

Rationale for Changes to MATH 1113 - Precalculus

The time is right for a few tweaks to MATH 1113. The minimum SAT score for MATH 1501 will be increased for Fall 2010 (and on an advisory basis for Fall 2009). This change will lead to an increase in enrollment that will likely prevent MATH 1113 and MATH 1111 (formerly MATH 2804) from being offered in a structure where they are taught by a single instructor in a single classroom. The previous combined format of MATH 1113/2804 led to some material being taught in MATH 1113 that wasn't in the course description. The topic outline no longer corresponds to the text in use and it is not clear what text and edition the topic outline corresponds to. Furthermore, the terminology of the course description is dated and grammatically unsound.

The primary effects of the proposed changes are:

- (1) Catalog description uses clearer terminology while retaining all topics except mathematical induction, a topic too advanced for the consistently weak students enrolled in MATH 1113. Clearly includes rational functions in catalog description.
- (2) Topic outline uses a more appropriate text for the class and agreement with the catalog description. (Existing topic outline does not include mathematical induction, which is part of the catalog description.)
- (3) Increased consistency between offerings of MATH 1113, since the course description and topic outline will match each other and the chosen text. In recent terms, decisions on what material to teach in this course has been overly driven by the abilities of the students in the course rather than ensuring success in calculus.
- (4) Sections of another text will have to be distributed to students (likely online) to cover the basic analytic geometry of the course or else careful lecture notes should be given. (This material is among the least important for success in calculus, as students will not see most of it again until MATH 2401.)
- (5) Five buffer days are retained, allowing instructors time to review prerequisite material at the start of the term for particularly weak classes or adjust pace mid-term if the class has difficulty. (Number of course sessions per topic is estimated until the course is first taught from Axler.)

The proposed text by Sheldon Axler stands as a stark contrast to any other precalculus text available. Most of its competitors are a combination of a college algebra text and a trigonometry text. These texts are usually priced in excess of \$150 and contain over 1,000 pages, as compared to \$65 to \$95 (depending on format) and less than 600 pages (including student solutions manual) for Axler's text. Most importantly, Axler's text is written exclusively for students who will take calculus, while other texts are suitable for a terminal mathematics course and attempt to engage the students through artificial examples, many of which students will learn better ways to address in calculus. Axler's text looks forward to calculus and prepares students for their future coursework, which should be our primary goal for MATH 1113.

Axler made a number of pedagogical decisions in writing his text that I believe we at Georgia Tech support. A copy of the preface discussing those decisions is attached to this proposal. The only topic on the topic outline not covered by Axler is the basics of conic sections, which is easily covered in class. One possibly problematic omission in the text is the rational root test (now usually called the rational zeroes theorem in texts at this level). In response to an inquiry, Axler sent the attached carefully-argued justification for the topic's omission. Instructors wishing to cover the topic can easily do so, but it is unlikely to be essential for students' future success.

Existing MATH 1113 - Precalculus

Hours (Lecture-Lab-Recitation-Total Credit): 3-0-2-4

Catalog description:

Analytic geometry, the function concept, polynomials, exponential, logarithms, trigonometric functions, mathematical induction, the theory of equations.

Prerequisites: Permission of the Instructor

Text : At the level of *Precalculus*, 7th edition by Larson and Hostetler, Cengage

| Topic | Text sections* | Class sessions |
|---|----------------------------|----------------|
| Real Numbers; Factoring | 1.1, 1.3, 1.4 | 2 |
| Graphs; Lines; Inequalities; Absolute Value | 2.1-2.6, 1.2 | 6 |
| Functions and Their Graphs; Inverse Functions | 3.1-3.5 | 5 |
| Linear, Quadratic, Polynomial, and Rational Functions; Optimization | 4.1-4.2, 4.4-4.7 | 4 |
| Exponential and Logarithmic Functions | 5.1-5.5 | 3 |
| Trigonometric Functions and Their Graphs | 6.1-6.5, 7.1, 7.3-7.5, 7.7 | 7 |
| Complex Numbers; Roots of Polynomials | 12.1-12.7 | 6 |
| Polar Coordinates | 9.5-9.6 | 2 |
| Analytic Geometry and the Conic Sections | 11.1-11.2, 11.4-11.5, 11.8 | 5 |
| | TOTAL | 40 |
| * Section numbers do not correspond to Larson. Topic list was not updated when text was changed last. | | |

Proposed MATH 1113 - Precalculus

Hours (Lecture-Lab-Recitation-Total Credit): 3-0-2-4

Catalog description:

The function concept; polynomial, rational, exponential, and logarithmic functions; trigonometric functions and identities; systems of equations; Gaussian elimination; equations and graphs of circles, ellipses, and hyperbolas.

Prerequisites: Permission of the Instructor

Text : At the level of *Precalculus: A Prelude to Calculus*, First Edition by Axler, John Wiley & Sons

| Topic | Text sections | Class sessions |
|--|---------------------------|----------------|
| Real Numbers; Inequalities | 0.1-0.3 | 2 |
| Functions and Their Graphs; Inverse Functions | 1.1-1.6 | 6 |
| Linear, Quadratic, Polynomial, and Rational Functions | 2.1-2.5 | 5 |
| Complex Numbers | 2.6 | 1 |
| Systems of Equations and Matrices | 2.7 | 2 |
| Exponents and Logarithms | 3.1-3.5 | 5 |
| Area, e , and the Natural Logarithm | 4.1-4.5 | 5 |
| Trigonometric Functions and Their Graphs; Inverse Trigonometric Functions | 5.1-5.4, 5.6-5.7, 6.3-6.5 | 7 |
| Right-triangle trigonometry; Using trigonometry to compute area; Law of Sines and Law of Cosines | 5.5, 6.1-6.2 | 3 |
| Polar Coordinates | 6.6 | 1 |
| Circles, ellipses, and hyperbolas | Supplement | 3 |
| | TOTAL | 40 |