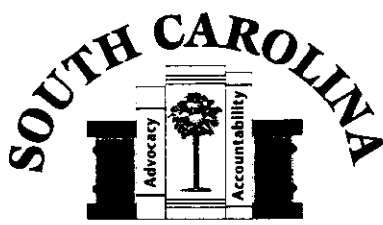


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CHE
07/12/01
Agenda item 3.02.E

Rayburn Barton
Executive Director

July 12, 2001

MEMORANDUM

To: Mr. Dalton B. Floyd, Jr., Chairman, and Members, Commission on Higher Education

From: Ms. Dianne Chinnes, Chairman, Committee on Academic Affairs and Licensing *DC/gm*

CHE Consultants' Evaluation of Existing Programs in Engineering and Engineering Technology

Summary of Process

Attached please find a report from the Commission's external consultant team for engineering and engineering technology (**Attachment 1**). This team, comprised of nine members, visited the five public universities in the state that offer academic degree programs in engineering and engineering technology with the expressed intent of assessing the quality of the programs offered at these institutions. The site visits occurred during the week of November 12, 2000.

The five institutions under review (please see **Attachment 2** for a list of programs by campus)—The Citadel, Clemson University, Francis Marion University, South Carolina State University, and USC-Columbia—submitted to the Commission self-study materials drawn largely from recent Accreditation Board for Engineering and Technology (ABET) self-studies. In preparing for its site visits, the consultant team relied primarily on these documents along with supplemental materials on enrollment trends, faculty salaries, and other pertinent data provided by the Commission staff.

It is important to note, as with all Commission-sponsored program reviews, that the consultant team focused on *program* quality rather than on the general health of academic departments. To this end, the team limited its scope of evaluation to existing majors only.

Summary of Team Findings

The narrative sections of the report culminate in the assessment of a program status level for each program reviewed, as required and defined by the Commission's *Guidelines for the Review of Existing Academic Programs at Public Senior Institutions*. These status levels are Commendation of Excellence, Continuing Approval, Provisional Approval, and Termination. Of the sixty programs reviewed statewide, 57 received Continuing Approval status, one received a Provisional Approval status (Bachelor of Science in Engineering Technology at Francis Marion), and two received Commendation of Excellence status (Master of Science and Doctor of Philosophy in Environmental Systems Engineering at Clemson).

From a statewide perspective, the team's findings can be summarized in the following statements.

1. Overall, engineering and engineering technology programs are of good quality and all meet the Commission's program productivity standards despite the fact that funding levels are "marginal, at best."
2. The existing program array for this discipline area within the state is adequate for existing state needs. The team did not identify any significant gaps in the state's complement of engineering and engineering technology programs, either geographically or in terms of curriculum.
3. Faculty in most programs and at most institutions are of high quality and are productive scholars relative to the requirements of the institutions that they serve (i.e., research or teaching). The team did note that faculty in these disciplines are extremely marketable and that academic leaders at all institutions in South Carolina should take care to provide the incentives needed to retain faculty (e.g., salaries, research lab space, teaching/research assistants, etc.).
4. Students reveal an overall satisfaction with programs. No significant systemic problems with student experiences were identified.
5. Library resources are adequate and have improved dramatically at some institutions in recent years.
6. Much work is needed in the recruitment of women and minority faculty and students in almost all program areas. The team did note, however, that the lack of women and minorities is a national problem that continues to plague the engineering profession.

7. South Carolina should consider the development of an engineering "extension service," not unlike the existing agricultural extension service. This service would be designed to meet the emerging and ongoing needs of high tech business and industry in the state.
8. The Commission should continue to monitor the development of new programs in these disciplines and to encourage collaboration in program development among existing providers where possible.

(NB: Subsequent to questions posed by the Committee on Academic Affairs and Licensing relating to the admission of students from the technical college system into the BS in Engineering Technology at Francis Marion University, the University has informed the Commission staff of changes in the admissions policy to the program. The Commission consultant notes in his report on the program that Francis Marion has excluded students from technical colleges other than Florence Darlington Technical College from gaining admission into the BS in Engineering Technology degree program. Moreover, the University has insisted that students desiring to transfer credits from other state technical colleges obtain approval from Florence-Darlington Technical College prior to gaining admission to FMU (please see page 70 of the attached report). Effective immediately, the University will consider for admission students who have obtained associate degrees in engineering technology from any technical college in South Carolina and will also "accept transfer credits directly from all of the technical colleges in South Carolina for students wishing to pursue" the BS in Engineering Technology degree program.)

Recommendations

The Committee on Academic Affairs and Licensing recommends that the Commission accept the report of the external consulting team on engineering and engineering technology, and approve the following program status levels:

- 1) Continuing Approval status for the programs listed as such on **Attachment 2** (last page in this item);
- 2) Provisional Approval status for the Bachelor of Science in Engineering Technology at Francis Marion University (p.69 of report) with the requirement that the University provide to the Commission staff by July 1, 2002, a report on efforts undertaken to address the shortcomings identified by the Commission consultant; and,
- 3) Commendations of Excellence to the degree programs leading to the Master of Science and Doctor of Philosophy in Environmental Systems Engineering at Clemson University (p.38 of report.)

**Review of
Engineering and Engineering Technology Programs
in South Carolina Public Institutions
of Higher Learning**

**Submitted to
The South Carolina Commission on Higher Education
May 2001**

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Introduction

This report represents an evaluation of engineering and engineering technology programs in the State of South Carolina. This evaluation was conducted at the request of the South Carolina Commission on Higher Education by a team of nine engineering and engineering technology consultants. These consultants were selected by the Commission on Higher Education, and their names and affiliations are given in the appendix of this report. The consultants were requested to conduct their evaluation using the guidelines prepared by the South Carolina Commission on Higher Education and published November 1998. These guidelines outline a process that seeks answers to the following questions:

1. What generalizations can be made pertaining to the level of development and overall quality of undergraduate/graduate programs in this discipline in South Carolina?
2. Does the state support an adequate number of programs of this type? Does it offer too many programs of this type?
3. Are the programs meeting the Commission's productivity standards?
4. How important is the continuation of these programs to South Carolina? To the region? To the individual institution? To the field?
5. Are sufficient resources, including facilities and library access, available to programs in this discipline and around the state?
6. What common strengths do programs of this type have throughout the state? Common weaknesses? What individual strengths/weaknesses or other unique characteristics do programs of this type have throughout South Carolina?
7. Is it appropriate to offer the program via distance education? And, if so, does the institution possess guidelines or a plan for integrating the program successfully into its distance education offerings?
8. What direction should the state follow in considering requests for new undergraduate or graduate programs in this field of study?

The consultants reviewed extensive information about each program prior to visiting the institutions. The team met in Clemson on November 12, 2000 and subsequently visited the various institutions over the following four days.

The consultants were most appreciative of the hospitality of administrators, faculty, and students at each of the institutions visited. In particular, the consultants thank the institutions for their care in preparing the extensive documentation needed as background for the various visits. Special thanks are due to Dr. David R. Loope of the Commission on Higher Education for his assistance to the team and for his excellent implementation of the planning for the various campus visits.

Chapter 1. Status of Engineering and Engineering Education in the United States

As a major engine of economic progress, the field of engineering is strongly linked to the economic success of this nation and thus to the state of South Carolina. The integration of the products and processes of technology into our lives continues to accelerate and the scope of technology is increasingly global. Thus, it is not surprising that engineering education continues to achieve an important role in the future success of both local and global communities. It is also not surprising that the rapid changes in technological progress have been accompanied by a corresponding need for change in content and educational delivery methods. While the fundamental sciences upon which all fields of engineering are based are still valid, new components of these fundamentals are being added at an ever-increasing rate. In addition, the appropriate and innovative application of the fundamental principles of science continues to be a challenge to all of the fields of engineering education.

As the economy of the U.S. has seen cyclic patterns, so also the demand for engineering education has seen cyclic times. Recent data by the Engineering Workforce Commission shows that the largest number of engineering degrees in the U.S. (78,178) was produced in the 1985-86 academic year. An almost continuous decline followed through 1998-99, which had only 62,500 graduates, the lowest since 1980-81. By contrast, the excellent state of the U.S. economy in the later part of the 1990's has signaled the need for new engineering graduates in quantities that exceed those of any time in the recent past. Nationwide, the rate of growth of the degrees in mechanical, electrical, civil, industrial, and chemical engineering are flat, and only computer science and computer engineering are experiencing a three-year upward slope. Because of the time required to complete a baccalaureate degree, there is at least a four-year lag between a change in demand and a corresponding change in output of colleges and universities. There is an even longer time delay in responsiveness if the capacity of academic programs has been diminished in the recent past. The result is that we now see an unprecedented need for more engineering baccalaureate graduates at a time when they are simply not available. This has, in turn, resulted in the development of recruiting practices that treat our best engineering students like professional athletes, with high starting salaries, stock options, and signing bonuses. Unfortunately, these same high starting salaries are making graduate degrees seem less desirable to recent baccalaureate recipients. This limits the future availability of doctoral candidates who become the feedstock for faculty hiring in institutions of higher education.

Freshman Engineering Enrollments

The size and mixture of freshman engineering enrollments in the United States provide considerable insight into the nature of the graduating class of engineers four years later. In the fall of 1999 the top disciplines of engineering by size were as shown on the next table:

Fall 1999 Freshman Engineering Enrollments in the U.S.

Discipline	Freshman enrollment
Computer	14,504
Electrical Engineering	12,511
Mechanical Engineering	12,191
Civil Engineering	6,387
Chemical Engineering	5,186
Aerospace Engineering	2,917
Bioengineering	1,771
Industrial Engineering	1,435

Source: Engineering Workforce Commission, Summer 2000.

It should be noted that a large number of freshmen engineering students (24,186) are classified as pre-engineering each year since many engineering colleges require their freshmen to wait a year or two before declaring a major field of study. It should also be noted that a number of the freshmen students who are enrolled in computer engineering departments are not studying to become computer engineers. These students are earning various degrees such as computer science, software engineering, and information science.

Total Engineering Enrollment

The 1999-2000 total enrollment in engineering programs at various degree levels is shown in the next table:

Fall 1999 Total Engineering Enrollments in the U.S.

Discipline	Bachelor's Enrollments	Master's Enrollments	Doctorate Enrollments
Electrical	56,969	8,965	6,794
Mechanical	56,523	5,548	3,825
Computer	48,239	5,766	2,800
Civil	32,396	4,395	2,441
Chemical	26,027	1,983	3,119

Source: Engineering Workforce Commission, Summer 2000.

It is interesting to note that, although electrical engineering has the largest enrollments in the academic year 1999-2000, the largest freshman enrollments are in the computer areas. This suggests that the order in this table will soon be changed owing to the rapid growth rate of computer related fields.

Ethnic Mix of Engineering Students

Unfortunately the ethnic mix of engineering students in the U.S. has seen only small change in the past five years. This mix is shown in the next table:

Ethnic Mix of Engineering Students in the U.S.

Ethnic group	Bachelor's	Master's	Doctorate
African American	6.9%	2.3%	1.8%
Hispanic American	7.5%	2.8%	1.7%
Native American	0.7%	0.2%	0.2%
Asian American	11.2%	6.4%	5.9%
Foreign Nationals	5.9%	50.4%	57.4%

Source: Engineering Workforce Commission, Summer 2000.

While the ethnic mix of the population of the U.S. in general has become more diverse over the past decade, the ethnic mix of engineering enrollments has not progressed as much. The high demand for minority engineers in industry has created a very small pool of available minority students to pursue graduate degrees. Thus, it is doubly difficult to recruit and retain qualified faculty members who are from diverse ethnic backgrounds. Because immigration requirements limit the hiring of foreign nationals into entry-level industry positions in the U.S. but are less restrictive on graduate admissions, a disproportionately higher number of these professionals are seeking graduate degrees in engineering in the U.S. This fact is reflected in the last row of the table above.

Gender Mix of the Engineering Workforce

Although the number of women enrolled in engineering schools has risen slightly over the past several years, the number of women employed in the engineering workforce as a percentage of the total workforce has declined from 12% in 1998 to 9.9% in 2000. This trend is especially alarming since women currently make up more than 50% of college enrollments in the U.S.

Facilities and Equipment

In the 1980's equipment obsolescence and maintenance was a major problem for engineering programs. Because of pressure brought about by the Accreditation Board for Engineering and Technology (ABET), most institutions have made significant progress in upgrading their laboratories and equipment holdings. Yet rapid changes in the technologies associated with engineering practice have led to rapid changes in the equipment needs for engineering programs. Thus the topic of facilities and equipment continues to be a challenge for engineering programs throughout the U.S.

Chapter 2. Status of Engineering Education in South Carolina

The previous chapter pointed out the strong relationship between engineering education and economic development. It should be no surprise that engineering education in the State of South Carolina is one of the most important ingredients to the present and future well being of the state. South Carolina is undergoing a rapid transition in its economic development from an agricultural leader to that of a leader in technology. A recent report prepared by the U.S. National Science Foundation shows that South Carolina ranks 31 in the U.S. in doctoral engineers, and 29 in academic research and development of which 22% is in engineering. In 1994 the state gross annual product was over \$80M, which ranks 29 in the U.S. in this regard. One of South Carolina's greatest strengths and greatest challenges is its inherent diversity. According to the U.S. Bureau of the Census, in 1999 the population of South Carolina was 29.84% African American, 1.30% Hispanic, 0.24% Native American, and 0.89% Asian/Pacific Islander. Thus a significant challenge to higher education in South Carolina and to engineering education in particular, is to respond to the needs of this diverse population. A recent report of the South Carolina Chamber of Commerce lists "Engineers" and "Computer Related" occupations among the top 15 difficult-to-fill occupations. It is notable that this same report lists "Computer Scientists" as the number one, fastest growing occupation in the state.

The engineering colleges in South Carolina are continuing their tradition of supplying educational opportunities for the youth of the state. They are also providing opportunities for graduate education and research to meet the needs of the growing industry base.

General Recommendations to the South Carolina Commission on Higher Education

Whenever possible, reviews of the engineering programs in South Carolina should be conducted in conjunction with regularly scheduled ABET visits. Such a procedure would provide much less work for the academic institutions and would create a much better linkage between the recommendations of the ABET team and the South Carolina visitor.

In general, the funding levels for engineering programs in all institutions in South Carolina is marginal at best. Most leaders of the institutions visited reported the need to generate external funds to maintain adequate levels of service to the students and the faculty. While it is true that funding allocations to engineering units are made at the university level, it is also true that the ability to operate a quality program is strongly dependent on having adequate resources for all program areas.

Many states wishing to have their institutions of higher education become leaders in industry/university partnerships have established engineering extension services with branches associated with various universities throughout the state. As the economy of South Carolina transitions from an agricultural economy to an industrial and information based economy, the establishment and funding of a state wide engineering extension service would seem to have strong political and economic advantages to both campuses and communities. Such a development would have the potential to enhance technology transfer, and would foster opportunities for synergistic interactions among the various engineering programs throughout the state. The time would seem right for South Carolina to make this important investment in economic development.

Because of the long-term benefits that expanded research and development activities can have on the economic well being of the state, the growth of research activities on the part of all university campuses in South Carolina is a worthwhile goal. As one considers this challenge, it would seem prudent to consider the establishment of a statewide initiative for the promotion of industry partnerships in applied research. Similar programs in Texas, Michigan, Ohio, Pennsylvania, and Florida have proven highly successful in leveraging R&D for the benefit of both campus and community. The time would seem right for South Carolina to make this investment in economic development.

Overall, the engineering programs in South Carolina appear to be making good use of rather limited resources to respond to rapid changes in the technological climate of the state. The various curricula are based on a good mix of traditional engineering disciplines that are appropriate for the needs of industry in the state. Rather than adding a number of new programs, the universities in South Carolina have chosen to innovate from within the existing disciplinary structures and this is a sound approach. Evolutionary innovation that engages the faculty and the leadership of higher education in shaping the curricula has been shown to be a highly effective approach to keeping engineering curricula up-to-date. Continuing accreditation by ABET of these programs is a positive outcome of the strategic and the tactical efforts of the leaders at these institutions. Whenever possible, the Commission on Higher Education should encourage collaboration among the various engineering and technology programs throughout the state.

