

Calculators and Science and Engineering Calculus

Occasionally students ask why we do not allow the use of calculators on calculus examinations. The purpose of this statement is to explain our reasons.

The Differential and Integral Calculus is perhaps the most powerful tool ever invented to further our understanding and analysis of the physical world. It is fundamental to an understanding of much of modern science and engineering. Our goal in educating students is to help them understand the basic concepts of the Calculus which provide the basis not just for subsequent Mathematics courses but also for many other Science and Engineering courses.

Our reasons for not allowing the use of calculators on examinations are primarily pedagogical. Calculus courses typically illustrate and test the understanding of the basic concepts through relatively simple examples and problems. More complex use of the concepts is made in subsequent Mathematics, Science and Engineering courses. The better graphing or programable calculators can now “solve” many of these problems—for example symbolically differentiate and integrate simple functions, “evaluate” some limits and even sum some series. If learning how to get answers to these particular problems were the goal of the courses, it would make sense to train students on the solution of these problems using calculators. We believe, however, that this would be counterproductive in helping students master the underlying concepts. Indeed, we believe that developing the ability to work simple problems by hand is a crucial step in mastering the concepts of the Calculus, which is the main goal of our courses. The use of sophisticated software packages in problem solving is introduced in later courses. These packages can be better used by scientists and engineers who have already mastered the basic ideas of the Calculus. The same principle applies in other parts of mathematics. For example, nobody would try to solve a large system of linear equations by hand, but in order to understand the underlying concepts students need to develop the ability to solve small systems by hand, even though they may never have to carry out the procedure “in the real world.”

Current Policy MA 161, 161E, 165, 166 and 261 do not allow the use of calculators on examinations and quizzes. These courses do spend some class time discussing the use of graphing calculators, and some of the pitfalls into which graphing calculators (and computers) can lead the unwary. They also assign some homework problems to be done using calculators. The use of calculators in the advanced placement courses (MA 173, 174, and 271) is at the instructors’ discretion. MA 265 and 266 use the software package MATLAB as an integral part of the course. Though they are not needed, students may use non-graphing, non-programmable calculators on the Calculus Credit Exams for MA 165, 166, 261, 265 and 266.