

Index

A

Abscissa	of absolute convergence	116ff
	of simple convergence	116
	of holomorphy	114
Absolute value	262, 266	
Adjoint	34ff	
	generator	35ff
	operator	87ff, 98, 160
Admissible function	171ff	
Algebra homomorphism	162ff	
Algebraic multiplicity	95	
AL-space	266	
AM-space	266	
Approximation theorems	49ff, 59, 102	
Asymptotics	107ff, 227ff, 369ff, 379, 442ff	
Automorphism group	165ff	

B

Banach lattice	262	
	complex	269, 286, 311
	real	269
Band	263	
	band projection	264
Boundary spectrum	232ff, 309ff, 328ff, 331	

C

C*-algebra	156, 366	
Calkin algebra	95	
Cauchy problem	8ff, 44ff	
	abstract	8ff, 44ff, 107ff, 363
	autonomous	107ff
	homogeneous	107ff
	inhomogeneous	126ff, 367ff
	retarded	241ff, 383ff

	well-posed	44ff
Center	272, 297, 303ff, 312	
Cesàro	mean	373, 442, 444
	summable	104ff
Chapman-Kolmogorov equation	236ff	
Characteristic equation	199, 252, 328	
	generalized	248, 389
Characterization of generators	144ff, 276ff, 286ff	
Chain rule	155	
Closable	8ff, 65	
Closure	8ff, 65	
Cocycle	166ff	
Cone	positive cone	64, 262, 403
Conditional expectation	normal	445ff, 420
Core	8ff, 61	
Cyclic	232, 193ff, 210ff, 328ff, 331, 417ff, 425	
	imaginary additively	193ff, 210ff, 328ff
D		
Datko's theorem	120ff	
Decomposition	88ff, 349ff, 378ff	
Delay		
	differential equation	241ff
	equation	383ff
Derivative		
	first order	15ff, 165, 227ff,
	242, 290, 301, 334ff, 384	
	higher order	292ff
	second order	19ff, 51ff, 198,
	204, 277ff, 334ff	
Differential equation		
	homogeneous	107ff
	inhomogeneous	126ff, 367ff
	ordinary	170ff, 214ff, 241ff
	partial	44
	retarded	153ff, 161, 193ff, 241ff
	system of	392

Differential operator	15ff, 19ff, 51ff, 165, 198, 204, 242, 284ff, 290, 292ff, 301, 334ff, 384	
Disjointness preserving	operator	314
	semigroup	305ff
Dispersive	271ff	
	strictly	277ff
Dissipative	62ff	
	p-dissipative	62ff, 139ff
	strictly	63ff
Doeblin's condition	295, 372	
Domain	8ff, 63ff	
	Fredholm	95ff
Domain of uniqueness	63ff	
Dominant spectral value	196ff, 330, 342ff	
	strictly	196ff, 233, 239, 342ff
Domination	294ff, 405	
	semigroup	25ff
Dunford-Pettis property	62	
E		
Eigenspace	76, 96	
Eigenvalue	76, 433	
	approximate	76, 339
	simple	84, 331, 335, 427
	normalized	427
Eigenvector	76, 433	
	approximate	76, 339
Elliptic differential operator	204, 208ff, 286, 331, 342	
Equation	differential	6
	heat	21
	population	251, 371ff, 381ff, 391ff
	retarded	383ff
	transport	335ff, 344
Example	counter	72ff, 119, 151, 291ff, 336
	standard	9ff, 50ff, 113ff, 203, 354

Exponential estimate 4ff

F

\mathcal{F} -product 34ff, 325ff, 339ff

\mathcal{F} -product with respect to a semigroup 34ff, 85ff, 210

Féjer's theorem 104ff

Feller property
strong 236

Fixed space 370ff, 408ff

Flow 162ff
continuous 165, 210ff, 354
semi 162ff, 356ff
separately continuous 166ff

