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Nota di contenuto	Contents; 1 Quantum field theory and the renormalization group; 1.1 Quantum electrodynamics: A quantum field theory; 1.2 Quantum electrodynamics: The problem of infinities; 1.3 Renormalization; 1.4 Quantum field theory and the renormalization group; 1.5 A triumph of QFT: The Standard Model; 1.6 Critical phenomena: Other infinities; 1.7 Kadanoff and Wilson's renormalization group; 1.8 Effective quantum field theories; 2 Gaussian expectation values. Steepest descent method; 2.1 Generating functions; 2.2 Gaussian expectation values. Wick's theorem 2.3 Perturbed Gaussian measure. Connected contributions2.4 Feynman diagrams. Connected contributions; 2.5 Expectation values. Generating function. Cumulants; 2.6 Steepest descent method; 2.7 Steepest descent method: Several variables, generating functions; Exercises; 3 Universality and the continuum limit; 3.1 Central limit theorem of probabilities; 3.2 Universality and fixed points of transformations; 3.3 Random walk and Brownian motion; 3.4 Random walk: Additional remarks; 3.5 Brownian motion and path integrals; Exercises; 4 Classical

statistical physics: One dimension

4.1 Nearest-neighbour interactions. Transfer matrix
4.2 Correlation functions;
4.3 Thermodynamic limit;
4.4 Connected functions and cluster properties;
4.5 Statistical models: Simple examples;
4.6 The Gaussian model;
4.7 Gaussian model: The continuum limit;
4.8 More general models: The continuum limit; Exercises;
5 Continuum limit and path integrals;
5.1 Gaussian path integrals;
5.2 Gaussian correlations. Wick's theorem;
5.3 Perturbed Gaussian measure;
5.4 Perturbative calculations: Examples; Exercises;
6 Ferromagnetic systems. Correlation functions;
6.1 Ferromagnetic systems: Definition
6.2 Correlation functions. Fourier representation
6.3 Legendre transformation and vertex functions;
6.4 Legendre transformation and steepest descent method;
6.5 Two- and four-point vertex functions; Exercises;
7 Phase transitions: Generalities and examples;
7.1 Infinite temperature or independent spins;
7.2 Phase transitions in infinite dimension;
7.3 Universality in infinite space dimension;
7.4 Transformations, fixed points and universality;
7.5 Finite-range interactions in finite dimension;
7.6 Ising model: Transfer matrix;
7.7 Continuous symmetries and transfer matrix
7.8 Continuous symmetries and Goldstone modes
Exercises;
8 Quasi-Gaussian approximation: Universality, critical dimension;
8.1 Short-range two-spin interactions;
8.2 The Gaussian model: Two-point function;
8.3 Gaussian model and random walk;
8.4 Gaussian model and field integral;
8.5 Quasi-Gaussian approximation;
8.6 The two-point function: Universality;
8.7 Quasi-Gaussian approximation and Landau's theory;
8.8 Continuous symmetries and Goldstone modes;
8.9 Corrections to the quasi-Gaussian approximation;
8.10 Mean-field approximation and corrections;
8.11 Tricritical points; Exercises
9 Renormalization group: General formulation

Sommario/riassunto

The renormalization group is one of most important theoretical concepts that has emerged in physics during the twentieth century. It explains important properties of fundamental interactions at the microscopic scale, as well as universal properties of continuous macroscopic phase transitions. - ; This work tries to provide an elementary introduction to the notions of continuum limit and universality in statistical systems with a large number of degrees of freedom. The existence of a continuum limit requires the appearance of correlations at large distance, a situation that is encountered in sec

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