Topics in Advanced Statistical Mechanics
2020-2021 – A. Maritan (14h) and Sandro Azaele (10h)

Abstract. The course will provide various sophisticated tools of fundamental importance in statistical mechanics. It will introduce (local and global) asymptotic methods to obtain approximate analytical solutions to differential equations. These methods allow one to analyze problems which arise in physics (including statistical mechanics) that are not solvable in closed form and for which brute-force numerical methods may not converge to useful solutions. The discussion of the various applied problems will be elaborated in detail and the discussion will emphasize care and insight, rather than rigour.

Program
Large Deviations and statistical mechanics
Renormalization group in equilibrium statistical mechanics
Introduction to singular perturbation and asymptotic matching
Introduction to multiple scales and homogenization
Rigorous approach to saddle points method

Bibliography

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Niemeijer, Th, and J. M. J. Van Leeuwen. "Renormalization theory for Ising-like spin systems." *Phase transitions and critical phenomena* 6 (1976): 425-505.

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C. M. Bender, S. A. Orszag, *Advanced Mathematical Methods for Scientists and Engineers*, Springer (1999).

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