IE Objectives and Outcomes

Educational Objectives:
The Industrial Engineering program prepares graduates to:

- design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and energy using appropriate analytical, computational and experimental practices
- apply information technologies to the practice of industrial engineering
- conduct themselves in a professional and ethical manner
- work and communicate effectively with colleagues at every level in the organization

Program Outcomes:
Students in the Industrial Engineering program attain:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- an ability to design, develop, implement and improve integrated systems that include people, materials, information, equipment and energy using appropriate analytical, computational and experimental practices
- an ability to apply information technologies to the practice of industrial engineering
- the requisite background for graduate education in industrial engineering and allied disciplines
Overview of the Graduate Program
www.ces.clemson.edu/ie/

Master of Engineering
Master of Science
Doctor of Philosophy
Industrial engineers design, develop and improve integrated systems that include people, materials, information, equipment and energy. In addition to these issues, graduates learn to address communications throughout the organization while completing their specialized education. Focus areas for specialization are human factors/ergonomics and production and service systems. Work at the doctoral level includes College of Engineering and Science independent research, dissemination of findings and preparation for research and teaching careers.

Students with baccalaureate degrees in engineering, the physical sciences, mathematics, or related majors with a strong mathematical background may be admitted into the program. Entering graduate students are assumed to have competence in calculus, probability and statistics, calculus-based physics, and computing. Students admitted without this background will be required to complete successfully additional courses, some of which may not carry graduate credit.

The Master of Engineering program is an interdisciplinary program that focuses on capital projects supply chain engineering directed to working professionals. It is offered in collaboration with the Department of Management and the Department of Civil Engineering. The program is available fully in a distance learning format and courses are delivered asynchronously. Courses required in the program are I E 850, 851, 852, 853, 854, 855, 856, 857, 858, and 859, for a total of 30 hours of graduate coursework.

Master of Science students may select a thesis or nonthesis option. Students in the thesis option must complete a minimum of 30 hours of graduate coursework, including six credits of thesis research. Students in the nonthesis option must complete a minimum of 33 hours of graduate coursework.

The PhD program provides the student with a comprehensive knowledge of the field of industrial engineering and a mastery of the methods of research. A minimum of 48 hours of graduate coursework beyond a baccalaureate degree is required. Since a dissertation is mandatory for all PhD candidates, 18 hours of doctoral research are required. A qualifying examination is required, in addition to examinations required by the Graduate School.

Undergraduates Involved in Graduate Programs
Undergraduate students majoring in Industrial Engineering at Clemson may take courses for graduate credit in two ways:

1. Seniors with a minimum cumulative grade-point ratio of 3.0 may apply to take graduate courses while continuing to pursue their bachelor’s degrees. If successfully completed, these courses may be eligible to be counted towards a master’s degree. Students selecting this option will not be allowed to count these courses towards the bachelor’s degree. (See Graduate School form GS-6 for details.)
2. Students with a minimum cumulative grade-point ratio of 3.4 may apply to take up to 12 semester hours of courses and have them count toward both the bachelor’s and master’s degrees in Industrial Engineering. To take advantage of this opportunity, students must have a minimum cumulative grade-point ratio of 3.4, must have completed the junior year and must have been admitted to the graduate program prior to enrolling in courses. Courses eligible for this program include IE 652, 656, 660, 685, 687, 689, 691, 800, 802, 803, 804, 809, 811, 812, 813, 860, 865, 871, 880, 886, 888, and 893. The Undergraduate Curriculum Committee has preapproved these classes as acceptable technical and free electives in a student’s BS program. Determination of whether the classes count towards the master’s degree will be made by the student’s advisory committee after he/she becomes a full-status graduate student. Students should notify the Graduate Coordinator in writing that they wish to be considered.

In both programs, the decision whether courses count towards the bachelor’s degree is determined by the undergraduate committee and whether they count towards the master’s degree is determined by the advisory committee that is formed after the student becomes a full-status graduate student. Students should consult with their undergraduate advisor, the Graduate Coordinator and/or the Honors Coordinator before enrolling in graduate courses.

**Overview of the Undergraduate program:**

**Bachelor of Science**

Industrial engineers design, install, and improve the complex systems that provide goods and services vital to our society and economy. These systems place unique demands for breadth of preparation on industrial engineers. Baccalaureate degree graduates demonstrate the ability to design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and energy. Graduates demonstrate the ability to apply the principles and techniques of industrial engineering analysis and design supported by a foundation in mathematical, physical, and social sciences, and economic, operational, and engineering analyses. Graduates possess a breadth of knowledge that allows them to practice industrial engineering with an appropriate awareness of information issues in systems improvement. In addition, graduates are able to work and communicate effectively with colleagues at every level in an organization.