Forcing term 126ff, 367ff
periodic 130
p-periodic 127ff

Fourier transformation 17ff, 101, 279
inverse 17, 101
coefficient 100

Fredholm
domain 84ff
operator 84ff

G

Gateaux-derivative 58, 155, 284, 307

Generalized solution 112, 126

Generator 5ff
bounded 4, 61ff, 149, 276, 282, 311, 411ff

Geometric multiplicity 84

Graph 8

Graph norm 8

Grothendieck space 62ff

Group 3, 8, 12, 43, 77, 165ff, 350ff, 379ff
automorphism 165ff
lattice homomorphism 232
one-parameter 3, 8, 40
positive 165, 166ff, 322, 350ff

	rotation	14, 80, 379ff
	unitary	17
Growth bound	4, 8, 71ff	
	of a semigroup	4, 8, 71ff, 85, 99ff, 150, 185, 227ff, 322, 361ff, 370
	of mild solutions of a Cauchy problem	111ff
	of solutions of a Cauchy problem	111ff, 227ff, 363ff
	essential	85, 370

H

Half-norm	58ff, 148ff	
	canonical	58ff, 148ff, 290ff
	strict	58ff, 148ff
Heat equation	17	
Hille-Yosida theorem	41	

I

Ideal	263	
	algebraic	157
	closed	157, 363
	invariant	210ff, 329, 332ff, 341
	lattice	263
Imaginary additively cyclic subset	193ff, 210ff, 333	
Inhomogeneous differential equation	126ff, 367ff	
Integral equation	390	
Interpolation	362, 375, 379	
Invariant		
	ideals	210ff, 329, 332ff, 341
Irreducible	155ff, 283ff, 447	
	semigroup	150, 161ff, 233, 332ff, 336ff, 339ff

J

Jordan decomposition 391, 421

K

Kakutani-Krein theorem 267, 324, 338, 361

Kato's

equality 157ff, 308ff, 349ff
inequality 158, 309ff, 284ff, 308
classical 157ff, 284ff
distributional

Krein-Rutman theorem 150, 188, 361

L

Laplace transform 114, 121

Laplacian 43ff, 113, 124, 158, 189,
204, 228, 278ff, 284, 365

Lattice

homomorphism 159, 269, 270, 305
norm 262

Locality 165ff, 293ff, 306, 310

Long term behavior 111ff, 227ff, 369ff, 379,
442ff

Lumer-Phillips theorem 60ff

M

Markov

algebra homomorphism 162ff
lattice homomorphism 159ff, 210ff, 217ff
operator 139, 209
process 236ff
semigroup 163, 209
transition function 236ff, 374ff

Matrix semigroup 12ff

Maximum principle 187, 208

Mild solution 112, 138

Modulus 155, 284, 305ff, 305

Multiplication

operator 99ff, 272
semigroup 15ff, 50ff, 76ff, 310ff

Multiplicity	84ff	
	algebraic	84ff, 232, 335
	as a pole	84
	geometric	84, 335
N		
Negative part	262	
Norm		
	graph norm	8
	Sobolev norm	23ff
O		
Operator		
	closable	8ff
	closed	8ff
	contractive	55ff
	densely defined	8
	differential	11ff
	dissipative	55ff
	dispersive	271ff
	elliptic	204, 208ff, 286, 331, 342
	kernel	117, 207ff, 334ff, 344, 367ff, 390, 394
	lattice	139, 269
	local	165ff, 293ff, 306, 310
	Laplace	43ff, 113, 124, 158, 189, 204, 228, 278ff, 284, 365
	multiplication	9ff, 99ff, 272, 310
	positive	139ff
	p-contractive	56ff
	p-dissipative	56ff, 149ff
	resolvent positive	148ff
	Schrödinger	198, 298, 298ff, 363
	strictly dissipative	56ff
	strictly p-dissipative	56ff
	strictly dispersive	277ff
	weakly compact	200, 234ff
Operator semigroup	3ff, 437	
	weakly compact	442ff
Order bounded	265	
Order		

