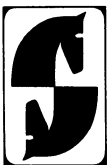


Richard Beals

Advanced Mathematical Analysis

Periodic Functions and Distributions,
Complex Analysis, Laplace Transform
and Applications



Springer Science+Business Media, LLC

Richard Beals

Professor of Mathematics
University of Chicago
Department of Mathematics
5734 University Avenue
Chicago, Illinois 60637

Managing Editors

P. R. Halmos

Indiana University
Department of Mathematics
Swain Hall East
Bloomington, Indiana 47401

C. C. Moore

University of California
at Berkeley
Department of Mathematics
Berkeley, California 94720

AMS Subject Classification

46-01, 46S05, 46C05, 30-01, 43-01
34-01, 3501

Library of Congress Cataloging in Publication Data

Beals, Richard, 1938-

Advanced mathematical analysis.

(Graduate texts in mathematics, v. 12)

1. Mathematical analysis. I. Title. II. Series.

QA300.B4 515 73-6884

All rights reserved.

No part of this book may be translated or reproduced in any form
without written permission from Springer-Verlag.

© 1973 by Springer Science+Business Media New York

Originally published by Springer-Verlag New York Inc in 1973

ISBN 978-0-387-90066-7

ISBN 978-1-4684-9886-8 (eBook)

DOI 10.1007/978-1-4684-9886-8

TABLE OF CONTENTS

Chapter One Basis concepts

§1. Sets and functions	1
§2. Real and complex numbers	5
§3. Sequences of real and complex numbers	10
§4. Series	14
§5. Metric spaces	19
§6. Compact sets	23
§7. Vector spaces	27

Chapter Two Continuous functions

§1. Continuity, uniform continuity, and compactness	34
§2. Integration of complex-valued functions	38
§3. Differentiation of complex-valued functions	42
§4. Sequences and series of functions	47
§5. Differential equations and the exponential function	51
§6. Trigonometric functions and the logarithm	57
§7. Functions of two variables	62
§8. Some infinitely differentiable functions	67

Chapter Three Periodic functions and periodic distributions

§1. Continuous periodic functions	69
§2. Smooth periodic functions	72
§3. Translation, convolution, and approximation	77
§4. The Weierstrass approximation theorems	81
§5. Periodic distributions	84
§6. Determining the periodic distributions	89
§7. Convolution of distributions	94
§8. Summary of operations on periodic distributions	99

Chapter Four Hilbert spaces and Fourier series

§1. An inner product in \mathcal{C} , and the space \mathcal{L}^2	103
§2. Hilbert space	109
§3. Hilbert spaces of sequences	113
§4. Orthonormal bases	116
§5. Orthogonal expansions	121
§6. Fourier series	125

Chapter Five Applications of Fourier series

§1. Fourier series of smooth periodic functions and periodic distributions	131
§2. Fourier series, convolutions, and approximation	134
§3. The heat equation: distribution solutions	137
§4. The heat equation: classical solutions; derivation	142
§5. The wave equation	145
§6. Laplace's equation and the Dirichlet problem	150

Chapter Six Complex analysis

§1. Complex differentiation	155
§2. Complex integration	159
§3. The Cauchy integral formula	166
§4. The local behavior of a holomorphic function	171
§5. Isolated singularities	175
§6. Rational functions; Laurent expansions; residues	179
§7. Holomorphic functions in the unit disc	184

Chapter Seven The Laplace transform

§1. Introduction	190
§2. The space \mathcal{L}	193
§3. The space \mathcal{L}'	197
§4. Characterization of distributions of type \mathcal{L}'	201
§5. Laplace transforms of functions	205
§6. Laplace transforms of distributions	210
§7. Differential equations	213

Notes and bibliography	223
----------------------------------	-----

Notation index	225
--------------------------	-----

Subject index	227
-------------------------	-----