The traditional arenas for the practice of industrial engineering are the manufacturing facilities of industry; however, many practicing industrial engineers are employed in non-manufacturing institutions such as hospitals, banks, and government agencies. In addition to numerous employment opportunities in professional practice, industrial engineering graduates may further their formal education.

The Department of Industrial Engineering offers programs leading to the Master of Science and Doctor of Philosophy degrees. The Department of Industrial Engineering allows students to count up to 12 hours of graduate credit (approved 600- and 800-level courses) toward both the bachelor’s and master’s degrees. Students participating in this program must have a minimum grade-point ratio of 3.4 and be admitted to the Graduate School prior to registering for graduate courses. Details of the suggested curriculum and program information are available from the Industrial Engineering Department. Detailed curriculum and department information is available at [www.ces.clemson.edu/ie](http://www.ces.clemson.edu/ie).

See Appendix 1 for a list of Graduate Courses and Appendix 2 for a list of Undergraduate Courses.
Research and innovation continue to be driving factors as Clemson University climbs in the *U.S. News & World Report* rankings. With advanced technology and state-of-the-art laboratories, Clemson provides an environment where researchers and industry professionals can come together to create ideas for the future.

For years, Clemson has created and nurtured research and economic development centers to build a knowledge-based economy. Clemson’s more than 100 centers and institutes are dedicated to everything from automotive excellence to advanced materials, from international diversity to community outreach, from ethics to the arts. The link between academics and industry grows stronger every day.

*See Appendix 3 for Centers, Alliances, and Affiliated Institutes in the College of Engineering and Science.*

### Clemson University Emphasis Areas

http://www.clemson.edu/administration/provost/emphasisareas.bbsea.html

Instead of assigning all of the financial resources to departments and colleges, Clemson instead focuses on programmatic areas that provide interdisciplinary research and service venues, unique platforms for enhanced scholarship, and more opportunities for graduate and undergraduate students. Clemson University has identified eight emphasis areas, which are the foundation for the [Academic Plan](http://www.clemson.edu/administration/provost/emphasisareas.bbsea.html). The College of Engineering and Sciences has a stake in five of these emphasis areas.

- **Advanced Materials** *
- **Automotive and Transportation Technology** *
- **Biotechnology and Biomedical Sciences** *
- General Education
- Family and Community Living
- **Information and Communication Technology**
- Leadership and Entrepreneurship
- **Sustainable Environment**

*Several collections have been purchased to particularly support these Emphasis areas: Historical files in Engineering Village, and the Referex collection of e-books (Elsevier) for Advanced Materials; POLYMERSnetBASE (CRC Press) for Advanced Materials; additional technical reports in the SAE Digital Library for Automotive Engineering; Rosetta Stone language learning for Automotive Engineering.*

*See Appendix 4 for a list of faculty research interests*
1. Purpose of Collection:
To support the teaching, research, and information needs at the undergraduate and graduate level in Industrial Engineering.

Primary Users:
- Graduate Industrial Engineer majors pursuing either the MS or PhD degree
- Undergraduate Industrial Engineering majors
- Industrial Engineering faculty

Secondary Users:
- Students and faculty of departments whose subjects overlap with the interests of Industrial Engineering, including Industrial/Organizational Psychology
- Clemson University Centers and Institutes - these in particular:
  - Researchers and Engineers at South Carolina companies

2. General Collection Guidelines:

Scope of the Collection - Materials will be selected in electronic formats when available
- Reference Books, including handbooks, dictionaries, and encyclopedias (for example Encyclopedia of Materials Science and Kirk-Othmer Encyclopedia of Chemical Technology).
- Monographs – print and electronic – will be selected to support the research and coursework of undergraduate and graduate students as well as the research and teaching needs of the faculty. E-book packages from Knovel and Springer are especially valued. During budget crisis times (such as now) books will be chosen very selectively, primarily in response to requests from faculty and students. A formal analysis of the monographs collection will begin in Spring 2011.
- Industry standards play an important role in the research process. Therefore, we will maintain a subscription to ASTM standards, and bibliographic access to additional standards through ANSI. Standards will be purchased on an as-needed basis, with a budget of $5,000. per year.
- Journals /serials / periodicals will be selected to support undergraduate research and coursework, and to support graduate and faculty research. General interest titles and trade publications generally are included in Aggregators (databases such as Academic Search Premier, Lexis / Nexis, and General Business file, so will not be purchased individually.

