Math 18.01A-02A - Concourse: Single & Multivariable Calculus
Fall 2016 & IAP 2017

Lectures and Recitations by: Robert Winters

Class times: Mon, Wed, 1:30-3:00pm (primarily lecture); Tues, Thurs 1:00-2:00pm (primarily recitation) in 16-160.

Office hours: Most likely Tues, Thurs 2:00-3:00pm and at other times to be determined.

Office: 16-137 and Concourse Lounge

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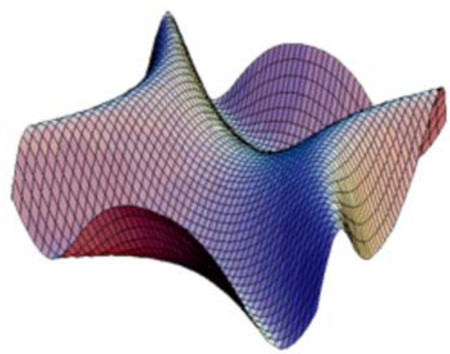
This sequence, intended for students who have had a full year of high school calculus, begins with 18.01A, a six-week review of one-variable calculus, emphasizing integration techniques and applications, polar coordinates, improper integrals, and infinite series. Prerequisite is a score of 4 or 5 on the Advanced Placement Calculus AB exam or a passing grade on the first half of the 18.01 Advanced Standing Exam, covering differentiation and elementary integration. Most students completing 18.01A continue directly into 18.02A, in which the remaining weeks of the fall term is devoted to the material in the first half of Calculus II. 18.02A is taught at the same pace as 18.02. Concourse students complete the second half of Calculus II during Independent Activities Period (IAP) in January.



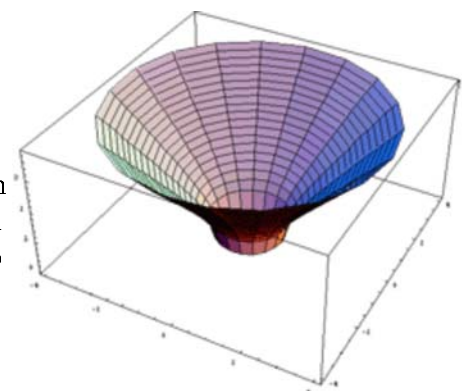
Text: *Calculus with Analytic Geometry, 2nd Edition* by George F. Simmons (ISBN 9780070576421), published by McGraw-Hill

Supplementary Notes:
18.01 Supplementary Notes authored by Prof. Arthur Mattuck of the MIT Mathematics Department, exercises by David Jerison.
18.02 Supplementary Notes authored by Prof. Arthur Mattuck of the MIT Mathematics Department.

18.01/02 Mathlets (to appear)

Homework: Homework will be posted on the course website and will be due approximately weekly. Exact due dates will be indicated in the Course Calendar accessible from the website. Typical assignments will include some exercises that are to be turned in as well as additional practice problems. Some of the exercises will be drawn from the text(s), but a typical problem set will contain both text exercises plus additional exercises. Homework may be submitted in class or at my office, but it should be completed by the posted due date. You should not consult any solutions manual or similar sources in preparing your assignments. You are encouraged to work with your fellow students on the homework, but your written solutions must be your own. Solutions will be made available (as PDF files) on the course website shortly after they are due.

Website: **http://math.rwinters.com/18012A**. Homework assignments, solutions, supplements, and anything that needs posting for the course will be found at this website. We will also have a Stellar site for other administrative matters as well as a link to the active website.



Exams: We anticipate one midterm exam and the Final Exam for the 18.01A portion of the course. The 18.01A Final Exam will take place during the 7th week of the fall semester. We will then proceed to the 18.02A part of the course which will have two midterms in the fall, one midterm during January, and a Final Exam at the end of IAP. Consult the Course Calendar for tentative dates. The intention is to have our exam dates correspond closely with the mainstream 18.01A and 18.02A exam dates.

Grading: (This scheme is preliminary and may be adjusted slightly.)
Homework assignments – 30%
Midterm exams – 40%
Final exam – 30%

Condensed Syllabus: (See the **Calendar** for day-by-day details and assignments, updated as the course proceeds.)

18.01A Topics:

- Review of basic ideas of Differential Calculus. (Chaps. 2-7, Appendix)
- Applications of Integration: area, volume, volume of solids of revolution, arclength, area of a surface of revolution, work and energy, hydrostatic force. (Chap. 7)
- Techniques of integration: substitution, trigonometric integrals, trigonometric substitutions, partial fractions, integration by parts, miscellaneous methods, numerical integration and Simpson's Rule. (Chap. 10)
- Further Applications of Integration: Center of mass, centroids, moment of inertia. (Chap. 11)
- Indeterminate forms, L'Hôpital's Rule, improper integrals.
- Sequences, infinite series, convergent vs. divergent series, comparison tests, integral test, ratio and root tests, alternating series, absolute vs. conditional convergence. (Chap. 13)
- Power series, interval of convergence, differentiation and integration of power series, Taylor Series and Taylor's Formula, applications to differential equations. (Chap. 14)
- Polar coordinates and polar graphs. (Chap. 16)

18.02A Topics:

- Coordinates, vectors and vector algebra in $\mathbf{R}^2$ and $\mathbf{R}^3$; dot product, cross product, projection, equations of lines and planes, matrix methods. (Chaps. 17-18 and Notes)
- Parametric equations of curves in $\mathbf{R}^2$ and $\mathbf{R}^3$; coordinates, derivatives of vector-valued functions, velocity and acceleration, tangent vectors, arclength; curvature and unit normal vector, tangential and normal components of acceleration, Kepler's Laws and Newton's Law of Gravitation. (Chaps. 17-18)
- Cylinders and surfaces of revolution, cylindrical and spherical coordinates; parameterized surfaces in $\mathbf{R}^2$ and $\mathbf{R}^3$. (Chap. 18)
- Functions of several variables - limits, continuity, and differentiabilty; partial derivatives, gradients, linear approximation, directional derivatives, Chain Rule. (Chap. 19)
- Optimization - unconstrained and constrained; implicit functions and implicit differentiation. (Chap. 19)
- Multiple integrals, integration over regions in $\mathbf{R}^2$ and $\mathbf{R}^3$ and their applications using Cartesian, polar, cylindrical, and spherical coordinates, gravitational attraction. (Chap. 20)
- Vector fields and their applications. (Notes)
- Integration over curves in $\mathbf{R}^2$ and $\mathbf{R}^3$ by parameterization; work integrals, and applications; independence of path and conservative vector fields; Green's Theorem. (Chap. 21)
- Integration over surfaces in $\mathbf{R}^3$ by parameterization - flux integrals, surface area, and applications. (Chap. 21)
- Calculus of vector fields; curl and divergence of vector fields; Stokes' Theorem, Divergence Theorem; Maxwell's equations. (Chap. 21)