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From Engineering Technology Undergraduate to Graduate Engineering Studies

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This paper describes the Bachelor of Electrical Engineering Technology degree curriculum with minor in mathematics from the State University of New York at Canton, and how it can enhance student ability in the pursuit of graduate study in Electrical Engineering.

Many Engineering Technology programs have four or five levels of mathematics which are: College Algebra or Pre-Calculus, Calculus I, Calculus II, Differential Equations and Calculus III. Some do not require Calculus III, but others do. For a graduate to be able to continue his/her education at the graduate level in Engineering and not in Engineering Technology, they need to demonstrate competency in mathematics. Some students when admitted into graduate Engineering program, may have to take few more undergraduate mathematics courses. Those Engineering Technology graduates who are hired as Engineers may have limited design and analytical skills to compete with those graduates with Electrical Engineering degrees.

The mathematics requirements in the Electrical Engineering Technology curriculum with minor in mathematics from the State University of New York at Canton, is compared to four other institutions with Electrical Engineering degree programs. This comparison shows that if a student graduates from the Electrical Engineering Technology program with minor in mathematics, that student may either have the same level of mathematics, or even more mathematics than the graduate from those four institutions with degrees in Electrical Engineering. The curriculum shown in figure (A) has flexibility that allows student to complete the degree with minor in mathematics in four years. There is also a flexibility in the program for student to take University Physics which is calculus based, or College Physics which is algebra based.

Mathematics requirements for Engineering Technology program without minor in mathematics:

Core Mathematics Requirements	Credits

Math 123 Pre-Calculus	4
Math 161 Calculus I	4
Math 162 Calculus II	4
Math 364 Differential Equations	4
Math 141 Statistics I	3

Mathematics minor needs to complete three more courses from the following:

Select two course plus Math 263	Credits
Math 263 Calculus III (required)	4
Math 351 Discrete Mathematics	3
Math 361 Linear Algebra	3
Math 371 Graph Theory	3
Math 341 Statistics II	3

Figure (A) below shows the Bachelor of Electrical Engineering Technology curriculum.

Semester (1) Fall		
Course Number	Course Title	Credits
ENGL 101	Expository Writing	3
MATH 123	Pre-Calculus	4
SOET 116	Introduction to CAD and Design	2
ENGS 101	Introduction to Engineering	2
ELEC 101	Electric Circuits I	3
ELEC 109	Electric Circuits I Lab	1
		15

Semester (2) Spring		
Course Number	Course Title	Credits
ENGS 102	Programming for Engineers	2
ELEC 102	Electric Circuits II	3
ELEC 129	Electric Circuits II Lab	1
MATH 161	Calculus I	4
ELEC 165	Digital Fundamentals & Systems	3
ELEC 166	Digital Fundamentals & Systems Lab	1
		14

Semester (3) Fall		
Course Number	Course Title	Credits
PHYS 121/131	College/University Physics I	3
PHYS 125	College/University Physics I Lab	1
ELEC 213	Microprocessors	3
	GER	3
ELEC 231	Electronic Circuits	4
ELEC 141	Industrial Controls	2
		16

Semester (4) Spring		
Course Number	Course Title	Credits
ELEC 243	Automated Control Systems	2
PHYS 122/132	College/University Physics II	3
PHYS 126	College/University Physics II Lab	1
ELEC 215	Electrical Energy Conversion	4
ELEC 225	Telecommunications	3
MATH 162	Calculus II	4
		17

Semester (5) Fall		
Course Number	Course Title	Credits
MATH 141	Statistics I	3
ELEC 343	Advanced Circuits Analysis	3
ELEC 332	Industrial Power Electronics	3
	GER	3
SOET 377	Engineering Ethics	1
MATH 364	Differential Equations	4
		17

Semester (6) Spring		
Course Number	Course Title	Credits
ELEC 380	LAN/WAN Technology	3

ELEC 385	Electronic Communications I	3
ELEC 383	Power Transmission & Distribution	3
	GER	3
	Program Elective	3
SOET 348	Engineering Safety	1
		16

Semester (7)Fall		
Course Number	Course Title	Credits
SOET 361	Project Management	3
	Program Elective	3
ELEC 386	Electronic Communications II	3
ELEC 416	Microelectronics Circuit Design	3
	GER	3
		15

Semester (8)Spring		
Course Number	Course Title	Credits
	Program Elective	3
	Program Elective	3
ELEC 477	Capstone Project	3
SOET 370	Engineering Economics	3
ELEC 488/436	**Elect Power Systems/Biomedical Electronics**	3
		15

Program Electives	
ELEC 375	Fiber Optic Communications
SOET 373	Management Telecommunications
AREA 303	Wind Turbines
ELEC 405	Satellite Communications
MECH 351	Design of Experiments
MECH 342	Thermodynamics
AREA 340	Geothermal Energy
or Electives approved by the program director	

Figure (B) below shows the comparison of B. Tech program with mathematics minor to mathematics requirements from four institutions with B.S.EE programs.

