# Advanced Mathematics Courses

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## Courses Completed(listed by time order):

1. **Point Set Topology**(95/100): junior level, Munkres's *Topology,* including the part of point set topology of this book.
2. **Real Variable Analysis**(100/100): junior level, Zhou Minqiang's *Real variable function* (Chinese text book)*,* including Cantor set, Baire category theorem, Lebesgue measure, differential, Lebesgue integral, L^p space.
3. **Differential Geometry**(98/100): junior level, Chen Weihuan's *Differential Geometry* (Chinese text book), including basic curves and surfaces theory, first and second fundamental forms, curvatures, geodesics, differential forms, Gauss-Bonnet theorem.
4. **Stochastic Process**(95/100): junior level, Su Zhonggen's *Stochastic Process* (Chinese text book), including Poisson process, Markov chain, Brownian movement, Ito integral, Galton-Watson process.
5. **Abstract Algebra**(97/100): junior level, Qiu Weisheng's *Abstract Algebra* (Chinese text book), including group, ring, field, module and finitely generated module, Sylow theorems, Chinese remainder theorem, Hilbert's basis theorem, Galois's theory
6. **Complex Variable Functions**(92/100): junior level, Yu Jiarong's *Complex Variable Functions* (Chinese text book), including Cauchy's integral formula, Laurent series, conformal map, analytic continuation, Riemann surfaces, Dirichlet problems, Riemann mapping theorem.
7. **Algebraic Topology**(A, taken at MIT): graduate level, Hatcher's *Algebraic Topology*, including homotopy theory, homology and cohomology of this book, Van Kampen's theorem, covering spaces, Mayer-Vietoris sequences, cup product, Kunneth formula, Poincare duality, homotopy groups, fibrations.
8. **Geometry of Manifolds**(A, taken at MIT): graduate level, do Carmo's *Riemannian Geometry* and Yau's *Lectures on Differential Geometry*, including connections, geodesics and convex neighborhoods, curvature, Jacobi fields, Hopf-Rinow and Hadamard theorems, Variation of Energy, Bochner's formula, Rauch comparison theorem, Hessian comparison theorem and volume comparison theorem, Morse index theorem, Gromov-Hausdorff metric, gradient estimates, eigenvalues theory.
9. **Introduction to Lie Groups**(A, taken at MIT): graduate level, course notes, including basic Lie group and Lie algebra theory, root system and Dynkin diagram, mostly focusing on some

specific examples like Clifford algebra, special linear groups, unitary groups, spin groups and symplectic groups.

10. **Algebraic Number Theory**(99/100): graduate level, Jurgen Neukirch's *Algebraic Number Theory*, including Minkowski theory, Dirichlet's unit theorem, extensions of Dedekind domains, Hilbert's ramification theory, cyclotomic fields, p-adic numbers, valuations, local fields, Henselian fields, extension of valuations, different and discriminant.
11. **Partial Differential Equations**(97/100): senior level, Zhou Shulin's *Partial Differential Equations* (Chinese text book), including divergence theorem, Fourier transform,Dirichlet problems, Neumann problems, energy method, harmonic equations, harnack inequality, maximum principles, wave equations and heat equations.
12. **Elliptic Partial Differential Equations of Two Orders**(93/100): graduate level, Lin Fanghua's *Elliptic Partial Differential Equations*, including mean value properties of harmonic functions, energy method, maximum principles, gradient estimates, Sobolev spaces, weak solutions, growth of local integrals, Holder continuity of solutions and gradients.
13. **Progress in Modern Mathematics**(93/100): senior level, course notes, including Sobolev inequality, Nash inequality, logarithmic Sobolev inequality, Poincare inequality, maximal function, segment inequality, Gromov-Hausdorff metric, Gromov's precompact theorem, Cheeger's compactness theorem, tangent cone.

## Courses in Progress:

1. **Functional Analysis**: junior level, Zhang Gongqing's *Lectures on Functional Analysis*. (I have read Peter D.Lax's *Functional Analysis* and did exercises in this book, which covers the contents of graduate level functional analysis courses. I take this course just for credits.)
2. **Seminar of Lie Algebra**: graduate level, Humphreys's *Introduction to Lie Algebras and Representation Theory,* including Engel's theorem, Weyl's theorem, root space decomposition, root systems, classification of irreducible Dynkin diagrams, isomorphism and conjugacy theorems, Serre's theorem, the representation theory part of this book. (I have read the first five chapters of this book in my junior year.)
3. **Seminar of Riemann Surfaces**: senior level, Phillip Griffiths's *Introduction to Algebraic Curves*, including Normalization theorem, genus formula, Riemann-Hurwitz formula, Bezout's theorem, Riemann-Roch theorem and Abel's theorem.

## Courses Expect to Complete

1. **Algebraic Geometry**

## Other High-Level Readings

1. Peter Lax's *Functional Analysis* (completed most exercises in the first twenty five chapters in sophomore year)
2. Michael Atiyah's *Introduction to Commutative Algebra* (completed)
3. John Milnor's *Morse Theory* (completed)
4. Raoul Bott's *Differential Forms in Algebraic Topology* (completed, studied at Chinese University of Hong Kong)
5. Victor Guillemin's *Differential Topology* (completed)
6. Phillip Griffiths's *Principles of Algebraic Geometry* (chapter 0)
7. Robin Hartshorne's *Algebraic Geometry* (chapter 1)