	complete	262
	continuous norm	268
	interval	262
Order continuity	266, 309, 310ff	
Order unit	265	
	weak	265
Ordered		
	Banach space	262, 262
	vector space	262
P		
Periodic		
	semigroup	90ff, 95, 338, 416
P-periodic	127ff	
Perron-Frobenius theory	185ff, 193ff, 219ff, 325ff, 417ff	
Perturbation		
	additive	51ff
	bounded	52ff, 333
	compact	237ff, 343
	multiplicative	151ff, 160
Perturbation by multiplication	198, 202, 207, 299ff, 303,	
operators	333	
Perturbation theorems	51ff	
Phillip's theorem	277	
Polar decomposition	418, 418	
Pole	78ff, 83ff, 87, 217ff, 331, 339ff	
	algebraically simple	84ff, 200, 204, 232ff, 238, 339ff
	of order k	84ff, 96, 194ff, 322, 328ff
	simple	84ff, 232ff, 335, 339ff
	first order	84ff, 199
Population equation	251ff, 371ff, 381ff, 391ff	
Positive part	262	
Positive minimum principle	147ff, 152ff, 289ff, 293	
Positive subeigenvector	287	
Positivity	157ff, 265, 269, 270, 404	
	n -	404, 439
	strict	265, 269, 335, 340
Predual	353	

Projection	83, 232ff, 370ff, 444ff, 423	
	ergodic	444ff, 424
	recurrent	443ff
	semigroup	232ff, 335, 370ff, 445
	spectral	96ff
Pseudo-resolvent	312ff, 339ff, 406ff, 380ff, 429ff, 419ff	
	positive	326ff
Q		
Quasi-compact	236ff, 370ff	
Quasi-interior point	265, 332	
R		
Range condition	62ff, 165ff, 277, 295	
Regular mapping	269, 297, 303ff	
Regularity	269, 297, 303ff	
Residue	78ff, 83ff, 335ff, 422ff	
Resolvent	75ff, 404	
	compact	48, 84, 150, 187, 196, 331, 339, 363
	positive	145ff
	pseudo	325ff, 339ff, 406ff, 380ff, 429ff, 419ff
	slowly growing	327ff
	equation	148, 325
	integral representation	8, 320ff
Resolvent	positive	148
	set	75ff, 86
Retarded	differential equation	241ff
	equation	383ff
Riesz Decomposition theorem	264	
Riesz Schauder theory	83ff	

S

Schrödinger operator	298ff, 302ff, 363	
Schwarz map	404ff, 417ff, 419ff, 443ff	
	identity preserving	404ff, 417ff, 419ff, 443ff
Schwarz inequality	404	
Schwartz space	24, 286	
Self-adjoint part	403	
Semiflow	162ff, 356ff	
	continuous	163ff, 210
	injective	211
	surjective	211
Semigroup	3ff	
	adjoint	25ff, 88, 437
	analytic	94ff
	bounded holomorphic (of angle α)	94ff, 130
	compact	48ff
	commuting	105
	contraction	55ff, 276ff, 324ff, 333
	differentiable	45ff, 49
	diffusion	19ff
	disjointness preserving	305ff
	eventually compact	48ff, 232, 234, 236
	eventually differentiable	45, 49
	eventually norm continuous	46ff, 49, 97ff, 120, 196, 330ff, 342, 364, 372
	\mathcal{F} -product	34ff, 85ff, 210
	holomorphic (of angle α)	42ff, 49, 113, 185, 331ff, 336ff
	identity preserving	404ff, 417ff, 419ff, 443ff, 424ff
	implemented	439
	induced	85ff, 325, 408
	irreducible	178ff, 233, 339ff, 365ff, 444ff
	lattice homomorphism	155ff, 162ff, 212ff, 262, 344ff
	Markovian	163ff, 209
	mean-ergodic	373
	modulus	302ff, 319ff
	multiplication	9ff, 50ff, 76ff, 310ff
	nilpotent	19, 49ff, 85ff

