This five-year program leads to the degree of Bachelor of Arts or Bachelor of Science and the degree of Bachelor of Chemical, Civil, Electrical, or Mechanical Engineering.

The Arts Engineering Program serves to both broaden the engineer's knowledge of the liberal arts and provide him or her with additional professional expertise. Many employers recognize the utility of hiring engineers who have extra proficiency in the language arts, the social sciences, and the humanities. Increasingly they search for employees with knowledge in some field that is interrelated with modern engineering, for example, economics, law, communication, mathematics and computer science and many of the biological and physical sciences. Yet some Arts-Engineering students have opted for this five-year program mainly for the personal satisfaction it can provide. These students, while committed to engineering as a profession, seek to enrich their nonworking hours with artistic or cultural knowledge acquired while in the College of Arts and Science.

In this program, students pursue courses in both the College of Arts and Science and the College of Engineering. It has attracted all kinds of students, among them freshmen who are undecided between a career in engineering or some field in Arts and Science. After sampling courses in both colleges, they can decide to continue in the program or switch to a four-year engineering or Arts and Science program. Conversely, a significant number of students who graduate as Arts-Engineers transferred into the program at some later time in their college career, either seeking to enrich their engineering studies or, if they were originally Arts and Science majors, deciding to become engineers.

The five-year Arts and Science-Engineering program assumes that all requirements will be fulfilled in the engineering department of the student's choice. A minimum of thirty additional credits in Arts and Science is required. The additional courses are selected in consultation with an Arts and Science adviser in such a way as to fulfill all requirements in that college. Since many courses taken as part of the engineering curricula are also applicable to Arts and Science degrees, all requirements for both degrees can usually be met within the framework of the "bachelor's-plus-30."

For his or her degree in the College of Arts and Science the student must fulfill the following requirements.

Second Writing Course: Must be passed with a grade of C or better; the course may also simultaneously fulfill one of the group or elective courses listed below.

Language: Must pass in an intermediate-level language course or pass a proficiency test at the intermedi-
This requirement may be fulfilled through a course taken to complete major, group, breadth, or elective requirements. See page 24.

While a few departments do not require a language proficiency for a B.S., nevertheless all Arts-Engineers must fulfill the language requirement.

**Group Requirements**

**Group A:** Analysis and appreciation of the creative arts and humanities (12 credits, in at least two departments or programs).

**Group B:** The study of culture and institutions over time (12 credits in at least two departments or programs).

**Group C:** Empirically based study of human beings and their environment (12 credits in at least two departments or programs).

**Group D:** The study of natural phenomena through experiment and analysis. Automatically satisfied by means of the engineering curriculum.

Consult the latest listing of courses fulfilling group requirements available at the Arts and Science Dean’s Office, 127 Memorial Hall.

*NOTE:* The above groups differ from General Education groups of the College of Engineering. (See page 199.) This requires the student to make careful course selection in order to have courses that satisfy both curricula simultaneously.

**Area of Concentration:** 15 credits of Arts and Science electives to be used for acquiring some depth of knowledge in a field chosen by the student in consultation with an Arts and Science adviser. It is recognized that the 15 credits designated for specialization may well be insufficient to qualify the student for an official major in most departments of the College of Arts and Science. Hence no major is required. Arts-Engineers whose “Area of Concentration” falls short of a major will graduate with a B.A. from the College of Arts and Science.

However, some students do manage to major in an Arts and Science department either by taking more than the minimum number of Arts and Science courses, or by specializing in a scientific or mathematical field, several of whose courses are also required for their engineering program. Some science departments give B.A. and B.S. degrees. Arts-Engineers majoring in such a department can attain either degree by following the appropriate departmental requirements. But there is one exception. While a few departments do not require a language proficiency for a B.S., nevertheless all Arts-Engineers must fulfill the language requirement.

---

**ARTS AND SCIENCE • ENGINEERING CURricula**

**DEGREE: BACHELOR OF ARTS or BACHELOR OF SCIENCE—BACHELOR OF CHEMICAL ENGINEERING**

**MAJOR:** NONE REQUIRED—CHEMICAL ENGINEERING

**CURRICULUM**

**CREDITS**

**UNIVERSITY REQUIREMENTS**

- E 110 Critical Reading and Writing ........................................... 3
- Three credits in an approved course or courses stressing multicultural, ethnic, and/or gender-related content # ........................................... 3

**ARTS AND SCIENCE COLLEGE REQUIREMENTS**

**Skill Requirements**

- Writing: .......................................................... 3

A writing course involving significant writing experience including two papers with a combined minimum of 3,000 words to be submitted for extended faculty critique of both composition and content.

