

Institutional Effectiveness Report  
Academic Year 2007-2008  
For Physics and Engineering Technology  
Programs

*Joe Mehaffey*  
*Coordinator of IE*

*Dr. David Peterson*  
*Chair of Department*

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## *Program Mission and Goals*

### Physics

The Department of Physics and Astronomy offers a baccalaureate degree in Physics with a concentration in Computational Physics or Health Physics. Students completing the majors offered by the department will be prepared for careers in industry and scientific research or for graduate school.

### Engineering Technology

The Francis Marion University B.S. degree programs in Civil Engineering Technology (CET) and Electronics Engineering Technology (EET) allow students with an associate's degree in Engineering Technology or those in pursuit of such a degree to earn their bachelor's degree after approximately two years of additional coursework. FMU's Engineering Technology programs provide a unique cooperative educational opportunity to students and workers of the Pee Dee region and South Carolina by offering a liberal arts education to Engineering Technology students from the state's Technical Colleges in addition to their chosen technical and scientific training. The Engineering Technology degree programs enable graduates to compete more effectively for technical positions within local and regional industry.

## *Assessment Activities*

The institutional effectiveness assessment for the programs in Physics and Engineering Technology has been divided into five sections:

1. Student learning and development
2. Faculty and student scholarly activity
3. Departmental technology
4. Reviews of student graduate school admission and fellowship acquisition
5. Faculty service to the university and the community

### **1. Student Learning And Development**

- A. All laboratory courses will require mandatory written lab reports. Benchmark: 70% of the physics and engineering technology majors who complete the 300 and 400 level physics laboratory courses will submit a complete set of laboratory reports for each course.
- B. Physics majors will complete one or more senior projects in PHYS 420: Senior Laboratory in Physics and will submit a written report. Benchmark: The PHYS 420 written reports will be graded by two physics faculty members for accurate and clear scientific information reporting, and 70% of the students will score 4 or more on a 1-7 point scale.
- C. Physics majors will be required to make at least one oral scientific report. An oral presentation based on a student's senior projects will be required as part of PHYS 420. Benchmark: Students will make an oral presentation at a special Society of Physics Students meeting, which will be evaluated by the physics faculty and at least one faculty member from another discipline for oral presentation quality. The mean score for these presentations should be at least 70 on a 100-point scale.

### **2. Faculty and Student Scholarship**

The physics department has been concerned with assessing the scholarship of both the faculty and upper level students. The physics department has encouraged interested faculty and students to attend regional conferences. The department also encourages collaborations between its faculty and other institutions. In addition, the faculty and students are encouraged to participate in our science colloquium.

### **3. Instructional Technology**

Students will be required to demonstrate the ability to use computers to solve physics problems Physics 301 or Physics 302 or Physics 401.

Benchmark: one computer project will be completed in either physics 301, 302, or 401 and 70% of the students will score 4 or better on a 1-7 point scale of computer use, as assessed by two faculty members.

### **4. Reviews Of Student Graduate School Admission And Fellowship Or Assistantship Acquisition**

- A. Within any four-year period, 80% of FMU physics graduates who apply to graduate school in a related discipline will be accepted.
- B. One in eight of FMU physics graduates who are accepted to graduate school in a related field will receive a fellowship or assistantship.

### **5. Faculty Service To The University And To The Community**

A. The level of involvement of the physics faculty in University committees will be evaluated through an examination of the faculty's annual reports. The benchmark for this activity is for the department's faculty, on average, to serve on at least two campus committees.

B. The extent of the physics faculty's participation in activities of the community at large is assessed through an examination of the faculty's annual reports.

## *Results and Evaluation*

### **1. Student Learning And Development**

- A. The 300 or 400 level physics laboratory courses that were taught during the 2003-2004 academic year were PHYS 310, 314, 316, 416 and 417. A total of 44 students completed these courses, and 38 of these submitted a complete set of lab reports (86%). Thus the benchmark of 70% of the students submitting a complete set of reports was met.
- B. In the current academic year, eight seniors submitted papers on either their senior projects or their summer internship work. All of the papers were judged by the faculty to be of acceptable quality.
- C. Six senior students presented talks concerning their senior projects. These talks were evaluated by six faculty members and rated on a 100-point scale. The scores generated were 92, 81, 91, 82, 88, and 89, yielding a mean score of 87. The benchmark for this area was met or exceeded by all the students.

