Course Syllabus for Math 185
sections 001, 101, course control number 58850, 58855
MTWTh 10:00–12:00, N.Reshetikhin, Summer 2009

Textbook: Brown, J. and Churchill, R. *Complex Analysis and Applications.* Eighth Edition. McGraw-Hill Science/Engineering/Math, 2008

Reshetikhin's office: 917 Evans

Reshetikhin's office hours: M,Tu 1:00–2:30,

- Never fall behind in this course, either in the reading assignments or in the homework assignments. It will go fast.
- The course web-site is http://math.berkeley.edu/ reshetik/ .
- There will be two midterms (7/9 and 7/30) during normal class hours.
- The course grade will be computed as follows: Homework 20%, Midterm I 25%, Midterm II 25%, Quizzes 25%, Final 30%.
- The homework is 20% but you should understand that if you will fail on homework, you will most likely fail the exams. Some problems on the exams will be similar to homework problems.
- Homework is due every Monday in class. Due to the quick pace of this class, late homeworks will not be accepted. Solutions will be posted after the homework has been collected. Students are encouraged to work together, but each student should turn in a complete write up by themselves. Each problem graded will be graded out of 4 points.

  1. 4 points The solution to the problem is correct and perfectly presented.
  2. 3 points The solution to the problem is almost correct with the exception of a few minor errors.
  3. 2 points At least 75% of the solution is correct, and there are no major gaps in reasoning.
  4. 1 point At least 50% of the solution is correct.
  5. 0 points The solution is incorrect, or the homework is not in the required format.

  Four problems a week will be graded by the grader. An additional eight or so problems will be assigned each week and are strongly recommended. Please note the required format for homeworks:

  1. Use blank, white paper and pen (or LaTeX).

2. Only one side of each sheet of paper may be used, and each page should only have work for one problem (unless the student has used LaTeX).
3. Solutions must be written in complete sentences. Symbols such as $\in$, $\Rightarrow$, $\forall$, and $\exists$ are perfectly acceptable, but these symbols stand for words which must fit into a complete sentence.

- Official University policy states that an incomplete can be given only for valid medical excuses with a doctor's certificate and only if, at the point the grade is given, the student has a passing grade (a C or better). If you are behind in the course, an incomplete is not an option!

1. Introduction. Real and Complex numbers (addition, multiplication, division, etc.). The complex plane (complex numbers as vectors, polar coordinates. (1-10).

2. A neighborhood of a point. Interior points, boundary points, boundary. Open sets, closed sets, closures. Connectedness (domain is connected). Bounded, unbounded domains. Accumulation points. Sequences of points and their limits. Closure is the addition of limit points to the set (11).

3. Complex values functions on a complex plain $f(x, y) = u(x, y) + iv(x, y)$. Functions as mappings. Continuous mappings. Inverse mappings can be 'multivalued'.

   Examples: polynomials in $z, \bar{z}$, rational functions, power series in z (analytic functions).

4. Directional derivative. Partial derivative. Derivative in z. Cauchy-Riemann equation. Holomorphic functions.

5. Entire functions. (BN, 56-64). The existence of an antiderivative for an entire functions.

6. Power series. Absolute and conditional convergence. (BN, 25).(BC, 184-190).

7. Paths in complex plane. Contour integrals. Independence of the integral on the contour of integration for entre functions. (BN, 43-54).(BC, 119-127).

8. Cauchy's formula for entire functions. (BN, 56-64). Cauchy's theorem for domains. Simply connected and multiply connected domains. (BC, 151-163). Cauchy's integral formula (BC, 164).

9. Cauchy's formula for derivatives. (BC, 165-167). Analyticity of derivatives of analytic functions. (BC, 168). Analytic function is represented by its Taylor series. (BC, 189-195).

10. Liouville theorem and the fundamental theorem of algebra. (BC, 172-174) (BN, 62-64).

11. Morera's theorem (BC, 169)(BN, 85-87). Maximum modulus theorem. (BC, 175-180).

12. Isolated singular points (classification, examples, and non-examples). (BN, 103-106) (BC, 229-230). Laurent series. (BC, 197-230)(BN, 107-113).

13. Residue at an isolated singularity. Cauchy's residue formula. (BC, 231-236).

14. Residue at ∞. Repeat of the discussion of ∞ for the complex plane. (BC, 237).

15. Zeroes of analytic functions. Winding number. (zeroes can not accumulate). The number of series of a polynomial in a region. (BC, 249-251). (BC, 291-297).

16. Analytical continuation. Monodromy. Covering surfaces. Branch cuts. $\ln z$, $\sqrt{z}$, $\sqrt{(z-a)(z-b)}$, etc. Boundary values on branch cuts. (BC, 336-352).

17. Computation of integrals by residues. Deformation of integration contours. Computation of integrals for functions with branch cuts. (BC, 261-290).

18. Functions $\Gamma(z)$ and $\zeta(z)$. (BN, 228-242).

19. Conformal mappings. Analytic is locally conformal and one-to-one. (BC, 355-362)(BN, 157-175).

20. Linear-fractional mappings. Preserving circles. Compositions. (BC, 319).

21. Vector fields and analytic functions. Riemann mapping theorem. (BN, 178-189). Examples of conformal mappings between domains.

22. Harmonic functions. Solutions to the Dirichlet problem. Conformal mapping $D_1 \to D_2$ establishes an equivalence between Dirichlet problems on these domains. (BC, 363-372, 413-416). (BN, 200-213).