
Index

- Acoustic pressure, 22
- Acoustic wave speed, 95
- Acoustic waves, 1–285
 - acoustic pressure, 22
 - boundary conditions, 29–31
 - at impenetrable object, 30–31
 - at interface, 29–30
 - causality conditions, 71–75
 - Kramers–Kronig relations, 72
 - Bode relations, 73
 - compatibility relation, 34
 - constitutive coefficients:
 - compressibility, 26, 27
 - compliance relaxation function, 27–28
 - inertia relaxation function, 27–28
 - inverse, 35–36
 - volume density of mass, 26, 27
 - constitutive properties, 25–28
 - (an)isotropy, 26
 - (in)homogeneity, 26
 - linearity, 25
 - local reactivity, 26
 - relaxation, 25–26
 - time invariance, 25
 - cubic dilatation, 34
 - cubic dilatation rate, 24
 - deformation rate equation, 24–25
 - direct scattering problem, 193–199.
 - See also* Acoustic waves, scattering of
 - direct source problem, 181–193
 - equation of motion, 20–24
 - energy relations, 37–43
 - deformation energy, 38, 42, 43
 - dissipated power, 42, 43
 - kinetic energy, 38, 39, 42
 - Poynting vector, 38, 42
 - power flow, 38, 42
 - frictional-force/bulk-viscosity loss
 - mechanism, 41–43
 - Huygens’ principle, 218–219
- Acoustic waves,
 - in configurations with symmetry, 51–68
 - symmetry with respect to a line, 58–63
 - symmetry with respect to a plane, 52–58
 - symmetry with respect to a point, 63–68
 - in the complex frequency domain, 69–81
 - Bode causality relations, 73
 - boundary conditions, 75–76
 - compatibility relation, 79
 - constitutive relations, 71–75
 - coupled acoustic wave equations, 76–77
 - deformation rate equation, 70–71
 - equation of motion, 70–71
 - frictional-force/bulk-viscosity loss
 - mechanism, 77
 - Green’s functions, 80–81
 - Kramers–Kronig causality relations, 78
 - point-source solutions, 80–81
 - scalar potential, 77–80
 - vector potential, 77–80
 - in angular wave-vector space, 83–86
 - initial-value problem, 122–125
 - inverse scattering problem, 205–212
 - inverse source problem, 199–205
 - longitudinal impedance per length, 76
 - loss mechanism, frictional-force/
 - bulk-viscosity, 41–43, 77
 - low-velocity linearisation, 31–34
 - mass flow density, 11–13, 34
 - mass flow density rate, 24
 - null-field method, 219
 - Oseen’s extinction theorem, 218
 - particle velocity, 24
 - plane waves, 127–147
 - attenuation coefficient, 134–140
 - attenuation vector, 133–140
 - dispersion equation, 128, 129, 134, 137
 - energy transmission, 142
 - non-uniform, 128, 130
 - phase coefficient, 134–140

- Acoustic waves,
 plane waves,
 phase vector, 133–140
 propagation coefficient, 128
 propagation factor, 127
 propagation vector, 127
 slowness, 131
 slowness surface, 130–133
 slowness vector, 130
 uniform, 128–130, 131, 140–144
 wave admittance, 128, 129, 141
 wave impedance, 130, 141
 wavelength, 143
 radiation of, 83–125
 far-field radiation characteristics, 116–119,
 119–122
 from dipole transducer, 111–116
 from monopole transducer, 106–111
 Green's functions, 47–48, 181–193
 point-source solutions, 47–48, 181–193
 scalar potential, 44–47
 source potentials, 85–86, 90, 94, 105
 source-type integral representations,
 89–93, 93–97, 104–106, 181–193,
 212–220
 vector potential, 44–47
 reciprocity, 149–220
 reciprocity properties:
 for transmission/reception, 173–177,
 177–181
 of Green's functions, 189–192
 of plane wave far-field scattering
 amplitudes, 231–239, 240–249
 reciprocity theorems, 149–173
 of the time convolution type, 157–160,
 164–169
 of the time correlation type, 160–164,
 169–173
 scattering of, 221–285.
