

References

1. R. Azencott, *Espaces de Poisson des groupes localement compacts*, Lecture Notes in Math. **148**, Springer-Verlag, Berlin, 1970.
2. B. Blackadar, *K-theory for operator algebras*, MSRI Publ. **5**, Springer-Verlag, Heidelberg, 1986.
3. D. Bakry, *On Sobolev and logarithmic Sobolev inequalities for Markov semigroups*, in “New Trends in Stochastic Analysis” (ed. K. D. Elworthy) World Scientific (1997) 43–75.
4. C. Berg and J.P.R. Christensen, *On the relation between amenability of locally compact groups and the norms of convolution operators*, Math. Ann. **208** (1974) 149–153.
5. J.F. Bonnans and A. Shapiro, *Perturbation analysis of optimization problems*, Springer-Verlag, Berlin, 2000.
6. A. Böttcher, Y.I. Karlovich and I.M. Spitkovsky, *Convolution operators and factorization of almost periodic matrix functions*, Birkhäuser Verlag, Berlin, 2002.
7. C. Chen and C-H. Chu, *Spectrum of a homogeneous graph*, J. Math. Anal. Appl. (to appear).
8. G. Choquet and J. Deny, *Sur l’équation de convolution $\mu = \mu * \sigma$* , C.R. Acad. Sc. Paris **250** (1960) 779–801.
9. C-H. Chu, *Matrix-valued harmonic functions on groups*, J. Reine Angew. Math. **552** (2002) 15–52.
10. C-H. Chu, *Harmonic function spaces on groups*, J. London Math. Soc. **70** (2004) 182–198.
11. C-H. Chu, *Jordan triples and Riemannian symmetric spaces*, Preprint (2008).
12. C-H. Chu, T. Hilberdink and J. Howroyd, *A matrix-valued Choquet-Deny Theorem*, Proc. Amer. Math. Soc. **129** (2001) 229–235.
13. C-H. Chu and A.T.M. Lau, *Harmonic functions on groups and Fourier algebras*, Lecture Notes in Math. **1782**, Springer-Verlag, Heidelberg, 2002.
14. C-H. Chu and A.T-M. Lau, *Jordan structures in harmonic functions and Fourier algebras on homogeneous spaces*, Math. Ann. **336** (2006) 803–840.
15. C-H. Chu and C-W. Leung, *The convolution equation of Choquet and Deny on [IN]-groups*, Integr. Equat. Oper. Th. **40** (2001) 391–402.
16. C-H. Chu and T.G. Vu, *A Liouville theorem for matrix-valued harmonic functions on nilpotent groups*, Bull. London Math. Soc. **35** (2003) 651–658.
17. C-H. Chu and Z. Qian, *Dirichlet forms and Markov semigroups on non-associative vector bundles*, Studies in Adv. Math., Amer. Math. Soc. (to appear).
18. C-H. Chu and N-C. Wong, *Isometries between C^* -algebras*, Rev. Mat. Iberoamericana **20** (2004) 87–105.
19. F.R.K. Chung, *Spectral graph theory*, CMBS Lecture Notes, Amer. Math. Soc. Providence, 1997.
20. F.R.K. Chung and S. Sternberg, *Laplacian and vibrational spectra for homogeneous graphs*, J. Graph Theory **16** (1992) 605–627.