- Foreign Language: .................................................. 0-12

Completion of the intermediate-level course (107 or 112) in a given language or, for students with more than 4 years of high school foreign language or the equivalent, satisfactory performance on a proficiency test in that language.

**Breadth Requirements (See page 74)**

**Group A**

Understanding and appreciation of the creative arts and humanities. Twelve credits representing at least two areas.

**Group B**

The study of culture and institutions over time. Twelve credits representing at least two areas.

**Group C**

Empirically based study of human beings and their environment. Twelve credits representing at least two areas.

The above groups differ from the General Education groups of the College of Engineering. This requires careful course selection in order to have courses that satisfy both curricula simultaneously.

**AREA OF CONCENTRATION REQUIREMENTS**

**Area of Concentration:**

Fifteen credits of Arts and Science electives to be used for acquiring some depth of knowledge in a field chosen in consultation with an Arts and Science adviser.

**Arts-Science Courses Completed**

1-5

The liberal arts component is listed as 51 credit hours. The absolute minimum required to satisfy the requirements listed above is 45; this assumes that the foreign language requirement is satisfied from high school work, the writing course is in one of the Groups A, B, or C, and that nine credits of the Area of Concentration are also from one of the Groups A, B, or C. Thus, students without language skills and concentrating in science or mathematics will need more than 51 credit hours to complete all of these requirements.

**ENGINEERING COLLEGE REQUIREMENTS**

**Mathematics**

- M 241 Analytic Geometry and Calculus A .................................. 4
- M 242 Analytic Geometry and Calculus B .................................. 4
- M 243 Analytic Geometry and Calculus C .................................. 4
- M 302 Ordinary Differential Equations .................................... 3

*Superior figures indicate semester (fall or spring) and/or years in which the course is normally taken, i.e., 1F fall of freshman year, 2S spring of sophomore year, etc.

#This requirement may be fulfilled through a course taken to complete major, group, breadth, or elective requirements. See page 24.
**ENGINEERING CURRICULA • ARTS AND SCIENCE**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physics</strong></td>
<td>PS 207</td>
<td>General Physics</td>
<td>4 2F</td>
</tr>
<tr>
<td></td>
<td>PS 208</td>
<td>General Physics</td>
<td>4 2S</td>
</tr>
</tbody>
</table>

**MAJOR REQUIREMENTS**

<table>
<thead>
<tr>
<th>Section</th>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External to the College</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Biology</strong></td>
<td>B 207</td>
<td>Introductory Biology I</td>
<td>4 2F</td>
</tr>
<tr>
<td><strong>Chemistry</strong></td>
<td>C 111</td>
<td>General Chemistry</td>
<td>3 1F</td>
</tr>
<tr>
<td></td>
<td>C 119</td>
<td>Quantitative Chemistry I</td>
<td>2 1F</td>
</tr>
<tr>
<td></td>
<td>C 112</td>
<td>General Chemistry</td>
<td>3 1F</td>
</tr>
<tr>
<td></td>
<td>C 120</td>
<td>Quantitative Chemistry II</td>
<td>3 13</td>
</tr>
<tr>
<td></td>
<td>C 443</td>
<td>Physical Chemistry</td>
<td>3 1F</td>
</tr>
<tr>
<td></td>
<td>C 444</td>
<td>Physical Chemistry</td>
<td>3 1S</td>
</tr>
<tr>
<td></td>
<td>C 531</td>
<td>Organic Chemistry</td>
<td>3 1F</td>
</tr>
<tr>
<td></td>
<td>C 392</td>
<td>Organic Chemistry</td>
<td>3 2S</td>
</tr>
<tr>
<td></td>
<td>C 333</td>
<td>Organic Chemistry Laboratory I</td>
<td>1 1F</td>
</tr>
</tbody>
</table>

**Technical Electives**

<table>
<thead>
<tr>
<th>Technical Electives</th>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biology</strong></td>
<td>B 301</td>
<td>Cellular and Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>B 303</td>
<td>Genetic and Evolutionary Biology</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>B 305</td>
<td>Cell Biology</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>B 306</td>
<td>General Physiology</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>B 4xx</td>
<td>Biology course chosen with the approval of the adviser</td>
<td>3-4</td>
</tr>
</tbody>
</table>