See also Acoustic waves, direct scattering
 problem; Acoustic waves, inverse
 scattering problem.
 boundary integral equation method, 226,
 229
 domain integral equation method, 226,
 229
 extinction cross section, 254
 extinction cross-section theorem, 254
 plane wave far-field amplitude reciprocity,
 231–239, 240–249
 plane wave far-field energy theorem,
 249–253
 plane wave far-field scattering coefficient,
 235, 239
 Neumann solution, 254–258
 null-field method, 226, 230
- Acoustic waves,
 scattering of,
 Rayleigh–Gans–Born approximation
 (first-order), 259–285
 shape factor (for canonical geometries of
 scattering object), 260–268,
 269–285
 shape factor (of scattering object), 260, 269
 SI-units, 49
 superposition, principle of, 51–52
 time evolution of. *See* Acoustic waves,
 initial-value problem
 traction, 20
 transverse admittance per length, 76
 volume density of force, 20
 volume density of mass, 11
 volume density of volume injection rate, 24
 wave speed, 95
- Admittance matrix (of electromagnetic system
 accessible via low-frequency ports),
 947
- Angular frequency, 69, 367, 693
 Angular wave vector, 84, 382, 720, 1060
 Anisotropy *See* Constitutive properties
- Antennas,
 surface action (aperture), 835, 839–840
 reciprocity of, 835, 839–840
 volume action, 833–834, 837–839
 reciprocity of, 833–834, 837–839
- Area density of power flow. *See* Poynting vector
- Barycentric coordinates, 1028
- Base vectors, linearly independent set of
 in affine space, 993
 in Euclidean space, 996
 reciprocal set of, 1013
- Bode causality relations, 1070
 for acoustic wave fields, 73
 for elastic wave fields, 371
 for electromagnetic wave fields, 697–698
- Boundary conditions
 in acoustic wave theory, 29–31
 in elastic wave theory, 322–324
 in electromagnetic wave theory, 647–652
- Boundary integral equation method
 in acoustic wave scattering, 226, 229
 in elastic wave scattering, 511, 516
 in electromagnetic wave scattering, 884, 887
- Bromwich inversion integral, 1053
- Cartesian coordinates, xxviii
 Cartesian tensors, 991–1047
 addition of, 1003–1004
 base vectors for the definition of,
 in affine space, 993
 in Euclidean space, 996

- Cartesian tensors,
 - base vectors for the definition of, reciprocal set of, 1013
- Cauchy–Schwarz inequality, 1000, 1007, 1008
- definition of, 1001
- differentiation of, 1019–1023
 - with respect to a parameter, 1021
 - with respect to the spatial coordinates, 1021–1022
- directional derivative of, 1020
- Gauss’ integral theorem for, 1045–1047
- integration of, 1032–1043
 - along a curve in space, 1033–1034
 - over a domain and its boundary surface, 1034–1042
 - with respect to a parameter, 1032–1033
- multiplication of, 1004–1006
- subscript notation, 992
- subtraction of, 1003–1004
- summation convention, 992
- symmetry properties of, 1008–1009
 - antisymmetrical part, 1009
 - symmetrical part, 1009
- Taylor expansion of, 1043–1044
- triangle inequality, 995
- unit tensors, 1010–1016
 - antisymmetrical, of rank four, 1016
 - diagonalising, of rank four, 1014–1015
 - Kronecker tensor, 1010–1011
 - Levi–Civita tensor, 1011–1014
 - symmetrical, of rank four, 1015–1016
- Cauchy–Schwarz inequality, 1000, 1007, 1008
- Causality conditions
 - for acoustic wave fields, 71–75
 - for elastic wave fields, 369–378
 - for electromagnetic wave fields, 695–698
- Causality relations. *See* Bode causality relations; Kramers–Kronig causality relations
- Collision frequency, 634
- Co-moving time derivative, 17, 303, 633
- Compatibility relations
 - for acoustic wave fields, 34
 - for electromagnetic wave fields, 612
- Compliance, 317, 318
- Compliance relaxation function
 - in acoustic wave theory, 27–28
 - in elastic wave theory, 319–320
- Compressibility, 26, 27
- Conduction relaxation function, 620–621
 - of electron plasma, 639–641, 702
 - of metal, 632–639, 698–702
 - of superconductor, 636
- Conductivity, 618–619, 619–620, 634
- Configurations with symmetry:
 - symmetry with respect to a line, acoustic waves in, 58–63
- Configurations with symmetry:
 - symmetry with respect to a line, elastic waves in, 356–361
 - electromagnetic waves in, 681–686
 - symmetry with respect to a plane, acoustic waves in, 52–58
 - elastic waves in, 350–356
 - electromagnetic waves in, 674–681
 - symmetry with respect to a point, acoustic waves in, 63–68
 - elastic waves in, 361–366
 - electromagnetic waves in, 686–691
- Conservation properties
 - of electric charge, 628
 - of mass, 13, 299,
 - of particles in particle flow, 9–11, 15, 16–19, 295–297, 301, 302–305, 624
- Constitutive coefficients.
 - See* Acoustic waves, constitutive coefficients; Elastic waves, constitutive coefficients; Electromagnetic waves, constitutive coefficients
- Constitutive properties.
