

Index

The index contains **bold**, underlined and *italic* page numbers. **Bold** numbers refer to places where an idea or a quantity is explained or defined. References to Problems are underlined, while references to Figures are typed in *italic*.

- absorption, 86, 87, 118, 204
 - fraction, 251, 289
 - maximum, 204–241
 - at resonance, 54
 - width, 206
 - maximum, 238
- acceleration, 16, *144*
 - complex amplitude, 16
 - phasor, *16*
- acoustic wave, *see* wave, acoustic
- added damping coefficient matrix, 130
- added mass, 46, **54**, *136*, 149
 - coefficient, **175**, 177
 - matrix, 130, 155, 160
- adjoint companion, 264
- air
 - compressibility, 252, 260
 - pressure, *see* pressure, air
 - turbine, *see* turbine, air
- amplitude, 9, 154
 - absolute, 14
 - complex, **13**, *14*, *19*, 154
 - constraints, 272
 - optimum, 241, 252
 - response, *10*
- angle of incidence, 89, *151*
- angular frequency, 70
- angular repetency, **47**, 69, 70, **73**
- angular wave number, *see* wave, number
- antenna, 54, 60
- applied-pressure description, 242
- arrays, 262
- attenuator, 207
- axisymmetric
 - body, *see* body, axisymmetric
 - oscillating system, *177*, 177
 - OWC, *see* oscillating water column, axisymmetric
- bandwidth, 11
 - relative, 11, 56
 - resonance, **10**, 43, 57
- Bernoulli equation, 63
- Bessel function, 93, 197
- block diagram, *31*, 35, *144*, *220*
- Bode plot/diagram, **10**
- body
 - axisymmetric, 174, *180*, 198, 237, 240
 - cylindrical, floating, 193
 - oscillating, and OWCs, 273
 - oscillation, 123, 204
 - without wave generation, 135
 - symmetric, two-dimensional, 291
- boundary condition, 70, 97, 243
 - on body, 123
 - dynamic, **66**
 - free surface, 72, 174
 - homogeneous, 68
 - kinematic, **66**
- Bristol Cylinder, 205, 207, 290
- Budal upper bound (BUB), 223, 225, 226

- buoyancy
 - force, *see* force, buoyancy
 - stiffness, 190
- capacitance, 12
- capillary waves, *see* wave, capillary
- capture width, 206
- causal system, *see* system, causal
- channel
 - tapered, 115
- circular waves, *see* wave, circular
- complex
 - amplitude, *see* amplitude, complex
 - conjugate, 13
 - representation, 13, 42
- complex plane decomposition, 14
- complex-conjugate control, *see* control, complex-conjugate
- continuity equation, 62
- control
 - complex-conjugate, **218**, 220
 - device, 210
 - force, *see* force, control
 - optimum, **216–223**
 - phase, **218**, 219, 249
 - by latching, 218
 - reactive, **218**
 - suboptimal, 218, 222
 - surface, 96, **97**, 154
- convolution
 - product, 33
 - with sinusoidal oscillation, 44
 - theorem, **33**
- coordinates, 101, 104
- critical damping, **9**, 26, 44
- cylinder, 137, 144, 146, 184, 193
 - hydrodynamic parameters, 138
- damper, 6, 52, 53
 - force, 6
- damping coefficient, 7, 56
- damping factor, 56, 57
- delta function/distribution, *see* function, (Dirac) delta
- depth, 67, 76, 76, 78, 114
- depth function, 73, 77, 116
- diffraction, 97, 126, 154
 - force, **168**, 171, 172
 - interaction, 167
 - problem, 242
 - two dimensions, 187
- dipole, 207
- Dirac delta function, *see* function, (Dirac) delta
- dispersion, **48**, 58
- dispersion relation, **48**, 70, 111
- distribution
 - delta, *see* function, (Dirac) delta
- drift forces, 86
- eigenfrequency, **56**
- eigenfunction, 71
- eigenvalue, **25**, 44, 71, 200
- eigenvector, **25**, 44
- electric 2-port, 291
- electric analogue, 12, 12
- electromagnetic wave, *see* wave, electromagnetic
- energy, 20, 49
 - absorber, 86
 - absorption, *see* absorption
 - average, 22
 - converted, *see* power, absorbed
 - flux, 82
 - incident, 82
 - initial, 7
 - instantaneous, 22
 - kinetic, 7, 46, 53, 80, 113, 161
 - density, 113
 - loss, 237
 - potential, 7, 46, 53, 79, 161
 - relation, 40
 - spectrum, **88**
 - directional, **89**
 - Pierson-Moskowitz (PM), **89**, 90
 - semiempirical, 89
 - stored, 8, 82
 - at resonance, 12
 - total, 81
 - transport, 49, **50**, 73, 79, 81, 82, 91
 - velocity, **82**
- equilibrium position, 6
- Euler's formulae, 13, 93
- excitation force, **54**, **126**, 128, 144, 150, 151, 154, 165, 173, 181, 195
 - coefficient, **128**, 137, **141**, 150, 166, 186, 273
 - on sphere, 199
 - on submerged body, 176
 - reciprocity relation, 151
- excitation moment, 126
- excitation power, 208, 209
- excitation problem, 242
- excitation voltage, **56**

