

The Modernization of the Surveying Engineering Program at Old Dominion University

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Abstract

In its college of engineering, Old Dominion University (ODU) offers a plethora of degrees in engineering technology. Surveying Engineering and Geomatics is one of them. Because all of the courses in Surveying and Geomatics are offered on the Teletechnet, this program not only serves the state of Virginia but also the surrounding states of North Carolina, West Virginia, Maryland, the District of Columbia and anywhere in the United States including US military battle ships in the high seas. Recently, the course offerings in this program went through a major upgrade to provide its students with a broader and deeper knowledge in the various fields of surveying engineering and geomatics. Some courses were removed from the old curriculum, other courses remained under the same name and course number but went through a major content upgrade, and five new courses were added. This course change was performed based on a comprehensive study of the local and national workplace challenges and demands in the various fields of geospatial information engineering. This change in course offerings, created three fields of specialty including Land Surveying, Photogrammetry, and GIS/Remote Sensing. This course change also produced two minor options for students who are interested in Surveying and geomatics but are pursuing degrees in a different field. Those are a minor in Land Surveying and a minor in Photogrammetry. In this paper the authors try to provide a comprehensive description of the current program, after it went through a major overhaul process.

Introduction

The primary goal of the Department of Engineering Technology is to prepare students for technology based careers. ODU's Bachelor of Science in Engineering Technology (BSET) programs are developed specifically for students who desire a technical baccalaureate education with an emphasis on applications of engineering and technical knowledge to solve actual work place problems. There are two program alternatives leading to the BSET. One alternative meets the needs of students who are interested in practice as professional engineers or geomatics professionals and includes concentrations in Mechanical (MET), Civil (CET), and Electrical (EET) Engineering Technology. The Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC of ABET) accredits these programs and graduates are eligible to sit in the Fundamentals of Engineering (FE) or the Fundamentals of Land Surveying (FLS) examination in Virginia and in most of the other states or certified photogrammetrist and/or certified mapping scientist exams of the American Society of Photogrammetry and Remote Sensing (ASPRS). The second program alternative is the BSET with a concentration in General Engineering Technology. Many students have technical career goals in business and industry areas that do not involve a professional license. For career and development in these technology driven fields, it is often essential to complete a bachelors degree program. The diverse technical education background and career goals of these students require a program with a career focus and the BSET with a concentration in General Engineering Technology (GET) meets this educational need. One of the GET option areas is Geomatics.

The Surveying Engineering and Geomatics Program at ODU

Success in the field of surveying engineering and geomatics requires understanding of the science and technology required to bring together the many forms of earth measurement data. It includes the collection, sorting, analysis, management, storage, and presentation methodologies for these earth-related spatial data. The use of data has applications in a wide range of disciplines and professions. The technology overlaps a broad group of related fields including surveying, mapping, land division and registration, civil engineering, project engineering, natural resource management, infrastructure engineering, geography, and agriculture. The Geomatics program courses provide the broad skill set required for both long-term advancement and entry-level success. Students learn by examining problems and issues based on current technologies and concepts. Additionally, the program is structured to permit extensive focus on cross-discipline skills such as computers and data management, engineering, the sciences, GIS applications, and geography. The GET option in Geomatics supports careers in a wide range of private and government enterprises such as surveying, engineering and design firms, state Departments of Transportation and resource management agencies, and federal agencies such as NOAA, NGS, Forest Service, Homeland Security, and FEMA. Graduates of the Geomatics option pursue careers as land surveyors, land developers, photogrammetrists, GIS and remotely-sensed data specialists, project managers, and field engineers.

