AC 2012-5259: THE DEVELOPMENT OF AN INTERDISCIPLINARY BACHELOR’S DEGREE COMPLETION PROGRAM IN THE STEM FIELDS

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The Development of an Interdisciplinary Bachelor’s Degree Completion Program in the STEM Fields

Introduction:

Much of the economic growth of the twentieth century has been driven by the advancements in the scientific arena, the applications of engineering principles, and the spirit of entrepreneurship and innovation. As we move forward in the twenty-first century, every aspect of our lives from communication, transportation, education to healthcare and agriculture is closely linked to the research and innovation that is conducted in the STEM (Science, Technology, Engineering, and Mathematics) fields. It is predicted that the demand for STEM talent will increase dramatically within the coming decades.

And yet there is a shortage of properly trained graduates to contribute to the advancement of these fields. This has resulted in a national calling by the institutions of higher education, policy makers and education experts for an increase in the number of bachelor’s and advanced degrees that are granted in the engineering, theoretical and applied science fields.

There is also a sense of urgency to promote the STEM fields among the non-traditional and community college students who constitute about forty percent of all college students. Every year, thousands of Americans drop out of college due to unforeseen circumstances and enter the workforce without finishing their post-secondary education. Many never return to college, despite having a strong desire to finish their bachelor’s degree. Many of these students have the aptitude and talent to undertake studies in a science or engineering field but will never foster that talent or get a second chance to do so. Increasingly, younger students are also choosing to start their post-secondary education at a community college to alleviate the high cost of attending a four-year institution. Many of these students, who enroll with the intention to transfer, lose their direction within the pipeline and do not continue their studies beyond an associate’s degree.

To address both the demand to increase the number of STEM graduates and also the need to provide an alternative route for non-traditional students, we have developed and implemented a “Bachelor’s Degree Completion” program for working professionals, adult learners and community college students who are interested in careers in science and technology.

This new Bachelor’s Degree Completion program is an integrated approach to science and technology that provides an opportunity for non-traditional students to finish their degrees in two innovative tracks of Information Systems Technology and Biotechnology. The program is also designed to provide a conduit to accelerated master’s programs where eligible students can pursue an advanced degree in Information Technology or Molecular Biotechnology.

Through partnerships with community colleges within the metropolitan DC, the program also aims to create a pipeline for outstanding community college students to transfer to the completion program easily. Students are advised by both institutions and have a comprehensive program plan that will keep them on the transfer track. This partnership increases the retention rate and also graduation rate at local community colleges.
Motivation for an Integrated Approach

Traditionally, academic disciplines are divided into distinct departments (i.e. Mathematics, Biology, Philosophy, etc.) where the students take the majority of their classes in a particular department. In today’s competitive job market and with the rapid advances in the fields of science and technology, a traditional academic curriculum might not be enough to prepare the students for their career endeavors. Students will need a broader set of skills and knowledge to succeed in the scientific arena. A more relevant approach would be to combine different disciplines and create a multidisciplinary or interdisciplinary program. Combining scientific knowledge with information systems tools, technology innovation and business practices will provide the students with a broader spectrum of skills that are desired in a competitive job market.

We have created a curriculum that couples a series of foundation courses in science and technology with complimentary courses in business/entrepreneurship, energy/environmental sciences and technology ethics. Students also have the opportunity to take specialized courses in Information Systems Technology or Biotechnology tracks during their senior year. Figure 1 represents a comparison view of a traditional academic program versus a more multidisciplinary approach to a technical education.

(A)Traditionally students major in a particular subject and take all their upper level classes in the corresponding department. There is little overlap between academic programs and the courses that the students take. (B) In an interdisciplinary approach, science and technology is overlapped with business practices and innovation skills. Environmental issues, ethical consideration and an understanding of public policies are also integrated within the curriculum to provide students with a broader perspective.
Program Curriculum:

Our Bachelor’s Degree Completion program is a two-year completion program. We accept students who have an associate’s degree from a community college or have completed 60 credit hours of course work at an accredited institution of higher education. In the first year of the program, students enroll in a series of foundation courses in mathematics, computing, writing and communication. This is equivalent to the junior year of a traditional undergraduate degree. During the second year, students have the opportunity to choose one of the program tracks and specialize in their area of interest. This is equivalent to the senior year of an undergraduate degree. A capstone project (senior thesis) provides the students with the opportunity to tackle a real world problem and work on an independent project for an entire year. Table 1 provides an overview of the structure of this program and how the courses are distributed over the two years.

