Henneaux, Marc; **Teitelboim, Claudio**
Quantization of gauge systems. (English) Zbl 0838.53053
Princeton, NJ: Princeton Univ. Press. 514 p. (1992).

This book is devoted to the general theory of classical and quantum gauge systems. The quantum mechanical analysis deals with both operator and path integral methods. As an application, a chapter on the Maxwell field and the two-form gauge field is included. Exercises and a modest bibliography are provided at the end of each of the twenty chapters.

The authors give a fully general and unified treatment of the subject. Moreover, the mathematical background needed to develop the formalism is included. Such a treatment was not previously available to such an extent. The presentation of the theory begins with the Dirac analysis of constrained Hamiltonian systems and the geometry of the constraint surface. The explicit relation between the first-class constraints and the gauge invariance of the action is described. Then the graded phase space with the Grassmann coordinates and the generalized graded Poisson bracket are introduced to analyse systems with Fermi variables. The next part of the book deals with the BRST method. The algebraic structure of BRST symmetry and the BRST construction in the reducible and irreducible case (with the use of the Koszul-Tate differential) are described. Then gauge fixed actions, dynamics of the ghost fields and the BRST construction in the case of local field theories are analyzed. Further, three chapters deal with the quantum mechanics of constrained systems: standard operator methods, BRST operator method (quantum BRST cohomology), path integral method for constrained and unconstrained systems. Then the antifield formalism is presented (Koszul-Tate resolution) in classical and path integral formulations and its equivalence with canonical methods are derived. The last two chapters contain applications of the formalism and complementary material on exterior calculus and integration on supermanifolds. Moreover, the relation of Clifford algebras to the quantization of Fermi degrees of freedom is explained.

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MSC:

53Z05	Applications of differential geometry to physics
81T70	Quantization in field theory; cohomological methods
81S40	Path integrals in quantum mechanics
17B70	Graded Lie (super)algebras
58A50	Supermanifolds and graded manifolds
81-02	Research exposition (monographs, survey articles) pertaining to quantum theory

Keywords:

constrained systems; classical gauge theory; quantum gauge theory; BRST quantization; cohomology; path integrals; graded Lie algebras; supermanifolds