**Chemistry**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 334</td>
<td>Organic Chemistry Majors Laboratory II</td>
<td>2</td>
</tr>
<tr>
<td>C 457</td>
<td>Inorganic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>C 527</td>
<td>Introductory Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>C 6xx</td>
<td>Chemistry course chosen with the approval of the adviser</td>
<td>3</td>
</tr>
<tr>
<td>C 8xx</td>
<td>Chemistry course chosen with the approval of the adviser</td>
<td>3</td>
</tr>
</tbody>
</table>

**Computer Science**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIS 300</td>
<td>Introduction to Scientific Computation</td>
<td>3</td>
</tr>
</tbody>
</table>

**Mathematics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 349</td>
<td>Elements of Linear Systems</td>
<td>3</td>
</tr>
<tr>
<td>M 389</td>
<td>Discrete Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>M 426</td>
<td>Introduction to Numerical Analysis and Approximation Theory</td>
<td>3</td>
</tr>
<tr>
<td>M 427</td>
<td>Algorithmic Computation</td>
<td>3</td>
</tr>
<tr>
<td>M 428</td>
<td>Algorithmic and Numerical Solution of Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>M 5xx</td>
<td>Mathematics course chosen with the approval of the adviser</td>
<td>3</td>
</tr>
<tr>
<td>M 6xx</td>
<td>Mathematics course chosen with the approval of the adviser</td>
<td>3</td>
</tr>
</tbody>
</table>

**Mechanical Engineering Applied Mathematics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 361</td>
<td>Applied Engineering Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ME 865</td>
<td>Engineering Analysis</td>
<td>3</td>
</tr>
<tr>
<td>M E 864</td>
<td>Engineering Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

**Physics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS 419</td>
<td>Analytical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PS 420</td>
<td>Analytical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PS 6xx</td>
<td>Physics course chosen with the approval of the adviser</td>
<td>3</td>
</tr>
</tbody>
</table>

**Statistics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST 450</td>
<td>Statistics for the Engineering and Physical Sciences</td>
<td>3</td>
</tr>
<tr>
<td>ST 6xx</td>
<td>Statistics course chosen with the approval of the adviser</td>
<td>3</td>
</tr>
</tbody>
</table>

**Electronics Materials**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>(please note prerequisites)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EE 314</td>
<td>Electronics and Instrumentation</td>
<td>4</td>
</tr>
<tr>
<td>EE 340</td>
<td>Solid State Electronics</td>
<td>5</td>
</tr>
<tr>
<td>EE 4xx</td>
<td>Electrical Properties of Matter I</td>
<td>1</td>
</tr>
<tr>
<td>EE 623</td>
<td>Electrical Properties of Matter I</td>
<td>3</td>
</tr>
<tr>
<td>EE 626</td>
<td>Integrated Circuits</td>
<td>3</td>
</tr>
<tr>
<td>EE 629</td>
<td>Digital Structures</td>
<td>3</td>
</tr>
</tbody>
</table>

**Polymeric Materials**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 410</td>
<td>Experimental Mechanics for Composite Materials</td>
<td>3</td>
</tr>
<tr>
<td>ME 415</td>
<td>Finite Element Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

**Chemical Engineering Technical Electives**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 432</td>
<td>Chemical Process Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

**The curriculum provides three chemical engineering technical electives in the senior year. These courses are intended to provide some flexibility in selecting a chemical engineering program at the advanced level. Students should decide with the assistance of their advisers if they should conduct a program of independent research and then choose their course elective(s).**

Chemical engineering technical electives are defined as follows:

Any Chemical Engineering course numbered between 470 and 499; any 400- or higher-level Materials and Metallurgy course; U 401–U 402 Senior Thesis; any 600- or 800-level course in Chemical Engineering. Courses at the 600 level and 800 level are graduate courses open, with the consent of the instructor, to advanced students in senior standing.

**Concentrations**

The technical electives and chemical engineering electives can be coupled to provide a more intense concentration in an area of interest. The groupings below are some examples of this approach.