Chapter 3. Institutions and Individual Programs

In this section we will address first the general observations for a given institution and then the specifics of the individual programs at each of these institutions.

The Citadel, The Military College of South Carolina– General Observations

The two engineering programs at The Citadel, civil engineering (BSCE) and electrical engineering (BSEE), are both mature and stable components of the institution. The Citadel provides a military college experience option for the citizens of the state, with excellent academic instruction within a structured environment, and many opportunities for leadership and character development. Through the College of Graduate and Professional Studies, upper-division engineering courses are taught to civilian students in the afternoons and evenings. Both student groups have the same degree requirements, less the ROTC and physical education requirements of the military students, and earn the same Citadel degrees.

The academic departments of the institution report to the Vice President for Academic Affairs/Dean of the College through one of two “Designated Deans.” The Dean of Planning and Assessment is the “Designated Dean” for the two engineering departments, three science departments, and the mathematics department. This individual also supervises Institutional Research, Information Technology Services, and the Registrar. In an effort to provide a measure of disciplinary coordination, as called for in their 1996 engineering accreditation review, the two engineering department heads alternate in three-year terms as Associate Dean for Engineering Program Development. This organizational structure is currently under review at The Citadel, and the consultants were informed that a Dean of Engineering might be appointed.

The engineering faculty are competent and dedicated to undergraduate teaching. The students are complimentary of the faculty and are satisfied with their programs. Electrical engineering has recently moved to a building immediately adjacent to civil engineering, and both buildings appear to be quite suitable for their needs. Classrooms and laboratories are well equipped for undergraduate instruction.

Funding for faculty development and travel is very limited, but the faculty have optimized their developmental opportunities by active participation in regional professional organizations.

While the two engineering programs received full accreditation in their most recent national accreditation review, the report included concerns in the areas of heavy teaching loads and low faculty salaries. In its response, the institution promised improvements that have not yet been realized.

Consideration should be given to reducing the total credit hours required for the BSCE degree to levels that are fully accredited at other schools by the national engineering accreditation agency. Such reduction, along with possible limited or experimental consolidation of the cadet and civilian course sections, offers relief in faculty teaching loads and may help with military student retention.

In the interests of faculty retention and attracting new engineering faculty, The Citadel should take all possible steps to improve engineering faculty salaries. Two recent resignations from the Electrical Engineering faculty apparently resulted from low salary levels, and a pending retirement may further reduce the experience level of that group. Average salaries of Civil Engineering Professors are lower than the average for that academic rank in the institution.

**THE CITADEL, THE MILITARY COLLEGE OF SOUTH CAROLINA
CIVIL ENGINEERING**

CIP Code	Degree	Program Title	Status Level
140801	BS	Civil Engineering	Continuing approval

Statewide Perspective

The Civil Engineering program at The Citadel is well known and established, and is an important segment of the broad and diverse educational programs of the State of South Carolina. While similar undergraduate programs are offered at Clemson University and the University of South Carolina, this program provides geographic coverage to a different section of the state. The Citadel also provides instruction within a rigorous military framework that is nationally and internationally recognized as producing exceptional leaders for both the military and civilian sectors.

Through the College of Graduate and Professional Studies (the evening program) the same degree program is available to civilian students who complete lower-division courses at state technical colleges and other institutions.

Curriculum

The civil engineering (CE) program at The Citadel is structured and traditional. It provides rigorous and relevant instruction in each of the generally accepted specialty areas within the profession, thereby preparing the graduate for entry-level positions throughout the broad spectrum of contemporary CE practice. The program includes both hands-on laboratory courses and the use of modern computational tools, and culminates in a comprehensive major design experience. Appropriate assessment procedures appear to be in place, and considerable emphasis is placed upon professional registration as a goal for graduates.

The CE curriculum is essentially identical to that granted full accreditation in 1997 by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC/ABET). CE students who are members of the Corps of Cadets and those of the College of Graduate and Professional Studies (the evening program) have identical degree requirements, except for the ROTC and physical education (PE) requirements of the cadet students.

The curriculum has a higher credit hour requirement (133 credits, not including ROTC and PE) than many other programs fully accredited by EAC/ABET, and the institution may wish to consider reducing the number of required credits, particularly in the first year, to gain teaching load reductions and to enhance student retention.

The Citadel CE program is also characterized by complete separation of the cadet students and the civilian students of the evening program. Teaching load reductions and offering of additional elective courses may be possible if some relief from this restriction is possible without damaging the unique Citadel educational system.

Institutional support

Both of the two engineering programs at the Citadel appear to be highly visible and respected. Institutional funding restraints lead to a marginal level of state funding for department operations, but the CE department faculty has recently been successful in soliciting private funds for equipment purchases, field trips, and other program enhancements. Support by members of the CE Advisory Council has been excellent.

Civil engineering salaries at The Citadel are low. The salary data provided by CHE indicate that the average salary of CE Professors at Clemson University is \$3.9K higher than the university average for Professors. At USC-Columbia, CE Professors earn \$10.0K above the university average for their rank. At The Citadel, CE Professor average salaries rank 11 of 14 academic departments, with an average salary \$2.8K below the institution average for their grade.

Faculty

The eight full-time faculty members are well qualified by education and experience for their duties at this undergraduate institution. Adjunct faculty are only rarely used. Faculty are enthusiastic and highly motivated, although their teaching loads are high, and their salaries lag behind regional levels for undergraduate engineering programs. Improvement in teaching loads and salaries was promised in the institution response to the most recent EAC/ABET accreditation report, but has yet to be realized. Although limited by operations funding levels, the faculty actively participate in activities of regional professional organizations.

Facilities

Classrooms, offices, and laboratories are located in LeTellier Hall. Classrooms have new furniture and are being equipped with modern teaching aids. Laboratories are spacious, and equipment is being modernized as funds become available. The program has two well-equipped computer laboratories.

Students

A group of about twenty senior class cadets was interviewed, and they were uniformly complimentary and satisfied with their program, their faculty, and their facilities. They praised the caring nature, the quality of advising, and the availability of the faculty. In this sample, only two were candidates for military commissioning, and the others were highly motivated towards entering professional practice and/or graduate school. The program has consistently exceeded CHE productivity standards.

Student retention

The institution and the CE faculty both expressed concern over excessive student attrition from the military student program. [Attrition from the evening program is minimal.] The institution offers an open choice of major to all admitted cadets, and some academic attrition is to be expected. In addition, military schools always experience resignations and occasional dismissals not common at civilian schools. Nevertheless, the institution may wish to consider credit hour reduction discussed above and/or a pre-matriculation summer program to reduce the academic load of the first year cadets.

Minority representation

The department has two minority faculty members (Asian), and relatively few racial minority and female students.

The statistics for student diversity are as follows:

Students	Women	Minorities	Foreign Nationals
Civil Engineering 1999	1.9%	6.2%	3.8%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

Transfer

As is common in other military colleges, relatively few students transfer into the military program. There was one such transfer student in the group interviewed, and he reported no difficulties associated with his integration. The evening program is composed largely of students who have completed lower division course work elsewhere.

Library

Holdings and services from the institution library appear to be adequate. A knowledgeable library staff member provided a tour of the facilities, and the student group expressed satisfaction with the library.

**THE CITADEL, THE MILITARY COLLEGE OF SOUTH CAROLINA
ELECTRICAL AND COMPUTER ENGINEERING**

CIP Code	Degree	Program Title	Status Level
141001	BSEE	Electrical Engineering	Continuing approval

Statewide Perspective

The Electrical and Computer Engineering program (ECE) at The Citadel was first approved in 1941 and its first degrees were conferred in 1948, following World War II. The program is well established, enjoys an excellent reputation, and clearly forms an important part of the overall engineering education program in the State of South Carolina. The Citadel, along with similar programs at Clemson University and the University of South Carolina, provides excellent educational opportunities for students throughout South Carolina. In addition, The Citadel offers a widely recognized and respected military program whose graduates have led distinguished civilian and military careers. In recent years, the College of Graduate and Professional Studies has made the same excellent program available to civilian students who have completed their lower division courses at other institutions. This program, which clearly fills a strong regional need, now makes up a significant portion of the ECE program at The Citadel and promises further growth in the future.

Curriculum

The Electrical and Computer Engineering (ECE) program at The Citadel is both rigorous and of sufficient depth. One indication of the success of the program is the excellent pass rates for the Fundamentals of Engineering (FE) exam, which is taken by students nationwide during their senior year. For the fall 1999 exam, 83% of The Citadel students passed this important and widely recognized exam compared with the national average of 81%. Modern and well-maintained classrooms and laboratory facilities effectively support the teaching program. It is worth noting that each student has dedicated laboratory workspace available for both semesters of the senior design project. The ECE program is currently fully accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC/ABET). Students of both Corps of Cadets and the College of Graduate and Professional Studies (evening program) must meet identical degree requirements, with the exception of additional ROTC and physical education courses required by the cadets. The Bachelor of Science in Electrical Engineering (BSEE) degree currently requires 125 semester hours. In addition, cadets must complete 16 semester hours of ROTC and 4 semester hours of Required Physical Education. The current program provides complete separation of the day and evening programs, thus maintaining The Citadel's traditional military structure while at the same time meeting the increasing needs of the region for engineering education opportunities beyond those offered by two-year programs.

Faculty

The ECE program currently has six (6) full time faculty positions with five (5) of these currently filled. The most recent faculty departure occurred in May of this year. The faculty turnover rate has been quite significant during recent years. The reported reason for the low faculty retention is a combination of low salary and high teaching loads. The visitor interviewed all five current members of the faculty and came away with the impression that there is little confidence that the

salary situation will significantly improve in the foreseeable future. Furthermore, the teaching load, currently 12 hours, requires that all faculty members participate in both day and evening classes. This leaves little time for scholarly development and clearly impacts the quality of home life, especially for younger faculty. Exacerbating this situation is the fact that some of the faculty members are also employed elsewhere, on a part time basis, in order to maintain professional contact or simply in order to supplement their salary. Considering teaching load and resulting limited time for scholarly activity it would appear that a level of seven (7) full time faculty members might be more appropriate. It is also clear that salary, workload, and faculty recruiting will require serious attention prior to the next ABET visit, scheduled for the fall of 2002, especially in light of the fact that several of these issues received comment following the 1996 visit.

Despite the salary and workload issues, the visitor was deeply impressed with the obvious enthusiasm and dedication shown by the current faculty, from the most senior to the newest member. They enjoy teaching, enjoy working with the students, and completely subscribe to the larger goals of The Citadel. They also clearly enjoy a close inner relationship, which seems to be based on mutual respect and the shared recognition of the importance of close cooperation in a very challenging environment. The visitor, coming from a much larger faculty, rarely sees this level of camaraderie. This spirit is a very strong asset.

Students

The visitor interviewed approximately twenty (22) students, twelve (12) day students and ten (10) evening students. Of the day students approximately four (4) were seniors, five (5) were juniors and three (3) were sophomores. The students, day and evening alike, were clearly pleased with the educational experience at The Citadel. When asked why they had selected The Citadel, several indicated that they felt they needed a structured environment; others indicated that the school's reputation was a prime factor; while others indicated that the small class size, "taught by faculty rather than graduate students" was a strong attraction. In fact they quickly "outflanked" the visitor, asking, "How large are your classes at Georgia Tech?" and "Do you know the names of any of your students?" There was a strong feeling that they would choose the ECE major again. They also felt that they enjoy excellent access to the faculty and that the faculty is truly devoted to teaching and the success of the students. They felt that the current classroom, lab, and computer facilities are quite acceptable. They recognize that the recent loss of one of the faculty will make the spring semester of 2001 more challenging. When asked about the relatively low number of freshman making the transition to sophomores (for 1999, of the 42 entering freshman only approximately 12 made the transition to the sophomore class), they indicated two possible reasons. First, they felt that many entering freshmen lack the math background necessary for the ECE program. Secondly, they felt that some of the freshmen were simply not willing to invest the long study hours involved in the ECE program. When asked what single change would be most helpful in making the ECE program more attractive, the entire group, sophomores, juniors and seniors alike, were in close agreement. They felt that the ELEC 104 and 105 classes (Engineering Fundamentals I and II) were quite "discouraging." When pressed further, they indicated that, although neither course is "difficult," there appears to be little relationship between the various assignments and the student's perception of "what engineers actually do." Some simply felt that the courses do not adequately convey "how

exciting engineering can be.” It would appear that some very productive work could be done in this area, perhaps resulting in better student retention.

Minority representation

As of the 2000 fall semester there were 83 Cadets, 28 Evening, 5 Active duty, and 9 FY Evening Cadets, for a total of 125 students in the ECE program. Of this total, 5 were females, 6 were Asian, 4 were Black and 6 were Hispanic. The diversity distribution of this program is shown in the table below.

Students	Women	Minorities	Foreign Nationals
Electrical Engineering 1999	2.3%	17.2%	10.2%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

Transfer

The students currently involved in the evening program appear to have transferred from several different regional programs. All those interviewed indicated that the transfer process went quite smoothly.

Library

The visitor had an opportunity to briefly tour the institution’s library and meet with members of the library staff. The library resources appear to be quite adequate and the library staff is quite dedicated to meeting the specific needs of the engineering program.

Clemson University – General Observations

Within the College of Engineering and Science at Clemson University, dynamic leadership has fostered the development of a strategic plan that is forward thinking and has the potential to be highly responsive to the needs of the communities served by the campus. The goal of 30% undergraduate enrollment growth over five years to respond to state needs in engineering and computer science is an exciting challenge. Early progress would seem to indicate that this goal is achievable and the early success toward this goal while simultaneously increasing student quality is particularly commendable. Yet it is important to recognize that this increased student load will carry with it the need for a proportionally larger resource base. It is our hope that the leadership of the University and the State of South Carolina will provide the necessary resources to enable Clemson to succeed in this highly desirable goal. It should also be recognized that it might be easier to retain existing students than to recruit additional students. Thus Clemson should look carefully at its retention rates.

As difficult as it might seem to increase the size of the undergraduate population at Clemson, it will be even more difficult to increase the size of the graduate population. Yet, a strategic metric in this domain will be required if Clemson is to achieve its third strategic goal of “national stature in research.”

The goal of “leadership in industry partnerships” is another commendable goal that will require considerable energy on the part of Clemson to achieve. Yet, the general understanding of the role of land grant universities is that this is a fundamental value that is held as essential to the land grant charter.

The visiting team noted a number of administrative and management functions in the college of engineering at Clemson that were decentralized. An example of this is the project administration of contracts and grants that is currently handled at the departmental level. While the decision to deploy staff resources should remain the purview of the institution, it should be kept in mind that appropriate centralization of resources can sometimes lead to efficiency and cost savings. For this reason, the Clemson leadership may wish to consider the implications and tradeoffs between centralization of functions and decentralization of these functions.

Both the undergraduate and graduate students interviewed were happy with the quality of the holdings and service offered by the Library. The facilities are excellent with adequate study space. The arrangement of the books and periodicals are very accessible and the holdings are excellent with respect to engineering and applied science. All of the students interviewed felt that if the library didn't have a resource that they needed in its collection, the staff was always able to acquire it from other sources within 48 hours, on average. The library currently acquires approximately 400 journal titles on an annual basis. They have recently joined in a consortium with other universities in the region with an arrangement with Elsevier to obtain all of their titles, over 900, on line. Elsevier is the major publisher of scientific and engineering journals, and this arrangement will add significantly to the availability of current journals for students and faculty. The on-line catalog needs to be improved and updated; however, this is currently being addressed. Clemson had a contract with a vender to accomplish this, but the vender defaulted on

the contract. A new vender is being sought. The library staff interviewed is very dedicated to the students and the university. They are well qualified and hold faculty positions.

