

# **Engineering Handbook**

**Fall 2007**

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# Introduction

The faculty and staff of the Engineering Division are happy that you chose to come to Lafayette College. It is our goal to give you an excellent engineering education. We have prepared this handbook to answer questions you might have concerning your education during the next four years. While this handbook is a good place to start looking for answers to questions, we know that there are questions that may not be addressed here. So start here, but if you don't find the answer, talk to your advisor, professors, the staff, and/or the Director of Engineering. We want to be sure that you have all the information you need.

Mary J. S. Roth, Ph.D., P.E.  
Associate Provost/Director of Engineering

# The Common First Year

## ***Academic Advisor***

The faculty adviser guides student advisees in their course of study, helps them assess their academic capabilities and progress, and directs them to other specialized resources when needed.

Specific functions of the academic adviser include:

- Meeting regularly with the student to assess their needs and progress.
- Receiving reports on a student's academic progress and maintaining a record of this progress.
- Discussing future plans with the student to assist them in making appropriate course selections.
- Approving a student's course selections before they are permitted to register for the next semester.
- Referring the student to other offices on campus for assistance if necessary.

When you meet with your advisor feel free to ask questions about:

- Majors and minors
- AP credits
- Course sequences
- Social Science and Humanities courses
- Study abroad opportunities
- Research opportunities
- Employment
- Graduate school
- Co-curricular activities

## ***Standard Course Sequence***

The standard course sequence for all engineers during their first year is as follows:

### **Fall Semester**

- FYS: First-Year Seminar
- ES 101: Introduction to Engineering
- Math 161: Calculus I
- Chem 121: General Chemistry

### **Spring Semester**

- Engl 110: College Writing  
*Or* Social Science/Humanities
- Math 162: Calculus II
- Phys 131: Newtonian Dynamics
- Chem 122: General Chemistry  
*Or* ES 231: Nature of Materials

## FAQs

1. How do I know if Math 161 is the right course for me?
  - Math 161 is the default math course for first-year engineering students. If you have an AP score of 4 or 5 on the AB calculus test you have earned credit for Math 161 and may enroll in Math 162 if you choose to do so. If you are unsure about this decision, we highly recommend that you take our in-house placement exam. Contact the math department (x5267) for more information about this exam. If you have an AP score of 4 or 5 on the BC calculus test, you have earned credit for both Math 161 and Math 162 and may enroll in Math 263. Please speak with your academic advisor if you have additional questions about the most appropriate math course for you.
2. What do I do if I have AP credit in chemistry?
  - If you have an AP chemistry score of 4 or 5 you have earned credit for Chem 121 and Chem 122. There are several options available for your fourth course this semester and you should speak with your academic advisor to determine the best choice for you. Some of the common options include taking:
    - Another Chemistry course. Students planning to major in ChE or the environmental side of CEE may elect to enroll in Chem 252: Environmental Chemistry (no lab). Students planning to major in ChE may wish to enroll in Chem 221: Organic Chemistry I (with lab). This is an aggressive option and should be reserved for students who are confident in both their analytical and laboratory skills in chemistry.
    - A course in a field in which you wish to minor. Some students with AP chemistry credit elect to take a course in a particular field of interest outside of engineering during their first semester. You should discuss the implications of this choice with your faculty advisor before proceeding.
3. Can I take a fifth course during my first semester?
  - NO! (Sorry.) The only exceptions are an ROTC course or a 1/4-credit music course.
4. Can I take a fifth course during my second semester?
  - Yes! If your GPA during the fall semester meets the College's requirements, you can petition to take a fifth course during the spring semester.
5. What should I do if I have a problem with my schedule?
  - See your academic advisor and then go to the drop/add session.

## The Engineering Majors

Lafayette offers B.S. degrees in four fields of engineering (Chemical, Civil, Electrical and Computer, and Mechanical Engineering) and a Bachelor of Arts degree in Engineering. The first year courses are the same for all five programs. You will be asked to select one of these five degree programs during April of your first year when you begin to consider enrolling in courses for the fall of your second year. Typical course sequences for each of our engineering degree programs are shown on the next few pages.

## ***A.B. Engineering***

This program presents an unusual opportunity for you to obtain a strong technical education within the context of a broad liberal arts curriculum. Engineering courses are combined with courses in the social sciences and the humanities. The program is grounded in mathematics, natural sciences, and engineering science with upperclass courses drawn from traditional engineering disciplines, engineering management, and engineering and public policy. Students with a bachelor of arts degree in engineering are aiming for careers in management, law, architecture, public policy, medicine, and other fields in which their technical background is a recognized asset.

# AB Engineering Typical Schedule of Courses<sup>1,2,3,4</sup>

(Class of 2009+)

[students may want to consider the various optional concentrations as a course selection guide]

<i>Fall Semester</i>		<i>Spring Semester</i>	
<b>FIRST YEAR</b>			
Math 161 Calculus 1	1	Math 162 Calculus 2	1
Chemistry 121 General Chemistry 1	1	Chemistry 122 Chemistry 2 or ES 231 Natures of Materials	1
First Year Seminar	1	English 110	1
ES 101 Intro to Engineering	1	Physics 131	1
Courses	4	Courses	4
<b>SECOND YEAR</b>			
Math 263 Calculus III	1	Math Elective <sup>5</sup>	1
EP 251 Introduction to Engineering and Public Policy	1	EP 261 Engineering Economics and Management	1
Econ 101 Principles of Economics	1	VAST Elective (or ES 225)	1
Engineering Systems Elective <sup>6</sup>	1	Science Elective <sup>7</sup>	1
Courses	4	Courses	4
<b>THIRD YEAR</b>			
200 Level Engineering Elective <sup>8</sup>	1	Humanities Elective	1
200 Level Engineering Elective <sup>8</sup>	1	EP 482 Internship or 300/400 Engineering Elective	1
Social Science Elective <sup>9</sup>	1	Social Science Elective <sup>9</sup>	1
Free Elective	1	Free Elective	1
Courses	4	Courses	4
<b>FOURTH YEAR</b>			
300/400 Level Engineering Elective	1	EP 451 Capstone Seminar	1
Free Elective	1	300/400 Engineering Elective	1
Free Elective	1	Free Elective	1
Free Elective	1	Free Elective	1
Courses	4	Courses	4

<sup>1</sup> All AB Engineers must meet the foreign studies cluster by one of three options (1. proficiency in a foreign language through intermediate level, 2. approved semester study abroad, 3. established cluster of 3 related courses dealing with another culture).

<sup>2</sup> All AB Engineers must meet the writing requirement (FYS, English 110, VAST, EP 451, one other designated writing course)

<sup>3</sup> Minors: no more than 1 minor; no minors if double major; no more than 3 named courses count from major or common course of study.

<sup>4</sup> Double majors: no more than 4 courses count for both majors; no more than 12 courses in each major.