INDEX

303

- excitation volume flow, *see* volume flow, excitation
- excursion
 - amplitude, 9
 - response, 11, [42](#)
- exponential damping, 7
- far field, 94, 133, 179
 - coefficient, **94**, 100, 132, 147, [197](#)
- fluid
 - ideal, 92
 - incompressible, 63
 - inviscid, 65
 - irrotational, 63
 - non-viscous, 92
 - particle
 - displacement, 75, 75
 - trajectory, 75
 - velocity, 48, 50
- flux, 82
- force, 6
 - balance, 19, 20
 - buoyancy, 189
 - compensation, **185**
 - control, 190
 - damper, 6
 - damping, 19
 - diffraction, *see* diffraction, force
 - drift, 86
 - excitation, *see* excitation force
 - external, 6, 19, 52, 54
 - Froude–Krylov, *see* Froude–Krylov, force
 - hydrodynamic, 124
 - inertia, 19
 - load, 190, 212
 - mooring, 190
 - phasor diagram, 19
 - radiation, *see* radiation, force
 - reaction, 54
 - spring, 6
 - vector, **125**
 - viscous, 190
- Fourier
 - analysis, 31
 - component, 34
 - integral, 33
 - inverse transform, 31
 - series, 33
 - transform, 31
 - convolution, 33
 - frequency shifting, 32
 - inverse, 108
 - symmetry, 32, 33
 - table, 32
 - time differentiation, 32
 - time integration, 32
 - time scaling, 32
 - time shifting, 32
- frequency
 - angular, 7, 9
 - damped, 7
 - eigen, *see* eigenfrequency
 - natural, 7, **56**
 - peak, **90**
 - response, 10, 57
 - function, 35
- Fresnel integral, 110
- friction, 211, 237
- Froude–Krylov
 - force, 126, **168**, 169, [198](#)
 - moment, **169**
- function
 - (Dirac) delta, **28**, 32
 - even, 32
 - odd, 32
 - signum, **29**, 32
 - transfer, 30, 35
 - unit step (Heaviside), **29**, 32
- gain function, 210, 265, 269
- Gauss’s divergence theorem, 96
- generalised modes, **255**
- gravity waves, *see* wave, gravity
- Green’s theorem, 95
- group velocity, **48**, [58](#), 73, 76, 78, 82
- Hankel function, **93**
- harmonic component, 88
- harmonic wave, *see* wave, harmonic
- Haskind relation, 150, 165
 - OWC analogue, 250
- heave, 122, 189, 190, [239](#)
 - coefficient, 136
- Heaviside function, **29**, 32
- Helmholtz equation, 69, 91, 95
- Hilbert transforms, 36
- hydrodynamic parameter, 136, 184
 - dimensionless, 139
- hydrostatic stiffness, 256, 257, 260
- identity matrix, 24
- impedance, 9
 - electric, **17**

