AC 2011-2819: PROVIDING TECHNICAL FLEXIBILITY TO A CIVIL ENGINEERING TECHNOLOGY PROGRAM

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Professor Timothy Zeigler has been Chair of the Civil Engineering Technology Department at Southern Polytechnic State University since 1997 and is a PE and an active member of ASCE and ASEE-ETD. Professor Zeigler has served ASEE-ETD in the past as Newsletter Editor, Treasurer, Vice-Chair and Assistant Vice-Chair of Programs, and Editor-in-Chief (and other editorial board positions) of the Journal of Engineering Technology. As a member of ASCE Professor Zeigler is an accreditation program evaluator and a member and past chair of the ASCE Curricula and Accreditation Board for Engineering Technology. Professor Zeigler is presently a commissioner on the Technology Accreditation Commission (TAC) of ABET and is presently a member of the ABET-TAC Executive Committee. Professor Zeigler received a BS and MS in Civil Engineering from the University of Illinois in 1968 and 1969 respectively.
Recent approval of engineering degrees at Southern Polytechnic State University has prompted the Civil Engineering Technology (CET) Department to review its B.S. Civil Engineering Technology curriculum to differentiate its course offerings and contents from those of the Engineering Division. The new curriculum is believed to provide technical flexibility and introduces the students to standard practices in different aspects of the civil engineering practice. This paper discusses changes proposed and approved to the civil engineering technology program.

Background

Prior to the 2009-2010 academic year the Board of Regents of the Georgia University System approved for Southern Polytechnic State University to offer undergraduate degrees in civil, electrical and mechanical engineering; in addition to previously approved degrees in construction and mechatronics engineering. In order to provide a broader and practical engineering technology curriculum that will embrace the Vision for Civil Engineering in 2025 to “create a sustainable world and enhance the global quality of life”; the faculty of the CET department proposed to modify the existing sequence and content of courses in the civil engineering technology program to highlight technical application and standard practice.

The CET faculty was charged to make changes to the curriculum to satisfy the requirements of the Board of Regents for general education in baccalaureate degrees, while maintaining the quality of the program that meets the needs of the industry. Since the technical demands in the civil engineering profession have seemed to increase as the deteriorating infrastructure of the nation is in need of major improvements, as documented by ASCE in the Report Card for American Infrastructure, the CET faculty proposed the creation of technical concentrations in the program.

To understand the changes introduced to the academic program, it is necessary to start the discussion with the existing curriculum. The Board of Regents of the Georgia University System in 1996 set the number of credit hours for engineering and engineering technology at 129 hours, of which 60 credit hours include social sciences, science, mathematics, humanities, fine arts, and some major related basic courses. The remaining credit hours represent the technical core of the engineering technology programs. The subsequent section discusses the specific changes introduced to the program to provide the flexibility envisioned by the faculty.

Civil Engineering Technology Curriculum (2009 – 2010)

The prior (2009 – 2010) civil engineering technology curriculum was structured in a way that all the students had to take at least one upper level class in structural design, transportation, soil mechanics, environmental engineering, and thermodynamics or electrical principles. In addition to the required courses, students had the opportunity of taking 12 hours of elective courses to satisfy the graduation requirements. The students could select technical electives from five...
different areas, environmental, geotechnical, structural, surveying and transportation, or a

general path. The 2009-2010 curriculum for the civil engineering technology program is

presented in Table 1. This 2009 – 2010 CET curriculum (and the CET curricula of prior years)

had always been considered a strong program with rigor, theory and application similar to

traditional civil engineering programs. With the new “civil engineering” program now being

offered at Southern Polytechnic State University, students did not have a distinct choice in

content and emphasis between civil engineering and civil engineering technology programs.

Thus the development of the 2010-2011 CET curriculum was essential to maintain student

interest in technology and meet industry needs.