<sup>5</sup> One chosen from Math 186, Math 264, Math 272, Math 282, Math 335.

<sup>6</sup> Chosen from ES 226, ES 241, ChE 211, ME 351.

<sup>7</sup> One chosen from Phys 104, Phys 106, Phys 108, Phys 132, Biol 101/102, Biol 231, Biol 234, CS 102, Geol 100, Geol 110, Geol 120, Geology 130

<sup>8</sup> One may come from CE 271, ME 210, or EP 255. See note#6 for other choices. ES 230 and CE 251 are common choices.

<sup>9</sup> Two Social Science electives (from different departments) chosen from AS 241, A&S 215, A&S 219, A&S 222, A&S 235, A&S 245, A&S 247, Econ 330, Econ 331, Econ 332, Econ 335, Econ 346, Govt 101, Govt 102, Govt 211, Govt 217, Govt 234, Govt 235, Govt 310, Hist 215, Hist 250, Hist 251, Hist 252, Psych 326, Psych 335, Psych 336.

## Optional AB Engineering Concentrations

Concentration	Courses			
<b>Civil Engineering</b> <sup>10</sup>	ES226 Statics	CE251 Fluids or ES230 Strength of Materials	CE271 Design I or CE201 CE Computing	Any 300/400-level CE course
<b>Chemical Engineering</b> <sup>1,11</sup>	ChE211 Materials and Energy Balances	ChE222 Thermodynamics	ChE311 Transport Processes	Any ChE 300/400-level course
<b>Construction Management</b>	CE271 Design I	CE331 Project Management	CE431 Construction Management	Any other related course
<b>Electrical and Computer Engineering</b> <sup>1,3,5</sup>	ECE211 Digital Circuits I	ECE221 Basic Electrical Circuit Analysis	ECE331 Signals and Systems	Any other ECE course
<b>Mechanical Engineering</b> <sup>1,12</sup>	ES226 Statics	ES230 Strength of Materials	ME241 Dynamics	Any 300/400-level MechE course
<b>Environmental Engineering</b> <sup>1,13</sup>	CE251 Fluids	CE321 Intro. To Environmental Engineering	CE351 Water Resources	Any 300/400-level environmental or water resources course from CE, EP, or ChE
<b>Structural Engineering</b> <sup>1</sup>	ES226 Statics	ES230 Strength of Materials	CE311 Structures	Any 300/400-level structural engineering course
<b>Infrastructure Management and Policy</b>	CE271 Design I, CE201CE Computing or EP255 GIS	CE341 Transportation Systems	Two courses from CE331 Project Management, EP452 Systems Analysis, CE442 Transportation Planning, CE444 Infrastructure Management	
<b>Engineering Management</b>	CE331 Project Management	Three courses chosen from: CE331 Construction Management, EP452 Systems Analysis, EP462 Management of Technology Innovation, EP480 Design and Policy Project, EP255 GIS, CE444 Infrastructure Management, EP450 Engineering Management , EP355 Sustainable Environmental Management		
<b>Engineering Policy</b>	CE331 Project Management	Three courses chosen from:EP352 Energy Policy, EP452 Systems Analysis, EP462 Management of Technology Innovation, EP480 Design and Policy Project, EP255 GIS, EP355 Sustainable Environmental Management		
<b>Manufacturing</b>	ME210 Manufacturing and Design	CE331 Project Management	EP450 Engineering Management	EP355 Sustainable Environmental Management or EP452 Systems Analysis
<b>Information Systems</b> <sup>14</sup>	EP255 Introduction to GIS	CE201 CE Computing	CE331 Project Management	EP452 Systems Analysis

<sup>10</sup> Math elective = Math 264 Differential Equations

<sup>11</sup> Required Science = Chemistry II

<sup>12</sup> Required Science = Physics II

<sup>13</sup> Required Science = Geol110 or Biol234 or Chem252

<sup>14</sup> Required Science = CS102

## ***Chemical Engineering***

Chemical engineers have the responsibility to discover and implement new products and processes that are useful and economical. The chemical engineering profession has evolved in concert with the technological landmarks of the last century: from petroleum refining initially, to biotechnology and biomedical developments, innovations in digital communications and microelectronics, and nanotechnology. The need for exploitation of new energy and raw material sources and the increased emphasis on the life sciences offers new opportunities for chemical engineers in diverse industries such as biological, medical and pharmaceutical firms, and presents new challenges.

## Chemical Engineering Curriculum

First Year Fall Semester	Chemistry 121 -- General Chemistry Mathematics 161 -- Calculus I Engineering Science 101 -- Introduction to Engineering FYS -- First Year Seminar
First Year Spring Semester	Chemistry 122 -- General Chemistry Mathematics 162 -- Calculus II Physics 131 -- Newtonian Dynamics English 110 -- English Composition
Second Year Fall Semester	Chemistry 221-- Organic Chemistry I Mathematics 263 -- Calculus III SS/Hum Elective <sup>1</sup> ES Elective <sup>2</sup> Chemical Engineering 211 -- Material and Energy Balances
Second Year Spring Semester	Chemistry Elective <sup>3</sup> Mathematics 264 -- Differential Equations SS/Hum Elective <sup>1</sup> Chemical Engineering 222 -- Thermodynamics I Engineering Science 225 -- Professionalism and Ethics
Third Year Fall Semester	Chemical Engineering 311-- Transport Processes Chemical Engineering 312 -- Chemical Engineering Laboratory I Chemical Engineering 314 -- Chemical Engineering Computing Chemistry Elective <sup>3</sup> SS/Hum Elective <sup>1</sup>
Third Year Spring Semester	Chemical Engineering 321-- Unit Operations I Chemical Engineering 322 -- Chemical Engineering Laboratory II Chemical Engineering 323 --Thermodynamics II Chemical Engineering 324 -- Process Control Free Elective
Fourth Year Fall Semester	Chemical Engineering 411 -- Unit Operations II Chemical Engineering 412 -- Chemical Engineering Laboratory III Chemical Engineering 413 --Reaction Kinetics and Design Chemical Engineering 415 -- Design Analysis Technical Elective <sup>4</sup>
Fourth Year Spring Semester	Chemical Engineering 422 -- Design Synthesis Chemistry 324 -- Physical Chemistry II Free Elective Technical Elective <sup>4</sup> SS/Hum Elective <sup>1</sup>

*See next page for notes*

<sup>1</sup>Social Science Humanities Electives: Courses selected from an approved posted list  
At least one course in the social sciences and one course in the humanities; at least two courses in the same department with one at the upper level.