### **2. Faculty And Student Scholarship**

#### **Dr. David Peterson**

Invited Presentation, "Recruitment and Program Design for the Health Physics Major at Francis Marion University", given at the National Health Physics Society Meeting, Portland, Oregon, July 8-12, 2007

Poster Presentation, "X-Ray Fluorescence of Meteorites with a Krypton Gas Proportional Counter and a Planar HPGE Detector" at the American Physical Society Meeting, Southeast Section, Nashville, Tennessee, November 8-10, 2007.

Attended three other conferences related to Health Physics.

#### **Dr. Derek Jokisch**

"Health Physics Society's assistance in academic education", address given at the Health Physics Society Annual Meeting, July 10, 2007, Portland Oregon.

Directed and participated in an address given by two health physics majors, "Radiation: What it is and where you find it", given at the 31<sup>st</sup> Pee Dee Regional High School Mathematics Tournament.

Collaborated in address, “Quantifying the inhomogeneity of dose in marrow/bone interface-rich skeletal sites”, Health Physics Society Annual Meeting, July 10, 2007, Portland Oregon.

Dr. Seth Smith

Presented “Francis Marion University’s Middle School Science Institute” at the Physics Teacher Education Conference, Boulder, Colorado, March 2007.

Presented “A Model for Training In-Service Middle School Science Teachers” at the American Physical Society Meeting, Southeast Section, Nashville, Tennessee, November 8-10, 2007.

Presented “Francis Marion University’s Summer Science Camp for Middle School students” at the Meeting of the American Association of Physics teachers, Baltimore, Maryland, January 2008.

Dr. Jeannette Myers

Attended a workshop at the NAFSA conference on recruiting students into Study Abroad programs, October 2007.

Presented results of ongoing research work concerning galactic interactions at the American Physical Society Meeting, Southeast Section, Nashville, Tennessee, November 8-10, 2007.

Attended a meeting of the South Carolina Space Grant Consortium members to review proposals form each of the member institutions.

Dr. Phillip Fulmer

Co-authored an invited presentation, “The Health Physics Major at Francis Marion University” at the Health Physics Society Annual Meeting, July 10, 2007, Portland Oregon.

Continues membership and participation in the eight person-working group established by the American National Standards Institute (ANSI) to develop the national standard model for the thyroid gland, including its structure, function, and its tendency to absorb and concentrate radioactive materials such as certain iodine isotopes.

Work continues toward preparation of an article for the ‘Operational Radiation Safety’ journal on Monte Carlo Principles for Gamma Ray transportation processes.

Dr. Larry Engelhardt

Co-authored “Extending the  $(\text{Mo})\text{Mo}_5\text{I}_2\text{Mo}_{30}$  Capsule Keplerate Sequence: A  $\text{Cr}_{30}$  Cluster with 3/2 Metal Centers with a  $(\text{Na}(\text{H}_2\text{O})_{12})$  Encapsulate, published in *Angewandte Chemie International Edition* 46. (2007)

Co-authored “Heisenberg model of an  $\text{Fe}_8$ -cubane cluster, *Physical Review B* 76. (2007)

Co-authored “Octa-, Deca-, Trideca- and Tetradecanuclear Heterometallic Cyclic Chromium-Copper Cages, published in *Angewandte Chemie International Edition* 47. (2008)

Gave four addresses on Quantum Monte Carlo techniques at seminar and scholarly meetings.

Dr. Todd Vaccaro

Principal author, “The Enigmatic Light Curve of the Eclipsing Binary FF Aqr and the Nature of its Hot Star, a presentation/publication given at the American Astronomical Society Meeting. (2007)

Co-author of “V471 Tauri Light Curves and Spot Modeling”, published in the *Journal of the Southeastern Association of Research in Astronomy*. (2007)

Co-author of presentation “Fragile Binaries: Observational Leverage on Difficult Astrophysical Problems”, in *Proceedings of IAU Symposium* held in August, 2006, with a publication date of August, 2007.

