

# A Course on String Theory

*Lecturer: M.M. Sheikh-Jabbari*

This is a PhD level course, designed for second-third year PhD students in Theoretical High Energy Physics (HEP-TH) area and is equivalent to 4 units (one semester course with 4 hours a day). It assumes a background knowledge of Quantum Field Theory, General Relativity and 2d Conformal Field Theory and Supersymmetry to the level I have taught in my previous courses. Their films and/or lecture notes are available.

## A short description of the course

String theory in its 50 years history has passed many ups and downs and “revolutions”. It is fair to say now that string theory and related topics is a nickname for Theoretical High Energy Physics (HEP-TH). Although it has not reached its very much advertised goals of final formulation and umbrella for grand unified theory and quantum gravity, it has guided us to many fruitful ideas and mathematical tools and formulations; it continues to inspire, and rightfully dominate, the HEP-TH area.

String theory has a vast literature and “jargon” encompassing many topics in 2d CFTs, supergravities in various dimensions, D-branes and their dynamics, many topics in complex geometry, supersymmetric gauge theories in various dimensions, QFT in curved space time, black hole physics, and recently, quantum information theory and exotic matter and strange metals and so on.... It takes a least a one year course to give a reasonable and somewhat selfcontained coverage on the field. However, assuming that students are familiar with the relevant topics I covered in my CFT and QFT-III courses, and given my own time limitations, I will try to make it an a one-semester course.

## Text book and readings

There are several very good books on the topic, like the classic 2 volume book by Joe Polchinski (1998), the book by Becker-Becker-Schwarz (2007) and by Kiritsis (2007). These are, however, more fitting into the one-year program. Instead for a one semester course I find the book by *Clifford Johnson*, entitled **D-branes** (2003) more appropriate. I shall use this book as my text book, however, will not necessarily follow the topics in the same order as the book. I will also briefly add discussions on some more recent developments of the last 15 years or so.

## Topics

The topics we will cover in the course are

- Historical review and overview of the field (*2 sessions*).
- Basics of bosonic string worldsheet theory and its quantization (*5 sessions*).
- Superstrings and 10d supergravities (*3 sessions*).

- String scattering (*2 sessions*).
- T-duality and strings on circle and orbifolds (*2 sessions*).
- Basics of  $p$ -branes and D-branes (*4 sessions*).
- String compactifications, a short account (*1 session*).
- String dualities and M-theory (*3 sessions*).
- More on D-brane dynamics and intersections (*3 sessions*).
- D-branes and black holes in string theory (*2 sessions*).
- Basics of AdS/CFT (*4 sessions*).
- Closing session, naming some current topics (*1 session*).

## Date and time of lectures

*Place:* Lectures will be in Farmanieh Bldg of IPM.

*Time:* Saturday and Monday 10-12am.

*Starting date:* 10th of Mehr, 1396; 2nd of October 2017.

Those who want to attend or formally register the course should contact Ms. Pileroudi, [pileroudi@theory.ipm.ac.ir](mailto:pileroudi@theory.ipm.ac.ir)

There will be a mid-term and a final take-home exam, the dates of which will be fixed later.