- impedance (Cont)
 - mechanical, 9, 17, *18*, *44*, *45*
 - intrinsic, **192**, 212, 216
 - radiation, *see* radiation, impedance
- impulse response, 29, *31*, 35, 109, 141, 186, 216
 - causal, 37, 221
 - causal approximation, 222
 - noncausal, 144, 221
- incompressible fluid, 63
- inductance, 12
- input
 - matrix, **24**
 - variable, **24**, *31*
- integral transform, 31
- integration surface labels, 96, 97
- interference, 204
 - destructive, 204, 209
- Keulegan-Carpenter number, 233, 253
- kinematic viscosity, 62
- Kochin functions, 100, **103**
 - two-dimensional, 187
- Kramers–Kronig relations, 36, 142
- Laplace transform, 37
- Laplace’s equation, 64
- latching, 218
- line absorber, 207
- linear system, *see* system, linear
- linearisation, 62
- long-wavelength approximation, 172
- longitudinal wave, 48
- loudspeaker, 51, 52, *59*
- mass transport, 83
- matrix
 - exponential, 24
 - rank, **180**, 235, 267–270
 - transformed, 25
 - transpose, 123
- microphone, 54, *59*
- modes of body motion, 121, 273
- momentum
 - density, 83
 - transport, 83
- monopole, 207
- mooring forces, *see* force, mooring
- natural period, **7**
- Navier–Stokes’s equation, 62
- near field, 94, 133, 149, 161
- Newton’s law, 6, 190
- noncausal system, *see* system, noncausal
- nonlinear system, *see* system, nonlinear
- numerical results, 136, 184
- ocean waves, 87
- optimum amplitude condition, **55**
- optimum condition, 216–223
- optimum phase condition, **55**
- oscillating surface-pressure distribution, 242
- oscillating water column, 65, 247, 242–292
 - axisymmetric, 246
 - circular, *260*
 - and oscillating bodies, 273
 - reciprocity relation, 250
 - resonance, 247
 - wave interaction, 242
- oscillation, 6, 46
 - body, *see* body, oscillation
 - critically damped, **9**, *44*
 - exponentially damped, 7
 - forced, 6, **9**, *42*, 52
 - free, 6, **7**, *41*, *44*
 - harmonic, 13, 21, *42*
 - non-sinusoidal, 40
 - overdamped, **8**
 - superposition, *43*
- oscillator, 46, 273
 - damping coefficient, 56
 - mechanical, 6, 7
 - representation of body, 153
 - wave-absorbing, 57
- output
 - matrix, **24**
 - variable, **24**, *31*
- OWC, *see* oscillating water column
- Parseval’s theorem, 40
- peak frequency *see* frequency, peak
- period
 - energy, **91**
 - natural, *see* natural period
 - peak, **90**
- phase, 154
 - advance, **18**
 - angle, *128*
 - constant, 9, 14, 42
 - control, *see* control, phase
 - diagram, 17
 - difference, 9, *10*