 - See* Acoustic waves, constitutive properties; Elastic waves, constitutive properties; Electromagnetic waves, constitutive properties
- Continuity equation
 - of electric current, 628
 - of mass flow, 13, 299
 - of particle flow, 11, 297, 626
- Continuum hypothesis (in spatial averaging theory)
 - in acoustic wave theory, 8
 - in elastic wave theory, 294
 - in electromagnetic wave theory, 622
- Convolution
 - in space, 1062–1063
 - Fourier transform of, 1062–1063
 - in time, 1052
 - Laplace transform of, 1052
- Correlation
 - in space, 1063
 - Fourier transform of, 1063
 - in time, 1052–1053
 - Laplace transform of, 1052–1053
- Cubic dilatation, 34
- Cubic dilatation rate, 24
- Deformation, 327
- Deformation rate, 314
- Deformation rate equation
 - in acoustic wave theory, 24–25
 - in elastic wave theory, 313–315
- Determinant (of a set of linearly independent vectors), 1011–1012

- Dielectric relaxation function
 - of isotropic dielectric (Lorentz model for), 642–644, 702–706
- Dipole transducer, acoustic radiation from, 111–116
- Direct scattering problem
 - in acoustic wave theory, 193–199
 - in elastic wave theory, 475–481
 - in electromagnetic wave theory, 851–857
- Direct source problem
 - in acoustic wave theory, 181–193
 - in elastic wave theory, 463–475
 - in electromagnetic wave theory, 840–851
- Domain integral equation method
 - for scattering of acoustic waves, 226, 229
 - for scattering of elastic waves, 511, 516
 - for scattering of electromagnetic waves, 884, 887
- Elastic waves, 289–597
 - boundary conditions, 322–324
 - at impenetrable object, 323–324
 - at interface, 322–323
 - causality conditions, 369–372
 - Kramers–Kronig relations, 370
 - Bode relations, 371
 - constitutive coefficients:
 - compliance, 317, 318
 - compliance relaxation function, 319–320
 - inertia relaxation function, 319–320
 - inverse, 327–329
 - Lamé coefficients, 320
 - stiffness, 319
 - volume density of mass, 317–318
 - constitutive properties:
 - (an)isotropy, 317
 - (in)homogeneity, 317
 - linearity, 316
 - local reactivity, 316
 - relaxation, 316
 - time invariance, 316
 - deformation, 327
 - deformation rate, 314
 - external, 314
 - deformation rate equation, 313–315
 - dilatational waves (equivalent fluid model for), 343–347
 - direct scattering problem, 475–481.
 - See also* Elastic waves, scattering of
 - direct source problem, 463–475
 - dynamic stress, 308, 310, 326
 - elastodynamic wave equation, 341–343
 - equation of motion, 305–311
 - energy relations, 330–334, 335–337
 - deformation energy, 331, 335
 - dissipated power, 335, 336
- Elastic waves,
 - energy relations,
 - kinetic energy, 331, 335, 336
 - Poynting vector, 331, 335
 - power flow, 331, 336
 - frictional-force/viscosity loss mechanism, 334–335
 - Huygens' principle, 501
 - in configurations with symmetry, 349–366
 - symmetry with respect to a line, 356–361
 - symmetry with respect to a plane, 350–356
 - symmetry with respect to a point, 361–366
 - in the complex frequency domain, 367–380
 - Bode causality relations, 371
 - boundary conditions, 372–373
 - constitutive relations, 369–372
 - coupled elastic wave equations, 373–374
 - deformation rate equation, 368
 - dilatational waves (equivalent model for), 378–370
 - equation of motion, 368
 - Green's functions, 376–377
 - Kramers–Kronig causality relations, 370
 - tensor potential, 374–377
 - vector potential, 374–377
 - in angular wave-vector space, 381–384, 384–385
 - initial-value problem, 407–411
 - inverse scattering problem, 487–494
 - inverse source problem, 481–487
 - longitudinal impedance per length, 373
 - low-velocity linearisation, 325–327
 - mass flow density, 297, 311, 327
 - mass flow density rate, 311
 - Oseen's extinction theorem, 501
 - P*-wave speed, 383
 - particle velocity, 307
 - plane waves, 413–427
 - attenuation coefficient, 420–421
 - attenuation vector, 420–423
 - dispersion equation, 414
 - energy transmission, 425–426
 - non-uniform, 414
 - P*-wave, 415, 418–419
 - phase coefficient, 420–421
 - phase vector, 420–423
 - propagation coefficient, 414
 - propagation factor, 413
 - propagation vector, 413
 - S*-wave, 415, 418–419
 - slowness, 417
 - slowness surface, 417
 - slowness vector, 417
 - uniform, 414
 - wave admittance, 425
 - wave impedance, 426

- Elastic waves,
 plane waves,
 wavelength, 427
 radiation of, 381–411
 far-field radiation characteristics,
 398–403, 403–407
 from point source, 396–398
 Green's functions, 340–341, 463–475
 P-waves, 391–392
 point-source solutions, 340–341, 463–475
 S-waves, 391–392
 source potentials, 389–390, 394–395
 source-type integral representations,
 389–393, 394–396, 463–475,
 494–503
 tensor potential, 337–339
 vector potential, 337–339
 reciprocity, 429–503
 reciprocity properties
 for transmission/reception, 455–459,
 459–463
 of Green's functions, 471–474
 of plane wave far-field scattering
 amplitudes, 517–534, 534–551
 reciprocity theorems, 429–455
 of the time convolution type, 437–441,
 445–450
 of the time correlation type, 441–445,
 450–455
 S-wave speed, 383–384
 scattering of, 505–597.