Additionally, the department’s faculty took twenty-seven students to the American Physical Society Meeting, Southeast Section, held at Vanderbilt University in Nashville, Tennessee, November 8-10, 2007.

### 3. Instructional Technology

The measure of this criteria had, in the past, had as its focus the courses PHYS 301, 302, and 401. The department has determined that an introduction to computers in physics should occur in the introductory courses 200, 201, and 202. This approach has been put in place, and now the use of computers in these courses is routine. These students use computers for the purposes of data acquisition and for the analysis of results.

The upper division student projects that rely heavily on computer simulation and advanced computational techniques seem to have “gravitated” to the 400 level courses. This year’s projects involved computational modeling/simulations of several topics from mechanics (earth’s orbit, projectiles), health physics (liquid scintillation counting) and astrophysics (interstellar extinction). All of the projects were judged by the faculty to be of acceptable quality, the mean score being 85%.

#### **4. Reviews Of Student Graduate School Admission And Fellowship Or Assistantship Acquisition**

- A. Of this year's seven graduates, four have applied to graduate schools and all four have been accepted. This maintains an acceptance rate of at least 80% for our recent graduates.
  
- B. Of this year’s graduates who have been accepted to graduate schools, all have been awarded either a fellowship or teaching assistantship. Additionally, one of our Physics graduates, Samantha Penland, was recognized by the Society of Physics Students (SPS) as one of their Leadership Awardees and will receive an additional \$2000.

#### **5. Faculty Service To The University And To The Community**

- A. Examination of the faculty annual reports reveals that 7 faculty members served on 22 campus committees, yielding an average of 3.1 committees per faculty member. This result, once again, exceeds the established benchmark of 2.0 committees per faculty member.
  
- B. The Department's faculty continues to be heavily involved in service related to the community in a number of ways. There are no less than 18 documented endeavors that indicate the strong commitment of the faculty to the local community.

### *Improvements in Place*

- A. Dr. Jokisch obtained a \$10,000 grant from the Instructional Technology Committee for the purchase of CPO Science physics equipment and has written several laboratory experiments associated with this equipment for use in the department's introductory courses.
- B. Several of the department's faculty have incorporated the Turning Point presentations into their courses. This system includes the use of PowerPoint presentations coupled with radio frequency "clickers", which allows the students to respond to presented questions and get immediate feedback. This approach facilitates direct engagement of the students in lecture and serves as a diagnostic tool for the professor.
- C. A new course, PHYS 220, Computational Methods for Physics and Engineering, has been approved and added to the department's requirements for the physics and pre-engineering majors. The motivation for this new course stems from several perceived problems with the computational component of these majors. Students will be exposed to a wide variety of computational tools including Excel, Matlab, Maple and Vpython.
- D. Dr. Fulmer has incorporated the use of an electronics circuit simulation software package into the Electronics course (PHYS310). The software allows students to assemble virtual circuits in a graphical user interface complete with virtual measuring and test equipment so that they can sharpen their skills in circuit assembly and testing.
- E. The department acquired additional computational abilities to the Nuclear Radiation Physics course (PHYS416). The commercial software package, Microshield, is an industry-recognized standard for performing gamma ray shielding calculations. Dr. Fulmer developed a new laboratory exercise where students learn the point kernel techniques used by Microshield to perform shielding calculations for a realistic real-world scenario that previously would not have been possible.
- F. In addition to the department's formal recruiting effort, the South Carolina Physics Scholars Institute (SCPSI), the students themselves organized and carried out their own "mini" version of SCPSI, which they called the Pee Dee Physics Day. Local area high school students were invited to the campus on a Saturday and performed many of the same activities used in SPSCI. This effort was entirely conceived by our students and was run with limited faculty involvement. It is anticipated that this may become an annual event that will supplement the department's recruiting efforts.

### *Planned Improvements*

- A. The faculty members involved with the Health Physics program have developed a new course, PHYS 418: Practical Applications of Health Physics. This 3-credit hour course will give health physics students familiarity with applications of health physics principles.
- B. Another new course is being developed for the Health Physics major, PHYS 210: Introduction to Radiation Protection. This 1-credit hour course will serve to introduce health physics majors to the fundamental principles involved in their major during the sophomore year. The course will further prepare students for working safely in a radiation environment.
- C. The laboratory manual for the introductory physics courses is being revised and will include several new experiments.
- D. Changes to the South Carolina Physics Scholars Institute (SCSPI) are being considered, most notably moving the timing of the event from the spring semester to the fall in order to make earlier contact with prospective students. In the past academic year, three of the twenty-nine attending students are known to have committed to Francis Marion. The department hopes to improve upon these results.

