semesters specified below. The engineering electives may be chosen from any of the graduate chemical engineering courses offered within the school of engineering for which the prerequisites have been completed. The elective courses may also be used to complete either the cosmetic engineering, biopharmaceutical, or petroleum engineering concentrations offered by the department of chemical engineering. Graduate courses from outside the department may be allowed on a case-by-case basis with approval from the Graduate Program Director.

### Required Courses (three courses, 9 credits)

<table>
<thead>
<tr>
<th>CHMG 713</th>
<th>Chemical Reactor Design (Fall)</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHMG 722</td>
<td>Elements of Transport Phenomena (Fall)</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 707</td>
<td>Process Thermodynamics (Spring)</td>
<td>3</td>
</tr>
</tbody>
</table>

### Total Credits

9

Additionally, students select a total of seven elective courses (21 credits) to complete the degree requirement.
Research Option

Students may replace two electives with a research project (CHMG 735) or thesis (CHMG 736). Students choosing the research project/thesis option are required to:

1. complete one or two semesters of research, and
2. present a written report/thesis upon completion of the project. All student presenting a thesis will need to follow procedures to archive a copy in the Manhattan College Library.

The program offers a number of general electives as well as electives specific to cosmetic, biopharmaceutical, or petroleum engineering concentrations.

General Electives

The general electives offered within the program vary from year to year, but typically include:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHMG 708</td>
<td>Advanced Heat Transfer Applications</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 710</td>
<td>Advanced Transport Phenomena</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 727</td>
<td>Air Pollution Control Design</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 746</td>
<td>Advanced Chemical Processes for Water Purification</td>
<td>3</td>
</tr>
<tr>
<td>ENGG 652</td>
<td>Project Management</td>
<td>3</td>
</tr>
<tr>
<td>ENGG 670</td>
<td>Pollution Prevention</td>
<td>3</td>
</tr>
<tr>
<td>ENGG 678</td>
<td>Sustainable Energy</td>
<td>3</td>
</tr>
<tr>
<td>ENGG 700</td>
<td>Creativity &amp; Innovation</td>
<td>3</td>
</tr>
</tbody>
</table>

Consumer Products and Cosmetic Engineering Electives

The Chemical Engineering Department offers a concentration in consumer products and cosmetic engineering at the graduate level. This concentration, the only one of its kind in the nation, will prepare students for a variety of roles in the cosmetic and consumer product industries, including product formulation and development, process engineering, and research and development. Coursework will provide students specialized training in product formulation, polymers and emulsions, complex fluids, and regulatory issues relevant to cosmetic and consumer product industries. In addition to the three required chemical engineering core courses, students are required to complete at least four of the following cosmetic engineering electives for a total of 12 credits:

Required Courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHMG 752</td>
<td>Advanced Processing Theory</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 753</td>
<td>Advanced Processing Techniques</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 758</td>
<td>Formulations I</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 759</td>
<td>Formulations II</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 760</td>
<td>Emulsion &amp; Polymer Tech</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 763</td>
<td>Industrial Regulations&amp;Quality</td>
<td>3</td>
</tr>
</tbody>
</table>
Total Credits: 12

The remaining nine elective credits for the cosmetic engineering concentration can be chosen from the available general electives, cosmetic engineering electives, biopharmaceutical engineering electives, and/or engineering materials electives (see the following).

Biopharmaceutical Engineering Electives

The Chemical Engineering Department offers a concentration in biopharmaceutical engineering at the graduate level. The Biopharmaceutical Engineering concentration will prepare students for a variety of roles in the biopharmaceutical and biotechnology sectors, including discovery, development, formulation and production of pharmaceutical products and therapeutic agents. Coursework will provide students with specialized training in microbial and cell growth, polymers and emulsions, bioseparation processing, bioprocess design, formulation of pharmaceutical products, and regulatory issues relevant to the biopharmaceutical field. In addition to the three required chemical engineering core courses, students are required to complete at least four of the following biopharmaceutical engineering electives for a total of 12 credits:

Required Courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHMG 759</td>
<td>Formulations II</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 760</td>
<td>Emulsion &amp; Polymer Tech</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 761</td>
<td>Industrial Practice in Pharmaceutical Industry</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 762</td>
<td>Manufacturing and Analysis of Pharmaceutical Products</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 763</td>
<td>Industrial Regulations&amp;Quality</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 770</td>
<td>Bioseparations</td>
<td>3</td>
</tr>
<tr>
<td>CHMG 772</td>
<td>Bioreaction Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credits: 12

The remaining nine elective credits for the biopharmaceutical engineering concentration can be chosen from the available general electives, consumer products and cosmetic engineering electives, biopharmaceutical engineering electives, and/or engineering materials electives (see the following).

Principles and Processing of Novel Materials Electives

The Chemical Engineering Department offers a focus area in principles and processing of novel materials at the graduate level. This focus area covers topics of interest to engineers in the consumer products, semiconductor, and biomaterials industries. The focus is on the properties and production of these materials including additive manufacturing, thin film deposition and biomaterials. In addition to the three required chemical engineering core courses, students must complete at least four of the following materials engineering electives for a total of 12 credits:

Required Courses
CHMG 760  Emulsion & Polymer Tech
CHMG 773  Synthesis & Deposition of Thin Films
CHMG 774  Additive Manufacturing: Technologies, Materials and Applications
CHMG 775  Production & Application of Biomaterials

Total Credits: 12

The remaining nine elective credits can be chosen from the general chemical engineering graduate electives, biopharmaceutical engineering electives, or consumer products and cosmetic engineering electives.