Request for Authorization to Establish a
Master of Nanoengineering program at North Carolina State University

North Carolina State University requests authorization to establish a Master of Nanoengineering degree program (CIP 14.9999).

Program Description

The Master of Nanoengineering program will educate and train students in science, engineering systems, and manufacturing associated with the multidisciplinary field of nanotechnology. Nanoengineering skills are used to design devices and systems for the manufacture of nanoscale products. The program consists of ten courses and thirty credit hours. Core courses include an introduction to nanomaterials, concepts in materials science, nanoelectronics, nanoscale manufacturing and fabrication, and nanoelectromechanical systems. Students then pursue a minimum of 12 credit hours in one of three concentration areas: materials science in nanoengineering; nanoelectronics and nanophotonics; or biomedical sciences in nanoengineering. No thesis is required, but students can opt to conduct supervised research through a Research Project in Nanoengineering course. The program draws from existing courses that are being taught on-campus and also delivered via distance education. The degree will be offered through the Engineering Online Distance Education Network at North Carolina State University.

Mission Relevance

The degree program in Nanoengineering fits well with the overall mission of North Carolina State University and strengths in science and technology. The program also aligns with the goals and strategies of *The Pathway to the Future: NC State's 2011-2020 Strategic Plan*, particularly to build interdisciplinary graduate programs that emphasize areas of strategic strength (Goal 3). In 2009, the nanotechnology journal *Small* ranked North Carolina State University in the top ten academic institutions in nanotechnology commercialization and research.

Student Demand

In addition to regular inquiries from interested students, North Carolina State University has experienced growth in enrollments in recent years in existing nanotechnology courses, which draw students from a wide variety of majors. Program faculty also have existing relationships with three technology institutes in India that have expressed strong interest in the online degree program. Additionally, students in degree programs with the Joint School of Nanoscience and Nanoengineering (JSNN) may enroll in program courses to fulfill electives requirements (see Collaborative Opportunities).

Societal Demand and Opportunities for Program Graduates

Advances in nanotechnology have impacted multiple industry sectors, including aerospace, agriculture, biotechnology, defense, electronics, energy, and medicine and will require individuals with specialized knowledge and skills. 3M, Cree, GE, Intel, and HP are examples of US companies involved in nanotechnology. The National Science Foundation estimates market impact of innovations associated with nanoscience and nanotechnology to be $1 trillion by 2015 and estimates a need for two million individuals trained in nanotechnology to support projected market growth. Reports by Lux Research and others similarly project 30-40% market growth in nanotechnology related industries over the next decade.

Resource Implications
No new faculty, library resource, facilities, or information technology resources are needed to launch the program. Reallocation of existing funds within the College of Engineering Distance Education Program will cover partial salary of an existing faculty member to serve an academic advising and coordinating role, administrative support, and marketing.

Collaborative Opportunities
Some collaboration among faculty with the Master of Nanoengineering program and the Joint School of Nanoengineering and Nanoscience (JSNN) at UNC Greensboro and NC A&T State University already occurs in teaching and research. Leaders of these two initiatives met to discuss additional collaborative opportunities that could be facilitated by the addition of the degree program and identified several potential areas. The online courses offered through North Carolina State University enhance the options for suitable nano-related electives available to JSNN students. The programs see significant opportunities to collaboratively seek graduate student training funds from NSF IGERT and other funding sources. The programs can expand on existing teaching collaborations and jointly develop new courses. JSNN faculty currently collaborate in the teaching of a Materials Science of Nanoelectronics course at North Carolina State University, and there is interest to jointly develop a course on modeling of nanoscale systems. While some collaborative research and publication exists, this can also be expanded. Additionally, through the UNC Graduate Council review process, several other institutions also expressed interest in collaborative teaching and research opportunities upon program approval.

Outcome of Consultation with Disciplinary Experts
The proposal was reviewed by twenty-one faculty and graduate program administrators from ten UNC campuses. Reviewers overwhelmingly found the proposal to be acceptable and consistently noted the alignment with institutional strength and mission. While some reviews commended plans to offer the degree online, others questioned the viability of an online program offering that would not provide hands-on experiences in nanoengineering. North Carolina State University currently offers fourteen online engineering degree programs that enroll students from all fifty states and twenty foreign countries. The online engineering degree programs make extensive use of modeling and simulations to provide engaging student learning experiences.

Recommendation
It is recommended that the Board of Governors approve North Carolina State University's request to establish a Master of Nanoengineering degree program (CIP 14.9999).