21. E.B. Davies and O.S. Rothaus, *Markov semigroups on C^* bundles*, J. Funct. Analysis **85** (1989) 264–286.
22. Diestel and Uhl, *Vector measures*, (Math. Surveys **15**) Amer. Math. Soc. Providence, 1977.
23. J. Dixmier, *Les C^* -algèbres et leur représentations*, Gauthier-Villars, Paris, 1969.
24. N. Dunford and J.T. Schwartz, *Linear Operators I*, J. Wiley & Sons, New York, 1988.
25. E.B. Dynkin, *Markov Process*, Vol. I, Springer, Berlin, 1965.
26. R. J. Elliot, *Two notes on spectral synthesis for discrete abelian groups*, Proc. Camb. Phil. Soc. **61** (1965) 617–620.
27. E.B. Folland, *A course in abstract harmonic analysis*, CRC Press, Boca Raton, 1995.
28. Y. Friedman and B. Russo, *Solution of the contractive projection problem*, J. Funct. Analysis **60** (1985) 56–79.
29. H. Furstenberg, *A Poisson formula for semi-simple Lie groups*, Ann. of Math. **77** (1963) 335–386.
30. H. Furstenberg, *Boundaries of Riemannian symmetric spaces*, in ('Symmetric spaces', Pure Appl. Math. **8**, Marcel Dekker, 1972) 359–377.
31. J. E. Gilbert, *Spectral synthesis problems for invariant subspaces on groups*, Amer. J. Math. **88** (1966) 626–635.
32. R.E. Greene and H. Wu, 'Integrals of subharmonic functions on manifolds of nonnegative curvature', Invent. Math. **27** (1974) 265–298.
33. F.P. Greenleaf, *Invariant means on topological groups*, van Nostrand, New York, 1969.
34. N.E. Gretskey and J.J. Uhl, *Bounded linear operators on Banach function spaces of vector-valued functions*, Trans. Amer. Math. Soc. **167** (1972) 263–277.
35. R.I. Grigorchuk, P. Linnell, T. Schick and A. Zuk, *On a question of Atiyah*, C.R. Acad. Sci. Paris, t. **331**, Série I (2000) 663–668.
36. L. Gross, *Logarithmic Sobolev inequalities*, Amer. J. Math. **97** (1975) 1061–1083.
37. S. Helgason, *Differential geometry, Lie groups and symmetric spaces*, Academic Press 1980.
38. E. Hewitt and K.A. Ross, *Abstract harmonic analysis*, Vol. I, Springer-Verlag, Berlin, 1963.
39. G.A. Hunt, *Semi-groups of measures on Lie groups*, Trans. Amer. Math. Soc. **81** (1956), 264–293.
40. B.E. Johnson, *Harmonic functions on nilpotent groups*, Integral Equations & Oper. Th. **40** (2001) 454–464.
41. W. Kaup, *A Riemann mapping theorem for bounded symmetric domains in complex Banach spaces*, Math. Z. **183** (1983) 503–529.
42. W. Kaup, *Contractive projections on Jordan C^* -algebras and generalizations*, Math. Scand. **54** (1984) 95–100.
43. M. Koecher, *Jordan algebras and differential geometry*, Proc. ICM (Nice 1970) 279–283.
44. R. Larsen, *An introduction to the theory of multipliers*, Springer-Verlag, Berlin, 1971.
45. K-S. Lau, J. Wang and C-H. Chu, *Vector-valued Choquet–Deny theorem, renewal equation and self-similar measures*, Studia Math. **117** (1995) 1–28.
46. P. Li and R. Schoen, ' L^p and mean value properties of subharmonic functions on Riemannian manifolds', Acta Math. **153** (1984) 279–301.
47. O. Loos, *Bounded symmetric domains and Jordan pairs* (Mathematical Lectures) University of California, Irvine 1977.
48. F. Lust-Piquard and W. Schachermayer, *Functions in $L^\infty(G)$ and associated convolution operators*, Studia Math. **93** (1989) 109–136.
49. B. Malgrange, *Existence et approximation des solutions des équations aux dérivées partielles et des équations de convolution*, Ann. l'Institut Fourier **6** (1955/56) 271–355.
50. J. Milnor, *Curvatures of left invariant metrics on Lie groups*, Adv. Math. **21** (1976) 293–329.
51. G.K. Pedersen, *C^* -algebras and their automorphism groups*, Academic Press, London, 1979.
52. F. Parreau, *Measures with real spectra*, Invent. Math. **98** (1989) 311–330.
53. R.R. Phelps, *Convex functions, monotone operators and differentiability*, Lecture Notes in Math. **1364**, Springer-Verlag, Heidelberg, 1989.
54. V. Rabinovich, S. Roch and B. Silberman, *Limit operators and their applications in operator theory*, Birkhäuser Verlag, Basel, 2004.

