

Claus Müller

Foundations
of the Mathematical Theory
of Electromagnetic Waves



Springer-Verlag Berlin Heidelberg GmbH 1969

Prof. Dr. Claus Müller
Technische Hochschule Aachen

Geschäftsführende Herausgeber:

Prof. Dr. B. Eckmann
Eidgenössische Technische Hochschule Zürich

Prof. Dr. B. L. van der Waerden
Mathematisches Institut der Universität Zürich

Revised and enlarged translation of
Grundprobleme der mathematischen Theorie
elektromagnetischer Schwingungen, 1957
(Grundlehren der mathematischen Wissenschaften, Vol. 88)

In cooperation with Dr. T. P. Higgins

ISBN 978-3-662-11775-0 ISBN 978-3-662-11773-6 (eBook)
DOI 10.1007/978-3-662-11773-6

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically those of translation, reprinting, re-use of illustrations, broadcasting, reproduction by photocopying machine or similar means, and storage in data banks.

Under § 54 of the German Copyright Law where copies are made for other than private use, a fee is payable to the publisher, the amount of the fee to be determined by agreement with the publisher

© by Springer-Verlag Berlin Heidelberg 1969
Originally published by Springer-Verlag Berlin Heidelberg New York in 1969
Softcover reprint of the hardcover 1st edition 1969

Library of Congress Catalog Card Number 75-81586.
Title No. 5138

Contents

Introduction	1
I. Vector Analysis	14
§ 1. Foundations of Vector Analysis	17
II. Special Functions	45
§ 2. The Spherical Harmonics	45
§ 3. Bessel Functions	68
III. The Reduced Wave Equation	79
§ 4. Solutions of the Equation $\Delta U + U = 0$	82
§ 5. The Radiation Conditions	88
§ 6. The Entire Solutions of the Reduced Wave Equation	95
§ 7. Vector Solutions of the Reduced Wave Equation	104
§ 8. The Behavior at Infinity	112
§ 9. The Local Behavior	116
IV. Electromagnetic Waves in a Homogeneous Medium	129
§ 10. The Integral Representation	130
§ 11. Generation of Electromagnetic Waves by Volume Currents	137
§ 12. Analysis of the Surface Currents	142
§ 13. Closed Surfaces and Their Fields	163
§ 14. The Generation of Electromagnetic Waves by Surface Currents	210
V. Linear Transformations	217
§ 15. Linear Spaces and Their Transformations	218
§ 16. The Inversion of the Linear Transformation	227
§ 17. The Adjoint Transformation	234
§ 18. A Solution of Fredholm's Equations	243
§ 19. Integral Operators	251
VI. Electromagnetic Waves in an Inhomogeneous Medium	260
§ 20. Formulation of the Problems	260
§ 21. The Uniqueness Theorems	267
§ 22. Problem I	285
§ 23. Problem II	297
§ 24. Problem III	320
VII. The Boundary Value Problems	326
§ 25. Boundary Value Problems	328
VIII. The Radiation Patterns	338
§ 26. The Polarization of the Radiation Pattern	341
List of Theorems, Lemmas and Definitions	345
Bibliography	347
Author and Subject Index	349