Title: Introduction to String Theory
Instructor: Sergey Cherkis

String Theory relates distant areas of mathematics such as Geometry, Topology, Representation Theory, Combinatorics, Integrable Systems, and Gauge Theory. It was originally designed to provide a framework for quantum gravity as well as for unification of all of the fundamental forces of Nature.

This course introduces perturbative string theory, explores the geometric implications of consistency of these theories leading to Calabi-Yau geometries, Ricci flow, and string dualities. In the later part of the course we explore mathematical consequences of string theory dualities, solitons, branes, and M theory. You will learn why string theory likes 26 and 10 dimensions, why the unifying M theory is 11 dimensional. You will study the moduli spaces of curves, use supersymmetry, and see how general relativity emerges.

Prerequisites: Math 511A, 523A, 534A and 534B.

Texts:
D. Lüst and S. Theisen, "Lectures on String Theory," Springer-Verlag, ISBN-13: 978-0387518824: for free Online Version Click Here.
V.G. Kac, "Infinite-dimensional Lie Algebras," Cambridge University Press, ISBN-13: 978-0521466936.
M.B. Green, J.S. Schwarz, E. Witten, "String Theory," Volume 2, Chapters 12, 14, and 15, Cambridge University Press, ISBN-13: 978-0521357531.

Syllabus:

- Conformal field theory in two dimensions: the σ-model.
- BRST quantization.
- Supersymmetry.
- Kac-Moody algebras.
- Five string theories: Type I, Type IIA, Type IIB, Heterotic SO(32), Heterotic $E_8 \times E_8$.
- Ricci flow from σ-model.
- Calabi-Yau geometry as a conformal field theory condition.
- Branes and string dualities.
- Integrable systems from brane world-volumes.