- 55. W. Rudin, *Fourier analysis on groups*, Interscience Publishers, New York, 1962.
- 56. P. Sarnak, *Spectra of singular measures as multipliers on L^p* , J. Funct. Analysis **37** (1980) 302–317.
- 57. I. Satake, *Algebraic structures of symmetric domains*, Princeton Univ. Press, Princeton, 1980.
- 58. L. Schwartz, *Théorie générale des fonctions moyennes-périodiques*, Ann. of Math. **48** (1947) 857–929.
- 59. B. Ya Shteinberg, *Convolution type operators on locally compact groups*, Funktsional. Anal. i Prilozhen. **15** (1981) 95–96.
- 60. B. Ya Shteinberg, *Boundedness and compactness of convolution operators with unbounded coefficients on locally compact groups*, Mat. Zametki **38** (1985) 278–292.
- 61. B. Ya Shteinberg, *Compactification of locally compact groups and Fredholmness of convolution operators with coefficients in factor groups*, Tr. St.-Peterbg. Mat. Obshch. **6** (1998) 242–260.
- 62. M. Takesaki, *Theory of operator algebras I*, Springer-Verlag, Berlin, 1979.
- 63. H. Upmeyer, *Symmetric Banach manifolds and Jordan C^* -algebras* (North Holland Math. Studies **104**) North Holland, Amsterdam, 1985.
- 64. S-T. Yau, *Some function-theoretic properties of complete Riemannian manifolds and their applications to geometry*, Indiana Univ. Math. J. **25** (1976) 659–670.
- 65. S-T. Yau, *Harmonic functions on complete Riemannian manifolds*, Comm. Pure Applied Math. **28** (1975) 201–228.
- 66. M. Zafran, *The spectra of multiplier transformations on the L_p spaces*, Ann. of Math. **103** (1976) 355–374.

List of Symbols

λ , 5	$f * \mu, \mu * f$, 7
δ_a , 7, 23	$f * g$, 7
σ^n , 8	$\mu * \nu$, 6, 23
\triangle_G , 7	$f * \sigma$, 24
$C(G), C_0(G), C_b(G), C_c(G)$, 6	$\int_G d\sigma(x) f(x)$, 23
M_n , 5	$\sigma *_{\ell} f$, 24
M_n^+ , 22	$\mu *_{\ell} \sigma$, 24
$\ \cdot\ _{tr}, \ \cdot\ _{hs}$, 5, 6	T_{σ} , 7, 26
Tr , 5	L_{σ} , 26
$M(G)$, 6	$\mathbf{1}$, 64, 74
$M(G, M_n), M(G, M_n^*)$, 23	$\mathcal{B}(E)$, 5
$\ \mu\ $, 6, 22	$\text{Spec}_{\mathcal{A}} a, \text{Spec}'_{\mathcal{A}} a$, 12
$C_0(G, M_n)$, 23	$\text{Spec}(T_{\sigma}, L^p(G))$, 12
$C_b(G, M_n), C_c(G, M_n)$, 23	$\text{Spec}(T_{\sigma}, L^p(G, M_n))$, 33
$L^p(G), L^p(G, M_n)$, 5	$R(\alpha, T_{\sigma})$, 36
$L^p(G, M_{n,2})$, 39, 95	$\Lambda(T_{\sigma}, L^p(G))$, 12
$\partial\ \cdot\ $, 15	$\Lambda(T_{\sigma}, L^p(G, M_n))$, 33
$\partial\ f\ _p$, 18	$H_{\alpha}(T_{\sigma}, L^p(G, M_n))$, 63
$\langle \cdot, \cdot \rangle$, 6, 23, 25	$H_{\alpha}(L_{\sigma}, L^p(G, M_n))$, 63
$\text{supp } \sigma, \text{supp } \sigma $, 7	$\text{Spec } \sigma$, 12, 33
G_{σ} , 7	$\text{Spec } \widehat{\sigma}(\pi)$, 13, 38
ℓ_x, r_x , 7	$\Lambda \mathcal{E}$, 40
$\widetilde{x}f, f_x$, 7	$\widehat{\sigma}(\pi)$, 13, 37
f , 7	$\widehat{f}(\pi)$, 13, 37
f^T , 38	$\det \sigma$, 42
f^* , 6	$\text{Adj } \sigma$, 42
f^{\star} , 39, 55	$A(\widehat{G}, M_n)$, 46
$\widetilde{\mu}$, 7	$C^*(G), C_r^*(G)$, 55
σ^T , 38	$G \times_{\beta} \mathcal{A}$, 55
ι , 13	$\{\cdot, \cdot, \cdot\}$, 73
$\widetilde{\pi}$, 38	\mathcal{L} , 1, 87

Δ , 75 $\{\sigma_t\}_{t>0}$, 88 \mathcal{S} , 90 $\tilde{\mathcal{S}}$, 90 $H_S^p(G, M_n)$, 90 $H_S^p(G, \mathbb{C}), H_S^p(G)$, 92 $H^\infty(\Omega, M_n)$, 77 $H^\infty(\Omega, \mathbb{C})$, 78

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