Process Control Systems
A Jointly Sponsored Undergraduate Program

Process Control Systems is a program intended to provide students with a broad background in chemical and systems engineering, with emphasis on the science and technology of process automation. Through a careful selection of courses in chemical engineering and systems engineering, a unified approach is developed to the analysis, design, operation and control of chemical and other manufacturing processes. Electives in systems engineering allow further in-depth specialization in applied mathematics, discrete-event systems, robotics, quality control, optimization and dynamical systems.

In addition to the traditional laboratory work in chemistry, physics and chemical engineering, a laboratory course in digital process control is offered based on computers and advanced commercial distributed-control equipment. Familiarity with computers and with process modeling, data acquisition and control software is an essential component of the training. In the senior year, students can elect to complete a major design project either in chemical processing systems (chemical engineering) or in technological or engineering systems (systems engineering).

Upon successful completion, a student receives both the Bachelor of Science in Chemical Engineering and the Bachelor of Science in Systems Science & Engineering.

The Process Control Systems program satisfies an increasing demand by manufacturing and petrochemical companies for professionals trained in advanced automation to improve product quality, to reduce costs, to improve capital productivity, and to improve safety and environmental quality. This interdisciplinary program provides the background necessary to combine traditional engineering skills with new systems engineering techniques and meet these challenges. The program is staffed by faculty members from both departments and is supervised by a coordinating committee. Students are assigned two advisers, one from each department, who are members of the committee.

Further information about the program can be obtained from the coordinating committee through either of the cooperating departments.

The Process Control Systems Program

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Year</td>
<td></td>
<td></td>
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<tr>
<td>Calculus II, III (Math 132, 233)</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

General Chemistry I, II (Chem 111A, 112A) | 3    | 3      |
General Chemistry Laboratory I, II (Chem 151, 152) | 2    | 2      |
Introduction to Energy, Environmental and Chemical Engineering (EECE 101) | 3    | —      |
General Physics I or Physics I (Physics 117A or Physics 197) | 4    | —      |
General Physics II or Physics II (Physics 118A or Physics 198) | —    | 4      |
Matrix Algebra (Math 309) | —    | 3      |
Humanities or social sciences elective | —    | 3      |

Second Year

Organic Chemistry I with Lab (Chem 261) | 4    | —      |
Differential Equations (Math 217) | 3    | —      |
Engineering Analysis of Chemical Systems (EECE 201) | 3    | —      |
Thermodynamics I in EECE (EECE 203) | 3    | —      |
Computer Science I (CSE 131) | 3    | —      |
Humanities or social sciences elective | 3    | —      |
Introduction to Systems Science and Engineering or Introduction to Engineering Design (ESE 151 or ESE 205) (ESE 205 is 3 units) | —    | 2      |
Engineering Mathematics A (ESE 318) | —    | 3      |
Engineering Mathematics B (ESE 319) | —    | 3      |
Probability and Statistics for Engineering (ESE 326) | —    | 3      |
Principles of Biology I (Biol 2960) | —    | 4      |
Computational Modeling in Energy, Environmental and Chemical Engineering (EECE 202) | —    | 3      |

Third Year

Signals and Systems (ESE 351) | 3    | —      |
Operations Research (ESE 403) | 3    | —      |
Transport Phenomena I: Basics and Fluid Mechanics (EECE 301) | 3    | —      |
Materials Science (EECE 305) | 3    | —      |
Systems science and engineering elective | 3    | 3      |
Engineering Ethics and Sustainability (Engr 4501) | 1    | —      |
Engineering Leadership and Team Building (Engr 4502) | 1    | —      |
Conflict Management and Negotiation (Engr 4503) | 1    | —      |
Thermodynamics II in EECE (EECE 204) | —    | 3      |
Transport Phenomena II: Mass Transfer (EECE 302) | —    | 3      |
Mass Transfer Operations (EECE 304) | —    | 3      |
Humanities or social sciences elective | —    | 3      |
Technical Writing (Engr 310) — 3

