AM-space 239

approximation theorems

32f, 44, 81, 116

asymptotics

98ff, 204ff, 342ff, 362, 406ff

automorphism group 146ff

Banach lattice 235

complex - 243, 260, 288

real - 243

band 236

- projection 237

boundary spectrum 169ff,

286ff, 302ff, 305, 379ff, 387

C*-algebra 117, 369

Calkin algebra 73

Cauchy problem 4, 26ff

abstract - 4, 26ff, 98ff, 336

autonomous -4, 26ff

homogeneous – 4, 98ff

inhomogeneous – 112ff, 340ff

retarded - 219ff, 356ff

well-posed-26 ff

Datko's theorem 108f

decomposition 66ff, 325ff, 351ff

delay

- differential equation 219ff

- equation 350ff

derivation 143ff

derivative

first order – 8ff, 146, 184f,

220, 265, 276, 308f, 357

higher order – 267f

second order - 11f, 34f, 179,

185, 249f, 308f

differential equation

homogeneous - 4, 98f

inhomogeneous – 112ff, 340ff

ordinary - 152f, 197f, 219ff

partial – 26

retarded - 134f, 142, 178f, 219ff

system of -365

differential operator 8ff, 111ff,

34f, 146, 179, 185, 220, 258f,

265, 267f, 276, 308f, 357

disjointness preserving

- operator 291

center 246, 272, 279f, 289	- semigroup 291ff
Cesàro	dispersive 249ff
- mean 346, 406, 408	strictly – 249ff
– summable <i>93f</i>	dissipative 47ff
Chapman-Kolmogorov equation 213f	p– 48ff, 120ff
characteristic equation 180, 220, 382	strictly – 49ff
generalized – 226, 362	Doeblin's condition 270, 343
	domain 3, 9, 49f
	Fredholm – 73f
	domain of uniqueness 49f
dominant spectral value	Gateaux-derivative 50, 136, 257,
	283
177ff, 304, 318ff	generalized solution 99, 112
strictly –	generator 3ff
177ff, 210, 217, 318ff	adjoint – 16
domination 269ff, 371	bounded – 9, 7, 54ff, 129, 247,
dual 16	255, 288, 376ff
semigroup – <i>16f</i>	weak – 16
Dunford-Pettis property 56	geometric multiplicity 73
	graph 5
	graph norm 5
	Grothendieck space 55ff
eigenspace 64, 86	group 1, 6, 9, 34, 66, 146ff,
eigenvalue 64, 337	326f, 352ff, 390f
approximate – 64, 314	automorphism – 146ff
simple – 73, 305, 310, 330	lattice homomorphism 202
normalized – 330	one-parameter – 1, 6, 31

positive - 146, 148ff, 295, 326f eigenvector 64, 337 approximate – 64, 314 rotation - 10, 69, 352ff elliptic differential operator unitary -13185, 190f, 260, 305, 312 growth bound 2, 6, 60ff equation - of a semigroup 2, 6, 60ff, 74, differential - 4 39ff, 130, 163, 204ff, 295, heat – 13 334ff, 343, 400ff population – 229, 344f, 354f, 364ff - of mild solutions of a Cauchy problem retarded - 356ff 98ff transport - 308f, 320 - of solutions of a Cauchy problem example 98ff, 204ff, 336ff essential - 74, 343 counter -3, 61ff, 105, 131, 266ff, 311 standard - 7ff, 9, 10, 11, 13, 42ff, 100f, 134, 380, 416 exponential estimate 2f half-norm 51ff, 127ff canonical – 51ff, 127ff, 265ff F-product 20f, 298ff, 314ff strict - 51ff, 127ff F-product with respect to a semigroup heat equation 13 Hilbert space 13, 62, 94ff, 105, 403 20f, 74ff, 192 **face** 336 Hille-Yosida theorem 32

invariant - 336, 410

faithful subset 380

Fèjer's theorem 93f

```
ideal 236
Feller property
  strong -213
                                            algebraic - 116
fixed space 343ff, 374ff, 380ff, 414
                                            closed - 110, 336
flow 143ff
                                            invariant - 192ff, 303, 306ff, 317
  continuous – 146, 192ff, 330
                                            lattice - 236
  semi – 143ff, 352ff
                                          imaginary additively cyclic subset
  seperately continuous – 148f
                                            172ff, 192ff, 297
forcing term 112ff, 340ff
                                          inhomogeneous differential equa-
                                          tion
  periodic - 116
                                            112ff, 340ff
  p-periodic - 113ff
                                          integral equation 363
Fourier transformation 12f, 91, 252
                                          interpolation 335, 348, 352
  inverse - 13, 91
                                          invariant
  coefficient 80
                                            - ideals 192ff, 303, 306ff, 317
Fredholm
                                            - subset 24, 346
                                          irreducible 130ff, 256ff, 414
  - domain 73f
  - operator 73f
                                            - semigroup 130, 192ff, 210, 306ff,
                                              311ff, 315ff, 405ff
                                            W*- 369
Jordan decomposition 334, 389, 420
                                            closed - 5f
                                            contractive - 47ff
                                            densely defined - 4
                                            differential - 8ff
                                            dissipative - 47ff
Kakutani-Krein theorem 240, 297,
                                            dispersive 249ff
  313, 334
                                            elliptic - 185, 190f, 260, 305, 312
                                            kernel - 104, 189f, 308ff, 320,
Kato's
```

