

Contents

1 Review of Foundational Concepts	1
1.1 Sequences and Series	1
1.2 Integrals	11
1.3 Two Dimensions	13
1.4 Analytic Functions	18
Problems	22
2 Evaluation of Definite Integrals I: The Residue Theorem and Friends	25
2.1 Poles	25
2.1.1 Cauchy's Theorem in the Presence of a Pole	26
2.1.2 The Residue Theorem is a Shortcut	32
2.2 Branch Points	34
2.3 Poles and Branch Points	39
Problems	47
3 Evaluation of Definite Integrals II: Applications to Various Types of Integrals	49
3.1 Integrands Defined Over $[0, \infty)$	49
3.2 Integration Over the Unit Circle	58
3.3 Residue Reduction Contours	75
3.4 Definite Integrals Evaluated Between Branch Points	85
3.5 Sums	91
Problems	99
4 Cauchy Principal Value	103
4.1 Removable Singularities	103
4.2 Poles on Contours	117
4.3 The Hilbert Transform	125
Problems	134

5 Integral Transforms	137
5.1 The Fourier Transform	139
5.2 Laplace Transforms	171
5.3 Two-Sided Laplace and Mellin Transforms	193
Problems	202
6 Asymptotic Methods	205
6.1 Asymptotic Expansions	205
6.2 The Monotonic h-Transform and a New Complex Integration Technique	217
6.3 Euler-Maclurin Summation	230
Epilogue	237