

---

# **Table of Contents**

TIE	6.31	Gamma function	540
2SE	6.12	Beta function	544
2EF	6.23	Error functions	545
1ef	6.34	Legendre polynomials	545
1OE	6.45	Sine, cosine, and exponential integrals	549
1OE	6.56	Special functions of mathematical physics	549
1OE	6.67	Orthogonal functions and series	555
1OE	6.78	Fourier series	555
1OE	6.89	Complex analysis	559
1OE	6.90	Interval analysis	565
1OE	6.91	Real analysis	66
1OE	6.92	Generalized functions	76
<b>Chapter 1</b>			
<b>Analysis</b>			<b>1</b>
<b>1.1</b>	Constants	3	
<b>1.2</b>	Special numbers	10	
<b>1.3</b>	Series and products	31	
<b>1.4</b>	Fourier series	48	
<b>1.5</b>	Complex analysis	53	
<b>1.6</b>	Interval analysis	65	
<b>1.7</b>	Real analysis	66	
<b>1.8</b>	Generalized functions	76	
<b>Chapter 2</b>			
<b>Algebra</b>			<b>79</b>
<b>2.1</b>	Proofs without words	81	
<b>2.2</b>	Elementary algebra	83	
<b>2.3</b>	Polynomials	89	
<b>2.4</b>	Number theory	93	
<b>2.5</b>	Vector algebra	131	
<b>2.6</b>	Linear and matrix algebra	137	
<b>2.7</b>	Abstract algebra	160	
<b>Chapter 3</b>			
<b>Discrete Mathematics</b>			<b>197</b>
<b>3.1</b>	Symbolic logic	199	
<b>3.2</b>	Set theory	202	
<b>3.3</b>	Combinatorics	206	
<b>3.4</b>	Graphs	219	
<b>3.5</b>	Combinatorial design theory	241	
<b>3.6</b>	Communication theory	253	
<b>3.7</b>	Difference equations	265	
<b>3.8</b>	Discrete dynamical systems and chaos	272	
<b>3.9</b>	Game theory	274	
<b>3.10</b>	Operations research	280	
<b>Chapter 4</b>			
<b>Geometry</b>			<b>297</b>
<b>4.1</b>	Coordinate systems in the plane	299	
<b>4.2</b>	Plane symmetries or isometries	305	
<b>4.3</b>	Other transformations of the plane	312	
<b>4.4</b>	Lines	314	

---

<b>4.5</b>	Polygons . . . . .	317
<b>4.6</b>	Conics . . . . .	325
<b>4.7</b>	Special plane curves . . . . .	336
<b>4.8</b>	Coordinate systems in space . . . . .	345
<b>4.9</b>	Space symmetries or isometries . . . . .	348
<b>4.10</b>	Other transformations of space . . . . .	352
<b>4.11</b>	Direction angles and direction cosines . . . . .	353
<b>4.12</b>	Planes . . . . .	354
<b>4.13</b>	Lines in space . . . . .	355
<b>4.14</b>	Polyhedra . . . . .	357
<b>4.15</b>	Cylinders . . . . .	361
<b>4.16</b>	Cones . . . . .	361
<b>4.17</b>	Surfaces of revolution: the torus . . . . .	363
<b>4.18</b>	Quadrics . . . . .	364
<b>4.19</b>	Spherical geometry & trigonometry . . . . .	368
<b>4.20</b>	Differential geometry . . . . .	373
<b>4.21</b>	Angle conversion . . . . .	381
<b>4.22</b>	Knots up to eight crossings . . . . .	382

## **Chapter 5**

Continuous Mathematics . . . . .	<b>383</b>
----------------------------------	------------

<b>5.1</b>	Differential calculus . . . . .	385
<b>5.2</b>	Differential forms . . . . .	395
<b>5.3</b>	Integration . . . . .	398
<b>5.4</b>	Table of indefinite integrals . . . . .	412
<b>5.5</b>	Table of definite integrals . . . . .	448
<b>5.6</b>	Ordinary differential equations . . . . .	456
<b>5.7</b>	Partial differential equations . . . . .	468
<b>5.8</b>	Eigenvalues . . . . .	477
<b>5.9</b>	Integral equations . . . . .	478
<b>5.10</b>	Tensor analysis . . . . .	482
<b>5.11</b>	Orthogonal coordinate systems . . . . .	492
<b>5.12</b>	Control theory . . . . .	497

## **Chapter 6**

Special Functions . . . . .	<b>499</b>
-----------------------------	------------

<b>6.1</b>	Trigonometric or circular functions . . . . .	503
<b>6.2</b>	Circular functions and planar triangles . . . . .	512
<b>6.3</b>	Inverse circular functions . . . . .	518
<b>6.4</b>	Ceiling and floor functions . . . . .	520
<b>6.5</b>	Exponential function . . . . .	520
<b>6.6</b>	Logarithmic functions . . . . .	522
<b>6.7</b>	Hyperbolic functions . . . . .	523
<b>6.8</b>	Inverse hyperbolic functions . . . . .	527
<b>6.9</b>	Gudermannian function . . . . .	530
<b>6.10</b>	Orthogonal polynomials . . . . .	532