Degree Completion Options

Engineering Technology students may pursue their studies on the main campus in Norfolk in a traditional four-year program of study. Alternatively, some students elect to complete an Associate in Applied Science (AAS) degree in a community college and finish the last two years of baccalaureate study either on campus or through the ODU TELETECHNET System. ODU is a national leader in distance learning. For career and family bound students, who are not able to come to the main campus to complete their degree, the ODU TELETECHNET system is an alternative. Through this system, courses are delivered to sites at community colleges, industry locations in Virginia and across the nation, and directly to students at home or in the work place. There are three primary methods of course delivery:

- Satellite video - courses are delivered to sites at community colleges, industry locations in Virginia and across the nation
- Streaming video allows students on high - speed Internet connections at home or at work to participate in live class sessions or to receive archived class lectures.
- CD-ROM/DVD instruction is used to provide supporting information related to lectures delivered by satellite or streaming video, 'virtual labs', and other materials such as specialized software. When students miss class due to travel or business, these methods allow taped or digitized copies of class to be available for viewing at a later time.

In all cases, distance students maintain close interaction with faculty by a number of means including telephone, email, and internet bulletin boards. Using TELETECHNET, it is possible for distance students to complete the technical content of the BS in ET in three years from AAS completion depending on the semester load taken.

The Previous Program's Curriculum

Prior to the 2004 academic year [Ref.4], the surveying engineering course list included the following :

CET 305	Principles of Surveying
CET 313	Advanced Surveying
CET 314	Boundary and Mock Trial Law
CET 318	GPS and Control Surveying
CET 411	Photogrammetry and Remote Sensing
CET 412	Route & Construction Surveying
CET 413	Elements of GIS
CET 415	GIS/GPS Impacts on Boundary Law
CET 425	Land Design and Site Development
CET 475W	Senior Project

A quick look at aforementioned course list shows redundancy and great emphasis on land surveying. There were no electives at. A student in the CET-Surveying program had no choices and/or options of what courses to take and what to leave. The analysis of course syllabi revealed that course material concentration is redundant in many aspects; yet it lacked some essential courses, such as a course in Adjustment Computations, needed by every

practicing surveyor to adjust his/her fieldwork and bring it to the acceptable standards of the practice and the required specifications of the client.

Furthermore, the course list lacked a separate course in geodetic surveying. As seen too, it lacked giving enough emphasis on modern fields of geomatics, such as photogrammetry, remote sensing and GIS. There was no advanced course in photogrammetry or a separate course in remote sensing. Talking about redundancy, it was concluded that two of the courses in this list could easily be combined with other courses and/or totally removed without any adverse effect. These are CET 412 (Route and Construction Surveying), CET 415 (GIS/GPS Impacts on Boundary Law).

The New Program's Curriculum

In 2003 a committee headed by the first author conducted a comprehensive review of the current state of the practice in the various fields of geomatics, a study of the current job market needs on the state and national levels, a detailed comparison against the nationally [Ref. 1 & 5] and internationally-renowned geomatics programs [Ref. 6, 7, 8 & 9] and finally, the recommendations of the program's board of advisors. There were many issues to be considered [Ref.2] and challenges to overcome. In comparison to the other programs [Ref. 1, 5, 6, 7, 8 &9], it was found that each of these programs provide a more comprehensive courses of study that cover more areas in the field of geospatial information engineering and/or geomatics. However, they have more resources, especially in the number of faculty members. In comparison the ODU program [Ref. 2] was mostly a Land Surveying program with only two full-time faculty members. One of the main challenges was to produce a major course change that could still be handled by the available resources (two to three faculty members and the current computer and lab equipment). The result was a new course list [Ref. 3] that covered all aspects of land surveying and geomatics, but could still be handled by two faculty members, offering four courses in surveying engineering and geomatics per semester. This list could also be handled by two full time faculty members with a course repeating cycle that enables a student to cover his/her choice of courses in a timely manner. CET 412 and CET 415 were eliminated from the old list. Topics covered in the two courses were added to those covered in CET 313 and CET 314 respectively. Four brand new courses were created and added to the curriculum. Those are CET 320 (Adjustment Computations), CET 416 (Geodetic and Astronomical Surveying), CET 421 (Advanced Analytical and Digital Photogrammetry) and CET 422 (Remote Sensing). The effort of the committee also resulted in the creation of two CET minor programs in surveying and geomatics. Those are a Minor in Land Surveying and another Minor in Photogrammetry. The new course list then and the suggested minor programs then went through the due process for approval by the course committee at ODU. The list and the two minor programs were approved and were quickly adopted starting in the fall semester of 2004. The new course list includes the following:

