

## MATH 313 – GENERAL SYLLABUS

**Texts:** Shaum's outline, **Complex Variables**  
Churchill/Brown or Brown/Churchill, **Complex variables and applications**

### Course Outline:

- Week 1: Basics.
  - Algebra of complex numbers (products, quotients, powers, roots)
  - Geometric representation in the complex plane
  - Cartesian and exponential representations. Euler's Formula.
- Weeks 2-3: Functions of a complex variable.
  - Mapping, images of points, curves, domains
  - Exponential function. Multivalued logarithm, principal branch.
  - preimages of vertical/horizontal lines (level curves of  $u, v$ )
  - Limits,  $\epsilon$ - $\delta$  definition
  - Continuity
- Weeks 3-4: Complex differentiation and Cauchy-Riemann equations.
  - Cauchy-Riemann equations in Cartesian and polar variables
  - Harmonic functions, harmonic conjugates
- Week 5: Catch up and Exam 1
- Week 6-7: Complex integration and Cauchy's Theorem
  - $\int_a^b f(t)dt$ , where  $f(t) = u(t) + iv(t)$
  - Line integrals  $\int_C f(z)dz$ , where  $C$  is a contour
  - Cauchy-Goursat
  - Path independence
  - Cauchy integral formula
  - Analytic functions
  - Maximum principle

- Week 8-9: Series
  - Taylor series
  - Laurent series
  - Differentiation, integration, uniqueness of series
  - Uniform convergence
- Week 9: Catch up and Exam2
- Weeks 10-11: Residues and poles
  - Residue Theorem
  - Residues at poles
  - Evaluating integrals and series using residues
  - Integrals involving sines and cosines
  - Integrals involving branch cuts
- Week 12: Mappings
  - Linear functions
  - Linear fractional transformations
  - Functions  $z^2$ ,  $z^{1/2}$ ,  $e^z$ ,  $\sin(z)$
- Week 13: Catch up and Exam3
- Week 14-15: Conformal mappings and applications
  - Definition and properties
  - Application: temperature distribution
  - Application: two-dimensional fluid flow
  - Application: potential flow past a cylinder
- Week 15: Review
- Wed, May 11, 12:30-2:30pm: Final Exam