Index

1-form, 60
1-Laplacian, 72

absolutely comonotonic, 188
adjacency matrix, 9, 81, 86, 100, 379
adjoint, 64
algebraic graph Laplacian, 80, 81, 152, 379
algebraic graph theory, 9
algebraic Laplacian, 118
ambiguous vertex, 151
antibalanced graph, 139
automorphism, 45
averaging property, 35

balanced, 151
balanced cycle, 139
balanced graph, 139
Banach space, 5
Betti number, 23
bipartite graph, 96, 97
bistar, 106, 117
book graph, 104, 137, 149, 319, 325
boundary of a vertex set, 379
boundary operator, 18, 36, 176
bounded variation, 70

category, 14
Cauchy interlacing theorem, 297
Cayley graph, 381
Čech complex, 15
chain, 92
Cheeger constant, 11, 66, 71, 116, 379
Cheeger constant on a chemical hypergraph, 197
Cheeger cut, 11
Cheeger cut problem, 12
Cheeger estimate, 11, 67
Cheeger inequality, 198
Cheeger problem, 114
Cheeger set, 71
chemical hypergraph, 16, 197, 203
Chung Laplacian, 9
clique, 101
clique of hypergraph, 230
clustering coefficient, 110
coarea formula, 67
coboundary, 22
cochain, 31
code, 382
cohomology group, 23, 32
collapse, 304
comonotonic, 186
complementary graph, 83
complete bipartite graph, 131, 212, 319, 325
complete graph, 82, 117, 137, 212, 319, 325
complete graph with self-loops, 82
concentrator, 12
connection Laplacian, 138
contraction, 314
cotangent vector, 60
coupling of measures, 323
covering, 47, 148, 311
critical point, 44
cube graph, 321, 325
cycle, 92, 96, 139, 363
cycle graph, 100, 319

d'Alembert operator, 4
dead end vertex, 151
degenerate weighted simplicial complex, 33
degree, 32, 77
degree matrix, 81, 86
denoising, 58, 72
diameter, 111

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 16:36:42, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009641821.020

diffusion through edge, 92
directed graph, 15, 151
directed hypergraph, 16
disjoint-pair Lovász extension, 187
distance, 111
divergence, 35
down Laplace operator, 29, 48
d-regular, 379
dual Cheeger constant, 123
dual signed Rayleigh quotient, 146
duplicated motif, 46
duplication of edge, 319
duplication of vertex, 99

Eckmann Laplacian, 8
edge, 76
edge boundary, 114
eigenfunction, 6, 8, 38, 52, 79
eigenpair, 188
eigenvalue, 6, 8, 52
eigenvalue equation, 6
eigenvalue of function pair, 188
eigenvalues, 78
eigenvalues of graph, 86
eigenvector centrality, 374
eigenvector of function pair, 188
Eigenwert, 8
Einstein summation convention, 60
elementary collapse, 304
elementary contraction, 314
error correcting code, 382
expander, 12
expander family, 381
exterior algebra, 7
exterior derivative, 62
exterior form, 61
exterior product, 61

(f, g)–Cheeger constant, 194
face, 21
facet, 21
fidelity term, 59, 72
Floer Theory, 176
Fourier series, 5
free face, 304
functor, 14

generalized gradient, 43
gradient flow, 175
graph, 15, 76
graph doubling, 320

Hamming distance, 383
Harary's characterization of balanced graphs, 139
harmonic form, 64
harmonic function, 65
Hashimoto graph, 351
heat equation, 7
Hilbert space, 5, 52
Hodge decomposition, 29
Hodge Laplacian, 8, 66
homology group, 178
homomorphism, 47
hyperedge, 15, 24
hyperflower, 170
hypergraph, 15
hypergraph expander, 384
hypervertex, 24

image denoising, 58, 72
independence number, 212, 229
independent set, 212
index of critical point, 175
induced subgraph, 101
integral equation, 8
interlacing theorem, 297
isoperimetric problem, 113
isospectral, 4, 94, 100, 370