- equality 138ff, 285ff, 335f	349f, 363, 367
- inequality 139, 256ff, 258ff, 285	lattice – 120, 243
– classical – <i>138f</i> , <i>258f</i>	local – 146f, 268f, 282, 287
– distributional –	Laplace – 13, 34f, 100, 110, 139,
Krein-Rutman theorem 130, 167, 334	163, 185, 205, 250f, 258, 333
	multiplication - 7f, 89f, 248, 287
	positive – 120ff
	p-contractive – 48ff
Laplace transform 101, 107	p-dissipative – 48ff, 128ff
Laplacian 13, 34f, 100, 110, 139,	resolvent positive – 127ff
163, 185, 205, 250f, 258, 333	Schrödinger – <i>179</i> , <i>273</i> , <i>278f</i> , <i>336</i>
lattice	strictly dissipative – 48ff
- homomorphism 120, 243, 244, 281	strictly p-dissipative – 48ff
– norm 235	strictly dispersive 249ff
locality 146f, 268f, 282, 287	weakly compact – 181, 211f
long term behavior 98ff, 204ff,	operator semigroup 1ff, 400
342ff, 352, 406ff	weakly compact – 406f
Lumer-Phillips theorem 53f	order bounded 236
	order
	- complete 234
	– continuous norm 241
	- interval 235
Markov	order continuity 239, 286, 287ff
– algebra homomorphism 143ff	order unit 236
– lattice homomorphism 120,	weak – 238
192ff, 200f	ordered
– operator 120, 181	- Banach space 234, 293

- process 213f - vector space 234 - semigroup 144, 181 - transition function 213f, 347f matrix semigroup 7 maximum principle 165, 190 mild solution 99, 112 periodic modulus 136, 257, 285f, 381 - semigroup 10, 79ff, 85, 313, 416 multiplication p-periodic 113ff - operator 7f, 89f, 246 Perron-Frobenius theory 163ff, 172ff, 292ff, 298ff, 379ff - semigroup 7f, 42ff, 65f, 287ff multiplicity 73ff perturbation algebraic - 73f, 209, 310 additive - 43ff - as a pole 73 bounded - 44ff, 307 geometric - 73, 310 compact - 215f, 319 multiplicative - 131ff, 141 perturbation by multiplication operators 179, 183, 188, 274ff, 279, 307 negative part 235 perturbation theorems 43ff norm Phillip's theorem 243 graph - 5polar decomposition 380, 392 Sobolev – 13ff pole 67f, 72ff, 76, 209ff, 305, 315ff normal linear functional 369 algebraically simple – 73f, 161, 185, 209ff, 218, 315ff - of order k 73f, 86, 174f, 295, 302ff

```
simple - 73f, 209ff, 310, 315ff
operator
  closable – 5f
                                             first order – 73f, 160
population equation 229ff, 344f,
                                          Schwarz inequality 370
  354f, 364ff
                                          Schwartz space 12, 250
positive part 235
                                          self-adjoint part 369
positive minimum principle
                                          semiflow 143ff, 352ff
  165ff, 133ff, 253ff, 368
                                             continuous - 144ff, 192
positive subeigenvector 261
                                             injective – 193
positivity 119, 119, 120,
                                             surjective - 193
  128ff, 238, 243, 244, 370
                                          semigroup 1ff
  n-370, 403
                                             adjoint - 16ff, 77, 400
  strict - 119, 119, 120,
                                             analytic - 83ff
                                             bounded -3
     238, 242, 310, 316
predual 369
                                             bounded holomorphic (of angle \alpha)
                                               83ff, 110
projection 73, 209ff, 343ff,
  410ff, 433
                                            compact - 40ff
  ergodic - 410ff, 434
                                             commuting - 24
  recurrent - 407
                                            contraction - 3, 47ff, 247ff,
  semigroup -
                                               287f, 337
     209ff, 310, 343ff, 411
                                             convolution - 12
  spectral - 66ff
                                             differentiable - 37f, 41
pseudo-resolvent 209ff, 314ff,
                                             diffusion – 11ff
  372ff, 383ff, 392ff, 419ff
                                             disjointness preserving – 291ff
positive – 239ff
                                             eventually compact -
                                               40ff, 209, 211, 214
                                             eventually differentiable – 37, 41
```