**Applied Mathematics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 426</td>
<td>Introduction to Numerical Analysis and Algorithmic Computation</td>
<td>3</td>
</tr>
<tr>
<td>M 389</td>
<td>Discrete Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>CHE 827</td>
<td>Chemical Engineering Problems</td>
<td>2</td>
</tr>
</tbody>
</table>

**Biology**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>B 301</td>
<td>Cellular and Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td>C 527</td>
<td>Introductory Biochemistry</td>
<td>4</td>
</tr>
<tr>
<td>CHE 620</td>
<td>Biochemical Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

*Students may enter Chemical Engineering after completing the eight-credit freshman Chemistry sequence, C 103-104. However, an additional three-credit Chemistry course will be required.*
**ARTS AND SCIENCE • ENGINEERING CURRICULA**

**CHEMISTRY**
- C 457 Inorganic Chemistry ............................................ 3\textsuperscript{1S}
- C 327 Introductory Biochemistry ...................................... 3\textsuperscript{1S}
- CHE 606 Introduction to Catalysis ..................................... 3\textsuperscript{1S}
- CHE 610 Industrial and Engineering Chemistry ..................... 3\textsuperscript{1S}
- CHE 868 Applied Chemical Kinetics .................................... 3\textsuperscript{1S}

**Electronic Materials**
- EE 314 Electronics and Instrumentation ................................ 4\textsuperscript{1F}
- EE 340 Solid State Electronics ........................................ 3\textsuperscript{1S}
- EE 4xx Solid State Fabrication Laboratory ................................ 1\textsuperscript{1S}
- CHE 667 Solid State Device Fabrication ................................ 3\textsuperscript{1S}

**Polymeric Materials**
- ME 213 Principles of Mechanics I ...................................... 4\textsuperscript{1W}
- ME 415 Finite Element Analysis ....................................... 3\textsuperscript{1S}
- ME 410 Experimental Mechanics for Composite Materials .......... 3\textsuperscript{1S}
- CHE 601 Structure and Properties of Polymer Materials .......... 3
- or
- CHE 603 Polymerization Reaction Engineering ......................... 3\textsuperscript{1F}
- CHE 602 Polymer Process Analysis and Design ....................... 3\textsuperscript{1S}
- or
- CHE 604 Introduction to Polymer Science and Engineering II ...... 3

**CREDITS TO TOTAL A MINIMUM OF** ........................................ 160

---

**DEGREE: BACHELOR OF ARTS or BACHELOR OF SCIENCE**

**MAJOR: NONE REQUIRED—CIVIL ENGINEERING**

**UNIVERSITY REQUIREMENTS**
- E 110 Critical Reading and Writing .................................... 3\textsuperscript{1S}

Three credits in an approved course or courses stressing

- multicultural, ethnic, and/or gender-related content

**ARTS AND SCIENCE COLLEGE REQUIREMENTS**

**Skill Requirements**

**Writing**

A writing course involving significant writing experience

including two papers with a combined minimum of 3,000

words to be submitted for extended faculty critique of both

composition and content.

**Foreign Language** .......................................................... 0-12

Completion of the intermediate-level course (107 or 112) in a
given language or, for students with more than 4 years of high

school foreign language or the equivalent, satisfactory perfor-

mance on a proficiency test in that language.

**Breadth Requirements (See page 74)**

**Group A** ........................................................................... 12

Understanding and appreciation of the creative arts and

humanities. Twelve credits representing at least two areas.

**Group B** ........................................................................... 12

The study of culture and institutions over time. Twelve credits

representing at least two areas.

**Group C** ........................................................................... 12

Empirically based study of human beings and their environ-

ment. Twelve credits representing at least two areas.

The above groups differ from the General Education groups of

the College of Engineering. This requires careful course selection

in order to have courses that satisfy both curricula simultaneously.

**AREA OF CONCENTRATION REQUIREMENTS**

**Area of Concentration:**

Fifteen credits of Arts and Science electives to be used for ......... 15

acquiring some depth of knowledge in a field chosen in con-

sultation with an Arts and Science adviser.

**Arts-Science Courses Completed** ........................................... 1-5

The liberal arts component is listed as 51 credit hours. The

absolute minimum required to satisfy the requirements listed

above is 45; this assumes that the foreign language requirement

is satisfied from high school work, the writing course is in one

of the Groups A, B, or C, and that nine credits of the Area of

Concentration are also from one of the Groups A, B, or C.

Thus, students without language skills and concentrating in scien-

tific or mathematics will need more than 51 credit hours to

complete all of these requirements.

