

# Index

- Airy equation 50, 64, 87  
 Airy functions 50, 89, 244  
 alternating symbol 5–6  
 analytic functions 103  
 associated Legendre functions 47, 213  
 asymptotic series 30
- Bernoulli's equation 59–61  
 Bessel equation 22, 31, 44, 213  
 Bessel functions 22, 31–45, 181–2, 213,  
 215–16  
 Bessel functions (modified) 42–5  
 beta function 26  
 biharmonic equation 192  
 Bohr–Sommerfeld formula 96  
 boundary conditions 194  
 brachistochrone 231  
 branch points 100, 150–4, 179–80  
 branches of a complex function 100, 108  
 Bromwich contour 175–80, 216
- calculus of variations 224–45  
 canonic form 203  
 catenary 233  
 catenoid 233  
 Cauchy conditions 194  
 Cauchy Integral Formula 116  
 Cauchy Residue Theorem 131–4  
 Cauchy–Riemann equations 105  
 Cauchy's Theorem 112–16  
 characteristics 195–205  
 $Ci$  function 28  
 complementary error function 29–31,  
 167–9, 215, 217–18  
 complex derivatives 103–8  
 complex functions 98–136  
 complex integration 109–12  
 complex numbers 98–9
- constraints 238–40  
 contour integration 98–136  
 contravariant vectors 15–18  
 convolution theorem 164–6, 185  
 coordinate systems 9–13  
 coordinate transformations 13–14  
 covariant vectors 16–18  
 curl of a vector 8–11, 13  
 cycloid 232  
 cylindrical polar coordinates 10–12
- differential equations  
   non-linear 53–73  
   approximate solution of 75–96  
   partial 190–218  
 diffusion equation 192, 208–11, 214–18  
 Dirac delta functions 170–1  
 direct methods (in the calculus of  
   variations) 240–5  
 Dirichlet conditions 194  
 divergence of a vector 8–13  
 Duffing's equation 68–73  
 dummy indices 3–4
- eigenvalues 88–90, 244–5  
 elliptic equations 193–4  
 elliptic integrals 67–70  
 error function 28–31, 167–9  
 Euler's constant 26, 44  
 Euler's equation 202–5  
   in the calculus of variations 225–35  
 Euler's formula 99, 101  
 exponential integral function 28  
 extremal curve 227, 233
- factorial function 23  
 Fourier cosine transform 183–6

Fourier sine transform 184–6, 217  
 Fourier transform 161, 183–7  
 Fredholm equation 186  
 free indices 3–4  
 Frobenius series 31–6, 78–9  
 functional 224  
 functions  
   Airy 50, 89, 244  
   associated Legendre 47, 213  
   Bessel 22, 31–45, 181–2, 213, 215–16  
   beta 26  
   *Ci* 28  
   complementary error function 29–31,  
     167–9, 215, 217–18  
   Dirac delta 170–1  
   error 28–31, 167–9, 216–18  
   exponential (complex) 101–2  
   exponential integral ( $E_1$ ) 28  
   factorial 23  
   gamma 23–8  
   Heaviside step 169–71  
   incomplete gamma 26–7  
   Legendre (associated) 47, 213  
   logarithmic (complex) 102  
   Neumann 37  
   *Si* 28  
   sign 167  
   Weber 37  
   Weber–Hermite 49, 88

gamma function 23–8  
   incomplete 26–7  
 generalised coordinates 234–6  
 generating function 39, 44, 46, 48–9  
 gradient of a scalar 8–13  
 Green's Theorem 113

heat conduction equation 192, 208–11,  
 214–18  
 Heaviside step function 169–71  
 Helmholtz equation 192  
 Hermite polynomials 48–9, 88  
 hyperbolic equations 193–4, 204

incomplete gamma function 26–7  
 integral equations 182–3, 186–7  
 integral transforms 161, 214–18  
 integration (contour) 98–134, 137–58  
 inverse transforms 162, 173–80, 183–4  
 isolated singularity 121

kernel 161  
 Klein–Gordon equation 192  
 Kronecker delta 4–5, 15–16

Lagrange's equations 234–7  
 Lagrangian 235  
 Laguerre polynomials 48  
 Lane–Emden equation 65–6  
 Laplace inversion 173–80  
 Laplace transform 161–83  
 Laplace's equation 192  
 Laurent series 120–5  
 Laurent's Theorem 121–5  
 Legendre polynomials 45–7  
 Liouville–Green technique 90–6  
 Lipschitz condition 82  
 logarithmic (complex) function 102  
 Lommel integrals 45

metric 19  
 minimum sequence 241  
 modified Bessel functions 42–5  
 multi-valued functions 100, 108

Neumann conditions 194  
 Neumann function 37  
 non-linear differential equations 53–73  
 non-linear pendulum 66–8, 235–6  
 normal form 83–4, 91

ordinary differential equations  
   special functions 22–50  
   non-linear 53–73  
   approximate solution of 75–96  
 orthogonal coordinate systems 9–13

parabolic equations 193–4, 203  
 partial differential equations 190–218  
 perturbation series 82–3  
 phase-plane 70–3  
 Picard iterative method 79–82  
 Poisson equation 192  
 poles 125–34  
 principal part (of a Laurent series)  
   122–5  
 principal value  
   of a complex function 102  
   of an integral 146–50  
 Principle of Superposition 53, 205

Rayleigh–Ritz method 240–3  
 recurrence relations 23–4, 39–41, 45–6,  
 48–9  
 reflection formula 26  
 regular functions 104  
 residue theorem (Cauchy) 131–4  
 residues (calculation of) 125–31  
 Riccati equation 61–4, 80

Cambridge University Press

0521363128 - Advanced Mathematical Methods for Engineering and Science Students

G. Stephenson and P. M. Radmore

Index

[More information](#)*Index*

255

- scalar 16–17, 19
- scalar (dot) product of vectors 1
- Schrödinger equation 192, 211–14
- Schwarzian derivative 91
- separation of variables 205–14
- shift theorem 163–4
- Si* function 28
- sign function 167
- simple poles 126–9
- singularities 104, 107, 120–34
  - isolated 121
- special functions 22–50
- spherical polar coordinates 12–13
- Stirling's formula 27–8
- Sturm–Liouville form 89–90
- suffix notation 1–19
- summation convention 1–3
- summation of series 154–8
- Taylor series 120–5
- Taylor's Theorem 120–1
- tensor algebra 1–19
- van der Pol equation 73
- vector operators 8–9
- vector product 6
- Volterra equation 182–3
- wave equation 191–2, 204
- Weber function 37
- Weber–Hermite function 49, 88
- Wentzel–Kramers–Brillouin (WKB)
  - method 84–8