norm continuous	46ff, 49
of Schwarz type	404ff, 417ff, 444ff, 424ff
one-parameter	3
partially periodic	386ff, 444ff
periodic	90ff, 95, 338, 416
positive	145ff
preadjoint	447
quasi-compact	236ff, 370ff
quotient	24, 85
reduced	408, 443ff
rescaled	23
rotation	18, 80, 207, 338, 379ff
similar	23ff
Sobolev	28ff
strongly continuous	4ff
strongly ergodic	442ff, 443ff, 424ff
subspace	23ff, 85

S

semigroup dual	21ff	
signum	156ff, 291ff, 301, 323ff	
singularity	operator	191ff, 271, 284ff, 323
Sobolev space	isolated	90ff
	20ff	
	classical	24
solid subset	263	
solution of a Cauchy problem	6, 36ff	
	generalized	100, 126ff
	mild	100, 126ff
	p-periodic	127ff
	strong	105ff, 100, 126ff, 240ff, 383ff
spectral	decomposition	71ff, 349ff, 378ff
	projection	80ff, 90
	theorem	71ff, 102ff
spectral bound	71ff, 114ff, 119ff, 150, 185, 178, 227ff, 247, 306ff, 340, 361ff, 388, 417ff, 437	
essential	89ff, 236ff, 340	

spectral inclusion theorem	105ff	
spectral mapping theorem	71ff, 78, 93ff, 120	
	weak	76ff, 94ff, 107ff
	for the resolvent	78ff
spectral radius	71	
essential	89ff, 196, 236ff, 340	
spectral value		
	dominant	196ff
	strictly dominant	196ff, 233, 239
spectrum	71ff	
	approximate point	76ff, 430
	boundary	190ff, 231ff, 328ff, 331, 417ff, 424
	cyclic	190, 193ff, 328ff, 331, 417ff, 423ff
	essential	89ff
	point	76ff, 430
	residual	76ff
stability	111ff, 249, 364ff, 388, 438ff	
	exponential	99ff, 249
	uniform	99ff, 439, 438ff
	uniform exponential	99ff, 231, 438ff
	weak	125ff, 228ff, 438ff
	weak uniform	125ff
state space	403, 437	
stationary point	173	
stochastic continuity	236ff	
strictly positive	157, 263, 269, 287	
	element	287
	functional	263, 287
	operator	269
	subset	287ff
subdifferential	56ff, 139ff	
subeigenvector	287	
	positive	287
subinvariant subset	418	
sublattice	263	
sublinear function	55ff	

T

tensor product

	of Banach spaces	26ff
	of operators	26ff
	of semigroups	26ff, 98ff
translation	12ff, 15, 20, 23, 49, 77ff, 228	
	uniformly continuous	4, 9, 61ff, 175, 276, 282, 304, 411ff
	uniformly ergodic	428ff, 444, 419, 424ff
	weakly continuous	4
	weak*-continuous	20, 404ff, 439
	weak*-irreducible	418, 414, 424ff
translation property	242, 385	
translation semigroup	12ff, 20, 23, 72ff, 77ff, 86, 228	
	nilpotent	15, 49ff, 75, 186ff
	periodic	77
transformation		
	Fourier	17ff
	Laplace	114, 121
transport equation	327ff, 344	
type of a semigroup	4	
U		
ultrapower	339, 412, 430, 420	
unimodular function	338	
unitary	427	
V		
vector		
	lattice	262
	sublattice	263
W		
W*-algebra	403	
W*-dynamical system	414ff	
	irreducible	414ff
weakly sequentially compact	269, 346	
well-posedness	35ff	

Z

Zero-Two law (0-4 law)

374ff