**Humanities Departments:**

Art  
English  
Foreign Languages  
Music  
Philosophy  
Religion  
Comparative Literature

**Social Science Departments:**

African Studies  
American Studies  
Economics and Business  
Government and Law  
History  
International Affairs  
Psychology  
Women's Studies

<sup>2</sup>Engineering Science Electives

Engineering Science 241 -- Basic Electric Circuit Analysis  
Engineering Science 226 – Statics

<sup>3</sup>Chemistry Electives may be taken from the following:

**Course:**

Chemistry 212 -- Inorganic Chemistry I  
Chemistry 213 -- Inorganic Chemistry I (with laboratory)  
Chemistry 222 -- Organic Chemistry II  
Chemistry 231 -- Analytical Chemistry I  
Chemistry 252 -- Environmental Chemistry  
Chemistry 342 -- Advanced Organic Chemistry  
Chemistry 351 -- Biochemistry Survey  
Chemistry 352 -- Experimental Biochemistry  
Chemistry 462 -- Advanced Physical Chemistry  
\*ES 231 -- Nature of Engineering Materials  
\*Chemical Engineering 331 -- Polymers  
\*Chemical Engineering 344 – Introduction to Colloid and Surface Science

**Prerequisites:**

Chemistry 122  
Chemistry 122  
Chemistry 221  
Chemistry 122  
Chemistry 121  
Chemistry 222  
Chemistry 222  
Chemistry 351  
Chemistry 323

\*Only one Chemistry Elective may be chosen outside of the Chemistry Department

<sup>4</sup>Technical Electives

Any upper level Engineering, 3xx Science, or 3xx Mathematics course. At least one must be taken within the Chemical Engineering Department.

## ***Civil Engineering***

Civil engineering emphasizes a broad understanding of engineering principles for solving problems in such areas as the environment, water resources, geotechnical, construction management, structural design and analysis, and transportation. Civil engineers are employed in transportation, construction, waterway design and analysis, geotechnical, management, environmental engineering, urban planning, and structural design.

## Civil and Environmental Engineering Curriculum

Fall Semester		Spring Semester	
<b>FIRST YEAR</b>			
Math 161 (Calc I)	1	Math 162 (Calc II)	1
Chemistry 121	1	Chemistry 122 or ES 231	1
First Year Seminar	1	English 110 or Hum/Soc Elective	1
ES 101 Intro to Engineering	1	Physics 131	1
Courses	4	Courses	4
<b>SECOND YEAR</b>			
Math 263 (Calc III)	1	Math 264 (Differential Equations)	1
ES 226 Statics	1	ES 225 Professionalism & Ethics (VAST course)	1
CE 321 Environmental Engineering	1	ES 230 Strength of Materials	1
CE 271 Design I	1	Science/Math Elective	1
Hum/Soc Elective or English 110	1	CE 341 Transportation Systems	1
Courses	5	Courses	5
<b>THIRD YEAR</b>			
CE 331 Project Management	1	CE 372 Design II	1
CE 311 Fundamentals of Structural Engineering	1	CE 201 Civil Engineering Computing	1
CE 361 Geotechnical Engineering	1	CE 351 Water Resources	1
CE 251 Fluids	1	Science/Math Elective	1
Hum/Soc Elective	1	Hum/Soc Elective	1
Courses	5	Courses	5
<b>FOURTH YEAR</b>			
CE Elective	1	CE 473 Design III	1
CE Elective	1	CE Elective	1
Technical Elective	1	Technical Elective	1
Hum/Soc Elective	1	Hum/Soc Elective	1
Free Elective	1	Free Elective	1
Courses	5	Courses	5
<p><b>Note 1:</b> CE electives must be selected from at least two sub-fields of civil engineering. (Technical electives and free electives can be used to take additional CE electives in any sub-field).</p>			
<p><b>Note 2:</b> A technical elective is an upper-level mathematics, science, or engineering course (including CE electives), usually requiring one or more prerequisites. <i>EP 251 and EP 271 may not be used as technical electives but may be taken as free electives.</i></p>			
<p><b>Note 3:</b> Four Hum/Soc Electives must be selected from the list of approved electives for engineering majors.</p>			
<p><b>Note 4:</b> One additional Hum/Soc Elective must be selected from the list of approved electives for civil engineering majors. (This list is a subset of the approved electives for engineering majors). However, if EP 251 is taken as a free elective, this requirement is dropped and the fifth Hum/Soc Elective can be selected from any course on the list of approved electives for engineering majors.</p>			
<p><b>Note 5:</b> Of the five Hum/Soc Electives, at least one must be in humanities and at least one must be in social science.</p>			
<p><b>Note 6:</b> At least two Hum/Soc Electives must be in the same discipline with one course at the 200 or higher level</p>			
<p><b>Note 7:</b> Courses in geology, biology, physics or chemistry can be science electives. Math courses with a prerequisite of at least Math 161 will be considered math electives.</p>			

## **Policy and Economics Electives within the Civil and Environmental Curriculum**

### Economics

Econ 101 Principles of Economics  
Econ 210 Foundations of International Economics  
Econ 211 Intermediate Microeconomics  
Econ 212 Intermediate Microeconomics  
Econ 330 Urban Economics  
Econ 331 Industrial Organization  
Econ 332 Economics of Labor  
Econ 335 Environmental Economics  
Econ 340 Law and Economics  
Econ 341 Public Finance  
Econ 343 Economic History of the U.S.  
Econ 366 History of Economic Thought

### Anthropology and Sociology

AS 219 American Communities: Cities, Suburbs and Towns  
AS 223 Anthropology of Politics  
AS 235 Business and Society

### Government and Law

Gov 101 Introduction to U.S. Politics  
Gov 102 Introduction to International Politics  
Gov 211 State and Local Government and Politics  
Gov 213 Law and Society  
Gov 217 Public Administration  
Gov 221 Government and Politics in Western Europe  
Gov 224 Government and Politics of East Asia  
Gov 225 Politics of Russia, and Other Post Soviet States, and Eastern Europe  
Gov 227 Politics of Latin America and the Caribbean  
Gov 229 Government and Politics of South East Asia  
Gov 230 International Politics of the Middle East and Persian Gulf  
Gov 234 American Security Policy  
Gov 237 German Foreign Policy  
Gov 238 Contemporary Russian and Post Soviet Foreign Policy  
Gov 239 International Politics of Asia  
Gov 310 Politics, Policy and Law in American Federalism  
Gov 316 American Public Policy

### History

Hist 215 History of Technology  
Hist 250 Technology and the American Imagination  
Hist 251 The American City

## ***Electrical and Computer Engineering***

The curriculum builds on the fundamentals in the physical and engineering sciences plus mathematics and computer skills. Electrical and Computer Engineering covers basic topics in circuits, electronics, digital systems, programming languages, and electromagnetics. These core subjects lead to studies in wireless and wired communications, speech and image processing, satellite communications, biomedical instrumentation and processing, microwaves, computer design, antennas, lasers, fiber optics, Integrated Circuit (IC) design, audio engineering, control and manufacturing, computer networks, power distribution, electric machines, and advanced analog and digital electronics.