eventually norm continuous -

quasi-compact 214ff, 343f 38ff, 41, 87ff, 106, 178, 304f, quasi-interior point 238, 306 310, 337, 345 **F-product** – 20f, 74ff, 192 holomorphic (of angle α) – 83ff, 41, 100, 163, 305ff, 311ff identity preserving – 370ff, 379ff, range condition 55f, 146f, 249, 270 383ff, 408ff, 424f **regular mapping** 242, 272, 279f implemented -403regularity 342, 273, 279f induced - 14f, 74ff, 298, 374 residue 67f, 72ff, 308ff, 385ff irreducible - 182ff, 210, 315ff, resolvent 63ff, 370 336ff, 406ff compact - 40, 73, 130, 166, lattice homomorphism - 136ff, 143ff, 177, 305, 316, 336 192ff, 235, 320ff **Markovian** – 144ff, 191 positive – 133ff pseudo – 299ff, 314ff, 372ff, matrix - 7 383ff, 392ff, 419ff mean-ergodic - 346 slowly growing - 301ff modulus – 278ff, 282ff multiplication - 7f, 42ff, 65f, 287ff resolvent 6, 63ff, 370 - equation 137, 298 **nilpotent** – 11, 41f, 74ff – integral representation 6, 293ff norm continuous – 38ff, 41 - positive 127 - of Schwarz type 370ff, 379ff, - set 63ff, 75 408ff, 424f retarded one-parameter – 1 - differential equation 219ff partially periodic - 352ff, 416ff - equation 356ff **periodic –** 79ff, 85, 313, 416

Riesz Decomposition theorem 237 positive - 128ff Riesz Schauder theory 72f preadjoint - 414 **quasi-compact** – 214ff, 343ff **quotient** – 15, 74 reduced - 374, 407 rescaled - 14 Schrödinger operator 273f, 278f, 336 rotation - 10, 69, 189, 313, 352ff Schwarz map 370ff, 379ff, 381ff, 407ff **similar** – *13f* identity preserving – 370ff, 379ff, Sobolev - 19ff 381ff, 408ff strongly continuous – 2ff strongly ergodic - 406, 408ff, 424f subspace - 14f, 74 tensor product – 21ff, 88f strictly positive **translation** – 9f, 11, 16, 78, 41, 118, 119, 120, 236, 242, 261 66ff, 205 - element 261 uniformly continuous – 2, 7, 54ff, - functional 236, 261 129, 247, 255, 288, 376ff - operator 242 uniformly ergodic - 391ff, 410, - subset 261ff 419, 424f subdifferential 48ff, 120ff weakly continuous – 2 subeigenvector 261 weak* continuous - 16, 370ff, 403 positive - 261 weak*-irreducible - 369, 414, 424f subinvariant subset 380 semigroup dual 16f sublattice 236 signum 137ff, 266ff, 276, 296f sublinear function 47f

- operator 170ff, 245, 258ff, 296

singularity

isolated -72ff

```
Sobolev space 16ff
  classical - 19
                                         tensor product
solid subset 236
                                            - of Banach spaces 21ff
solution of a Cauchy problem 4, 27ff
                                            - of operators 21ff
  generalized - 99, 112ff
                                            - of semigroups 21ff, 88f
  mild - 99, 112ff
                                         translation property 220, 358
  p-periodic – 113ff
                                         translation semigroup 9f, 16, 78,
  strong – 26ff, 99, 112ff,
                                            61f, 66ff, 75, 205
     218ff, 356ff
                                            nilpotent - 11, 41f, 63, 164f
                                            periodic – 66
spectral
  - decomposition 66ff, 325ff, 351f
                                         transformation
  - projection 66f, 73
                                            Fourier – 12f
  - theorem 66ff, 82ff
                                            Laplace - 101, 107
spectral bound 60ff, 101f, 105ff,
                                         transport equation 308f, 320
  130, 163, 162, 204ff, 225, 292ff,
                                         type of a semigroup 2
  318, 334ff, 361, 379, 400ff
  essential - 73f, 214ff, 318
spectral inclusion theorem 84f
spectral mapping theorem
  60ff, 67, 82ff, 106
                                         ultrapower 315, 377, 394, 420
  weak — 66f, 83f, 86ff
                                         unimodular function 313
  — for the resolvent 67f
                                         unitary 390
spectral radius 60
  essential – 73f, 177, 214ff, 318
spectral value
  dominant – 177ff
  strictly dominant - 177ff, 210, 217
                                         vector
```

```
spectrum 60ff
                                           - lattice 235
  approximate point – 64f, 394
                                           - sublattice 236
  boundary - 169ff, 208ff, 302ff,
    305, 379ff, 387
  cyclic - 169, 172ff, 302ff,
    305, 379ff, 388ff
                                         W*-algebra 369
  essential – 73f
                                         W*-dynamical system 414ff
  point - 64f, 394
                                           irreducible - 414ff
  residual – 64f
                                         weakly sequentially compact 242,
                                         322
stability
                                         well-posedness 26ff
  98ff, 227, 337ff, 361, 402ff
  exponential 99ff, 227
  uniform - 89f, 339, 402ff
  uniform exponential – 99f,
    203, 402ff
                                         Zero-Two law (0-2 law) 347f
weak - 111f, 205f, 402ff
weak uniform – 111f
state space 369, 400
stationary point 156
stochastic continuity 213f
```