

Contents

| Preface | v |
|--|---------------------|
| Background Notation | vii |
| CHAPTER 1 | |
| Topology | 1 |
| 1.1 Topological Spaces | 2 |
| 1.2 Metric Spaces | 9 14 |
| 1.3 Continuity | 18 |
| 1.4 Subspaces, Products, and Quotients | 24 |
| 1.5 Compactness 1.6 Connectedness | 31 |
| 1.6 Connectedness 1.7 Baire Spaces | 37 |
| | |
| CHAPTER 2 Banach Spaces and Differential Calculus | 40 |
| 2.1 Banach Spaces | 40 |
| 2.2 Linear and Multilinear Mappings | . 56 |
| 2.3 The Derivative | 75 |
| 2.4 Properties of the Derivative | 83 |
| 2.5 The Inverse and Implicit Function Theorems | 116 |
| CHAPTER 3 Manifolds and Vector Bundles | 141 |
| 3.1 Manifolds | 141 |
| 3.1 Maintoids 3.2 Submanifolds, Products, and Mappings | 150 |
| 3.2 Submanifolds, Froducts, and Wappings 3.3 The Tangent Bundle | 157 |
| 3.4 Vector Bundles | 167 |
| 3.5 Submersions, Immersions and Transversality | 196 |
| CHAPTER 4 | |
| Vector Fields and Dynamical Systems | 238 |
| 4.1 Vector Fields and Flows | 238 |
| 4.2 Vector Fields as Differential Operators | 265 |
| 4.3 An Introduction to Dynamical Systems | 298 |
| 4.4 Frobenius' Theorem and Foliations | 326 |
| CHAPTER 5 | 220 |
| Tensors | 338 |
| 5.1 Tensors in Linear Spaces | 338 349 |
| 5.2 The Lie Derivetive: Algebraic Approach | 359 |
| 5.3 The Lie Derivative: Algebraic Approach | 370 |
| 5.4 The Lie Derivative: Dynamic Approach | 370 3 7 7 |
| 5.5 Partitions of Unity | 511 |

| CHAP | TER 6 | |
|----------------------------|---|-------|
| Diffe | rential Forms | 392 |
| 6.1 | Exterior Algebra | 392 |
| 6.2 | Determinants, Volumes, and the Hodge Star Operator | 402 |
| 6.3 | Differential Forms | 417 |
| 6.4 | The Exterior Derivative, Interior Product, and Lie Derivative | 423 |
| 6.5 | Orientation, Volume Elements, and the Codifferential | 450 |
| COLUMN TO SERVICE SERVICES | TER 7 | |
| Integ | ration on Manifolds | 464 |
| 7.1 | The Definition of the Integral | 464 |
| 7.2 | Stokes' Theorem | 476 |
| 7.3 | The Classical Theorems of Green, Gauss, and Stokes | 504 |
| 7.4 | Induced Flows on Function Spaces and Ergodicity | 513 |
| 7.5 | Introduction to Hodge-deRham Theory and Topological Applications of | |
| | Differential Forms | 538 |
| СНАР | TER 8 | |
| Appl | ications | 560 |
| 8.1 | Hamiltonian Mechanics | 560 |
| 8.2 | Fluid Mechanics | 584 |
| 8.3 | Electromagnetism | 599 |
| 8.3 | The Lie-Poisson Bracket in Continuum Mechanics and Plasma Physics | 609 |
| 8.4 | Constraints and Control | 624 |
| Refe | rences | 631 |
| Index | | 643 |
| Supp | lementary Chapters—Available from the authors as they are prod | luced |
| | | |

- S-1 Lie Groups
- S-2 Introduction to Differential Topology
- S-3 Topics in Riemannian Geometry

