1. **CONTENTS, PROGAMME**

Tentative program:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Week 1** | **Mon 31/10** | **Tue 1/11** | **Wed 2/11** | **Thu 3/11** | **Fri 4/11** |
| 08:30- |  |  |  |  | **Special lecure** (08:30-09:30)Arithmetic properties of complex local systems |
| 09:00-09:50 | Course 1 Introduction to algebraic curves | Course 1 Introduction to algebraic curves | Course 2 Jacobian of Curves | Course 1Introduction to algebraic curves |
| Course 1(09:30-10:20) Introduction to algebraic curves |
| 10:00-10:50 | Course 1 Introduction to algebraic curves | Course 1 Introduction to algebraic curves | Course 2 Jacobian of Curves | Course 1Introduction to algebraic curves | Course 1(10:30-11:20)Introduction to algebraic curves |
|  | *Coffee* |
| 11:10- 12:00 | Exercise  | Exercise | Exercise | Exercise  | Exercise (11:30-12:20) |
|  | *Lunch* |
| 14:00- 14:50 | Course 2 Jacobian of Curves | Course 2Jacobian of Curves | Course 1 Introduction to algebraic curves | Course 2 Jacobian of Curves | Course 2Jacobian of Curves |
| 15:00- 15:50 | Course 2 Jacobian of Curves | Course 2Jacobian of Curves | Course 1 Introduction to algebraic curves | Course 2 Jacobian of Curves | Course 2Jacobian of Curves  |
|  | *Coffee* |
| 16:00- 17:00 | Exercise | Exercise | Exercise | Exercise | Exercise |
|  |  |  |  |  |  |
| **Week 2** | **Mon 7/11** | **Tue 8/11** | **Wed 9/11** | **Thu 10/11** | **Fri 11/11** |
| 8:30-9:30 |  |  |  |  | **Special lecure**(08:30-09:30) Some applications of group representation theory |
| 09:00- 09:50 | Course 3 Abelian varieties | Course 3: Abelian varieties | Course 3: Abelian varieties | Course 3: Abelian varieties |
| Course 3(09:30-10:20): Abelian varieties |
| 10:00 – 10:50 | Course 3 Abelian varieties | Course 3: Abelian varieties | Course 3: Abelian varieties | Course 3: Abelian varieties | Course 3(10:30-11:20) Abelian varieties |
|  | *Coffee* |
| 11:10 – 12:00 | Exercise  | Exercise  | Exercise | Exercise  | Exercise(11:30-12:20) |
|  | *Lunch* |
| 14:00 – 15:00 | Course 4: Algebraic groups | Course 4: Algebraic groups | Course 4: Algebraic groups | Course 4: Algebraic groups | Course 4: Algebraic groups |
| 15:00 – 15:50 | Course4: Algebraic groups | Course4: Algebraic groups | Course4: Algebraic groups | Course4: Algebraic groups | Course4: Algebraic groups |
|  | *Coffee* |
| 16:00 – 17:00 | Exercise | Exercise | Exercise | Exercise | Exercise |

**CONTENTS**

* Special Lecture 1

Hélène Esnault

Arithmetic properties of complex local systems.

Abstract: We show some integrality properties of complex local systems on smooth complex quasi-projective varieties which are shown using arithmetic methods (Langlands program). In particular it yields an obstruction of a new kind  for a finitely presented group to be the topological  fundamental group of a smooth complex quasi-projective variety. (Work in progress  with J. de Jong).

* Special lecture 2

Phạm Hữu Tiệp

Some applications of group representation theory

Abstract: We will discuss how representation theory and group theory are used to resolve some problems motivated by applications in number theory and algebraic geometry.

* Course 1: Introduction to algebraic curves

Đào Văn Thịnh;

Divisors, differentials, statement of the Riemann-Roch theorem and some applications.

Normalisation and correspondence function fields smooth non-singular curves.
Cohomology.

References:

Griffiths book on Algebraic curves

* Course 2: Jacobian of Curves

Ngô Đắc Tuấn;

In this course we develop the algebraic theory of Jacobians for smooth projective curves. We present the construction, some basic properties and if time permits, we study the case of hyperelliptic curves.

* Divisors, lines bundles on curves.
* The Hilbert schemes of points. Symmetric powers.
* The Picard functor and the construction of Jacobians.
* The theta divisor and self-duality of Jacobians.
* Some examples.

References

[1] R. Hartshorne. Algebraic geometry. Graduate Texts in Mathematics, No. 52. Springer-Verlag, New York-Heidelberg, 1977.

[2] J. S. Milne. Abelian varieties. In Arithmetic geometry (Storrs, Conn., 1984), pages 103–150. Springer, New York, 1986.

* Course 3: Abelian varieties

Joao Pedro dos Santos

Rigidity lemma and applications: every morphism of abelian varieties is the composition of a group homomorphism and a translation, abelian varieties are commutative.

Rational maps to an abelian variety: abelian varieties contain no rational curve, every rational map from a smooth variety to an abelian variety is a morphism.

Theorem of the cube and applications: pullbacks of line bundles by multiplication by integers; the theorem of the square; projectivity of abelian varieties; structure of n-torsion subgroups.

Quotients by finite groups: existence and basic properties of the quotient of a quasi-projective variety by a finite group.

References:
[1] Mumford, Abelian Varieties, Chapter II (+ Chapter III for the theorem of the cube)
[2] Milne, Abelian Varieties. <https://www.jmilne.org/math/CourseNotes/AV.pdf>

* Course 4: Algebraic groups

Michel Brion

Definitions and basic examples. Group actions, orbits, closed subgroups generated by images of morphisms.

Structure of connected algebraic groups of dimension one via algebraic curves (this could give a nice application of the lectures on curves)

The Albanese morphism
Relation to the Jacobian.

Statement of Chevalley's structure theorem

Duality between the Picard and Albanese varieties.
Statement of Chevalley's structure theorem: every connected algebraic group is an extension of an abelian variety by a connected linear group.
Semi-abelian varieties and algebraically trivial line bundles on abelian varieties.