**ENGINEERING COLLEGE REQUIREMENTS**

**Mathematics**
- M 241 Analytic Geometry and Calculus A ................................ 4\textsuperscript{1F}
- M 242 Analytic Geometry and Calculus B ............................... 4\textsuperscript{1S}
- M 243 Analytic Geometry and Calculus C ............................... 4\textsuperscript{1F}
- M 302 Ordinary Differential Equations .................................... 3\textsuperscript{2S}

**Physics**
- PS 207 General Physics .................................................... 4\textsuperscript{1F}
- PS 208 General Physics .................................................... 4\textsuperscript{1F}

**MAJOR REQUIREMENTS**

**External to the College**
- C 103 General Chemistry .................................................. 4\textsuperscript{1F}
- C 104 General Chemistry .................................................. 4\textsuperscript{1F}
- C S 306 General Computer Science for Engineers ................... 3\textsuperscript{1F}
- GEO 107 General Geology .................................................. 3\textsuperscript{1S}
- E 410 Technical Writing ..................................................... 3\textsuperscript{1S}
- ST 450 Statistics for the Engineering and Physical Sciences ....... 3\textsuperscript{1S}

**Within the College**
- EG 125 Introduction to Engineering (MAE) .......................... 2\textsuperscript{1F}
- EG 132 Engineering Graphics/Analysis .................................. 2\textsuperscript{1F}
- MEC 305 Fluid Mechanics .................................................. 3\textsuperscript{3S}
- MEC 306 Fluid Mechanics Laboratory .................................... 1\textsuperscript{1S}
- MAT 302 Material Science for Engineers .............................. 4\textsuperscript{1S}

**Within the Department**
- CE 211 Statics ................................................................. 3\textsuperscript{2F}
- CE 212 Strength of Materials ............................................. 3\textsuperscript{1S}
- CE 215 Materials Laboratory ............................................... 1\textsuperscript{1S}
- CE 331 Introduction to Environmental Engineering ................. 3\textsuperscript{1F}
- CE 331 Analysis of Structures ............................................. 3\textsuperscript{1S}
- CE 311 Dynamics ............................................................. 3\textsuperscript{1F}
- CE 351 Transportation Engineering .................................... 3\textsuperscript{1S}
- CE 381 Civil Engineering Analysis ..................................... 3\textsuperscript{1S}
- CE 420 Soil Mechanics ...................................................... 4\textsuperscript{1F}
- CE 461 Senior Design Project .............................................. 3\textsuperscript{1S}
- CE 482 Systems Design and Operation ................................... 3\textsuperscript{1S}

**One of:**
- CE 402 Steel Design ....................................................... 3\textsuperscript{1F}
- CE 403 Concrete Design ................................................... 3

**One of:**
- CE 431 Water Supply Engineering ....................................... 3\textsuperscript{1S}
- CE 432 Waste Water Engineering ......................................... 3

---

\* Superior figures indicate semester (fall or spring) and/or years in which the course is normally taken, i.e., \textsuperscript{1F}fall of freshman year, \textsuperscript{1S}spring of sophomore year, etc.

# This requirement may be fulfilled through a course taken to complete major, group, breadth, or elective requirements. See page 24.
One of:
CE 441 Hydrology ........................................ 3 48
or
CE 442 Hydraulic Engineering .......................... 3

Technical Electives

Technical Electives: ........................................ 12 3,4

Four courses: Three additional design points must be satisfied; see current department technical elective listing.

CREDITS TO TOTAL A MINIMUM OF ........................................ 161

DEGREE: BACHELOR OF ARTS or BACHELOR OF SCIENCE—ARTS AND SCIENCE

MAJOR: NONE REQUIRED—ELECTRICAL ENGINEERING

CURRICULUM CREDITS*

UNIVERSITY REQUIREMENTS

E 110 Critical Reading and Writing ..................... 3 18
Three credits in an approved course or courses stressing multicultural, ethnic, and/or gender-related content #

ARTS AND SCIENCE COLLEGE REQUIREMENTS

Skill Requirements

Writing: .................................................. 3

A writing course involving significant writing experience including two papers with a combined minimum of 5,000 words to be submitted for extended faculty critique of both composition and content.

Foreign Language: ......................................... 0-12
Completion of the intermediate-level course (107 or 112) in a given language or, for students with more than 4 years of high school foreign language or the equivalent, satisfactory performance on a proficiency test in that language.

Breadth Requirements (See page 74)

Group A ..................................................... 12
Understanding and appreciation of the creative arts and humanities. Twelve credits representing at least two areas.

Group B ..................................................... 12
The study of culture and institutions over time. Twelve credits representing at least two areas.

Group C ..................................................... 12
Empirically based study of human beings and their environment. Twelve credits representing at least two areas.

The above groups differ from the General Education groups of the College of Engineering. This requires careful course selection in order to have courses that satisfy both curricula simultaneously.