See also Elastic waves, direct scattering
 problem; Elastic waves, inverse
 scattering problem.
 boundary integral equation method, 511,
 516
 domain integral equation method, 511, 516
 extinction cross section, 559, 560
 extinction cross-section theorem, 558–560
 Neumann solution, 560–565
 null-field method, 511, 516
 plane wave far-field amplitude reciprocity,
 517–534, 534–551
 plane wave far-field energy theorem,
 551–558
 plane wave far-field scattering tensor, 523,
 525
 Rayleigh–Gans–Born approximation
 (first-order), 565–597
 shape factor (for canonical geometries of
 scattering object), 570–578,
 582–597
 shape factor (of scattering object), 567,
 569
 SI-units, 347–348
 stress (dynamic), 308, 310, 326
- Elastic waves,
 superposition, principle of, 349–350
 time evolution of. *See* Elastic waves,
 initial-value problem
 traction, 306
 transverse admittance per length, 373
 volume density of force, 306
 volume density of deformation rate, 314
 volume density of mass, 297
 wave impedance,
 P-wave, 403
 S-wave, 403
- Electric charge,
 volume density of, 627
- Electric current, 631–632
 volume density of, 610, 627
- Electric dipole, radiating,
 in spherical shield, 979–983
- Electric dipole antenna, radiation from, 752–757
- Electric flux density, 611
- Electric point charge, 606
 force on, 605–607
 electric force on, 607
 magnetic force on, 607
- Electric polarisation, 610
- Electric susceptibility, 618–619, 619–620
- ElectroMagnetic Compatibility (EMC), 943–988
 level of a quantity in, 969–970
 standard test pulse shapes in, 970–974
 double exponential pulse, 970–972
 piecewise linear, continuous pulse,
 976–978
 spectral plot of, 970–974
 trapezoidal pulse, 972–974
 triangular pulse, 978–979
 terminology, 967–969, 975
- ElectroMagnetic Interference (EMI), 967–979
 emission analysis, 947–950
 of current-carrying wire segment, 752–757
 of current-carrying loop, 757–762
 susceptibility analysis, 950–959
 in the Norton representation, 954, 957, 962
 in the Thevenin representation, 953, 956,
 961
- Electromagnetic low-frequency port systems,
 943–967
 emission analysis of, 947–950
 input admittance matrix of, 947
 input impedance matrix of, 947
 interaction between, 959–967
 reciprocity of, 943–947
 susceptibility analysis, 950–959
 in the Norton representation, 954, 957, 962
 in the Thevenin representation, 953, 956,
 961
- Electromagnetic wave speed, 731

- Electromagnetic wave speed,
in vacuum, 608
- Electromagnetic waves, 601–988
- boundary conditions, 647–652
 - at impenetrable object, 650–651, 651–652
 - boundary conditions,
at interface, 647–649
 - causality conditions, 695–698
 - Kramers–Kronig relations, 696
 - Bode relations, 697–698
 - compatibility relations, 612
 - constitutive coefficients:
 - conduction relaxation function, 620–621,
632–639, 639–640, 698–702
 - conductivity, 618–620, 634
 - dielectric relaxation function, 620–621,
642–644, 702–706
 - electric susceptibility, 618–619, 619–620
 - magnetic relaxation function, 620–621
 - magnetic susceptibility, 618–619, 619–
620
 - permeability, 606, 619, 620
 - permittivity, 608, 619, 620
 - constitutive properties, 617–618
 - (an)isotropy, 618
 - (in)homogeneity, 618
 - linearity, 617
 - local reactivity, 618
 - relaxation, 617
 - time invariance, 617
 - direct scattering problem, 851–857.