Civil Engineering Technology Curriculum (2010 – 2011)

The CET faculty proposed modifications to the curriculum to provide technical flexibility and

introduce students to different aspects of the civil engineering practice. These modifications

included revisions of course contents, redefinition of learning outcomes and implementation of

new courses and specialty areas or concentrations to meet industry needs. Significant

modifications made to the technical core include the creation of a problem solving methods

course, and the requirement of two structural design courses (applied structural steel design and

concrete infrastructure design, two environmental engineering courses (water treatment and

distribution; and wastewater collection and treatment), two geotechnical courses (soil properties

and site exploration; and foundation and retaining wall design); and the addition of a course in

geographic information systems I. In total five distinct concentration areas were created, while

maintaining the general path. These concentration areas were created using existing elective

courses plus five new elective courses. The proposed curriculum was approved by the

undergraduate curriculum committee for implementation in the 2010-2011 academic year. The

new curriculum for the civil engineering technology program is presented in Table 2.

The new curriculum in its required technical core provides the students with academic

background to perform analysis and design in three areas of civil engineering, and allows them to

select a concentration to enhance their knowledge in specific subjects. Courses were modified to

provide more emphasis on practice and application of technology. Laboratory experiences were

added to several courses to provide time for added learning in standard design, testing and

technology application

Industrial Advisory Board Input.

The concept of the new curriculum was first presented to the CET Industrial Advisory Board

(IAB) in late Fall 2009 to solicit input on content and objectives. The IAB was influential in

ultimately choosing the “concentration” format. They also provided recommendations on

content to make CET different from civil engineering, while enhancing value of the graduates to

the industry. Full implementation of the new curriculum began in fall 2010 with complete

approval of the IAB. Since its implementation, students in the program have commented that

they like the available concentrations. Note that completion and name of the concentration does

appear in a student graduation transcript.
Table 1. Southern Polytechnic State University  
B.S. Civil Engineering Technology  
2009 – 2010 Curriculum

<table>
<thead>
<tr>
<th>UNIVERSITY CORE</th>
<th>CET MAJOR CORE</th>
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<tbody>
<tr>
<td><strong>Area A. Essential Skills</strong> (9 hr.)</td>
<td>CET REQUIRED COURSES 58 hr</td>
</tr>
<tr>
<td>ENGL 1101</td>
<td>CE 1000 – Orientation to Profession 1</td>
</tr>
<tr>
<td>ENGL 1102</td>
<td>CET 1002 – CET Computer Practices 1</td>
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<tr>
<td>MATH 1113</td>
<td>ENGR 2214 - Engineering Mechanics - Statics 3</td>
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<td></td>
<td>CET 2215 – Engineering Mechanics - Dynamics 2</td>
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<tr>
<td></td>
<td>ENGR 3131 - Strength of Materials 4</td>
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<td></td>
<td>CET 3301 - Soil Mechanics 4</td>
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<td></td>
<td>CET 3302 – Construction Materials 4</td>
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<td></td>
<td>CET 3316 – Structural Analysis 4</td>
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<td></td>
<td>CET 3321 – Transportation Systems 4</td>
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<td>CET 3324 – Project Cost Analysis 4</td>
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<td></td>
<td>CET 3343 – Fluid Mechanics 4</td>
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<td></td>
<td>CET 3344 – Fundamentals of Environmental Eng. Tech. 4</td>
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<td></td>
<td>CET 3371 – Steel Design or CET 3381 Reinforced Concrete Design 3</td>
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<td></td>
<td>CET 4444 – Hydrology 4</td>
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<td></td>
<td>CET 4480 – Senior Project 4</td>
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<td>SURV 2221 – Surveying I 4</td>
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<td></td>
<td>CET 3000 – Electrical Principles or MET 3400 – Survey of Thermodynamics or MET 3401 – Thermodynamics I 3</td>
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<td>CET ELECTIVES (3000-4000 level) 12 hr</td>
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<td>CET Elective ________________</td>
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<td><strong>Area B. Institutional Option</strong> (4 hr.)</td>
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<td>COMM 2400</td>
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<td>STS 2400</td>
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<td><strong>Area C. Humanities/Fine Arts</strong> (6 hr.)</td>
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<tr>
<td>ENGL Literature</td>
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<td><strong>Area D. Science, Math, Technology</strong> (11 hr.)</td>
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<tr>
<td>BIOL 2107 k or 2108 k, or CHEM 1211 k or 1212 k, or PHYS 1112 k, 2211 k or 2212k</td>
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<tr>
<td>MATH 2253</td>
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<tr>
<td><strong>Area E. Social Sciences (one from each group) 12 hr</strong></td>
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<tr>
<td>G1. HIST 2111, 2112, POLS 1101</td>
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<td>G2. HIST 1011, 1012, 1013, 1111, 1112</td>
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<td>G3. ECON 1101, PYSC 1101</td>
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<td>G4. ANTH 1102, ES 1100, GEOG 1101, POLS 2401, RELG 1200</td>
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<tr>
<td><strong>Area F. Core Related to Major</strong> (18 hr.)</td>
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<tr>
<td>EDG 2160 – Civil Graphics/CAD</td>
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<tr>
<td>MATH 2306 – Differential Equations</td>
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<tr>
<td>MATH 2260 – Probability and Statistics I</td>
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<tr>
<td>MATH 2254 – Calculus II</td>
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<tr>
<td>PHYS 2211 k – Principles of Physics I</td>
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<tr>
<td>Math excess from Area A</td>
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<tr>
<td>TOTAL UNIVERSITY CORE 60 hr</td>
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</tbody>
</table>

