

Syllabus

Professor: Andrei Rodin (andrei@philomatica.org ; web: philomatica.org)

Course Title: History and Philosophy of Mathematics

When: Fall 2021, Saturdays 13h40-15h15

Where: room 301

Office Hours: Saturday 15h30-16h30, by appointment

Course Description:

The course provides a concise overview of some key episodes in the history of mathematics and on this basis introduces major themes of today's philosophy of mathematics in line of historical and practice-oriented epistemology. A special emphasis is made on the foundations of mathematics, broadly conceived, and on epistemological and other philosophical issues related to applications of mathematics in sciences and technology.

Program (by weeks):

1) History of Mathematics and Philosophy of Mathematics. Historical Epistemology and its critics. Foundations of Mathematics and their history. History and Philosophy of Mathematical Practice. (Introductory Lecture)

Reading: A. Rodin, One Mathematic(s) or Many? Foundations of Mathematics in the 20-th century Mathematical Practice, in: Sriraman et al. (eds.) Handbook of the History and Philosophy of Mathematical Practice, Springer 2021 https://link.springer.com/referenceworkentry/10.1007/978-3-030-19071-2_28-1

2) Hellenistic Mathematics 1: Euclid's: Definitions, Postulates, Axioms, Problems, Theorems
Reading: (1) The Elements, Book 1; (2) Rodin, Category Theory and Axiomatic Method, ch.2.

3) Hellenistic Mathematics 2: Eudoxus, Appolonius, Archimedes, Diophantus, Pappus
Reading: The Elements, Book 5, 7, 10 (Definitions, Proposition). Archimedes (ed., tr. Heath): Squaring of Parabola, The Sand-Reckoner

4) Platonism and Aristotelianism in the Philosophy of Mathematics

Reading: (1) Plato, Meno; (2) Aristotle, Metaphysics (fragments); (3) Standford Encyclopedia of Philosophy (SEP, <https://plato.stanford.edu>): (a) Platonism in the Philosophy of Mathematics, (b) Aristotle and Mathematics.

5) The birth of Algebra and its reception in Europe.

Reading: (1) Al-Khwarizmi, al-Jabr (tr. Rosen); (2) R. Rashed, "The Idea of Algebra"

6) Descartes: Philosophy of Method and new foundations of geometry. Analysis and Synthesis.

Reading: Descartes, (a) Discourse on Method, (b) La Géométrie (fragments)

7) Invention of the Infinitesimal Calculus by Newton and Leibniz and its applications in Physics.

Reading: (1) Leibniz, A New Method of Maxima and Minima; On a Deeply Hidden Geometry; (2) Newton, Quadratura of Curves (all in D.J. Sruik (ed.), A Source Book in Mathematics 1200-1800, p. 271 ff)

8) Kant's Philosophy of Mathematics and the "unreasonable effectiveness of mathematics in natural sciences".

Reading: Kant, KRV (fragments); E. Wigner (1960), The unreasonable effectiveness of mathematics in the natural sciences

9) Analysis Situs and the pre-history of Topology

Reading: Leonard Euler on Königsberg's Bridges and on polyhedra

Deadline for Student Paper Proposals (title and abstract of 100-300 words)

10) The Problem of Parallels and the discovery of non-Euclidean geometries in the 19th century.

Reading: N.I. Lobachevsky, Geometrical Investigations

11) Hilbert's works in the foundations of geometry and arithmetic. Modern axiomatic method.

Hilbert's Program: meta-mathematics and proof theory. Formalism and Finitism. Epistemic completeness.

Reading: (1) D. Hilbert, Foundations of Geometry (1899), (2) (2) A. Rodin, Category Theory and Axiomatic Method, ch.3.

12) Mathematical Logicism, Mathematical Constructivism and Mathematical Formalism.

Reading: P. Martin-Löf, Hilbert-Brouwer Controversy Resolved?

13) Set theory, Category theory and Mathematical Structuralism.

Reading: (1) N. Bourbaki, Architecture of Mathematics, (2) A. Rodin, Category Theory and Axiomatic Method, ch.4-5.

14) Univalent Foundations of mathematics and computer-assisted mathematical proofs.

Reading: (1) D. Grayson, An Introduction to Univalent Foundations for Mathematicians, (2) A. Rodin, Computer-Assisted Proofs and Mathematical Understanding: Univalent Foundations as a Leibnizian Language

15) Computer models and Today's Mathematics.

Reading: A. Rodin, Voevodsky's Unfinished Project, <https://arXiv:2012.01150>

16) *Student presentations*

Deadline for Student Final Papers (1500-2000 words) : TBA

Evaluation (per cents):

In-class participation - 15

Paper Proposal - 15

Project Presentation - 15

Final Paper - 55