INDEX

305

- lag, **18**, *19*
- optimum, 252
- response, *10*, 10
- stationary, 104
- velocity, **47**, 48, 73, 76, 78
- phasor, **13**, *15*, *16*, 17, 20, 43
 - diagram, *16*, 20, 75
- Pierson–Moskowitz (PM) spectrum, 89
- pitch, *122*, 195
- plane wave, 47, 73
- point absorber, 59, 206, 207
- position, 14
 - phasor, *16*
- power, 20, 44, 46, 49
 - absorbed, 57, 245
 - maximum, 55, 60, 204–241, 248, 292
 - two dimensions, 287
- active, 21, 130
- apparent, 23
- average, 21
- complex, 23, 130
- consumed, 21
- delivered, 21
- excitation, *see* excitation power
- flux, 82
- incident, 82
- instantaneous, 22, 125
- level, 82
- lost, 211
- radiated, 51, 95, 159
- reactive, 21, 130, 218, 246
- reflected, 82
- takeoff
 - hydraulic, 242
 - pneumatic, 242, 252
- transport, 82
 - complex, 133
 - in wave channel, 135
- useful, *209*, *211*, 235, **237**
 - maximum, 211
- power-to-volume ratio, 240
- Poynting vector, 50
- pressure
 - air, 242
 - absolute, 252
 - applied, 242
 - complex amplitude, 47
 - dynamic, **47**, 50, 273
 - hydrodynamic, 67, 74, 110, 176
 - hydrostatic, 63
 - static, **47**, 50
 - surface
 - periodic, 242
 - total, **47**, 50
- quadrupole, 207
- quality factor, **8**, 11, 12, 41, 43
- quasi-point absorber, 207
- radiation
 - admittance, **245**
 - matrix, 283
 - pneumatic, 252
 - condition, 67, 79, **93**, 99
 - conductance, **245**
 - matrix, 284
 - damping matrix
 - reciprocity relations, 284
 - force, 189
 - reaction, *144*
 - impedance, **52**, 59, 173, 179
 - energy interpretation, 130
 - matrix, 128, 149, 155, 157, 182, 282
 - numerical results, *136*
 - interaction, 167
 - from oscillating body, 128
 - problem, 123, 242
 - reactance, **54**, 149, 173
 - matrix, 130, 155, 160
 - resistance, 46, **52**, *136*, 147, 149, 181, 196, 197
 - for cylindrical body, 199
 - matrix, **130**, 155, 157, 200, 235
 - matrix singularity, 182, 183, 189, 204, 235–239, 269, 290
 - reciprocity relation, 151
 - source, *51*, 51
 - susceptance, **245**, 246
 - volume flow, *see* volume flow, radiation
- reactance
 - capacitive, **12**
 - inductive, **12**
 - mechanical, 17
 - radiation, *see* radiation, reactance
- reactive control, *see* control, reactive
- reciprocity relation, 108, 129, 146, 151, 201, 250, 283, 284
 - for radiation parameters, 281
 - two dimensions, 188
- reflection, 86, 87, 116
 - coefficient, **74**
 - two dimensions, 187

- repetency, *see* angular repetency
- resistance, 6
 - damping, 7
 - electric, 12
 - load, 60
 - mechanical, **6**, 17
 - intrinsic, **216**
 - radiation, *see* radiation, resistance
- resonance, **10**, 22, 54, 192, 218, 247
 - absorption, 54
 - bandwidth, **10**, 43
 - condition, **55**
- roll, *122*
- Salter Duck, 206, 207, 290
- scattering, *see* diffraction
- separation constant, 69, 71
- shallow water, 76
- shape function, **255**, 261
- significant wave height, **88**
- signum function, *see* function, signum
- similarity
 - transformation, 25, 44, 265, 266, 268
- simulation of real waves, 90
- SISO system, *see* system, SISO
- small-body approximation, 168, **172**
 - group of bodies, 172
 - single body, 173
- sound intensity, 50
- sound pressure, 47
- spectrum, **88**
- sphere
 - semisubmerged, *136*, 136, 190, *191*, 199
 - resonance frequency, 192
- spherical wave, 47
- spring, 6, 52, 52
 - force, 6
- state variables, 24
- state vector, 25
- state-space analysis, 23, 44
- stationary phase, method of, 104
- stiffness, **6**, 18
 - buoyancy, *see* buoyancy, stiffness
 - hydrostatic, 246
- Stokes drift, 83
- Sturm–Liouville problem, 73
- surface
 - labels, 96, 97
- surface tension, 47
- surge, *122*, 195
 - coefficient, *136*
- sway, *122*
- swell, **87**
- symmetry theorem, **33**
- system
 - causal, **28**, 30, 34, 37, 142, 221
 - linear, 26, 34, 110, 194, 253
 - time-invariant, 29
 - mass-spring-damper, 6, 7
 - matrix, **24**
 - noncausal, **28**, 221
 - nonlinear, 27
 - SISO, **26**, 30
 - time-invariant, 29, **34**
 - two-dimensional, 186, 201
- tension-leg platform, 138
- terminator, 207
- time domain, 108, 221
- time-domain representation, 194
- time-invariant system, *see* system, time-invariant
- transcendental equation, 77
- transfer function, 30, *31*, 35
 - intrinsic, **192**
- transmission, 87, 116
 - two dimensions, 187
- transmission, coefficient, 117, 188, 202
- transpose of matrix, 123
- turbine, 252
 - air, 242
 - Wells, *see* Wells turbine
- two-body system, 182, 257, 269
- two-dimensional system, 186, 201, 287
- unit normal, 64
- unit step function, **29**, 32
- velocity, 14, *144*
 - amplitude
 - complex, 15, 53, 154
 - of energy transport, **82**
 - of fluid, 48, 50, 67
 - group, *see* group velocity
 - optimum, 236, 237
 - phase, *see* phase, velocity
 - phasor, *16*
 - potential, 63
 - decomposition, 156, 243
 - general solution, 78, 94
 - of incident waves, 102
 - satisfying the radiation condition, 99
 - of propagation, 73
 - response, 10, 11

