

MATH-410

**Riemann surfaces**

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Cursus	Sem.	Type
Ing.-math	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
<b>Hours</b>	<b>4 weekly</b>
Courses	2 weekly
Exercises	2 weekly
<b>Number of positions</b>	

**Summary**

This course is an introduction to the theory of Riemann surfaces. Riemann surfaces naturally appear in mathematics in many different ways: as a result of analytic continuation, as quotients of complex domains under discontinuous group actions, as algebraic curves.

**Content**

- Complex manifolds
- Topology of compact Riemann surfaces
- Differential forms
- De Rham cohomology
- Hodge decomposition
- Holomorphic differentials
- Riemann-Roch theorem
- Serre duality
- Embedding of compact Riemann surfaces into projective spaces

**Keywords**

- Riemann surfaces
- holomorphic maps
- differential forms
- meromorphic functions
- cohomology of sheaves

**Learning Prerequisites****Required courses**

- Complex analysis
- Differential geometry
- Topology

### Recommended courses

- Introduction to differentiable manifolds
- Complex analysis

### Important concepts to start the course

- Topological spaces
- Manifolds
- Coordinate charts. Change of coordinates
- Differential forms. Integration of differential forms. Stokes theorem
- Holomorphic functions. Cauchy integration formula
- Meromorphic functions. Residue theorem

### Learning Outcomes

By the end of the course, the student must be able to:

- Define main mathematical notions introduced in the course
- State main theorems
- Apply main theorems to concrete examples
- Prove main theorems
- Solve problems similar to those discussed on tutorials
- Compute degree of a map, genus of a surface, intersection pairing, period matrix, basis of holomorphic differential forms, image under Abel map, etc.
- Construct examples and counterexamples
- Sketch proves of main results

### Transversal skills

- Access and evaluate appropriate sources of information.
- Write a scientific or technical report.
- Demonstrate a capacity for creativity.
- Take feedback (critique) and respond in an appropriate manner.

### Teaching methods

- lectures
- tutorials
- feedback on submitted homework solutions

### Expected student activities

- attending lectures
- attending tutorials
- submitting written homeworks
- presenting solutions of the exercises

### Assessment methods

- weekly submitted homeworks 40%
- final exam 60%

Dans le cas de l'art. 3 al. 5 du Règlement de section, l'enseignant décide de la forme de l'examen qu'il communique aux étudiants concernés.

### Supervision

Office hours	Yes
Assistants	Yes
Forum	No
Others	Moodle page

### Resources

#### Bibliography

1. S. K. Donaldson. Riemann surfaces
2. J. Jost, Compact Riemann Surfaces: An Introduction to Contemporary Mathematics
3. J. B. Bost, Introduction to Compact Riemann Surfaces, Jacobians, and Abelian Varieties.
4. P. Griffiths and J. Harris, Principles of algebraic geometry.

#### Ressources en bibliothèque

- [Find the references at the Library](#)

#### Moodle Link

- <https://go.epfl.ch/MATH-410>