

# Mathematical Methods of Modern Physics

Prof. Dr. Bernd Rosenow, SS 2024

**For:** Bachelor: Physics (6. semester) & IPSP (6. semester),  
Master: Physics & IPSP & Mathematical Physics

**Workload:** 5 LP, 1 lecture (English) + 1 tutorial (English) per week

**Exam:** 1 exam (90 min), prerequisite is 50% of the points from the weekly exercise sheets

## Contents:

- Complex analysis:

- Holomorphic functions

$$f'(z_0) = \left. \frac{df(z)}{dz} \right|_{z_0}$$

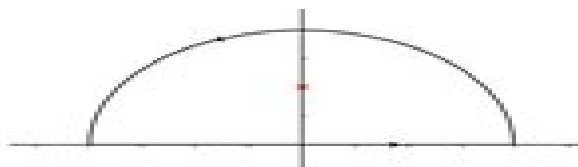
- Residue theorem

$$\oint_{\gamma} f(z) dz = 2\pi i \sum_k \Gamma(\gamma, a_k) \operatorname{Res}(f, a_k)$$

- Laurent series

$$f(z) = \sum_{n=-\infty}^{\infty} b_n z^n$$

- Applications to real integrals



$$\int_{-\infty}^{\infty} \frac{1}{x^2 + 1} dx = 2\pi i \frac{1}{2i} = \pi$$

- Distributions and Fourier transformation

$$G^<(k, E) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \frac{1}{2\pi} \frac{e^{-ixk} e^{iEt}}{x - vt - i\delta} dx dt = 2\pi i \delta(E - vk) \Theta(-vk)$$

- Eigenvalues and eigenfunctions

# Mathematical Methods Of Physics

**JR Anderson**



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## **Table of Contents Mathematical Methods Of Physics**

1. Understanding the eBook Mathematical Methods Of Physics
  - The Rise of Digital Reading Mathematical Methods Of Physics
  - Advantages of eBooks Over Traditional Books
2. Identifying Mathematical Methods Of Physics
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Mathematical Methods Of Physics
  - User-Friendly Interface
4. Exploring eBook Recommendations from Mathematical Methods Of Physics
  - Personalized Recommendations
  - Mathematical Methods Of Physics User Reviews and Ratings
  - Mathematical Methods Of Physics and Bestseller Lists
5. Accessing Mathematical Methods Of Physics Free and Paid eBooks
  - Mathematical Methods Of Physics Public Domain eBooks
  - Mathematical Methods Of Physics eBook Subscription Services
  - Mathematical Methods Of Physics Budget-Friendly Options

6. Navigating Mathematical Methods Of Physics eBook Formats
  - ePub, PDF, MOBI, and More
  - Mathematical Methods Of Physics Compatibility with Devices
  - Mathematical Methods Of Physics Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Mathematical Methods Of Physics
  - Highlighting and Note-Taking Mathematical Methods Of Physics
  - Interactive Elements Mathematical Methods Of Physics
8. Staying Engaged with Mathematical Methods Of Physics
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Mathematical Methods Of Physics
9. Balancing eBooks and Physical Books Mathematical Methods Of Physics
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Mathematical Methods Of Physics
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Mathematical Methods Of Physics
  - Setting Reading Goals Mathematical Methods Of Physics
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Mathematical Methods Of Physics
  - Fact-Checking eBook Content of Mathematical Methods Of Physics
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
  - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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