CLEMSON UNIVERSITY
BIOSYSTEMS ENGINEERING
(Department of Agricultural and Biological Engineering)

CIP Code	Degree	Program Title	Status Level
140301	BS	Biosystems Engineering	Continuing approval
140301	MS	Biosystems Engineering	Continuing approval
140301	Ph.D.	Biosystems Engineering	Continuing approval

National Perspective

The Biosystems Engineering program at Clemson has followed an evolutionary process similar to that in many other states. Over the past 20 years or so, traditional agricultural engineering programs have expanded to include more emphasis upon the biological systems involved. This has resulted in name changes for most programs. Unfortunately, for various reasons, the new names have differed among schools. Biological, Biological Systems, Bioresources, and Biosystems are the most common replacements for Agriculture in the title. Biosystems Engineering appears to be the most popular name for recently renamed programs. With a few exceptions, these degree programs are offered at only one school (the land grant institution) in each state. Nationally, the demand has consistently exceeded the number of graduates in these programs. Graduates are employed in a variety of industries including traditional agricultural companies and biotechnology companies.

Statewide Perspective

The Biosystems Engineering program at Clemson is the only such program in South Carolina. Agriculture, biotechnology, and other supported industries represent a significant portion of the state's economy. Many of these industries are expanding in South Carolina, and they have an increasing need of well-trained college graduates, including those with advanced degrees. Thus, a strong Biosystems Engineering program is important to the continued well-being of this important portion of South Carolina's economy. Continuation and further development of the programs at Clemson should be encouraged. It does not appear that additional programs are needed elsewhere at this time.

Curriculum

The College of Agriculture, Forestry and Life Sciences (CAFLS), and the College of Engineering and Science (CES) jointly administer the three programs reviewed. For enrollment and graduation statistics, students are counted in the CES. Student credit hours are credited to the CAFLS where the department faculty are located. Three undergraduate emphasis areas are offered. In order of student enrollment, these areas are: Natural Resources Emphasis, Biotechnology Emphasis, and Agricultural Emphasis. The Biotechnology Emphasis has considerable growth potential if additional faculty resources can be provided to support added teaching and research in this area. The three concentrations include a common core of courses plus specific specialty courses in each area. A common capstone design course is required. The design component of the program was noted as a concern during the last ABET visit. The department faculty have made changes in the capstone design sequence to address that concern. Faculty should continue to closely review this component of the curriculum and further improve it as appropriate.

Laboratory facilities were diverse, ranging from fair to excellent. An extensive laboratory improvement program is currently under way in some laboratories. This includes building modifications, equipment replacement, and disposal of old unused equipment. These changes will probably have greater positive impact for the graduate programs, although all students should benefit. Concern was expressed regarding difficulty in obtaining used computers from upgraded campus computer laboratories for use in departmental laboratories.

Opportunities may exist for distance education offering of selected undergraduate and graduate courses, including joint offerings by two or more universities. However, with the strong laboratory and team design components of many upper division courses a distance education offering of the entire program is not practical at this time.

Faculty

Almost all teaching faculty in the department have joint teaching/research appointments. These joint appointments range from 25% to 50% teaching. The full time equivalent, based upon teaching appointment only, is approximately four faculty. All nine departmental teaching faculty met with the visitor in three separate meetings. Additional meetings were held with the department chair and the director of the School of Applied Science and Agribusiness. The departmental faculty are dedicated and well respected by students in the program. Their teaching performance is commendable. The number of recent peer reviewed publications is a bit low. However, the teaching load has been quite high. Five faculty were lost to retirement or to other schools between 1994 and 2000. This resulted in high teaching loads for the remaining seven faculty and the department chair. Two new faculty hired during the past year will help alleviate this problem. The department has been active in obtaining outside funds. The department is the eighth largest in the College of Agriculture, Forestry and Life Sciences. However, only the Department of Environmental Toxicology exceeds Agricultural and Biological Engineering in total external funds received and in dollars awarded per faculty member.

Students

Student quality appears good. Assessment surveys of the undergraduate program indicate that employers are well satisfied with the graduates. The demand for graduates is consistently well above the number available. Students interviewed during the visit (both undergraduate and graduate) were enthusiastic about the programs and felt that they were well prepared for engineering careers.

Biosystems Engineering undergraduate students benefit from a generous scholarship program. For the current academic year, 37 students received \$109,050 in scholarships, an average of almost \$3,000 per student. Approximately 40 percent of all scholarships awarded to students in the department (Biosystems Engineering and Agricultural Mechanization programs) were designated by donors specifically for students in the department. This is evidence of a department with strong alumni support. Six Palmetto Fellows are currently enrolled in the program, indicating that it is attractive to some of the top high school graduates in the state.

Enrollments in all three degree programs meet the minimum Program Productivity Standards although higher enrollment in both graduate programs is desirable. The undergraduate

enrollment, after dropping significantly between 1995 and 1998 leveled in 1999 and increased significantly in 2000. Two of the three programs also meet the minimum Program Productivity standards for degrees awarded. The Ph.D. program is currently averaging slightly less than the standard of two per year. This has been identified as a concern by the department and a plan has been developed to significantly increase enrollment in the program. Enrollment has increased over the past two years and has never dropped below the minimum standards.

Minority representation

The departmental faculty include two natives of other countries (Korea and Kenya). Thus, diversity in cultural background and experience is present. The two new faculty noted in the Faculty section above were the first additions in several years. These additions allowed for increased diversity, as one of the two is a native of Kenya. There are no women on the faculty.

Statistics for student diversity (1999-2000 academic year data) for Biosystems Engineering are listed in the following table.

Students	Women	Minorities	Foreign Nationals
Undergraduate Fall 1999	32.5%	0.0%	7.5%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%
M.S. Fall 1999	28.6%	28.6%	28.6%
Ph.D. Fall 1999	28.6%	0.0%	71.4%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

A review of actual enrollment for Fall 2000 shows a significant increase in minority enrollment in the undergraduate program. The percentage of black students enrolled in the current semester is between 9.8% and 11.4%. The range is due to uncertainty regarding the enrollment status of one minority student. Undergraduate minority enrollment will be influenced by minority enrollment in the General Engineering program since this is the primary source of undergraduate students in the program.

Transfer

The transfer evaluation process was not viewed as a problem by students and faculty in the department.

CLEMSON UNIVERSITY BIOENGINEERING

CIP Code	Degree	Program Title	Status Level
140501	MS	Bioengineering	Continuing approval
140501	Ph.D.	Bioengineering	Continuing approval

State-Wide Perspective

The graduate programs in bioengineering are focused on medical applications of engineering technologies that are important for advanced treatment of human and animal health needs. The Clemson bioengineering program has high external visibility and serves important state, national, and international needs. The program is changing rapidly and should be continued and encouraged to maintain the pace of recent changes that will enhance program breadth and quality.

Curriculum

Bioengineering has two historically recognized stems, biochemical and biomedical. The biochemical stem involves the application of science and engineering to bioreactions for chemical/drug processing. The biomedical stem, which is the thrust of the Clemson Bioengineering Department, is focused on medical applications. Advances in the biological sciences have clouded the boundaries between these two areas, but most academic programs focus on one or the other. The purpose of the Clemson MS and Ph.D. programs in bioengineering is to prepare students to apply science and engineering principles to solve problems in biology and medicine. The curriculum offers a broad range of graduate courses and the undergraduate courses that are necessary to bring incoming students up to the knowledge level necessary to pursue graduate study. The undergraduate courses also serve as electives for students in other majors who have an interest in bioengineering. The laboratories are well equipped and serve instructional, research, and service activities. The Godley-Snell Research Center, a centralized animal research facility, is a major asset for the Bioengineering Program. Facilities for distance learning via video conferencing also add to program capabilities. Potential problems that need to be addressed to insure continued progress include space for expanded activities and matching funds for equipment grants. In summary, however, the curriculum is rigorous and well balanced to serve the needs of students who enter this program from different undergraduate backgrounds.

Faculty

Eight permanent professors and one visiting professional comprise the present faculty. Four faculty and the department chair were interviewed during the visit. All faculty have very good credentials and are qualified to contribute to the graduate degree programs. The department is changing rapidly with four of the current faculty members hired during the past two years with an ongoing search for two new faculty to be located at the Medical University of South Carolina in Charleston. These rapid changes have broadened the program from one focused almost exclusively on biomaterials to one that also has significant new thrusts other areas such as vascular engineering. Research activities include work supported by government funding agencies and by industry with significant work in testing to predict long-term performance of implanted devices. Research, which has been less than one would expect over the past several

years, has increased significantly with addition of the new faculty. Total external funding is expected to reach \$2,000,000/year if faculty growth is continued and added space is allocated to house the increasing research and educational activities.

Students

Approximately twelve students, both MS and Ph.D. candidates met with the visitor. These students were all very pleased with their experiences at Clemson. They were especially happy with the attention they received from the faculty and with being a part of interdisciplinary teams of students and faculty. The students indicated that they were currently working with the faculty and departmental administration on issues related to course selection and qualifying examinations for students with different undergraduate degrees. The prevailing opinion was that course requirement programs would need to be individually tailored to insure competence needed for the degree with adequate consideration for the credentials of the entering students. The programs meet the CHE productivity standards.

Minority Representation

The permanent faculty in Bioengineering included two women but no underrepresented minorities. This issue needs additional attention as the faculty is expanded.

The statistics for student diversity in Bioengineering are as follows.

Students	Women	Minorities	Foreign Nationals
M.S. Fall 1999	25.8%	6.5%	19.4%
Ph.D. Fall 1999	28.6%	0.0%	44.4%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

The diversity of undergraduate educational degree is also program strength. About one-half are engineers and one-half hold science bachelors degrees.

Transfer

Transfer students are not a normal component of the student population. No problems were noted.

**CLEMSON UNIVERSITY
CERAMIC AND MATERIALS ENGINEERING**

CIP Code	Degree	Program Title	Status Level
140601	BS	Ceramic and Materials Engr.	Continuing Approval
140601	MS	Ceramic and Materials Engr.	Continuing Approval
140601	Ph.D.	Ceramic and Materials Engr.	Continuing Approval

Statewide Perspective

The undergraduate and graduate programs in ceramic and materials engineering meet important state, regional and national needs in teaching, research, and service. Clemson has the only degree programs in ceramic and materials engineering in South Carolina that are very important to the traditional ceramics industry in the state. The program has strong links with statewide industries in traditional ceramics. The program is an important asset to the economy of the state and should be continued, developed, and encouraged to succeed. The Center for Engineering Ceramic Manufacturing supports the ceramic industry in South Carolina and offers employment and applied research opportunities for both undergraduate and graduate students. It is recommended that the Materials Science and Engineering Program be moved into the Department of Ceramic and Materials Engineering.

Curriculum

The Department of Ceramic and Materials Engineering prepares its undergraduate and graduate students for careers in ceramic and materials science and engineering. The department has recently expanded and broadened the undergraduate curriculum from a purely ceramic-base program to a ceramic and materials engineering program. The new curriculum is similar to those of the top materials undergraduate programs in the country. It will be reviewed by ABET by both the ceramic and materials components of that accreditation organization. The undergraduate students benefit from strong cooperative work experiences, summer internships, and hands-on design projects supervised by faculty and industry. The building that houses the department, Olin Hall, and contains the laboratories for the undergraduate program is currently being renovated so it was impossible to evaluate the quality of the equipment and laboratories. The laboratory technician that was recently hired was interviewed, however, and appeared to be very capable and prepared to handle the installation and maintenance of modern laboratory facilities.

The MS and Ph.D. graduate programs are designed to prepare students for work in all industries that rely on materials as an enabling technology. They are educated in fundamental principles and are required to solve complex problems and conduct independent research. Although the program is separate from the "other" Materials Science and Engineering Program at Clemson, the research active faculty also participate in that program. This arrangement has many drawbacks with respect to student and faculty interaction and is a severe hindrance to Clemson being competitive in attracting graduate students at the national and international level. The graduate courses in the Clemson programs are commensurate with those in traditional ceramic and materials programs. However, the department needs to develop a core program, similar to that of the Materials Science and Engineering Program, to ensure a minimum base knowledge in

materials for their graduate students. There was some concern among the students about the frequency of coarse offerings.

Faculty

All faculty members interviewed during the visit were very interested in and dedicated to the program and to the students. The undergraduate and graduate students interviewed all felt that the quality of instruction in the department was very high. On the other hand, at least half of the faculty do not conduct sponsored research and this has a negative impact on the graduate program, publications, national recognition, and the quality of instructional equipment. The young, recently hired faculty are outstanding and are conducting cutting edge research. The department has two vacancies and if these are filled with similar quality individuals, the graduate programs will be significantly enhanced. An additional approach would be to assign faculty from other departments who are active in materials teaching and research to the Department of Ceramic and Materials Engineering.

Students

Both the undergraduate and graduate students in the program are enthusiastic and show great admiration and respect for their faculty. They are interested in the department, in student organizations, and in each other. The undergraduates actively participate in national competitions and often win first place. They take great pride in their department and Clemson University. The undergraduate cooperative program is very popular. The undergraduate program exceeds the CHE productivity standards at all levels. The graduate program meets the minimum standards for productivity using the guidelines provided. However, the productivity standard for degrees awarded is marginal. Combining the programs in the Department of Ceramic and Materials Engineering with those in the Department of Materials Science and Engineering would more than exceed the productivity minimums and is recommended.

Minority representation

The faculty in the Department of Ceramic and Materials Engineering has no women or minorities. This is a national problem in this field and much work needs to be done to rectify the problem.

The statistics for student diversity in Ceramic and Materials Engineering are as follows:

Students	Women	Minorities	Foreign Nationals
Undergraduate Fall 1999	4.3%	10.9%	2.2%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%
M.S. Fall 1999	20.0%	0.0%	53.5%
Ph.D. Fall 1999	14.3%	0.0%	71.4%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

**CLEMSON UNIVERSITY
CHEMICAL ENGINEERING**

CIP Code	Degree	Program Title	Status Level
140701	BS	Chemical Engineering	Continuing approval
140701	MS	Chemical Engineering	Continuing approval
140701	Ph.D.	Chemical Engineering	Continuing approval

Statewide Perspective

Undergraduate and graduate programs in chemical engineering are offered at Clemson University and the University of South Carolina as well as at universities in all surrounding states. The Clemson programs meet important state, regional, and national needs in teaching, research, and service. The graduates and research results of the Clemson chemical engineering programs support traditional industries such as textiles, basic chemicals, pulp and paper, nuclear, petroleum, and automotive components. These academic outputs are also important for newer economic development areas related to biotechnology, microelectronics, and environmental preservation. The chemical engineering programs should be continued and encouraged to improve at all levels.

Curriculum

The Department of Chemical Engineering prepares its undergraduates for careers in the process industries (examples are listed above) and for graduate study in chemical engineering and closely related fields such as bioengineering, environmental engineering, polymer/textile engineering, and chemistry. B.S. Chemical Engineering graduates also often pursue advanced study in business/management, law and medicine. The B.S. curriculum is coherent and rigorous. The curriculum would also satisfy both the accreditation requirements and the needs of many employers. It does not appear, however, that technologies more relevant to newer growth areas such as biotechnology and microelectronics are well represented. The undergraduate cooperative education program involves about 50% of undergraduate majors and is a major asset. The undergraduate students interviewed felt that the laboratory equipment was old and in need of updating to reflect current industrial practice.

Two degrees are offered at the graduate level (M.S. and Ph.D). These degrees prepare students for industrial careers and, at the doctoral level, for academic and industrial research positions. The range of advanced courses and thesis research areas is adequate for the degrees offered. The masters and doctoral programs meet the minimum standards for degree productivity but the number of students is small compared to nationally recognized programs. The faculty and the new departmental leadership recognize that this problem needs more attention and resources. Growth of the graduate program and increased funded research activities is a priority for the new chair. New faculty slots and a reduction of individual teaching loads will be necessary to accomplish this goal.

