Course guide
200241 - HM - History of Mathematics

Last modified: 02/10/2024

Unit in charge: School of Mathematics and Statistics
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN MATHEMATICS (Syllabus 2009). (Optional subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: MONICA BLANCO ABELLAN

Others: Segon quadrimestre:
MONICA BLANCO ABELLAN - M-A

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
3. CE-2. Solve problems in Mathematics, through basic calculation skills, taking in account tools availability and the constraints of time and resources.
4. CE-4. Have the ability to use computational tools as an aid to mathematical processes.
5. Ability to solve problems from academic, technical, financial and social fields through mathematical methods.

Generical:
1. CB-4. Have the ability to communicate their conclusions, and the knowledge and rationale underpinning these to specialist and non-specialist audiences clearly and unambiguously.
2. To have developed those learning skills necessary to undertake further interdisciplinary studies with a high degree of autonomy in scientific disciplines in which Mathematics have a significant role.
6. CG-1. Show knowledge and proficiency in the use of mathematical language.
7. CG-2. Construct rigorous proofs of some classical theorems in a variety of fields of Mathematics.
8. CG-3. Have the ability to define new mathematical objects in terms of others already know and ability to use these objects in different contexts.
9. CG-4. Translate into mathematical terms problems stated in non-mathematical language, and take advantage of this translation to solve them.
10. CG-6 Detect deficiencies in their own knowledge and pass them through critical reflection and choice of the best action to extend this knowledge.

Transversal:
11. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
12. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

TEACHING METHODOLOGY

In the course we will try to work whenever possible with primary or secondary historical sources specialist. The course is located within the line of historical research that attempts to understand the formation processes of mathematical concepts in their own context, in terms of mathematical knowledge and intent with which they worked more in terms of what will happen then. The relationship between the contributions show the path.
The themes are usually developed as part of a presentation and discussion of the topic of the session and one of explanation and introduction to the next topic. The exhibition, at times, for some students following a script of questions on the topic, in attempts to clarify the comments after the doubts and problems that may have emerged in the readings. We present the major periods of history (six are considered) and the rest of the sessions are structured based on monographic presentations, some, by students, the rest by the teacher. Most activities are related to any mathematical text of the period treated. A significant part of the course is final projects that must be submitted in writing and orally defend the final session. These works, on an author or a text chosen by the students, allow them to practice certain procedures and learn mathematical concepts from a different perspective.

LEARNING OBJECTIVES OF THE SUBJECT

The aim of the course is to explore the past of mathematics showing how they emerged and how they developed over time concepts, theorems, and axiomatic methods that are exposed today in the texts under a pragmatic conception, logic and teaching often does not match the historical order in which they were invented or discovered. Through the course, students should develop an overview of the development of the mathematics. This aim is broken down into four specific objectives, which lay with different facets of this development:
1. Knowing the sources on which knowledge of mathematics in the past. This involves read and interpret a selection of classic texts in mathematics, and learn to locate and use the historical literature.
2. Recognize significant changes in the Mathematics discipline, which have affected the structure and classification, their methods, their concepts and their relationship to other sciences.
3. To reveal the cultural relations of mathematics (with politics, religion, philosophy, or culture, among other areas).
4. Get pupils to reflect on the development of mathematical thinking and transformation of natural philosophy.
The capabilities to acquire are deducted from these goals.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	30,0	20.00
Hours small group	30,0	20.00

Total learning time: 150 h

CONTENTS

Mathematics in the Antiquity

Description:
Cuneiform tablets. The Egyptian papyrus. Greek Science. The Rhind papyrus. The Pitagoric. The incommensurability problem. Euclid's Elements (300 BC). The measurement of the universe in Aristarchus of Samos (ca. 210-230 BC). The quadrature of the circle in Archimedes (287 BC-212 BC). The Arithmetic by Diophantus of Alexandria (250-350).

Full-or-part-time: 25h
Theory classes: 5h
Laboratory classes: 5h
Self study : 15h

From Arab science to the Renaissance

Description:
The beginnings of algebra. Mohamed Ben Musa al-Khwarizmi (850 AD). The beginnings of plane trigonometry and first trigonometric developments. Calculus and merchandise in medieval mathematics. Geometry and art. Leon Battista Alberti (1404-1472) and Leonardo da Vinci (1452-1519). Arte Mayor in the Iberian Peninsula. The resolution of the third and fourth degree polynomial equations in Girolamo Cardano (1501-1576) and Rafael Bombelli (1526-1572).

Full-or-part-time: 25h
Theory classes: 5h
Laboratory classes: 5h
Self study : 15h

The birth of Modern Mathematics.

Description:
François Viète (1540-1603) and the Analytic Art.The symbolic language and the first mathematical courses: Pierre Hérigone (1580-1643). The algebrization of mathematics René Descartes (1596-1650) and analytical geometry. The arithmetical triangle by Blaise Pascal (1623-1662). The birth of the logarithms. Harmonic series and the harmonic triangle by Pietro Mengoli (1627-1686).