## Electrical and Computer Engineering Curriculum

<u>FIRST YEAR</u>	FIRST-YEAR SEMINAR (FYS)	PHYSICS 131 or 151 (L)
	INTRO. TO ENGRNG ES101 (L)	NATURES OF MATERIALS ES231
	CHEMISTRY (CHEM 121) (L)	WRITING (ENG110)
	CALCULUS I (Math 161 or Math 165)	CALCULUS II (Math 162 or 166)
<u>SECOND YEAR</u>	INTRO TO PROGRAMMING (CS102)(L)	SOC/HUM ELECTIVE
	CALCULUS III (Math 263)	ELECTRICAL CIRCUITS (ECE221) (L)
	PHYSICS II (Phys 132 or 152) (L)	DISCRETE MATH (Math 182)
	SOC/HUM ELECTIVE	DIGITAL SYSTEMS II (ECE212) (L)
	DIGITAL SYSTEMS I (ECE211) (L)	DIFFERENTIAL EQNS. (Math 264)
<u>THIRD YEAR</u>	COMP. ORGANIZATION (ECE313)	ELECTRONICS II (ECE323) (L)
	ELECTRONICS I (ECE322) (L)	COMMUNICATIONS (ECE332)
	SIGNALS AND SYSTEMS (ECE331)	SOFTWARE ENGRNG. (CS205) (L)
	SOC/HUM ELECTIVE	ELECTROMAGNETICS (ECE341)
	COMP SCI. (JAVA) (CS103) (L)	ENGINEERING ETHICS (ES225)
<u>FOURTH YEAR</u>	INDUSTRIAL CONTROL (ECE433) (L)	ECE ELECTIVE
	SEMI CONDUCTOR PHYSICS (ECE445)	ECE/CS ELECTIVE
	SENIOR DESIGN I (ECE491)	SENIOR DESIGN II (ECE492)
	ECE ELECTIVE	SOC/HUM ELECTIVE
	FREE ELECTIVE	FREE ELECTIVE

(L)denotes a course with a lab. Updated April 2008.

## ***International Studies and Engineering***

Globalization of engineering and technology is increasing the number of attractive job opportunities in foreign countries for engineers with proficiency in a second language and an understanding of foreign cultures. This program enables students to earn a B.S. degree in an engineering field and an additional A.B. degree in International Studies. In this program, you acquire proficiency in a chosen language and develop an in-depth understanding of the culture of a country or region where the language is spoken. You take international politics and international history courses, as well as others in the humanities and social sciences that relate to those particular countries or regions. The capstone experience is total immersion in a foreign culture. Students either study or work abroad in a country where their chosen language is spoken, typically during the summer before the senior year.

## ***Mechanical Engineering***

Mechanical engineers are responsible for the design, development, and manufacture of a wide variety of products and systems. Mechanical Engineers play a central role in the design of complex systems such as aircraft, electricity-generating stations, automobiles, and artificial limbs.

Mechanical Engineering is a key discipline in biotechnology. Mechanical Engineers are versatile in that they are prepared for employment in virtually all industries. Mechanical engineering is an outstanding undergraduate degree for those who wish to pursue graduate studies in engineering, patent law, dentistry or medicine.

## Mechanical Engineering Curriculum

Fall Semester		Spring Semester	
<b>FIRST YEAR</b>			
Math 161 Calculus I	1	Math 162 Calculus II	1
Chemistry 121 General Chemistry	1	Chemistry 122 or ES 231	1
First Year Seminar	1	English 110 College Writing	1
ES 101 Intro to Engineering	1	Physics 131 Newtonian Physics	1
Courses	4	Courses	4
<b>SECOND YEAR</b>			
Math 263 Calculus III	1	Math 264 Differential Equations	1
ES 226 Statics	1	ES 230 Strength of Materials	1
Physics 132 Electricity and Magnetism	1	ME 210 Manufacturing and Design	1
ES 225 Professionalism and Ethics	1	ME 240 Dynamics	1
Hum/Soc Elective	1	Hum/Soc Elective	1
Courses	5	Courses	5
<b>THIRD YEAR</b>			
ME 331 Instrumentation and Data Acquisition	1	ME 352 Dynamics of Physical Systems	1
ME 350 Thermodynamics I	1	ME 360 Thermo II	1
ME 353 Design I	1	ME 362 Fluid Mechanics	1
Math/Science Elective <sup>1</sup>	1	ME 371 Engineering Design II	1
Hum/Soc Elective	1	Hum/Soc Elective	1
Courses	5	Courses	5
<b>FOURTH YEAR</b>			
ME 470 Heat Transfer	1	ME 475 Thermal/Fluids Engineering Lab	1
ME 478 Control Systems and Mechatronics	1	ME 498 Senior Design Project I	1
ME 479 Dynamic Systems, Controls, & Mechatronics Lab	1	Free Elective	1
ME 497 Senior Design Project I	1	Technical Elective <sup>3</sup>	1
Free Elective <sup>2</sup>	1	Technical Elective	1
Courses	5	Courses	5
<b>Note 1:</b> See ME faculty advisor for list of approved math/science electives.			
<b>Note 2:</b> See ME faculty advisor for a description of free electives.			
<b>Note 3:</b> See ME faculty advisor for a list of approved technical electives			

# Social Science and Humanities Electives for Engineering Students

*March, 2007*

## I. APPROVED SOCIAL SCIENCE - HUMANITIES ELECTIVES

The list, effective for all classes, is in accord with the recommendations of the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology. It is the student's responsibility that any deviation from this list or special topics, independent study, research internships, thesis (outside engineering) be approved by petition to the Director of Engineering.

Two (2) elective courses must be taken in the same department, at least one (1) of which is at the 200 level. If the courses are foreign language courses, one (1) course must be at the 111 level or higher. Students must take a minimum of one (1) course in the social sciences and one (1) course in the humanities.

## II. SCIENCE ELECTIVES

Courses in geology, biology, physics, or chemistry will be permitted as science electives, subject to approval of the student's major department.

## III. TECHNICAL ELECTIVES

Upper-level courses in math, sciences, and engineering which normally require prerequisites are acceptable as technical electives for engineering students, subject to the approval of the student's major department.