B. Tech with Minor in Math	U. Maryland (CP) B.S.EE	U. Hawaii Manoa B.S.EE	U.C.F B.S.EE	U.N.C.C B.S.EE
			Math	Math
Math Required	Math Required	Math Required	Required	Required
Math 161 Calculus I	Math 140 Calculus I	Math 241 Calculus I	MAC 2311C Calculus I	Math 1241 Calculus I
Math 162 Calculus II	Math 141 Calculus II	Math 242 Calculus II	MAC 2312 Calculus II	Math 1242 Calculus II
Math 263 Calculus III	Math 241 Calculus III	Math 243 Calculus III	MAC 2313 Calculus III	Math 2241 Calculus III
Math 141 Statistics I	Math 246 Diff Equations	Math 244 Calculus IV	MAC 2302 Diff Equations	Math 2171 Diff Equations
Math 364 Diff Equations			STA 3032 Probability & Statistics	STAT 3128 Probability & Statistics
Math 361 Linear Algebra				
Math 351 Discrete Math, *Or* Math 371 Graph Theory, *Or* Math 341				

Statistics II				

Figure (C) below shows the mathematics requirements for seven institutions offering Bachelor of Science in Electrical Engineering Technology.

Electrical Engineering Technology Institutions	BS- Degree in Electrical Engineering Technology and Mathematics Requirements
Louisiana Tech University, LA	MATH 100 College Algebra MATH 112 Trigonometry MATH 220 Applied Calculus MATH 223 Applied Calculus for EET
Kennesaw State University, GA	MATH 1112/1113 Trigonometry or Pre-calculus MATH 1190 Calculus I MATH 2202 Calculus II MATH 2306 Ordinary Differential Equations
Cleveland State University, OH	MTH 148 Mathematics for Business Majors I MTH 149 Mathematics for Business Majors II MTT 300 Applied Mathematics MTT 301 Advanced Applied Mathematics
Central Washington University, WA	MATH 130 Finite Mathematics MATH 172 Calculus I MATH 173 Calculus II MATH 265 Linear Algebra I MATH Elective (Differential Equations, Statistic, or etc.)
Fairmont State University, WV	MATH 1185 Applied Calculus I MATH 1186 Applied Calculus II MATH 1113 Applied Statistics
California State Polytechnic University, Pomona, CA	MAT 130 Technical Calculus I MAT 131 Technical Calculus II MAT 132 Technical Calculus III
Pennsylvania State University, Harrisburg, PA	MATH 140 Calculus with Analytic Geometry I MATH 141 Calculus with Analytic Geometry II MATH 230 Calculus and Vector Analysis or other recommended course such as MATH 250 Ordinary Differential Equations, MATH 408 Advanced Calculus, or etc.

Figure (C) above is an indication whether students graduating with degrees in Engineering Technology are prepared mathematically

for graduate school in Engineering without having to take more undergraduate courses in mathematics, or how do they compete with BSEE graduates in industries where Engineering design is the main function of the Engineer?

Where some of the graduates from Electrical Engineering Technology with minor in mathematics are currently studying or working

Institution	Program	Expected Graduation Date	Number of Students
Clarkson University	M.S. Electrical Engineering	Fall 2016	1
Organization	Title	Location	Number of Graduates
New York Independent System Operator (NYISO)	Interchange Scheduler	New York	1
Substation Engineering Company	Electrical Design Engineer	New York	1
Alcoa Inc.	Electrical Engineer	New York	1
Progressive Machine and Design	Controls Hardware Engineer	New York	1
Bechtel Marine Propulsion Corporation	Electrical Designer	New York	1

Conclusion

The Bachelor of Engineering Technology degree curriculum with minor in mathematics prepares student with mathematics

competency for him or her to continue in Engineering Graduate program in Electrical Engineering. Figure (B) above shows that a graduate from the Bachelor of Engineering Technology program with minor in mathematics has either the same level or more mathematics than a graduate from the Engineering program in any of the four institutions indicated in this paper. Indeed, the B. Tech graduate now has the opportunity to compete equally with B.S.EE graduates in either at the graduate school, or for engineering positions. This new program has produced graduates of which some are working as design engineers, and one student accepted into Master's Degree program in Electrical Engineering at Clarkson University. Enrollment is expected to increase as a result of curriculum flexibility that allows very good student who may be interested in engineering graduate school to consider the mathematics minor with no extra course load. An average student still has the opportunity to complete the B. Tech degree in Electrical Engineering Technology without minor in mathematics. The technical content of the curriculum is not impacted due to flexibility of elective courses.

The regular mathematics requirements for the B. Tech degree in Electrical Engineering Technology are: Pre-Calculus, Calculus I, Calculus II, and Differential Equations.

Curriculum improvement expected in 2016/2017:

(1) Calculus III will be required for all B. Tech students
(2) Engineering Ethics course will be changed from 1 credit to 3 credits

Bibliography/Website

(1) University of Maryland College Park: www.umd.edu
(2) University of Hawaii at Manoa: www.manoa.hawaii.edu
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(4) University of North Carolina Charlotte: www.uncc.edu
(5) Kennesaw State University: www.**kennesaw**.edu
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(7) Cleveland State University: www.csuohio.edu
(8) Central Washington University: www.**cwu**.edu
(9) Fairmont State University: www.**fairmontstate**.edu
(10) California State Polytechnic University, Pomona: www.cpp.edu

(11) Pennsylvania State University, Harrisburg:
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