Faculty

The Chemical Engineering Department has 13 faculty, with one on a sabbatical leave, plus two with administrative positions outside the department. One faculty member also has major responsibilities as Director of the National Science Foundation Engineering Research Center.

Three faculty members and the new department chair, were able to meet with the visitor. Other faculty were attending the annual national meeting of the American Institute of Chemical Engineering for presentation of papers and professional development. The credentials of the present faculty are very good and they are clearly interested in teaching and the professional development of both undergraduate and graduate students. Faculty research productivity is highly variable with some very active and others doing very little. The impact of the NSF Engineering Research Center on the department is very significant with about 50% of external research funding derived from this source. Future growth with funding from other sources would be beneficial as new faculty are hired and existing faculty expand their research efforts. Reduced instructional loads for those with active research programs would help with this departmental goal.

Students

Four undergraduates and two graduate students were interviewed during the visit. All were very satisfied with their educational experiences at Clemson. They were pleased with the accessible faculty, the educational and social environment within the department, and with employment opportunities in career areas of their choice. The programs meet the CHE productivity standards.

Minority Representation

The faculty in Chemical Engineering has no women or minorities. This issue needs considerable attention as new faculty are hired. Women represent about 20% of U.S. chemical engineering faculty at the assistant professor rank and in new doctorates awarded. Unfortunately, however, the pool of potential minority chemical engineering faculty is much smaller.

The statistics for student diversity in Chemical Engineering are as follows:

Students	Women	Minorities	Foreign Nationals
Undergraduate Fall 1999	31.7%	14.4%	1.7%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%
M.S. Fall 1999	11.8%	0.0%	17.6%
Ph.D. Fall 1999	26.7%	0.0%	66.7%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

Non-residents are not a significant part of the undergraduate population but they represent 67% of the doctoral students. Thus the undergraduate Chemical Engineering program is contributing to the diversity of the student body. More effort is needed, however, to increase the number of minorities and U.S. citizens in the graduate programs.

Transfer

No problems were reported with processes for transfer students.

**CLEMSON UNIVERSITY
CIVIL ENGINEERING**

CIP Code	Degree	Program Title	Status Level
140801	BS	Civil Engineering	Continuing approval
140801	MS	Civil Engineering	Continuing approval
140801	Ph.D.	Civil Engineering	Continuing approval

Perspective

The undergraduate and graduate programs in civil engineering at Clemson University serve both state and national needs by providing quality graduates and by maintaining reputable teaching, research, and public service activities. Recent and planned additions to the faculty will provide the vigor and renewal necessary to maintain a competitive edge. There have been innovations introduced into the undergraduate curriculum, notably related to technical writing and capstone design. The department has developed a unique research enterprise that targets hurricane safety on both regional and national scales. All degree programs meet the minimum standards for degree productivity.

Curriculum

The undergraduate curriculum was accredited in 1999 by ABET for a six-year cycle, demonstrating that it has sufficient rigor and relevance. Specialty areas include structural and geotechnical engineering, project management, construction materials, applied fluid mechanics, and transportation systems. Two notable innovations are the technical writing program (now university wide) and the capstone design experience. For the latter, a dedicated laboratory has been provided along with a full-time lecturer/coordinator. The combination provides a means for innovative design initiatives to be offered by the department, and in the future may provide leadership on a national scale. The first year of undergraduate studies is structured and intensive, but the undergraduate students that were interviewed were of the opinion that the load was appropriate and served to form good study habits and atmosphere for the next three years of study. The integration of computers into the classroom environment appears to be adequate. The students expressed some concern that there were too many required specialty courses, and they would like more flexibility to select technical electives. Another concern was the three-semester scheduling cycle of some required courses, causing the students to take longer than four years to complete the baccalaureate program.

The graduate curriculum appears to be comprehensive in all specialty areas. The wind-engineering program is unique in that it focuses on hurricane issues, and is the only one situated in southeastern United States. All specialty areas have faculty and graduate students actively involved in research. Several new research initiatives are underway; they should result in strengthening the reputation of the department on both a regional and national level. Overall, the graduate program appears to be strong and vigorous in both teaching and research, and should become stronger in the future with the addition of two new faculty members. The research productivity is good, and should increase in the next few years as new faculty members become acclimated. The fluid mechanics area is expected to grow in areas of sediment and hydraulic modeling. Transportation systems has new faculty members and needs additional time to define

growth areas. Geotechnical engineering is moving into new areas related to flood mitigation. The construction materials area remains strong, and structural engineering will continue to maintain strength in natural hazards research.

Facilities

The undergraduate teaching laboratories have sufficient space resources. The continued updating of equipment and procedures that was evident is commendable. Two exceptions to this were the construction materials and geotechnical laboratories, which have insufficient space. The research laboratories on and off campus appear adequate, recognizing the aging problems and need for more space. Some of the laboratories are being renovated, and there are planned research laboratories in a proposed new facility that are receiving high priority by the university administration.

Faculty

Generally the faculty credentials are good, and they include research-active senior faculty and high-quality new junior faculty. The faculty consists primarily of full-time hires, but there may be need for more faculty positions in order to create the appropriate critical mass within the subspecialty areas. The external research funding expenditures were increasing for two years, but fell off slightly this past year, due in part to loss of productive faculty and new faculty arriving. The teaching loads are three to four courses per year, and the chair expects that these will come down in the future. There appears to be good professional development for the faculty, but travel expense funds are limited and are prioritized for junior faculty.

The visitor met with two groups of faculty. They expressed concern about the surge in freshmen and sophomore enrollment-teaching loads. Some of the new members were apprehensive about the outcome in the open position regarding which specialty area would be filled. They felt that demands on research productivity were constrained by needed space and by lack of critical mass in the materials and transportation specialties. Some of the faculty members mentioned that there were insufficient financial resources for recruiting quality graduate students (little or no fellowship money available). The TA/RA stipend levels are low and have not been increased significantly in several years; hence it was difficult to recruit students into the program. Additional concerns included the following: the undergraduate teaching surveying lab lacks adequate equipment; more graduate course offerings were necessary in the transportation program; and there were problems with the university research accounting support services.

Students

The visitor met with a single combined group of undergraduate and graduate students. Generally they were supportive of the academic programs. The undergraduate students felt that some of their class sizes may be too large for effective teaching, and they would like to have more freedom to select technical electives. They were active in extracurricular activities, and are to be commended in winning the national concrete canoe competition for the last two years. The graduate students were generally satisfied with the education they were receiving. Mention was made of the need for newer desktop computers and networking in graduate student offices. Neither undergraduates nor graduates offered any comments regarding advising and job placement.

Minority representation

One minority student was interviewed as part of the group of total students. That student recognized the level of minority enrollment, but did not find any problems with treatment in the department, and mentioned that faculty and staff members were supportive. There are no women or minorities presently on the faculty. The department should be encouraged to remedy this situation, although the difficulty in doing so is recognized.

Student diversity in this program area is distributed as follows:

Students	Women	Minorities	Foreign Nationals
Undergraduate Fall 1999	20.8%	7.7%	0.0%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%
M.S. Fall 1999	20.5%	4.5%	22.7%
Ph.D. Fall 1999	21.4%	0.0%	64.3%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

Ease of transfer for students from state technical colleges

This visitor did not address this issue directly, but there appeared to be few such transfers into the civil engineering program. Distance learning is not presently active; there is no demand, even though attempts have been made in the area of earthquake engineering.

CLEMSON UNIVERSITY COMPUTER ENGINEERING

CIP Code	Degree	Program Title	Status Level
140901	BS	Computer Engineering	Continuing approval
140901	MS	Computer Engineering	Continuing approval
140901	Ph.D.	Computer Engineering	Continuing approval

General

The computer engineering programs at Clemson are important to the university and to the state. These programs have excellent students, faculty, and administration. They are part of a combined Department of Electrical and Computer Engineering. The programs are headquartered in Riggs Hall, a building devoted to the department except for the Dean of Engineering's office. Some ECE research is conducted in an outstanding research building not far from Riggs. The facilities afforded the ECE department speak of its importance to the university and the state.

Curriculum

The BS in computer engineering degree program is very solid. The latest ABET review was complimentary towards the BSCE program.

In interviews with CE faculty, they were not enamored of the common freshman year, feeling that it "served too many masters." They were concerned that no real computer programming is taught at the freshman level, and they believe that this situation is negatively impacting the BSCE degree. The faculty want to go to a philosophy of "computing across the curriculum" mirroring Clemson's philosophy of "communications across the curriculum." Programming is the language of computing. In some way, the BSCE program must be allowed to teach two semesters of programming in the freshman year, or at least, as a bare minimum, one semester's worth.

The computer engineering faculty should be commended for the approach they are taking with their undergraduate curriculum beyond the freshman year. They are formalizing the three required threads of electrical engineering, computer hardware, and computer software. In addition, they are increasing the number of technical electives from four to five and specifying focus areas of specialization. This is an excellent approach that brings organization to the program, helping both the students and the faculty.

The faculty members interviewed are opposed to a merger with computer science in general, especially a combined computer engineering and science department. The visitor is opposed as well to the formation of a CSE department. Merging computer science (but not the CIS component) into the ECE department could bring dividends, but it is not necessary.

The BSCE degree makes good use of computer science courses where appropriate. The faculty members interviewed feel the BSCE rates well among comparable programs in the region. This was expressed by, among others, a graduate of Georgia Tech and a former faculty member at Rice. The difference they see between Clemson and these institutions is that some of the other institutions attract students of higher quality.

The students expressed satisfaction with their academic programs. Most felt the BS and MS degrees were strong, especially the MS degree. The Ph.D. degree was not regarded as highly the B.S. and M.S. degrees. The undergraduate students liked the special topics course where they could work with a faculty member on a project. They were happy with the electives and would like more. Most like the 10-hour free elective requirement and the common freshman year, although some felt it is weak. Many would all like to see one semester of programming in the common freshman year, but said the real need was formal problem solving. Also, they recommend that freshman advisors remind students who have elected computer engineering by the second semester to enroll in ECE 101, not some other programming course. The students strongly feel that more computer engineering faculty are needed. Indeed, it is recommended that ECE work diligently to fill new slots with qualified computer engineering faculty given the imbalance of the faculty between electrical and computer engineering. The students reported problems getting into graduate computer science courses even though they typically do very well. They were happy with the ease with which the graduate students could get involved in research projects.

All degree programs in ECE meet at least one of the minimum enrollment requirements. Enrollment has been low in the telecampus distance education courses.

Faculty

The faculty in the department are competent and well-suited to offer solid computer engineering programs. Research expenditures from external sources run about \$4 million for the department. This is a good total for a department of 30 faculty. More research funding for the computer engineering faculty is needed. The department has a good balance between teaching and research, which makes a very attractive situation for the students. Clemson won an NSF Engineering Research Center, a most prestigious distinction. ECE faculty members participate in the research work of the ERC.

The faculty members interviewed are very pleased with recent computer engineering faculty acquisitions. These new faculty members are strong researchers and strong teachers. One problem concerns the fact that undergraduate enrollments in computer engineering are rising and those in electrical engineering are declining so that the mix is about 50-50. Yet the electrical engineering faculty outnumber the computer engineering faculty by about 2:1. This imbalance within the department will be hard to change quickly, but the focus should be on adding additional qualified computer engineering faculty whenever possible.

Students

All the graduates get good employment or graduate school offers. The faculty members interviewed felt that Clemson's top students are as good as anyone's; the poorer students however are poorer. Underfunding of graduate teaching assistants is a problem in ECE; there has been no increase in the budget for 10 years. Some major universities in the U.S. now have graduate teaching assistant unions, and this is not something that Clemson should aspire to have.

Minority representation

The faculty in the ECE department has one African American faculty member and one female faculty member. Work is needed to diversify the faculty. The statistics for student diversity in computer engineering are as follows:

Students	Women	Minorities	Foreign Nationals
Undergraduate Fall 1999	13.6%	24.1%	2.5%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%
M.S. Fall 1999	17.6%	0.0%	88.2%
Ph.D. Fall 1999	11.1%	0.0%	22.2%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

Source: South Carolina Higher Education 2000 Statistical Abstract.

The number of undergraduate minority students is fairly good compared to the state average, but there were no minority graduate students in 1999. Much work is needed here. The number of women students at all levels needs to increase.

Transfer

Students report that the transfer process seems to be working smoothly.

**CLEMSON UNIVERSITY
ELECTRICAL ENGINEERING**

CIP Code	Degree	Program Title	Status Level
141001	BS	Electrical Engineering	Continuing approval
141001	MS	Electrical Engineering	Continuing approval
141001	Ph.D.	Electrical Engineering	Continuing approval

General

The electrical engineering programs at Clemson are important to the university and to the state. These programs have excellent students, faculty, and administration. They are part of a combined Department of Electrical and Computer Engineering. The programs are headquartered in Riggs Hall, a building devoted to the department except for the Dean of Engineering's office. Some ECE research is conducted in an outstanding research building not far from Riggs. The facilities afforded the ECE department speak of its importance to the university and the state.

Curriculum

The BS program in electrical engineering is very solid. The latest ABET review was highly complimentary of the BSEE program at Clemson.

A major curriculum change was made in 1992, and the faculty interviewed feel that the curriculum is very healthy. The faculty complained about the required 10 hours of free electives. This requirement is apparently a holdover from the days of an ROTC requirement. The faculty believe that this requirement is an impediment to reducing the number of hours in the undergraduate programs even though there is pressure to do this. Students also complained about the 10 hour free elective requirement, saying that most students don't use the hours wisely. Two students in the group supported the requirement stating that ROTC was extremely important to Clemson, and that ROTC brought national honor to Clemson, for example, through the success of the Pershing Rifles. The students would prefer to see suggested focus areas at the undergraduate level to make better use of the 10 hours of free electives.

The faculty members visited were concerned about the mathematics preparation of the students and felt that the courses offered by the Mathematics Department were not as rigorous as they should be.

Students commented that there are not enough Ph.D. level courses. They commented that the 600-800 level requirement for the Ph.D. program is too strict and that it limits the possibility for breadth in the program. The students also commented that timing of graduate classes is a problem.

In the laboratories the visitor was shown, there were sufficient resources so that each student could have a station to himself/herself. Some students reported that the partnership associated with sharing stations was also beneficial. In general the students were complimentary about the labs, and one graduate student even described the facilities as "phenomenal."

Students reported that the senior design course was not interdisciplinary, but that this was something they would like. None of the group of students interviewed had undertaken an international experience.

All degree programs in ECE meet at least one of the minimum enrollment requirements.

Faculty

The faculty in the department are competent and well-qualified to offer solid electrical engineering programs. Research expenditures from external sources run about \$4 million for the department. This is a good total for a department of 30 faculty, and shows a strong commitment to research and scholarship. More than half of the external funding of the department is from federal sources, an important benchmark for ranking programs nationally. There are 5 named professors and one distinguished professor. Donated funds should be sought to add to the number of distinguished professors in the department.

The department has a good balance between teaching and research that makes a very attractive situation for the students. Clemson won an NSF Engineering Research Center, a most prestigious distinction. ECE faculty members participate in the research work of the ERC.

One problem concerns the fact that undergraduate enrollments in computer engineering are rising while those in electrical engineering are declining. The current student mix is about 50-50, yet electrical engineering faculty outnumber computer engineering faculty by about 2:1.

Students

The electrical engineering faculty members receive excellent feedback from recruiters about the quality of the graduates. The Clemson ECE Department should be congratulated for holding focus groups with recruiters to elicit their feedback when they come to campus. The recruiters assume good technical skills and are more interested in "soft" skills. The focus groups report that Clemson electrical engineering graduates are doing very well in soft skills such as ethics, lifelong learning, teamwork, communications, etc. The BSEE students, especially the coop students, get good job offers from all over the country.

Faculty complained of a bimodal distribution of undergraduate students; half are very good and half are not so good. They feel this is due to the number of poor high schools in South Carolina, especially in rural areas. They feel there has been a steady decline over the years in student ability, especially in mathematics and critical thinking skills.