INDEX

307

- viscosity, *211*, *237*
- volume flow, *245*
 - excitation, **244**
 - coefficient, **245**, *273*
 - radiation, **244**
- vortex, *233*, *253*
- water plane area, *169*
- wave, *46*
 - absorbed, *87*, *205*
 - acoustic, *46*
 - and gravity, *47*
 - capillary, **47**, *58*, *111*
 - channel, *131*, *250*
 - power transport, *135*
 - circular, *51*, **91**, *119*, *206*
 - convergent, *93*
 - cross, in wave channel, *113*
 - diffracted, *126*, *156*, *243*
 - reciprocity relation, *201*
 - two dimensions, *201*
 - dispersive, *48*
 - divergent, *93*
 - electromagnetic, *46*
 - elevation, *67*, *108*, *110*
 - energy, *see* energy
 - evanescent, **79**, *94*, *112*, *114*
 - force, *121*
 - generated, *205*
 - generation, *97*
 - generator, *see* wavemaker
 - gravity, **47**, *62*, *65*
 - harmonic, *47*, *50*, *67*, *87*
 - height, **82**
 - significant, **88**
 - in the time domain, *108*
 - incident, *74*, *102*, *128*, *156*
 - intensity, *49*
 - interference, *see* interference
 - irregular, *87*
 - longitudinal, *48*
 - measurement, *220*, *220*, *221*
 - moment, *121*
 - momentum
 - density, *83*
 - transport, *79*, *83*
 - monochromatic, *47*
 - non-dispersive, *48*
 - number, **47**, *70*, **73**
 - period, **82**
 - plane, *47*, *73*
 - power, *see* power
 - prediction, *108*, *146*
 - progressive, *75*, *82*, *88*
 - propagating, **79**, *112*
 - radiated, *99*, *156*, *243*
 - two dimensions, *201*
 - real ocean, *87*
 - reflected, *74*, *82*, *87*
 - reflection at vertical wall, *112*
 - regular, *47*, *87*
 - sinusoidal, *47*
 - spectrum, *57*, *88*
 - spherical, *47*
 - on a string, *46*
 - superposition, *88*, *205*
 - and surface tension, *47*
 - transmitted, *87*
 - velocity, *47*, *112*
 - on water, *46*
 - wind-generated, *87*
 - wave-body interaction, *121*
 - several bodies, *153*
 - wave-energy converter
 - arrays, *262*
 - wave-energy converter (WEC), *224*, *242*
 - wave-power island, **214**, *215*, *241*
 - wavelength, **47**
 - wavemaker, *196*, *196*
 - circular waves, *196*
 - in wave channel, *131*
 - WEC, *see* wave-energy converter
 - Wells turbine, *252*
 - wide-spacing approximation, *167*
 - yaw, *122*