See Appendix 5 for a list of Important Journals in Industrial Engineering.
- The primary databases supporting Industrial Engineering are: Engineering Village (Compendex, Engineering Index historical, and Inspec), SciFinder Scholar, Medline, IEEE Xplore, and Web of Knowledge (Science Citation Index and Inspec)
- Textbooks used in Clemson classes will not be purchased, unless they are deemed to be useful for other reasons. Nor can Clemson textbooks be borrowed on Interlibrary Loan.

Languages
Unless otherwise requested by a faculty member, all material will be written in English.
Date of Publication
Most materials purchased will have been published within the preceding two years. Older works will be purchased at the request of a faculty member, to replace heavily-used volumes that have been lost, or for which demand has been shown through Interlibrary Loan borrowing.

Geographical Guidelines
I recognize the global nature of research, and the importance of representing a wide variety of points of view and international perspectives. However, due to serious budget constraints, materials originating/published in the United States will be the primary focus.

Format
Wherever possible, reference works, indexes, and journals will be purchased in electronic format and made available from the Libraries' Web site for access by students and faculty, on and off campus. Print materials will also be selected. Micro formats will be purchased if it is the only format available. Appropriate materials will be purchased on CD-ROM or DVD, when requested by a faculty member.

3. Access to Information Not Available at Clemson

Interlibrary Loan
The primary means of access to materials not owned or accessible by the library is Interlibrary Loan, a service available free to Clemson University students, faculty, and staff.

PASCAL Delivers
Books available from other research institutions in South Carolina can be supplied by PASCAL Delivers, also free to Clemson University students, faculty and staff.

4. Selection, Evaluation, and Assessment Tools:

- Faculty requests and recommendations
- Review sources, e.g. Choice
- Approval slips from YBP ensure notification of titles that fit the needs of the library’s circulating collection. The approval plan is reviewed yearly to ensure that it remains relevant. During bad budget years (as now), the approval plan will be suspended.
- Publishers’ catalogs
- Vendor’s databases (GOBI)
- Indexes, bibliographies, and series lists
- Teaching and research interests of the Industrial Engineering faculty
- Books for College Libraries and Magazines for Libraries
- Interlibrary loan activity
- Circulation activity
- Usage statistics for databases, e-journals and e-books
5. Weeding Guidelines

Books will be weeded from the collection if they are in poor condition and cannot be repaired. A replacement copy will be purchased, if available, for important titles. Duplicate copies of books that have not circulated, and material that is clearly outdated and not of historical interest will also be considered for weeding.

6. Summary of Primary Subject Classifications, LC Call Numbers, and Collecting Levels

<table>
<thead>
<tr>
<th>Subject</th>
<th>LC Class</th>
<th>Collecting Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Engineering</td>
<td>T 55-60.8</td>
<td>undergraduate/graduate</td>
</tr>
<tr>
<td>Human Engineering</td>
<td>TA 166-167</td>
<td>undergraduate/graduate</td>
</tr>
<tr>
<td>Operations Management</td>
<td>TS 155-194</td>
<td>undergraduate/graduate</td>
</tr>
<tr>
<td>Human Factors Psychology</td>
<td>BF 636-637</td>
<td>undergraduate/graduate</td>
</tr>
</tbody>
</table>
Appendix 3

College of Engineering and Science, Centers, Alliances and Affiliated Institutes

**Bioengineering Alliance of South Carolina**
Dr. Richard Swaja, Director
BSB 612, Medical Univ. of South Carolina, 171 Ashley Ave., Charleston, SC 29425
(Voice) 843-792-0430; swajar@musc.edu

**National Brick Research Center**
Dr. Denis Brosnan, Director
The Bishop Center, Clemson Research Park
(Voice) 656-0603; bdenis@clemson.edu

**Center for Advanced Engineering Fibers and Films (CAEFF)**
Dr. Amod A. Ogale, Director
203 Earle Hall
(Voice) 656-5483; ogale@clemson.edu

**Construction Industry Cooperative Alliance (CICA)**
Dr. Steve Sanders, Director
114 Lowry Hall
(Voice) 656-3661; steves@clemson.edu

**Center for Research in Wireless Communication**
Dr. Wilson Pearson
301 Fluor Daniel Building
(Voice) 656-3946; PL@clemson.edu

**Center for Optical Materials Science and Engineering Technologies (COMSET)**
Dr. John Ballato, Director
AMRL, 91 Technology Dr., Clemson Res. Park
(Voice) 656-1035; jballat@clemson.edu

**CU Electrical Power Research Association (CUEPRA)**
Dr. Adly A. Girgis, Director
303 Riggs Hall
(Voice) 656-5936; adly.girgis@ces.clemson.edu

**Center of Excellence in Mathematics & Science Education (CEMSE)**
Dr. Calvin Williams
Mathematical Sciences, O323 Martin Hall
(Voice) 656-5241; CALVINW@CLEMSON.EDU