Underfunding of graduate teaching assistants is a problem in ECE; there has been no increase in the budget for 10 years. Some major universities in the U.S. now have graduate teaching assistant unions, and this is not something that Clemson should aspire to have.

The students complained about some of the faculty's knowledge of the details of the program. They also said that some of the faculty lacked enthusiasm for the advising process. They felt the department had excellent laboratories and would like to see more hands-on experience. A perceived concern was the lack of sufficient training in electrical safety and practice. Also they would like to have more interdisciplinary experiences.

Minority representation

The faculty in the ECE department has one African American faculty member and one female faculty member. Work is needed to diversify the faculty.

The statistics for student diversity in electrical engineering are as follows:

Students	Women	Minorities	Foreign Nationals
Undergraduate Fall 1999	12.2%	23.5%	3.6%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%
M.S. Fall 1999	7.7%	2.6%	75.6%
Ph.D. Fall 1999	15.6%	3.1%	59.4%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

The number of undergraduate minority students is fairly good compared to the state average, but the number of minority graduate students in 1999 was small. Much work is needed here. The number of women students at all levels needs to increase.

Transfer

Students report that the transfer process seems to be working smoothly. The faculty members visited reported that there is a problem with transfers from the technical colleges in that the technical college programs appear to have widely different quality levels. The students from urban technical colleges are much better prepared than students from the more rural colleges. The faculty are opposed to reducing the intensity of the curriculum in order to accommodate the weaker transfer students.

**CLEMSON UNIVERSITY
ENVIRONMENTAL ENGINEERING & SCIENCE**

CIP Code	Degree	Program Title	Status Level
141401	MS	Environmental Engineering & Science	Commendation of Excellence
141401	Ph.D.	Environmental Engineering & Science	Commendation of Excellence

Perspective

The graduate program in environmental engineering at Clemson University ranks as one of the best in the United States and may arguably be considered the best regionally. The faculty and student body are cohesive and well integrated, and the facilities are of good quality. The research and teaching components are excellent, and the students represent a mix, coming from regional, national, and international locales, and possessing both engineering and non-engineering backgrounds. There are several innovative activities taking place; for example the integration of recruiting, retention, and placement of students handled by a student services coordinator is a model that could be emulated by other engineering departments. The degree programs meet the minimum standards for degree productivity.

Curriculum

The curriculum is for the most part broad and comprehensive. There are several specialty tracks available, and the combination is unique in comparison with other environmental engineering programs nationwide. Several students mentioned that more aspects of design could be integrated into some of the engineering courses, and that there is a need for more topics on water resources and hydrology to be incorporated into the curriculum. It was later discovered, in conversation with faculty members, that the Civil Engineering Department does offer some of these desired courses, and that the students could elect to take them. It may be that better communication could take place between the environmental engineering students and the faculty of both departments to create an awareness of this opportunity. The internship program in nuclear engineering is one of few graduate internships available in the country.

Facilities

The department is located at the Clemson Research Park. While this is a distance from campus, the facility is roomy, well equipped and accommodating to students, staff, and faculty. The laboratories appear to be adequately equipped, although there was some concern about the need for capital funds to acquire updated instrumentation.

Faculty

The environmental engineering and science faculty represent a cohesive and comprehensive mix of several disciplines, not all of which are engineering. This makes for a well-rounded group that provides a synergistic and innovative atmosphere for both teaching and research. The credentials of the faculty are excellent: nearly all of them are active in research and publish frequently. The annual research expenditures are adequate and sustainable.

The visitor met with several faculty members who comprised a mix of the discipline areas.

Teaching loads are typically three courses per year and the substantial advising load equates to one course per year. The faculty has the freedom to vary graduate stipend rates. The overhead return allows flexibility in programming and scheduling. There appear to be a sufficient number of teaching assistants. Professional development activities included an annual review of tenure track junior faculty by senior faculty, the chairperson, and the dean of the college. There seems to be a strong emphasis on the MS program, and the students also mentioned this.

Some concerns surfaced in the discussion. Carry over of discretionary principal investigator money is difficult from one fiscal year to the next. The infrastructure needs for the university as a whole, including health/safety and radiological issues, have been recognized, and apparently are being addressed. Technician staff support is currently funded by soft money. Operating funds from the university have been constant for several years, with a small increase in the past year. A recurring comment was the status of financial reporting and accounting as provided by the university; many of the faculty members are forced to perform internal bookkeeping themselves. Desktop computer support appeared to need improvement.

Students

The program has high quality graduate students who are recruited from around the United States and abroad. There is a good mix of both MS and Ph.D. students, and they appeared to be close knit and highly motivated. They spoke highly of the Student Services Coordinator and her interaction with them. In particular they were favorable about their graduate recruiting trips and the placement service provided by the department. On the slightly negative side, they felt that there was somewhat of a disconnection between Environmental Engineering & Science and Civil Engineering, and that perhaps more interaction could be developed. They also questioned the policy of discouraging outside work for pay, as some of them felt that they needed additional financial resources beyond their university stipends.

Minority representation

The faculty has one female faculty member and no minority member. Student diversity is distributed as follows:

Students	Women	Minorities	Foreign Nationals
M.S. Fall 1999	33.3%	4.8%	11.9%
Ph.D. Fall 1999	33.3%	0.0%	61.9%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

Ease of transfer from state technical colleges

This is not an issue for this program, since it is graduate degree based only. There is an inter-university center located in Greenville, with a small number of part-time students. Presently, there is no activity related to distance learning.

Library issues

In addition to the university library on the main campus, the department has its own specialized library at its site. Some faculty members mentioned that the main library could use some improvement in its collection.

CLEMSON UNIVERSITY
INDUSTRIAL/MANUFACTURING ENGINEERING

CIP Code	Degree	Program Title	Status Level
141701	BS	Industrial Engineering	Continuing approval
141701	MS	Industrial Engineering	Continuing approval
141701	Ph.D.	Industrial Engineering	Continuing approval

Statewide Perspective

Because this program provides the only industrial engineering degrees in South Carolina, the undergraduate and graduate programs in this department meet important state, regional, and national needs in the domains of teaching, scholarship, and service. Because of a strong relationship between this engineering discipline and the needs of manufacturing industries now moving into South Carolina, these engineering programs should be viewed as an important investment in the economy of the state. The industrial/manufacturing engineering programs at all levels should be continued, developed, and encouraged to succeed.

Curriculum

The Department of Industrial Engineering prepares its undergraduates for careers in the areas of quality engineering, ergonomic engineering and systems design. Based on a review of the written materials, an inspection of sample course materials, and conversations with students and faculty, the program appears to be doing a very good job of meeting its goals. Its laboratories are furnished with equipment that is adequate to the task, but the facilities themselves are not well configured. One faculty member described their facilities as "dreary" and this would seem to be a good description of the facilities in their current configuration. Having a workplace for an industrial engineering faculty that is ergonomically and mentally discouraging to productivity is much like having an architecture building with peeling paint. It would seem that an investment in remodeling costs could go a long way toward creating an environment that is inviting for both faculty and students.

The positive outcome of the recent ABET review further reinforces the fact that the undergraduate program is meeting its goals. The baccalaureate program appears to be both relevant and rigorous. The capstone project course, which makes use of industry-based problems that cross disciplines, is especially worthy of note. The recent use of Web-CT asynchronous learning modules to augment the learning in the course IE 486 appear to be very productive. Baccalaureate students commented that the humanity and social science requirements at Clemson are confusing both to the students and to their faculty advisors.

At the graduate level, the MS and Ph.D. programs have the purpose of providing advanced educational opportunities to qualified baccalaureate graduates. These programs prepare students for work in a wide spectrum of occupations related to the field of industrial engineering. The Industrial Engineering Department has in place an active industry advisory board and appears to be making good use of this resource to shape its programs and activities. The students think that more graduate offerings with depth and breadth in sub areas of IE would be desirable. The MS students said that they would like to have more seminars with practicing professionals. The students also commented that some elective courses are only offered every three or four years.

Faculty

During the visit all faculty members were able to meet with the visitor in four different group meetings. The Industrial Engineering Department has 9 full time faculty who are well qualified and appear to be making good use of professional development to maintain their competency. An additional vacant position is being used to conduct a national search for a new chair after a regretfully unsuccessful attempt during the last academic year. The faculty is quite mature with no members currently at the assistant professor level. An upcoming resignation of one of the full professors is creating an opportunity to recruit an assistant professor and the possibility of adding an assistant professor is a good step for the department. More diversity of ages is desirable.

The faculty are engaged in sponsored research activities and produce an average of 1 journal paper per tenure-track position per year. This productivity level is a bit low for the college goal of establishing a faculty of national caliber. The students mentioned that they would like to see more research assistantship opportunities. MS students would also welcome internships in industry, but do not seem aware of this possibility.

Students

During the visit 1 Junior, 5 Seniors, 4 MS students, and 4 Ph.D. students were interviewed. In general the students (both undergraduate and graduate) appear pleased with the education that they have received. Many of the undergraduates have taken advantage of the co-op experience, and most of the graduate students have benefited from assistantships of various types that appear to be competitive. The programs meet the CHE productivity standards.

Minority representation

The faculty in industrial engineering has only men. Much work is needed to diversify this faculty. The leadership may want to do some target of opportunity recruiting for faculty.

The statistics for student diversity in industrial engineering are as follows:

Students	Women	Minorities	Foreign Nationals
Undergraduate Fall 1999	39.8%	20.4%	3.2%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%
M.S. Fall 1999	10.8%	3.1%	92.3%
Ph.D. Fall 1999	41.2%	0.0%	82.4%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

The undergraduate engineering pipeline programs at Clemson appear to be helping the diversity of the engineering student body. The undergraduate program in industrial engineering has good diversity while the graduate programs are less diverse.

Transfer

Students report that the transfer evaluation process appears to be working satisfactorily.

CLEMSON UNIVERSITY
MATERIALS SCIENCE AND ENGINEERING PROGRAM

CIP Code	Degree	Program Title	Status Level
141801	MS	Materials Science and Engineering	Continuing Approval
141801	Ph.D.	Materials Science and Engineering	Continuing Approval

Statewide Perspective

The graduate programs in materials science and engineering meet important state, regional and national needs in teaching, research, and service. Clemson has the only degree programs in materials science and engineering in South Carolina. Materials science and engineering is an enabling technology for many of the industries currently in South Carolina and should be viewed as an important asset. The degree programs should be continued, developed and encouraged to succeed. However, the current arrangement with two graduate programs in materials (the other in the Department of Ceramic and Materials Engineering) is not a healthy one and the graduate degree programs should be combined into one program housed in the Department of Ceramic and Materials Engineering.

Curriculum

The Materials Science and Engineering Program is an interdisciplinary program involving faculty from the departments of Bioengineering, Ceramic and Materials Engineering, Chemistry, Mechanical, Physics, and Textile Fiber and Polymer Science. Students are affiliated with the department in which their research professor holds a faculty position. Due to the variety of backgrounds of students entering the program, a core curriculum consisting of four courses has been established. This includes courses in phase equilibria in materials systems and kinetics of phase transformations. Students without a materials background are required to take two review courses in materials at the undergraduate level. Masters degree candidates must complete 24 credits of course work with a maximum of 12 credit hours from 600 level courses. The Ph.D. requires a minimum of 45 hours of course work, qualifying and comprehensive exams. There is some concern among the students over the frequency of course offering at the graduate level, and most felt that courses required by their advisor should be offered on an annual basis. The required and other selected graduate courses are what would be expected for traditional graduate degrees designed to prepare students for a career in materials science and engineering. Both the MS and Ph.D. programs require that the students complete a research thesis.

The quality of the equipment available for the graduate students in this program is mixed. Some is certainly state-of-the-art, but some is also very old and requires extensive graduate student time for repair. The equipment issue needs to be addressed by the State of South Carolina. A program similar to the Higher Education Equipment Trust Fund of the Commonwealth of Virginia would be a good model to follow.

Faculty

Eight faculty members, involved in the MSE program, met with the visitor as individuals. All were active in sponsored research. The quality of the research is considered to be very high and the faculty members actively participate in national and international meetings. While the morale of this group of faculty is satisfactory, all (with one exception) felt that the program

should be housed in the Department of Ceramic and Materials Engineering and the graduate programs combined. Some faculty felt that, since the majority of their students and research were involved in materials science, they should be assigned to the Department of Ceramic and Materials Engineering. Others felt that they should have joint appointments, have voting rights on program and curricula issues, qualifying exams, etc., and should be allowed to add materials science and engineering to their academic title. There is a strong perception on the part of the faculty that infrastructure support for the materials program, space, research equipment and the computer accounting system, is inadequate.

Students

Ten graduate students were interviewed during the visit. All were pleased with the quality of the academic program. However, as mentioned most were concerned with the frequency of course offerings and the general quality of equipment. All of the graduate students felt that they should be housed in the Department of Ceramic and Materials Engineering. They felt that being assigned to a variety of different departments didn't allow the opportunity to discuss materials research problems with their fellow students or build the camaraderie with other materials students which they felt is important for the educational experience at Clemson University. The program meets the minimum standards for productivity using the guidelines provided. However, the productivity standard for degrees awarded is marginal. Combination of the program in the Department of Ceramic and Materials Engineering and that administrated by the Director, Materials Science and Engineering would more than exceed the productivity minimums and is recommended.

Minority representation

There were no women or minority faculty among those interviewed. A number of very high quality young faculty have been hired recently but none were minorities or women. This is a major problem nationally for this discipline.

The statistics for student diversity in the Materials Science and Engineering Program are as follows:

Students	Women	Minorities	Foreign Nationals
M.S. Fall 1999	31.2%	0.0%	93.8%
Ph.D. Fall 1999	21.4%	0.0%	85.7%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

CLEMSON UNIVERSITY
MECHANICAL ENGINEERING AND ENGINEERING MECHANICS

CIP Code	Degree	Program Title	Status Level
141901	BS	Mechanical Engineering	Continuing approval
141901	MS	Mechanical Engineering	Continuing approval
141901	Ph.D.	Mechanical Engineering	Continuing approval
141101	MS	Engineering Mechanics	Continuing approval
141101	Ph.D.	Engineering Mechanics	Continuing approval

Statewide Perspective

The undergraduate and graduate programs in mechanical engineering and engineering mechanics meet important state, regional, and national needs in the domains of teaching, scholarship, and service. Because of a strong relationship between this engineering discipline and the types of industries now moving into South Carolina, these engineering programs should be viewed as an important investment in the economy of the state. The mechanical engineering related programs at all levels should be continued, developed, and encouraged to succeed.

Curriculum

The Department of Mechanical Engineering prepares its undergraduates for careers in the thermal, manufacturing, and mechanical systems areas. Based on a review of the written materials, an inspection of sample course materials, and conversations with students and faculty, the program appears to be doing a very good job of meeting its goals. Its laboratories seem appropriately equipped and have adequate space for the types of educational activities needed for this discipline. The positive outcome of the recent ABET review further reinforces the fact that the undergraduate program is meeting its goals. The baccalaureate program is both relevant in content and academically rigorous. The capstone project course, which makes use of industry-based problems, is especially worthy of note. It would appear that there is good use of computational tools throughout the curriculum. This is a topic that will require continued attention and resources as information technology continues to accelerate. Undergraduate students commented that the use of a few integrated laboratory courses rather than distributed labs associated with individual courses made for a learning environment that has a disconnect between the lecture material and the actual laboratory experience. The students also commented that there is a need for a uniform format for laboratory reports.

At the graduate level, the MS and Ph.D. programs have the purpose of preparing students for work in the mechanical engineering profession with the ability to apply fundamental principles to solve complex problems and to conduct independent research. The blending together of the graduate programs in engineering mechanics and mechanical engineering is a realistic approach and the composite data on enrollments and degrees meets the South Carolina standards for productivity. The required graduate courses in these programs are what would be expected for traditional graduate degrees designed to equip students seeking careers in research and development. The array of elective course offerings appears to respond well to a spectrum of recent technological topics. To its credit the Mechanical Engineering Department has in place an active industry advisory board and appears to be making good use of this resource to shape its programs and activities.