AREA OF CONCENTRATION REQUIREMENTS

Area of Concentration:
Fifteen credits of Arts and Science electives to be used for acquiring some depth of knowledge in a field chosen in consultation with an Arts and Science adviser. Arts-Science Courses Completed. ....... 1-5

The liberal arts component is listed as 51 credit hours. The absolute minimum required to satisfy the requirements listed above is 45; this assumes that the foreign language requirement is satisfied from high school work, the writing course is in one of the Groups A, B, or C, and that nine credits of the Area of Concentration are also from one of the Groups A, B, or C. Thus, students without language skills and concentrating in science or mathematics will need more than 51 credit hours to complete all of these requirements.

ENGINEERING COLLEGE REQUIREMENTS

Physics
PS 207 General Physics ..................................... 4 18
PS 208 General Physics ..................................... 4 28

MAJOR REQUIREMENTS

External to the College

Mathematics
M 242 Analytic Geometry and Calculus B ............ 4 18
M 243 Analytic Geometry and Calculus C ............ 4 18
M 367 Differential Equations & Linear Algebra I .... 3 28
M 367 Differential Equations & Linear Algebra II .... 3 28

Chemistry
C 105 General Chemistry ................................ 4 18
CIS 180 Introduction to Computer Science I ........ 3 18
CIS 181 Introduction to Computer Science II ......... 3 18
E 301 Problems in Composition ......................... 3 38
PHL 367 Ethics in the Engineering Profession ....... 1 48

Within the Department

EE 210 Introduction to Combinational Logic ......... 2 28
EE 211 Introduction to Sequential Circuits .......... 2 28
EE 295 Linear Circuit Theory .......................... 4 38
EE 220 Microprocessor Based Systems I .............. 2 38
EE 309 Electronic Circuit Analysis I ................. 3 38
EE 221 Microprocessor Based Systems II .............. 3 38
EE 302 Electrical Properties of Materials ........... 4 38
EE 305 Signal Processing I ............................... 3 18
EE 312 Electronic Circuit Analysis II ................. 4 28
EE 320 Field Theory ...................................... 4 18
EE 306 Signal Processing II .............................. 4 18
EE 310 Random Signals and Noise ..................... 3 38
EE 340 Solid State Electronics ......................... 3 48
EE 417 Feedback Control Systems ..................... 3 38
EE 413 Field Theory II .................................. 4 28
EE 439 Energy Systems .................................. 3 58
EE 410 may be taken in the senior year (s) and EE 413 and/or EE 439 in the junior year (s) when appropriate to a plan for a technical concentration.

Design Requirement

In addition to the design content of the normal program, every student must take at least one course in their senior year in which one design project is at least 50% of the coursework. Regularly offered courses that presently meet this requirement are EE 420, 422, 650 and 664. The design requirement may also be met with special projects carried out in conjunction with faculty research with the prior approval of the Departmental Undergraduate Representative. Students must consult with their advisers for the proper selection of design courses.

* Superior figures indicate semester (fall or spring) and/or year or years in which the course is normally taken, i.e., Fall of freshman year, Spring of sophomore year, etc.

# This requirement may be fulfilled through a course taken to complete major, group, breadth, or elective requirements. See page 34.

† The technical elective program is under constant review by the faculty. An updated list is available in the department office. Students should check with their advisers before selecting courses and should be aware that a formal mechanism exists to provide additional flexibility in selection of their Technical Elective courses.
Technical Electives

Technical Electives
Each student must select a concentration to structure their technical elective program. Four concentrations are now defined (computer engineering, systems and signals engineering, electronic devices and materials engineering, and power systems engineering). Students with a special interest may define their own concentrations in conjunction with their adviser. With some exceptions, upper-level engineering, computer science, physics, science and mathematics courses are acceptable technical electives. However, students planning their own programs of concentration should realize that there must be a theme holding together at least most of the courses chosen. Any special concentrations must be approved by the Departmental Undergraduate Representative prior to the start of the senior year.

Each of the four regular concentrations specifies 15, or more, of the 21 technical elective credits in the core program. Students should note that the requirement for a senior design project will, in some cases, further constrain the choice of technical electives.