2 CET students MUST take CHEM 1211 k as part of Area D  
3 1 hr. of MATH 2253 will be counted in Major  
4 Math excess from Area D  
5 Excess from ECET 3000 (if completed)  
6 CET Elective ________________  
7 CET Elective ________________  
8 CET Elective ________________  
9 CET Elective ________________  
10 CET Elective ________________  
11 CET Elective ________________  
12 CET Electives are CET or SURV 3xxx or 4xxx courses which are not required for the CET degree  
13 Environmental : CET 4354 Unit Operations 4  
14 CET 4374 Solid Waste Management 3  
15 CET 4484 Hydraulic Analysis and Design 4  
16 Structural : CET 3371 or 3381 if not chosen under major 4  
17 CET 4371 Concrete Design II 4  
18 CET Computer Methods in Structures 4  
19 Surveying: Up to 6 hours of SURV 3xxx or 4xxx 6  
20 Transportation: CET 4331 Highway Design 4  
21 CET 4450 Pavement Design 4  
22 CET 4471 Transportation Network Design 4  
23 Geotechnical: CET 4418 Engineering Geology 3  
24 CET 4415 Foundation Design 3  
25 Ethics: CET 4402 Engineering Ethics 1  
26 General: MGNT 3105 Management and Org. Behavior 3  
27 CET 4405 Mathematical Modeling in CET 3
### UNIVERSITY CORE

**Area A. Essential Skills**
- **ENGL 1101** 3
- **ENGL 1102** 3
- **MATH 1113** 4

**Area B. Institutional Option**
- **COMM 2400** 2
- **STS 2400** 2

**Area C. Humanities/Fine Arts**
- **ENGL Literature** 3
- **FREN, GER, SPAN 1002** 3

**Area D. Science, Math, Technology**
- **CHEM 1211 k** 4
- **PHYS 2211 k** 4
- **MATH 2253** 4

**Area E. Social Sciences (one from each group)**
- **HIST 2111, 2112, POLS 1101** 3
- **HIST 1011, 1012, 1013, 1111, 1112** 3
- **ECON 1101, PYSC 1101** 3
- **ANTH 1102, ES 1100, GEOG 1101, POLS 2401, RELG 1200** 3