Faculty

During the visit ten faculty were able to meet with the visitor in three different group meetings. The ME Department has 25 full time and 4 part time faculty who are well qualified and appear to be making good use of professional development to maintain their competency. The students report that all courses now utilize the faculty teaching evaluation that was not used as extensively prior to the previous CHE visit. The faculty are engaged in significant sponsored research activities (over \$3M of annual sponsored research expenditures in 1999-2000) and produce an average of 3 journal papers per tenure-track position per year. This productivity level is consistent with the college goal of establishing a faculty of national caliber. While faculty morale is satisfactory, the department has had 8 resignations and 2 retirements in the past 5 years. This level of attrition is cause for concern, and may suggest a need for further investigation into the perceptions of the faculty. The self-study documentation cites a faculty perception of a state climate that is unsupportive of higher education and that is disrespectful of productive faculty as one of the major reasons for attrition. The report also cites low salaries and better benefit packages available at other schools as additional reasons for leaving Clemson. It should be noted that recent startup packages for new faculty appear to be adequate to attract bright assistant professors of high potential. Although assistant and associate professor salaries appear to be making progress toward the benchmark averages, for full professors of national caliber, the overall compensation may still be a bit low. There was also a strong perception on the part of the faculty that infrastructure support for research grant management is inadequate and that the computer accounting system in use on campus is difficult to use.

Students

During the visit 2 sophomores, 3 juniors, 2 seniors, 2 MS students, 2 Ph.D. students, and a class of about 15 seniors were interviewed. In general the students (both undergraduate and graduate) appear pleased with the education that they have received. Many of the undergraduates have taken advantage of the co-op experience, and most of the graduate students have benefited from assistantships of various types that appear to be competitive. The programs meet the CHE productivity standards.

Minority representation

The faculty in Mechanical Engineering has only one woman and no minorities. Much work is needed to diversify the faculty.

The statistics for student diversity in Mechanical Engineering are as follows:

Students	Women	Minorities	Foreign Nationals
Undergraduate Fall 1999	11.7%	13.8%	2.9%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%
M.S. Fall 1999	5.4%	1.4%	47.3%
Ph.D. Fall 1999	22.2%	0.0%	83.3%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

The undergraduate engineering pipeline programs at Clemson appear to be helping the diversity of the engineering student body. In spite of this fact, there may be a need to deploy additional programs in order to bring the gender mix and the minority mix more in line with state or national averages.

Transfer

Students report that the transfer evaluation process appears to be working satisfactorily.

USC - Columbia:

At the University of South Carolina – Columbia, the process of change has been rapid and significant. The University now has five new academic deans on campus. The College of Engineering and Information Technology has had three different deans in place in as many years. The college has split one department and merged it with another from a different college on campus. In this process the name of the college has been changed. Each of the academic departments in the new College of Engineering and Information Technology has seen changes in leadership in the past three years. The leadership team now in place appears to be forward thinking and highly competent. Nevertheless, the recent rate of change on campus has the potential to create stress for both faculty and students. This, in turn, has the potential to impact the quality of academic programs, to impact student recruiting, to impact faculty retention, and to diminish overall academic productivity. It is the hope of the visiting team that the University is now entering into an era of strategic progress that will be characterized by more focus, more stability, and more continuity. On the positive side of change, the new dean of the College of Engineering and Information Technology reports the recent availability of \$2.5M and 25 new faculty positions. These resources, if carefully deployed, have the potential to enable the college to achieve new levels of positive progress in teaching, research, and service.

Although the faculty of the College of Engineering and Information Technology is both energetic and competent, it is not as diverse in terms of gender or ethnic mix as might be hoped. A diverse faculty is a strong asset to the recruitment and graduation of a diverse student body, and such diversity in the graduating classes can strongly benefit the economic future of the state of South Carolina. As the College moves toward adjusting the diversity of its faculty, there may be a need for adjustments to create an environment that is helpful in promoting diversity. For women faculty members this might include more generous maternity accommodations to the leave policy and the ability to temporarily stop the tenure clock.

It should be noted that the Provost at the University of South Carolina – Columbia has set aside \$250K in a special fund to assist with “target of opportunity” hiring of underrepresented faculty members. This approach to encouraging diversity is highly commendable.

The undergraduate students in several of the academic areas of engineering commented that they felt somewhat isolated from the rest of the campus because of the distance between the engineering buildings and the social/academic centers associated with the library and the cafeteria.

Faculty members in several of the academic areas commented that the university’s sponsored projects office, SPAR, has been unsuccessful in assisting them with contract research involving small projects with local industry. If this is true it is highly unfortunate, since these types of projects can be a good source of financial support for students, can provide relevant engineering experiences for students and faculty, and can facilitate relationships with those organizations most likely to hire the graduates.

The college is to be commended for its work in distance learning through the APOGEE program. This program is enabling place-bound students at the MS level to progress toward graduate degrees, and is thus providing a valuable service to the industries in which these students work.

**UNIVERSITY OF SOUTH CAROLINA
CHEMICAL ENGINEERING**

CIP Code	Degree	Program Title	Status Level
140701	BSE	Chemical Engineering	Continuing approval
140701	ME & MS	Chemical Engineering	Continuing approval
140701	Ph.D.	Chemical Engineering	Continuing approval
140701	ME & MS	Chemical Engineering (APOGEE)	Continuing Approval

Statewide Perspective

Undergraduate and graduate programs in chemical engineering are offered at the University of South Carolina-Columbia and at Clemson University as well as at universities in all surrounding states. The USC/Columbia programs meet important state, regional and national needs in teaching, research and service. The graduates and research results of the USC-Columbia chemical engineering programs support traditional industries such as textiles, basic chemicals, pulp and paper, nuclear, petroleum and automotive components. These academic outputs are also important for newer economic development areas related to biotechnology, microelectronics and environmental preservation. The chemical engineering programs should be continued and encouraged to improve at all levels.

Curriculum

The Department of Chemical Engineering prepares its undergraduates for careers in the process industries (examples are listed above) and for graduate study in chemical engineering and closely related fields such as bioengineering, environmental engineering, polymer/textile engineering and chemistry. B.S. chemical engineering graduates also often pursue advanced study in business/management, law and medicine. The B.S. curriculum is coherent, rigorous and would clearly satisfy accreditation requirements and the needs of many employers. Although the curriculum continues to be modified to permit more technical and science electives, it is not clear that subjects more relevant to newer growth areas such as biotechnology and microelectronics are well represented in undergraduate student course selection. The chemical engineering department has modern instructional laboratory equipment and the students recognize the value of these hands-on team experiences. An undergraduate cooperative education program is also an asset that is valued by the students. One problem that was mentioned by both faculty and students was the small number of advanced elective courses offered. An expansion of the faculty will probably be necessary to resolve this issue.

Three degrees are offered at the graduate level, M.E., M.S., and Ph.D. The M.E and M.S. degrees are also offered via distance learning (APOGEE). These degrees prepare students for industrial careers and, at the doctoral level, for academic and industrial research positions. The range of advanced courses and thesis research areas is adequate for the degrees offered. The masters and doctoral programs meet the minimum standards for degree productivity. In fact, Ph.D. productivity of 10 in each of the past two years is outstanding. The number of elective courses offered at the graduate level is limited, as is the case with the undergraduate program. The planned expansion of the faculty should resolve this issue.

Faculty

The Department of Chemical Engineering has 14 tenure-track faculty members and one research professor, including the College of Engineering Dean and Associate Dean. A new department chair will be recruited to fill the vacancy created by Professor White's appointment as Dean. Nine faculty were interviewed during the visit, including two via telephone from the American Institute of Chemical Engineers Annual National Meeting. The faculty has changed dramatically during the past decade with a number of dynamic professionals recruited. These faculty members are qualified to offer high-quality undergraduate and graduate degree programs that span the range of most important chemical engineering topics. All faculty were excited about being a part of the rapidly improving Chemical Engineering Department at USC. They are clearly interested in teaching and student guidance in both the undergraduate and graduate programs. They are also productive researchers with significant external research funding leading to regular publications and presentations at professional meetings. The faculty seem to be a coherent team dedicated to continuing the growth and quality of USC Chemical Engineering Programs. They also see potential constraints to this continued progress. The most serious issues are perceived to be quality space with wet labs and fume hoods and State support of start-up packages for new faculty. The faculty who have been added during the past 5-10 years are now establishing solid external reputations. Some will be actively recruited by well-known chemical engineering programs in other states. USC must meet these challenges if they wish to continue progress toward national prominence.

Students

A group of about 15 students, both undergraduate and graduate, were interviewed during the visit. These students were, without exception, pleased with their educational experiences at USC. They indicated that the faculty were accessible and interested in helping with their success in the chemical engineering program. The number of awards won by undergraduates, including NSF fellowships, various undergraduate scholarships, and one Rhodes Scholarship is truly impressive. The USC AIChE student chapter has won national awards in each of the last three years. One issue of concern for undergraduate co-op students was potential problems with frequency of course offerings that could hinder progress toward meeting degree requirement. The graduate student population is comprised of approximately 60 doctoral and 20 masters candidates. This is a very good ratio for an active and growing research program, but space for housing these students and their research activities is a problem that will require attention if the program is to continue to grow.

Minority Representation

The faculty in Chemical Engineering has only one woman and a limited number of ethnic minorities. More work is needed to diversify the faculty as new positions are filled.

The statistics for student diversity in Chemical Engineering are as follows:

Students	Women	Minorities	Foreign Nationals
Undergraduate Fall 1999	35.0%	21.6%	1.9%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%
M.S. Fall 1999	43.8%	0.0%	56.2%
Ph.D. Fall 1999	21.2%	3.8%	71.2%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

It should be noted that the national average for foreign nationals in doctoral programs in chemical engineering is about 50%, however, highly ranked programs are normally well below this average. Continued progress in the chemical engineering graduate programs will depend on an increased ability to attract more high quality students from respected U.S. undergraduate programs.

Transfer

Transfer students are not a large component of the USC chemical engineering student population. Several transfer students were among those interviewed and no significant problems were noted.

Summary Note

The present program evaluator for the Chemical Engineering Programs has visited this department on two previous occasions; the first visit was in 1980 and the second in the early 1990s. The improvements that have taken place since the mid 1980s have been truly exceptional. The recommendations with regard to program status level, as noted above, are *Continuing Approval*. However, both the undergraduate and the doctoral programs may be positioned to earn status levels of *Excellence* in the near future. USC and the State of South Carolina have an opportunity to be the home of an internationally recognized Chemical Engineering Department if financial support is adequate to sustain the rapid rate of improvement that has characterized the past 10+ years.

**UNIVERSITY OF SOUTH CAROLINA
CIVIL AND ENVIRONMENTAL ENGINEERING**

CIP Code	Degree	Program Title	Status Level
140801	BS	Civil Engineering	Continuing approval
140801	ME & MS	Civil Engineering	Continuing approval
140801	Ph.D.	Civil Engineering	Continuing approval
140801	ME & MS	Civil Engineering (APOGEE)	Continuing Approval

Perspective

The undergraduate and graduate programs in civil and environmental engineering at the University of South Carolina are presently experiencing a vigorous and vital growth phase. The department provides a vital niche in the production of graduates for the state. In contrast to Clemson University, the department at South Carolina is smaller, but situated in an urban setting, a locale that attracts a different student clientele. For example, there appears to be a better opportunity for the department to successfully recruit minority students. A chairperson is in his third year and is aggressively positioning the department to become strong in research and teaching. The research areas targeted for growth tend to complement existing programs within the state, rather than compete with them. The recently announced addition of new positions to the college will hopefully include positions in this department; such action is essential if the appropriate critical mass of faculty members in the four specialty areas is to be attained. The undergraduate enrollment appears to be increasing, commensurate with the growing demand for civil engineers in the state. All degree programs meet the minimum standards for degree productivity.

Curriculum

The undergraduate program was accredited in 2000 by ABET for a six-year cycle, demonstrating that it has sufficient rigor and relevance. Specialty areas include structural, geotechnical, water resources, and environmental engineering. There are four undergraduate courses that include a laboratory experience, and a capstone design course with appropriate facilities is in place. The undergraduate curriculum possesses flexibility with respect to the choice of specialty electives, a feature that the interviewed students appreciated. The college-wide Center for Engineering Education Excellence has the potential to provide the students with an interdisciplinary learning experience related to ethics and communication skills. However, students mentioned that the center lacks adequate assistance capability in technical writing skills. Students expressed concern with the requirement to declare a major early in their program. They also mentioned a mismatch between their specialty interest and the advising that they were receiving from their academic advisors. In addition, there was a mention of difficulty with honors advising. Several of the undergraduates expressed the need for introductory courses in transportation and construction management.

The graduate curriculum is sufficiently comprehensive for students to complete either MS or Ph.D. degrees in the four specialty areas. Students in the environmental engineering program mentioned one deficiency, namely the lack of air pollution courses. Several of the graduate

students suggested that some of the courses in their programs include advanced design analysis, making use of state-of-the-art modeling software.

Facilities

The teaching and research laboratories are adequate to good, and planned additions to alleviate some crowding are underway. The hydraulics laboratory recently underwent renovation to incorporate a major basin, and a new facility may soon be constructed to conduct research in coastal hydraulics.

Faculty

The faculty has recently been infused with new members who are productive and actively involved in research. Presently there are sixteen members (one position is currently unfilled) and it is hoped that four to five additional positions will be forthcoming. This additional strength will be needed if the department is to move to a competitive and prominent level of performance. A number of faculty members are conducting high-quality research and their publication rate is good. The annual research revenue per faculty member is adequate and has been increasing in recent years. This increase is likely to continue. With respect to teaching, the goal is to have research active faculty teach three courses per year. One difficulty is that there are no internal funds to support graduate teaching assistants. The resources must come from released faculty salaries; this is a situation that should be corrected.

In conversation with the faculty, the visitor found that they were concerned if it became necessary to teach undergraduate core courses more frequently; this would add to their teaching loads. They also expressed the need for internal teaching assistant support. The need to improve the advising process for undeclared engineering majors was mentioned, as well as the need for resources for recruiting undergraduate majors. The faculty members' assessment of student quality—both undergraduate and graduate—was mixed. Several members spoke of a bimodal distribution of students in which students were either very good or rather poor. There was also some concern about the number of graduate students. Presently there is no faculty development support (travel, discretionary funds, etc.). Overall, the faculty members stressed that additional resources are required for appropriate administrative support. An inadequate amount of funding is available for the next year to each specialty group for equipment upgrades, laboratory improvements, and the like. Without additional resources, the department stands to lose its younger productive faculty as they become nationally and internationally recognized.

Students

The visitor met with a group of undergraduate students. Several of them planned to attend graduate school in South Carolina. For the most part, they spoke positively about their undergraduate education. They approved of the flexibility in the curriculum that enables them to elect specialty courses. They actively participate in the concrete canoe and steel bridge competitions. They did suggest that some of the required courses be offered more often than the current cycle. They spoke favorably of the program that makes use of juniors and seniors to mentor freshmen and sophomores. One overriding concern was the isolation of the engineering college from the remainder of the university campus. Students felt to some degree to be "pigeon-holed," and that the university was doing little to remedy the problem. There seemed to be

concerns about both the physical disconnect and the lack of social activities centered at the engineering campus.

In a conversation with graduate students, it became apparent that these students often did not find opportunities to communicate with one another. During the course of the discussion, one idea that surfaced was the possibility of creating a departmental graduate student group. Overall, the students appeared to be satisfied with their educational experiences. As mentioned earlier, the department has no internally funded financial resources for teaching assistants. This combined with lack of fellowship endowment places a high burden on the chairperson and faculty to adequately compete with other research institutions in the state and region for students. There is a need to improve the quantity and quality of graduate student recruits.

The APOGEE program has been successful in recent years in producing a number of civil engineering graduates. An assessment of this should be made to see whether the program can continue to be productive, or whether it has reached saturation.

