ΑΝΑΛΥΤΙΚΗ ΔΥΝΑΜΙΚΗ

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Abstract

This book is intended for teaching, mainly at graduate level but it can be used at advanced undergraduate level too. At the beginning fundamental concepts of Analytical Mechanics are introduced, generalized coordinates, constraints, displacements, virtual displacements, virtual work. Then Lagrange's formalism follows where d' Alembert's principle is introduced , the constrain forces, the inverse problem of Mechanics. Next Hamilton's principle is described and elements of the theory of variations. Applications to General Relativity follow. Problems with boundary conditions for free boundaries are discussed. The principle of gravity wave detection is given. We refer to the path integral approach of quantum mechanics. The idea of symmetries is introduced with theorems of conservation for discrete systems. Motion in a Schwarzschild field is studied. The lagrangian formulation in special relativity follows. We continue next to the Hamiltonian formalism, with Hamilton's equations. We refer to Ostrogradsky's theorem. The canonical transformations are introduced and the generating function of the transform is given. The Poisson brackets follow with the equations of motion with these brackets. Then we study the infinitesimal canonical transformations together with the corresponding conservation theorems. We say something about quantization. The concept of Dirac's brackets is given and their relation to quantization. The method of Hamilton-Jacobi is studied, and the concept of actions-angles as canonical variables is introduced. The Theory of Classical Fields is the next subject together with Noether's theorems for fields. The spontaneous symmetry breaking in classical physics is presented. The theory of disturbance is analyzed and the concept of adiabatic invariance is introduced. An introduction to Non Linear Dynamical Systems is given including parametric resonance and classical chaos. A special subject treated is self-excitation – synchronization. This is observed naturally in several phenomena. At the end, several appendices exist where a detailed analysis of various subjects is given that completes the one given in the chapters of the main book.