### IDENTIFICATION OF HUMANITIES AND SOCIAL SCIENCES

<b>Humanities</b>	<b>Social Sciences</b>
Art History	African Studies
English	American Studies
Foreign Languages	Anthropology & Sociology
Music	Economics & Business
Philosophy	Education
Religion	Government & Law
Comparative Literature	History
	International Affairs
	Psychology
	Women's Studies

*(SEE NEXT PAGE FOR FULL LISTING OF COURSES)*

**AFRICANA STUDIES** All Courses

**AMERICAN STUDIES** All Courses

**ANTHROPOLOGY & SOCIOLOGY**

All Courses *Except* A&S 340 and A&S 341

**ART** All Courses

**COMPARATIVE LITERATURE** All Courses

**ECONOMICS & BUSINESS**

ECON 101 Principles of Economics  
ECON 210 Foundations of International Economics  
ECON 211 Intermediate Microeconomics  
ECON 212 Intermediate Macroeconomics  
ECON 270 Women and the Economy  
All 300- and 400-Level Courses, *Except* ECON 365

**EDUCATION** None

**ENGLISH (& Theater)** All Courses *Except* ENG 110

**GOVERNMENT & LAW** All Courses

**HISTORY** All Courses

**INTERDISCIPLINARY STUDIES**

**Humanities**

*(Can be used to satisfy breadth, but not depth.)*

INDS 150/151 \*Anatolia: The Cradle of Civilizations  
INDS 175 \*Israel, Greece, Rome  
INDS 180 The Colorful Sunset of the Habsburg Empire  
INDS 190 \*Pol & Cult Carribe  
INDS 200 \*The Land & Landscape of Ireland  
INDS 210 \*Exploring South America  
INDS 215 Medieval Northern Europe  
INDS 220 \*Florence: Birthplace of Renaissance  
INDS 230 \*Paris, Province and the Midi...  
INDS 245 Social & Ethical Aspects of Health Care...  
INDS 270 A Moveable Feast: American Writers in Paris  
INDS 361 \*The Gothic Cathedral: Structural...

**Social Science/Humanities**

*(Can be used as a "fourth" social science/humanities,  
but cannot be used to satisfy either breadth or depth.)*

INDS 112 Introduction to Asia  
INDS 232 Charisma & Charismatic Leadership  
INDS 240 From Generosity to Justice  
INDS 380, 381 Internship in Ethical Studies  
INDS 390, 391 Independent Studies in Ethics

**Continuation – Interdisciplinary Studies**

**Social Sciences**

*(Can be used to satisfy breadth, but not depth)*

INDS 120 Inside the People's Republic of China  
INDS 135 \*Thailand & Myanmar: Chall Devel...  
INDS 160 \*Comparative Legal Systems...  
INDS 165 \*The Open Wall & New Europe...  
INDS 170 \*Modern Sub-Saharan Africa  
INDS 185 Guatemala: Innovations and Development  
INDS 195 \*History & Politics of Israel...  
INDS 205 \*Green Europe: Germany/Austria  
INDS 250 \*French Commerce & Culture  
INDS 275 Paris: Intro to the French Exception  
INDS 280 \*Russia  
INDS 321, 322 Technology Clinic

**INTERNATIONAL AFFAIRS** All Courses

**LANGUAGES** All Courses

(Native Tongue *Excluded*)

**MILITARY SCIENCE**

MS 402 Officer Responsibilities

**MUSIC** All Full-Credit Courses

**PHILOSOPHY** All Courses *Except* PHIL 150 & 321

**PSYCHOLOGY**

Most Psychology courses require PSYC 110 as a prerequisite. PSYC 110 can be taken only as a free elective.

All courses *Except* PSYC 120, 203, 304

**RELIGION** All Courses

*Note:* REL 221 and REL 222  
*are Social Science Courses*

**WOMEN'S STUDIES**

WS 101 counts as a Social Science and can be used to satisfy the breadth requirement. All other WS courses can be used as a "fourth" social science/humanities, *but cannot be used to satisfy either breadth or depth.*

\*Interim Session

# International Experiences for Engineering Students

***Bremen Program:*** The faculty-led program in Bremen, Germany enables students to go abroad during the spring semester of their second year and stay current with their required courses. Students take one or two courses from the Lafayette faculty member and additional courses at International University Bremen (IUB). A wide range of courses is available, including several in engineering, which enables engineering majors to participate in this study-abroad semester. Students live in an international dormitory with other students from around the world. One of the required courses centers around European culture and includes trips to Belgium, The Netherlands, Germany, and France. Although no prior knowledge of German is required, students are encouraged to study the language while they are in Bremen.

***Interim Program:*** Students have the opportunity for intensive study-abroad experiences through the optional January or May interim session. In recent years, Lafayette faculty have traveled with students to teach courses in China and Hong Kong, England, France, Germany, Hawaii, Ireland, Israel, Kenya and Tanzania, South America, Turkey, and the West Indies. While most courses are interdisciplinary with a broad emphasis on culture, some, such as The London Theatre and Geologic Evolution of the Hawaiian Islands, are discipline specific. The cost for these courses, which run for about three weeks, ranges from \$2,800 to \$4,200 for tuition, airfare, room, and other expenses. Financial aid is available.

***International Studies and Engineering:*** Globalization of engineering and technology is increasing the number of attractive job opportunities in foreign countries for engineers with proficiency in a second language and an understanding of foreign cultures. This recently implemented program enables highly capable and motivated students to earn a B.S. degree in chemical, civil, electrical and computer, or mechanical engineering and an additional A.B. degree in International Studies.

***Study Abroad and other Off-campus programs:*** Lafayette Engineering Students have occasionally taken advantage of Lafayette's study abroad program or other off-campus programs. Students who wish to pursue these opportunities should contact their advisors as soon as possible. Students must work closely with their advisors to insure that the study abroad program will meet their degree requirements and that they will remain on schedule for graduation.

## Design Experience

**Coursework:** Many of your courses starting with ES 101 Introduction to Engineering and throughout all of the engineering programs will give you hands-on opportunities for design.

**Independent Study:** Students who wish to pursue special academic design topics endorsed by a faculty member may register for a credit-bearing course of Independent study. Independent study projects are selected based on the background and interests of the student. An outline of the proposed work is submitted for approval by the department head and the faculty member who serves as advisor. A final paper presenting the results of the work is required. A presentation to student and faculty may also be required. The student receives one course credit for an independent study project. Their work in these courses will be supervised by a faculty member and will be graded in the usual way.

**Design Teams:** Student organizations often sponsor design teams (e.g, the concrete canoe and the Baja car). First-year students are encouraged to become involved in these teams. Contact the individual organizations for additional information.

**Internships:** Internships are designed to focus on a special project with an emphasis on learning the work related to a particular field. These experiences can be paid, volunteer, or for academic credit. Paid and unpaid internships are available during the summer months. Meet with your Gateway adviser to begin your summer internship search. Begin your search in October to secure a position for the following summer. Your Gateway adviser will show you how to search Job Vault for summer internships, alumni-sponsored internships, as well as how to apply to regional and national internship programs.

**Faculty Projects:** Many faculty research projects have design components. If you are interested in working in a particular field, contact the appropriate faculty member. They may be able to supervise you on a particular design project.

## Opportunities for Research Experience

***Independent Study:*** A student may initiate an independent study project through discussions with a faculty member. Independent study projects are selected based on the background and interests of the student. An outline of the proposed work is submitted for approval by the department head and the faculty member who serves as advisor. A final paper presenting the results of the work is required. A presentation to student and faculty may also be required. The student receives one course credit for an independent study project. Their work in these courses will be supervised by a faculty member and will be graded in the usual way.

