

Departmental Syllabus **Math 4530 -- Complex Variables**

Textbook: Complex Variables and Applications (Sixth Edition), by James W. Brown and Ruel V. Churchill

Prerequisites: MATH 2840, or an equivalent course, with a grade of "C" or better

Calculators: No specific calculator required.

Course Description: Complex numbers, complex functions, differentiation, elementary functions, integration, and infinite series.

Course Outline:

Chapter 1: Complex Numbers

1. Sums and Products
2. Algebraic Properties
3. Moduli and Conjugates
4. Triangle Inequality
5. Polar Coordinates and Euler's Formula
6. Products and Quotients in Exponential Form
7. Roots of Complex Numbers
8. Regions in the Complex Plane

Chapter 2: Analytic Functions

9. Functions of a Complex Variable
10. Mappings
11. Limits
12. Theorems on Limits
13. Limits Involving the Point at Infinity
14. Continuity
15. Derivatives
16. Differentiation Formulas
17. Cauchy-Riemann Equations
18. Sufficient Conditions for Differentiability
19. Polar Coordinates
20. Analytic Functions

Chapter 3: Elementary Functions

23. The Exponential Function
24. Trigonometric Functions
25. Hyperbolic Functions
26. The Logarithmic Function and Its Branches
27. Some Identities Involving Logarithms
28. Complex Exponents
29. Inverse Trigonometric and Hyperbolic Functions

Chapter 4: Integrals

30. Complex-Valued Functions $w(t)$
31. Contours
32. Contour Integrals
33. Examples
34. Antiderivatives
35. Examples
36. Cauchy-Goursat Theorem
37. Proof of the Theorem
38. Simply and Multiply Connected Domains
39. Cauchy Integral Formula
40. Derivatives of Analytic Functions

Chapter 5: Series

43. Convergence of Sequences and Series
44. Taylor Series
45. Examples
46. Laurent Series
47. Examples
48. Absolute and Uniform Convergence of Power Series
49. Integration and Differentiation of Power Series
50. Uniqueness of Series Representations
51. Multiplication and Division of Power Series

Chapter 6: Residues and Poles

53. Residues
54. Residue Theorems
55. The Three Types of Isolated Singular Points
56. Residues at Poles
57. Zeros and Poles of Order m

Chapter 7: Applications of Residues

60. Evaluation of Improper Integrals
61. Improper Integrals Involving Sines and Cosines
62. Definite Integrals Involving Sines and Cosines
63. Indented Paths
64. Integration along a Branch Cut

(This outline is meant to be a guide. Individual topics may be added or deleted according to the preference of the instructor).