Contents

PART A LIE GROUPS AND ALGEBRAS

Chapter 1 Lie Groups

1.	Continuous Groups: Covering Groups	3
2.	The Rotation Group in R^3	6
3.		8
	The Covering Group of SO(3)	10
	The Lorentz Group	16
		18
6.	The Classical Groups	10
Cha	apter 2 Lie Algebras	
7.	Real and Complex Lie Algebras	21
8.	Representations of Lie Algebras	24
9.	The state of the s	26
		29
10.	The Classical Lie Algebras	
Cha	apter 3 Lie Groups and Algebras: Matrix Approach	
11	Exponentials and Logs	32
		38
12.	Automorphisms and Derivations	
Cha	apter 4 Applications to Physics and Vice Versa	
13	Poisson Brackets and Quantization	41
14.		44
14.	WIGHOR OF A KIER DOGY, Edici o Education	

VIII	Contents
15. The Harmonic Oscillator and Boson Calculus16. Boson Realizations of Lie Algebras	48 51
PART B DIFFERENTIAL GEOMETRY AND LIE GROUPS	
Chapter 5 Calculus on Manifolds	
 17. Vector Fields, Flows, and 1-Forms 18. Differential Forms and Integration 19. Transformation Groups and Frame Invariance 20. The Lie Derivative 	57 63 67 73
Chapter 6 Symmetry Groups of Differential Equations	
 21. Group Actions on Jet Bundles 22. Infinitesimal Symmetries of Differential Equations 23. Symmetries and Conservation Laws 	76 80 85
Chapter 7 Invariant Forms on Lie Groups	
 24. Invariant Forms on Linear Groups 25. The Maurer-Cartan Equations 26. Geometry "à la Cartan" 27. Variations on a Theme by Euler 	89 94 96 105
Chapter 8 Lie Groups and Algebras: Differential Geometric Approach	
28. The Maurer-Cartan Equations, bis29. Construction of the Group from the Algebra	109 113
PART C ALGEBRAIC THEORY	
Chapter 9 General Structure of Lie Algebras	
30. Ideals, Solvability, and Nilpotency31. Theorems of Lie and Engels32. Cartan's Criteria	119 123 127
Chapter 10 Structure of Semi-Simple Lie Algebras	
33. Weyl-Chevalley Normal Form34. Cartan Subalgebras, and Root Space Decompositions	130 134

Contents		ix
35. 36.	Root Figures and Dynkin Diagrams The Classical Algebras	140 147
Cha	pter 11 Real Forms	
37. 38.	Compact Real Forms; Weyl's Theorem Cartan Decompositions	153 156
	RT D PRESENTATION THEORY	
Cha	apter 12 Representation Theory	
39.	The Eight-Fold Way	163
40.	Weights and Weight Vectors	170
41.	Tensor Products	175
42.	Enveloping Algebras and Casimir Operators	179
Cha	apter 13 Spinor Representations	
43.	Looking Glass Zoo	181
	Clifford Algebras	182
	RT E PLICATIONS	
Cha	apter 14 Applications	
45.	Completely Integrable Systems	189
46.		200
Bibliography		208
		213
Index		