Minority representation

The department has two female faculty members, one of them a minority member. There are a number of minority students, but attention apparently needs to be paid to retaining these students.

Student diversity is distributed as follows:

Students	Women	Minorities	Foreign Nationals
Undergraduate Fall 1999	30.5%	10.6%	1.4%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%
M.S. Fall 1999	30.6%	2.0%	20.4%
Ph.D. Fall 1999	8.3%	0.0%	58.3%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

Ease of transfer from state technical colleges

There are five to ten students each year transferring from the state technical colleges. Some of them have been successful in completing their baccalaureate degrees, in part because they tend to be older and more mature than most of their classmates.

**UNIVERSITY OF SOUTH CAROLINA
COMPUTER ENGINEERING**

CIP Code	Degree	Program Title	Status Level
140901	BSE	Computer Engineering	Continuing approval
140901	ME & MS	Computer Engineering	Continuing approval
140901	Ph.D.	Computer Engineering	Continuing approval
140901	ME & MS	Computer Engineering (APOGEE)	Continuing Approval

General

Computer engineering is poised to flourish at USC. The new merged department that contains both computer science and computer engineering will prove to be a very strong combination. Outstanding new leadership for the new department also bodes well for the future. It is important to co-locate the new department so that the benefits of the combination can be better realized. The total current amount of space occupied in two buildings is adequate, so it's just the location itself that needs to change.

Curriculum

The BS in computer engineering degree has been modified and now appears to be a solid program. One possible improvement would be the addition of computer-aided-design experience. The latest ABET review cited concerns about programming across the BSCE curriculum, the senior design courses, and the amount of electives available. The new curriculum introduces programming in the freshman year, a very positive move. In addition, the senior design courses have been revamped and both faculty and students are pleased. The students who were interviewed reported excitement at being able to build a computer and then install an operating system; they would like to see the experience earlier than the senior year with one saying, "Recruiters ask if you have ever built a computer given that we're computer engineers, and we'd like to be able to say, 'Yes.'" The students did report that there was not enough hardware in the curriculum. An additional senior level hardware course would be another possible improvement to help overcome any deficiency here. The APOGEE and distance education programs appear to work well.

The merger of computer science and computer engineering has lead to an increased offering of electives. Graduate students reported that they were very pleased with the array of courses they could now take. At one time the computer science courses were off limits except for a small number. The MS/ME array of course offerings is excellent. In short, the department has worked to correct the ABET deficiencies and has built a solid undergraduate curriculum while expanding the offerings to graduate students.

Care must be taken to ensure that the separation of electrical engineering from computer engineering doesn't widen the boundary between the two. Telecommunications, networking, digital signal processing, hardware, etc. are important areas for CE majors and could be lost if a gulf develops.

All programs meet at least one of the minimum productivity standards.

Faculty

The faculty members in the department are well suited to offer solid computer engineering programs. Research productivity could be improved considerably. (The current amount is \$900,000 in annual external research expenditures.) With 19 faculty members, achieving annual totals of \$4 million or more would start to put the department in the distinguished category. However, there are pockets of excellent research with some of the faculty. The Dean and Department Chair are interested in increasing the research volume, so new faculty and funds (startup, matching, etc.) to help leverage funded research should pay dividends for USC. Computer engineering is a fundable area. Additional faculty would also help in course coverage.

The computer engineering students are pleased with the faculty, although they expressed some reservations about some of the former computer science faculty. The students are pleased with advising.

Students

The department has excellent students although there are some students at the other end of the scale that probably shouldn't be in the program. All the graduates get good job offers. CSE has extremely high quality graduate students. They have too many masters students, and attempts to limit the number by raising standards has led to more and better students due to higher than anticipated matriculation rates.

Minority representation

The faculty in the CSE Department has two women out of 19 total faculty. Two of the faculty are Hispanic, and there are no African-Americans. The Department needs to continue to work hard to diversify the faculty.

The statistics for student diversity in computer engineering are as follows:

Students	Women	Minorities	Foreign Nationals
Undergraduate Fall 1999	19.4%	41.7%	5.1%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%
M.S. Fall 1999	16.7%	5.6%	80.5%
Ph.D. Fall 1999	14.3%	0.0%	89.3%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

The number of undergraduate minority students is above the state average, and the university should be proud of this accomplishment. Work is needed to increase minority enrollment in the graduate programs.

Transfer

Students report that the transfer process seems to be working smoothly.

**UNIVERSITY OF SOUTH CAROLINA
ELECTRICAL ENGINEERING**

CIP Code	Degree	Program Title	Status Level
141001	BSE	Electrical Engineering	Continuing approval
141001	ME & MS	Electrical Engineering	Continuing approval
141001	Ph.D.	Electrical Engineering	Continuing approval
141001	ME & MS	Electrical Engineering (APOGEE)	Continuing Approval

General

The electrical engineering program at USC is a solid, traditional program that is housed in a stand-alone department following the splitting off of computer engineering to join computer science in a new department in the College of Engineering. The department attracts a distinguished volume of funded research on a per capita basis. Without a computer engineering degree program, declining undergraduate enrollments could hurt the department. There is excellent new leadership for the department. The greatest need for the department is stability. Care needs to be taken that the separation of computer engineering doesn't become a detriment; particular attention should be paid to curricular and research areas that form a broad border with computing and information technology. Some faculty members interviewed expressed concern at the splitting off of computer engineering, with one faculty member saying the department had lost "its intellectual property."

Curriculum

The BS in electrical engineering degree program is very solid. The BSEE curriculum contains tracks including power, microelectronics, communications, and modeling/simulation. It is a curriculum designed for a larger department and this can lead to problems offering a sufficient variety of courses, a concern raised by the students. Students were concerned about the variety of course offerings. The department has had to resort to adjunct faculty to cover the courses. More faculty would remedy the situation.

The research facilities in microelectronics and photonics are world class. The university's commitment to supporting the creation of these facilities and the diligence and competence of the faculty members in acquiring them are to be commended. Because of this facility, USC is poised to become a national leader in this area. Graduate students studying in this area are receiving a top-notch education; a Ph.D. student coming out of this area should be competitive with those from any institution in the country.

The students would like to see more practical experiences including implementation and safety issues included in the curricula. The department has excellent computer staff support and infrastructure. The electrical engineering writing center was listed as a positive factor by one faculty member. The APOGEE and distance education programs appear to work well.

Faculty

The faculty in the department are competent and well suited to offer solid electrical engineering programs. Research productivity is excellent with approximately \$6 million in annual external research expenditures. With 11 faculty members, the average of over \$500,000 per faculty member puts the department in the distinguished category. In addition, they had 30 refereed

journal articles last year, an outstanding per capita number. Besides the 11 tenured/tenure-track faculty, there are five adjunct faculty. Adding additional faculty could eliminate the use of adjuncts and could add research expenditures to the university if the new faculty are as productive as the current group. The strategic decision to add new faculty should be driven by a close look at the enrollment history for the programs in this department.

Students reported that they were unhappy with advising in the past, because it was done by staff. Now faculty members advise, and the students report much more satisfaction. Students are quite pleased with many of the faculty members, but not all. The recently hired faculty members appear to be excellent additions to the faculty.

The faculty is committed to improving the electrical engineering programs at USC.

Students

The department has excellent students although there are some students at the lower end of the scale that probably shouldn't be in the program. All the graduates get good job offers. A serious concern is the decline in enrollments at the bachelors and masters levels. From 1995 to 1999, the number of master's students declined from 72 to 22, a serious drop. The hot job market is partly to blame for this. Additionally, the number of bachelor's students dropped from 217 to 139 in the same period of time. If this decline is not halted, the quality of the department could be in jeopardy. At the same time, the number of Ph.D. students has risen, from 15 to 30 in five years. This is a positive reflection of the increased research productivity of the faculty.

Minority representation

The faculty in the EE Department has no women and no minorities out of 11 tenure track faculty. The Department needs to work hard to diversify the faculty.

The statistics for student diversity in electrical engineering are as follows:

Students	Women	Minorities	Foreign Nationals
Undergraduate Fall 1999	15.8%	35.3%	2.9%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%
M.S. Fall 1999	9.5%	19.0%	42.9%
Ph.D. Fall 1999	3.3%	3.3%	73.3%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

The number of undergraduate minority students is near the state average. Enrollment of women is low and work is required here. Historically retention of African American students has been poor, but it has improved in recent years. Attention at the freshman year could help with retention.

Transfer

Students report that the transfer process seems to be working smoothly.

UNIVERSITY OF SOUTH CAROLINA - COLUMBIA
MECHANICAL ENGINEERING

CIP Code	Degree	Program Title	Status Level
141901	BSE	Mechanical Engineering	Continuing approval
141901	ME&MS	Mechanical Engineering	Continuing approval
141901	ME&MS APOGEE	Mechanical Engineering	Continuing approval
141901	Ph.D.	Mechanical Engineering	Continuing approval

Statewide Perspective

The undergraduate and graduate programs in mechanical engineering meet important state, regional, and national needs in the domains of teaching, scholarship, and service. Because of a strong relationship between this engineering discipline and the types of industries now moving into South Carolina, these engineering programs should be viewed as an important investment in the economy of the state. The mechanical engineering related programs at all levels should be continued, developed, and encouraged to succeed.

Curriculum

The Department of Mechanical Engineering prepares its undergraduates for successful careers in the mechanical engineering professions. Based on a review of the written self-study materials, a visit to the facilities, and conversations with students and faculty, the program appears to be doing a very good job of meeting its goals. Its laboratories seem well equipped and have adequate space for the types of educational and research activities needed for this discipline. There would appear to be adequate staff support for the department. To its credit, the department has made good use of gifts and indirect cost recovery to equip its laboratories. The state-provided resources alone would not be enough to maintain and renew the equipment in the department laboratories. The rigorous baccalaureate program is relevant in content, and the positive outcome of the recent ABET review further reinforces the fact that this program is meeting its goals. The capstone project course, which makes use of industry-based problems, is worthy of note. The department may wish to consider adding cross-disciplinary teams to this capstone experience. The inclusion of a microprocessor laboratory in the curriculum is most worthwhile, but students report that they feel unprepared for the programming required in this lab. The department may wish to add a higher level programming language such as C++ to its early course offerings to prepare students for this laboratory experience. It would appear that there is good use of computational tools throughout the curriculum, and the equipment used for this is up-to-date and of good quantity. Maintaining this and all other laboratory equipment in this state will require continued attention and resources as technology continues to accelerate. The undergraduate program in mechanical engineering appears to have a heavy emphasis on the solid mechanics stem of mechanical engineering and less of an emphasis on the thermo/fluids stem. This characteristic reflects the interests of the faculty and is a uniqueness that differentiates the program from the other mechanical engineering program in the state at Clemson.

At the graduate level, the MS and Ph.D. programs have the goal of preparing students for work in the mechanical engineering profession with the ability to apply fundamental principles to solve complex problems and to conduct independent research. The graduate programs appear to

be meeting their goals. The graduate programs also meet the productivity levels of the State of South Carolina. It is important to note that the low rate of Ph.D. degree production of approximately one degree per year, is inconsistent with the average enrollment of 13-20 doctoral students over the last five years. Faculty members report that this anomaly is caused by students who leave the program to complete their doctoral degree at other, more prestigious programs in the U.S. Students report that this anomaly is caused by recent increases in the quality standards required to continue progress toward the degree. Whatever the reason, the department may want to look for ways to enhance the rate of success for Ph.D. students so that the early investment in these students can produce positive outcomes. The department has its own rules and procedures for the operation of its Ph.D. program. The University and its students might be better served if college-wide or university-wide procedures were in place for the operation of Ph.D. programs. To its credit the Mechanical Engineering Department has in place an active industry advisory board and appears to be making good use of this resource to shape its programs and activities.

Faculty

During the visit, nine faculty were able to meet with the visitor and several others were present during a tour of the laboratories. The ME Department has 15 full time and 4 part time faculty who are well qualified and appear to be making good use of professional development to maintain their competency. They are dedicated to the goals of the institution. Most important of all, they appear to be working well together and are enthusiastic about the future. The faculty are engaged in significant sponsored research activities (over \$2.7M of annual sponsored research expenditures in 1999-2000) and thus produce an average of \$160,000 per tenure-track position per year. The faculty also generates an average of two refereed journal articles per tenure track faculty member per year. The faculty seems to understand well the need for balance between the teaching, scholarship and service roles of their professional activities. The department has made good progress toward higher quality since the previous visit of CHE. Given the current level of productivity in the domains of teaching and research, faculty resources may need to grow if the programs are to continue their upward movement toward increased quality in the days ahead.

Students

During the visit 1 junior, 7 seniors, 5 MS students, and 2 Ph.D. students, were interviewed. In general the students (both undergraduate and graduate) appear pleased with the education that they have received. The students were especially pleased with the personal attention that they have received from the faculty. Many of the undergraduates have taken advantage of the co-op experience, and all of the graduate students have benefited from assistantships of various types that appear to be competitive. The undergraduate students were especially pleased about the availability of student professional societies and the team activities such as the solar boat, the Legend car, and the Mini Baja competition. The graduate students were especially pleased with the culture of USC that encouraged networking with students across disciplines. The departmental effort in Sustainable Design and Development was cited as an excellent example of cross-disciplinary activities available to the graduate students. The MS and Ph.D. students expressed a need for an orientation program and a peer-mentoring program to help new graduate students to succeed. They also would like to see the return of the graduate student-run seminar series.

Minority representation

The faculty in Mechanical Engineering has only one woman and no minorities. Much work is needed to diversify the faculty. Some target of opportunity hiring practices may be needed to assist with this situation.

The student diversity in Mechanical Engineering is making good progress but still needs improvement, particularly in the domain of women and minorities as follows:

Students	Women	Minorities	Foreign Nationals
Undergraduate Fall 1999	10.2%	18.0%	2.9%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%
M.S. Fall 1999	13.3%	10.0%	25.0%
Ph.D. Fall 1999	8.3%	12.5%	54.2%
State averages for graduate and first professional programs*	64.6%	26.9%	7.4%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

Transfer

Undergraduate students report that the transfer evaluation process appears to be working satisfactorily.

South Carolina State University – General Comments

Founded in 1896 as a historically black institution, South Carolina State University is a land-grant institution. Located in Orangeburg, South Carolina, it is a public, senior comprehensive teaching institution with the mission to provide affordable and accessible quality undergraduate and graduate degree programs. It is one of South Carolina's twelve public senior institutions and offers sixty baccalaureate degree programs in applied professional sciences, arts, business, education, engineering technology, humanities, and sciences. Also, it offers a small number of master's degree programs in agribusiness, human services, and teaching and the doctorate in education. It is primarily a residential campus serving approximately 4,000 traditional students.

The university's academic programs are organized into the following Schools: Applied Professional Sciences, Arts and Humanities, Business, Education, and Engineering Technology and Sciences. The engineering technology programs are administered by two departments: Civil and Mechanical Engineering Technology, and Industrial and Electrical Engineering Technology. The current administration at the institution appears to be forward thinking and willing to explore ways to serve state education and workforce needs. The university has initiated a strategic planning process that involves participation at all levels including the program faculty, and has setup an internal evaluation system that is based on goal and outcomes assessment procedures. This indicates the university's commitment to carry out its mission in a dynamic manner and it will provide the institution with a head start in preparing for the implementation of forthcoming accreditation criteria for the engineering technology programs.

The Miller F. Whittaker Library contains over 1.3 million holdings and subscribes to approximately 1300 print serials and electronic journals. It provides access to more than twenty-five databases and belongs to a state consortium, which provides access to other resources. The library facility is located in a four level building occupying approximately 48,000 square feet. Its holdings in physical sciences as well as engineering subject area are very good. The library staff appears to be well prepared and provides excellent service. The library-faculty liaison program with various academic units and schools works very well to benefit students, faculty, and the community at large.

