

**SAMPLE:** *Advanced Analytic Methods in Applied Mathematics, Science, and Engineering*  
by Hung Cheng ISBN: 0975862510

# Contents

<b>1</b>	<b>The Algebra of Operators</b>	<b>1</b>
A.	Calculus . . . . .	1
B.	Ordinary Differential Equations . . . . .	7
<b>2</b>	<b>Complex Analysis</b>	<b>35</b>
A.	Complex Numbers and Complex Variables . . . . .	35
B.	Analytic Functions . . . . .	41
C.	The Cauchy Integral Theorem . . . . .	47
D.	Evaluation of Real Integrals . . . . .	59
E.	Branch Points and Branch Cuts . . . . .	70
F.	Fourier Integrals and Fourier Series . . . . .	87
G.	The Laplace Transform . . . . .	105
<b>3</b>	<b>First-Order Partial Differential Equations</b>	<b>117</b>
A.	Trivial Example . . . . .	118
B.	Linear Homogeneous PDEs . . . . .	119
C.	Quasi-Linear PDEs . . . . .	127
D.	General Case . . . . .	134
<b>4</b>	<b>Second-Order Partial Differential Equations</b>	<b>145</b>
A.	The Laplace Equation . . . . .	145
B.	The Wave Equation . . . . .	158
C.	The Heat Equation . . . . .	161
<b>5</b>	<b>Separation of Variables</b>	<b>175</b>
A.	The Laplace Equation . . . . .	176
B.	The Wave Equation with Two Spatial Variables . . . . .	186
C.	The Schrödinger Equation . . . . .	192

<b>6 Singular Points of Ordinary Differential Equations</b>	<b>201</b>
A. Taylor Series Solutions . . . . .	201
B. Frobenius method . . . . .	208
C. Solutions Near an Irregular Singular Point . . . . .	220
Appendix: The Gamma Function . . . . .	235
<b>7 The WKB Approximation</b>	<b>239</b>
A. WKB in the Zeroth and the First Order . . . . .	239
B. Solutions Near an Irregular Singular Point . . . . .	246
C. Higher-Order WKB Approximation . . . . .	252
D. Turning Points . . . . .	255
<b>8 Asymptotic Expansions of Integrals</b>	<b>269</b>
A. Integral Representation . . . . .	269
B. The Laplace Method . . . . .	273
C. Method of Stationary Phase . . . . .	293
D. The Saddle Point Method . . . . .	309
Appendix A: Gaussian Integrals . . . . .	337
Appendix B: Infinite Contours . . . . .	337
<b>9 Boundary Layers and Singular Perturbation</b>	<b>347</b>
A. Regular Perturbation . . . . .	347
B. Boundary Layer Theory . . . . .	349
C. Turning Points . . . . .	364
D. Turning Point at an Endpoint . . . . .	373
E. Interior Turning Points . . . . .	380
F. Other Problems . . . . .	384
<b>10 Small Nonlinear Oscillations</b>	<b>405</b>
A. Summing Leading Terms . . . . .	405
B. Renormalized Perturbation—The Improved Poincare Method . .	414
C. The Two-Scale Method . . . . .	430
D. The Renormalized Two-Scale Method . . . . .	443
E. The Renormalization Group . . . . .	453
<b>Appendix of Useful Formulae</b>	<b>461</b>
<b>Bibliography</b>	<b>471</b>
<b>Index</b>	<b>487</b>