The technical electives must be chosen from an area of concentration. The four concentrations follow:

Technical Electives—Computer Engineering
CIS 220 Data Structures ............... 3
CIS 360 Computer Architecture ........ 3
EE 325 Digital System Design I ....... 3
EE 422 Digital System Design II ...... 3
EE 618 Modern Control Engineering ... 3
or
EE 631 Digital Signal Processing ....... 3
Technical electives chosen with the approval of an adviser.............. 6

Technical Electives—Systems and Signals Concentration
CIS 220 Data Structures ............... 3
M 426 Introduction to Numerical Analysis and Algorithmic Computation ... 3
EE 403 Communication Systems Engineering ....... 3
EE 618 Modern Control Engineering ... 3
EE 631 Digital Signal Processing ....... 3
Technical electives chosen with the approval of an adviser.............. 6

Technical Electives—Devices and Materials Concentration
Students whose primary interest is in the Devices and Materials Engineering concentration should take:
PS 209 General Physics ............... 3
PS 313 Physical Optics ............... 3
EE 623 Electronic Properties of Matter ....... 3
Students whose primary interest is in optoelectronics and electron-optics should take:
EE 640 Optoelectronics ............... 3
and
EE 642 Special Topics in Electrooptics ...... 3
Students whose primary interest is in electronic services should take:
EE 626 Integrated Circuits ............ 3
and
EE 650 Semiconductor Device Design and Fabrication** ..... 3
Technical electives chosen with the approval of an adviser.............. 6

Technical Electives—Power Systems Concentration
ME 307 Thermodynamics I ............. 3
EE 412 Introduction to Power Systems Analysis ...... 4
EE 414 Electrical Machines, Motors and Generators ....... 4
EE 618 Modern Control Engineering ....... 3

ME 408 Power Generation Systems Design ....... 3
or
EE 523 Digital Systems Design I ....... 3
Technical electives chosen with the approval of an adviser.............. 6

CREDITS TO TOTAL A MINIMUM OF .......... 158

DEGREE: BACHELOR OF ARTS or BACHELOR OF SCIENCE
—BACHELOR OF ELECTRICAL ENGINEERING
MAJOR: SELECTED ARTS AND SCIENCE MAJOR
—MECHANICAL ENGINEERING

UNIVERSITY REQUIREMENTS
E 110 Critical Reading and Writing .......... 3
Three credits in an approved course or courses stressing multicultural, ethnic, and/or gender-related content.#

ARTS AND SCIENCE COLLEGE REQUIREMENTS
Skill Requirements
Writing: 3
A writing course involving significant writing experience including two papers with a combined minimum of 3,000 words to be submitted for extended faculty critique of both composition and content.

Foreign Language: 0-12
Completion of the intermediate-level course (107 or 112) in a given language or, for students with more than 4 years of high school foreign language or the equivalent, satisfactory performance on a proficiency test in that language.

Breadth Requirements (See page 74)
Group A: Understanding and appreciation of the creative arts and humanities. Twelve credits representing at least two areas. 12
Group B: The study of culture and institutions over time. Twelve credits representing at least two areas. 12
Group C: Empirically based study of human beings and their environment. Twelve credits representing at least two areas. 12

The above groups differ from the General Education groups of the College of Engineering. This requires careful course selection in order to have courses that satisfy both curricula simultaneously.

AREA OF CONCENTRATION REQUIREMENTS
Area of Concentration: Fifteen credits of Arts and Science electives to be used for acquiring some depth of knowledge in a field chosen in consultation with an Arts and Science adviser. 15

Arts-Science Courses Completed: 1-5
The liberal arts component is listed as 51 credit hours. The absolute minimum required to satisfy the requirements listed above is 45; this assumes that the foreign language requirement is satisfied from high school work, the writing course is in one of the Groups A, B, or C, and that nine credits of the Area of Concentration are also from one of the Groups A, B, or C.

* Superior figures indicate semester (fall or spring) and/or year or years in which the course is normally taken, i.e., fall of freshman year, spring of sophomore year, etc.
# This requirement may be fulfilled through a course taken to complete major, group, breadth, or elective requirements. See page 24.
** Courses must be taken as a sequence, EE 640 and EE 642 or EE 626 and EE 650.
Thus, students without language skills and concentrating in science or mathematics will need more than 51 credit hours to complete all of these requirements.

