

# Syllabus for Physics 239

## Integrable method and conformal field theory in condensed matter physics

Fall 2019-2020, Physics Department, UCSD

INSTRUCTOR: Congjun Wu (5430 MH)

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Time/Place: MW 9:30a-10:50a, MYR-A 2623

Instructor Office hour:

Text Books:

1. N. Andrei, arXiv:cond-mat/9408101 Integrable Models in Condensed Matter Physics.
2. P. Di Francesco, P. Mathieu, D. Senechal, *Conformal Field Theory*, Cambridge University Press; 1st edition (August 31, 2017).

## Class Schedule

### 1. Integrable methods

Lecture 1: 2 magons, Bethe Ansatz equation, string states (bound states)

Lecture 2: Many-magon states, factorization of scattering amplitude

Lecture 3: Spin-1/2 antiferromagnetic spin chain, ground state energy, and spinon excitations

Lecture 4: Lieb-Linger model

Lecture 5: Spin-1/2 fermions – Yang-Baxter equation

Lecture 6: Quantum inverse scattering method

Lecture 7: 1D Hubbard model – Lieb-Wu solution

Lecture 8: Kondo problem

### 2. Conformal Field theory

Lecture 9: Conformal Invariance in 2D – constraints in correlation functions

Lecture 10: Operator expansion, radial quantization

Lecture 11: Energy-Momentum tensor, Ward identities

Lecture 12: Virasoro Algebra, centra charge

Lecture 13: Representations of Virasoro algebra

Lecture 14: Kac-Moody algebra

Lecture 15: Minimal models

Lecture 16: Fusions

Lecture 17: Column gas