***Honors:*** Departmental honors are awarded for outstanding performance in writing a Senior Thesis or in conducting Senior Research. A sequence of two courses in the department is required. Students who hope to become candidates for departmental honors must register for the two courses in Thesis or Research beginning the first semester of their senior year, or, with the permission of the Academic Progress Committee, the second semester of their junior year. Their work in these courses will be supervised by a faculty member and will be graded in the usual way. Candidates for honors must have and maintain cumulative (grade point) averages of 3.00 and averages of 3.20 in the honors department and must fulfill such other requirements as may be established by the department (e.g., writing and presenting a progress report after the first semester).

***EXCEL:*** Lafayette's EXCEL Scholars Program enables selected students to participate in research projects with faculty members under their direct supervision. The purpose of the EXCEL Program is to enhance the learning opportunities for students and to encourage collaboration in learning and research between faculty and students. The work of the student assistant, therefore, must be research-oriented and not clerical in its primary emphasis. EXCEL research assistantships are available to full-time students in all disciplines. EXCEL Scholars receive a stipend of \$8-10 per hour and may work part-time during the academic year (8-10 hours per week) or full time during the summer (8-10 weeks) and the Interim Session (three weeks). EXCEL Scholars receive College housing in the residence halls during the period they are working in the Interim and summer. To be eligible as an EXCEL Scholar, students should have completed their first year at Lafayette and should maintain an overall and major GPA of 3.25. Students who would like to be considered for the EXCEL Scholars Program must be nominated by the faculty members who will serve as their mentors.

***Research Experiences for Undergraduates (REU):*** REU's are available at research institutions throughout the United States. For further information concerning possible REU opportunities, students should speak to a professor in their field of interest or visit the National Science Foundation web site, [www.nsf.gov](http://www.nsf.gov).

## Student Groups in Engineering

<b>AIChE</b>	American Institute of Chemical Engineers Contact: Prof. Morton
<b>ASCE</b>	American Society of Civil Engineers. Contact: Prof. Kurtz
<b>ASME</b>	American Society of Mechanical Engineers Contact: Prof. Merz
<b>IEEE</b>	Institute of Electrical and Electronics Engineers Contact: Prof. Jemison
<b>Leonardo Society</b>	Organization of students pursuing a Bachelor of Arts in Engineering Contact: Prof. Jones
<b>Tau Beta Pi</b>	Engineering National Honor Society Contact: Prof. Martin
<b>SWE</b>	Society of Women Engineers Contact:
<b>MSE</b>	Minorities in Math, Science, and Engineering Contact: Prof. Tavakoli
<b>ESAC</b>	Organization of student leaders of Lafayette engineering organizations Contact: Prof. Roth

### Teams:

- Concrete Canoe (ASCE)
- Steel Bridge (ASCE)
- Formula Car (ASME)
- Chem Car (AIChE)
- Engineers Without Borders
- Society of Environmental Engineers and Scientists
- ?? (start your own!)

## Your Future

**Internships:** Internships are designed to focus on a special project with an emphasis on learning the work related to a particular field. These experiences can be paid, volunteer, or for academic credit. Paid and unpaid internships are available during the summer months. Meet with your Gateway adviser to begin your summer internship search. Begin your search in October to secure a position for the following summer. Your Gateway adviser will show you how to search Job Vault for summer internships, alumni-sponsored internships, as well as how to apply to regional and national internship programs.

**Careers:** Engineering students go on to a variety of different jobs when they graduate. The following is just a partial list of possibilities!

- Industry (e.g., Merck, Ingersall Rand)
- Consulting (e.g., URS Greiner)
- Government
- Business
- Law
- Construction
- Peace Corps
- ??

The best time to start thinking about jobs is NOW!

The best places to ask about jobs are...

- Your advisor's office
- Career Services (201 Hogg Hall) at meetings of your professional society

**Graduate Schools:** Many students want to continue their engineering education beyond four years. These students are interested in developing specific fields of expertise within engineering or in pursuing a career in academia. For students who are interested in doing research at the graduate level, there is usually funding available (research assistantships or teaching assistantships) to cover the cost of tuition and a stipend for living expenses.

The best way to learn about graduate school opportunities is to...

- Talk with your advisor.
- Visit Career Services (201 Hogg Hall).
- Attend brownbag presentations featuring current graduate students
- Browse web pages of the different graduate programs

## Sources for Help

### ***Academic Help***

Professors – Your professors will have posted office hours and may also offer help sessions throughout the semester to give students assistance with assignments.

Tutors – Tutors are students recommended by faculty who are hired and trained to assist students with courses offered at the College. Tutors meet with their students one-on-one on a regular basis throughout the semester. Students may sign up for an appointment to be assigned a tutor at the bulletin board in 302 Hogg Hall. Appointments are offered daily at various times. Tutors and students set up the tutoring schedule at their convenience.

Department Heads – DHs coordinate the courses and curriculum for each engineering program.

Academic Resource Center – The ARC provides academic support services to all students. These services include the Peer Tutoring Program (described above) and Study Skills Workshops. Workshops are scheduled on a regular basis with topics including time management, note taking, reading, and exam preparation skills. The office also acts as the liaison to the Athletic Department and provides services for special needs students.

Office of the Dean of Studies – The Dean of Studies is responsible for the academic aspects of student life. He supervises counseling in all phases of academic work and provides for review and determination of the academic status of students. He has primary responsibility for the faculty advising system, orientation programs, the Marquis Scholars Program, national fellowship competitions, and pre-professional advising.

Registrar – The Office of the Registrar keeps records of the scholastic work and standing of students. The Registrar's office prepares course and hour schedules and conducts registration and scheduling of students.

Director of Engineering – The Director of Engineering oversees the engineering facilities and coordinates aspects of the engineering curriculum that affect all engineering programs.

### ***Non-Academic Help***

Office of the Dean of Students – The Dean of Students is responsible for: residence life; intramural and intercollegiate athletics; other extracurricular activities and religious programs; all non-academic aspects of student life; and health services, cultural programs student conduct and discipline, and student volunteer programs

Resident Advisers – The RA is there to help students achieve their academic goals and to derive maximum benefits from group living. In addition to student RAs, faculty residents live in several of the residence halls.

Counseling Services – The Counseling Center is staffed by counseling psychologists who provide Lafayette students with individual and group counseling for personal and academic concerns. Consultation with one of the counselors is available by appointment. The confidentiality of the counselor-client relationship is strictly observed.

Director of Health Services – While school is in session, a registered nurse is on duty at the Health Center from 8 a.m. to 8 p.m. on weekdays and from 10 a.m. to 6 p.m. on weekends. General clinic hours for physicians are on weekdays from 9:30 to 11:30 a.m. and from 2:30 to 4:30 p.m. Scheduled appointments are available at other times.