<table>
<thead>
<tr>
<th>First year (Fall &amp; Spring term)</th>
<th>Foundation courses in:</th>
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<tbody>
<tr>
<td></td>
<td>Mathematics and statistics</td>
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<td></td>
<td>Computing and information technology</td>
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<tr>
<td></td>
<td>Writing and communication</td>
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<tr>
<td>Summer term</td>
<td>Ethics in science and technology</td>
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<td></td>
<td>Entrepreneurship and management of innovation</td>
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<td></td>
<td>Start of the senior thesis</td>
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<td>Second year (Fall &amp; Spring term)</td>
<td>Information systems technology track:</td>
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<td></td>
<td>Telecommunication networking</td>
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<tr>
<td></td>
<td>Information and network security</td>
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<td></td>
<td>Relational databases</td>
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<td>System integration</td>
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<td>Alternative energy</td>
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<td>Biotechnology track:</td>
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<td></td>
<td>Computational modeling</td>
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<td></td>
<td>Bioinformatics</td>
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<td>Molecular biotechnology</td>
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<td></td>
<td>Biomedical instrumentation</td>
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<td>Alternative energy</td>
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</tbody>
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Table 1: Program curriculum (can be completed in five consecutive terms).

Program Learning Outcomes:

Upon the completion of this program the students should:

- Have a mastery of the scientific concepts:
  An appropriate mastery of the knowledge, techniques, skills, and modern tools in the science and information technology fields is required from our graduates.
• Be able to apply their knowledge to real world problems:
  Students should be able to apply their knowledge to the emerging applications of 
  mathematics, science, engineering, and technology. They should also be able to integrate 
  scientific and technical expertise with successful business practices.

• Be able to solve complex problems:
  Students should be able to identify, analyze and solve technical problems by breaking 
  them into smaller sub-problems, by adapting reverse engineering principles and by 
  thinking outside of the box.

• Have effective verbal and written communication skills:
  Students should be able to write scientific papers, be able to utilize different research 
  methodologies and be able to communicate effectively with their peers.

• Establish positive team work attitude:
  Students should develop effective team work and leadership skills while working on team 
  projects.

Class Model: Accommodating the Needs of Non-traditional Students

Many non-traditional students start their education at community colleges due to economical 
constraints, but also because community colleges provide a more flexible curriculum and course 
schedule for them. We have constructed our program to follow a similar pattern. Our goal is to 
be mindful of our student body, many of whom have full time jobs and family obligations. Our 
classes are scheduled during the evening hours and the weekends to allow for working 
professionals to attend lectures. We also have a series of hybrid classes where we combine 
classroom lectures with online activities. This model allows for an efficient use of class time and 
maximizes learning both inside and outside lecture time. Our tuition rate is also significantly 
discounted compared to our regular undergraduate programs. This allows us to provide an 
opportunity for a larger population of lower-income students who are in the need of financial aid.

Retention Rate:

This completion program has been offered for the past two years and our retention rate is close to 
100%. The students who come back to school to complete this program are very motivated. They 
are determined to finish their studies and despite many other life obligations such as full time 
jobs, family and children care responsibilities, they tend to be hard working and on top of their 
studies. This pattern demonstrates a need for more flexible educational options to accommodate 
such talented non-traditional students. With the opportunity to finish their bachelor’s degree, our 
students can start their careers in the STEM fields and contribute to the much-needed expertise in 
these areas.
**Future:**

Employment trends in our geographical region and the data provided by government agencies have indicated positive employment prospects for the graduates of STEM degrees. This trend favors the emphasis and focus of our Bachelor’s Degree Completion program as we continue to grow and improve the program. We hope to better serve our metropolitan region and contribute to the overall increase of college graduates within the region. We plan to expand the program in the future to provide students with a larger number of elective courses and more options for specialized tracks. Several tracks such as health IT, engineering patent and nanotechnology are under consideration to be added to this program.