CET 305	Principles of Surveying
CET 313	Advanced Surveying
CET 314	Boundary Law

CET 318	GPS & Control Surveying
CET 320	Adjustment Computations
CET 411	Photogrammetry
CET 413	Elements of Geographic Information Systems (GIS)
CET 416	Geodetic and Astronomical Surveying
CET 421	Advanced Analytical and Digital Photogrammetry
CET 422	Remote Sensing
CET 425	Land Design and Site Development
CET 475W	Senior Project

Two Course Sequences

In addition to the creation of two minor programs in surveying and geomatics, the new course offerings enable an ODU student to tailor his/her route through the program. According to his/her interests and needs, the student can now select between a land surveying course sequence, or a modern geomatics (photogrammetry, GIS and remote sensing). The way it works as follows, If CET 475 is excluded, there are eleven courses in the list. Out of them only three courses are compulsory. Those are CET 305, CET 320, and CET 425. Thereafter, a student picks any other five courses that fit his/her interest and/or future objectives. If a student wants to become a land surveyor, he or she can pick a land surveying sequence, which would include CET 305, CET 313, CET 314, CET 318, CET320, CET 416, and CET 425. Meanwhile, if a student wants to become a Photogrammetrist, he/she would pick a different course sequence that includes CET 305, CET 318, CET 320, CET 411, CET 413, CET 421, CET 422, and CET425. Obviously, a student is also given the choice of not picking a course sequence, if he/she has no specific interest and/or interested in covering every thing. Table 1 shows an ideal course plan of study for a student civil engineering technology student majoring in Surveying and Geomatics, and Table 2 shows the long-term schedule of course offerings in the civil engineering technology, including surveying and geomatics courses and other courses.

CET Minor in Surveying and Geomatics

Starting in the Fall semester of 2004, students from outside the engineering technology department at ODU could pursue a minor program of study in geomatics. To earn that minor, a student needs to successfully complete twelve credits in an area of emphasis of his/her choice. As mentioned before, the areas of emphasis include Land Surveying or Photogrammetry. To complete a minor in Land Surveying, a student must complete the following courses: CET 305, CET 320, CET 313 and (CET 318 or CET 416). To complete a minor in photogrammetry, a student must complete the following courses: CET 305, CET 320, CET 411 and CET 421

Preliminary Results of this Modernization

Changes were enacted in the Fall semester of 2004. At the time of publishing this paper, the impact of this course change on the ODU surveying and geomatics program is currently an ongoing process. Thus far, the sensed impact is very positive. Since the employment of the demonstrated changes, student enrollment in the surveying and geomatics program has increased by at least 33% over what used to be the norm. Course evaluation data that the authors have accumulated since the fall of 2004 indicate that students are very satisfied with new courses. On average, student evaluations for the new courses are also about 33% higher than their satisfaction levels with the old courses. The data also indicate between 15% and 25% increase in student satisfaction with the quality of teaching they receive from their instructors.

Conclusions

The new surveying and geomatics curriculum was meant to provide ODU students with the broader knowledge and superior skills in the various fields of surveying engineering and geomatics. This change was also meant to increase a student's employment potential and equips him/her with all the means to succeed in the workplace whether as an employee or even as a business owner.

Preliminary results and evaluation of the impact of the course modernization process are very encouraging. Nevertheless, with the pass of time and accumulation of more course evaluation data from the students and evaluation data from the industry that hires those students, more solid conclusions about the impact of the demonstrated course modernization will be drawn.

Table 1: Ideal plan of study for a student a CET student majoring in Surveying and Geomatics.

