

The Modernization of the Surveying Engineering Program at Old Dominion University

Nidal Dahman
Dept. of Engineering Technology
Old Dominion University
ndahman@odu.edu

Anthony W. Dean
Dept. of Engineering Technology
Old Dominion University
adean@odu.edu

Isaac L. Flory IV
Dept. of Engineering Technology
Old Dominion University
iflory@odu.edu

Wes Lewis
Dept. of Engineering Technology
Old Dominion University
wlewis@odu.edu

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.

Acknowledgement

This paper was inspired by a similar paper published by the authors' friends at East Tennessee State University [Ref. 1].

References

1. Ali, A. A., Nave J. W. and Clark, M. M., "A New Bachelor Degree Curriculum at East Tennessee State University," *Surveying and Land Information Science*, Vol. 65, No. 3, 2005, pp. 195-200.
2. Burkholder, E. F. "Geomatics Curriculum Design Issues," *Surveying and Land Information Science*, Vol. 65, No. 3, 2005, pp. 151-157.
3. Dahman, N. A., "A course Change Proposal," a proposal manuscript submitted to the Chairman of the Engineering Technology Department, Old Dominion University, College of Engineering, 2003.
4. ODU (Old Dominion University). The 2002 Surveying Engineering and Geomatics Program Curriculum.
5. California State University at Fresno, Geomatics Engineering program <http://www.csufresno.edu/geomatics/Home.html>
6. The University of Florida Geomatics program course listing and descriptions URL, <http://www.surv.ufl.edu/programs/undergrad.htm>
7. The course listing URL of the Department of Civil and Environmental Engineering and Geodetic Science, The Ohio State University, <http://www-ceg.eng.ohio-state.edu/GSGRADUATE/index.php>
8. The course listing and plan of study URL of the School of Civil Engineering, Purdue University, <https://engineering.purdue.edu/CE/Academics/Undergraduate/PlanStudy/>
9. The course listing and description URL of Civil and Environmental Engineering Department, University of Wisconsin-Madison, <http://courses.engr.wisc.edu/cee/>

Biographies

NIDAL DAHMAN is currently the coordinator of the surveying engineering and Geomatics program at ODU. He holds a Ph.D. in civil and environmental engineering from the University of Wisconsin-Madison. He is a certified Photogrammetrist by the American society of photogrammetry and remote sensing (ASPRS) he is also an ASPRS-certified Remote Sensing Mapping Scientist and an ASPRS-Certified GIS/LIS mapping scientist. His research interests are modern geomatics, digital photogrammetry, active and passive remote sensing and in modern sensors and sensor data fusion.

ANTHONY W. DEAN is Assistant Professor of Engineering Technology at Old Dominion University. He received a Ph.D. in Engineering Management and a B.S. in Engineering Technology from ODU. Additionally, Dr. Dean received an MBA from the College of William and Mary. Prior to his appointment, Dr. Dean was Director of Operations and Business Development for Clark-Smith Associates, P.C., and served as an Electrician in the U.S. Navy aboard the USS South Carolina and the USS Enterprise.

ISAAC L. FLORY IV is an Assistant Professor of Engineering Technology at Old Dominion University, teaching courses in power distribution, energy conversion, electronics and technical analysis. He has received B.S. (1984) and M.S. (1993) degrees in Electrical Engineering from Virginia Tech and is currently pursuing his Doctorate from the same institution (a.b.d.). He served in many positions as an employee of Hubbell Lighting Incorporated including Manager of Electrical Engineering and Intellectual Property Coordinator. He has been awarded 25 United States Patents and is a licensed Professional Engineer in the Commonwealth of Virginia.

WES LEWIS is Senior Lecturer and Program Director of the Civil Engineering Technology Program at Old Dominion University. He has received both a BS and MS in Civil Engineering from Old Dominion University. A licensed Professional Engineer in several states, Mr. Lewis is in strong demand both as a lecturer and consultant in the Mid-Atlantic Region.