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

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Providing Technical Flexibility to a Civil Engineering Technology Program

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”¹; 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 degrees², 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^{3,4,5}, 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 courses². 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 curriculum⁶ 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**

UNIVERSITY CORE		CET MAJOR CORE	
<u>Area A. Essential Skills (9 hr.)</u>		CET REQUIRED COURSES	
ENGL 1101	3	³ Math excess from Area D	1
ENGL 1102	3	CE 1000 – Orientation to Profession	1
¹ MATH 1113	4	CET 1002 – CET Computer Practices	1
<u>Area B. Institutional Option (4 hr.)</u>		ENGR 2214 - Engineering Mechanics - Statics	3
COMM 2400	2	CET 2215 – Engineering Mechanics - Dynamics	2
STS 2400	2	ENGR 3131 - Strength of Materials	4
<u>Area C. Humanities/Fine Arts (6 hr.)</u>		CET 3301 - Soil Mechanics	4
ENGL Literature	3	CET 3302 – Construction Materials	4
ARTS 2001, 2002, 2003, 2004 or FREN, GER, SPAN 1002	3	CET 3316 – Structural Analysis	4
<u>Area D. Science, Math, Technology (11 hr.)</u>		CET 3321 – Transportation Systems	4
² BIOL 2107 k or 2108 k, or		CET 3324 – Project Cost Analysis	4
CHEM 1211 k or 1212 k, or		CET 3343 – Fluid Mechanics	4
PHYS 1112 k, 2211 k or 2212k	8	CET 3344 – Fundamentals of Environmental Eng. Tech.	4
³ MATH 2253	4	CET 3371 – Steel Design or CET 3381 Reinforced Concrete Design	3
<u>Area E. Social Sciences (one from each group)</u>		CET 4444 – Hydrology	4
G1. HIST 2111, 2112, POLS 1101	3	CET 4480 – Senior Project	4
G2. HIST 1011, 1012, 1013, 1111, 1112	3	SURV 2221 – Surveying I	4
G3. ECON 1101, PYSC 1101	3	⁴ ECET 3000 – Electrical Principles or MET 3400 – Survey of Thermodynamics or MET 3401 – Thermodynamics I	3
G4. ANTH 1102, ES 1100, GEOG 1101, POLS 2401, RELG 1200	3	⁵CET ELECTIVES (3000 - 4000 level)	
<u>Area F. Core Related to Major (18 hr.)</u>		⁴ Excess from ECET 3000 (if completed)	
EDG 2160 – Civil Graphics/CAD	3	CET Elective _____	
MATH 2306 – Differential Equations	3	CET Elective _____	
MATH 2260 – Probability and Statistics I	3	CET Elective _____	
MATH 2254 – Calculus II	4	CET Elective _____	
PHYS 2211 k – Principles of Physics I	4	CET Elective _____	
¹ Math excess from Area A	1	TOTAL CET CORE	
TOTAL UNIVERSITY CORE		70 hr	
² CET students MUST take CHEM 1211 k as part of Area D		⁵ CET Electives are CET or SURV 3xxx or 4xxxx courses which are not required for the CET degree	
³ 1 hr. of MATH 2253 will be counted in Major		<i>Environmental</i> : CET 4354 Unit Operations	
			4
			3
			4
		<i>Structural</i> : CET 3371 or 3381 if not chosen under major	4
		CET 4371 Concrete Design II	4
		CET Computer Methods in Structures	4
		<i>Surveying</i> : Up to 6 hours of SURV 3xxx or 4xxx	6
		<i>Transportation</i> : CET 4331 Highway Design	4
		CET 4450 Pavement Design	4
		CET 4471 Transportation Network Design	4
		<i>Geotechnical</i> : CET 4418 Engineering Geology	3
		CET 4415 Foundation Design	3
		<i>Ethics</i> : CET 4402 Engineering Ethics	1
		<i>General</i> : MGNT 3105 Management and Org. Behavior	3
		CET 4405 Mathematical Modeling in CET	3

**Table 2. Southern Polytechnic State University
B.S. Civil Engineering Technology
2010 – 2011 Curriculum**

UNIVERSITY CORE		CET MAJOR CORE	
<u>Area A. Essential Skills</u>		<u>9 hr</u>	CET REQUIRED COURSES
ENGL 1101	3	CE 1000 – Orientation to Profession	1
ENGL 1102	3	ENGR 3131/3132 - Strength of Materials	4
¹ MATH 1113	4	CET 3410 - Soil Properties and Site Exploration	4
		CET 3110 - Construction Materials and Sustainability	4
<u>Area B. Institutional Option</u>		<u>4 hr</u>	CET 3210 – Structural Mechanics
COMM 2400	2	CET 3120 – Cost Est. and Scheduling in CET	4
STS 2400	2	CET 3130 – Applied Fluid Mechanics & Hydraulics	3
		CET 3310 – Water Treatment and Distribution	3
<u>Area C. Humanities/Fine Arts</u>		<u>6 hr</u>	CET 3320 – Wastewater Collection and Treatment
ENGL Literature	3	CET 3220 – Applied Structural Steel Design	3
ARTS 2001, 2002, 2003, 2004 or		CET 3230 – Concrete Infrastructure Design	3
FREN, GER, SPAN 1002	3	CET 4310 – Stormwater Mgt. and Erosion Control	3
		CET 3510 – Traffic Analysis and Road Design	3
<u>Area D. Science, Math, Technology</u>		<u>11 hr</u>	CET 4410 – Foundation and Retaining Wall Design
CHEM 1211 k	4	CET 4110 – Ethics of Engineering	1
PHYS 2211 k	4	CET 4120 – Senior Project	3
² MATH 2253	4	SURV 2221 – Surveying I	4
		SURV 3421 – Geographic Information Systems I	4
<u>Area E. Social Sciences (one from each group)</u>		<u>12 hr</u>	CET PROGRAM CONCENTRATIONS (12 hr. min.)
G1. HIST 2111, 2112, POLS 1101	3	Choose one concentration	
G2. HIST 1011, 1012, 1013, 1111, 1112	3	MGNT 3105 Mgt. and Org. Behavior can be taken in any concentration	
G3. ECON 1101, PYSC 1101	3	General Civil Engineering Technology	
G4. ANTH 1102, ES 1100, GEOG 1101, POLS 2401, RELG 1200	3	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
<u>Area F. Core Related to Major</u>		<u>18 hr</u>	ECET 3000 or MET 3400 or MET 3401
EDG 2160 – Civil Graphics/CAD	3	Environmental Engineering Technology	
MATH 2306 – Differential Equations	3	CET 4320 – Unit Operations in Env. Engineering	4
ENGR 2214 – Engineering Mechanics – Statics	3	CET 4330 – Solid Waste Management	3
MATH 2254 – Calculus II	4	CET 4340 – Air Pollution Control	3
CET 2110 – Problem Solving Methods in CET	3	CET 3xxx or 4xxx (not in CET required core)	3
¹ Math excess from Area A	1	Structural Engineering Technology	
² Math excess from Area D	1	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
TOTAL UNIVERSITY CORE	60 hr	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, 2011
- 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