

The text for the course this semester is “Basic Complex Analysis” 3rd ed. (1999) by J.E. Marsden & M.J. Hoffman (Freeman, N.Y.) plus its Internet Supplement “BCA\_NS.pdf” from Marsden's web page <<http://cds.caltech.edu/~marsden>> (Click on "Books") and a “Student Guide” from Freeman. More classroom notes and an annotated list of other texts are posted on the class web page <[www.cs.berkeley.edu/~wkahan/Math185](http://www.cs.berkeley.edu/~wkahan/Math185)>.

### Topics:

Connection between the Complex Plane and Cartesian or Polar Coordinates for elementary geometry of the Euclidean Plane: Text ch. 1, 31Aug.pdf, Conics.pdf, ConccyclicS.pdf,

Differentiable real vector-valued functions of vector arguments vs. complex differentiable scalar functions of a complex scalar argument, the Cauchy-Riemann equations, locally conformal maps: Text ch. 1, Derivative.pdf

Conformal Stereographic Map between the complex plane and the Riemann Sphere carrying circles to circles (and straight lines as circles of infinite radius in the plane). Möbius functions and Cross-Ratios: Text ch. 1 & §5.2, Mobius.pdf, Cnfrml.pdf

Constructions of Complex Analytic Functions on Open Domains and their Closures:

- Algebraic Expressions, Elementary Transcendental functions: Text, Derivative.pdf
- Implicit Functions (and Riemann Sheets): Text §6.1 & 6.3, Derivative.pdf pp. 6-9
- Derivatives  $f'(z)$  and Path Integrals  $\int_{\gamma} f(z) dz$  of analytic functions: Text ch. 2
  - Homotopy, Goursat's proof of path independence, Morera's theorem
- Integrals of Cauchy Type: Text ch. 2.4
- Differential equations  $df(z)/dz = \dots f(z) \dots$
- Power Series, Taylor Series, Laurent Series, Analytic Continuation
  - The Monodromy Theorem (two versions!): Text §6.1

Harmonic functions and their conjugates

Convergence (Conditional, Absolute, Uniform)

- When is term-by-term differentiation legitimate? ... integration...? Text ch. 3
  - Tests for convergence; Cauchy's, Weierstrass', ...
- Radius of convergence of Power Series from coefficients, from nearest singularity

Singularities, Isolated, Poles, Branch-points, Essential, Removable, Natural boundaries, ...

- Casorati-Weierstrass theorem, Picard's theorem: Text §3.3
- No finite singularities? Entire. Bounded Entire? Liouville's theorem: Text §2.4
- Meromorphic functions (regular on the Riemann Sphere).

The Residue Calculus and its applications to contour integrals: Text ch. 4

Maximum Modulus principle for analytic and harmonic functions, Poisson's integral

- Gauss' Fundamental Th'm of Algebra (Zeros of Polynomials), D'Alembert's Pple.
- Schwarz Lemma

Conformal Maps applied to two-dimensional problems of Mathematical Physics: Text ch 5.

Winding numbers, Counting zeros & poles, Rouché's Theorem, *Schlicht* functions: Text §6.2