See also Electromagnetic waves,
scattering of
 - direct source problem, 840–851
 - electric charge, 606
 - volume density of, 626
 - electric current, 631–632
 - volume density of, 610, 626
 - electric field strength, 606
 - electric flux density, 611
 - electric polarisation, 610
 - elementary charge, 622
 - energy relations, 653–666
 - dissipated power, 661, 663
 - electric field energy, 655–657, 661–663
 - magnetic field energy, 655–657, 661–663
 - Poynting vector, 657, 661
 - power flow, 656, 658, 662–663
 - field equations. *See also* Maxwell's equations
 - quasi-static, 613–614
 - force on point charge, 601–608
 - Huygens' principle, 876
 - in configurations with symmetry, 673–691
 - symmetry with respect to a line, 681–686
 - symmetry with respect to a plane, 674–681
 - symmetry with respect to a point, 686–691
- Electromagnetic waves,
in the complex frequency domain, 693–714,
715–718
- Bode causality relations, 697–698
 - boundary conditions, 710–711
 - constitutive relations, 695–710
 - coupled wave equations, 711–714
 - field equations, 694–695
 - Green's functions, 717–718
 - Kramers–Kronig causality relations,
696–697
 - point-source solutions, 717–718
 - vector potentials, 715–717
- in angular wave-vector space, 719–723
- initial-value problem, 768–771
- inverse scattering problem, 863–869
- inverse source problem, 857–863
- longitudinal impedance per length, 712
- loss mechanism, conductive electric/linear
hysteresis magnetic, 740–741
- magnetic current,
volume density of, 610
- magnetic field strength, 606
- magnetic flux density, 611
- magnetic susceptibility, 618–619, 619–620
- magnetisation, 610
- Maxwell's equations, 605–616
 - in matter, 610–613
 - in vacuum, 608–609
- Oseen's extinction theorem, 876
- plane waves, 773–806
 - attenuation coefficient, 782–802
 - attenuation vector, 782–783
 - dispersion equation, 774, 776
 - energy transmission, 804–805
 - non-uniform, 773–775
 - phase coefficient, 782–802
 - phase vector, 782–783
 - propagation coefficient, 775
 - propagation factor, 773
 - propagation vector, 773
 - slowness, 781
 - slowness surface, 780–782
 - slowness vector, 780–782
 - uniform, 775–776
 - wave admittance, 775, 804
 - wave impedance, 775, 804
 - wavelength, 806
- radiation of, 719–771
- far-field radiation characteristics,
762–765, 765–768
 - from electric dipole antenna, 752–757
 - from loop, 757–762
 - from magnetic dipole antenna, 757–762
 - from wire segment, 752–757
 - Green's functions, 670–671, 840–851

- Electromagnetic waves,
 radiation of,
 point-source solutions, 670–671, 840–851
 source potentials, 722–723, 726, 731, 741, 750
 source-type integral representations, 726–730, 730–733, 740–743, 749–752, 840–851, 870–878
 vector potentials, 667–669
- reciprocity, 807–878
 reciprocity properties,
 of Green's functions, 848–850
 of plane wave far-field scattered wave amplitudes, 888–897, 897–906
 reciprocity theorems, 807–832
 for transmission/reception, 832–835, 835–840
 of the time convolution type, 814–818, 822–827
 of the time correlation type, 818–822, 827–832
- scattering of, 879–942.
See also Electromagnetic waves, direct scattering problem;
 Electromagnetic waves, inverse scattering problem
 boundary integral equation method, 884, 887
 domain integral equation method, 884, 887
 extinction cross section, 910
 extinction cross-section theorem, 910
 Neumann solution, 911–915
 null-field method, 884, 887
 plane wave far-field amplitude reciprocity, 888–897, 897–906
 plane wave far-field energy theorem, 906–910
 plane wave far-field scattering tensors, 892, 895
 Rayleigh–Gans–Born approximation (first-order), 915–942
 shape factor (for canonical geometries of scattering object), 917–925, 927–942
 shape factor (of scattering object), 916–917, 926
- SI-units, 615, 644–645, 666
 static distribution of electric charge, 628
 stationary electric current, 628
 superposition, principle of, 673–674
 time evolution of. *See* Electromagnetic waves, initial-value problem
 transverse admittance per length, 711
 volume density of electric charge, 626
 volume density of electric current, 610, 626
- Electromagnetic waves,
 volume density of magnetic current, 610
 wave speed, 731
 in vacuum, 608
- Electron, classical model for, 664–665
 Electron cyclotron angular frequency, 634
 Electron plasma angular frequency, 639
 Emission analysis. *See* ElectroMagnetic Interference (EMI)
- Energy relations (electromagnetic),
 active media, 659–661
 dissipative media, 659–661
 lossless media, 659–661
 passive media, 659–661.
