

<b>Course Title (in English)</b>	Gauge Fields and Complex Geometry
<b>Course Title (in Russian)</b>	Калибровочные поля и комплексная геометрия

<b>Lead Instructor(s)</b>	Rosly, Alexei
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### Course Description

1. Self-duality equations, Bogomolny equations.
2. Relation to holomorphic bundles.
3. Relation to holomorphic bundles on twistor space.
4. Conformal symmetry and complex geometry in twistor space.
5. Elements of superfield formulation of SUSY field theories.
6. Chirality type constraints and complex geometry.
7. Some examples of superfield theories which require complex geometry.
8. BPS conditions in SUSY theories and complex geometry.
9. Elements of Hitchin's integrable systems and related complex geometry.

<b>Course Prerequisites / Recommendations</b>	Student should be familiar with classical mechanics and classical field theory (Landau-Lifshitz' Vol 1 and 2), calculus, and basic differential geometry.
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<b>Course Academic Level</b>	Master-level course suitable for PhD students
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<b>Number of ECTS credits</b>	6
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Topic	Summary of Topic	Lectures (# of hours)	Seminars (# of hours)	Labs (# of hours)
Gauge Theory	Mathematical aspects of Gauge Theory	1.5 h	0	0

**Type of Assessment** Graded

**Grade Structure**

Activity Type	Activity weight, %
Final Exam	100

**A:** 86

**B:** 76

**C:** 66

**D:** 56

**E:** 46

**F:** 0

**Attendance Requirements** Optional

**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	

**Course Tags**Math  
Physics

Required Textbooks	ISBN-13 (or ISBN-10)
The Classical Theory of Fields. Vol. 2 (4th ed.). Landau LD, Lifshitz EM. Butterworth-Heinemann, 1975.	9780750627689

Recommended Textbooks	ISBN-13 (or ISBN-10)
Superstring Theory. Vol. 2: Loop amplitudes, anomalies and phenomenology. Green, M. B.; Schwarz, J. H.; Witten, E., Cambridge University Press 1987. XII, 596 pp.	9780521329996
String Theory and M-Theory: A Modern Introduction. Becker K, Becker M, Schwarz JH. Cambridge University Press, 2006.	9780521860697
Geometry, Topology and Physics, 2nd Edition. Nakahara M. CRC Press. 2003.	9780750306065
Integrable Systems: Twistors, Loop Groups, and Riemann Surfaces. Hitchin NJ, Segal GB, Ward RS. Oxford University Press, 1999.	9780199676774
Geometry of Yang-Mills fields. Atiyah M. Edizioni della Normale, 2013	9788876423031
Атья М. Геометрия и физика узлов. Мир, 1995.	5-03-002892-7
Грин М., Шварц Дж., Виттен Э. Теория суперструн, том 2. Мир, 1990.	5-03-001567-1

**Knowledge**

Basic constructions and theorems in complex geometry which are widely used in modern field theory.

**Skill**

Understanding of mathematical terminology encountered in modern theoretical physics papers. Some know-how in exploiting complex geometry in field theory.

**Experience**

Solving problems in classical field theory which are most characteristic and basic for modern theoretical physics.

**Select Assignment 1 Type**

Final Exam

**Or Upload Example(s) of Assignment 1**

<https://ucarecdn.com/a0ef7a9e-e91a-4979-973e-b1c65b23d566/>

**Assessment Criteria for Assignment 1**

Solving problems on day of exam. Activity during the semester.

**Free Style Comments (if any)**

Examples of problems given above come from the last year. Their topics not always coincide with the present year's course. Nevertheless, students are encouraged to solve them also and this will count for the final assessment. New problems will appear in the lectures. Presenting solutions during the semester is particularly welcomed.