Kazhdan's property (T), 381
Kirchhoff Laplacian, 9, 81
Krasnoselskii genus, 42, 211

Laplace operator, 6, 29, 48, 51, 52, 77
Laplace operator for hypergraphs, 18
Laplace operator of graph, 77, 85
Laplace operator of oriented hypergraph, 37
Laplace-Beltrami operator, 7, 64, 65
Laplacian, 6, 18
Laplacian of graph, 85
Laplacian of signed graph, 141
Lebesgue integral, 5
Lovász extension, 183, 184, 199
lower semi-continuous, 53
Lusternik-Schnirelman theory, 43

magical graph, 382
magnetic Laplacian, 138
Margulis expander, 381
metric tensor, 63
minimizing sequence, 53
min-max principle, 37

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 16:36:42, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009641821.020

modular, 185
morphism, 14
Morse function, 174
motif, 46

negative basis, 62
neighbor, 77
neighborhood graph, 129
network, 3
nodal domain, 269
node, 76
non-backtracking graph, 351, 354, 356
non-backtracking Laplacian, 354
non-backtracking matrix, 353
non-local model, 73
non-local TV model, 73
normalized combinatorial Laplace operator, 32, 85
normalized graph Laplacian, 85, 151, 379

opposite graph, 138
orientable manifold, 64
orientation, 16, 22, 61
oriented hypergraph, 16

page rank algorithm, 375
partial differential equation, 4
petal graph, 104, 105, 117, 137, 149, 319, 325
p-form, 61
p-Laplacian, 68
Poincaré inequality, 53
Pólya-Cheeger constant, 11, 116
positive basis, 62
proper difference, 34
property (T), 381

quantum mechanics, 8

Ramanujan graph, 380
random graph, 4, 13, 322
rate of a code, 383
Rayleigh quotient, 38, 41, 54, 69, 79, 80, 163
Rayleigh-Ritz quotient, 38
relative cohomology, 32
Rellich compactness theorem, 53
Riemannian geometry, 7
Riemannian metric, 63
Riemann's habilitation thesis, 4

self-loop, 24, 77
separation of variables, 5
signed Cheeger constant, 150
signed graph, 138
signed Rayleigh quotient, 146
simplicial complex, 21
simplicial complexes with loops, 33
simplicial map, 305
smoothness term, 59, 72
Sobolev space, 52
spectral class, 325
spectral distance, 324
spectral gap, 105, 360
spectral theory of linear operators, 4
spectrum, 30
  bipartite graph, 97
  bistar, 107
  book graph, 104, 150
  complete bipartite graph, 100
  complete graph, 82, 92
  complete graph with self-loops, 82, 92
  cube graph, 321
  petal graph, 104
  signed graph, 141
  windmill graph, 105
star, 47
star graph, 83, 101, 117, 212, 319
strong covering, 312
strongly connected, 151
subcomplex, 34
subdifferentiable, 44, 182
subgradient, 44, 183
submodular, 185
super concentrator, 382
switching, 140
switching equivalent, 140
switching function, 140
symmetric bistar, 106

tangent vector, 60
tensor, 328
topological expander, 384
tree, 92, 96, 102
triangle, 110
tripartite, 108
TV model, 72

unweighted graph, 85
up Laplace operator, 29, 48
up path connected, 313

vector field, 60
vertex, 76

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 16:36:42, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009641821.020

vertex boundary, 114
vibration, 6
volume, 111

water wheel graph, 319, 325
wave equation, 6
wave operator, 4
weak convergence, 52
weakly connected, 151
weighted adjacency matrix, 151
weighted directed graph, 151
weighted graph, 85
weighted simplicial complex, 31
Weyl estimate, 58, 66
wheel graph, 101, 319
windmill graph, 105, 106

Downloaded from https://www.cambridge.org/core. UNIVERSIDAD AUTONOMA METROPOLITANA, on 14 Nov 2026 at 16:36:42, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781009641821.020