Full-or-part-time: 25h
Theory classes: 5h
Laboratory classes: 5h
Self study : 15h

Contributions preceding calculus.

Description:
Quadraturas of Archimedes (about 250 BC). The theory of the indivisibles of Cavalieri (1635). Methods for tangents: Fermat (1629) and Descartes (1637).

Full-or-part-time: 25h
Theory classes: 5h
Laboratory classes: 5h
Self study : 15h

Conceptual development of calculus in the eighteenth century

Description:
The Newton and Leibniz calculus. Debates on the calculus foundation. Series of powers: Newton and the general binomial theorem (1664-1665). Gregory and the expansion of the binomial (1670). The method of Taylor's increase (1715). The Kerala School: Non-Western Roots of Development in series. First definitions of function: Johan Bernoulli (1718) and Leonhard Euler (1748,1755). Euler and the logarithmic and circular functions (1748).

Full-or-part-time: 25h
Theory classes: 5h
Laboratory classes: 5h
Self study : 15h

Aritmetization and rigorous formulation of calculus

Description:
Limit definitions in D'Alembert (1765) and Cauchy (1821). Definitions of continuity: Euler (1748), Bolzano (1817), Cauchy (1821). The mean value theorem. The functions derived from Lagrange (1797) and Cauchy (1823). The notation epsilon-delta. Introduction to the integration of reals functions of Euler (1768). Cauchy (1823) and the foundamental theorem of calculus.

Full-or-part-time: 25h
Theory classes: 5h
Laboratory classes: 5h
Self study : 15h

GRADING SYSTEM

The final grade is obtained, with the activities done in class and the final project of the year, broken down as follows.

Coursework: 40% from written or oral practice made each week. Each week, students develop an activity. The activity consists of playing a demo of some text, a dossier prepared to fill (from a text) or a short summary of a text prepared with questions. Can answer them in writing or orally, can be completed, reviewed, or annotating the text in class, during practice. It assesses the clarity of explanations and our understanding of mathematical activity.

Essay: analysis of a significant demonstration of the text or history of mathematics. In the essay, they should clearly exhibit the main ideas of selected text and its significance for the history of mathematics. In the evaluation (written and oral presentation) will assess the clarity in the exposition of the ideas of the author chose, as well as the ability to connect with the text reviewed the history of mathematics that have been developed. In case of any demonstration will also analyze the level of mathematical understanding. It is divided in two parts: mid-term submission (20%) and final submission + oral presentation (40%).

BIBLIOGRAPHY

Basic:
- Rommevaux, S.; Spiesser, Maryvonne. Pluralité de l'algèbre à la Renaissance. Paris: Honoré Champion, 2012. ISBN 9782745323989.
- Fauvel, John; Gray, Jeremy. The History of mathematics : a reader. London: Macmillan Press, 1987. ISBN 0333427904.
- Katz, Victor; Hunger Parshall, Karen. Taming the unknown: a history of algebra from antiquity to the early twentieth century. Princeton: Princeton University Press, 2014. ISBN 9780691149059.
- Katz, Victor. The Mathematics of Egypt, Mesopotamia, China, India and Islam: a sourcebook. Princeton: Princeton University Press, 2007. ISBN 9780691114859.
- Stedall, Jacqueline. The History of mathematics : a very short introduction. Oxford: Oxford University Press, 2012. ISBN 9780199599684.
- Barrow-Green, June; Gray, Jeremy; Wilson, Robin J. The History of mathematics: a source-based approach (vol. 1, vol. 2). American Mathematical Society, ISBN 9781470443528.

Complementary:
- Stedall, Jacqueline. Mathematics emerging : a sourcebook 1540 -1900 [on line]. Oxford: Oxford University Press, 2008 [Consultation: 27/06/2023]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=415528. ISBN 9780191527715.
- Serres, Michel; Bensaude-Vincent, Bernadette. Historia de las ciencias. 2a ed. Madrid: Cátedra, cop. 1991. ISBN 8437609887.
- Grattan-Guinness, I. The Norton history of the mathematical sciences : the rainbow of mathematics. New York: W. W. Norton & Company, 1998. ISBN 0393046508.
- Chemla, Karine. The History of mathematical proof in ancient traditions [on line]. Cambridge: Cambridge University Press, 2012 [Consultation: 27/06/2023]. Available on: https://web-p-ebscohost-com.recursos.biblioteca.upc.edu/ehost/ebookviewer/ebook?sid=da92ebea-25e3-40da-922c-74b538feb9e0%40redis&vid=0&format=EB. ISBN 9781107012219.
- Stedall, Jacqueline A. From Cardano's great art to Lagrange's reflections : filling a gap in the history of algebra. Zürich: European Mathematical Society, 2011. ISBN 9783037190920.

- Baron, Margaret E. The Origins of infinitesimal calculus. Dover Publications, 2003. ISBN 9780486495446.
- Grattan-Guinness, I. Companion encyclopedia of the history and philosophy of the mathematical sciences. London: Routledge, 1994. ISBN 9780415037853.