**Area F. Core Related to Major**
- **EDG 2160 – Civil Graphics/CAD** 3
- **MATH 2306 – Differential Equations** 3
- **ENGR 2214 – Engineering Mechanics – Statics** 3
- **MATH 2254 – Calculus II** 4
- **CET 2110 – Problem Solving Methods in CET** 3
- **MATH 2253** 4

| **TOTAL UNIVERSITY CORE** | **60 hr** |

### CET MAJOR CORE

**CET REQUIRED COURSES**
- **CE 1000 – Orientation to Profession** 1
- **ENGR 3131/3132 - Strength of Materials** 4
- **CET 3410 - Soil Properties and Site Exploration** 4
- **CET 3110 - Construction Materials and Sustainability** 4
- **CET 3210 – Structural Mechanics** 3
- **CET 3120 – Cost Est. and Scheduling in CET** 4
- **CET 3130 – Applied Fluid Mechanics & Hydraulics** 3
- **CET 3310 – Water Treatment and Distribution** 3
- **CET 3320 – Wastewater Collection and Treatment** 3
- **CET 3220 – Applied Structural Steel Design** 3
- **CET 3230 – Concrete Infrastructure Design** 3
- **CET 4310 – Stormwater Mgt. and Erosion Control** 3
- **CET 3510 – Traffic Analysis and Road Design** 3
- **CET 4410 – Foundation and Retaining Wall Design** 3
- **CET 4110 – Ethics of Engineering** 1
- **CET 4120 – Senior Project** 3
- **CET/SURV 3xxx or 4xxx (not in CET required core)** 3

**CET PROGRAM CONCENTRATIONS (12 hr. min.)**
Choose one concentration
- **MGNT 3105 Mgt. and Org. Behavior can be taken in any concentration**

**General Civil Engineering Technology**
- **MGNT 3105 – Management and Org. Behavior** 3
- **CET 4xxx – Civil Software Applications** 3
- **CET/SURV 3xxx or 4xxx (not in CET required core)** 6 max
- **ECET 3000 or MET 3400 or MET 3401** 3 or 4

**Environmental Engineering Technology**
- **CET 4320 – Unit Operations in Env. Engineering** 4
- **CET 4330 – Solid Waste Management** 3
- **CET 4340 – Air Pollution Control** 3
- **CET 3xxx or 4xxx (not in CET required core)** 3

**Structural Engineering Technology**
- **CET 4220 – LRFD Steel Design** 4
- **CET 4230 – Advanced Concrete Design** 4
- **CET 4210 – Computer Methods in Structures** 4
- **CET 3xxx or 4xxx (not in CET required core)** 3

**Geotechnical Engineering Technology**
- **CET 3xxx – Geosynthetics** 3
- **CET 4xxx – Earth Dam and Levee Design** 3
- **CET 4xxx – Slope Stability** 3
- **CET 3xx or 4xxx (not in CET required core)** 3

**Transportation Engineering Technology**
- **SURV 3222 – Surveying II** 4
- **CET 4510 – Transportation Network Design** 4
- **CE 4706 – Pavement Design** 3
- **CET 3xxx or 4xxx (not in CET required core)** 3

**Surveying and Mapping**
- **SURV 3222 – Surveying II** 4
- **SURV 4470 – Land Development Design** 4
- **CET 3xxx or 4xxx (not in CET required core)** 4

| **TOTAL CET MAJOR CORE** | **68 hr** |
Bibliography

1 http://www.asce.org, consulted February 24, 2011
2 http://www.usg.edu/academic_affairs_handbook/section2, consulted March 7, 2011
3 http://www.infrastructurereportcard.org/fact-sheet/roads, consulted February 24, 2001
4 http://www.infrastructurereportcard.org/fact-sheet/drinking-water, consulted February 24, 2011
5 http://www.infrastructurereportcard.org/fact-sheet/wastewater, consulted February 24, 2011