Math 156 - Applied Honors Calculus II

Math 156 is a calculus 2 class designed for STEM majors (though all majors are welcome). The prerequisite is a score of 4 or 5 on the AP Calculus exam (AB or BC) or equivalent.

Course website: **course website**

Goals: Math 156 aims to provide students with the calculus knowledge they need to progress in STEM majors. The course develops conceptual understanding and computational skill with a focus on science applications. Theorems are stated carefully and proofs are sketched, but without technical details, so that students see the main ideas and understand why the theorem is true. Examples are given to illustrate the theory.

Organization: The class meets four times per week (MTuWF) in fifty-minute sessions. There are weekly homework sets. Students are encouraged to work together on homework, but each student submits their own solutions. There are two midterm exams and a final exam, and sample problems are distributed to help students prepare for the exams. The lectures, homework, and exams are synchronized. An interactive classroom environment is encouraged.

Syllabus: The course starts by recalling the definition of the integral as a limit of Riemann sums. The Fundamental Theorem of Calculus is derived and improper integrals are discussed. Standard topics from the AB syllabus are omitted (e.g. volumes of revolution) in favor of topics that students are less likely to have seen (e.g. work, center of mass, arclength, surface area, probability density functions). The standard integration methods are discussed (e.g. integration by parts, partial fractions, trigonometric substitution) as they arise in specific problems (e.g. computing the arclength of a parabola). The next part of the course concerns differential equations (exponential growth/decay, Newton's law of cooling/heating, logistic equation). The stability of constant solutions is discussed with reference to the phase plane. Euler's method is introduced. Finally, infinite series are discussed including geometric series, alternating series, power series, Taylor series, binomial series. Special topics include asymptotic approximations, error function, Gamma function, Bessel function, polar coordinates, complex numbers, Euler's formula. Science applications of calculus include the escape velocity from the Earth's gravitational field, Maxwell-Boltzmann distribution of speeds of gas molecules, ground state electron density of the hydrogen atom, far-field of an electric dipole, and Planck's resolution of the ultraviolet catastrophe. Students are also treated to **Leonhard Euler's solution of the Basel problem**.

Additional features

1. There is no required textbook; lecture notes will be posted on the course website.

2. The Science Learning Center organizes **study groups** for Math 156. Each group has 8-12 students and is facilitated by a student who took the class previously. The groups meet weekly in two-hour sessions. The SLC study groups are voluntary and students may form their own informal study groups or study independently if they wish.