See also Acoustic waves, energy relations;
 Elastic waves, energy relations;
 Electromagnetic waves, energy relations
- Equation of motion
 for acoustic waves, 20–24
 for elastic waves, 305–311
- Extinction cross section (of obstacle)
 for plane acoustic wave scattering, 254
 for plane elastic wave scattering, 559, 560
 for plane electromagnetic wave scattering, 910
- Extinction cross-section theorem
 for plane acoustic wave scattering, 254
 for plane elastic wave scattering, 558–560
 for plane electromagnetic wave scattering, 910
- Extinction theorem. *See* Oseen's extinction theorem
- Ewald–Oseen extinction theorem. *See* Oseen's extinction theorem
- Far-field radiation characteristics
 of acoustic wave radiation, 116–119, 119–122
 of elastic wave radiation, 398–403, 403–407
 of electromagnetic wave radiation, 762–765, 765–768
- Fourier series, 1071–1072
 Bessel's inequality, 1072
 completeness relation, 1072
- Fourier transformation, 1060–1065
 angular wave vector, 1060
 of derivative, 1062
 of localised function in space, 1060–1065
 asymptotic behaviour at infinity, 1062
 of spatial convolution, 1062–1063
 of spatial correlation, 1063
 of spatial derivative, 1062
 of spatial inverse with respect to a point, 1063–1064
 Plancherel's theorem, 1064
 Parseval's theorem, 1064
 Riemann–Lebesgue lemma, 1062

- Gauss' integral theorem, 1045–1047
- Geometrical objects (in N -dimensional Euclidean space), 1023–1031
- ball, 1028
 - block, 1025
 - boundary surface (of a domain), 1029–1031
 - unit normal to, 1031
 - cube, 1025
 - curve, 1023–1025
 - unit tangent vector to, 1025
 - ellipsoid, 1029
 - parallelepiped, 1026
 - parallelogram, 1026
 - rectangle, 1025
 - simplex, 1026–1028
 - sphere, 1028
 - star-shaped domain, 1031
 - unit sphere, 1029
- Green's functions
- for acoustic waves, 47–48, 80–81, 181–193
 - reciprocity properties of, 189–192
 - for elastic waves, 340–341, 376–377, 463–475
 - reciprocity properties of, 471–474
 - for electromagnetic waves, 670–671, 717–718, 840–851
 - reciprocity properties of, 848–850
 - for the dissipative wave equation, 97–104, 734–740
 - for the wave equation, 86–89, 385–389, 723–726
 - for the wave equation associated with superconductivity and a collisionless plasma, 743–749
- Hall coefficient, 638
- Hall effect, 638
- Hilbert transform, 1069
- Huygens' principle
- for acoustic waves, 218–219
 - for elastic waves, 501
 - for electromagnetic waves, 876
- Impedance matrix (of electromagnetic systems accessible via low-frequency ports) 947
- Inertia relaxation function
- in acoustic wave theory, 27–28
 - in elastic wave theory, 319–320
- Inhomogeneity. *See* Constitutive properties
- Initial-value problem
- for acoustic waves, 122–125
 - for elastic waves, 407–411
 - for electromagnetic waves, 768–771
 - for wave equation (Poisson's solution), 124–125, 410–411, 770–771
- Inverse scattering problem
- for acoustic waves, 205–212
 - for elastic waves, 487–494
 - for electromagnetic waves, 863–869
- Inverse source problem
- for acoustic waves, 199–205
 - for elastic waves, 481–487
 - for electromagnetic waves, 857–863
- Jordan's lemma, 1054–1056
- Kirchhoff's law (for electric currents), 631–632
- Kramers–Kronig causality relations, 1065–1070
- for acoustic wave fields, 72
 - for elastic wave fields, 370
 - for electromagnetic wave fields, 696
- Kronecker tensor, 1010–1011
- Lamé coefficients, 320
- Landau order symbols, 1019–1020
- Laplace transformation, 1049–1059
- Bromwich inversion integral for, 1053
 - Cauchy theorem, 1054
 - complex frequency, 1050
 - of a causal time function, 1049–1059
 - asymptotic behavior at infinity, 1051
 - of time convolution, 1052
 - of time correlation, 1052–1053
 - of time derivative, 1051
 - of time reversal, 1053
 - Jordan's lemma, 1054–1056
 - Parseval's theorem, 1058
 - Plancherel's theorem, 1057–1058
 - Schouten–Van der Pol theorem, 1056–1057
- Levi–Civita tensor, 1011–1014
- Linearity. *See* Constitutive properties
- Linearisation. *See* Low-velocity linearisation
- Local reactivity. *See* Constitutive properties
- London equation (in superconductivity), first, 636
- Longitudinal impedance per length
- for acoustic waves, 76
 - for elastic waves, 373
 - for electromagnetic waves, 712
