Skoltech
Skolkovo Institute of Science and Technology

Course Syllabus

Course Title (in English)	Gauge fields and complex geometry
Course Title (in Russian)	Калибровочные поля и комплексная геометрия
Lead Instructor(s)	Rosly, Alexei

Status of this Syllabus	The syllabus is a final draft waiting for form approval
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1. Annotation

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.
Course Prerequisites	Student should be familiar with classical mechanics and classical field theory (Landau-Lifshitz' Vol 1 and 2), calculus, and basic differential geometry.

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)
Gauge Theory	Mathematical aspects of Gauge Theory	1.5 h	0	0

3. Assignments

4. Grading

Type of Assessment	Graded

Grade Structure

Activity Type	Activity weight, %
Final Exam	100

A:	Grading Scale
B:	86
C:	76
D:	66
E:	56
F:	46

0

5. Basic Information

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

6. Textbooks and Internet Resources

Required Textbooks	ISBN-13 (or ISBN-10)
Landau LD, Lifshitz EM. The Classical Theory of Fields. Vol. 2 (4th ed.). Butterworth-Heinemann, 1975.	978-0-7506-2768-9

Recommended Textbooks	ISBN-13 (or ISBN-10)
Green, M. B.; Schwarz, J. H.; Witten, E., Superstring Theory. Vol. 2: Loop amplitudes, anomalies and phenomenology. Cambridge etc., Cambridge University Press 1987. XII, 596 pp.	0 521 32999 X
Becker K, Becker M, Schwarz JH. String Theory and M-Theory: A Modern Introduction. Cambridge University Press, 2006.	9780521860697
Nakahara M. Geometry, Topology and Physics, 2nd Edition. IOP Publishing Ltd 2003.	9780750306065
Hitchin NJ, Segal GB, Ward RS. Integrable Systems: Twistors, Loop Groups, and Riemann Surfaces. Oxford University Press, 1999.	0198504217
Atiyah M. Geometry of Yang-Mills fields. Edizioni della Normale, 2013	8876423036
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

7. Facilities

8. Learning Outcomes

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.

Do you want to specify outcomes in another framework?	Knowledge-Skill-Experience is good enough

9. Assessment Criteria

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.

10. Additional Notes

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.