CET Option in Surveying and Geomatics

Course Number	Course Title	Credits
Freshmen first semester (15 credits)		
MET 100	Engineering Graphics	3
ENGN 110	Freshman Engineering and Technology I	2
MATH 162M	Precalculus I	3
CHEM 115N	Foundations of Chemistry	4
ENGL 110C	English Composition	3
Freshmen second semester (15 credits)		
MET 230	Computer Aided Drafting	3
ENGN 111	Freshman Engineering and Technology II	2
MATH 163	Precalculus II	3
PHYS 111N	General Physics I	4
Gen Ed Literature Perspective (L)		3
Sophomore first semester (17 credits)		
CET 200	Statics	3
MATH 212	Calculus I	4
PHYS 112N	General Physics II	4
ENGL 131C	Technical and Scientific Writing	3
Gen Ed Social Science Perspective (S)		3
Sophomore second semester (16 credits)		
CET 220	Strength of Materials	3
CET 305	Principles of Surveying	3
CET 345	Material Testing Laboratory	1
COMM 101R	Public speaking	3
CET 310	Fundamentals of Building Construction	3
CET 320	Adjustment computations	3
Junior first semester (16 credits)		
CET	Surveying Elective	3
MET 330	Fluid Mechanics	3
MET 335	Fluid Mechanics Laboratory	1
** Upper Division Cluster or Minor		3
CET	Surveying Elective	3
Gen Ed Philosophy Perspective (P)		3
Junior second semester (17 credits)		
CET 340	Soils and Foundations	3
CET 341	Soils Testing and Inspection	1
FIN 331	Legal Environment and Business	3
MET 310	Dynamics	3
CET	Surveying Elective	3
EET 305	Advanced Technical Analysis	4
Senior first semester (15 credits)		
CET	Surveying Elective	3
CET 420	Hydrology and Drainage	3
**Upper division Cluster or Minor		3
Gen Ed History Perspective (H)		3
ENMA 302	Engineering Economics	3
Senior second semester (16 credits)		
CET	Surveying Elective	3
CET 425	Land Design	3
CET 475W	Senior Design Project	3
**Upper division Cluster or Minor		3
Gen Ed Fine and Perf. Arts Perspective (A)		3
ENGN 401	FE Review	1
	Total Credits	127

Note: Does not include the University's General Education foreign language requirement. Additional credits may be required.

** One or more additional courses will be required to complete the minor. See advisor for details.

Table 2: The long-term schedule of course offerings in the civil engineering technology, including surveying and geomatics courses and other courses.

<u>CET LONG RANGE SCHEDULE</u>									
Course	Fall 2004	Spr 2005	Sum 2005	Fall 2005	Spr 2006	Sum 2006	Fall 2006	Spr 2007	Sum 2007
CET 200	C	C	C	C	C	C	C	C	C
CET 220	C	C	C	C	C	C	C	C	C
CET 301	T			S			T		
CET 305	T	T		S	T		T	T	
CET 310	S			T			S		
CET 313				T				T	
CET 314		T					T		
CET 318	T			T			T		
CET 319		C			C			C	
CET 320			T		T				T
CET 340		T			C			T	
CET 341		C, V			C			C, V	
CET 345	C	C	V	C	C	V	C	C	V
CET 360		C			T			C	
CET 400		S			T			S	
CET 410		T			S			T	
CET 411					T				
CET 413	T				T				
CET 416				T					
CET 420				T					
CET 421	T						T		
CET 422		T						T	
CET 425		T						T	
CET 440	T						T		
CET 445		S			T			S	
CET 450	S		T				S		T
CET 452				S					
CET 460	S			T			S		
CET 465				S		T			
CET 475W	S	S		S	S		S	S	

C- Campus Only
T- Televised and streaming video
S - Streaming video
V - Virtual laboratory

*All televised and streaming video courses have an on campus section. Streaming video courses are also broadcast to ODU Higher Education Centers.

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9. The course listing and description URL of Civil and Environmental Engineering Department, University of Wisconsin-Madison, <http://courses.engr.wisc.edu/cee/>

Biographies

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