

Topics for Math 194 (Spring 2019, R. Boltje)

Prerequisites are useful but not always necessary.

- The RSA cryptosystem (Prerequisites: Math 110 or Math 134)
- Category Theory 1: Basic notions (Categories, functors, natural transformations, examples).
- Category Theory 2: Some universal constructions (products, coproducts, pull-back, push-out, kernels, cokernels).
- Category Theory 3: Adjoint functors.
- Ring Theory: Localization of a ring and field of fractions (Prerequisites: Math 111B).
- Geometry: Euler's formula for polyhedra, and regular Platonic solids.
- The symmetry groups of the Platonic solids. (Prerequisites: Math 111A).
- Algebraic and transcendental numbers. Liouville numbers.
- Transcendence of e .
- Transcendence of π .
- Knot theory.
- G -sets and the Burnside ring. (Prerequisites: Math 111A).
- Partially ordered sets and Möbius function.
- Simplicity of $\text{Alt}(n)$, $n \geq 5$. (Prerequisites: Math 111A).
- Finitely generated modules over PIDs. (Prerequisites: Math 111B).
- Sums of two squares. (Prerequisites: Math 110, Math 111B).
- Sums of three and of four squares. (Prerequisites: Math 110).
- Continued fractions.

- Constructions with straightedge and compass (impossibility of trisecting angle, doubling cube) (Prerequisites: Math 111B).
- Fundamental Theorem of Algebra (Prerequisites: Math 103A and Math 111B).
- Prime numbers and Tschebyschev's theorem. (Prerequisites: Math 110).
- Fermat's last Theorem for exponent 3. (Prerequisites: Math 111B).
- Fermat's last Theorem for Exponent 4 and history of the problem. (Prerequisites: Math 110)
- Steiner systems
- Linear codes. (Prerequisites: Math 117)
- Group extensions and H^2 . (Prerequisites: Math 111A).
- The fundamental group of a topological space (Prerequisites: Math 111A and Math 124).
- The braid group and the symmetric group (Prerequisites: Math 103A and 111A).
- Homological algebra: Chain complexes and homotopy (Prerequisites: Math 111A).
- Singular homology of a topological space (Prerequisites: Math 124).
- p -adic numbers (Prerequisites: Math 105A, 110 and 111B).
- Wallpaper classification (Prerequisites: Math 111A).
- Abel's Theorem on solvability of polynomial equations (Prerequisites: Math 111A and 111B).