### *Modifications in General Education Courses*

- A. Revisions to the Physical Science 101 lab manual are planned and will include several new experiments.
- B. The astronomy faculty within the department are planning additional course offerings which may involve topics such as imaging, photometry, and data analysis, which may, in part, lead to the department's ability to offer a minor in astronomy.
- C. Several improvements have been made to the observatory, which include two new telescopes. This should result in an improved observing experience for students in the astronomy courses as well as for the public at large.
- D. New laboratory experiments are being developed for Physical Science 103:Earth Science that will include topics in geology, meteorology, and astronomy.

### *Assessment of General Education Courses*

The Department of Physics and Astronomy has chosen to assess its General Education offerings by having students complete a survey concerning the results of an experiment they have just designed and completed. The techniques of data acquisition, experiment design, and analysis required in this experiment are considered representative of the students' mastery of the laboratory course material.

The experimental problem given to the students concerns a simple pendulum. The students must identify variables that may effect the time period of a pendulum (length, mass, amplitude) and investigate to see which one(s) actually have an influence. By analyzing the results, the students attempt to develop an empirical equation that correctly predicts the time period for any simple pendulum.

The tabulated results for the fall and spring semesters combined appear on the following page. A total of fourteen different laboratory sections across the two semesters are represented.

## 2007-2008 SURVEY RESULTS FOR FINAL EXAM SIMPLE PENDULUM EXPERIMENT

### 242 SURVEYS COMPLETED

Directions: In response to the following questions, circle the answers that best characterize your results from the Simple Pendulum Experiment.

1. Did variations in the amplitude of the oscillating pendulum affect its time period?  
97 a) The amplitude had no effect on the time period.  
126 b) The amplitude seemed to have a slight effect on the time period.  
19 c) The amplitude had a major effect on the time period.
  
2. Did variations in the length of the oscillating pendulum affect its time period?  
0 a) The length had no effect on the time period.  
39 b) The length seemed to have a slight effect on the time period.  
203 c) The length had a major effect on the time period.
  
3. Did variations in the mass of the oscillating pendulum affect its time period?  
109 a) The mass had no effect on the time period.  
116 b) The mass seemed to have a slight effect on the time period.  
17 c) The mass had a major effect on the time period.

4. Which of the following expressions best characterizes the relationship between the time period (T) of a simple pendulum and its length (l)?

125 a)  $T = kl$

83 b)  $T = k\sqrt{l}$

17 c)  $T = kl^2$

12 d)  $T = \frac{k}{l}$

5 e) none of the above

Key to color code:

**Green**=number of students with correct answer

**Blue**= number of students with reasonable, but incorrect answer

**Red**= number of students with answers not supported by data (incorrect)

Analysis of Survey Results

Q.1	Correct	52%	Reasonable	40%	Incorrect	8%
Q.2	Correct	84%	Reasonable	16%	Incorrect	0%
Q.3	Correct	45%	Reasonable	48%	Incorrect	7%
Q.4	Correct	34%	Reasonable	52%	Incorrect	14%

Commentary

In general, the results of the survey are somewhat encouraging, in that the vast majority of the students obtained at least reasonable results. In particular Q.4, which represents the students' final results for the experiment, indicates that 34% of these students must have exhibited careful thought, careful data collection, and a very good understanding of plotting their data and reaching a sound conclusion based on graphical analysis. For the 52% of the students that could reach a reasonable, though incorrect, conclusion, more thought and care in data collection is generally the reason for the shortcoming. Overall, the fact that 86% of the students could reach at least a reasonably satisfactory conclusion demonstrates, we feel, a respectable result for the course.

### *Footnotes and References*

This section is designed for inclusion of any qualify information and reference information you have cited in the body of the report. This is an optional section.

## *Appendices*

This section is designed for additional information you wish to make available that is not part of the main body of the report. It is an optional section.