**Center for Advanced Materials for Thermoelectric Energy Conversion (CAMTEC)**
Dr. Terry Tritt, Director
103 Kinard Lab
(Voice) 656-5319; ttritt@clemson.edu
Conservation Center
Dr. Michael J. Drews, Director
268 Sirrine Hall
(Voice) 656-5955; DMICHAE@CLEMSON.EDU

Laboratory for Emerging Materials
Dr. Ya-Ping Sun, Director
469 Hunter
(Voice) 656-5026; syaping@clemson.edu

Nuclear Environmental Sciences and Radiation Waste Management (NESRWM)
Robert Fjeld, Director
166 Rich Lab/Research Park
(Voice) 656-5569; FJELD@clemson.edu

SC COBRE Center of Biomaterials for Tissue Regeneration (SCBioMat)
Dr. Naren Vyavahare, Director
501 Rhodes Research Center
(Voice) 864-656-5558; narenv@clemson.edu

Affiliated Institutes

Campbell Graduate Engineering Center (CGEC)
Dr. Imtiaz Haque, Executive Director
Campbell Graduate Engineering Center @ CU-ICAR
4 Research Dr., Greenville, SC 29607
(Voice) 864-283-7212; sih@clemson.edu

Automotive Safety Research Institute (CU-ASRI)
Kim E. Alexander
D141 Poole AG Center
(Voice) 656-0664; KALXNDR@CLEMSON.EDU

Institute of Biological Interfaces of Engineering
Dr. Karen J. L. Burg, Director
401 Rhodes
(Voice) 656-6462; KBURG@CLEMSON.EDU

South Carolina’s Coalition for Mathematics and Science
Dr. Tom Peters, Director
Sears House #3, Highway 93
(Voice) 656-1863; tpeters@ssi.edc.org

Clemson Engineering Technology Lab (CETL)
Donald L. Erich
100 Technology Dr., Research Park, Pendleton, SC
(Voice) 646-2413; derich@clemson.edu
Clemson University International Center for Automotive Research
Robert T. Geolas
CU-ICAR, 10 Falcon Crest Dr., Greenville, SC 29603
(Voice) (864) 298-2292; GEOLAS@CLEMSON.EDU

Clemson Apparel Research (CAR)
Dr. Christine W. Cole, Director
500 Lebanon Road, Pendleton, SC 29670
(Voice) 646-8454; cwjrv@clemson.edu

SC Institute for Energy Studies (SCIES)
Dr. Robert Leitner, Director
200 Dillard Building, 400 Klugh Ave., Clemson, SC 29634
(Voice) 656-2267; RLEITNE@CLEMSON.EDU

Supply Chain Optimization and Logistics (CISCOL)
Dr. William G. Ferrell, Jr.
200 Freeman Hall
(Voice) 656-2724; FWILLIA@CLEMSON.EDU

Institute for Modeling and Simulation Applications
Dr. Steve (Dennis E.) Stevenson, Director
442 Edwards Hall
(Voice) 656-5880; STEVE@clemson.edu

Clemson Environmental Institute (CIES)
Dr. Alan Elzerman
Rich Lab, Clemson Research Park
(Voice) 656-5568; AWLZRMN@CLEMSON.EDU

Clemson Institute for Biomedical Science and Engineering
Dr. Martine LaBerge
301 Rhodes
(Voice) 656-5557; LABERGE@CLEMSON.EDU

Center for Motorsports Excellence
Dr. Thomas Kurfess, Director
4 Research Dr., Greenville, SC 29617
(Voice) (864) 283-7219; kurfess@clemson.edu

Clemson University Computational Center for Mobility Systems
Dr. James Leylek, Executive Director
74 Research Dr., CU-ICAR Campus, Greenville, SC 29607
(Voice) (864) 283-7300; jleylek@clemson.edu
Appendix 6

“Core” Journal Packages – Engineering

General
Elsevier (Science Direct)
Springer
Wiley-Blackwell

Professional Societies
ACM Digital Library
ASCE Digital Library
ASME Digital Library
IEEE / IET – IEEE Xplore
SAE Digital Library
SPIE Digital Library

Professional Societies (Great Britain)
ICE – Institution of Civil Engineers
IMechE – Institution of Mechanical Engineers

“Core” Databases

General
Engineering Village (Compendex, Historical Engineering Index, and Inspec)
Web of Knowledge (Science Citation Index, Inspec)
Scifinder Scholar (Chemical Abstracts)
Medline (from EBSCO) plus PubMed (free, from the National Library of Medicine)
Refworks (Bibliographic Citation Management package)