



COLLEGE OF ENGINEERING
THE UNIVERSITY OF TOLEDO

University of Toledo

Engineering Applications of Math

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Undergraduate Engineering at UT

- ABET accredited Engineering Science programs
 - BioE, ChE, CivE, CSE, EE, ME
 - Target population for WSU Engineering Mathematics
- ABET accredited Engineering Technology programs
 - Construction, Computer, Electrical, Information Technology and Mechanical
- Engineering Science credentials: ACT composite 25.6, ACT Math 26.9, HS GPA 3.64
- First to second year retention is greater than 70% remaining in Engineering, greater than 80% remaining at UT
- Mandatory co-op program for all Engineering Science students
 - Three semesters of co-op are required
 - Requires students to stay on schedule within their curriculum



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Mathematics for UT Engineering

- Various Mathematics offerings for UT Engineering students depending on level of preparation
 - MATH 1320 College Algebra (3 hrs)
 - MATH 1330 Trigonometry (3 hrs)
 - MATH 1340 College Algebra and Trigonometry (4 hrs)
 - MATH 1980 Trigonometry Review (1 hr)
 - MATH 1850 Calculus I (4 hrs)
 - MATH 1920 Honors Calculus I (4 hrs)
- Resulting pathways to Calculus I for DHS students
 - Start in MATH 1320 and/or MATH 1330 before MATH 1850
 - Start in MATH 1340 before MATH 1850
 - Direct entry into MATH 1850 supplemented by MATH 1980
 - Direct entry into MATH 1850 without supplemental instruction
 - Qualifying honors students can choose MATH 1920 instead of MATH 1850
 - Students with AP, IB or post-secondary credit can go directly into Calculus II

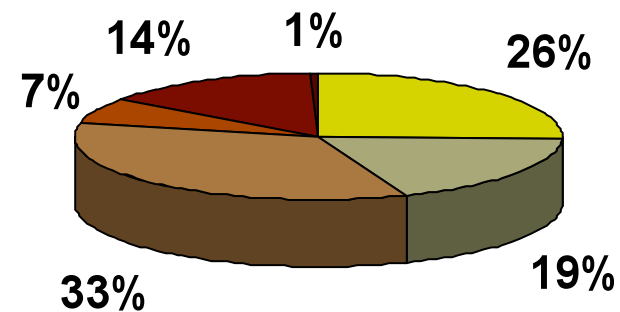


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Mathematics Placement

- Placement in Mathematics courses based on various factors
 - ACT or SAT Mathematics score
 - Elementary or College Algebra placement test
 - Trigonometry placement test
- Our goal is to have prepared students take Calculus I as soon as possible
 - Required for Physics and subsequent Engineering coursework
 - Many students go out on their first co-op after their 3rd semester of courses
 - 3 out of 4 first year students are on target or better

Math Placement (07-08) Engineering Science



- Alg and/or Trig
- Calc I w/ Trig
- Calc I alone
- Honors Calc I
- higher math
- no math



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UT Engineering Applications Course

- Supplement instruction for students that place into MATH 1320/30/40 Algebra and Trigonometry courses
 - Goal is to improve student performance when they take Calculus I
- Adapted Wright State Mathematics for Engineering Applications Course materials to create optional course
 - Topics range from vectors to differential equations
 - Present applications for each topic then introduce theory
 - Parallel hands-on laboratory reinforces lecture topics
- Provide tangible benefits to encourage students to enroll
 - Reimbursed students for extra tuition incurred for taking course
 - Physics department allows students that complete this course to enroll in Physics I and Calculus I simultaneously