- Lorentz force, 607
- Lorentzian absorption line, 643
- Loss mechanism,
- conductive electric/linear hysteresis magnetic, 740–741
 - frictional-force/bulk-viscosity, acoustic, 41–43, 77
- Low-velocity linearisation
- in acoustic wave motion, 31–34
 - in elastic wave motion, 325–327

- Magnetic current, volume density of, 610
- Magnetic dipole, radiating,
in spherical shield, 984–988
- Magnetic dipole antenna, radiation from,
757–762
- Magnetic flux density, 611
- Magnetic susceptibility, 618–619, 619–620
- Magnetisation, 610
- Mass flow density
in acoustic wave motion, 11–13, 34
in elastic wave motion, 279, 311, 327
- Mass flow density rate
in acoustic wave motion, 24
in elastic wave motion, 311
- Maxwell current density, 612
- Maxwell's equations
in matter, 610–613
in vacuum, 608–609
- Monopole transducer, acoustic radiation from,
106–111
- Neumann solution (of integral equation)
for scattering of acoustic waves, 254–258
for scattering of elastic waves, 560–565
for scattering of electromagnetic waves,
911–915
- Norton circuit (Equivalent-), 954, 957, 962
- Null-field method
for scattering of acoustic waves, 226, 230
for scattering of elastic waves, 511, 516
for scattering of electromagnetic waves, 884,
887
- Oseen's extinction theorem
for acoustic waves, 218
for elastic waves, 501
for electromagnetic waves, 876
- P*-wave speed, elastic, 383
- Parseval's theorem
for spatial Fourier transform, 1064
for temporal Laplace transform, 1058
- Particles, collection of moving, 7–19, 293–305,
622–632
conservation of, 9–11, 295–297, 624–626
drift velocity of, 9, 295, 624
number density of, 8–9, 294–295, 622–623
stationary flow of, 14, 299, 628
static distribution of, 14, 300, 638
- Particle velocity
in acoustic wave motion, 24
in elastic wave motion, 307
- Permeability, 619, 620
absolute, 619, 620
of vacuum, 606
- Permeability,
relative, 619, 620
- Permittivity, 619, 620
absolute, 619, 620
of vacuum, 608
relative, 619, 620
- Plancherel's theorem
for spatial Fourier transform, 1064
for temporal Laplace transform, 1057–1058
- Plane waves,
acoustic, 127–147.
See also Acoustic waves, plane waves
elastic, 413–427.
See also Elastic waves, plane waves
electromagnetic, 773–806.
See also Electromagnetic waves, plane waves
- Plane wave scattering. *See also* Acoustic waves,
scattering of; Elastic waves,
scattering of; Electromagnetic
waves, scattering of
by canonical shapes (Rayleigh–Gans–Born
approximation),
acoustic, 259–285
elastic, 565–597
electromagnetic, 915–942
far-field amplitude reciprocity,
acoustic, 231–239, 240–249
elastic, 517–534, 534–551
electromagnetic, 888–897, 897–906
far-field energy theorem,
acoustic, 249–253
elastic, 551–558
electromagnetic, 906–910
far-field scattering coefficients,
acoustic, 235, 239
elastic, 523, 525
electromagnetic, 892, 895
- Point-source solutions
in acoustic wave theory, 47–48, 80–81,
181–193
in elastic wave theory, 340–341, 376–377,
463–475
in electromagnetic wave theory, 670–671,
717–718, 840–851
- Poisson's solution to initial-value problem of the
wave equation, 124–125, 410–411,
770–771
- Poisson's summation formula, 1072–1073
- Power flow
in acoustic wave theory, 38, 42
in elastic wave theory, 331, 336
in electromagnetic wave theory, 656, 658,
662–663
- Poynting vector
in acoustic wave theory, 38, 42
in elastic wave theory, 331, 335

- Poynting vector
in electromagnetic wave theory, 657, 661
- Pressure (in fluid), 22
- Radiation characteristics. *See* Far-field radiation characteristics
- Rayleigh–Gans–Born approximation
for scattering of acoustic waves, 259–285
for scattering of elastic waves, 565–597
for scattering electromagnetic waves, 915–942
- Reciprocal base vectors, 1013
- Reciprocity of Green's functions
in acoustic wave theory, 189–192
in elastic wave theory, 471–474
in electromagnetic wave theory, 848–850
- Reciprocity, of plane wave far-field scattering amplitude
in acoustic wave theory, 231–239, 240–249
in elastic wave theory, 517–534, 534–551
in electromagnetic wave theory, 888–897, 897–906
- Reciprocity properties,
of transmitting/receiving antennas, 832–835, 835–840
of transmitting/receiving transducers
in acoustic wave radiation, 173–177, 177–181
in elastic wave radiation, 455–459, 459–463