Fourth Year
Chemical Reaction Engineering (EECE 403) 3 —
Unit Operations Laboratory (EECE 405) 4 —
Computer science elective for SSE (CSE 132 or CSE 247) 3 —
Systems science and engineering elective 3 3
Humanities or social sciences elective 3 3
Control Systems or Chemical Process Dynamics and Control (ESE 441 or EECE 401) 3 —
Transport Phenomena III: Energy Transfer Processes (EECE 303) — 3
Digital Process Control Laboratory (ESE 449 or EECE 424) — 3
Capstone Project or ChE Capstone (ESE 499 or EECE 402) — 3
Chemical Engineering elective — 3

Faculty

Coordinating Committee
Pratim Biswas (https://engineering.wustl.edu/Profiles/Pages/Pratim-Biswas.aspx)
Lucy and Stanley Lopata Professor
PhD, California Institute of Technology
(Energy, Environmental & Chemical Engineering)

Hiroaki Mukai (https://engineering.wustl.edu/Profiles/Pages/Hiro-Mukai.aspx)
PhD, University of California, Berkeley
(Electrical & Systems Engineering)

Heinz Schaettler (https://engineering.wustl.edu/Profiles/Pages/Heinz-Schaettler.aspx)
PhD, Rutgers University
(Electrical & Systems Engineering)

Jay R. Turner (https://engineering.wustl.edu/Profiles/Pages/Jay-Turner.aspx)
DSc, Washington University
(Chemical Engineering)

Majors
To satisfy the core requirements of the School of Engineering & Applied Science, the following courses are required:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 197</td>
<td>8</td>
</tr>
<tr>
<td>&amp; Physics 198</td>
<td></td>
</tr>
<tr>
<td>Chem 111A</td>
<td>6</td>
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<tr>
<td>&amp; Chem 112A</td>
<td></td>
</tr>
<tr>
<td>Chem 151</td>
<td>4</td>
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<tr>
<td>&amp; Chem 152</td>
<td></td>
</tr>
<tr>
<td>Math 132</td>
<td>9</td>
</tr>
<tr>
<td>&amp; Math 233</td>
<td></td>
</tr>
<tr>
<td>Math 217</td>
<td></td>
</tr>
<tr>
<td>&amp; Differential Equations</td>
<td></td>
</tr>
<tr>
<td>Humanities/social sciences electives</td>
<td>18</td>
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<tr>
<td><strong>Total units</strong></td>
<td><strong>45</strong></td>
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To complete the core requirements of both chemical engineering and systems engineering, the following additional requirements apply:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 261</td>
<td>4</td>
</tr>
<tr>
<td>EECE 305</td>
<td>3</td>
</tr>
<tr>
<td>ESE 326</td>
<td>3</td>
</tr>
<tr>
<td>Engr 310</td>
<td>3</td>
</tr>
<tr>
<td>ESE 318</td>
<td>6</td>
</tr>
<tr>
<td>&amp; ESE 319</td>
<td></td>
</tr>
<tr>
<td>Biol 2960</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total units</strong></td>
<td><strong>23</strong></td>
</tr>
</tbody>
</table>

The balance of the curriculum is carefully structured to satisfy the combined degree requirements and to meet the objectives of the program. Please refer to the accompanying Process Control Systems program chart (http://bulletin.wustl.edu/prior/2016-17/undergrad/engineering/process-control-systems) for details. The general degree requirements include the residency and other applicable requirements of the university and the School of Engineering & Applied Science.

The curriculum meets the requirements of both degrees and can be completed in four years. The total number of units required is 141. The semester course load exceeds the usual school-wide average of 15 units per semester, so students must be highly motivated to accomplish this objective in eight semesters. The course load in individual semesters may be lightened by attending summer school or by adding an additional semester. A number of courses (e.g., Engr 310, Math 309, ESE 318, ESE 319, ESE 326, ESE 351; and humanities and social sciences courses) usually are offered in the summer as well.

Minors
There is no minor in this area.

Courses
There are no courses specific to this program.