Office of the Chaplain – The Chaplains (Chaplain of the College, Catholic Chaplain, and Jewish Chaplain) coordinate the religious activity programs of the College. They may be contacted for religious, moral, family, personal, and emotional problems and questions. Such consultations are confidential.

## **Useful People and Contact Information**

	<b>Title</b>	<b>Name</b>	<b>Location</b>	<b>Phone</b>	<b>e-mail</b>
<b>Administration</b>	Associate Provost /Director of Engineering	Mary J. S. Roth	308A	5403	rothm
	Division Secretary	Beverly Bortz	319	5403	bortzb
	Reaccreditation Coordinator	Juanita Barna- Providoshin	308	5419	barnaj
<b>Heads of Engineering Programs</b>	CEE	Dave Brandes	320	5441	brandesd
	ChE	Polly Piergiovanni	264	5431	piergiop
	ECE	Ismail Jouny	414	5414	jounyi
	ME	Len Van Gulick (F)	254	5445	vangulil
		Scott Hummel (S)	256	5587	hummels
AB Engr	Sharon Jones	303	5410	jonessa	
<b>Department Secretaries</b>	CEE	Beverly Bortz	319	5437	bortzb
	ChE	Serena Ashmore	230	5435	ashmores
	ECE	Nicolette Stavrovsky	406	5428	stavrovn
	ME	Serena Ashmore	230	5435	ashmores
	AB Engr	Beverly Bortz	319	5437	bortzb
<b>Advisors for Student Groups</b>	ASCE	Steve Kurtz	321	5441	kurtzs
	AIChE	Sam Morton	266	5417	mortons
	ASME	Rich Merz	258	5451	merzr
	IEEE	Bill Jemison	415	5425	jemisonw
	Leonardo Society	Sharon Jones	303	5410	jonessa
	Tau Beta Pi	Bud Martin	231	5430	martinj
	SWE				
	MSE	Javad Tavokoli	229	5433	tavakoli
<b>Dean of Students</b>		Jim Krivoski	107 Markle Hall	5082	krivoskj
<b>Dean of the College</b>			1 Markle Hall	5080	bukicsr
<b>Counseling Center</b>			Bailey Health Center	5005	
<b>Career Services</b>			201 Hogg Hall	5115	

## **Time Management Suggestions**

(Taken from <http://www.iamnext.com/academics/beyond/timetips.html>)

Whether you were an efficient worker or practicing procrastinator in high school, good time management is a key element to a successful college career. Even if you were efficient in high school, college can be overwhelming - there seems to be so much extra time! Since most classes don't meet on a daily basis, it's easy to think your economics reading assignment can wait until later while you play a game of ultimate Frisbee instead. But beware: if this keeps up, by the time your midterm rolls along, you'll have hundreds of pages of reading to catch up on. The following tips will help you minimize your stress level and maximize your time for college fun.

- **Determine what's most important to you.** What's your first priority? What can be dropped? Write an ordered list of what you need to get done. Prioritize the items on your list.
- **Control your distractions.** Get rid of unnecessary jobs. Handle visitors well. For example, if you're studying in your room and don't want to be bothered, lock your door. Avoid phone distraction by turning off your ringer and letting the answering machine catch your calls.
- **Eat a good breakfast.** A good breakfast gives your body carbohydrates and sugars to keep you energized.
- **When working in groups, delegate jobs efficiently.** Often, people will hesitate to delegate jobs when working in groups, but take charge if there is not a designated leader.
- **Get the most out of class.** Go to class and be on time. Be well-prepared and ready for discussion. Read the material to be covered (check your syllabus). I promise this helps (plus, you'll feel super smart when you recognize the terms your professor talks about).
- One of the best things you can do to manage your time (then be managed by it) is to **learn to say "no."** Say "no" to people asking you to play pool when you should study or when someone wants help with something at an inconvenient time for you. Suggest a different time to help when it's more convenient for you.
- **Remember that there's a time for everything.** Sure, studying for a long time is good, but take breaks. Take power naps when your brain starts frying. If the weather's nice, a good game of ultimate Frisbee also refreshes the tired mind.

Everyone's different; some people like rigid day planners, others can deal with a simple note pad. Adjust these suggestions to best suit your needs. With good time management skills, you'll find yourself a happier and healthier person.

## **Study Skills**

(Taken from [http://www.unc.edu/depts/unc\\_caps/TenTraps.html](http://www.unc.edu/depts/unc_caps/TenTraps.html) )

### Ten Traps of Studying

#### **1. "I Don't Know Where To Begin"**

Take Control. Make a list of all the things you have to do. Break your workload down into manageable chunks. Prioritize! Schedule your time realistically. Don't skip classes near an exam -- you may miss a review session. Use that hour in between classes to review notes. Interrupt study time with planned study breaks. Begin studying early, with an hour or two per day, and slowly build as the exam approaches.

#### **2. "I've Got So Much To Study . . . And So Little Time"**

Preview. Survey your syllabus, reading material, and notes. Identify the most important topics emphasized, and areas still not understood. Previewing saves time, especially with non-fiction reading, by helping you organize and focus in on the main topics. Adapt this method to your own style and study material, but remember, previewing is not an effective substitute for reading.

#### **3. "This Stuff Is So Dry, I Can't Even Stay Awake Reading It"**

Attack! Get actively involved with the text as you read. Ask yourself, "What is important to remember about this section?" Take notes or underline key concepts. Discuss the material with others in your class. Study together. Stay on the offensive, especially with material that you don't find interesting, rather than reading passively and missing important points.

#### **4. "I Read It. I Understand It. But I Just Can't Get It To Sink In"**

Elaborate. We remember best the things that are most meaningful to us. As you are reading, try to elaborate upon new information with your own examples. Try to integrate what you're studying with what you already know. You will be able to remember new material better if you can link it to something that's already meaningful to you. Some techniques include:

Chunking: An effective way to simplify and make information more meaningful. For example, suppose you wanted to remember the colors in the visible spectrum (Red, Orange, Yellow, Green, Blue, Indigo, Violet); you would have to memorize seven "chunks" of information in order. But if you take the first letter of each color, you can spell the name "Roy G. Biv", and reduce the information to three "chunks".

Mnemonics: Any memory-assisting technique that helps us to associate new information with something familiar. For example, to remember a formula or equation, we may use letters of the alphabet to represent certain numbers. Then we can change an abstract formula into a more meaningful word or phrase, so we'll be able to remember it better. Sound-alike associations can be very effective, too, especially while trying to learn a new language. The key is to create your own links, then you won't forget them.

#### **5. "I Guess I Understand It"**

Test yourself. Make up questions about key sections in notes or reading. Keep in mind what the professor has stressed in the course. Examine the relationships between concepts and sections. Often, simply by changing section headings you can generate many effective questions. For example, a section entitled "Bystander Apathy" might be changed into questions such as: "What is bystander apathy?", "What are the causes of bystander apathy?", and "What are some examples of bystander apathy?"

