

Course Title (in English)	String theory and conformal theory
Course Title (in Russian)	Теория струн и конформная теория поля
Lead Instructor(s)	Bershtein, Mikhail
Status of this Syllabus	The syllabus is a final draft waiting for form approval
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1. Annotation

Course Description	<p>Conformal field theory is a quantum field theory that is invariant under conformal transformations. The course is devoted to a two-dimensional theory, there is an infinite-dimensional algebra of local conformal transformations.</p> <p>In the course, we will discuss aspects of the conformal theory, basic, but not included in the usual introductory courses. A small preliminary acquaintance with string theory and conformal field theory is assumed. We will mainly focus on the mathematical aspects of the theory, the relations with the representation theory, geometry, combinatorics, special functions.</p>
Course Prerequisites	<p>Students should be familiar with</p> <ol style="list-style-type: none">1. Representatation theory of Lie groups2. Basic topology3. Complex analysis (one dimensional)4. Bosonic string in d dimensions.

2. Structure and Content

Course Academic Level	Master-level course suitable for PhD students
Number of ECTS credits	6

Topic	Summary of Topic	Lectures (# of hours)	Seminars (# of hours)	Labs (# of hours)
Screening operators.	Screening operators in CFT. Felder complex. Existence of the cycle. Quantum groups. Drinfeld-Konno theorem.	4	6	6
Wess-Zumino theory	Wess-Zumino theory, KZ equations. Verlinde algebra. Various limits of the KZ equations Screening operators, integral presentation for the KZ solutions. qKZ equations. KZ equations on the Riemann Surface	3	6	6
W algebras	Classical W algebras. Quantum Hamiltonian reduction. Quantum W algebras.	2	6	4
Mathematical aspects	Modular functor for lattice vertex algebras, for affine Lie algebras. AGT relation for Heisenberg algebra. AGT relation for Virasoro algebra.	2	4	4

3. Assignments

Assignment Type	Assignment Summary
Problem Set	Study of the correlation functions in conformal field theory.

4. Grading

Type of Assessment	Pass/Fail	
Grade Structure	Activity Type	Activity weight, %
	Class Participation	50
	Exam/Quiz	50

Grading Scale

5. Basic Information

Attendance Requirements	Mandatory with Exceptions	
Course Stream	Science, Technology and Engineering (STE)	
Course Delivery Frequency	Every year	
Students of Which Programs do You Recommend to Consider this Course as an Elective?	Masters Programs	PhD Programs
	Mathematical and Theoretical Physics	

Please List the Teaching Assistants (TAs) You Propose for Your Course

First Name	Last Name
Alexei	Litvinov

Course Tags

Math
Physics

6. Textbooks and Internet Resources

Required Textbooks	ISBN-10 or ISBN-13
Francesco, Philippe, Mathieu, Pierre, Sénéchal, David Conformal Field Theory 1997.	978-1-4612-2256-9

Recommended Textbooks	ISBN-10 or ISBN-13
Bojko Bakalov and Alexander Kirillov, Jr. Lectures on Tensor Categories and Modular Functors	978-0-8218-2686-7
A.B. Zamolodchikov Al.B. Zamolodchikov Conformal Field theory and critical phenomena	978-5-94057-520-7

7. Facilities

8. Learning Outcomes

Knowledge
Basic properties of the space of fields in two dimensional conformal field theory. Basic properties of the correaltion functions in two dimensional conformal field theory.

Skill
Calculations with the vertex operators. Calculations with the quantum groups. Simple calculations in the homological algebra.

Experience
Free field constructions for the correlation functions in CFT.

Do you want to specify outcomes in another framework?

Knowledge-Skill-Experience is good enough

9. Assessment Criteria

Select Assignment 1 Type

Problem Set

10. Additional Notes