- Reciprocity theorems of the time convolution type
for acoustic waves, 157–160, 164–169
for elastic waves, 437–441, 445–450
for electromagnetic waves, 814–818, 822–827
- Reciprocity theorems of the time correlation type
for acoustic waves, 160–164, 169–173
for elastic waves, 441–445, 450–455
for electromagnetic waves, 818–822, 827–832
- Reference frames
in affine space, 993
in Euclidean space, 996
- Relaxation. *See* Constitutive properties
- Representative elementary domain,
in acoustic wave theory, 7–8
in elastic wave theory, 293–294
in electromagnetic wave theory, 622
- Reynolds' transport theorem, 16, 302, 631
- Riemann–Lebesgue lemma, 1062
- S-wave speed, elastic, 383–384
- Scalar potentials. *See* Acoustic waves, radiation of
- Scalar wave equation. *See* Wave equation
- Scattering coefficients, plane wave far-field,
for acoustic waves, 235, 239
for elastic waves, 523, 525
for electromagnetic waves, 892, 895
- Schouten–Van der Pol theorem, 1056–1057
- Shielding effectiveness
definition of, 975
of spherical shield,
with electric dipole at centre, 979–983
with magnetic dipole at centre, 984–988
- SI-units
basic, xxix
of acoustic waves, 49
of elastic waves, 347–348
of electromagnetic waves, 615, 644–645, 666
- Simplex,
barycentric coordinates in, 1028
integral of a polynomially varying function over, 1039–1040
volume of, 1038–1039
- Source potentials. *See* Acoustic waves, radiation of; Elastic waves, radiation of; Electromagnetic waves, radiation of
- Source-type integral representations
in acoustic wave radiation, 83–93, 93–97, 104–106, 181–193, 212–220
in elastic wave radiation, 389–393, 394–396, 463–475, 494–503
in electromagnetic wave radiation, 726–730, 730–733, 740–743, 749–752, 840–851, 870–878
- Spatial convolution, 1062–1063
Fourier transform of, 1062–1063
- Spatial correlation, 1063
Fourier transform of, 1063
- Strain. *See* Deformation
- Stress (dynamic), 308, 310, 326
- Superposition principle
in acoustic wave theory, 51–52
in elastic wave theory, 349–350
in electromagnetic wave theory, 673–674
- Susceptibility
electric, 618–619, 619–620
magnetic, 618–619, 619–620
- Susceptibility analysis. *See* ElectroMagnetic Interference (EMI)
- Symmetry considerations
in acoustic wave theory, 51–68
in elastic wave theory, 349–366
in electromagnetic wave theory, 673–691
- Taylor expansion, 1043–1044
- Tensor potentials. *See* Elastic waves, radiation of
- Tensors. *See* Cartesian tensors
- Thevenin circuit (Equivalent-), 953, 956, 961
- Time convolution, 1052
Laplace transform of, 1052
- Time coordinate, xxviii
- Time correlation, 1052–1053
Laplace transform of, 1052–1053

- Time derivative, co-moving, 17, 303, 633
- Time evolution (of wave field). *See* Initial-value problem
- Time invariance. *See* Constitutive properties
- Traction
 in acoustic wave theory, 20
 in elastic wave theory, 306
- Transducer, acoustic,
 surface action, 175–176, 180
 reciprocity of, 175–176, 180–181
 volume action, 174, 178
 reciprocity of, 174–175, 178–180
- Transducer, elastic,
 surface action, 457, 462
 reciprocity of, 457–458, 462–463
 volume action, 456, 460
 reciprocity of, 456–457, 460–462
- Transmission line equations,
 single-channel, 712–713
- Transmission/reception reciprocity
 of acoustic transducers, 173–177,
 177–181
 of elastodynamic transducers, 455–459,
 459–463
 of electromagnetic antennas, 832–835,
 835–840
- Transverse admittance per length
 for acoustic waves, 76
 for elastic waves, 373
- Transverse admittance per length
 for electromagnetic waves, 711
- Triangle inequality, 995
- Unit tensors
 antisymmetrical of rank four, 1016
 completely antisymmetrical (Levi-Civita tensor), 1011–1014
 diagonalising of rank four, 1014–1015
 symmetrical of rank two (Kronecker tensor), 1010–1011
- Vector potentials. *See* Acoustic waves, radiation of; Electromagnetic waves, radiation of,
- Wave equation, 86–89, 385–389, 723–726
 dissipative, 97–104, 734–740
 associated with superconductivity and a collisionless plasma, 743–749
- Wave speed,
 acoustic, 95
 elastodynamic,
 of *P*-waves, 383
 of *S*-waves, 383
 electromagnetic, 731
 in vacuum, 608
- Wave vector. *See* Angular wave vector
- Wave vector space. *See* Angular wave vector space