## **6. "There's Too Much To Remember"**

Organize. Information is recalled better if it is represented in an organized framework that will make retrieval more systematic. There are many techniques that can help you organize new information, including:

Write chapter outlines or summaries; emphasize relationships between sections.

Group information into categories or hierarchies, where possible.

Information Mapping. Draw up a matrix to organize and interrelate material. For example, if you were trying to understand the causes of World War I, you could make a chart listing all the major countries involved across the top, and then list the important issues and events down the side. Next, in the boxes in between, you could describe the impact each issue had on each country to help you understand these complex historical developments.

## **7. "I Knew It A Minute Ago"**

Review. After reading a section, try to recall the information contained in it. Try answering the questions you made up for that section. If you cannot recall enough, re-read portions you had trouble remembering. The more time you spend studying, the more you tend to recall. Even after the point where information can be perfectly recalled, further study makes the material less likely to be forgotten entirely. In other words, you can't overstudy. However, how you organize and integrate new information is still more important than how much time you spend studying.

## **8. "But I Like To Study In Bed"**

Context. Recall is better when study context (physical location, as well as mental, emotional, and physical state) are similar to the test context. The greater the similarity between the study setting and the test setting, the greater the likelihood that material studied will be recalled during the test.

## **9. "Cramming Before A Test Helps Keep It Fresh In My Mind"**

Spacing: Start studying now. Keep studying as you go along. Begin with an hour or two a day about one week before the exam, and then increase study time as the exam approaches. Recall increases as study time gets spread out over time.

## **10. "I'm Gonna Stay Up All Night 'til I Get This"**

Avoid Mental Exhaustion. Take short breaks often when studying. Before a test, have a rested mind. When you take a study break, and just before you go to sleep at night, don't think about academics. Relax and unwind, mentally and physically. Otherwise, your break won't refresh you and you'll find yourself lying awake at night. It's more important than ever to take care of yourself before an exam! Eat well, sleep, and get enough exercise.

# ABET

Lafayette's engineering programs which award a Bachelor of Science degree are accredited by the Engineering Accreditation Board for Engineering and Technology (ABET). The criteria for accreditation are listed below.

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## I. GENERAL CRITERIA FOR BASIC LEVEL PROGRAMS

It is the responsibility of the institution seeking accreditation of an engineering program to demonstrate clearly that the program meets the following criteria.

### **Criterion 1. Students**

The quality and performance of the students and graduates are important considerations in the evaluation of an engineering program. The institution must evaluate, advise, and monitor students to determine its success in meeting program objectives. The institution must have and enforce policies for the acceptance of transfer students and for the validation of courses taken for credit elsewhere. The institution must also have and enforce procedures to assure that all students meet all program requirements.

### **Criterion 2. Program Educational Objectives**

Each engineering program for which an institution seeks accreditation or reaccreditation must have in place:

- (a) detailed published educational objectives that are consistent with the mission of the institution and these criteria
- (b) a process based on the needs of the program's various constituencies in which the objectives are determined and periodically evaluated
- (c) a curriculum and processes that ensure the achievement of these objectives
- (d) a system of ongoing evaluation that demonstrates achievement of these objectives and uses the results to improve the effectiveness of the program.

### **Criterion 3. Program Outcomes and Assessment**

Engineering programs must demonstrate that their graduates have:

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs
- (d) an ability to function on multi-disciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Each program must have an assessment process with documented results. Evidence must be given that the results are applied to the further development and improvement of the program. The assessment process must demonstrate that the outcomes important to the mission of the institution and the objectives of the program, including those listed above, are being measured. Evidence that

may be used includes, but is not limited to the following: student portfolios, including design projects; nationally-normed subject content examinations; alumni surveys that document professional accomplishments and career development activities; employer surveys; and placement data of graduates.

#### **Criterion 4. Professional Component**

The professional component requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The engineering faculty must assure that the program curriculum devotes adequate attention and time to each component, consistent with the objectives of the program and institution. Students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating engineering standards and realistic constraints that include most of the following considerations: economic; environmental; sustainability; manufacturability; ethical; health and safety; social; and political. The professional component must include

- (a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline
- (b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study
- (c) a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.

#### **Criterion 5. Faculty**

The faculty is the heart of any educational program. The faculty must be of sufficient number; and must have the competencies to cover all of the curricular areas of the program. There must be sufficient faculty to accommodate adequate levels of student-faculty interaction, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners, as well as employers of students. The faculty must have sufficient qualifications and must ensure the proper guidance of the program and its evaluation and development. The overall competence of the faculty may be judged by such factors as education, diversity of backgrounds, engineering experience, teaching experience, ability to communicate, enthusiasm for developing more effective programs, level of scholarship, participation in professional societies, and registration as Professional Engineers.

#### **Criterion 6. Facilities**

Classrooms, laboratories, and associated equipment must be adequate to accomplish the program objectives and provide an atmosphere conducive to learning. Appropriate facilities must be available to foster faculty-student interaction and to create a climate that encourages professional development and professional activities. Programs must provide opportunities for students to learn the use of modern engineering tools. Computing and information infrastructures must be in place to support the scholarly activities of the students and faculty and the educational objectives of the institution.

#### **Criterion 7. Institutional Support and Financial Resources**

Institutional support, financial resources, and constructive leadership must be adequate to assure the quality and continuity of the engineering program. Resources must be sufficient to attract, retain, and provide for the continued professional development of a well-qualified faculty. Resources also must be sufficient to acquire, maintain, and operate facilities and equipment appropriate for the engineering program. In addition, support personnel and institutional services must be adequate to meet program needs.

### **Criterion 8. Program Criteria**

Each program must satisfy applicable Program Criteria (if any). Program Criteria provide the specificity needed for interpretation of the basic level criteria as applicable to a given discipline. Requirements stipulated in the Program Criteria are limited to the areas of curricular topics and faculty qualifications. If a program, by virtue of its title, becomes subject to two or more sets of Program Criteria, then that program must satisfy each set of Program Criteria; however, overlapping requirements need to be satisfied only once.

The specific Program Educational Objectives and Program Outcomes for each of the four B.S. engineering departments can be found at the web addresses listed below:

Chemical Engineering:	<a href="http://ww2.lafayette.edu/~chemeng/abet.php">http://ww2.lafayette.edu/~chemeng/abet.php</a>
Civil and Environmental Engineering:	<a href="http://ww2.lafayette.edu/~ce-enve/abet.php">http://ww2.lafayette.edu/~ce-enve/abet.php</a>
Electrical and Computer Engineering:	<a href="http://ww2.lafayette.edu/~ee/pro_student_abet.php">http://ww2.lafayette.edu/~ee/pro_student_abet.php</a>
Mechanical Engineering:	<a href="http://ww2.lafayette.edu/~mecheng/abet.html">http://ww2.lafayette.edu/~mecheng/abet.html</a>