### ENGINEERING COLLEGE REQUIREMENTS

#### Mathematics

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 241</td>
<td>Analytic Geometry and Calculus A</td>
<td>4 1F</td>
</tr>
<tr>
<td>M 242</td>
<td>Analytic Geometry and Calculus B</td>
<td>4 1S</td>
</tr>
<tr>
<td>M 243</td>
<td>Analytic Geometry and Calculus C</td>
<td>4 1S</td>
</tr>
<tr>
<td>M 302</td>
<td>Ordinary Differential Equations I</td>
<td>3 2S</td>
</tr>
</tbody>
</table>

#### Physics

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS 207</td>
<td>General Physics</td>
<td>4 2F</td>
</tr>
<tr>
<td>PS 208</td>
<td>General Physics</td>
<td>4 2S</td>
</tr>
</tbody>
</table>

### MAJOR REQUIREMENTS

#### External to the College

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 103</td>
<td>General Chemistry</td>
<td>4 1F</td>
</tr>
<tr>
<td>C 104</td>
<td>General Chemistry</td>
<td>4 1S</td>
</tr>
</tbody>
</table>

#### Within the College

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EG 125</td>
<td>Introduction to Engineering (ME)</td>
<td>3 1F</td>
</tr>
<tr>
<td>EG 132</td>
<td>Engineering Graphics/Analysis</td>
<td>3 1S</td>
</tr>
<tr>
<td>MAT 302</td>
<td>Material Science for Engineers</td>
<td>4 2S</td>
</tr>
<tr>
<td>EE 314</td>
<td>Electronics and Instrumentation</td>
<td>4 2F</td>
</tr>
<tr>
<td>MEC 305</td>
<td>Fluid Mechanics</td>
<td>3 1F</td>
</tr>
<tr>
<td>MEC 306</td>
<td>Fluid Mechanics Laboratory</td>
<td>1 1F</td>
</tr>
</tbody>
</table>

#### Within the Department

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 213</td>
<td>Principles of Mechanics I</td>
<td>3 2F</td>
</tr>
<tr>
<td>ME 214</td>
<td>Principles of Mechanics II</td>
<td>3 2S</td>
</tr>
<tr>
<td>ME 313</td>
<td>Strength of Materials</td>
<td>4 2S</td>
</tr>
<tr>
<td>ME 361</td>
<td>Applied Engineering Analysis</td>
<td>3 2F</td>
</tr>
<tr>
<td>ME 307</td>
<td>Thermodynamics I</td>
<td>3 4F</td>
</tr>
<tr>
<td>ME 308</td>
<td>Thermodynamics II</td>
<td>5 4S</td>
</tr>
<tr>
<td>ME 316</td>
<td>Materials Engineering</td>
<td>3 4F</td>
</tr>
<tr>
<td>ME 347</td>
<td>Mechanical Design I</td>
<td>3 4F</td>
</tr>
<tr>
<td>ME 348</td>
<td>Mechanical Design II</td>
<td>3 4S</td>
</tr>
<tr>
<td>ME 391</td>
<td>Engineering Science Laboratory I</td>
<td>4 3S</td>
</tr>
<tr>
<td>ME 356</td>
<td>Fluid Mechanics II</td>
<td>3 5S</td>
</tr>
<tr>
<td>ME 302</td>
<td>Heat Transfer</td>
<td>3 5S</td>
</tr>
<tr>
<td>ME 427</td>
<td>Systems Dynamics I</td>
<td>3 5S</td>
</tr>
<tr>
<td>ME 447</td>
<td>Design and Systems Synthesis I</td>
<td>3 5F</td>
</tr>
<tr>
<td>ME 448</td>
<td>Design and Systems Synthesis II</td>
<td>3 5S</td>
</tr>
</tbody>
</table>

#### Technical Electives

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<table>
<thead>
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<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 411</td>
<td>Structural Mechanics for Mechanical and Aerospace Engineering</td>
<td>3 2F</td>
</tr>
<tr>
<td>ME 413</td>
<td>Advanced Mechanics of Materials</td>
<td>3 2F</td>
</tr>
<tr>
<td>ME 415</td>
<td>Finite Element Analysis</td>
<td>3 2F</td>
</tr>
<tr>
<td>ME 432</td>
<td>Aerodynamics</td>
<td>3 2F</td>
</tr>
<tr>
<td>ME 435</td>
<td>Propulsion</td>
<td>3 2F</td>
</tr>
<tr>
<td>ME 436</td>
<td>Fluid Machinery</td>
<td>3 2F</td>
</tr>
<tr>
<td>ME 445</td>
<td>Senior Research</td>
<td>3 2F</td>
</tr>
<tr>
<td>ME 616</td>
<td>Composite Materials Structures</td>
<td>3 2F</td>
</tr>
</tbody>
</table>

**CREDITS TO TOTAL A MINIMUM OF 161**

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1 The technical elective program is under constant review by the faculty. An updated list is available in the department office. Students should check with their advisors before selecting courses and should be aware that a formal mechanism exists to provide additional flexibility in selection of their Technical Elective courses.