---

<b>6.11</b>	Gamma function . . . . .	540
<b>6.12</b>	Beta function . . . . .	544
<b>6.13</b>	Error functions . . . . .	545
<b>6.14</b>	Fresnel integrals . . . . .	547
<b>6.15</b>	Sine, cosine, and exponential integrals . . . . .	549
<b>6.16</b>	Polylogarithms . . . . .	551
<b>6.17</b>	Hypergeometric functions . . . . .	552
<b>6.18</b>	Legendre functions . . . . .	554
<b>6.19</b>	Bessel functions . . . . .	559
<b>6.20</b>	Elliptic integrals . . . . .	568
<b>6.21</b>	Jacobian elliptic functions . . . . .	572
<b>6.22</b>	Clebsch–Gordan coefficients . . . . .	574
<b>6.23</b>	Integral transforms: Preliminaries . . . . .	576
<b>6.24</b>	Fourier transform . . . . .	576
<b>6.25</b>	Discrete Fourier transform (DFT) . . . . .	582
<b>6.26</b>	Fast Fourier transform (FFT) . . . . .	584
<b>6.27</b>	Multidimensional Fourier transform . . . . .	585
<b>6.28</b>	Laplace transform . . . . .	585
<b>6.29</b>	Hankel transform . . . . .	589
<b>6.30</b>	Hartley transform . . . . .	591
<b>6.31</b>	Hilbert transform . . . . .	591
<b>6.32</b>	Z-Transform . . . . .	594
<b>6.33</b>	Tables of transforms . . . . .	599

## *Chapter 7*

Probability and Statistics . . . . .	615
--------------------------------------	-----

<b>7.1</b>	Probability theory . . . . .	617
<b>7.2</b>	Classical probability problems . . . . .	627
<b>7.3</b>	Probability distributions . . . . .	630
<b>7.4</b>	Queuing theory . . . . .	637
<b>7.5</b>	Markov chains . . . . .	640
<b>7.6</b>	Random number generation . . . . .	644
<b>7.7</b>	Control charts and reliability . . . . .	650
<b>7.8</b>	Risk analysis and decision rules . . . . .	656
<b>7.9</b>	Statistics . . . . .	658
<b>7.10</b>	Confidence intervals . . . . .	666
<b>7.11</b>	Tests of hypotheses . . . . .	669
<b>7.12</b>	Linear regression . . . . .	682
<b>7.13</b>	Analysis of variance (ANOVA) . . . . .	686
<b>7.14</b>	Probability tables . . . . .	695
<b>7.15</b>	Signal processing . . . . .	718

## *Chapter 8*

Scientific Computing . . . . .	727
--------------------------------	-----

<b>8.1</b>	Basic numerical analysis . . . . .	728
<b>8.2</b>	Numerical linear algebra . . . . .	740

---

<b>8.3</b>	Numerical integration and differentiation . . . . .	750
<b>8.4</b>	Programming techniques . . . . .	777
<b>Chapter 9</b>		
Financial Analysis . . . . .		779
<b>9.1</b>	Financial formulae . . . . .	779
<b>9.2</b>	Financial tables . . . . .	783
<b>Chapter 10</b>		
Miscellaneous . . . . .		791
<b>10.1</b>	Units . . . . .	792
<b>10.2</b>	Interpretations of powers of 10 . . . . .	798
<b>10.3</b>	Calendar computations . . . . .	799
<b>10.4</b>	AMS classification scheme . . . . .	801
<b>10.5</b>	Fields medals . . . . .	802
<b>10.6</b>	Greek alphabet . . . . .	803
<b>10.7</b>	Computer languages . . . . .	803
<b>10.8</b>	Professional mathematical organizations . . . . .	804
<b>10.9</b>	Electronic mathematical resources . . . . .	807
<b>10.10</b>	Biographies of mathematicians . . . . .	810
List of references . . . . .		817
List of figures . . . . .		821
List of notation . . . . .		823
Index . . . . .		835
<b>Chapter 6</b>		
Special Functions . . . . .		
<b>6.1</b>	Trigonometric or circular functions . . . . .	503
<b>6.2</b>	Circular functions and planar triangles . . . . .	512
<b>6.3</b>	Inverse circular functions . . . . .	518
<b>6.4</b>	Ceiling and floor functions . . . . .	520
<b>6.5</b>	Exponential function . . . . .	520
<b>6.6</b>	Logarithmic functions . . . . .	522
<b>6.7</b>	Hyperbolic functions . . . . .	527
<b>6.8</b>	Inverse hyperbolic functions . . . . .	527
<b>6.9</b>	Gudermannian function . . . . .	530
<b>6.10</b>	Orthogonal polynomials . . . . .	532