

**PROGRAM PLANNING SUMMARY  
A NEW DEGREE PROGRAM**

**Ph D in Engineering and Science Education**

Clemson University

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## **Ph.D. Program in Engineering and Science Education:**

**Designation:** New Doctoral Degree Program

**Proposed Credit Hours:** If enters as post-baccalaureate 50 semester hours; if enters post-masters, 32 semester hours

**Proposed Implementation Date January 1 2011**

### **Statement of the purposes and objectives of the Program**

The purpose of the PhD program in Engineering & Science Education is to establish a nationally-unique graduate program in STEM education and research. The Department of Engineering & Science Education in the College of Engineering and Science at Clemson University is the only department in the country that includes both engineering education and science education in a College of Science/Engineering. As such, it includes faculty who are experts in science education (physics, chemistry) and engineering education, and have active research programs in these areas. Students in this program will be exposed to the wide breadth of STEM education research under current investigation as well as be prepared to interface between the development of new theory in STEM education and the implementation of new research findings in practice.

The objectives of the new PhD program will be to prepare students for academic careers in STEM education. Students will be expected to be content experts in a STEM discipline (with at least a Master's degree or equivalent in their content area of expertise). Graduates from this program will be prepared to become faculty in traditional departments of engineering or science, as well as STEM education departments. They will be prepared to lead curricular and pedagogical reform at the post-secondary level as well as conduct research in the burgeoning fields in STEM education research.

### **Justification of need for proposed program**

There are numerous calls for improvements in both the number STEM education graduate, and the quality of their experiences (COSEPUP 2007). There is also a growing acknowledgement that there is a need for faculty (Bush 2008, Benson 2009) who are versed in both disciplinary content, and current research on how students learn, how attract and retain a diverse cadre of students, and what factors affect these outcomes.

Our experiences (and others) indicate that students who graduate with Ph.D. in STEM education research are in high demand as more colleges and universities realize the need for the expertise that they bring. We are currently losing undergraduate students who would like to pursue a Ph.D. in Engineering and Science Education, and are currently applying to other institutions such as Purdue or Virginia Tech. We have the faculty, the expertise and the funding to support such a program at Clemson.

### **Centrality of the program to the mission of Clemson University**

Clemson University was founded, in the words of Thomas Green Clemson, as a “high seminary of learning,” and throughout its public land-grant existence has maintained an emphasis on the education of students in science and technology related to economic growth of the state of South Carolina. The new department of Engineering and Science Education has a significant role to play in providing support to this mission through active research which creates new knowledge and practice in these areas of learning. A doctoral program would help fulfill the legacy of the university founder by not only producing valuable educational research, but expanding the ranks of experts capable of applying that research in the state, region, and beyond.

The synergy resulting from combining faculty from the sciences, math, and engineering makes this program unique among doctoral programs that emphasize discipline-specific educational investigations. This quality of uniqueness makes the program more attractive to potential students and funding agencies, and at the same time it contributes to the university plan of implementing strategic emphasis areas. The university and the College of Engineering and Science have demonstrated a commitment to this direction through creation of the department and addition of several new faculty hires. These faculty in turn are committed to the creation of a vibrant doctoral program that will support the core educational needs in engineering and science.

#### **Relationship of the program to existing programs at Clemson University**

The Ph.D. in Engineering and Science Education has little overlap with the already existing Ph.D. program in curriculum and instruction. The ESE program targets students who aim to continue in higher education teaching, developing research programs, and coordinating programs primarily at the higher education level within the Engineering and Science disciplines. The Ph.D. in curriculum and instruction typically attracts students whose goal is education at the K-12 level, be it research or teaching. While there are a small number of Ph.D. candidates whose focus is STEM education at K-12 level in curriculum and instruction, most candidates are in other fields.

#### **Relationship of the program to other institutions via inter-institutional cooperation.**

While this program is a unique program, there are a number of departments of Engineering Education (at Purdue, Virginia Tech, and Utah State) who offer Ph.D. degrees in Engineering Education. There are also currently about 30 Ph.D. programs in physics and a similar number in chemistry departments. We currently have a number of collaborations with these departments and faculty. For example we have a joint seminar program with the Engineering Education department at Virginia Tech. Our faculty also have collaborations with faculty at UC Berkeley, U Colorado at Boulder, U Iowa, Iowa State, Purdue, Harvard, U Virginia, U South Florida, Ball State University, Indiana University, California Polytechnic-San Louis Obispo, North Carolina State, Tennessee State University, University of Houston and University of Texas-El Paso

**Total new costs:** \$15,000 per year to be reallocated within the College of Engineering and Science. Expenses include seminar budget, travel and advertising.

## **Projected Curriculum**

### Course Requirements

- Core ESE courses – 8 credit hours, consisting of ALL of the following:
  - CES 800 - Seminar in Engineering and Science Education (1) \*
  - CES 861 - Teaching/Mentoring Practicum in Engineering and Science Education (1)
  - CES 870 or ED F 955 – Theoretical Basis of Instruction (3)
  - CES 871 - Engineering and Science Education Research Methods (3)
  
- Supporting ESE courses – ONE course to be chosen from the following:
  - CES 820/821 - Teaching Undergraduate Engineering/Science (3)
  - CES 825 – Engineering and Science Student Strategies (3)
  - CES 875 - Current Topics in STEM Education Research (3)
  - CES 888 - Preparing for the Professoriate (3)
  
- Supporting Areas – 3 credit hours, as approved by doctoral committee.  
Included areas:
  - Education
  - Psychology
  - Sociology
  - Statistics
  - Other
  
- Disciplinary requirement – 18 credit hours at the graduate level in a single STEM discipline (ie. mechanical engineering, physics, chemistry, etc.).  
Optional if student holds an M.S., M.E. or higher in a STEM discipline.
  
- Dissertation – 18 hours  
Enrollment in CES 990 – Thesis Research and Writing