**SOUTH CAROLINA STATE UNIVERSITY
ENGINEERING TECHNOLOGY**

CIP Code	Degree	Program Title	Status Level
150201	BS	Civil Engineering Technology	Continuing Approval
150303	BS	Electrical Engineering Technology	Continuing Approval
150603	BS	Industrial Engineering Technology	Continuing Approval
150805	BS	Mechanical Engineering Technology	Continuing Approval

Statewide Perspective

The undergraduate programs in engineering technology at SCSU meet an important need in the engineering spectrum at state, regional, and national levels. The thriving industrial infrastructure of South Carolina, as evidenced by a number of manufacturing, production, and related plants, indicates a strong need for a well-trained technical workforce. The engineering technology baccalaureate degree programs at South Carolina State University are strong, serve a special need of business and industry, and should be continued, nurtured, and encouraged to flourish.

Curriculum

The importance of the programs to the state is not difficult to assess since there are only two institutions offering baccalaureate degree programs in engineering technology in South Carolina (SCSU and Francis Marion University). Also, since there is a thriving economy with a number of manufacturing and related plants already located in the region. The SCSU is the only institution in the state that offers Technology Accreditation Commission of ABET accredited engineering technology curricula. The programs are very important to the state and nation, and they serve an important mission of preparing students for professional positions. The existing articulation agreements with technical colleges allow for smooth transition in the curricula. The institution offers, on site, EET degree programs at two technical colleges via distance learning. This indicates the institution's commitment to serve the state's education needs in a much broader way. This activity promotes and provides visibility to SCSU's engineering technology programs. Lab equipment for the curricula is adequate and generally in good shape. Recently, the institution has decreased its total semester credit hour requirements for the BS degrees to 128-131 credits. This action is a step in right direction and worth noting.

Faculty

The SCSU faculty teaching in the program have appropriate qualifications and credentials for the engineering technology programs. Besides teaching and service, most of the faculty members are active in scholarly activities comparable to the peer engineering technology institutions, nationally. With many collective years of industry experience, the faculty members are very dedicated to the profession as evidenced by their length of service and commitment to teaching. They are involved in teaching laboratories as well as lectures and some are active in developing distance learning techniques. In the faculty pool, there are no women.

Students

Students interviewed by the visiting team appeared to be very enthusiastic. They like the faculty

and are very appreciative of the engineering technology professional education opportunity offered to them by the university. Students complimented SCSU and its placement services for helping them with co-op opportunities, internships, and employment opportunities. Engineering Technology enrollments are steady with approximately 20% of students being women. Students are involved in professional society student chapters such as ASCE, ASME, IEEE, IIE, NSBE, and SME.

The diversity of these programs is illustrated in the table below:

Students	Women	Minorities	Foreign Nationals
Civil Engineering Tech.	7.7%	94.2%	3.8%
Electrical Engineering Tech.	13.1%	90.9%	6.1%
Industrial Engineering Tech.	29.8%	95.7%	2.1%
Mechanical Engineering Tech.	11.1%	93.1%	8.3%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

Other Issues

The institution should be complimented for organizing a very large and active industrial advisory committee that has broad representation from many types of businesses and industries. This has resulted in some funding opportunities, employment and internship opportunities for students and graduates, and acquisition of lab equipment.

Recommendations

1. **Program Vision:** SCSU is the only institution in the state of South Carolina that offers a good spectrum of TAC of ABET accredited engineering technology programs. The university should capture the moment by establishing a clear vision and mission of the engineering technology programs signature ones in the state. This opportunity could make its ET programs as signature ET programs in the state. It is very possible that business, industry, and more students would want to come and be a part of this vision.
2. **Industrial Park:** In the near vicinity of the university, the city and county governments are developing an industrial park. This would provide a tremendous opportunity for interaction between the university community and businesses/industries. Particularly important will be opportunities for students and faculty. Students interviewed by the team indicated that they would like to be involved in and exposed to some R&D related activities. The University should seek to collaborate with the Park in a way that involves its ET programs.
3. **Information Technology:** Information Technology is an emerging and new curriculum domain that SCSU should explore by bringing together faculty with common interests. This can be achieved by forming a unit and identifying faculty from areas such as EET, computer science, business, and others. The IT program has the potential to bring visibility to the institution, would address the infrastructure needs of the state of South Carolina, and could inspire more students to attend the institution.

4. **Financial Aid and Registration:** Students complained about the institution's financial aid being not available in a timely manner and about the institution's computer registration process failing frequently. It is recommended that the university administration investigate this matter and take corrective action(s) to address this situation.
5. **Recruitment Program:** The institution has articulation agreements with technical colleges; however, it does not have an active recruitment plan at those institutions. Such a plan can help the institution promote its programs and recruit additional students upon completion of their associate degrees. In addition, SCSU should strengthen its recruiting efforts with high school and middle school counselors in promoting its engineering technology programs. A recruitment plan should also include information about the availability of exciting career opportunities in the discipline, and the importance of math preparation for technical programs.

Francis Marion University – General Comments

Founded in 1970 as a state college, Francis Marion University is located in Florence, South Carolina with the mission to make available an excellent baccalaureate education in the liberal arts and selected professional programs in business, education, engineering technology, and nursing. Master's level graduate programs are also offered in business, education, and psychology. It is one of South Carolina's twelve public senior institutions. A regional comprehensive teaching university in the Pee Dee region, it serves approximately 4,000 traditional and non-traditional students.

The university is organized into the following academic units: College of Arts and Sciences, School of Business, School of Education, Other Academic Programs, and Graduate Academic Program. The engineering technology programs are a part of Department of Chemistry and Physics in the College of Arts and Sciences. The current administrative leadership team at the institution appears to be forward thinking. The university has established outcomes-based assessment processes to learn about various issues/activities and individuals have begun to ask questions about the engineering technology programs.

The James A. Rogers Library contains over 365,000 volumes and subscribes to approximately 2,000 print serials and electronic journals. It provides access to more than twenty databases and belongs to a state consortium that provides access to full-text science journals. The library facility is very modern, offers an excellent setting, and stays open for long hours. Its holdings in physical sciences are exceptional, but its holdings in the engineering subject area are limited in the number of books and very narrow in periodicals. The library staff appears to be well prepared and committed to providing excellent service.

FRANCIS MARION UNIVERSITY – ENGINEERING TECHNOLOGY

CIP Code	Degree	Program Title	Status Level
159999	BS	Engineering Technology	Provisional Approval

Statewide Perspective

The undergraduate program in engineering technology meets an important need within the engineering spectrum at state, regional, and national levels. The thriving industrial infrastructure of South Carolina as evidenced by a number of manufacturing, production, and related plants indicates a strong need for a well-trained technical workforce. The engineering technology programs at the associate and baccalaureate levels should be continued, nurtured, and encouraged to flourish.

Curriculum

Although the primary importance of this program may be to the Florence region, the institution does allow a nicely designed transfer path from Florence Darlington Technical College for a segment of students to achieve the baccalaureate degree in engineering technology. Ideally, the program represents a successful creative joint venture between two institutions with complimentary missions. In practice, however, there are some significant problems with this program. (See the recommendations section on the following page).

Faculty

The Francis Marion University faculty teaching in the program have appropriate qualifications and credentials in Physics and Chemistry. Almost all the faculty members are active in scholarly activities besides teaching and service. However, the faculty pool lacks widespread minority and women representation.

The Florence-Darlington faculty have qualifications and credentials appropriate to the associate degree engineering technology programs. All of the faculty except one have industrial professional experience and practically all of them are involved in appropriate level of professional development activity.

Students

Students are very enthusiastic, like the faculty, and are interested in the professional education opportunities offered to them by the university. They complimented FMU for preparing a useful and timely transfer guide.

The diversity of the student body in the engineering technology program at Francis Marion University is shown on the table on the next page.

Students	Women	Minorities	Foreign
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	Nationals		
Engineering Tech.	11.5%	36.5%	0.0%
Statewide averages for undergraduate programs in all disciplines*	58.2%	33.3%	1.1%

*Source: South Carolina Higher Education 2000 Statistical Abstract.

Recommendations

1. **Program Vision:** Francis Marion needs to establish a clear vision and mission for the engineering technology program. It should address such things as the program goals and objectives, business and industry needs, regional and state-wide educational impacts, TAC-ABET accreditation issues, the overall curriculum focus, and transfer articulation. Currently a vision for the program is lacking.
2. **Credit Hours:** The curricula for the Civil Engineering Technology track and the Electrical Engineering Technology track require a total of 138-145 and 146-153 semester credit hours, respectively, depending on the selection of a minor. In a four-year baccalaureate degree program, these are too many credits and the institution needs to explore avenues to reduce the total credit hour requirements to no more than 128. This step would bring the institution in line with the similar programs in the country and the state (see SCSU). Such a change would also enable the institution to be more competitive in recruiting students.
3. **Industrial Advisory Committee:** An industrial advisory committee with a broad representation can provide a good understanding of regional and national economic and technical needs in a professional program. The institution's faculty, students, and the program can benefit in many ways from such a committee. Since the inception of the engineering technology program more than twenty years ago, the institution has not taken advantage of such an activity. It is recommended that the FMU leadership take this into consideration for the success of its program. As a first step in this matter, FMU faculty should take advantage of the invitation by the FDTC and participate in FDTC's Industrial Advisory Committee activities.
4. **Degree Productivity and Enrollments:** The five-year enrollment trend at FMU shows an average total enrollment of 22 and 30 students in the CET and EET tracks, respectively. In the year 1999, there were merely 22-23 students enrolled in each track. Over the last thirty years, the degree productivity has been at a level of 1.4 and 2.6 graduates per year in the CET and EET tracks, respectively. In Fall 99, the institution awarded 2 degrees in CET and only 1 in EET. The awarded degree data indicates productivity levels below the South Carolina CHE productivity standard of five degrees per year. The program faculty and leadership appear to be content with this. The institution needs to address this issue as a part of its vision and mission for the programs.
5. **Articulation Agreement(s):** The institution's articulation agreement with FDTC's associate degree programs is good for the FMU BS degree program. However, based on student input, there appear to be problems in proper advising, transfer credits, course offering, and concurrent attendance between FMU and FDTC. There are a number of

technical colleges offering engineering technology and related curricula in the state of South Carolina. In order to maintain healthy enrollment levels and in order to meet South Carolina's technical workforce needs, it would be in the best for the institution to develop articulation agreements with other technical colleges, not just FDTC. Additionally, at present if the graduate of a technical college other than FDTC wants to attend the engineering technology at FMU, that student is required to enter FDTC prior to being admitted to FMU. This creates extra and possibly burdensome hurdles on the transfer student.

6. **Recruitment Program:** The institution needs to develop an active recruitment program for the BS Engineering Technology programs. The program brochure(s) and the FMU catalog need to specify clearly the full program requirements and the total credit hours needed for completion of the degree.
7. **Placement Services:** Students commented that the institution provides no help in career placement or coop placement. The university office in charge of this activity should address this matter.
8. **Student Organization(s):** Students commented that there exists no forum for students to be organized as a group, and there are no student chapters of professional societies such as IEEE, ASCE, etc. It is recommended that the program faculty explore avenues to start such activities for the benefit of students, faculty, and the program.

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Commission on Higher Education Existing Academic Program Review
Engineering and Engineering Technology Programs
Fall 2000

CIP Code	Degree	Program Title	Institution	Off-Campus Offerings	Recommended Status
140801	BSCE	Civil Engineering	The Citadel		Continuing Approval
141001	BSEE	Electrical Engineering	The Citadel		Continuing Approval
140301	BS	Biosystems Engineering	Clemson University		Continuing Approval
140301	MS	Biosystems Engineering	Clemson University		Continuing Approval
140301	PhD	Biosystems Engineering	Clemson University		Continuing Approval
140501	MS	Bioengineering	Clemson University		Continuing Approval
140501	PhD	Bioengineering	Clemson University		Continuing Approval
140601	BS	Ceramic Engineering	Clemson University		Continuing Approval
140601	MS	Ceramic Engineering	Clemson University		Continuing Approval
140601	PhD	Ceramic Engineering	Clemson University		Continuing Approval
140701	BS	Chemical Engineering	Clemson University		Continuing Approval
140701	MS	Chemical Engineering	Clemson University		Continuing Approval
140701	PhD	Chemical Engineering	Clemson University		Continuing Approval
140801	BS	Civil Engineering	Clemson University		Continuing Approval
140801	MS/MENGR	Civil Engineering	Clemson University	The Citadel	Continuing Approval
140801	PhD	Civil Engineering	Clemson University		Continuing Approval
140901	BS	Computer Engineering	Clemson University		Continuing Approval
140901	MS	Computer Engineering	Clemson University	The Citadel	Continuing Approval
140901	PhD	Computer Engineering	Clemson University		Continuing Approval
141001	BS	Electrical Engineering	Clemson University		Continuing Approval
141001	MS	Electrical Engineering	Clemson University	The Citadel	Continuing Approval
141001	PhD	Electrical Engineering	Clemson University		Continuing Approval
141101	MS	Engineering Mechanics	Clemson University		Continuing Approval
141101	PhD	Engineering Mechanics	Clemson University		Continuing Approval
141401	MS/MENGR	Environmental Systems Engineering	Clemson University		Commendation of Excellence
141401	PhD	Environmental Systems Engineering	Clemson University		Commendation of Excellence
141701	BS	Industrial Engineering	Clemson University		Continuing Approval
141701	MS	Industrial Engineering	Clemson University		Continuing Approval
141701	PhD	Industrial Engineering	Clemson University		Continuing Approval
141801	MS	Materials Science and Engineering	Clemson University		Continuing Approval
141801	PhD	Materials Science and Engineering	Clemson University		Continuing Approval
141901	BS	Mechanical Engineering	Clemson University		Continuing Approval
141901	MS/MENGR	Mechanical Engineering	Clemson University		Continuing Approval
141901	PhD	Mechanical Engineering	Clemson University		Continuing Approval
159999	BS	Engineering Technologies	Francis Marion University		Provisional Approval
150201	BS	Civil Engineering Technology	SC State University		Continuing Approval
150303	BS	Electrical Engineering Technology	SC State University	MTC, TTC and UCG	Continuing Approval
150603	BS	Industrial Engineering Technology	SC State University		Continuing Approval
150805	BS	Mechanical Engineering Technology	SC State University		Continuing Approval
140701	BSE	Chemical Engineering	USC-Columbia		Continuing Approval
140701	ME & MS	Chemical Engineering	USC-Columbia		Continuing Approval
140701	PhD	Chemical Engineering	USC-Columbia		Continuing Approval
140701	ME & MS	Chemical Engineering (APOGEE)	USC-Columbia	Distance Education	Continuing Approval
140801	BSE	Civil Engineering	USC-Columbia		Continuing Approval
140801	ME & MS	Civil Engineering	USC-Columbia		Continuing Approval
140801	PhD	Civil Engineering	USC-Columbia		Continuing Approval
140801	ME & MS	Civil Engineering (APOGEE)	USC-Columbia	Distance Education	Continuing Approval
140901	BSE	Computer Engineering	USC-Columbia		Continuing Approval
140901	ME & MS	Computer Engineering	USC-Columbia		Continuing Approval
140901	PhD	Computer Engineering	USC-Columbia		Continuing Approval
140901	ME & MS	Computer Engineering (APOGEE)	USC-Columbia	Distance Education	Continuing Approval
141001	BSE	Electrical Engineering	USC-Columbia		Continuing Approval
141001	ME & MS	Electrical Engineering	USC-Columbia		Continuing Approval
141001	PhD	Electrical Engineering	USC-Columbia		Continuing Approval
141001	ME & MS	Electrical Engineering (APOGEE)	USC-Columbia	Distance Education	Continuing Approval
141901	BSE	Mechanical Engineering	USC-Columbia		Continuing Approval
141901	ME & MS	Mechanical Engineering	USC-Columbia	Distance Education	Continuing Approval
141901	PhD	Mechanical Engineering	USC-Columbia		Continuing Approval
141901	ME & MS	Mechanical Engineering (APOGEE)	USC-Columbia	Distance Education	Continuing Approval