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Course Adaptations

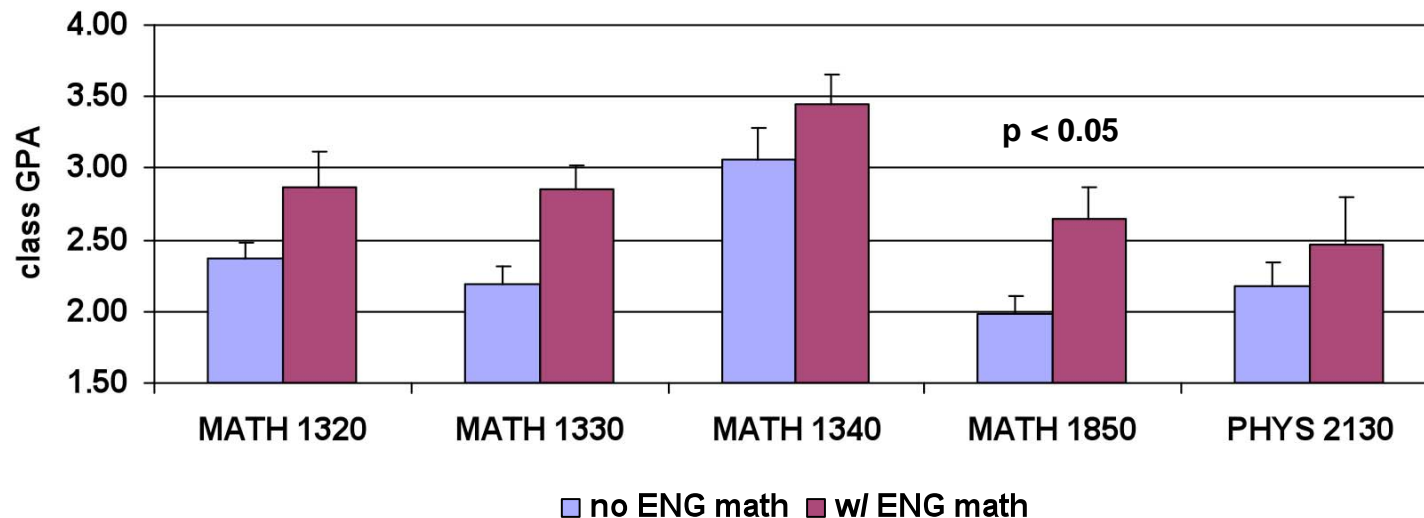
- Added ChE thermodynamics application for integration
 - Work produced by expanding gas in a cylinder-piston system
- Removed most MATLAB programming from laboratory component
 - All students except ChE and CivE take 1st year MATLAB course
 - Introduce matrix calculations for lab 4 and symbolic solver for labs 6 - 8
- Utilize simulation tools for laboratory component
 - Introduce PSpice for electrical circuit laboratories
 - Created MATLAB GUIs for two-link robot and high-speed video of ball drop
- Modified applications for selected laboratories
 - Lab 1 slope of a line – calibration of unmarked thermometer
 - Lab 3 sinusoids – filtering of sound
 - Lab 4 linear algebra – supplying electricity to homes on a grid
 - Lab 6 integration – finding the center of an arbitrary shape
 - Lab 8 second order ODEs – calculating the period of a pendulum



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Preliminary results

- Marginal improvement in MATH 1320/30/40 College Algebra and Trigonometry
 - Taken with Engineering Applications of Math course
- Significant improvement in MATH 1850 Calculus I performance after Engineering Applications course
- Marginal improvement in PHYS 2130 Engineering Physics I
 - Students taking Engineering Applications course take Physics I with Calculus I
 - All other students take Physics I after Calculus I





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Summary and future directions

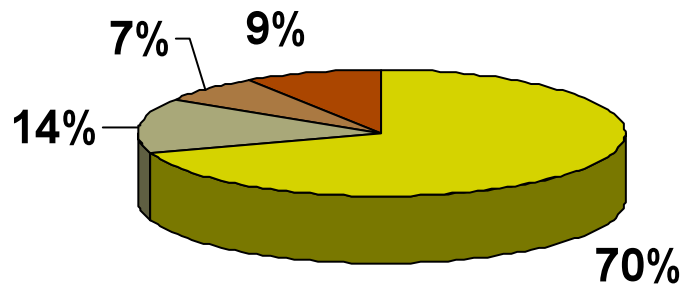
- Successfully implemented WSU course at UT
- Addressed our need to assist a population of students delayed by their insufficient preparation for Calculus I
 - Improved performance in Calculus I following the WSU course
 - Ability to directly transition into Physics without Calculus
- Future efforts to expand this offering to more students
- Target students that want to transfer from Engineering Technology to Engineering Science
 - Students not qualified for Engineering Science can be admitted to Engineering Technology
 - Need to pass Calculus I before entry into Engineering Science programs



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Summary and future directions

Calculus I grades (07-08) Engineering Science



■ C or better ■ less than C
■ failed ■ withdrew

- Over 50% of students place directly into Calculus I
- Nearly 1/3 of these students will retake this course
 - Perform poorly or withdraw
 - No longer on schedule
- Ongoing discussion with Mathematics department to include hands-on component in Calculus I recitation sessions
 - Emphasizes real-world application of theory being presented
 - Can provide a benefit to all students regardless of preparation level